PLANNING DEPARTMENT

CITY AND COUNTY OF HONOLULU

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DEPUTY CHIEF PLANNING OFFICER

MM

January 12, 1994

Honorable Brian J. J. Choy, Director
Office of Environmental Quality Control
State of Hawaii
Central Pacific Plaza
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Mr. Choy:

Acceptance Notice for the Proposed
Lihi Lani Country-Residential Community
Folder No. 93/NS-1(IC)
Final Supplemental Environmental Impact Statement (SEIS)

We are notifying you of our acceptance of the Final SEIS for the proposed Lihi Lani Country-Residential Community, as satisfactory fulfillment of the requirements of Chapter 343, Hawaii Revised Statutes.

Pursuant to Section 11-200-23 (c), Chapter 200, Title 11 ("Environmental Impact Statement Rules") of the Administrative Rules, this acceptance notice should be published in the January 23, 199~~3~~ 4 OEQC Bulletin.

We have attached our Acceptance Report of the Final SEIS for the Lihi Lani Recreational Community and the "DOCUMENT FOR PUBLICATION IN THE OEQC BULLETIN." Should you have any questions, please contact Melvin Murakami at 527-6020.

Sincerely,

FOR ROBIN FOSTER
Chief Planning Officer

RF:ft

Attachments

cc: Obayashi Hawaii Corporation
Group 70 Limited

ACCEPTANCE REPORT: LIHI LANI COUNTRY-RESIDENTIAL COMMUNITY
FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
OBAYASHI HAWAII CORPORATION
TAX MAP KEYS: 5-9-05, 06, 38, 82
5-9-6: 01, 08, 18 AND 24
TOTAL ACREAGE: 1,143 ACRES

A. BACKGROUND

The subject Lihi Lani project is located in Pupukea on the North Shore of Oahu in the Koolauloa Judicial District. The site consists primarily of wooded slopes, stream valleys, and plateaus with ground cover and lower field vegetation types. Slopes in excess of 20 percent occur over 70 percent of the property. The site is generally located above the 400-foot coastal bluff approximately 800 feet mauka of Kamehameha Highway. Approximately 18 acres of the site is situated makai of the bluff and connects to Kamehameha Highway.

The portions of the site have been used for different types of agricultural uses. Currently, a small part of the project site is being used to graze four or five horses. A propagation nursery has recently been developed on-site to establish erosion control plantings and agricultural stock.

A Final EIS (April 1991) for the Lihi Lani Recreational Community project was accepted by the Planning Department for a mixed-use <u>residential and recreational development</u>, including a golf course, driving range, clubhouse, tennis center, camp ground and horse ranch. The residential component included 120 one-acre country zoned lots and 180 affordable housing units in a mix of single and multi-family units. Community facilities proposed in this plan included a meeting facility with child care center and play fields for soccer and baseball.

The project has been revised to be a residential and agricultural development; the golf course, driving range and clubhouse have been eliminated from the plan. There is an overall increase in the number of residential units on site from 300 to 445: the number of country residential lots has increased from 120 to 315 and the number of on-site affordable housing units has decreased from 180 to 130. Of the 130 on-site affordable units, 50 single-family homes will be built by Obayashi, and 80 elderly rental apartments will be built and managed by the City, with Obayashi dedicating a 5.4-acre site with infrastructure improvements. In addition, Obayashi indicates they will contribute monies to the City for the development of up to 50 off-site single-family homes within the North Shore area or within an area that is acceptable to the City.

The proposed community facilities on the makai portion of the site are to be a branch of the YMCA of Honolulu. The facility will include a multi-purpose meeting room, exercise and child care center, swimming pool and soccer/baseball fields. Obayashi will make a substantial contribution toward this development of land and up to $4.7 million for construction.

Extensive recreational facilities will be developed in the main portion of the site, including a horse ranch, campground, and miles of hiking and horse riding trails. All of these facilities will be open to public use, some requiring a user fee. Public use of the hiking and horse riding trails will be free of charge.

Construction of the project's roads, utilities, agricultural areas and building sites will require site disturbances such as clearing, grubbing, grading, and excavation. Building construction will involve the ranch, maintenance buildings, campground facilities, community facilities and residential structures. Infrastructure improvements include: roadways; wastewater collection, reclamation and reuse facilities; potable water and irrigation water supply and distribution systems; and other utilities installations.

The proposed project is expected to create both beneficial and adverse effects on the natural/physical environment and the human/socio-economic environment.

Approximately 399 to 479 acres of the site will be developed, while between 664 to 744 acres of the project site will remain unaffected as natural areas in gulches and buffer areas.

The developer intends to install extensive drainage controls which are anticipated to limit storm water runoff generated by the developement to the same or less than existing runoff rates and volumes. The developer also anticipates that suspended sediments eroded from the site will be less after construction than under existing conditions. However, the most critical period will be during initial construction, when infrastructure and road construction would take place. According to Appendix H ". . . even with appropriate erosion potential measures, the annual erosion potential would be 29 times greater than for existing conditions." Appendix H further states that ". . . no data are available to accurately assess the potential impact or surface runoff water quality if a storm occurs during construction." As a mitigating measure, detention basins will be constructed prior to grading activities. The grading activities will be limited to 15 acres.

The developer intends to assist in the preservation of the habitat for the only known examples of the Koolau Eugenia tree, located on the adjacent State Forest Preserve land just mauka of the project site. Selective clearing of other encroaching plants, and propagation efforts will increase changes for survival of these rare trees.

Archaeological resources have been inventoried on the property, and significant sites will be intensively surveyed or will be preserved for future education and research, as recommended by DLNR.

An average rate of approximately 245,000 gallons per day (gpd) of potable groundwater will be utilized by the project from the BWS Waialua, Haleiwa, and Wailee water supply wells. Actual water use may be less due to the water conservation measures to be implemented. To gain a water allocation for the project, Obayashi will be required to participate with BWS in source development in the Waialua or Kawailoa areas.

Approximately 0.6 to 0.7 million gallons per day (mgd) of irrigation water will be drawn from the brackish water aquifer underlying the site during peak use periods. This water will be used for the common area landscaping, a portion of the ranch and for the landscaping and agriculture within the country lots subject to approval by the Commission on Water Resource Management (CWRM), Department of Land and Natural Resources. Two existing wells have been tested and permission will be sought from the CWRM to allow withdrawal. Approximately 0.18 mgd of reclaimed water (treated wastewater effluent) will be applied to larger common agricultural areas, subject to approval by the Department of Health.

Existing habitat for birds and other wildlife species will be affected. Some wildlife species are expected to leave these areas and relocate in adjacent open space areas within the project site. Landscape and agroforestry areas should serve to re-establish some habitat for wildlife.

The applicant projects only slight amounts of suspended sediments, fertilizer constituents, organic material and pesticides will be introduced to the ocean during peak storm water runoff periods, other than during construction. The concentration of suspended sediments and nitrogen in runoff from the property is anticipated to be lower than current levels after the project is completed. A baseline survey of ocean water quality has been made. Ongoing ocean water quality monitoring surveys will be conducted during the construction period and, if necessary, beyond to assess potential water quality effects of the project.

The project will create between two to three tons per day of refuse for removal and disposal by a private hauling firm at an appropriate City and County landfill or other solid waste disposal facility. Property tax revenues generated by the project are expected to alleviate any shortage in the waste disposal facilities capacity due to the added demand caused by the project.

Design plans will be established to minimize the visibility of structures, roadway features and lighting from the area makai of the project and from Sunset Hills and Pupukea Highlands.

As many as 154 school children could be added to local schools by the project at full build-out 20 to 30 years into the future. The project could create an impact on the capacity of area schools, corresponding to the phased home build-out.

By the year 2008, with or without the Lihi Lani project, Kamehameha Highway will be operating over capacity during peak traffic periods, assuming no improvements. Lihi Lani will represent an additional 5 to 8 percent of the highway traffic, assuming 100 percent occupancy of projected units.

B. PROCEDURES

1. A Supplemental Environmental Impact Statement Preparation Notice for the proposed project was published in the July 23, 1993 OEQC Bulletin. This bulletin was distributed to Federal, State and County agencies, private organizations and individuals. The comment period expired on August 23, 1993. Seventeen consultation letters were received. The applicant responded to substantive comments and included the appropriate information in the Final SEIS.

2. Notice of the Supplemental Draft EIS was published in the October 8, 1993 OEQC Bulletin. The 45-day public review period expired on November 22, 1993. All substantive comments were responded to by the applicant, and both comments and responses have been included in the Final SEIS.

3. Notice of Final SEIS was published in the December 23, 1993 OEQC Bulletin.

C. EIS CONTENT

The Final SEIS complies with the content requirements set forth in Section 11-200-18 of the Environmental Impact Statement Rules.

D. <u>RESPONSES TO COMMENTS</u>

The applicant has adequately responded to environmental concerns that were received during and beyond the public review and consultation period, with two exceptions. These comments and responses are found in the Final SEIS. Comments from the Department of Land and Natural Resources were received on December 9, after the review period. These comments were satisfactorily answered in the Draft EIS in response to DLNR's letter dated August 23, 1993. Consequently, there is no need for further response to their comments. Comments from the Department of Wastewater Management (DWM) were received on December 30, 1993, beyond the response period. They were concerned with the handling and disposal of sludge generated by the water reclamation process. In response to the DWM's letter, the applicant by letter dated January 7, 1994 states that ". . . sludge or biosolids generated by the Lihi Lani Water Reclamation Facility within the stabilization ponds is anticipated to require very infrequent removal . . . where removal of solids from stabilization ponds is required, we would like to consider the facilities of the Department of Wastewater Management as an option."

E. <u>UNRESOLVED ISSUES</u>

The following issues require further analysis. In most cases detailed studies were requested by reviewing agencies.

1. Appropriate development permits are required prior to construction.

2. Assessment of storm runoff has not been fully resolved. According to Appendix F, page 12, "The final storm runoff numbers from the developed conditions are dependent on the final design of the development and drainage facilities" which have yet to be completed. According to the applicant's December 13, 1993 letter to Mr. Peter Cole and Dr. James Blattau, ". . . project planning and design are not at a stage where a grading plan has been created or where final alignments and profiles of roadways have been determined."

3. Assessments of surface water quality during construction are unresolved. Appendix H, page 15, of the FEIS states "No data are available to accurately assess the potential impact on surface water quality if a storm occurs during construction."

4. The impact on schools is not fully determined at this time. Sunset Beach Elementary, Kahuku Intermediate and High School are near capacity and will be impacted in

1998 with the projected completion of the 50 single-family affordable homes on site. The DOE projections also do not include the 50 off-site units because the location has not been specified. There is no immediate solution to the projected problem.

5. The potential impacts on significant archaeological sites are not fully determined. A detailed archaeological inventory has been completed and accepted by the Historic and Preservation Division of the Department of Land and Natural Resources. However a detailed topographic study, detailed roadway design and a data recovery plan are needed to fully assess the impacts of the proposed development on significant sites. At this point, 16 of the 54 archaeological sites identified will be directly affected by the development. The applicant will abide by recommendations of the Historic Preservation Division of the Department of Land and Natural Resources.

6. No final decision has been made by the Board of Land and Natural Resources regarding use of State-owned lands within the subject development.

7. The proposed development water requirements may exceed the amount of water that is currently available. The Board of Water Supply indicates that the developer needs to submit a water master plan showing estimated water requirements and proposed water facilities with supporting calculations for peak hour pressures and fire flows at maximum daily demand.

8. The impact of the proposed brackish water wells on the City's Sunset Beach well has not been established. Any reduction in the sustainable yield of the Sunset Beach Well due to adverse impacts on the aquifer as a result of the project will need to be made up by the developer. The developer has not disclosed site specific proposals for possible new sources of potable drinking water, but is working with BWS on this matter.

9. The impacts of the proposed wastewater reuse on the underlying acquifer and existing wells are not completely resolved. According to the Department of Land and Natural Resources, Commission on Water Resource Management, there is the possibility of ground water contamination due to high chloride irrigation water. The applicant, in responding to DLNR, acknowledges that the BWS Sunset Beach Wells could be effected.

10. The water reclamation facility must conform to applicable Department of Health provisions for "Wastewater Systems" and Guidelines for the Treatment

and Reuse of Reclaimed Water. The Department of Health has stated that they "reserve the right to review the final detailed wastewater plans for conformance to applicable rules." Final detailed wastewater plans need to be developed and reviewed.

11. The State Department of Transportation commented that to accommodate future highway widening, "a fifty (50) foot setback should be established along the mauka boundary of the Kamehameha Highway right of way." The developer would like to meet with DOT to discuss accommodation of future highway widening and also consider potential timing of the widening. The widening would likely encroach into areas projected for detention basin to control the rate of storm water runoff.

12. The project will be visible from Kamehameha Highway, Sunset Beach Elementary School, nearby residences and local beaches. The full impact on existing views cannot be determined at this time. The applicant has indicated that adverse visual effects from the development of country lot homes will be controlled by a Code of Covenants and Restrictions (CCR). The CCR, yet to be developed, would establish general restrictions applicable to all properties and would contain specific restrictions on individual lots. The CCR is intended to be enforced by the Lihi Lani Homeowners Association.

F. DETERMINATION

The Planning Department of the City and County of Honolulu has determined that this Final EIS to be ACCEPTABLE under the procedures established by Chapter 343 of the Hawaii Revised Statutes.

APPROVED BY
FOR ROBIN FOSTER
CHIEF PLANNING OFFICER

DOCUMENT CAPTURED AS RECEIVED

1993 - [redacted] Oahu - FEIS -
Lihi Lani

FILE COPY

LIHI LANI

Paumalu & Pupukea

Final Supplemental Environmental Impact Statement

December 1993

OBAYASHI HAWAII CORPORATION

1993 - [redacted] Oahu - FEIS -
Lihi Lani

FILE COPY

LIHI LANI

Paumalu & Pupukea

Final Supplemental Environmental Impact Statement

December 1993

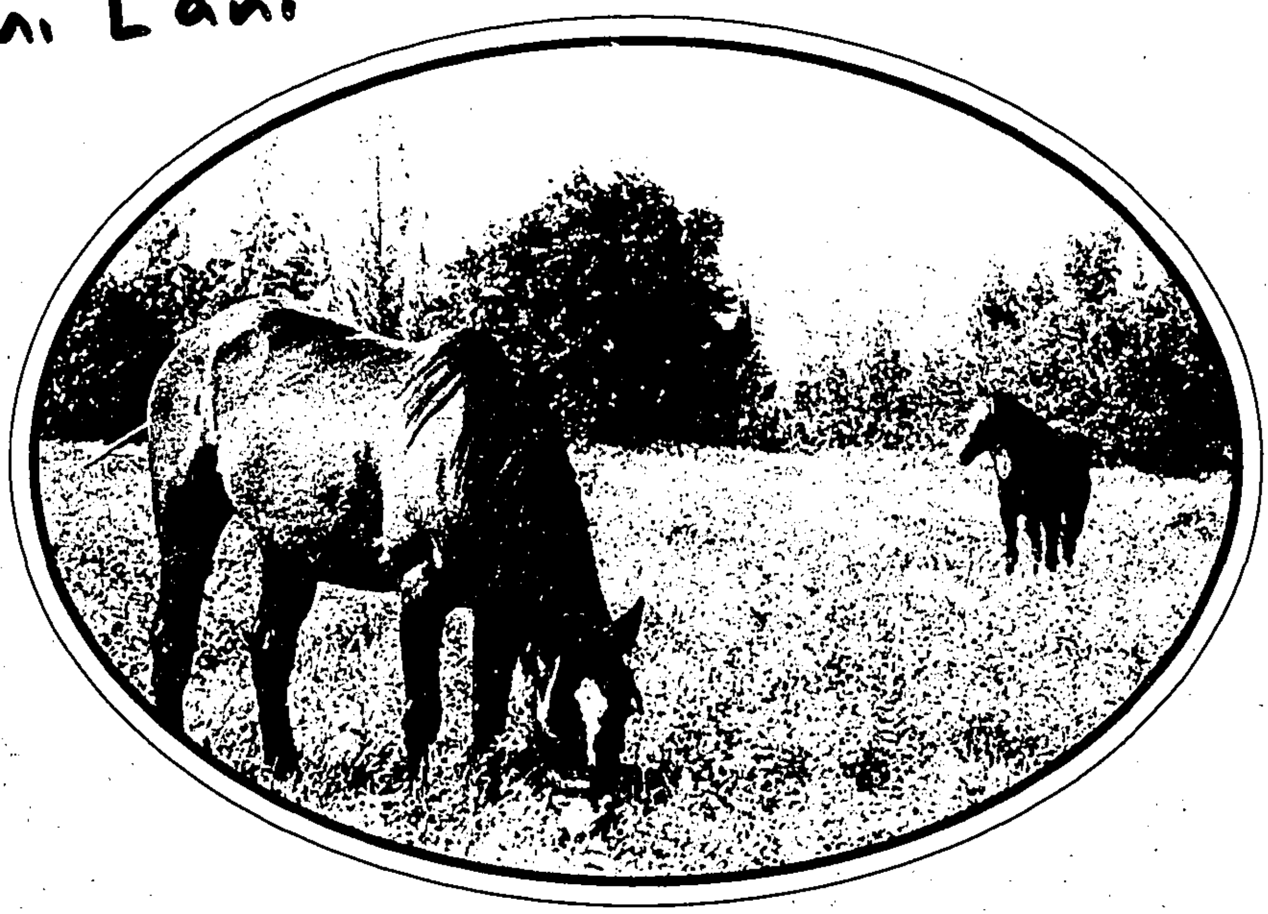
OBAYASHI HAWAII CORPORATION

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

1993 - Oahu - FEIS -
Lihi Lani

FILE COPY



LIHI LANI

Paumalu & Pupukea

Final Supplemental Environmental Impact Statement

December 1993

OBAYASHI HAWAII CORPORATION

LIHI LANI

Paumalu & Pupukea

Final Supplemental Environmental Impact Statement

PREPARED FOR:
OBAYASHI HAWAII CORPORATION

PREPARED BY:
GROUP 70 INTERNATIONAL, INC.

FOR SUBMISSION TO:
CITY AND COUNTY OF HONOLULU PLANNING DEPARTMENT

SUBMITTED BY:

FRANCIS S. ODA, CHAIRMAN
GROUP 70 INTERNATIONAL, INC.
HONOLULU, HAWAII

LIHI LANI

Final Supplemental Environmental Impact Statement

APPLICANT:

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DECEMBER 1993

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

PAGE

TABLE OF CONTENTS
(Continued)

LIST OF APPENDICES

LIST OF APPENDICES
(Continued)

LIST OF FIGURES

LIST OF FIGURES
(Continued)

LIST OF TABLES

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This Final Supplemental Environmental Impact Statement (Final SEIS) has been prepared to address the potential environmental impacts of the Lihi Lani project proposed by Obayashi Hawaii Corporation. It has been compiled to fulfill application requirements of the City and County of Honolulu Planning Department for a North Shore Development Plan Land Use Map Amendment, filed in July 1993.

This Executive Summary includes brief descriptions of the proposed project, potential beneficial and adverse impacts, proposed mitigative measures and alternatives. The project's relationship to existing government policies and plans for the area is also discussed, along with required permits and approvals.

Background

In May 1991, the Department of General Planning accepted a Final EIS (Group 70, April 1991) for the *Lihi Lani Recreational* Community project, as part of a North Shore Development Plan Land Use Map Amendment application. The project consisted of an 18-hole golf course, clubhouse, driving range, equestrian ranch, tennis center, 180 affordable homes, 120 Country lots and community facilities. In early 1992, this project was granted North Shore DP Land Use Map Amendments for the golf course, affordable housing, wastewater facilities and community facilities in the makai portion of the site.

Since that time, the project has been re-conceptualized into a residential and agricultural development, and the golf course was eliminated from the plan. The current plan follows much of the existing style of the adjacent Pupukea Highlands subdivision, and includes 315 low-density Country residential lots (one acre minimum) with agricultural uses planned for each lot.

Affordable housing is planned to include 50 on-site affordable single family homes to be built by Obayashi, and 80 on-site affordable elderly rental apartments to be built by the City and County of Honolulu at the makai portion of the site. Obayashi will also participate with the City in the development of up to 50 affordable homes off-site in a location to be designated by the City Department of Housing and Community Development.

Community facilities on the makai portion of the site will include a proposed branch YMCA which will be built and operated by the YMCA of Honolulu. The facility will include a multi-purpose meeting room, exercise and child care center, swimming pool and soccer/baseball fields. Obayashi will make a substantial contribution toward this development. In addition, the horse ranch and riding/hiking trails as planned in 1991 will remain in the project plan. Also common to the 1991 plan is the environmentally-sensitive water reclamation facility for wastewater treatment using oxidation ponds and wetlands, with land application for disposal on agricultural lands.

Key differences of the current proposal as compared to the 1991 plan are:

(1) Deletion of the 18-hole golf course, driving range and clubhouse;

(2) Increase in the number of residential units on-site from 300 to 445 (80 by the City), while maintaining affordable housing by participating in the creation of up to 180 units;

(3) Major focus on agricultural uses in Country lots and common areas over 160 acres of the property, including grazing pasture within the horse ranch;

(4) Phased development into four phases of three years per phase, each divided into one-year sub-phases for infrastructure, homes and agriculture areas;

(5) Smaller construction force required to develop the first phase of the project, equal to about one-half of the workers required in the 1991 plan; and

(6) Longer build-out period for the project due to phasing and the projected rate of individual home construction on the country lots (as witnessed at Pupukea and Hawaii Loa Ridge), with only 65 percent buildout projected by 2008, 80 percent buildout by 2014, and full buildout several decades later.

The phased development will allow for less area to be affected by construction at one given time, lessening potential for increased stormwater flows and potential erosion and silt runoff. As a result, this plan offers added protection of the community for drainage concerns and the ocean for water quality concerns. The smaller construction force needed to develop the first phase, since there will be no golf course, will also lessen the potential effect on local roadways and neighborhoods. In addition, the extended build-out period for the homes on the Country lots will slowly phase in population and traffic from the project, in contrast to the more rapid development program for affordable homes and Country lots that was expected in the 1991 plan.

<u>Description of the Proposed Project</u>

Lihi Lani is located on approximately 1,144 acres at Paumalu and Pupukea on the North Shore of Oahu, in the Sunset Beach area of the Koolauloa District between Haleiwa and Kahuku. Obayashi Hawaii Corporation, the applicant, is seeking the necessary government approvals to develop a residential and agricultural community consisting of 315 Country zoned residential lots (one-acre minimum), 130 on-site affordable housing units, horse ranch, campground, hiking and horse riding trails, and community facilities.

The project site is generally located above the coastal bluff, approximately 800 feet mauka of Kamehameha Highway, with approximately 18 acres of land connecting to the highway makai of the bluff. The Sunset Beach Elementary School is located adjacent to the project site on the Haleiwa-side, and the COMSAT facilities are located on the areas above the bluff on the Kahuku-side. The site has generally rolling terrain with three steep gulches containing intermittent streams, and two large plateau areas.

The land has historically been used for different types of agriculture, where grades have permitted this use. Currently, a small part of the project site is being used for horse grazing (approximately 4 to 5 animals). A propogation nursery has recently been developed on-site to establish erosion control plantings and agricultural stock.

Construction of the project's roads, utilities, agricultural areas and building sites will require site disturbances such as clearing, grubbing, grading, and excavation. Building construction will involve the Ranch, maintenance buildings, campground facilities, community facilities and approximately 445 residences. Infrastructure requirements that will be constructed include: roadways; wastewater collection, reclamation and reuse facilities; potable water and irrigation water supply and distribution systems; and other utilities installations.

The proposed project is expected to create both beneficial and adverse effects on the natural/physical environment and the human/socio-economic environment. A detailed description of the existing environmental conditions was prepared for each environmental factor, and this was used as a background to assess potential benefits and adverse effects.

Potential Beneficial Impacts

There are a number of project impacts that will be beneficial to residents of Sunset Beach and Pupukea Highlands, and North Shore and Oahu residents in general. Anticipated beneficial impacts of the proposed project are listed below, and compared to the proposed benefits of the 1991 plan.

1. A Community Benefits Package has been proposed by Obayashi, similar to that planned in 1991. A major portion of this package is represented by Obayashi's proposal to assist the development of a community facilities complex which will be developed on approximately 6.5 acres of the site makai of the bluff and adjacent to the Sunset Beach Elementary School. A complex is currently planned for this site by the YMCA of Honolulu that will include: a combined soccer field/baseball field, 25-meter swimming pool, and a multi-purpose building including meeting rooms, exercise facilities and a child care program. Obayashi is proposing to provide the land, infrastructure and a portion of the building development costs; the YMCA would fund the remainder of development costs.

2. Extensive recreational facilities will be developed in the main portion of the site, including a horse ranch, campground, and miles of hiking and horse riding trails. All of these facilities will be open to public use, some requiring a user fee. Public use of the hiking and horse riding trails will be free of charge. This is the same plan as proposed in 1991.

3. Between 664 to 744 acres of the project site will remain unaffected as natural areas in gulches and buffer areas. Approximately one-half of this area will be under private lot owner control with the remainder in common area (217 acres). More unaffected open space area will result from the proposed project, as compared to the 1991 plan.

4. Installation of extensive drainage controls will strictly limit storm water runoff generated by the developed project site, to the same or less than existing runoff rates and volumes. Suspended sediments eroded from the site will be less with development than under existing conditions. Even more extensive drainage control is planned under the proposed project, although the 1991 plan provided more than the standard drainage control requirements.

5. Cooperative efforts are being undertaken to preserve the habitat for the only known examples of the Koolau Eugenia tree, located on the adjacent State Forest Preserve land just mauka of the project site. Selective clearing of other encroaching plants, and propagation efforts will increase chances for survival of these rare trees. This is the same as planned for the 1991 plan.

6. Archaeological resources have been inventoried on the property, and significant sites will have intensive surveys conducted or will be preserved for future education and research, as recommended by DLNR. This is consistent with the 1991 plan.

7. Approximately 110 to 150 full-time equivalent direct construction jobs will be created over the short-term period between 1996 and 1998 (infrastructure development and first housing phase), tailing off to approximately 50 to 70 workers between 1999 and 2008 (subsequent three housing phases). The construction phase employment generation anticipated for the proposed project during the initial three year phase is about one-half of that anticipated under the 1991 plan.

8. Approximately 40 direct operational jobs (full-time equivalent) will be created for the period 1996 to 1998, stabilizing at approximately 30 direct jobs in the following years. Total direct, indirect and induced operational employment positions created by the project at build-out will be approximately 60 jobs in the 1996 to 1998 period, and 50 jobs thereafter. The number of operational jobs created by the proposed project are approximately one-half the number anticipated under the 1991 plan.

9. Net fiscal benefits to the State government as a result of the project are expected to be high during the initial construction years 1996 to 1998 ($4.4 million annually), stabilizing at $0.65 million (1993 dollars) annually by 2008. Net fiscal benefits to the City and County of Honolulu are projected to be $0.55 million (1993 dollars) annually by 2008. As compared to the 1991 plan, net fiscal benefits of the proposed project to the State will be five times higher and County net revenues will be 25 percent lower.

10. As planned in 1991, job training will be provided for interested local residents for positions available at Lihi Lani's horse ranch, YMCA and agricultural areas.

11. Up to 180 affordable housing units will be provided by the proposed project, including 50 on-site single family affordable homes built by Obayashi, land and infrastructure for the City's 80 units of elderly housing affordable rentals and a monetary contribution towards the development of up to 50 off-site affordable units by the City in the North Shore region. As compared to the 1991 plan, the same number of affordable homes will be provided by the affordable housing program of the proposed project, although only 130 homes will be on-site instead of 180 homes.

12. Obayashi will establish an educational scholarship and trust fund for the North Shore area students and schools, based on a monetary contribution from each of the 315 country lots sold at the project. Although the per unit contribution has decreased for the proposed project, the total contribution will be slightly higher than planned in 1991.

Potential Short-term Adverse Impacts and Mitigative Measures

Project development activities will involve the construction of the roadways, utilities, support facilities, agricultural areas and residences. Short-term construction-related impacts on the environment will be generated by the project, and mitigative measures will be implemented to minimize these impacts.

Potential short-term adverse impacts and mitigative measures are listed below, and compared to those anticipated under the 1991 project plan.

1. Soils will be disturbed for grading and excavation, and some soil erosion will occur. An Erosion Control and Sedimentation Plan for the construction will be prepared for the project, which must be approved by the City and County of Honolulu Department of Public Works. Proposed mitigation will include soils management measures and drainage controls that will minimize soil erosion. Where feasible, drainage detention basins will be constructed to control runoff during the construction period. New erosion control planting programs are already in effect at the property. In addition, Lihi Lani will utilize the State Department of Health (DOH) Best Management Practices and U. S. Environmental Protection Agency (EPA) (January 1993) recommendations for

drainage and erosion controls to minimize non-point pollution to coastal waters. This mitigation is more stringent than the 1991 plan.

2. Surface water quality (as storm runoff) could be slightly affected by additional suspended sediments as a result of some unavoidable soil erosion during the construction period. Proposed soil management measures and drainage controls will minimize soil erosion and subsequent addition of suspended sediments to storm water runoff, as per DOH and EPA/NOAA recommended techniques. This approach is more stringent than the 1991 plan, particularly due to the planned development phasing.

3. Introduced plant and wildlife species occur in areas of the project site that will affected for construction. Wildlife will generally be displaced temporarily to large undisturbed areas on the property. Landscape plantings are expected to provide replacement habitat for some wildlife types. Approximately 664 to 744 acres of the site will remain as undisturbed habitat areas. In the proposed plan, there will be less area affected by development than expected under the 1991 plan.

4. Trucks and worker vehicles will create a short-term effect on traffic conditions on local roadways, mainly Kamehameha Highway and its nearby intersections. Mitigative measures that will be implemented to minimize short-term traffic effects will include off-peak truck use of highways, and possibly staggered worker start and finish times. Construction equipment will access through Pupukea Highlands from the Boy Scout Camp Pupukea for 6 to 9 months until the main access road is completed at Kamehameha Highway. As compared to the 1991 plan, the proposed project will require about one-half the number of construction workers, therefore, many fewer vehicles will be required to access the site each day during the initial two to three-year construction phase.

5. Noise will be generated by construction activities on the project site. Construction operations must comply with the City and County of Honolulu Noise Ordinance, which limits construction operations and resultant noise to daytime hours and maximum levels. Noise conditions resulting from the proposed project will be similar to that generated by the 1991 plan.

6. Air quality will be affected by the generation of fugitive dust, and construction equipment and worker vehicle emissions. Dust conditions will be controlled by frequent watering of roadways, and equipment will be maintained in proper working order to minimize emissions. Air quality during construction could be expected to be better for the proposed project due to the phased construction planned for the proposed project.

7. Construction activities will be most visible at the entrance on the makai section of the project site, along the access roadway route across the bluff. The construction of some structures located near the bluff edge along the Kahuku-side plateau will be visible, including the clubhouse and a few residences.

Views of the construction operations on the site will be minimized by proper equipment and materials storage, minimized vegetation clearing, and expedient re-vegetation. View effects of the proposed project are comparable to those anticipated under the 1991 plan.

8. Modifications to Kamehameha Highway will be done to construct a left-turn lane into the new project access road. Highway construction will be limited to off-peak hours, and maintenance and protection of traffic will be undertaken according to Hawaii Department of Transportation requirements. Both the proposed project and the 1991 plan include this planned improvement.

9. As with the 1991 plan, emergency medical facilities in Kahuku may occasionally be utilized by construction workers during the period 1995 to 2008.

<u>Potential Long-term Adverse Impacts and Mitigative Measures</u>

Once the Lihi Lani project is completely developed and full operations are underway, some long-term adverse effects will have occurred or will continue to occur. Mitigative measures have also been proposed to minimize the long-term adverse effects of the project.

Anticipated long-term adverse impacts and proposed mitigative measures are listed below and are compared to those which were anticipated under the 1991 plan.

1. Grading of the project site will change some of its topographic features. Grading changes will only be undertaken where necessary and will be coordinated with drainage improvements. Under the County Ordinance, only 15 acres of land can be cleared at one time. A City and County of Honolulu Grading Permit must be obtained prior to construction, and proposed grading changes will be fully reviewed and approved.

2. Minor contributions of fertilizer constituents and pesticides will enter storm water runoff generated on the project site. Intermittent streams will collect and transport some of this runoff during peak precipitation periods. Fertilizers and pesticides will be carefully controlled in amounts applied in the common landscaped areas and agricultural areas following an Integrated Pest Management (IPM) program. No applications will be made during high precipitation periods. Less fertilizers and pesticides will be applied at the proposed project as compared to the 1991 plan (which included a golf course).

3. Minor concentrations of nitrates from reclaimed water (treated sewage effluent) and fertilizer and pesticides could enter groundwater through percolation of precipitation and irrigation water. Application of irrigation water, fertilizers and pesticides will be carefully controlled in the common areas and agricultural areas by a grounds manager to avoid over-application. The 1991 plan also included reclaimed water disposal by land application.

4. Approximately 245,000 gallons per day (gpd) of potable groundwater (average rate) will be utilized by the project from the BWS Waialua, Haleiwa, and Wailee water supply wells. Actual water use is likely to be less due to the water conservation measures to be implemented. To gain a water allocation for the project, Obayashi would be required to participate with BWS in source development in the Waialua or Kawailoa areas. The proposed project requires approximately 33 percent more potable water than would the 1991 plan.

5. Approximately 0.6 to 0.7 mgd of irrigation water will be drawn from the brackish water aquifer underlying the site during peak use periods and will be utilized by the common area landscaping, and portions of the Ranch and landscaping and agriculture on Country lots. Approximately 0.18 mgd of reclaimed water (treated wastewater effluent) will be applied to larger common agricultural areas. Over-pumping of groundwater will be avoided by careful management of pumping facilities. Safe pumping rates for these facilities will be approved by the Board of Water Supply and the Department of Land and Natural Resources. Brackish water use for the proposed project will be similar to that expected for the 1991 plan.

6. Vegetation clearing will be necessary for infrastructure development, including roadways and the water reclamation facility. This will amount to less than 100 acres. An additional 100 acres removal of vegetation will be required for residential construction and the community facilities. The remaining areas for clearing will be for agricultural and ranch purposes. However, these 200 to 280 acres will be re-vegetated with trees, grasses and other plants immediately upon clearing. Approximately 400 to 480 acres of existing vegetation will be removed in the course of constructing the proposed development but more than 50 percent will be re-vegetated.

   The phased development of the proposed project will create much less vegetation clearing at a single point in time, therefore, reducing potential erosion and runoff associated with vegetation clearing. The area to be cleared under the 1991 plan was about 20 percent less, however, no agricultural use was previously proposed and most development was slated to occur in a shorter, more intense construction period. No substantial numbers of native plants will be affected by the project. Extensive landscaping will be performed to re-establish vegetation across much of the area. Obayashi will continue participating in a cooperative effort with the State DLNR to preserve and enhance the habitat for the rare Koolau Eugenia trees, located on the State Forest Reserve land mauka of the property near.

7. Existing habitat for birds and other wildlife species will be affected. Some wildlife species will leave these areas, and relocate in adjacent open space areas within the project site. Landscape plantings and field stock and agroforestry areas will re-establish some habitat for wildlife.

8. Slight amounts of suspended sediments, fertilizer constituents, organic material and pesticides will be introduced to the ocean during peak storm water runoff periods. The concentration of suspended sediments and nitrogen in runoff from the property will be lower than current levels after the project is completed. Very extensive drainage controls and restrictive fertilizer and pesticides application rates, as well as special design features for on-site containment, will minimize the effect of these potential contaminants on marine water quality and marine ecology. Chemicals and nutrient concentrations in runoff carried off-site by intermittent streams will not create adverse impacts on the ocean environment. A baseline survey of ocean water quality has been made. Ongoing ocean water quality monitoring surveys will be conducted during the construction period; and, if necessary, beyond to assess potential water quality effects of the project. As compared to the 1991 plan, the proposed project will have less potential to cause water quality impacts.

9. There are 23 significant archaeological sites in the project area. Sixteen of the 23 significant sites will undergo archaeological data recovery and the remaining seven sites will be preserved. Fifty-four historical sites were located within the project area, and recommendations for treatment of sensitive sites will be reviewed by the State Department of Land and Natural Resources, Historic Preservation Division. For the proposed project, the same commitments will be made with respect to archaeological sites as made for the 1991 plan.

10. Lihi Lani will create a new intersection to Kamehameha Highway at the project access road. For the traffic analysis, the year 2008 was used as the study year for project completion. Actual build-out of Country lots is projected to be 65 percent by 2008, however, to analyze total project impact a worst case assessment was made which assumes 100 percent completion in 2008. Weekend peak hour traffic (Sunday pm) generated by the project (enter and exit) will be as follows: 142 trips for Country lots, 62 trips for affordable housing, and 53 trips for the Ranch and community facilities. As compared to the 1991 plan, the proposed project will result in less traffic because the golf course is not included. The proposed project will comparatively result in up to a 5 percent reduction in weekday peak period traffic, and up to a 22 percent reduction in weekend peak period traffic.

    As in the 1991 plan, a left-turn lane into the project access road will be installed to minimize delays associated with highway through-traffic. With or without the project, through-traffic flow along Kamehameha Highway at this location will experience delays during peak periods. Entrance onto Kamehameha Highway from the project access road will also experience delays during peak traffic periods.

11. Noise will be generated by vehicles traveling to and from the project on local roadways, and by the operation of the maintenance equipment. Comparable noise effects to the 1991 plan are anticipated with the proposed project.

12. Parts of the project will be visible from Kamehameha Highway, Sunset Beach Elementary School, nearby residences and local beaches. Visible elements of the project will include the project entrance, the project access road and portions of a few homes (such as a roof peak). The YMCA building and elderly apartments would also be visible from the project's entrance. Design plans will minimize the visibility of structures, roadway features and lighting from the areas makai of the project and from Sunset Hills and Pupukea Highlands. The proposed project will cause comparable changes in public views as in the 1991 plan.

13. A total of 315 Country lot residences and 130 on-site affordable housing units are proposed upon completion of the project, with indirect participation in up to 50 off-site affordable units (with the City). By 2008, a total full-time residential population of Lihi Lani will be approximately 687 persons, consisting of 437 persons at the Country lots and approximately 249 persons at the affordable housing. At full development of the Country lots, expected to be several decades beyond 2008, total population of Lihi Lani would be 977 persons, with 729 persons at the Country lots and 149 persons at the affordable housing. The population increase associated with Lihi Lani is of too small a magnitude (0.07 percent of the projected 2010 Oahu population) to materially alter the degree of consistency of the North Shore's development capacity with its Population Distribution Guidelines. Resident population of Lihi Lani at full build-out under the proposed project would be approximately 40 percent greater than the 1991 plan. The pace of resident occupancy of the proposed project, however, is slower than would be experienced the 1991 plan due to the greater proportion of Country lots versus affordable units on-site and the extended development phasing over 10 to 12 years.

14. The project will create between two to three tons per day of refuse for removal and disposal by a private hauling firm at an appropriate City and County landfill or other solid waste disposal facility. Property tax revenues generated by the project are expected to alleviate any shortage in the waste disposal facilities capacity due to the added demand caused by the project. The domestic solid waste generated by the 1991 plan would be somewhat less due to less resident population.

15. As many as 154 school children could be added to local schools by the project at full build-out some 20 to 30 years into the future. The project could create an impact on the capacity of area schools, corresponding to the phased home build-out. This estimate of enrollment increase follows enrollment rates currently experienced from the Pupukea Highlands/Sunset Beach/Waimea area. By 2000, the total number of school children would only be 40, with the additional growth caused during the 2000 to 2010 period. By 2010, up to 107 school children could be added. This increase will not exceed the capacity of Sunset Elementary School but could exceed the capacity of the Kahuku High and Intermediate School. Tax revenues generated by the project are expected to

more than pay for any increase in operational costs. Less school children would be generated by the proposed project, as compared to the 1991 plan, due to the lower relative number of affordable single-family homes on-site.

16. Public services such as police and fire protection, emergency medical facilities and recreational facilities will be required by the project, but only a minor effect is expected on these services. Property tax revenues generated by the project are expected to cover any increase in operational costs caused by the project. As compared to the 1991 plan, there is no significant change except for some additional population (at full build-out) and additional homes and longer internal roadways which will take longer to reach in a police or fire response.

<u>Alternatives to the Proposed Project</u>

Five alternatives to the proposed project have been considered involving different land use and development concepts. These alternatives include: the no-action alternative, an agricultural alternative, an agricultural subdivision alternative, a two golf course/no housing (recreational) alternative and the 1991 recreational community (golf and residential) plan. Included below are brief discussions of each alternative, selected associated impacts, and a comparison with the proposed project.

The no-action alternative would keep the project site in its present undeveloped condition. Small scale agricultural use for horse grazing could possibly be continued. Erosion of the property would continue unmitigated. No beneficial or adverse effects would be generated by this alternative. The owner of the land would continue to pay property taxes for this land without gaining any return on the initial investment or tax payments. In terms of environmental consequences, this alternative would create the least adverse and beneficial effects of all alternatives considered.

An intensive agricultural use alternative was considered which would involve the intensification of agricultural use on the site. Approximately 460 acres could be utilized for cultivated crops, tree fruit crops and grazing. Extensive land clearing would occur under this plan, and soil erosion and drainage problems would be created. Water quality and water use considerations would also be significant under this alternative. The establishment of a profitable agricultural enterprise on this land would not be realistic due to high up-front infrastructure costs (water system), high crop production costs and existing market conditions. A multi-million dollar access road rising from Kamehameha Highway would not likely be constructed, therefore, agricultural access would depend on Wilinau Road in Sunset Hills and Pupukea Road via the Boy Scouts Camp Pupukea.

Development of an agricultural subdivision on the site under the existing AG-2 zoning was considered as a potential alternative. Physically, as many as 500 two-acre lots could be subdivided into two-acre lots for agricultural use. However, due to the marginal agricultural soils found over most of this property, it is unlikely that City and County requirements for feasible agricultural use on each lot could be satisfied.

The development of as many as 80 to 120 agricultural lots might be possible, however, with similar infrastructure requirements as with the proposed project. There would be requirements for wastewater collection, treatment and disposal facilities to support the entire development, with disposal by irrigation on private agricultural lots. No community facilities would be developed under this scenario. Their would be no affordable housing requirement for this project since no change of zone would be required. In comparison to the proposed project, this alternative would create similar to greater environmental impacts without the benefits of community facilities and recreational facilities development. The costs of the roads, sewers and water supply infrastructure required to construct this project could not be offset by the revenues generated by sales of a much fewer lots, therefore, this alternative would not be feasible.

The recreational alternative would involve development of only recreational facilities within the project. This alternative would include: two 18-hole golf courses, two clubhouses, driving range, a tennis center, equestrian ranch, campground, and hiking and horse riding trails. Community facilities would also be constructed in this scenario. Approximately 586 acres would be developed, and impacts to topography would be substantial due to grading and extensive vegetation clearing due to the added golf course area. Additional non-potable water would be required to irrigate the two golf course areas, and potable water requirements would be greater. Traffic would be slightly less under this plan. No housing would be created by the recreational alternative, and property tax revenues would be less than with the proposed project. The environmental impacts of this alternative would be less than the proposed project in some cases, and greater in others.

The 1991 plan of a recreational community has been evaluated in comparison to the proposed project throughout the previous discussion of benefits and potential short-term and long-term impacts. In general, the 1991 plan would cause less resident population, more traffic and more fertilizer and pesticides use. The 1991 plan would be developed more rapidly that the proposed project due to the larger affordable component and the need to complete the golf course in a two-year period. Phasing of the new Lihi Lani project will greatly diminish the potential stormwater runoff, erosion and silt runoff, in comparison to the potential of development following the 1991 plan.

Relationship to Existing Policies and Plans

This Draft SEIS includes a detailed discussion of how the proposed project is generally consistent with most existing State and City/County policies and plans for the area. Specific measures are being taken to minimize project plans which contradict any of these policies and plans. Plans and policies considered are:

1. Hawaii State Plan: Objectives/Policies, Priority Guidelines, Functional Plans
2. City and County of Honolulu General Plan
3. North Shore Development Plan
4. State of Hawaii Coastal Zone Management Plan Program

5. Special Management Area Rules and Regulations, City & County of Honolulu

An extensive discussion of the project as compared to these policies and plans is contained in Section 7.

Required Permits and Approvals

Several "discretionary" permits and approvals will be required to implement the proposed project. These are listed below with their related agencies. Other permits not listed include more ministerial approvals such as grading and building permits.

1. State Land Use District Boundary Amendment
   Agriculture to Urban (single-family affordable housing site, elderly housing site, water reclamation facility and community facilities)
   Agency: Office of State Planning, State Land Use Commission

2. North Shore Development Plan Amendment
   Land Use Map (affordable housing, parks and community facilities)
   Public Facilities Map (water, wastewater, drainage and road systems)
   Agency: City and County Planning Department. Planning Commission, City Council, Mayor

3. Zoning District Change
   Agricultural (AG-2) to Country District (Country lots)
   Agricultural (AG-2) to Other Residential District (affordable housing)
   Agency: City and County Department of Land Utilization, Planning Commission, City Council, Mayor

4. Special Management Area Use Permit
   Agency: City and County Department of Land Utilization, City Council

5. Conditional Use Permit
   Ranch, Campground, Water Reclamation Facility and Community Facilities
   Agency: City and County Department of Land Utilization

6. Others
   Site Plan Review Agency:
   Department of Land Utilization (DLU)

   Planned Development-Housing (PDH)
   Agency: Department of Land Utilization

SECTION 1

INTRODUCTION

1.0 INTRODUCTION

Section 1 provides an introduction to the proposed Lihi Lani project, including a development summary and background information on the property and the Landowner/Applicant, Obayashi Hawaii Corporation ("Obayashi").

Obayashi has applied to the City and County of Honolulu Planning Department (the "Accepting Agency") for an amendment to the North Shore Development Plan (DP) Land Use Map to permit the development of a residential community, with market, single family affordable and elderly rental affordable homes, a horse ranch, campground, and community facilities which will include a park and branch YMCA. Supporting infrastructure development includes construction of a water reclamation facility for wastewater treatment, access and internal roadways, and water and utility transmission lines. The DP Amendment application is requesting the redesignation and reconfiguration of approximately 266 acres of land to DP classifications including Residential, Park, Public Facility and Agricultural.

1.1 DEVELOPMENT SUMMARY

Applicant/Landowner:	Obayashi Hawaii Corporation ("Obayashi") 725 Kapiolani Boulevard, Fourth Floor Honolulu, HI 96813 Mitsuru Kawasaki, President Telephone: 593-0000
Development Agent:	Quon • Yamagishi Partnership 46-387 Hololio Street Kaneohe, HI 96744 Craig Yamagishi, Project Coordinator Telephone: 235-4651
Planning Consultant and SEIS Preparers:	Group 70 International, Inc. 924 Bethel Street Honolulu, HI 96813 Jeffrey Overton, Senior Environmental Planner Telephone: 523-5866
Accepting Authority:	Department of Planning City and County of Honolulu 650 South King Street, 8th Floor Honolulu, HI 96813 Robin Foster, Chief Planning Officer

Proposed Action:	For the Development Plan Amendment, the Applicant requests a change in the land use designation of the North Shore DP Land Use Map to allow the development of the following: 50 single family and 80 elderly rental affordable housing (Residential - 16 acres), community facilities including a park and branch YMCA (Public Facility - 6.5 acres); a water reclamation facility for wastewater treatment (Public Facility - 24 acres) and an open space/agroforestry park (Park - 219 acres). Additionally, approximately five acres of land designated as Park will revert to Agriculture. All other proposed actions are consistent within the Agriculture classification.
Project Name:	Lihi Lani
Project Location:	The site is located in the Sunset Beach and Pupukea Highlands area of the North Shore of Oahu, mauka of Kamehameha Highway on the lands between the Comsat facilities.
TMK:	Tax Map Key designations for the total 1,144-acre site are: TMK 5-9-05: 6 Por. 38, 82 TMK 5-9-06: 1, 18, 24 TMK for areas proposed for Amendment include: Park (mauka location): TMK 5-9-06: 18, Por. 01, TMK 5-9-05: Por. 38 Residential (Single Family/Elderly): TMK 5-9-06: 24 Public Facility (YMCA): TMK 5-9-06: 24 Public Facility (WRF): TMK 5-9-06: 24 Agriculture: TMK 5-9-06: 24
Total Project Area:	Total area of the project site is 1,143.6 acres ("1,144 ac.").
Area of Application:	266 acres of the total 1,144 acres
Existing Use:	Existing uses and structures include grazing pasture and woodlands, dirt roadways, abandoned military bunkers, and a new nursery facility for propagation of erosion control and landscaping plants.
State Land Use District:	Agricultural District

North Shore Development Plan:

• **Land Use Map:**	Agriculture, Park/Golf Course, Residential, Park, Public Facility
• **Public Facilities Map:**	No designation
Zoning:	AG-2 General Agriculture

1.2 LOCATION

The property encompassed by this project consists of approximately 1,143.6 acres (1,144 acres) of wooded land, fields, bluffs and steep gulches located in Paumalu and Pupukea on the North Shore of Oahu in the Koolauloa Judicial District. The Tax Map Key designations for the property are: TMK 5-9-05: 06, 38, 82 and TMK 5-9-06: 01, 18, 24. The project site is located approximately 60 to 75 minutes by car from Honolulu. The location of the project site and the project boundaries in reference to the surrounding areas is shown in Figure 1-1.

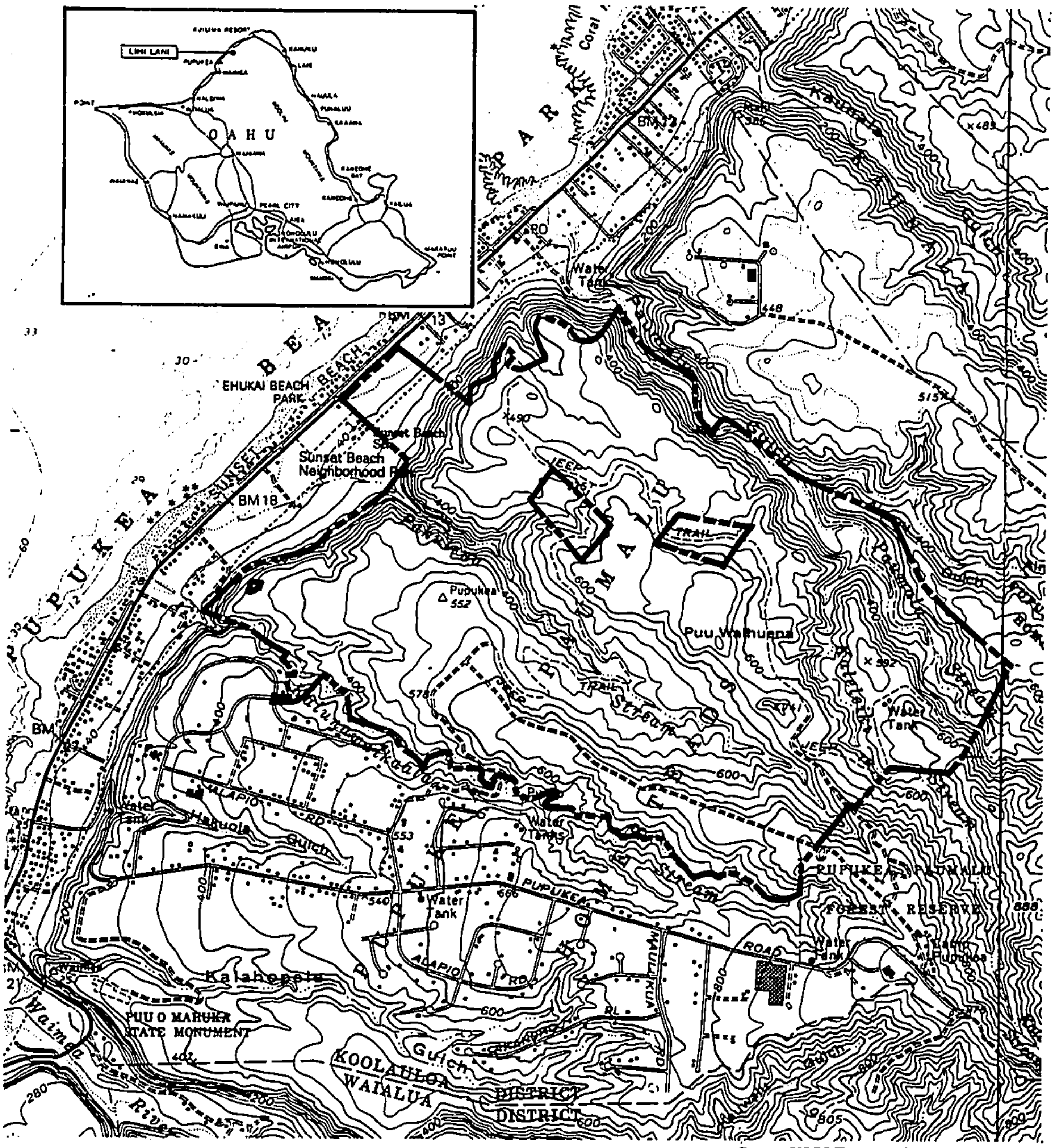
1.3 OWNERSHIP AND PRESENT USES OF THE PROPERTY

The property has been owned by Obayashi Hawaii Corporation and/or its parent company Obayashi Corporation, since 1974. Obayashi has been a developer in Hawaii for over 24 years, and has constructed buildings in Honolulu, Hawaii Kai and on Kauai. Obayashi is also the owner of the Sheraton Kauai Beach Resort and Sheraton Kauai Garden Hotel and has developed subdivisions on Maui (Kaanapali Hills, The Masters at Kaanapali and Kulanani Estates) and a 240-unit affordable housing subdivision (Waialaelae Estates) on Kauai. The parent company, Obayashi Corporation, is a major general contractor in Japan.

Existing uses and structures at the site include grazing pasture for horses and woodlands, dirt roadways, abandoned military bunkers, and a new 1,250 sq. ft. nursery facility for propagation of erosion control and landscaping plants. Recent activities on the property include the nursery program which is designed to test drought tolerant plant materials which would be appropriate for re-vegetating currently eroded slopes.

1.4 DESCRIPTION OF THE PROPERTY

The project site consists primarily of wooded sloping lands, intermittent gulches, and plateaus with ground cover and lower field vegetation types. Portions of the plateau areas are presently used for horse grazing. Steep slopes occur in the three gulches which extend over one-half of the land area of the property. Previous uses of the land have been in agriculture, including grazing, pineapple and avocado cultivation. Due to the steep terrain, isolated location, and lack of appropriate irrigation, infrastructure and roadways, these past agricultural endeavors have been unprofitable.



Source: USGS Topographic Quadrangle (1983)

LOCATION / PROJECT BOUNDARY MAP

0 1000' 2000' 4000'

NORTH

LIHI LANI

FIGURE 1-1

The range in elevation at the project site is approximately 20 feet above mean sea level (msl) near Kamehameha Highway, to nearly 850 feet on the mauka uplands of the plateau regions. An 18-acre makai section of land connects to Kamehameha Highway; this land gently slopes from the highway to the foot of the coastal bluff. The community facilities (park and YMCA) and the elderly housing are planned at this location. Most of the site is located above the 400-foot coastal bluff with narrow, steep intermittent stream gulches and small plateaus. From the upland portions at the top of the bluff are views of the Waianae Mountain Range and parts of the coast from Mokuleia to Sunset Beach are available, including spectacular ocean and sunset views. The mauka views include the Pupukea-Paumalu Forest Reserve, a portion of the Koolau Range.

Several intermittent streams traverse the project site, as shown in Figure 1-1. Pakulena Stream extends through the center of the site. Paumalu Stream forms the Kahuku-side boundary and Kalunawaikaala Stream delineates the Haleiwa-side boundary. These stream channels collect runoff during high precipitation events, discharging into the adjacent lowlands and eventually the ocean. Kaleleike Stream is a branch of Paumalu Stream that crosses the site near the mauka boundary.

Remnants of old government roads and easements are designated on legal maps of the project site. Physical signs of the old roadways, for the most part, do not exist. The origin and purpose of these roads is unknown; however, they may have once been used for coast and geodetic survey, agricultural, watershed and/or military purposes. Obayashi is currently in the process of obtaining the fee ownership interest in or otherwise realigning these remnant roads with the State Board of Land and Natural Resources and the Federal Government.

Along the top edge of the bluff, near the Kahuku-side and Haleiwa-side boundaries, are two abandoned Army defense lookout/gunnery bunkers that were likely manned during WWII. The government roads and easements may have provided access to these bunkers. There are three State-owned parcels located within the Obayashi project. Two State parcels of approximately 28 acres are labelled "water reserve" on historical maps. A third small state-owned parcel exists at the makai edge of the Haleiwa side. A mapped extension of Pupukea Highlands Road enters the property at the mauka boundary at the Boy Scouts Camp Pupukea, and follows the Kahuku-side plateau makai for nearly 5,000 feet.

1.5 SURROUNDING LAND USES

Residential, agricultural, and vacant open space areas border the project site. The surrounding Pupukea/Sunset Beach/Waimea community is primarily a low to medium density residential area with a few small commercial and numerous small-scale agricultural uses. The plateau on the Kahuku-side is occupied by the telecommunications facilities of COMSAT. The plateau on the Haleiwa-side of the upland area is occupied by large lot (one-acre and larger) subdivisions known as Pupukea Highlands and Sunset Hills. State Conservation District lands border the project on the mauka side. A portion of the State lands mauka of the project site are leased to the Boy Scout's Camp Pupukea. The Girl Scout's Camp Paumalu, on land owned by the Girl Scouts is located mauka of the southeastern corner of the property. The makai portion of the site which connects to Kamehameha Highway is bounded by residences on the Kahuku-side and the Sunset Beach Elementary School on it's Haleiwa-side. Kamehameha Highway borders the makai end of the property.

The Kuilima Resort and Turtle Bay Hilton Hotel are located approximately five miles from the site towards Kahuku. Some limited retail and service businesses are located along Kamehameha Highway in the Sunset Beach area, including Kammies Market and Sunset Beach Store. Beach-front and inland residences, beach-front parks, the Sunset Beach Elementary School and agricultural land uses make up the majority of land within the lowlands makai of the project from Sunset Beach to Waimea Bay. Haleiwa is the nearest commercial center, located approximately eight miles southwest of the site.

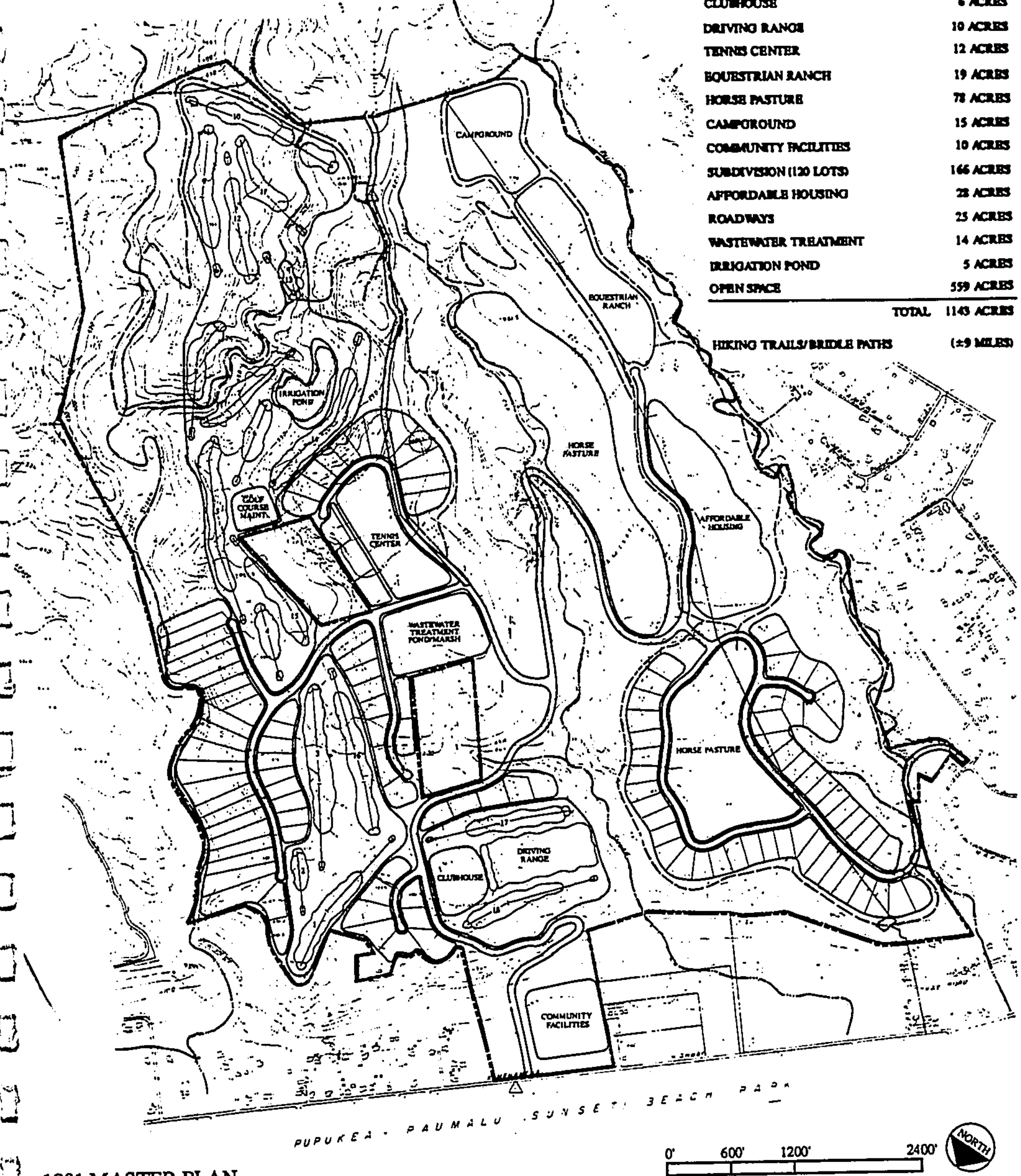
1.6 PROJECT BACKGROUND

A Final Environmental Impact Statement (EIS) (Group 70, April 1991) for Lihi Lani Recreational Community was accepted by the City and County Department of Planning in May 1991 in relation to a request for amendment of the North Shore Development Plan (DP) Land Use Map. The 1991 land use plan for the Lihi Lani Recreational Community (Figure 1-2) included a mixed-use residential and recreational development comprising of a golf course, driving range, clubhouse, tennis center, campground and horse ranch. The residential component of the 1991 plan, included 120 one-acre (or larger) Country zoned lots and 180 affordable housing units in a mix of single and multi-family units. Community facilities proposed in this plan would include a meeting facility with a child care center and playing fields for soccer and baseball. DP Land Use Map Amendments were granted in 1991 for: Park/Golf Course (212 acres) for an 18-hole golf course; Park (10 acres) for the Community Facilities; Residential (28 acres) for the Affordable Housing; and Public Facility (14 acres) for a Wastewater Treatment Facility. The remainder of the land would have remained in Agriculture for Country lot residences, and other open space and agricultural uses.

1.7 CURRENT DEVELOPMENT PLANS

Obayashi has revised the project concept since the approval of the DP Amendment. The new land use plan for Lihi Lani, as presented in this Draft Supplemental Environmental Impact Statement, is more complementary to the surrounding North Shore setting than the previous plans which focused on golf course and residential development. The major differences between the 1991 land use plan and the current development plan include the following: 1) the elimination of the golf course, driving range, golf clubhouse, and maintenance facility; 2) the increase in the number of residential units; 3) a change in the composition of units to include one-acre minimum residential lots (Country lots) and homes, single family affordable housing and elderly affordable rental units. The number of Country lots has been

OLD MASTER PLAN



1991 MASTER PLAN

LIHI LANI

FIGURE 1-2

increased from 120 to 315 lots. The increased number of lots will be located on lands which are currently designated for the golf course.

Affordable housing for Lihi Lani has been revised to include the following: 50 on-site single family homes, 80 on-site elderly rental apartments (City project), and participation with the City in the development of up to 50 off-site single family homes. Through these projects, Obayashi will participate in the development of 180 affordable homes. The affordable housing components to be evaluated in this SEIS process include the on-site homes only. The elderly housing is planned to be developed in conjunction with the City's Department of Housing and Community Development. Obayashi proposes to dedicate a six-acre site together with infrastructure connections to the City who will construct the buildings and manage the project. For the off-site affordable homes, Obayashi is seeking to participate with the City toward development of up to 50 off-site affordable units located in the North Shore/Koolauloa Region. Discussions with the City Housing Director are on-going and will be formalized during the Change of Zone process in binding agreements in the Unilateral Agreement.

1.8 UNRESOLVED ISSUES

The Final EIS (Group 70, April 1991) identified two unresolved issues which the current Lihi Lani Master Plan addresses. The first issue involved a community concern expressed by a small segment of the North Shore population regarding the land use mix of residential and golf course usage, with preference for "no development" or "no golf course". A second concern involved the density of development for the affordable housing on smaller lots of 5,000 square feet at a mauka location equivalent to Pupukea, which is entirely County-zoned (one acre minimum). The proposed uses of the present Master Plan address both of these concerns.

While "no development" is not an option for the owner who has carried the costs for this property since 1974 with no positive return on the investment, the new Master Plan no longer proposes a golf course. The second issue, regarding density of affordable housing development in a low density rural setting, has also been addressed. As now proposed, the number of single-family affordable homes on-site in the mauka portion of the property has been decreased from 180 in the 1991 plan to 50 in the current plan. The 80 elderly homes, to be developed by the City, are proposed to be located in the makai portion of the site closer to Kamehameha Highway and public services and facilities. Obayashi will also participate in the development of an additional 50 affordable units with the City, at a location to be specified by the City within the North Shore region.

The environmental assessment and review process involves the analyses of new potential impacts related to the changes in the Master Plan. The purpose of this document is to provide the City and County of Honolulu Planning Department, Department of Land Utilization and the State Land Use Commission with updated information in consideration of a North Shore Development Plan Land Use Map

Amendment, Change of Zone application, and the reclassification of land (57.3 acres) in the State Agricultural District to the State Urban District. In addition, this updated project information and environmental analysis has been prepared to be reviewed by other governmental agencies, community organizations and individuals. This Draft SEIS provides information addressing the revised project plans and its potential environmental impacts. A detailed project description and a thorough analysis of the potential impacts and proposed mitigative measures are provided in this report.

1.9 PURPOSE AND CONTENT OF THE FINAL SEIS

This Final SEIS identifies and evaluates the potential impacts which could result from the development of Lihi Lani. Potential impacts which were studied in the 1991 EIS (Group 70, April 1991) and which remain unchanged are summarized, with references to that document. The Chapter 343 process is undertaken as part of an application to the City and County of Honolulu Development Plan Land Use Map amendment process. The public review and comment process is incorporated by addressing the comments in the formulation of the Draft SEIS and the Final SEIS.

The content of this report includes an Executive Summary which summarizes the major issues of the report. The main text of the report is presented in 12 sections. Section 1 includes this Introduction which presents the Obayashi Hawaii Corporation as the Applicant and landowner of the property, and provides a background of the project. Section 2 presents a detailed description of the proposed development.

Section 3 includes a discussion of the existing land use and zoning designations applicable to the property. Requests for changes in land use and zoning classification are also presented in this section, along with the approvals required to complete the project.

Section 4 includes the description of existing physical and natural environmental conditions, potential impacts of the project and recommended mitigative measures. The existing human and socio-economic environment, potential impacts of the project and mitigative measures are presented in Section 5. The impact analysis in Sections 4 and 5 also include comparisons of the proposed project with aspects of the 1991 plan. Section 6 addresses potential cumulative impacts of Lihi Lani, and unavoidable impacts of the project. Section 7 includes a discussion of the relationship of the project to existing policies and plans for the area. Alternative uses to the proposed action, including no-action, an agricultural alternative, agricultural subdivision, recreational alternative, a two golf course alternative and the 1991 plan are presented in Section 8. A summary of unresolved issues is included in Section 9. Section 10 includes a list of preparers, governmental agencies and community organizations which have been contacted in the planning process. Section 11 includes a list of consulted parties and participants in the SEIS process. And finally, Section 12 includes the written comments received and the corresponding responses.

Several appendices are attached which include the technical studies and reports which have been updated to reflect the current Master Plan for Lihi Lani.

In addition to the application for a North Shore Development Plan Land Use Map Amendment, the SEIS process is being undertaken to provide additional environmental analysis in support of applications and petitions for State Land Use District Boundary Amendment, a City and County of Honolulu Change of Zone Application and Special Management Area Use Permit.

SECTION 2

PROJECT DESCRIPTION

2.0 PROJECT DESCRIPTION

This section presents a summary of the proposed Lihi Lani project, including a description of the overall development theme and individual elements of the conceptual land use development plan (Master Plan). Also discussed in this section are anticipated construction activities, market demand for residential lots, the preliminary development timetable, and approximate infrastructure costs.

2.1 GOALS AND OBJECTIVES OF THE LIHI LANI MASTER PLAN

The overall goal of the Lihi Lani project is to develop an integrated residential, agricultural and recreational community which will combine to maintain and enhance the rural lifestyle and character of the North Shore. Lihi Lani is unique in that it will provide for diversified small-scale agriculture with low-density residential uses which will subsidize land and infrastructure costs for farming.

The agricultural components at Lihi Lani include lands which will be dedicated to a variety of agricultural uses, including field stock tree nursery, fruit tree orchards, grazing pasture, flower and foliage nursery and agroforestry. The residential component of the proposed project include 315 one-to-three acre residential Country lots, 50 single family affordable homes, 80 affordable elderly housing rental units, and off-site affordable housing participation (up to 50 units). The on-site elderly housing and off-site affordable homes will be developed by the City and County of Honolulu, Department of Housing and Community Development. The recreational facilities include a horse ranch with horseback riding activities, hiking trails, campground, community park and a branch YMCA facility. The current land use master plan for Lihi Lani is shown in Figure 2-1.

In support of the development, facilities that will also be constructed include the following: access and circulation roadways; a wastewater treatment and disposal system (water reclamation facility); a potable water supply and fire protection system; a non-potable irrigation water system; and other utilities systems. A brief description of each element of the Master Plan is presented below.

2.1.1 Agricultural Component

The Lihi Lani theme emphasizes the rural lifestyle and community character of the North Shore. Agriculture has always been a part of the North Shore lifestyle, and small-scale agriculture has historically been successfully integrated within a low-density residential setting at Pupukea Highlands. The goal of the Lihi Lani Conceptual Agricultural Plan, as shown in Figure 2-2, is to promote and integrate small-scale agricultural activities into the Country lot residential areas and larger common areas.

An important objective for Lihi Lani is to sensitively plan, develop and manage

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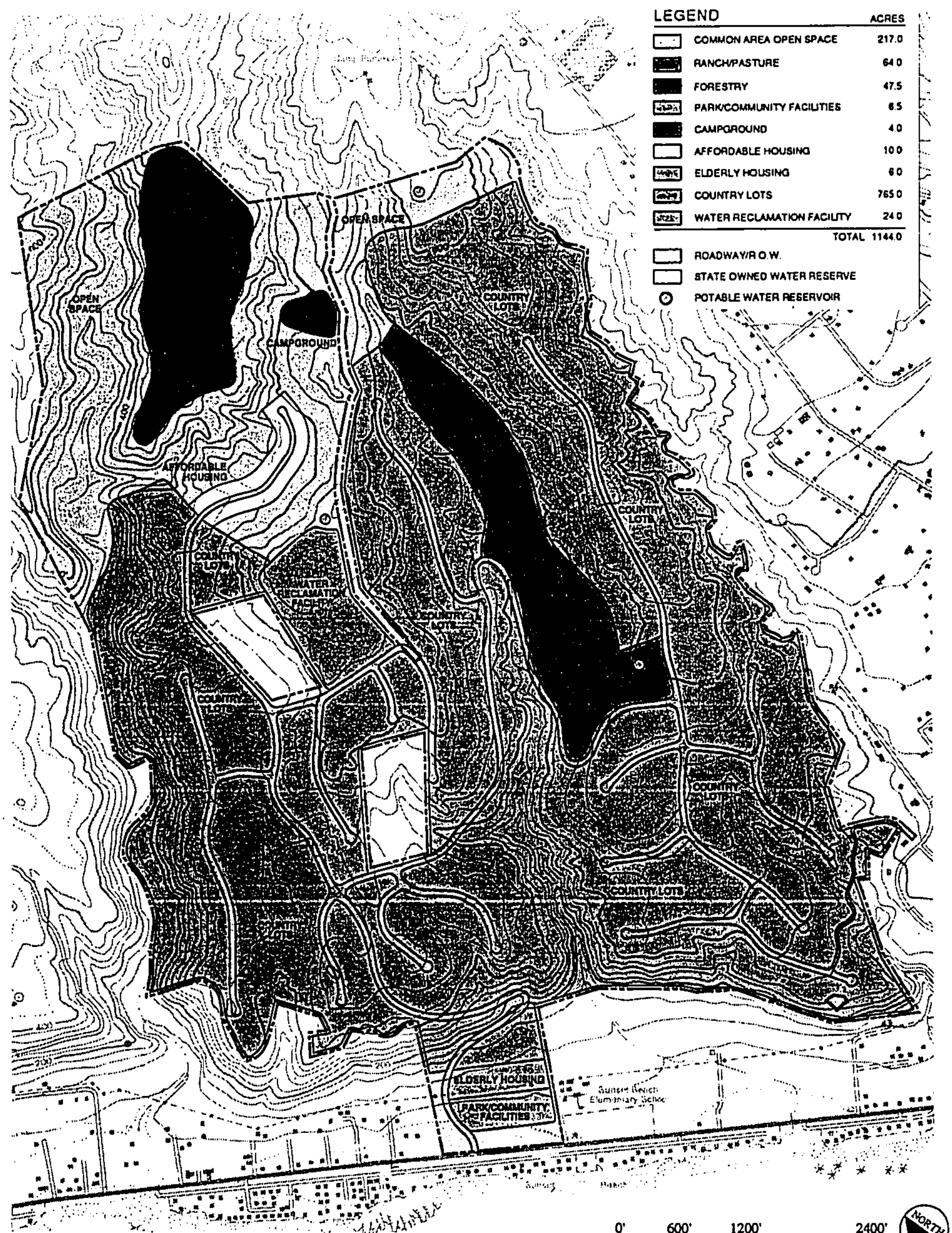
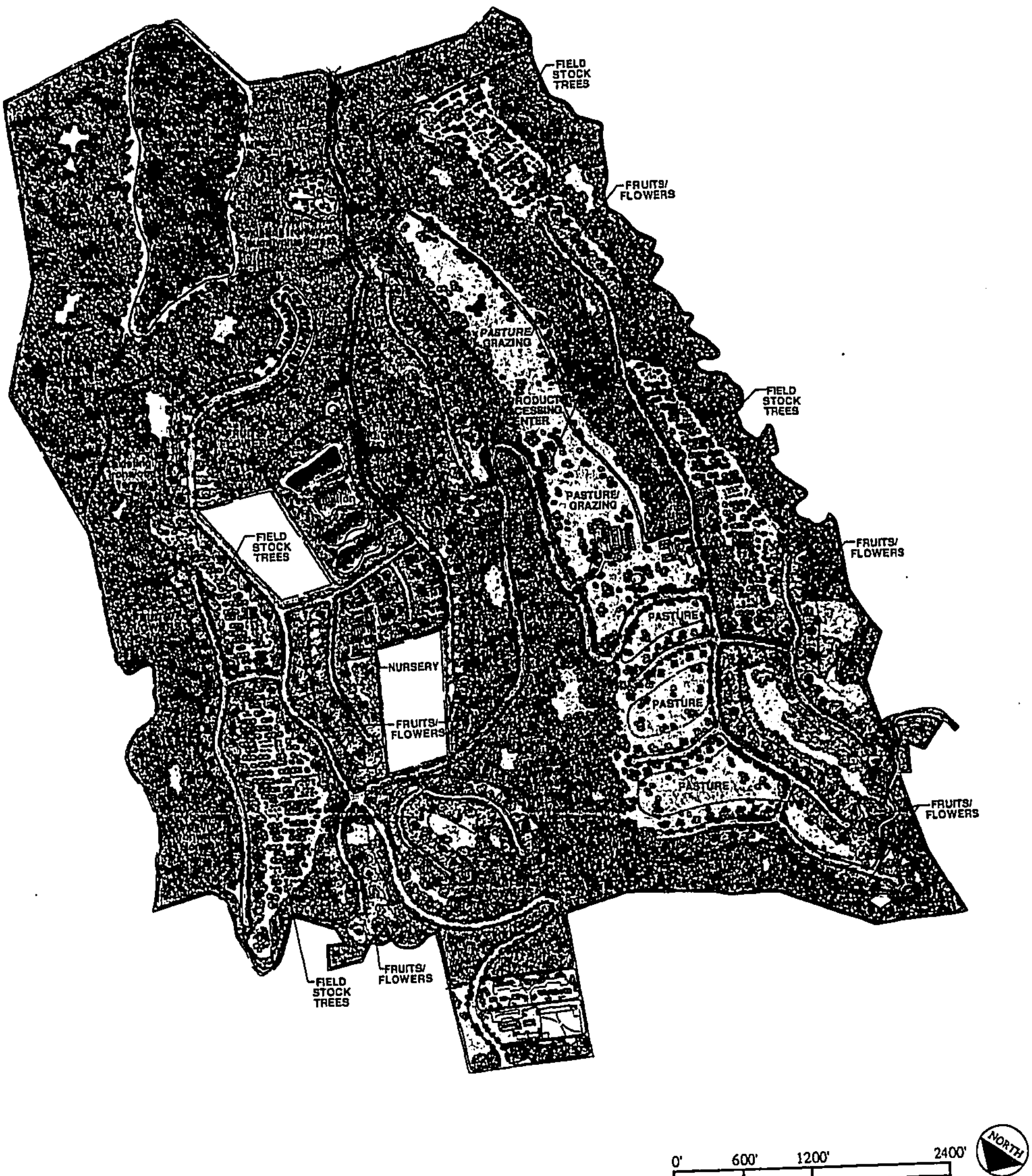


MASTER PLAN

LIHI LANI

FIGURE 2-1



CONCEPTUAL AGRICULTURAL PLAN

FIGURE 2-2

LIHI LANI

agricultural uses which will have long term economic viability, while at the same time preserve green open space. This can be made possible by the new access roadways and infrastructure to be installed to serve residential uses on a portion of this land.

Without the access and water supply, these lands, although classified as agricultural lands, would remain as unusable land. By installing an irrigation system and the access roadways, small but significant portions of the site will become available for crop cultivation.

The Conceptual Agricultural Plan which is discussed further in Section 4.4 and Appendix A identifies individual lots with uses established in agricultural easements and linked to adjacent lots. Agriculture easements of approximately 6,000 square feet per lot (50 ft. depth x frontage width min. 120 ft.) will be established along the roadway frontage in the Country lot residential neighborhoods. Field stock trees and/or fruit tree orchard (such as avocado) are being considered for this area. In some cases, side yard and rear yard easement positions may be more appropriate for some lot configurations.

Other potential agricultural crops which could be grown on the Country lots include fruit trees, cut flowers, foliage and pasture grass. These are similar to many Country lot uses in Pupukea. Ultimately, an agricultural cooperative could be established with centralized facilities for refrigeration, holding, shipping and marketing of the agricultural products. Agricultural management will be handled through a farming business which will lease lands through the Homeowner's Association.

The field-stock nursery is expected to be one of the more viable agricultural uses for Lihi Lani. Field stock trees are used as landscaping trees and include a wide range of palm varieties, shower trees, monkey pod, royal poinciana and other varieties. There are 50 to 75 types of trees which are typically used in major landscaping projects statewide which will be established at Lihi Lani. It is anticipated that each lot owner will commit a minimum of 6,000 sq. ft. of frontage or other easement to create planting areas for field stock trees. These areas would be controlled under a single management company. The common area and lot easements used for these trees would total approximately 43 acres of nursery (cumulative areas). Trees will be marketed to the rest of the state. The revenues generated from leasing the land for such a program will help to reduce the Homeowners Association costs to maintain and operate the Lihi Lani project (i.e. sewage system, roads, security, trails and drainage).

Field stock trees mature to a marketable transplant size in a five to seven year cycle. The use of up to 43 acres at Lihi Lani (both on-lot and in common areas) could establish a nursery of over 12,000 trees. The value of each tree at maturity is between $500 to $1,000. An analysis by an Oahu nursery management company has concluded that this would be a viable operation for Lihi Lani (included in Appendix A).

Fruit tree orchard development at Lihi Lani could also occupy portions of lot easements and common areas. By planting several varieties of avocado for example, a wider seasonal supply would be produced at Lihi Lani. The intent would be to offset a portion of the large imported amounts of avocado to Hawaii. Up to 23 acres of orchard could be established on Country lots and common areas.

The development of roadway access and water supply infrastructure to this site in support of the residential component also makes it possible to establish small-scale agriculture at the larger common areas at Lihi Lani. The Ranch will have 40 to 50 acres of pasture land which will be used to graze horses. A 43-acre section in the mauka area is planned for agroforestry development, which will have Hawaiian and exotic tree species grown for long-term timber use. Field stock trees could also be grown on a 17-acre contiguous area makai of the Boy Scout Camp. All of these areas will be irrigated using reclaimed water from the on-site Water Reclamation Facility.

2.1.2 Residential "Country Lots"

Approximately 315 country lots, generally ranging in size from one to three acres, are proposed to be subdivided within 765 acres of the site, and sold in four phases. These lots will occupy the interior and perimeter of the major plateau areas between Paumalu Stream and Pakulena Gulch and between Pakulena Gulch and Kalunawaikaala Gulch. Each Country lot is planned for one single-family residential unit, on-lot agricultural use and undeveloped open space (Figure 2-3). Obayashi may be developing a few of the lots to establish product quality and the theme for Lihi Lani. Internal circulation roadways, included in the 765 acre total area, will provide access to each residential lot. Dual water systems will provide brackish water for irrigation uses, thus preserving valuable potable reserves. As described in Section 2.1.1, agricultural use will be integrated into each Country lot.

2.1.3 Affordable Housing

Obayashi has proposed to participate toward the development of affordable housing units as part of the Lihi Lani project. The mix of affordable housing will include: 50 on-site single family residences (built on-site by Obayashi), 80 on-site elderly housing rental units (built on-site by the City), and participate in the development of approximately 50 single family residences off-site. The elderly housing and off-site homes are being planned in conjunction with the City's Department of Housing and Community Development. As a result of this program, Obayashi will participate in development of 180 affordable units.

On-site Single Family Affordable Housing: A total of 50 single family affordable homes are proposed to be developed at a mauka location on a gently sloping portion of the Kahuku-side plateau. A preliminary site plan for this housing is shown in Figure 2-4 and a Perspective view in Figure 2-5. Lots will be a minimum of 5,000 square feet. A needs assessment evaluation will be done to help determine the most suitable size and type of housing. A 3.5-acre park site is included in the plan, it includes a children's playground and a large drainage detention basin. Including the

Design Concept: Group 70 International, Inc.

COUNTRY LOT RESIDENCE PERSPECTIVE VIEW

LIHI LANI

FIGURE 2-3

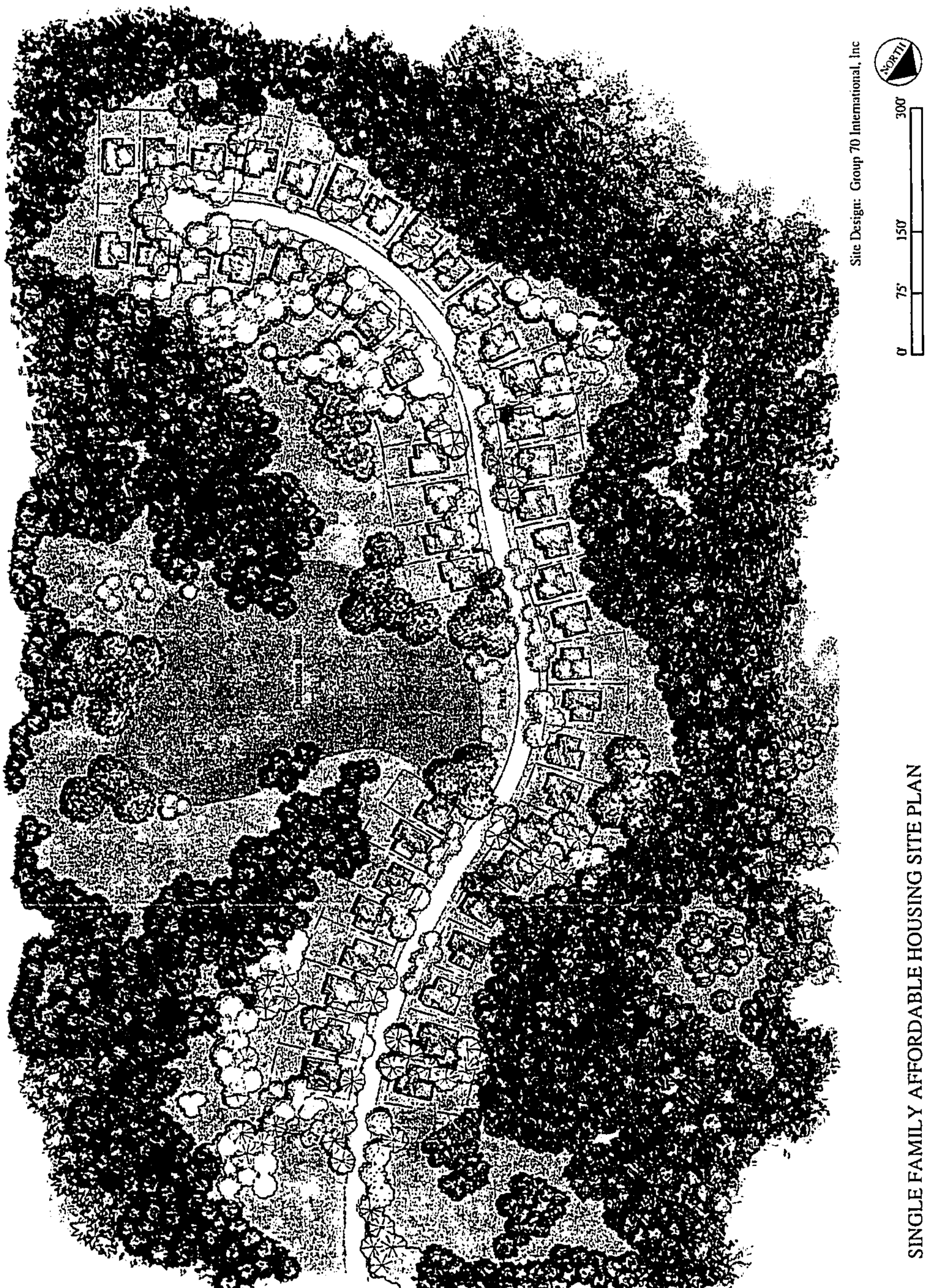
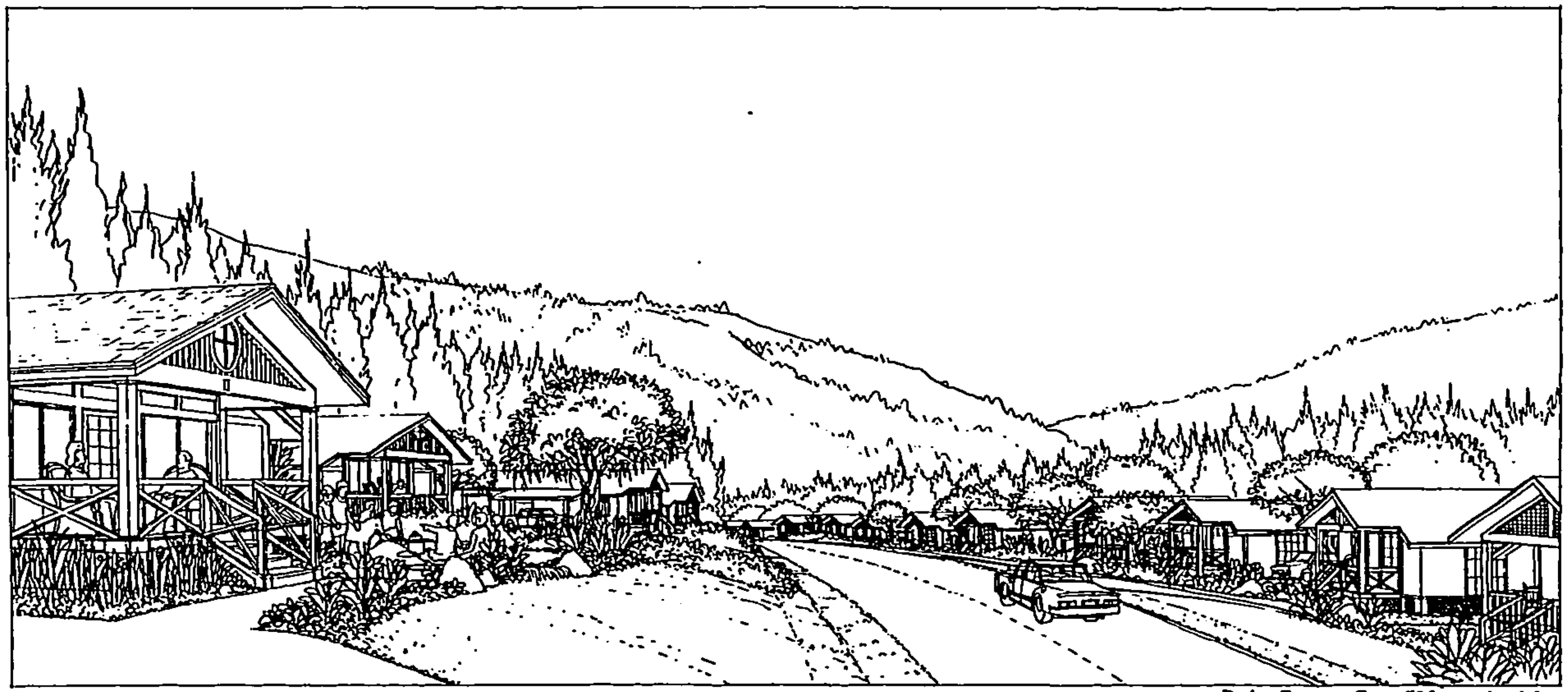


FIGURE 2-4

SINGLE FAMILY AFFORDABLE HOUSING SITE PLAN

LIHI LANI



Design Concept: Group 70 International, Inc.

SINGLE FAMILY AFFORDABLE HOUSING PERSPECTIVE VIEW

LIHI LANI

FIGURE 2-5

house lots, park, roadway and drainage facilities, the total site is approximately 10 acres.

The affordable housing will be a privately developed project constructed by Obayashi. Homes will be sold as fee simple to Oahu residents qualifying under the City's affordable housing guidelines for families earning 120 percent of median family income. The homeowners will become members of the Lihi Lani Homeowners Association. Common areas such as the park will be owned and maintained by the Association. Details of ownership and responsibility will be worked out in the future.

On-Site Affordable Rental Elderly Housing: Obayashi will dedicate a 6-acre site to the City and provide infrastructure connections to the site boundary for development of an 80-unit elderly affordable housing rental project (Figure 2-6). The project will be developed and operated by the City Department of Housing and Community Development. The site will be provided with infrastructure connections (water, sewer, electricity, roadway) and will be dedicated by Obayashi to the City. Patterned after the City's Manoa Gardens project, each of the eight buildings will consist of 10 rental units, with common garden plot areas and a central meeting facility. The units will be made available through the City and County of Honolulu to Hawaii residents who are at least 62 years old.

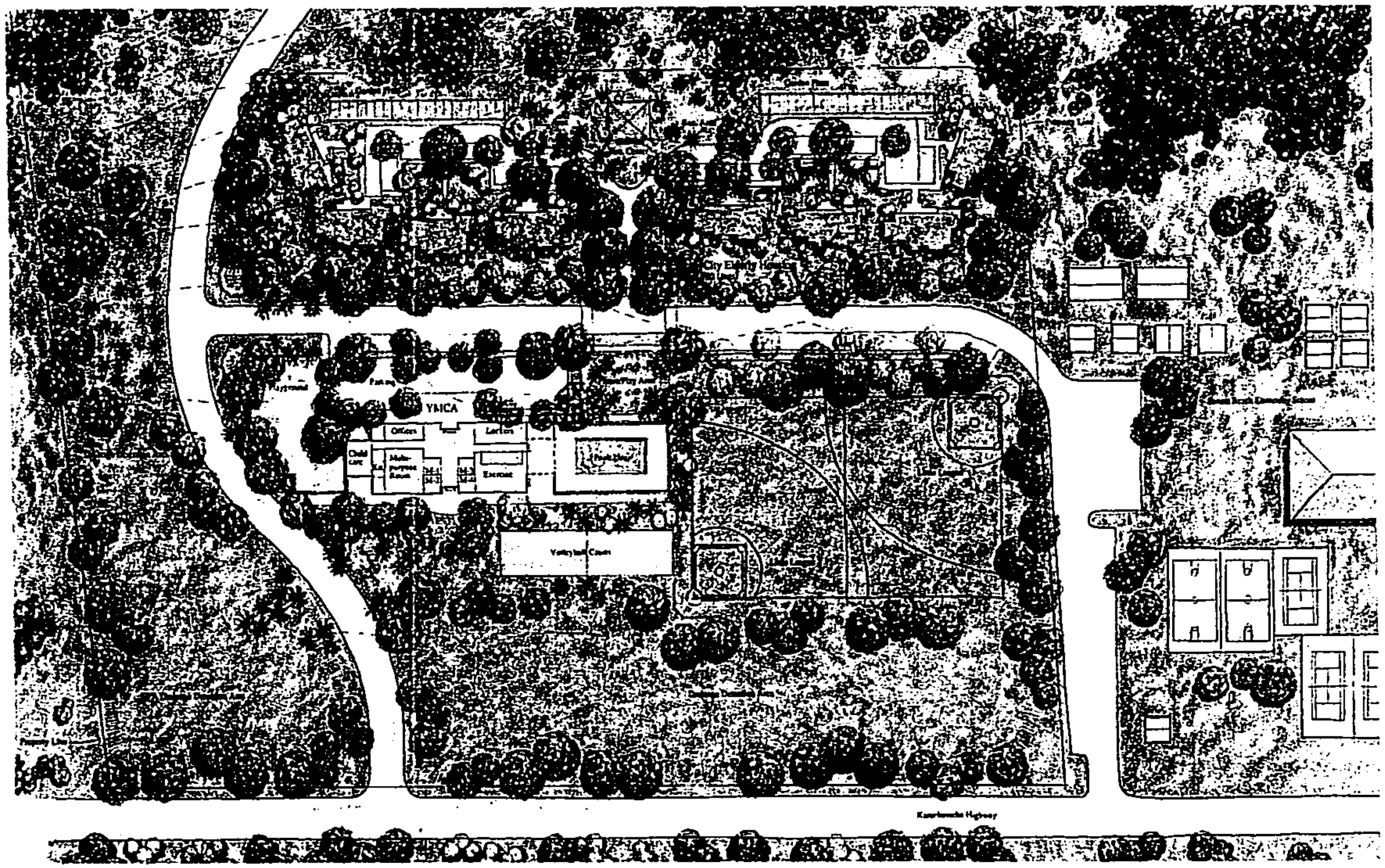
2.1.4 Horse Ranch

Approximately 64 acres will be allocated for the ranch, which will include horse stables, pasture areas, riding trails and orchards. The ranch facilities will include 50 stables, tack, arena, feed and maintenance facilities and pasture paddocks. A ranch house will also be constructed for use as a gathering place by the Lihi Lani Homeowner's Association, ranch members (horse stable users) and visitors to the Ranch. The ranch house will serve as an amenity to Lihi Lani as well as members of the community who are horse enthusiasts and the 1993 Aloha Week Award winning Lihi Lani pa'u riders.

The ranch setting is in the central valley of Pakulena Gulch. From this location residents and ranch members will experience the essence of Lihi Lani with its sweeping vistas of the lower reaches of the Koolau Range on the mauka side. Facilities for horse riding and boarding are dwindling on Oahu, and Lihi Lani will help to revitalize this part of the North Shore's tradition.

2.1.5 Horse Riding and Hiking Trails

A network of trails extending for several miles through the Ranch and the mauka open space areas of Lihi Lani is planned. These trails will be used for horseback riding and hiking, and will allow access to the valleys and plateaus in the mauka area of the property. Connection to the State's Pupukea Forest Reserve and the Kaunala Trail, in coordination with the DLNR and Na Ala Hele Advisory Committee is planned to allow access and enjoyment of the mauka wilderness areas.



Site Design: Group 70 International, Inc.

0' 90' 180' 360'

NORTH

ELDERLY HOUSING / PARK-YMCA SITE PLAN

LIHI LANI

FIGURE 2-6

2.1.6 Campground

A four-acre campground will be integrated into a central mauka open space area at 650 feet elevation and be accessible by jeep road, hiking paths and horseback. Eight to ten small cabins are planned for this site. The picnic area will remain largely natural, with a small area for rustic accommodations which would include restrooms and shower facilities and a central building for meal preparation and gatherings.

Current plans are for the campground to be available by advance registration for use by small groups of 20 to 30 people at a fee. Individual camping parties would not be accommodated unless linked to a registered organization. This facility may be ideal for youth groups, church organizations and seniors who wish to experience the mauka woodland setting at Lihi Lani.

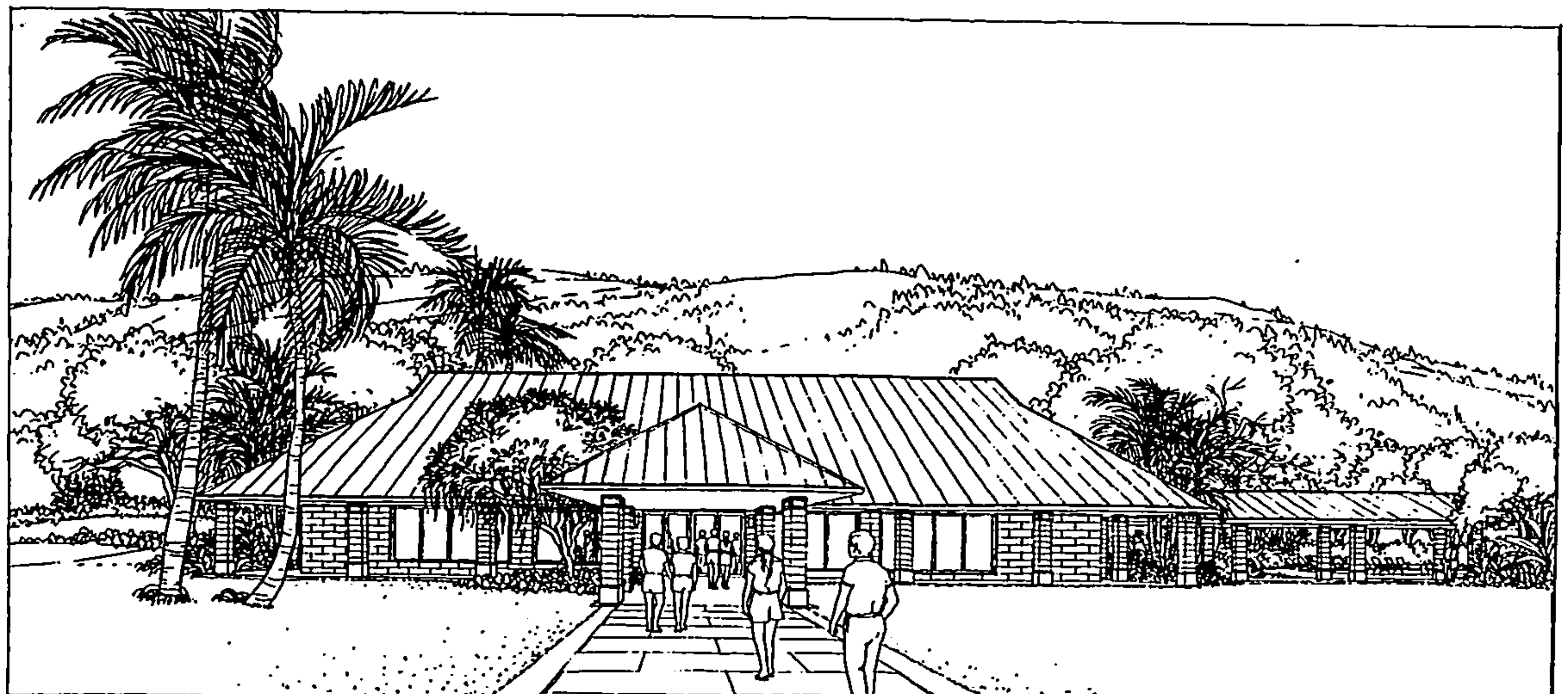
2.1.7 Community Park and Facilities

The community park and facilities will be developed on a 6.5-acre site located on the makai portion of the property adjacent to the elderly housing as shown in Figure 2-5. The YMCA's plans include a 10,000 square foot branch YMCA facility, with a 25-meter swimming pool, and play fields for soccer and baseball. YMCA programs will include child care, summer youth programs and after school care, exercise gym, arts and crafts classes, senior citizen programs and other offerings as noted by Don Anderson, President of the YWCA (see Appendix B). A perspective view of the YMCA is shown in Figure 2-7.

Obayashi would provide the land; in addition, Obayashi would develop the infrastructure and contribute a portion of the total facility costs, a combined value of approximately $4.7 million. YMCA would be responsible for the balance of project funding for facility development.

2.1.8 Open Space

Much of the land owned by Obayashi at Lihi Lani will be preserved as open space. Although the land use master plan and zone change request show over 900 acres of new "land uses", in reality much of this redesignated land will remain untouched. Between 400 and 480 acres of the site will be affected by phased clearing for infrastructure development, agriculture and residential uses. Development will occur over four phases extending 10 to 12 years. Actual unaffected open space area will be 664 to 744 acres. Due to the steep slopes (over 20 percent) occurring on 70 percent of this land, development uses are clustered in the usable 30 percent of the site. Actual building footprint coverage on the property will be less than two percent of the 1,144 acre project site. The extent of large contiguous undeveloped land at Lihi Lani will provide a unique residential setting and preserve environmental qualities of steep gulches and mauka reaches adjacent to the Forest Reserve.



Design Concept: Group 70 International, Inc.

COMMUNITY FACILITY - YMCA PERSPECTIVE VIEW

LIHI LANI

FIGURE 2-7

2.1.9 Roadways

Access to Lihi Lani will be via a new entrance and access road extending mauka into the project site from a new intersection with Kamehameha Highway. The new intersection will be located approximately 800 to 900 feet Kahuku-side of the Sunset Beach Elementary School driveway. The access road will extend approximately 800 feet from the highway to the base of the bluff, then traverse the face of the bluff for approximately 2,000 feet to reach the highland plateau areas. The construction of the roadway will require bench cuts in the bluff to stabilize slopes and vegetation clearing. Extensive landscaping along the roadway will protect bluff views and the roadway from off-site. The access roadway will connect to the project's circulation roadway system. Emergency and infrequent utility maintenance access will be provided at the Haleiwa-side project boundary via Wilinau Road, and from the mauka boundary via a dirt road through the Boy Scout's Camp Pupukea.

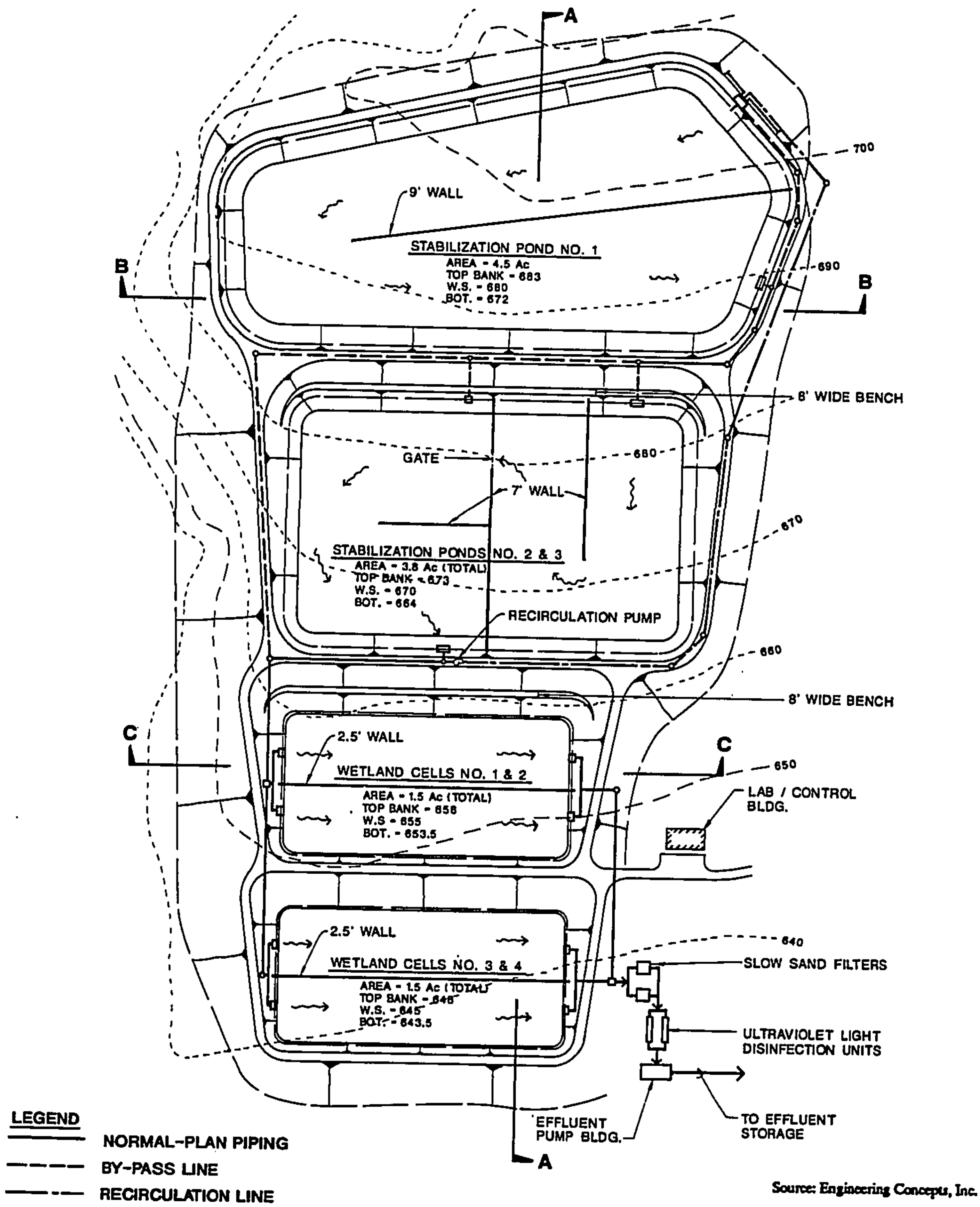
Obayashi plans to make improvements to Kamehameha Highway at the project entrance road intersection to facilitate traffic flow. Improvements will include a left-turn storage lane for Haleiwa-bound Kamehameha Highway and separate left and right turn lanes for the makai-bound project access road. Kamehameha Highway improvements are further discussed in Section 5-2.

As shown in the Lihi Lani Master Plan (Figure 2-1) a circulation roadway system is planned to provide access to the residences, the ranch and agricultural areas. Over the four development phases, roughly 45 acres will be graded for the two-lane roadway right-of-way including a 22-foot wide paved surface and grassed/landscaped shoulder area.

2.1.10 Water Reclamation Facility (WRF)

Domestic wastewater will be generated from the project by the residences, the ranch and the makai components, including the YMCA/park facilities and the elderly housing. The plans for the wastewater treatment facility and a management plan were prepared by Engineering Concepts, Inc. and were discussed in the Final EIS (Group 70, April 1991); the study has been updated to reflect the new project and is attached as Appendix C. The site plan and a flow diagram for treatment and disposal are shown in Figures 2-8 and 2-9.

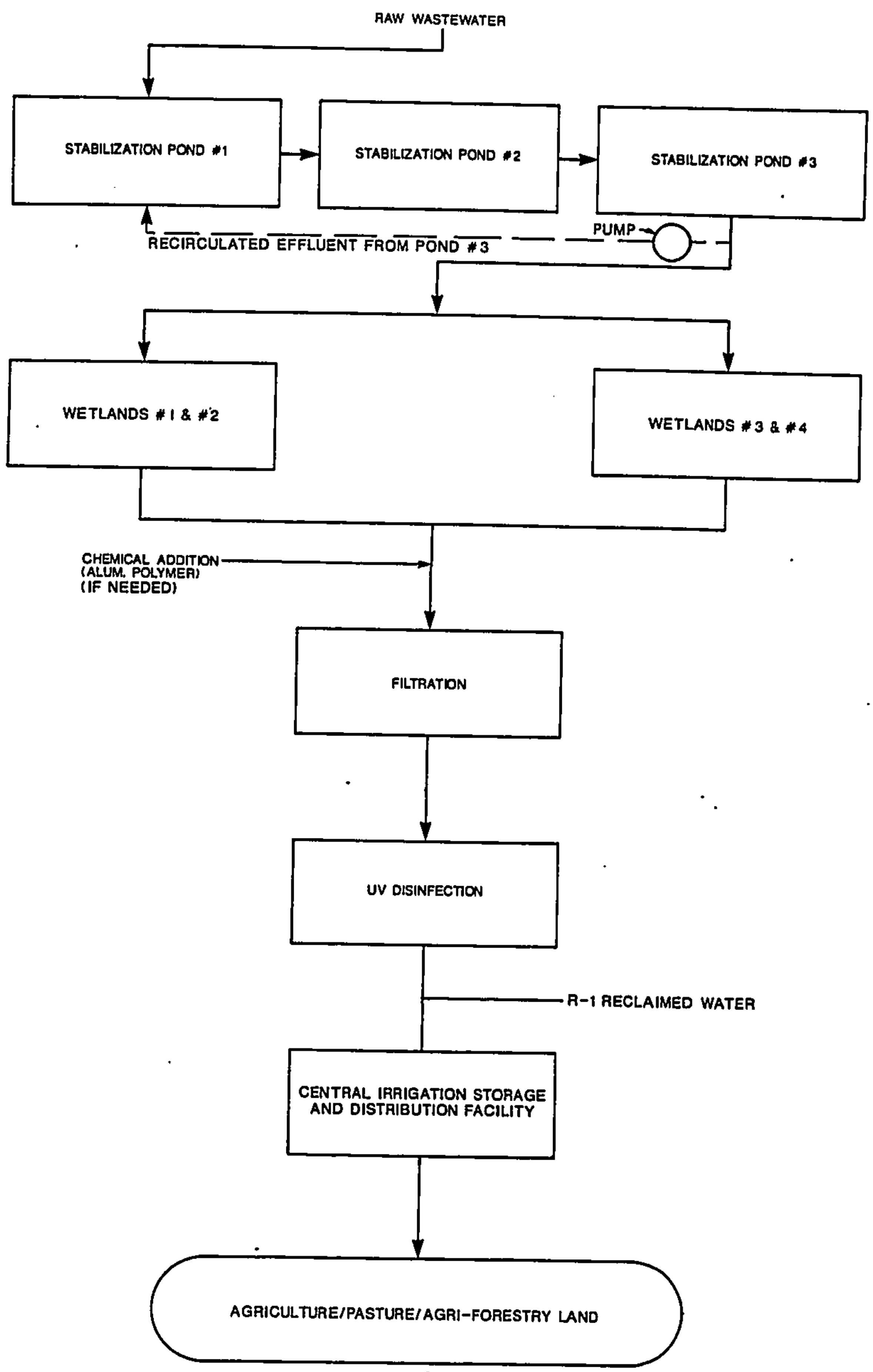
An environmentally sensitive Water Reclamation Facility (WRF) has been planned to enable a very high level of wastewater treatment and water reuse on agricultural areas. The WRF will encompass approximately 24 acres and consist of a low-tech system of oxidation ponds and wetlands which will provide advanced secondary treatment for up to 180,000 gpd of domestic wastewater at full build-out and occupancy. The highest level advanced secondary wastewater treatment as specified by the State Department of Health will be conducted at the WRF through the use of stabilization or facultative ponds followed by a wetlands and filtration system for effluent "polishing". Ultraviolet light disinfection will eliminate virus and bacteria in the reclaimed water. Up to 58 days of storage will be provided by the



WATER RECLAMATION FACILITY SITE PLAN

LIHI LANI

FIGURE 2-8



FLOW DIAGRAM FOR WASTEWATER TREATMENT AND DISPOSAL

LIHI LANI

Source: Engineering Concepts, Inc.

FIGURE 2-9

pond/wetland system without disposal during a 100-year storm. The perimeter of WRF site will be bermed adequately to prevent surface runoff from entering the ponds. The proposed wastewater collection and reclamation system layout is shown in Figure 2-10.

This land intensive, low-energy, ecological system has proven successful at wastewater treatment with extremely high reliability compared to standard mechanical systems. Engineering Concepts, Inc. of Honolulu is designing the Lihi Lani water reclamation facility in conjunction with Robert Gearheart, Ph.D. of Humboldt State University in California, a leader in designing wetlands treatment systems. Disposal of reclaimed water from the Lihi Lani WRF will be accomplished by land application on agricultural areas, as discussed in Section 2.1.12.

2.1.11 Potable Water System

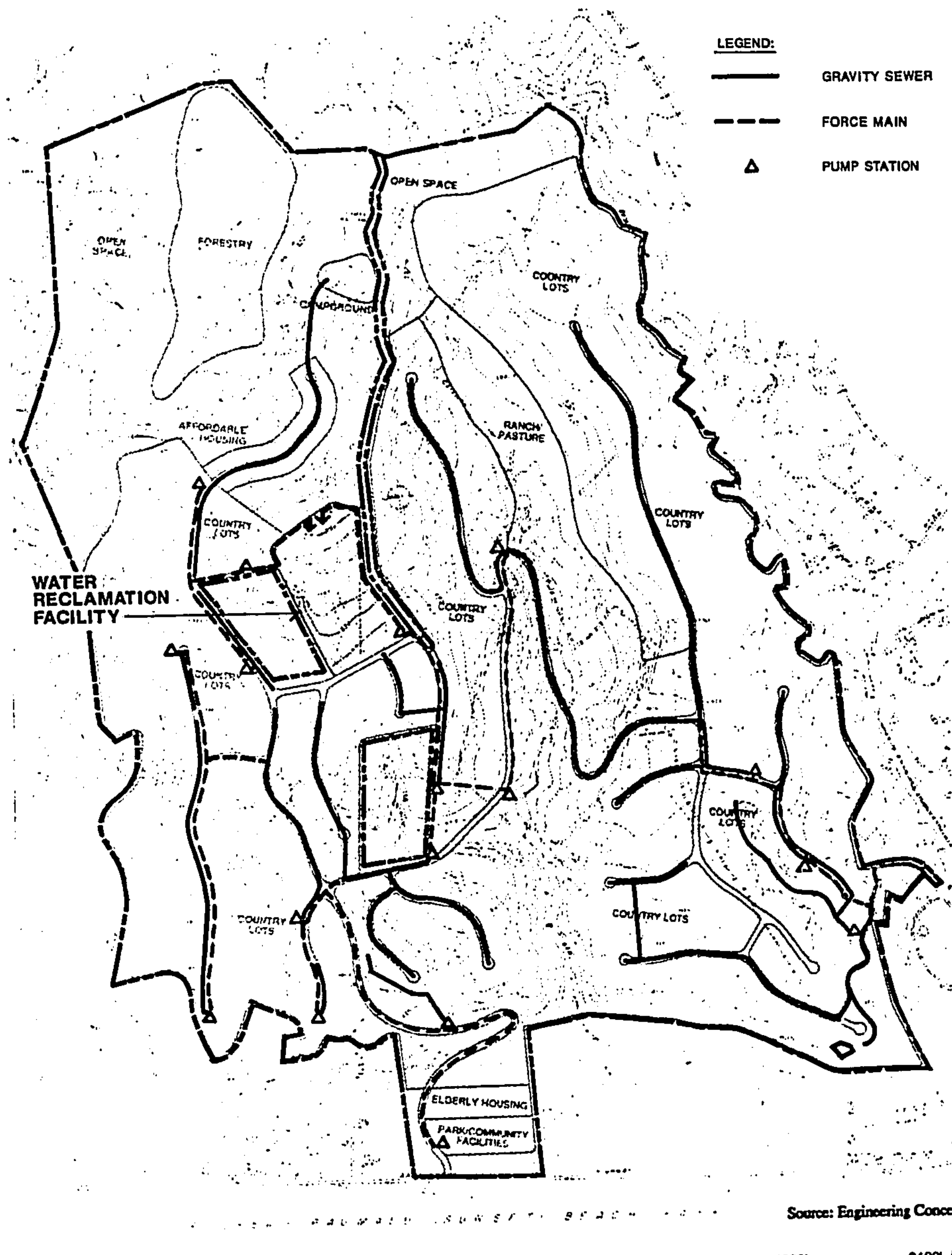
The proposed potable water system for the project was addressed in detail in the Final EIS (Group 70, April 1991); the studies by Engineering Concepts, Inc. have been revised to reflect the current development plans and is attached as Appendix E. Figure 2-11 shows the layout of the proposed portable water system.

At full build-out and occupancy, Lihi Lani will require approximately 245,500 gpd of potable water for domestic use. Briefly summarized, the proposed system will utilize the Board of Water Supply (BWS) transmission and storage system presently serving the Pupukea Highlands and Sunset Hills developments. Obayashi has credit for 48 percent of the storage and distribution in this system due to the former landowners' participation in the development of the Pupukea water system. This system derives water from wells located in Waialua. Obayashi is evaluating water development options within this aquifer with the BWS to allow for water allocation to serve Lihi Lani. In addition, the proposed system will also use the BWS Sunset Beach-Kawela transmission and storage system to service the makai development of the Elderly Housing and YMCA and community facilities.

2.1.12 Non-Potable Water System

Water for irrigation of the common areas, landscaping of the Country lots, and for the on-lot agricultural areas, will be supplied by the on-site brackish water wells as shown on Figure 2-12. Use of brackish water for all Country lot irrigation needs will conserve potable water for domestic use.

Two existing brackish water wells positioned in Pakulena Gulch will be utilized to meet the irrigation water requirements. Testing has shown that the two wells, drilled to a depth of approximately 450 feet below the surface can produce up to 1.0 million gallons per day (mgd). DLNR has issued permits for construction and testing of these irrigation wells. Refer to the Final EIS, Sections 4.5 and 4.17.1 (Group 70, April 1991) for more details on these facilities.

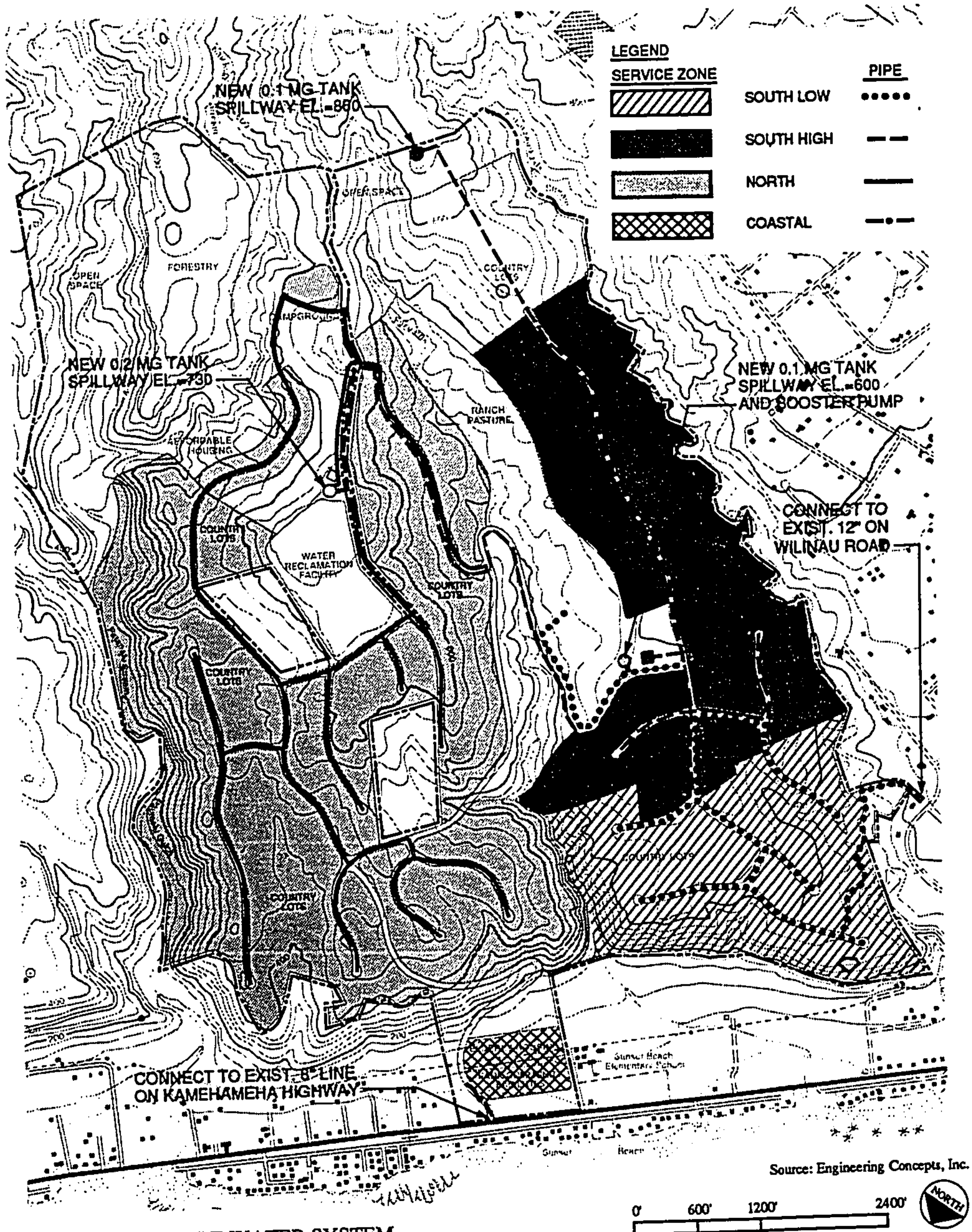


Source: Engineering Concepts, Inc.

PROPOSED WASTEWATER COLLECTION AND RECLAMATION SYSTEM LAYOUT

LIHI LANI

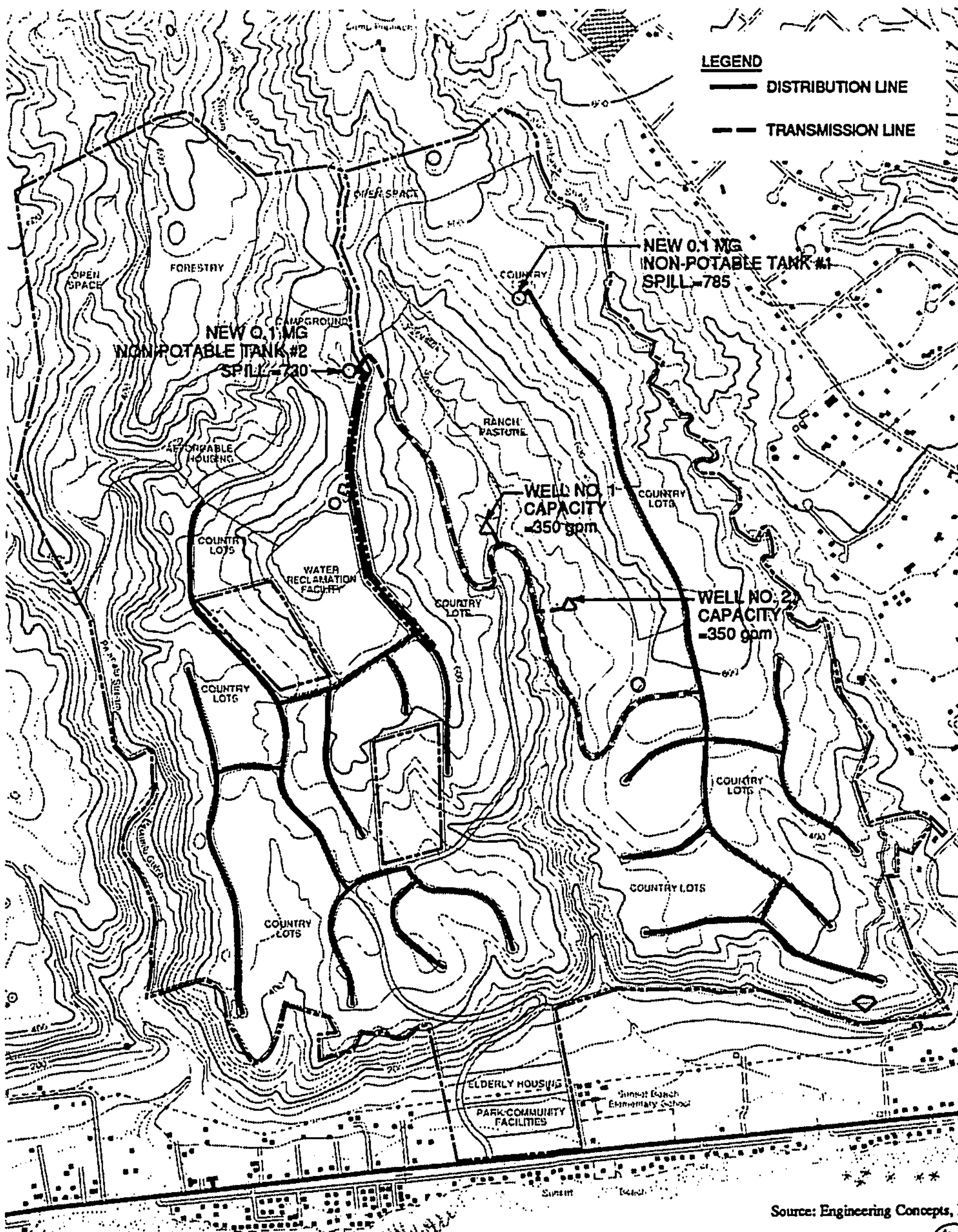
FIGURE 2-10



PROPOSED POTABLE WATER SYSTEM

FIGURE 2-11

LIHI LANI



Source: Engineering Concepts, Inc.

PROPOSED NON-POTABLE WATER SYSTEM

LIHI LANI

FIGURE 2-12

2.1.13 Water Reclamation in Agriculture Areas

The Lihi Lani WRF will produce the highest quality of reclaimed water (R-1) under the current State of Hawaii, Department of Health guidelines. Reclaimed water will be land applied as a disposal method, for irrigation of agricultural areas including

grazing pasture at the Ranch, a mauka field stock tree nursery and a large agroforestry areas as shown in Figure 2-13.

ITC Water Management of Haleiwa is designing the irrigation system for approximately 65 acres of agricultural land receiving reclaimed water. Land application will provide an additional level of treatment for reclaimed water by soil filtering, soil microbial action and plant nutrient removal. This method is recognized as one of the most environmentally sensitive technique for highly treated wastewater disposal. Additionally, it provides for substantial water conservation by reducing demand on potable resources. Appendix E provides a description of the planned reclaimed water application system for Lihi Lani.

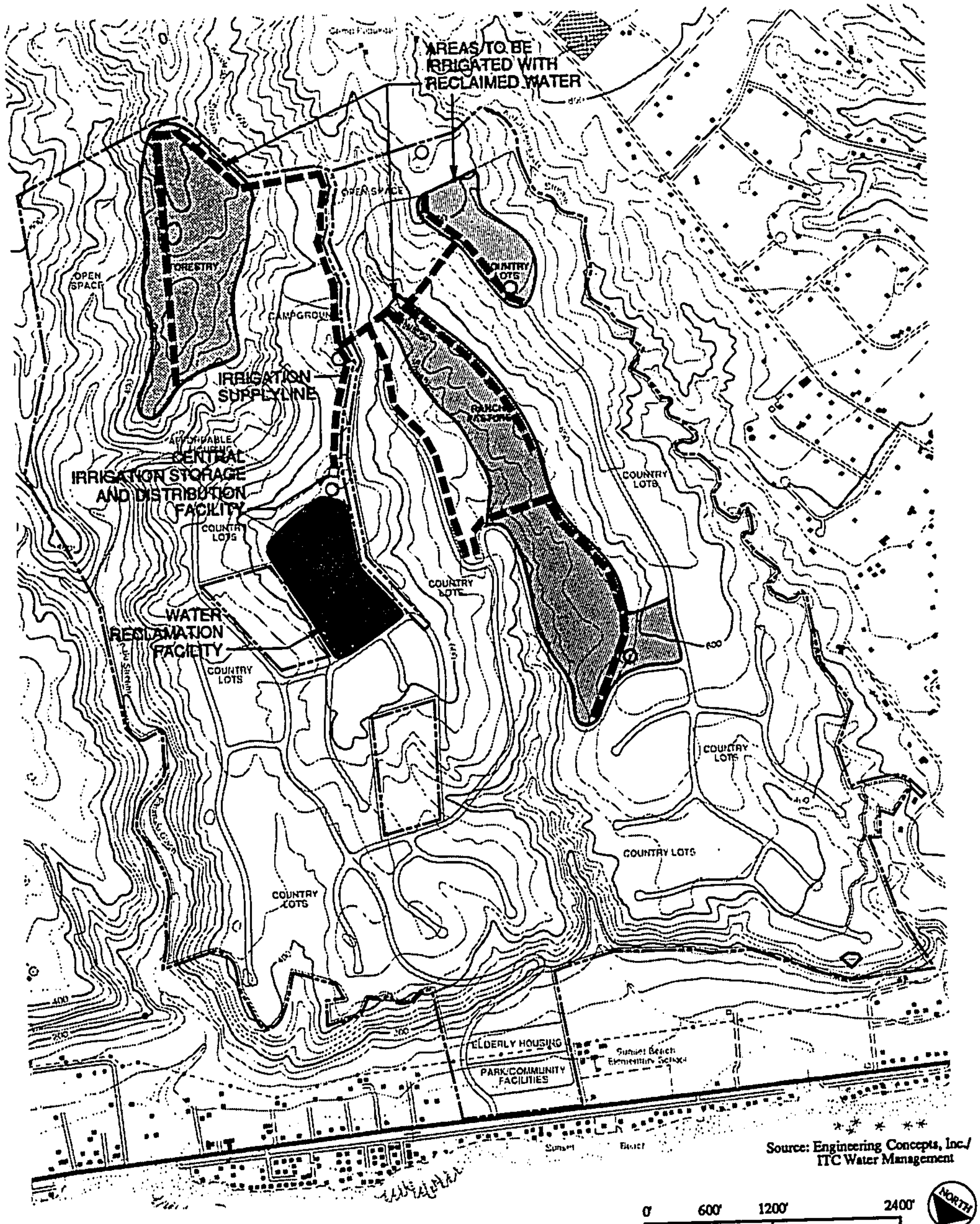
Initial studies indicate that only 65 acres of agricultural land may be required to dispose of up to 180,000 gpd of high quality reclaimed water. This agricultural land will include 48 acres of pasture and 17 acres of field stock trees. An additional 43 acres of agroforestry area could also be used for water reuse activities if desired.

2.1.14 Drainage Facilities

Very extensive drainage detention basins will be created at Lihi Lani through which storm water runoff will be controlled. The planned use of over 40 separate detention basins to control runoff and water quality goes far beyond standard requirements for such a project. Runoff rates and volumes from the completed project will be equal to or less than existing conditions. The basins will also effectively trap silt and nutrients in runoff from the project. State Department of Health and EPA guidelines will be used as resources to prepare mitigation plans. Temporary detention and sedimentation basins will be installed prior to each phase of construction. Permanent water detention basins will be developed throughout the project site. An updated storm drainage study has been prepared for the project by Engineering Concepts, Inc. attached as Appendix F. Further detailed discussion of the drainage facilities and the environmental effects of stormwater drainage is found in Section 4.6.

2.1.15 Solid Waste Disposal

Solid waste such as debris generated during construction, will be recycled or trucked off-site. As feasible, cleared trees will be chipped and used for mulch. Solid waste generated by the project will be collected by a private collection company and disposed of at a City and County sanitary landfill or other municipal solid waste disposal facility. It is estimated that up to three tons per day of refuse will be



PROPOSED RECLAIMED WATER SYSTEM

LIHI LANI

FIGURE 2-13

generated by the various components of this project at full build-out and occupancy.

2.1.16 Civil Defense

The adjacent residential communities at Sunset Beach and Pupukea are presently served by civil defense sirens at two locations nearby the Lihi Lani property boundary, at the Sunset Beach Elementary School and the corner of Pupukea Road and Alapio Road. A new 121 decibel (dB) siren is planned to be installed to serve Lihi Lani. Through discussions with the City and County Civil Defense and State Civil Defense agencies a location at the Water Reclamation Facility site has been selected. Obayashi is working with both civil defense governmental agencies in the planning and procurement of the system. The governmental agencies will maintain and operate the facility as part of the county and statewide systems.

2.1.17 Other Utilities

Electricity, communication and cable television conduits will be installed underground along the proposed access and circulation roadways. Utility lines will be installed underground throughout the project.

2.2 CONSTRUCTION ACTIVITIES

Construction activities at the project will involve vegetation clearing, grading (cut and fill), excavation, rock removal for the access road, construction of buildings and roadways, and planting and landscaping. The Final EIS (Group 70, April 1991) described general construction activities planned for Lihi Lani, which have been modified to reflect the revised project plans. Substantially less earthwork will be required for the current plan with the deletion of the golf course.

Construction at Lihi Lani will occur in four phases beginning in 1996 with substantial build-out expected by 2008. The major infrastructure development, affordable homes, community facilities and one-half of the country lots are anticipated to be completed by 2002. As experienced in other lot sales residential projects in Hawaii, full build-out of the Country lots could not be realistically expected for several decades.

Selective vegetation clearing will occur to create buildable areas for the project elements as described above. Careful planning of common areas and restriction on private lots will preserve as much of the area in its natural condition. It is estimated that 400 to 480 acres of the project site could be affected over four phases of development for public facilities, residential areas and agricultural uses.

As compared to the large contiguous work areas required to complete a golf course in one to two years, the current project will phase development over a 12-year build out. By eliminating the golf course, it is estimated that the quantity of excavation and fill has been reduced by more than 50 percent. The risk of erosion and silt runoff has thus also been reduced. Site grading will be limited to such project elements as the internal roadways, home sites, and portions of the agricultural and Ranch areas. By phasing construction of the project, as little area as possible is disturbed at any one time. At the makai location of the property, the sites for the elderly housing and the community facilities will require some land clearing and grading. As much as possible, the new development has been planned to match the existing terrain to avoid excessive clearing and grading.

Excavation and rock removal will be required for the construction of the portion of the access road from the makai areas rising across the bluff face. Planting and landscaping will be incorporated into the entire project with special emphasis on the project entrance, makai areas, and the access roadway along the bluff.

2.3 MARKET DEMAND

The existing and future projected market demand for the Country lot residential development has been identified through a market assessment prepared by KPMG Peat Marwick and is attached as Appendix G. An addendum to the market analysis which addresses the single family affordable housing, elderly rental apartments, the YMCA and the Water Reclamation Facility is also attached (KPMG Peat Marwick, November 17, 1993). A brief discussion of market demand for these project features is presented in this section.

2.3.1 Residential Country Lots

A residential development of 315 Country lots is proposed by Obayashi. A substantial segment of the Country lot buyers will be attracted by the project's rural and agricultural lifestyle and amenities such as the Ranch. At the present time there are few, if any comparable residential areas that encompass the range of amenities - open space preservation, agricultural opportunities, recreational uses - that Lihi Lani will offer. The lots will appeal to buyers attracted to the rural country lifestyle with large lots surrounded by open space and access to agricultural and ranch activities. The projected buyer markets are primarily Hawaii and other U.S. residents seeking large lots for primary homes in a rural location on Oahu. Other potential buyers will be Hawaii and other U.S. residents seeking a retirement or second home who are looking for a private and rural lifestyle.

An analysis of current market conditions for selected comparable projects, indicates that 80 to 85 percent of Lihi Lani country lot buyers are expected to be from Oahu. Fifteen to twenty percent would be other U.S. or international buyers. The price range for the lots will be comparable to other available Country-zoned lots in Pupukea Highlands, with price lots from approximately $290,000 to $540,000 (1993 prices). Per acre prices will range from $140,000 and up. The projected rate of absorption over nine years starting in 1996, is approximately 25 to 35 lots sold each year. It was assumed for this evaluation that sales of the Country lots would take place over an 11-year period.

Single Family Affordable Housing. The need for affordable housing on Oahu is documented in government publications. The recently published "Hawaii Housing Policy Survey" (Locations, Inc. Research and Consulting Division and SMS Research and Marketing Services, May 1993) confirms the high demand for housing on Oahu. A shortfall of 27,000 housing units for all income groups is projected by Peat Marwick (1993). Within the North Shore region, there has been no definitive study of the demand for affordable housing. The Kuilima Resort Socio-Economic Needs Assessment Study (Community Resources, Inc. 1990) indicated that overcrowding of residential units in the local community, along with high prices and rents for homes, demonstrates the need for affordable housing in this area.

Affordable housing development currently in progress on the North Shore includes the City Department of Housing and Community Development project at Kahuku. Other affordable housing development is planned at Laie and at Kahuku in conjunction with the Kuilima Resort development. Affordable single-family units generally stay on the market for less than a year. The majority of the projects have long wait lists which exceed the number of available units. Absorption is generally within a matter of a few weeks.

The 50 affordable homes to be constructed at Lihi Lani will make new homes available for fee simple purchase to a portion of the North Shore housing market which is currently not being served. The pricing of the single family affordable homes will correspond with the City and County of Honolulu and the State of Hawaii standards for families earning incomes between 100 to 120 percent of Oahu Median Family Income or approximately $170,000 to $210,000 (based on the median income in 1993 and standard 30-year financing with 10% down payment at 8.5% interest). Home purchase affordability would range based on the prevailing interest rates and terms of the financing. The 50 affordable single-family units at Lihi Lani are expected to be readily absorbed within less than a year.

Elderly Rental Affordable Housing. A survey by Peat Marwick of ten public and private elderly rental projects on Oahu indicates that occupancy rates generally range from about 95% to 100% (as shown in Table 2-1). The three existing North Shore projects -- Haleiwa Senior Citizen Housing Center, Kahuku Hauoli Hale, Kupuna Home O Waialua -- all have lengthy wait lists ranging from one to two years. This pent up demand and a growing elderly population on the island indicate a continued need for such projects. The Manoa Gardens project, developed and operated by the City Department of Housing and Community Development, is at 100% occupancy in both its affordable and market components.

Lihi Lani's elderly rental project is expected to serve the elder segment of the North Shore population at occupancy levels similar to those experienced at other public and private projects.

YMCA/Park Facilities. The proposed YMCA/Park Facilities will serve an existing need for organized recreational programs and facilities, including a multi-purpose community meeting center. The establishment of a YMCA facility will benefit the

TABLE 2-1

OCCUPANCY RATES AND RENTAL CHARACTERISTICS AT SELECTED ELDERLY PROJECTS

Occupancy rates at elderly rental projects generally range from about 95% to 100%

Development/ Project name	Number of units	Occupancy rate	Comments on demand and renter profile
Waipahu Crown Elderly	340	100% (1)	Built based on 1988 HHA statistics citing demand for 1,980 elderly rental units. The project consists of four phases. Phase 1, consisting of 111 units, is scheduled for occupancy as of December 1, 1993. The number of applicants for residency at Phase I were greater than the number of available units. Phase II is expected to begin construction as of December 1, 1993 while development information of Phases III and IV are not available.
West Loch Village	150	70%	Low occupancy rate after completion is attributed to the Ewa location, large project size and high rental rates which are similar to town rates.
Manoa Gardens	80	100%	Market units were last to be rented.
Ewa Elderly	84	100%	One year waiting list; 2 to 4 inquiries per month.
La'iola (Wahiawa Elderly)	108	97%	Sees continued demand for elderly units. Waipahu is more desirable compared to Wahiawa.
Whitmore Circle	44	100%	20- to 25-unit waiting list.
Haleiwa Senior Citizen Housing Center	60	100%	Waiting time for an available unit is estimated to be between 1 1/2 to 2 years.
Waipahu Hall Elderly	72	100%	Independent-care facility.
Kahuku Hauoli Hale	64	100%	Waiting time for an available unit is estimated to be between 1 to 1 1/2 years.
Kupuna Home O Waialua	40	95%	Over 120 families on the waiting list. 100% occupancy is expected once renters are notified.

(1) Based on the number of applicants being greater than the number of available units.
Source: discussions with property managers and representatives of the respective projects.

Source: KPMG Peat Marwick

Sunset Beach and Pupukea Highlands community as well as the surrounding North Shore region.

The estimated demand for the proposed 1,000-member community facility at Lihi Lani was determined based on the experience of similar YMCA facilities throughout Oahu. A YMCA facility of about 1,300 members could be supported (as shown in Table 2-2) based on the number of households on the North Shore and a participation rate of 0.15 members per household. Thus, there is expected to be ample demand for the 1,000 member YMCA proposed for Lihi Lani.

Water Reclamation Facility. The Water Reclamation Facility will serve all land uses which will generate wastewater including the Country lot homes, single family affordable housing, the City's elderly housing, ranch, campground and the YMCA and Park Facilities. This facility is planned to serve only Lihi Lani. Residences in the surrounding Sunset Beach and Pupukea communities are served by individual wastewater systems and will not be connected to the Lihi Lani wastewater system.

2.4 DEVELOPMENT TIMETABLE

The current schedule anticipates that all approvals for development will be in place to allow major infrastructure development to begin in 1996. This first phase would include the construction of the access road and Kamehameha Highway improvements and portions of the water system, wastewater system and internal roadways. Development of the elderly housing site and community facilities, subdivision and preparation of the first phase of Country Lots (60 to 80 lots), 50 single family affordable homes, and the Ranch would be completed between 1996 and 1998. The second phase of the Country lots (60 to 80 lots), and extensions of the internal infrastructure would be developed between 1999 and 2002. The subdivision and preparation of the remaining Country lots is planned to take place in Phases 3 and 4 over the following six years (2003 to 2008), pending lot absorption by the market place. Build-out of the homes was projected for the purposes of this study to be approximately by 2008. Actual residential build-out of this lot sales project will take at least another decade. Figure 2-14 shows the currently anticipated phasing plan for build-out of Lihi Lani.

2.5 APPROXIMATE INFRASTRUCTURE COSTS

The total estimated construction cost for infrastructure improvements is approximately $93 million. Construction of the single family affordable housing is estimated at $4.5 million and the community facilities costs covered by Obayashi will be $4.7 million. Construction of the Ranch and the agricultural areas is estimated to cost at least $1.0 million. Total development costs borne by Obayashi are estimated to be over $103 million.

TABLE 2-2

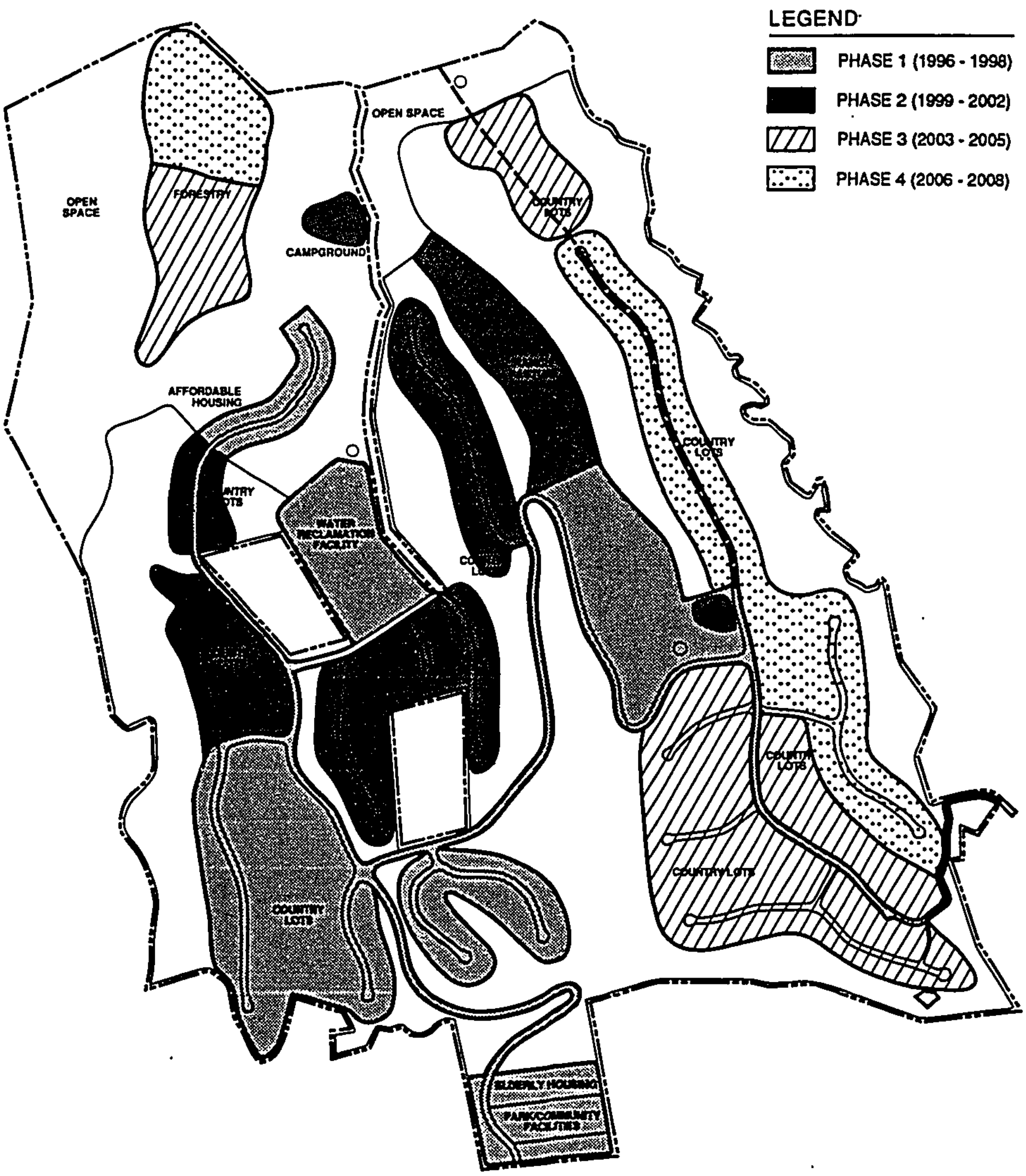
ESTIMATED DEMAND FOR YMCA MEMBERSHIP

Oahu's North Shore community could more than support the proposed 1,000-member community facility

	Existing areas with YMCA facilities			
	Mililani(1)	Kailua(2)	Kaimuki(3)	Total
Existing YMCA demand:				
Total YMCA members(4)	3,000	1,500	1,300	5,800
Total households (1989)	8,820	13,275	3,208	25,303
Members per household	0.34	0.11	0.41	0.23
Average household income (1989)	$54,573	$55,105	$63,816	--
Projected Lihi Lani community facility demand(5):				
Total households on the North Shore (1989)				8,834
Estimated members per household				0.15
Estimated membership demand				1,325

(1) Defined as census tracts 89.06, 89.07, 89.08, 89.09, 89.10.
(2) Defined as census tracts 109.01, 109.03, 109.04, 109.05, 110, 111.03, 111.04, 111.05, 111.06, 112.01, 112.02.
(3) Defined as census tracts 4.97, 5.0, 9.01.
(4) As provided by representatives of the YMCA.
(5) Defined as census tracts 99.01, 99.02, 100, 101, 102.1, 102.2. The average household income is about $36,500.

Source: KPMG Peat Marwick



0' 600' 1200' 2400' NORTH

CONSTRUCTION PHASING PLAN

LIHI LANI

FIGURE 2-14

SECTION 3

REQUIRED APPROVALS AND PERMITS

3.0 REQUIRED APPROVALS AND PERMITS FOR LIHI LANI

This section includes a description of the required approvals and permits to implement the proposed Lihi Lani development project. The entitlements, as shown in Table 3-1, include a North Shore Development Plan Land Use Map Amendment, State Land Use District Boundary Amendment, Change of Zone and a Special Management Area Use Permit. This Supplemental EIS is prepared pursuant to Chapter 343, HRS, for the new Master Plan in conjunction with a North Shore Development Plan Land Use Map Amendment application which was filed with the City Department of Planning in July 1993. Applications have been submitted to the Land Use Commission for the boundary reclassification and the Department of Land Utilization for a Change of Zone.

3.1 STATE OF HAWAII

3.1.1 State Land Use District Boundary Amendment

Current Land Use District classification. The entire project site currently lies within the State Agricultural District. In 1972, the Land Study Bureau (LSB) of the University of Hawaii classified lands on Oahu according to productivity and suitability for agriculture. Overall ratings of crop productivity range from Class A to E, with A being the best. On the Obayashi land, there are 162 acres of Class B soils. There are no Class A soils on the property. The remainder of the area (982 acres) is classified as either Class C, D, or E soils. LSB soil classifications overlayed on the Master Plan are shown in Figure 4-3.

Proposed Reclassification. There are several land uses proposed within Lihi Lani which will require reclassification from the State Agricultural District to State Urban. Approximately 57.3 acres of the project's total area of 1,144 acres will be proposed for Urban District designation. They are designated as Parcel 1 and Parcel 2 on Figure 3-1. Parcel 1 (44.8 acres) includes the sites for the wastewater reclamation facility, the single family affordable housing and a small buffer area of connecting open space. Parcel 2 (12.5 acres) includes the elderly rental housing and community facilities. The balance of the project lands (1,086 acres) are planned to remain in the State Agricultural District.

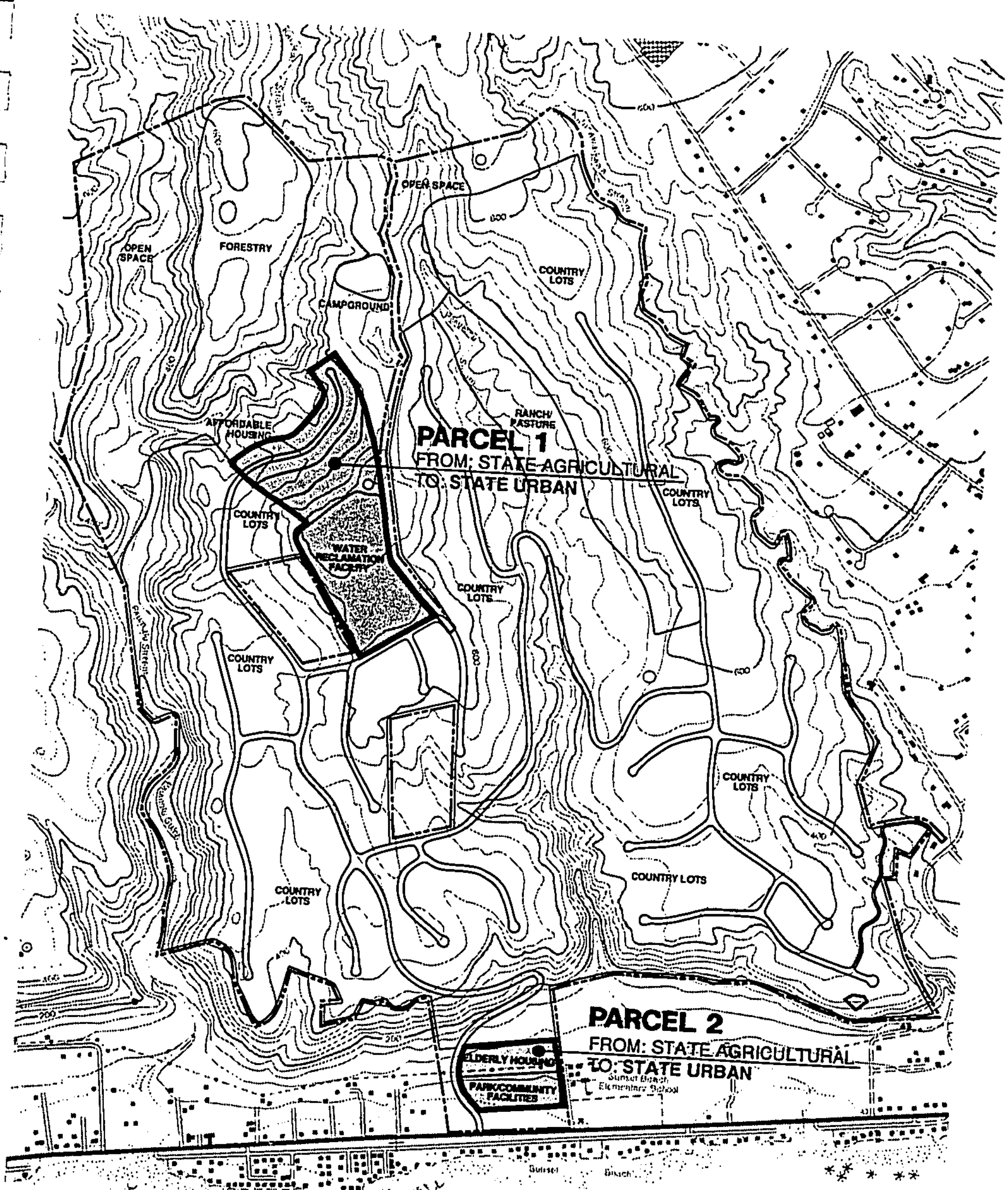
Responsible Agency. A petition for reclassification has been submitted to the Land Use Commission and Office of State Planning in November 1993.

TABLE 3-1

PROPOSED LAND USE CLASSIFICATIONS AND AREAS

Land Use	Acres	State Land Use	DP Amend[1]	Zoning	SMP[2]	OTHERS
Country Lots	765.0	Agricultural	Agricultural	Country	Outside SMA	--
SF Affordable Housing	10.0	Urban	Residential	R-5 Residential	Outside SMA	--
Elderly Housing	6.0	Urban	Residential	R-5 Residential	in SMA	PD-H[3]
Park/YMCA	6.5	Urban	Public Facility	P-2 Preservation	in SMA	CUP
WRF	24.0	Urban	Public Facility	AG-2 Agriculture	Outside SMA	CUP
Ranch/Pasture	64.0	Agricultural	Agriculture	AG-2 Agriculture	Outside SMA	CUP
Campground	4.0	Agricultural	Agriculture	AG-2 Agriculture	Outside SMA	CUP State SUP
Agri-Forestry	47.5	Agricultural	Agriculture	AG-2 Agriculture	Outside SMA	--
Open Space/Park	217.0	Agricultural	Park	AG-2 Agriculture	Outside SMA	--

[1]North Shore Develpment Plan Land Use Map
[2]Special Management Area Use Permit
[3]Planned Development - Housing
[4]Conditional Use Permit



PROPOSED STATE LAND USE
DISTRICT BOUNDARY AMENDMENT AREAS
LIHI LANI

0' 600' 1200' 2400' NORTH

FIGURE 3-1

3.2 CITY AND COUNTY OF HONOLULU

3.2.1 North Shore Development Plan Land Use Map Amendment

Current Designation: The property currently holds North Shore Development Plan (DP) Land Use Map designations for Park/Golf Course (212 acres), Residential 28 acres), Public Facility (14 acres), Park (10 acres) and Agriculture (880 acres) (Figures 3-2A and 3-2B). The non-agriculture designations resulted from the 1992 decision by the City Council to amend the DP Land Use Map. Since then the land use plans for Lihi Lani have changed, requiring revisions to the North Shore DP Land Use Map.

Proposed Amendment: To accommodate the portions of the revised Lihi Lani Master Plan, a request for amendment and reconfiguration of the North Shore DP Land Use Map has been filed with to the City and County of Honolulu Planning Department. Figure 3-3 depicts the proposed changes which are being requested. This Supplemental Draft Environmental Impact Statement has been prepared in order to meet the application requirements. The following is a summary of the proposed revisions to the North Shore DP Land Use Map.

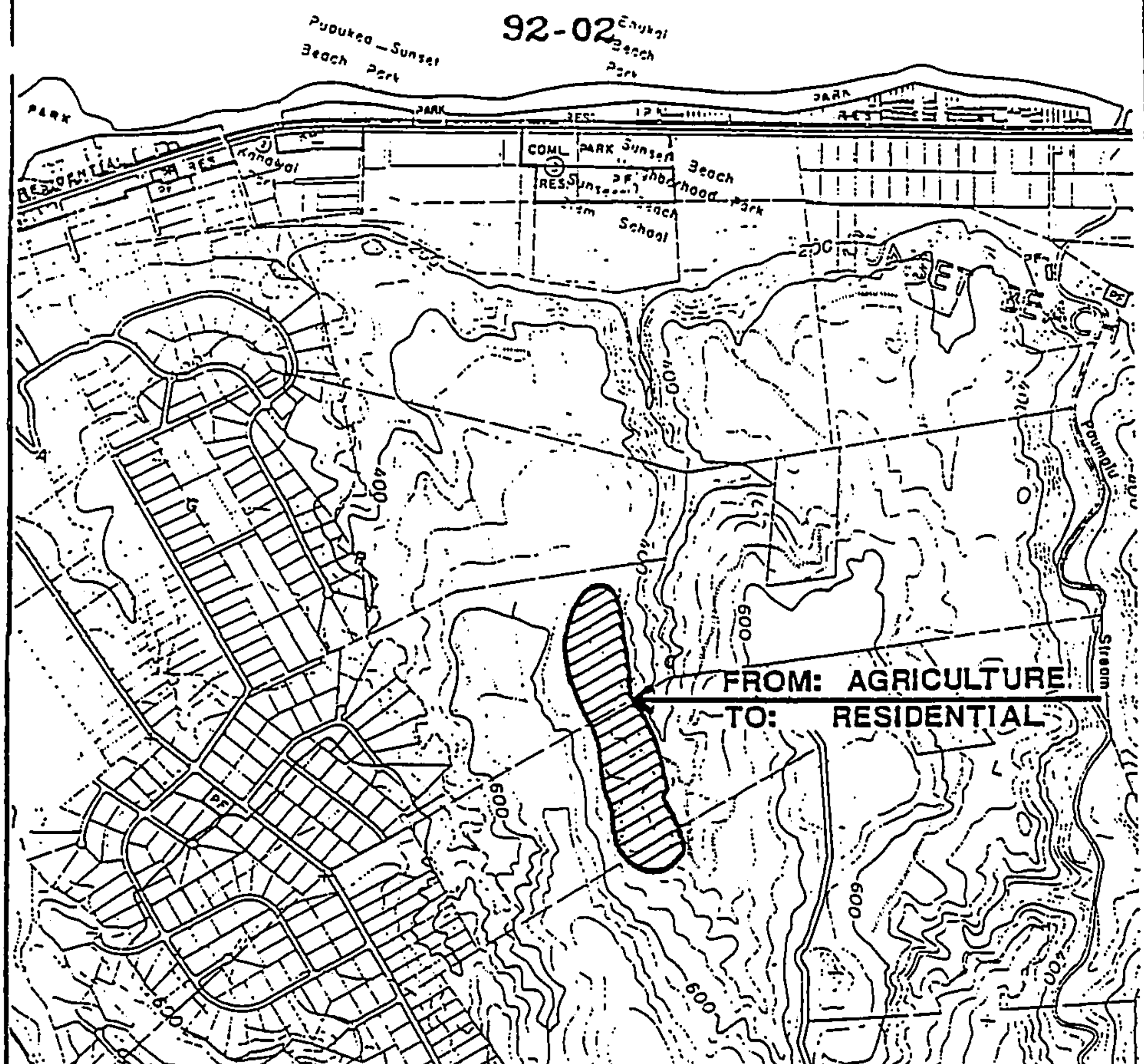
(a) Residential
Twenty-eight acres are currently designated as Residential, which was previously planned for affordable housing. The revised Master Plan provides affordable housing at two new sites which are non-contiguous. Fifty single family homes are planned on a 10-acre site at a mauka location, and 80 elderly housing rental apartments are planned on a 6-acre site on the makai portion of the site. The current plan calls for reconfiguration and relocation of 16 acres to remain as Residential, with amendment of 12 acres back to the previous Agriculture designation.

(b) Public Facility
The existing 10-acre Park designation requires reconfiguration to accommodate the 6.5 acre proposed park and community facilities. This action is required to allow for the development of the North Shore YMCA, including space for childcare, exercise meeting rooms, swimming pool and outdoor playfields for soccer and baseball. The remaining 3.5 acres would be redesignated to Agriculture.

(c) Park
The Park/Golf Course area which was previously approved for development of a golf course is requested to be re-configured to a more mauka location. The land will be utilized as a private passive park within the overall project for uses including hiking and horse riding trails, campground, agroforestry, and open space lands.

(d) Agriculture

Portions of the land which were designated in 1992 to Residential will be returned to the Agriculture designation as part of the overall project reconfiguration.



PORTION OF

DEVELOPMENT PLAN LAND USE MAP
NORTH SHORE

NORTH

250 500
500 0 1000
SCALE IN FEET

APPLICANT : OBAYASHI HAWAII CORPORATION

TAX MAP KEY : 5-9-5: POR. 38

FOLDER NO. : 91/NS 2

PREPARED BY : Department of General Planning
City and County of Honolulu

PUBLIC HEARING : Planning Commission AUG 28 1991 AUG 7 1991 SEP 11 1991 City Council NOV 13 1991

ORD.NO. 92-02

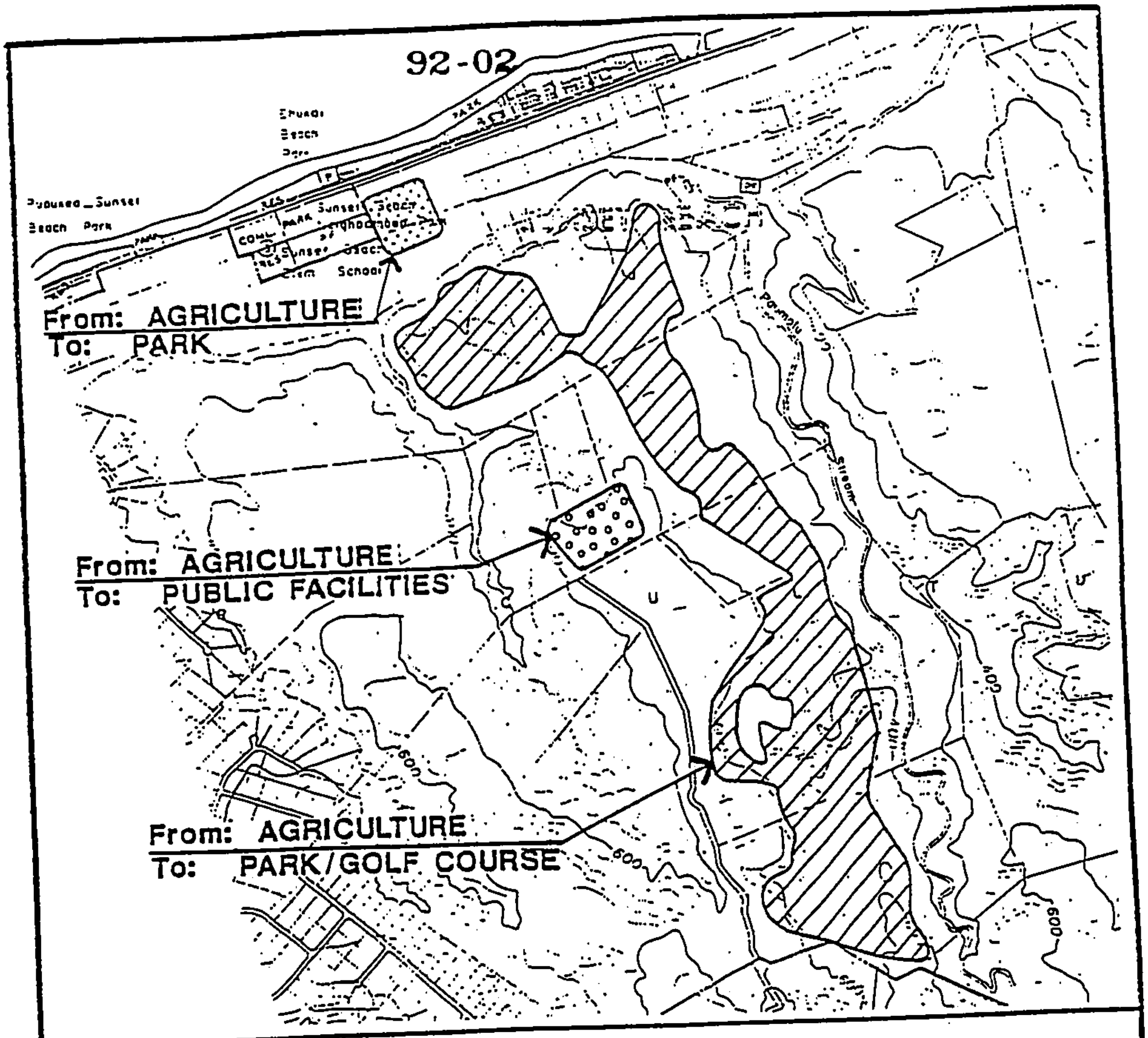
91/LU-6

EFF.DATE: JAN 16 1992

EXHIBIT A-2

Bill 114, 1991
(CD-1)

FIGURE 3-2A



PORTION OF

DEVELOPMENT PLAN LAND USE MAP
NORTH SHORE

NORTH

250 500
500 0 1000
SCALE IN FEET

APPLICANT: OBAYASHI HAWAII CORPORATION
FOLDER NO: 91/NS-02
TAX MAP KEY: 5-9-05: Por. 38;
5-9-06: Por. 18 & Por. 24
PREPARED BY: DEPARTMENT OF GENERAL PLANNING
CITY & COUNTY OF HONOLULU

PUBLIC HEARING: PLANNING COMMISSION CITY COUNCIL
AUG 28 1991
AUG 7 1991 SEP 11 1991 NOV 13 1991

91/LU-22

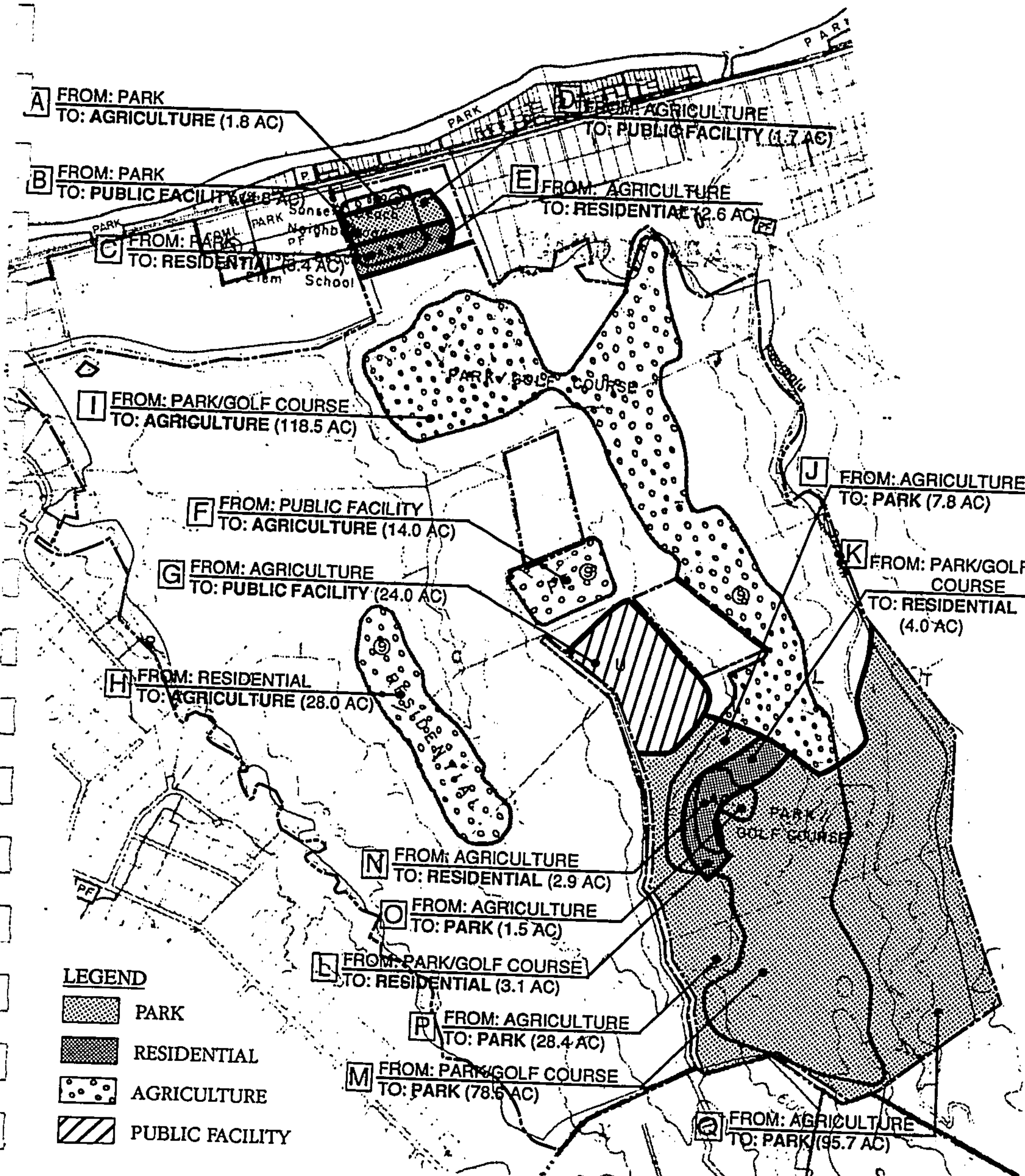
ORD. NO. 92-02

BILL 114, 1991
(CD-1)

EFF. DATE JAN 16 1992

EXHIBIT A-1

FIGURE 3-2B



PROPOSED DEVELOPMENT PLAN LAND USE MAP
LIHI LANI

FIGURE 3-3

Responsible Agency. The proposed DP Amendments are subject to approval by the City Council. The City Planning Department reviews the application and the Planning Commission holds a public hearing and makes its recommendation to the Council. The Mayor can approve or veto the Council's decision, however, the Council has override authority. The Council holds hearings in committee and the full Council makes its decision.

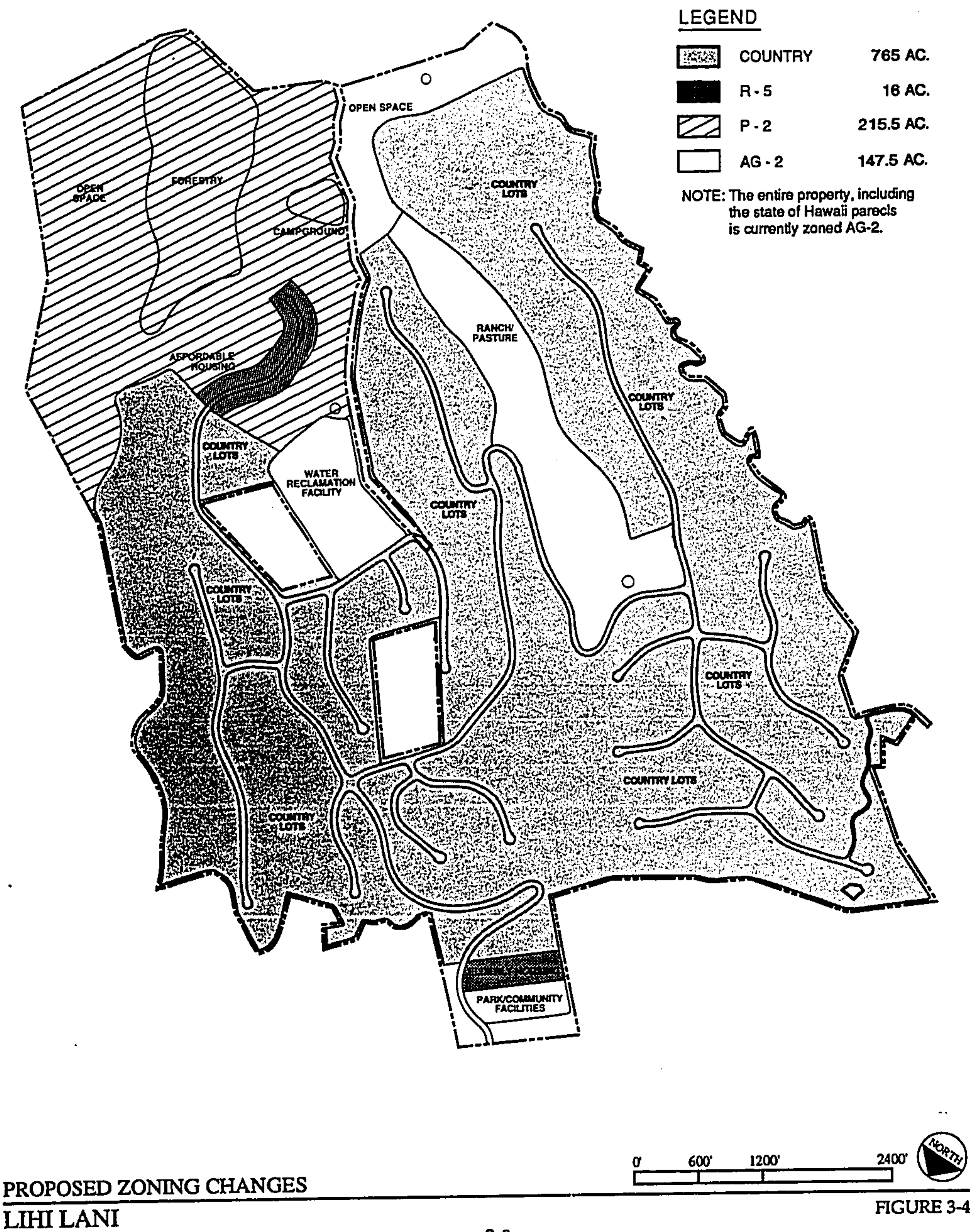
3.2.2 Change of Zone

Existing Zoning District: The zoning for the entire property is AG-2 General Agriculture District. This district generally include lands which are predominantly classified as "Other" under the Agricultural Lands of Importance to the State of Hawaii (ALISH) system, as discussed further in Section 4.3. (Lands predominantly classified as "Prime" or "Unique" under the ALISH system are generally zoned AG-1 Restricted Agricultural District). Eleven percent of the property is designated as "prime", twenty-nine percent (328 acres scattered in eight different areas) of the property is classified as "Other", and fifty percent is unclassified because of steep slopes. The City and County recognizes that the overall feasibility of agriculture on these lands is limited due to extreme topographic variations and/or separated agricultural soil sections. The entire Pupukea Highlands area, which is adjacent to Lihi Lani, is zoned Country (minimum one acre lot size).

Proposed Zoning District Changes: Several areas of the project will require a Change of Zone to allow for the development under the current plans. The proposed zoning changes are summarized below and Figure 3-4 shows the proposed zoning for Lihi Lani.

> **General Preservation (P-2):** A zoning change to P-2 General Preservation district is required to permit park uses over approximately 215.5 acres. This land is composed of generally steep areas in the mauka portion of the property to be used for the passive park area. Open space, agroforestry and a campground are the proposed uses in the P-2 zone.
>
> **Country:** A zoning change to Country district is required to permit the one- to three-acre Country lots; the requirement is a one-acre minimum lot size. A total of 315 lots are planned for 765 acres at Lihi Lani.
>
> **R-5 Residential:** A zoning change to R-5 for 10 acres is proposed at the mauka Affordable Housing site, to create 50 lots of approximately 5,000 sq. ft. in size and development of supporting infrastructure. A six-acre area will also be zoned R-5 for the elderly affordable housing development.

Responsible Agency. The Department of Land Utilization (DLU) reviews and processes the application. The proposed changes are subject to approval by the City Council. The review process involves public hearings before both the Planning Commission and City Council. An application for a Change of Zone for Lihi Lani was submitted to DLU in early December.



PROPOSED ZONING CHANGES
LIHI LANI

FIGURE 3-4

3.2.3 Special Management Area Use Permit (SMP)

Existing conditions. Approximately 30 acres of the site lie within the Special Management Area. This land area is adjacent to Kamehameha Highway on the makai portion of the Obayashi property. A Special Management Area (SMA) boundary generally extends along the lower portion of the coastal bluff in the Pupukea-Sunset Beach area (Figure 3-5). Uses of proposal for this area will require a SMP from the City and County of Honolulu after approval of the Change of Zone.

Required permit. A Special Management Area Use Permit (SMP) must be obtained to allow for the development of the access road, the elderly housing, the community facilities, and YMCA building located in the Special Management Area.

Responsible Agency. The City Council is the approving authority for this permit. The Director of Land Utilization must hold a public hearing as part of the Department's review of the application.

3.3 OTHER REQUIRED APPROVALS

3.3.1 North Shore Development Plan Public Facilities Map Amendment

The DP Public Facilities (PF) Map for the North Shore indicates the presence of existing Public Facilities such as schools, parks, water reservoirs, etc. The PF Map also indicates planned future development of similar public facilities which have yet to be built. For the Lihi Lani project, Development Plan PF Map Amendments will be required for the Water Reclamation Facility, Water Reservoirs and Parks.

3.3..2 Conditional Use Permit (CUP)

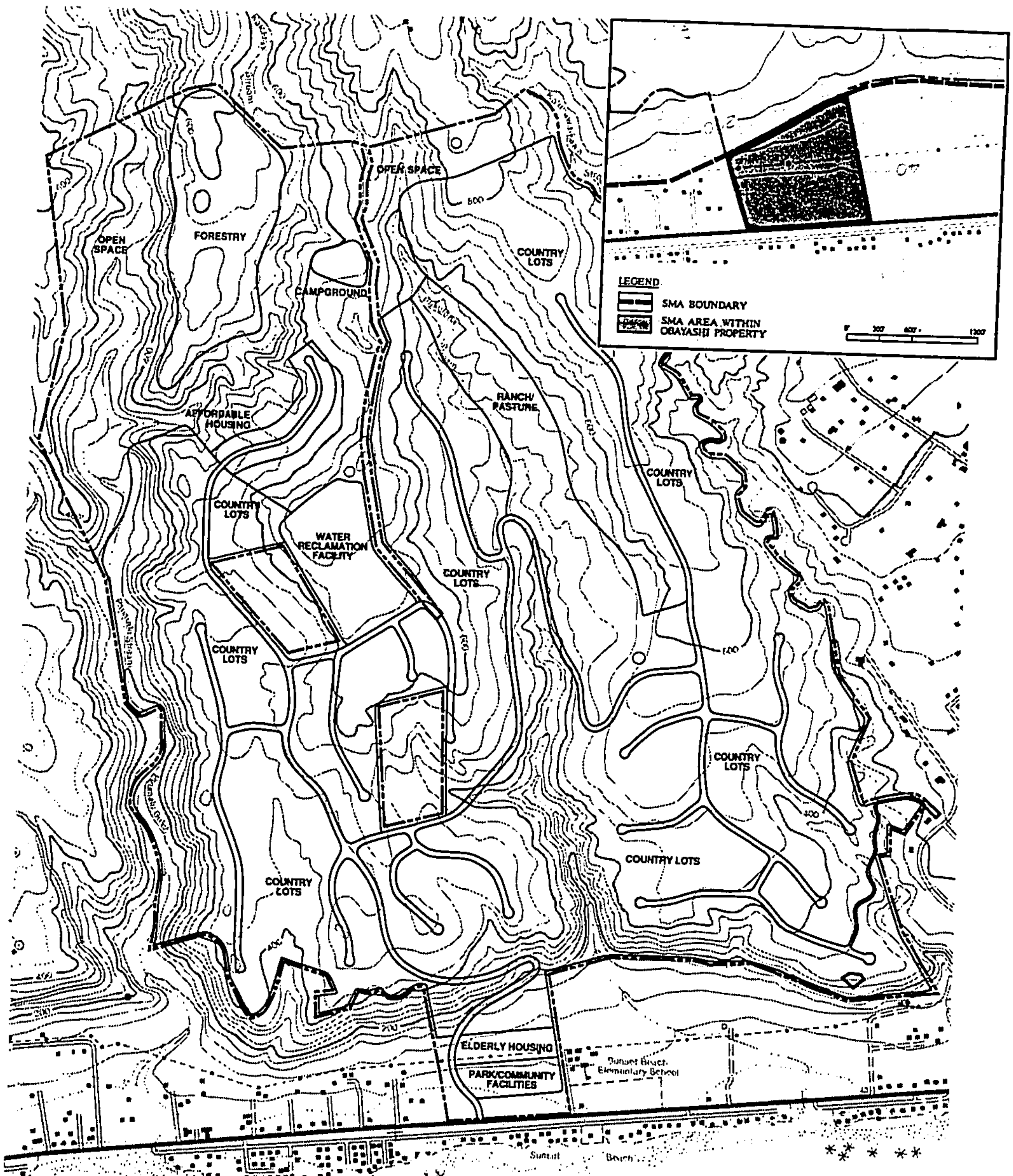
A Conditional Use Permit (CUP) will be required for the development of several facilities at Lihi Lani. The Ranch facilities, Water Reclamation Facility, Campground and Community Facilities will all require CUP approval.

The Ranch, Campground and Community Facilities (ball fields) all qualify as Outdoor Recreational Facilities which are listed as Type-1, and do not require a Public Hearing. The Water Reclamation Facility is classified as a Type B utility, which also requires a Type-1 CUP with no Public Hearing.

Essentially, The CUP process allows for the Department of Land Utilization (DLU) to review the planned extent of structures and intent of the use versus the underlying zoning classification. The DLU Director is responsible for approval of the CUP.

3.3.3 Site Plan Review

The Community Facility is permitted in the AG-2 General Agricultural district subject to Site Plan Review by the City Director of Land Utilization. Prior to submission for application for a Site Plan Review permit, the applicant must first



SPECIAL MANAGEMENT AREA BOUNDARY

LIHI LANI

0' 600' 1200' 2400' NORTH

FIGURE 3-5

present the proposal to the North Shore Neighborhood Board 27, and the local community associations. Adjacent property owners may request a public hearing, prior to final action by the DLU Director.

3.3.4 Planned Development - Housing

Development of the City's elderly housing project will require a PD-H approval. The PD-H allows for flexibility in certain infrastructure and site planning standards. Floor Area ratio of the Elderly Housing Site will be limited to 40 percent lot coverage.

3.3.5 State Special Use Permit (SUP)

A State Special Use Permit will be required to locate the proposed Campground on State Agricultural District lands.

3.4 REQUIRED PERMITS

Several other approvals will be required to implement the proposed action, some of which will include:

- Well Drilling/Withdrawal Permit (State Water Commission)
- Wastewater Treatment System Approval (State Department of Health, City Department of Public Works)
- Roadway Entrance Approval (State Department of Transportation)
- Grading and building permits (City and County of Honolulu)
- National Pollutant Discharge Elimination System (NPDES) (State Department of Health)
- Stream Channel Alteration Permit (Board of Land and Natural Resources) (For roadways and bridgework over streams, if streams are impacted.)

SECTION 4

ASSESSMENT OF THE EXISTING NATURAL ENVIRONMENT, POTENTIAL IMPACTS AND MITIGATIVE MEASURES

4.0 ASSESSMENT OF THE EXISTING NATURAL AND PHYSICAL ENVIRONMENT, POTENTIAL IMPACTS AND MITIGATIVE MEASURES

This section presents background information on the existing natural and physical environment of the project lands. The proposed Lihi Lani project is evaluated as to the potential for it to generate significant environmental impacts. Impact discussions are divided into short-term construction-related impacts, and long-term operations-related impacts. Mitigative measures have also been recommended to minimize the potential impact of the project construction and operation. Technical consultant reports have been prepared to supplement the impact assessment. Findings from these reports are summarized herein; the complete texts are enclosed in the Appendix.

4.1 CLIMATE

A. Existing Conditions

Annual average daily maximum and minimum temperatures have been recorded at the State Key Station 896.00 located at the Pupukea Farm. This weather station is at the elevation level closest to the site. Temperatures range from the low 60's to the mid-80's depending on the time of day and the season. Daily temperatures vary by about seven degrees between winter and summer seasons, and 15 to 18 degrees between day and night. Cooler temperatures are experienced at higher elevations in this area.

Precipitation has a definite seasonality on Oahu and at the site. Rainfall has been recorded by the Hawaii Sugar Planters Association at the Pupukea Farm State Weather Station. The median annual rainfall at this station is 51.7 inches. The distribution is uneven and varies from month-to-month, heavy at some times and non-existent at others.

The Pupukea area is subject to both trade winds and Kona storms, but damage from these storms is less severe than in the more exposed areas such as Kahuku. Average wind velocity is eight to ten miles per hour, with the prevailing wind directions being northeasterly and easterly.

Cloud cover is an indication of the amount of sunshine an area receives. On this particular area of the island, slightly less than one-third of the days per month are clear, about a third are partly cloudy, and a little more than a third of the days are cloudy.

The average relative humidity approximates 74.6 percent on the northern coast of Oahu; it is slightly lower in the summer and higher in the winter.

B. Anticipated Impacts and Mitigative Measures

Design of the proposed project will be typical for a tropical climate with extensive use of outdoor recreational facilities. The proposed project will have no affect on climatic conditions and no mitigative measures are required.

4.2 TOPOGRAPHY

A. Existing Conditions

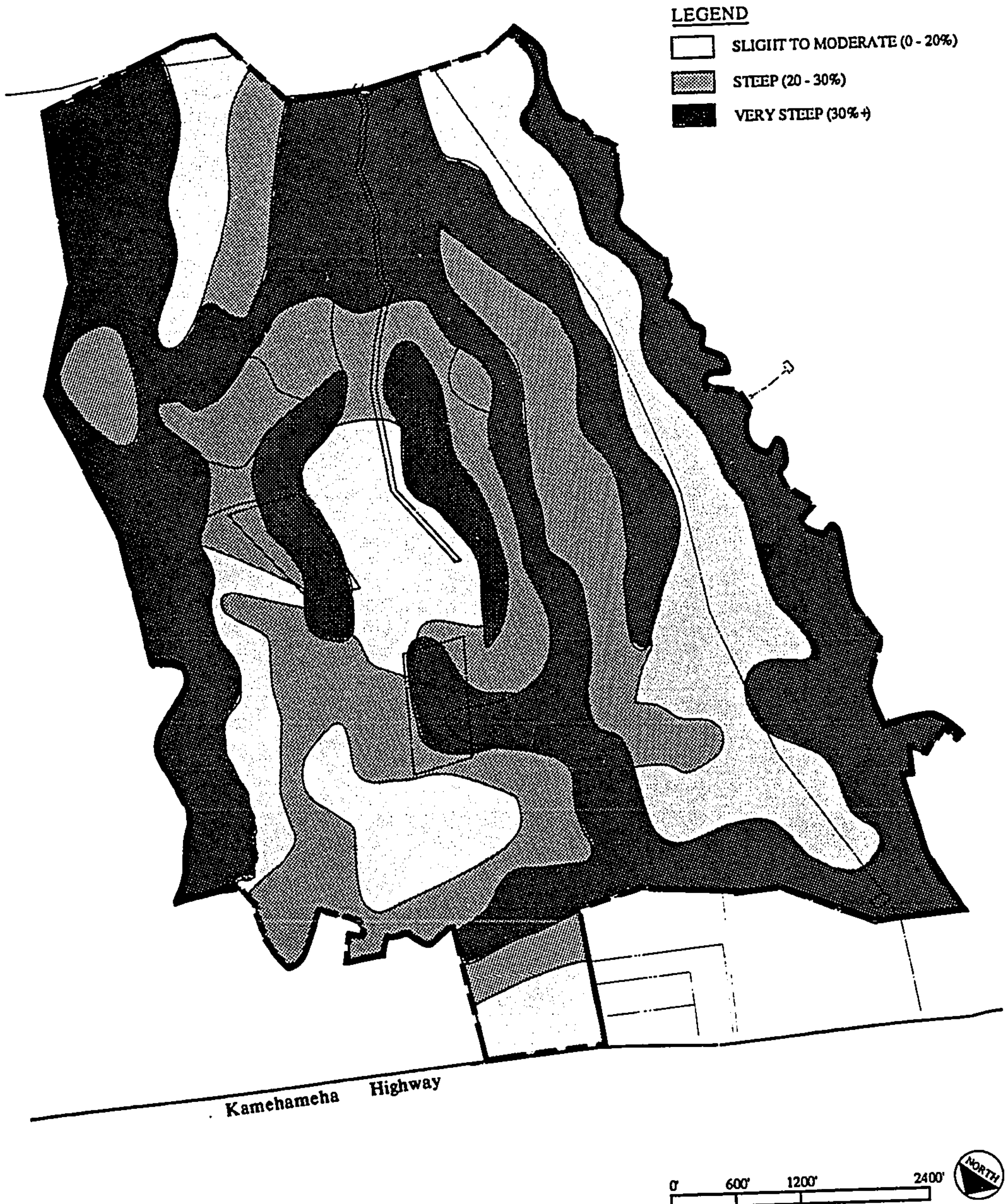
The project site consists of two large plateaus which are separated by the intermittent Pakulena Stream, a narrow, steep gulch. It is bordered on the Kahuku-side by the valley of Paumalu Stream and on the Haleiwa-side by the valley of Kalunawaikaala Stream (see Figure 1-1). Elevation ranges from 20 feet above mean sea level (msl) near Kamehameha Highway to nearly 850 feet above msl in the uplands behind the plateau areas. Puu Waihuena is a hill located on the Kahuku-side of Pakulena Stream at elevation 730 feet above msl.

The terrain is extremely rugged above of the pali between the plateaus. The talus slope bluff is very steep, jagged and rocky. Approximately 20 percent of the area has very slight (0-10 percent) slopes, another 10 percent is moderately (10-20 percent) sloping, and the remaining 70 percent is characterized by steep (20 to 30 percent) and very steep (over 30 percent) slopes. Lands on the makai section of the site along Kamehameha Highway are primarily level or moderately sloped, with some low-lying pockets of land. Figure 4-1 shows a generalized map of slope conditions on the property. Figure 1-1 includes topographic contours mapped by the U.S. Geological Survey.

B. Potential Impacts

To the extent practicable the project will be designed to minimize changes to topography. The development of the agricultural and residential areas will require disturbance of the vegetation and natural grades in some areas. Removal of the golf course from the project plans significantly reduces the requirements for topographic modification at the project.

The Lihi Lani Master Plan shows approximately 900 acres in various land use designations, however, it is estimated that between 400 and 480 acres of the site could be affected by construction activities over the four phases of development. After full build-out, a total of 640 to 720 acres of the property will essentially be unaffected by construction activities.



SLOPE ANALYSIS
LIHI LANI

FIGURE 4-1

Development of building sites will require some grading to establish level building surfaces. Rock removal will also be required to build the access road across the talus slope bluff face. The bluff will not be modified except for the construction of the access road. Cut material from grading will mostly be retained on the project site. The amounts of cut and fill will be balanced in the grading plan to minimize the need to import fill or to export excavated material.

C. Mitigative Measures

Several mitigative measures, as listed below, will be implemented to minimize impacts on topography.

(1) Project Design: The land uses in the Master Plan and the siting of facilities will be designed to avoid changes in topography as much as possible. The site's natural slopes and features will be respected to minimize grading requirements. The change in project concept which removed the development of the golf course has significantly reduced topographic modification requirements of the project.

(2) Grading Ordinance Compliance: All grading operations will be conducted in a manner which will ensure full compliance with dust and erosion control and other requirements of the City and County Grading Ordinance. A grading permit must be obtained from the City and County to modify the topography of the site. The grading plans for the site will be reviewed and approved in this process. A National Pollutant Discharge Elimination System (NPDES) permit will also be a requirement prior to construction to address non-point source discharges to bodies of water.

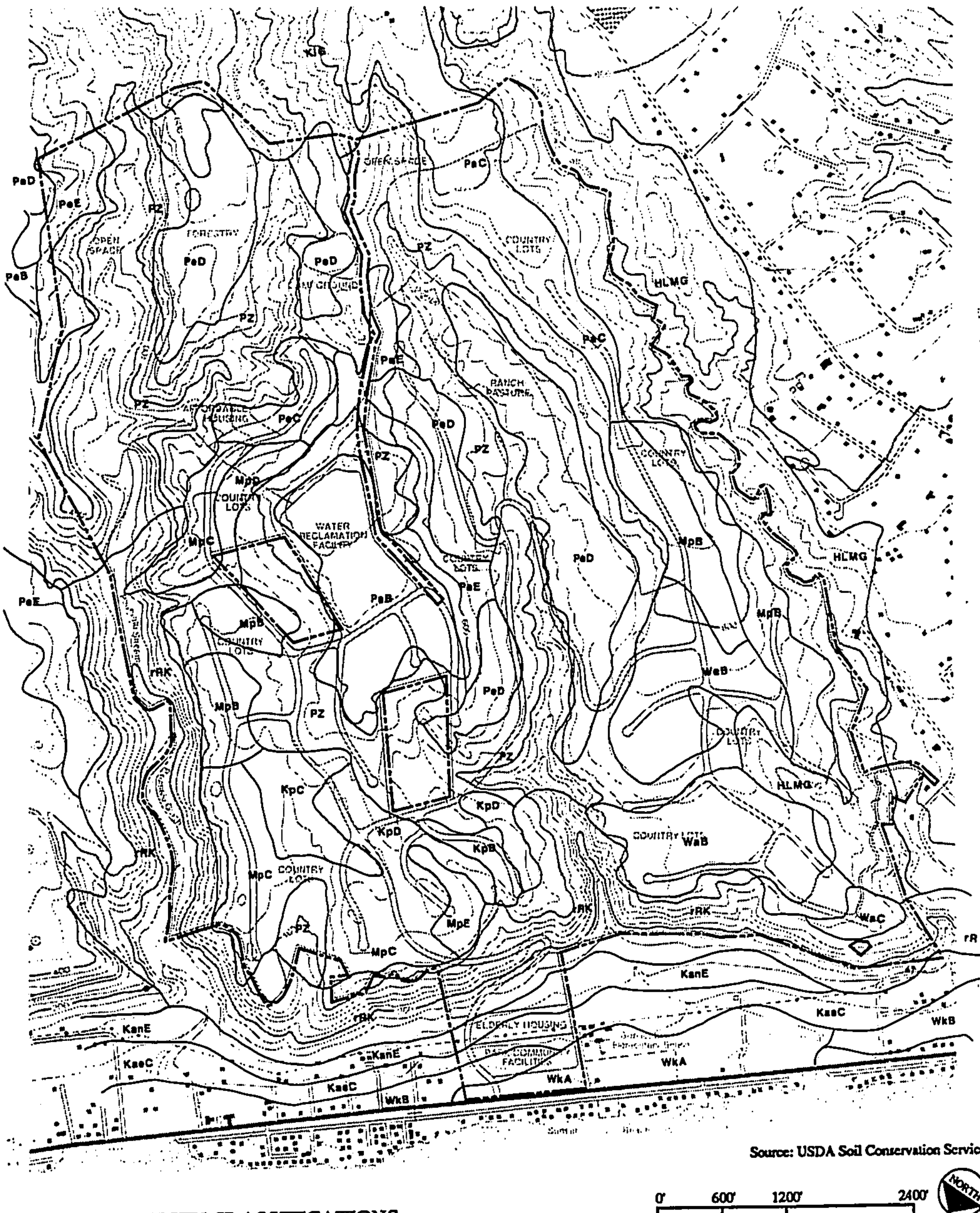
4.3 SOILS

A. Existing Conditions

There are three studies or documents which classify soil type and designate agricultural viability. Soil types or classifications for the project area are based on soil surveys by the USDA Soil Conservation Service (SCS) (1972), shown in Figure 4-2. The University of Hawaii Land Study Bureau (LSB) classifications, and the Agricultural Lands of Importance to the State of Hawaii (ALISH) designations are used to show the agricultural viability of the land considering its soils, shown in Figure 4-3 and Figure 4-4 respectively. Soil types at Lihi Lani are shown in Table 4-1.

Based on the SCS Soil Survey, a total area of 806 acres, or 71 percent, is categorized as soil classifications IV - VIII (exclusive of the State water reserve parcels). These classifications denote a poor soil quality without irrigation. Under the LSB classification system, 707 acres or, 62 percent of the land, is poorly rated in the D and E categories (similar to the SCS IV - VIII categories)

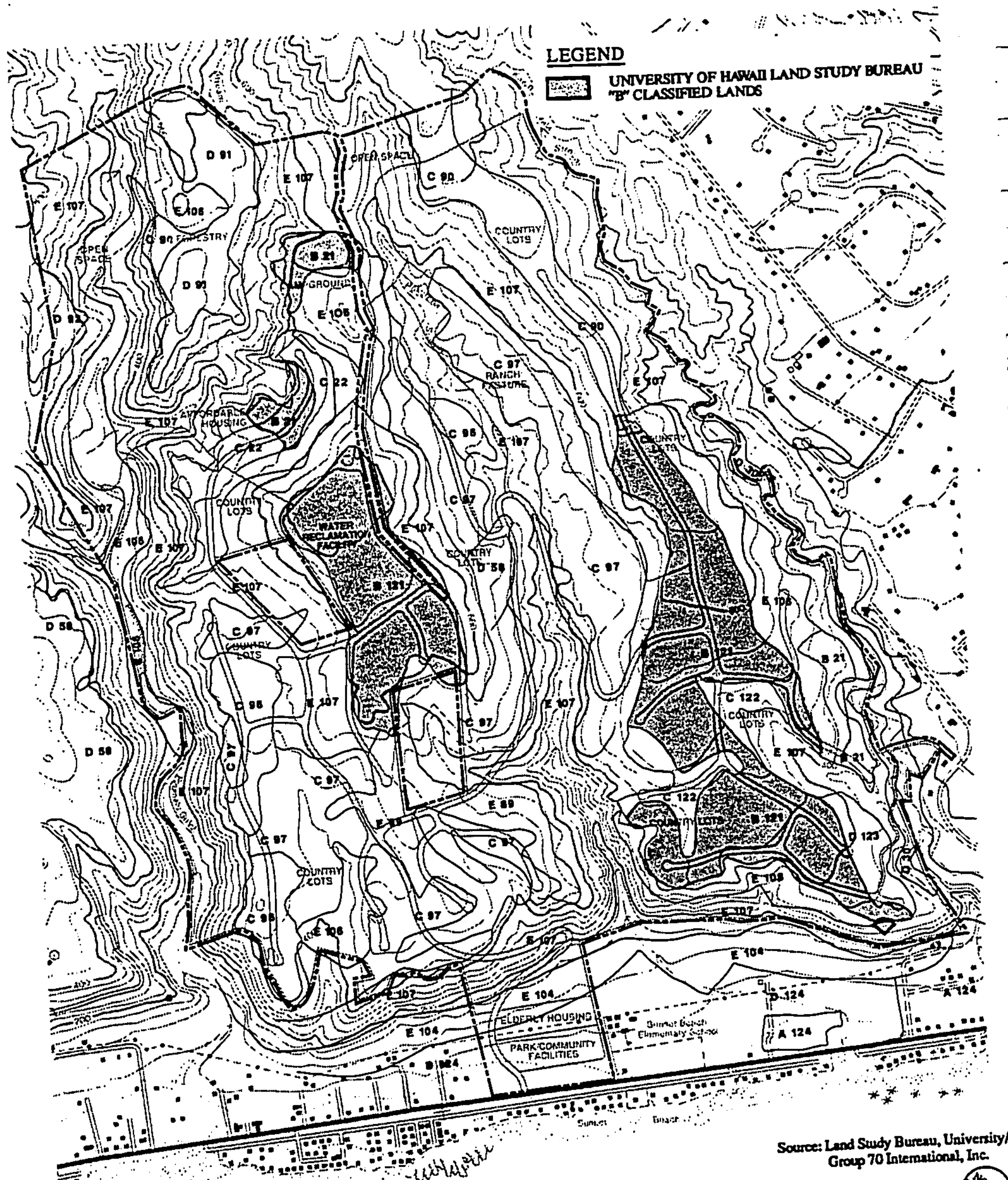
Under ALISH Prime Agricultural Land constitutes 328.2 acres, or 30 percent of the total land. Other Important Agricultural Land makes up 237.9 acres, or 21 percent of



SOIL CAPABILITY CLASSIFICATIONS

LIHI LANI

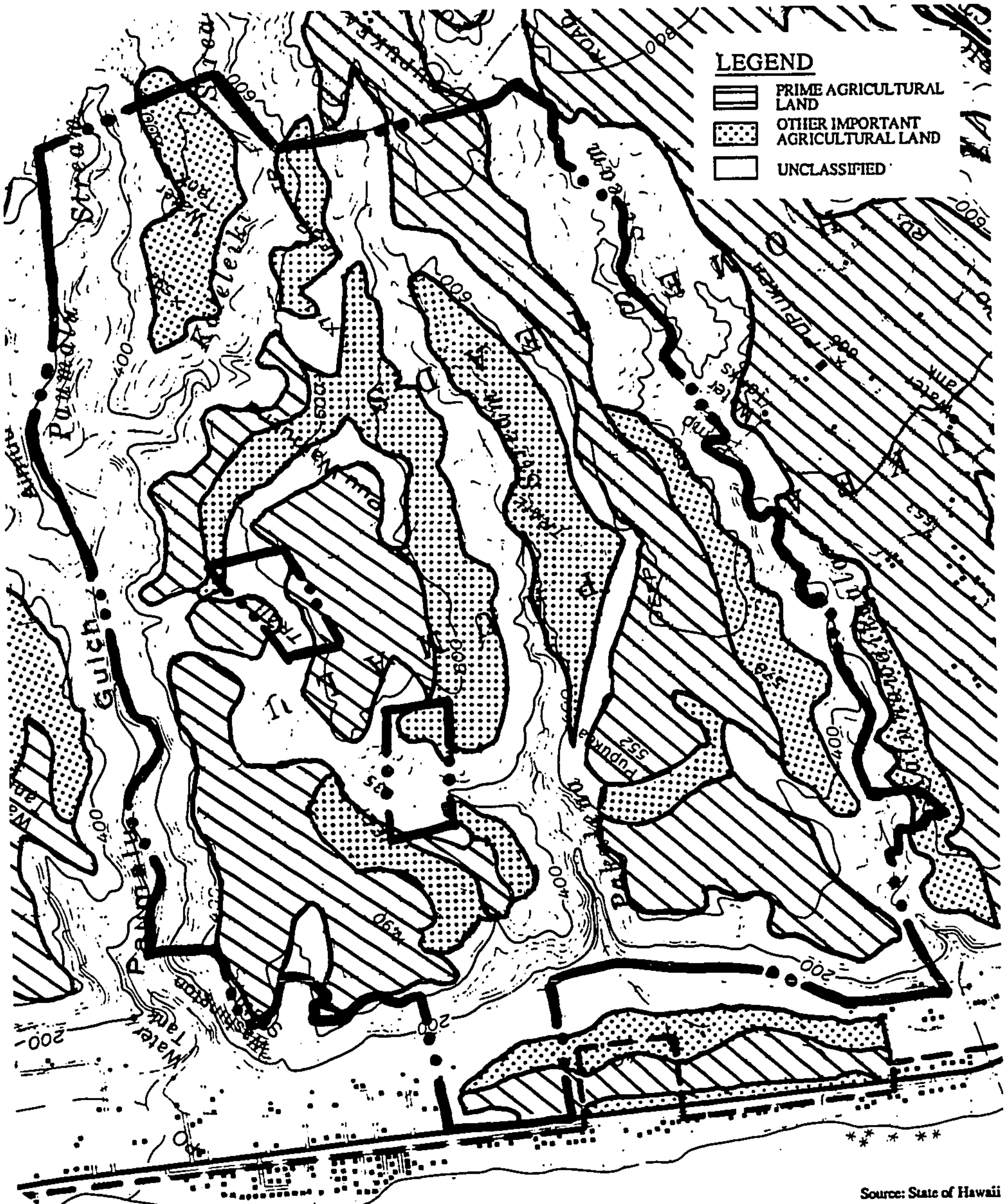
FIGURE 4-2



MASTER PLAN RELATIONSHIP TO LSB CLASSIFICATION

FIGURE 4-3

LIHI LANI



AGRICULTURAL LANDS OF IMPORTANCE
TO THE STATE OF HAWAII (ALISH)

LIHI LANI

FIGURE 4-4

TABLE 4-1
LIHI LANI SOIL PROPERTIES

SOIL SERIES	CLASSIFICATION	PERMEABILITY (inches/hour)	SHRINK-SWELL POTENTIAL	FOUNDATIONS
Helemano (HLMG)	Silty clay	2.0 to 6.3	Moderate	Slopes of 30% to 90%, susceptable to sliding.
Kaena (KaeC), (KanE)	Stony clay	0.06 to .63	High	High shrink swell potential, poorly drained, lowshear strength, seepage.
Kemoo (KpB), (KpC), (KpD)	Silty clay	0.63 to 6.3	Moderate	Slopes as much as 70%, high bearing strength.
Manana (MpB), (MpC), (MpD), (MpE)	Silty clay loam and silty clay	0.63 to 6.3	Moderate to low	Slopes as much as 40%, high shear strength.
Paaloa (PaC)	Silty clay and clay	2.0 to 6.3	Low	Slopes as much as 12%.
Paumalu (PeB), (PeC), (PeD), (PeE), (PZ)	Silty clay and gravelly silty clay	2.0 to 6.3	Moderate to low	Slopes as much as 70%, moderate shrink-swell potential in surface layer.
Wahiawa (WaB), (WaC)	Silty clay	2.0 to 6.3	Low	Slopes as much as 25%, high shear strength.
Waialua (WkA)	Silty clay	0.63 to 2.0	Moderate	Moderate shrink swell potential, low shear strength, stoniness in places.
Waikapu (WrK)	Silty clay loam	0.63 to 2.0	Low	Slopes as much as 15%.

Source: U.S. Dept. of Agriculture - Soil Conservation Service - Soil Survey of the State of Hawaii - August 1972 the land. Fifty percent of the total acreage is unclassified, consisting of steep, rocky and eroded gulches.

The Department of Agriculture's Land Evaluation and Site Assessment (LESA) analysis corroborates these findings. It shows that 73 percent of the total project area ranks below the agronomic scale cutoff value of 66, or is of a poor soil quality for agricultural use. However, although the land is of poor soil quality, with irrigation and roadway accessibility, agricultural crops can be economically viable.

Many of the site's steep sloped areas currently experience significant soil erosion. Vegetation has been eliminated in these areas by natural forces, exposing soils to wind and rain, and allowing for substantial erosion of soils. The total estimated soil loss under existing conditions is estimated at 35,719 tons/yr. (Engineering Concepts, Inc.; September 1993). Refer to the drainage study in Appendix F for more information regarding existing erosion potential.

To address the erosion problem Obayashi has implemented a program to control further soil erosion. A nursery facility has been constructed on site to propagate test plant materials suitable to revegetate bare slopes. This program is currently in progress.

B. <u>Potential Impacts</u>

Preparation of the land for construction will involve grading and clearing operations. At the same time, the proposed design will include a natural setting which will preserve extensive amounts of the existing vegetation. Potential impacts on soils will be less under the current plan (than the 1991 plan) with the first year of roadway development being the most intense. Thereafter, small areas of grading will be phased in increments.

The Lihi Lani Master Plan shows approximately 900 acres in various land use designations, however, it is estimated that between 400 and 480 acres of the site could be affected by construction activities over the four phases of development. After full buildout, a total of 640 to 720 acres of the property will essentially be unaffected by construction activities.

Clearing and grubbing activities during construction will temporarily disturb the soil retention values of the existing vegetation and expose the soils to erosional forces. Since the developing areas of the project site are located at the top of two plateaus, some wind erosion could also occur. Precipitation events will also cause the erosion of soils over disturbed areas of the land. Soil erosion during the construction phase of the project was estimated by Engineering Concepts, Inc. (ECI September 1993, Appendix F).

ECI analyzed the Phase 1 construction period which involves the largest amount of land disturbance, as compared to Phases 2, 3 and 4. Approximately 185 acres will be disturbed in Phase 1, in three sub-phases for development of infrastructure, house pads and agricultural areas over a three-year period. The potential increase in soil loss from the property during the construction in Phase 1 could be nearly nine percent increase over existing conditions. The sub-phase for the construction of roadways would represent this highest soil erosion potential, with subphases for house lots and agricultural areas posing lower property-wide soil erosion potential at five percent and seven percent increase, respectively. Subsequent phases of development would have lower total soil erosion potential due to the smaller total areas involved.

There will be a beneficial impact resulting from the project's long-term landscaping and erosion control program. The total estimated soil loss for developed conditions is 27,695 tons/year, or approximately 22 percent less than existing soil loss from the underdeveloped site (ECI, August 1993). Existing eroded areas on steep slopes will be planted with ground cover vegetation to minimize soil erosion.

C. Mitigative Measures

Mitigative measures will be implemented to reduce short-term soil erosion during construction. For example, limiting grading to not more than 15 contiguous acres at one time and seeding half of the area will reduce the estimated erosion of the site by about 47 percent. The impact of construction activities and long-term operations on soils will be mitigated by several measures, as listed below:

(1) Construction Erosion Control: Construction activities will follow strict erosion control measures specified in the following regulations and reports:

a. City and County of Honolulu (1972) Grading, Grubbing and Stockpiling Ordinance No. 3968

b. City and County of Honolulu, Department of Public Works (1975) Soil Erosion Standards and Guidelines

c. State of Hawaii, Department of Health (1968) Water Quality Standards, Chapter 37-A, Public Health Regulations

d. USDA, Soil Conservation Service (1968) Erosion and Sediment Control Guide for Hawaii

e. Department of Health, Hawaii's Non-Point Source Water Pollution Management Plan - Best Management Practices (November 1990)

f. U. S. Environmental Protection Agency (January 1993) Guidance Specifying Management Measures for Sources of Non-Point Pollution in Coastal Waters

g. National Pollutant Discharge Elimination System (NPDES) compliance requirements

Prior to issuance of a grading permit, by the City and County of Honolulu, Department of Public Works, an erosion control plan will be submitted which will include applicable measures as specified in the regulations and reports cited above. Erosion control measures such as the use of cut-off ditches, temporary ground cover and detention ponds as described in the Stormwater Drainage Plan (Appendix F, Engineering Concepts, Inc., September, 1993).

(2) Watering and Landscaping: A watering program will be implemented to minimize soil loss through fugitive dust particulate emission levels from construction sites. Other control measures include good housekeeping on the job-site, and pavement or landscaping of bare soil areas as quickly as possible.

(3) Landscaping and Long Term Erosion Control: Implementation of landscaping will generally re-establish the soil retention value of the removed vegetation. Lihi Lani will have extensive plantings throughout it's grounds, and establish control over existing erosion areas on steep slopes. This continuous, long-term management of the property will significantly reduce erosion from existing conditions.

(4) Other Mitigation: In addition to measures listed above, erosion control measures that could be implemented to further lessen construction impacts include:

a. Minimize time of construction.
b. Retain existing ground cover until the latest date before construction.
c. Early construction of drainage control features.
d. Use of temporary area sprinklers in nonactive construction areas when ground cover is removed.
e. Station water truck on-site during construction period to provide for immediate sprinkling, as needed, in active construction zones (weekends and holidays included).
f. Continue thorough watering of graded areas after construction activity has ceased for the day and on weekends.
g. Sod or plant all cut and fill slopes immediately after grading work has been completed.
h. Use temporary berms, cut-off ditches and other diversion channels, where needed, to interrupt runoff and divert it to the nearest sediment basin.
i. Construct temporary sediment basins to trap silt.
j. Construct temporary silt fences or straw bale barriers to trap silt.

4.4 AGRICULTURE

The following section includes a discussion of the existing agricultural uses of the site and its potential for future use. Impacts of the proposed project on agriculture and adjacent farm lands are evaluated herein. A discussion of the benefits associated with expanded agriculture on-site is also presented . A report was prepared by Frank S. Scott, Jr., Ph.D. (March 1988) to assess agricultural feasibility of the lands proposed for the 1991 project plans. For the current proposal there is small-scale agricultural use of the property, with an Agricultural Plan for Lihi Lani (September 1993) included as Appendix A.

A. Existing Conditions

A large part of the site is unsuitable for crop production or grazing. Seventy-one percent of the land area (807 acres) consists of soil types in very low compatibility classifications for agricultural use, as defined by the Soil Conservation Service (SCS) (excluding the State water reserve parcels). Many of these areas are eroded and consist of steep, rocky gulches.

The approximately 176 acres of better agricultural soils (according to LSB ratings) consist of many scattered small plateau areas, surrounded by steep, badly eroded gulches. For agricultural development, independent of any other development, this configuration prevents economies of scale and increases the cost of infrastructure for intensive crop production. At one time in the past, when manual labor was the method used for planting and harvesting, intensive crop production may have been feasible on some parts of the site. Other previous attempts to develop agriculture for an avocado farm and sugar cane did not succeed. Limits to agricultural use of the prime and marginal soils areas on the site is due to the lack of access roadways and water supply infrastructure.

During the 1970's and 1980's about 100 acres of the site was used to graze cattle and horses. Fences, a farm shack and equipment sheds are the only evidence of agriculture on the upper levels of the site. Currently, approximately 4 to 5 horses graze on the project site with permission of the owner.

The adjoining community of Pupukea Highlands includes a variety of agricultural uses within Country lots. Uses such as flower and foliage nurseries, fruit tree orchards, grazing pasture and other crop types are examples of on-going small-scale agriculture in the area.

B. Potential Impacts

With respect to existing grazing use of the land, people who are currently grazing their horses on the property will be asked to move their animals to the Ranch area. There will be no economic or employment impact as a result of this action. A much larger area of grazing land will become available as a result of the Ranch which will have 40 to 50 acres of pasture at Lihi Lani.

Farming use of other adjacent lands will not be affected by the proposed development. Small lot farms operating in Pupukea Highlands and along the lower Pupukea area do not directly border on the project site. These small farms are, in some cases, dependent on infrastructure that will service the project, such as potable water supply mains, electric lines and roadways. Development of the project is not expected to affect these facilities. Irrigation of agricultural areas will be accomplished through the on-site potable water system and reclaimed water system.

The agricultural use of this land will expand greatly under the proposed plans for Lihi Lani. Prime agricultural soils will be primarily used for portions of Country lots, on-lot agricultural areas and the Water Reclamation Facility. The previous plan basically discounted the potential for agricultural use of the site because the focus was primarily on the development of recreational components such as the golf course. With the availability of access roadways and irrigation supply and subsidized land costs, agricultural activities will become more feasible on this site and will be integrated into the residential area of the project.

A report on planned agricultural uses at Lihi Lani has been completed by several consultants and industry associates, and a copy of this report is included in Appendix A. The Conceptual Agricultural Plan is shown as Figure 2-2.

The preliminary plan is to develop agricultural easements on each of the 315 Country lots, encompassing over 45 acres of the property at full build-out of the property. Within this easement area, field stock nursery trees and fruit tree orchards (such as avocado) would be grown as crops. There are 50 to 75 different types of fieldstock ornamental landscape trees such as monkeypod, shower tree, and varieties of palms. The field stock trees grow to an adaptable size for transplanting in 5 to 7 years, and would be planted initially as lots are developed. Individual trees would be removed periodically from the easement areas as groups of trees are sold. Marketing for the operation would be conducted through a nursery or farm business which would lease initially land from Obayashi and later than the Homeowner's Association. Revenues from the program would be used to pay down a portion of the annual expenses for the maintenance of the roadways, water, drainage and wastewater systems.

Besides the Country lot agricultural areas (45 acres), other areas on the property would be used for agricultural purposes, including the Ranch (45 acres), mauka field stock tree area (17 acres), orchard (10 acres) and agroforestry area (47 acres). In total, approximately 164 acres of the property is planned to be used for agricultural purposes. Common areas including pasture and field stock trees will be irrigated with reclaimed water.

The agroforestry area would involve planting, maintenance and harvesting of a variety of timber products and hardwood trees. Many of these trees have a 10 to 20 year maturity cycle, which will require a long-term management program. In addition, about one-half of the Country lots will have gentle to moderately sloped land over most of the lot which will be available for a variety of agricultural uses. It is anticipated that many of the owners will follow the example of the small-scale operations in Pupukea Highlands, where owners are successfully raising fruits, flowers, foliage and vegetable crops on lots of one to two acres. There are both agricultural income and property tax reduction incentives available to such lot owners.

The Elderly Affordable Rental Housing project being developed by the City and County on the makai portion of the property will also include small individual garden plots for the residents. This program has been extremely successful for the residents of the City's Manoa Gardens elderly project, and will be implemented at the project on the Lihi Lani site.

C. Mitigative Measures

The emphasis of the project for agricultural uses is a significant positive impact on agriculture on the North Shore. Several mitigative measures are proposed for agriculture.

(1) **Clearing, Grading and Erosion Controls:** Areas to be developed for agricultural uses at Lihi Lani will be subject to the same careful design, construction and operation practices as the remainder of the project. The design of new agricultural areas will respect natural grades and follow Best Management Practices during construction to minimize erosion and silt runoff.

(2) **Fertilizer and Pesticides Use and IPM:** The agricultural areas at Lihi Lani will be under careful management by a land manager with extensive training in agricultural chemical use. Crops will generally use a minimum of fertilizers and pesticides. Field stock trees areas will require occasional pesticides treatment, mainly herbicide use to control needs. An Integrated Pest Management (IPM) program will be instituted to minimize pesticides use in agricultural areas at Lihi Lani.

4.5 GROUNDWATER RESOURCES

This section includes a discussion of the existing aquifer which underlies the site, the potential for deriving water supply from the aquifer, and the anticipated impacts that could result from the proposed project. Mitigative measures have also been recommended to minimize effects on groundwater.

A. Existing Conditions

Hydrogeological studies of the area and the previously proposed project was prepared by Mink (June 1988; December 1990), and additional studies have been completed by Tom Nance Water Resource Engineering (TNWRE, September 1993)(Appendix H). Water supply infrastructure for the region and the project has been addressed by Engineering Concepts, Inc. (September 1993) (Appendix D).

The project site is located in the northern sector of Oahu, which is underlied by the Kawailoa Aquifer System. This aquifer is unconfined and basal in the lavas of the Koolau Volcanic Series. The Kawailoa Aquifer System extends from the Anahulu River near Haleiwa to the Koolau rift zone at Waialee. The principal aquifer in the system is a thin basal lens of fresh to brackish water floating on sea water. This basal lens is the least robust in northern Oahu, having a hydraulic head of less than three feet at a distance of one to two miles from the coast. On the Waialua-side of the

Anahulu boundary the basal head is about 10 feet, while in the dike aquifers of the rift zone in Waialee it varies from 10 to 20 feet. The Pupukea-Paumalu basal lens is a thin aquifer of highly permeable Koolau basalt. The aquifer is open at the coast and consequently the lens discharges into the sea in a narrow band parallel to the coast. The hydraulic head and thickness of the lens is small because no effective caprock wedge exists to impede groundwater discharge.

The historical inventory of on-site wells is limited to a well and a test boring that were drilled on the Obayashi property in 1946 and 1956, respectively. Obayashi has since completed the installation and testing of two wells intended for non-potable irrigation water supply. At one time the Board of Water Supply (BWS) relied on a small pumping station at Sunset Beach for local water supply needs, located in lower Paumalu Valley just outside the Kahuku-side boundary of the property. These wells have not been actively used for the past 10 years, but are considered operable by the BWS. Sunset Beach residents are served with water from the BWS Wailee wells, located near Crawford Convalescent Home.

The top of the saturated aquifer is just above sea level, located a minimum of 400 feet and as much as 650 feet below the ground surface. Several feet of soil and subsoil constitute the surface, below which 25 to 100 feet of saprolite transitions into unaltered fresh Koolau basalt. The soil mantle is an effective medium for depleting biological constituents. The saprolite is thoroughly altered basalt in which most minerals have been hydrated and permeability elements destroyed by the expansion of rock mass, which is a very effective filter for removing particulate material escaping below the root zone. Percolate reaching the saturated aquifer in fresh basalt is clear of biological matter, but includes solutes such as nitrogen and chloride. Using available information, estimates of groundwater flow in this area range from 5.0 million gallons per day (MGD) (Mink,1988) and 6.35 MGD (TNWRE, 1993).

Two on-site irrigation brackish water source wells have been developed on the site. These wells were completed in 1989 under permits issued by DLNR, and each have capacity to pump up to 0.5 MGD. These wells have been temporarily capped, and are not in use.

Potable water supply for the Pupukea Highlands area is provided from BWS wells, tapping the Waialua aquifer. Water supply for the Pupukea Highlands area comes from the BWS wells at Waialua. The Waialua Aquifer is estimated to have a maximum sustainable yield of 40 MGD. Present allocations from this aquifer are 43.114 MGD, which exceeds current yield. Actual pumpage of the Waialua Aquifer is significantly less, and the over allocation on paper does not mean there is a current shortage of potable water from this system. Future use permits for the Waialua Aquifer will likely be accommodated by anticipated reductions in Waialua Sugar use. Aquifer capacity is present in the Kawailoa Aquifer system, north of Haleiwa, which the BWS is considering for additional potable water development in this region.

B. Potential Impacts

There are two possible effects on groundwater to consider with respect to the Lihi Lani project. First, the two existing on-site brackish wells will be utilized for irrigation. Withdrawals by these wells will cause the basal lens to adjust to pumping stress. Second, the fraction of the amount of water applied for irrigation which returns to the lens through deep percolation may pick up dissolved constituents which could affect the quality of the receiving groundwater.

The potential for the project to affect groundwater involves possible long-term impacts on both the quality and quantity of the resource. Extraction of potable water and irrigation water will both draw upon the existing and future quantity of the groundwater source for the area. Considerations for groundwater quality relating to this project include land application of fertilizers, treated wastewater effluent (reclaimed water), pesticides, and non-potable irrigation water; and other uses of chemicals on the land. Each of these potential impacts are discussed below.

Because the groundwater aquifer discharges into the nearshore ocean, potential impacts to groundwater quality must also be considered relative to the coastal marine environment, which is discussed in Section 4.8.

Potable Water Use Impacts: At full development, the project plans involve deriving approximately 245,000 gpd (0.245 MGD) of potable water through the existing BWS Pupukea-Waialua Water System and the Sunset Beach - Kawela System. The Pupukea-Waialua system currently provides potable water to the Pupukea Highlands area and the North Shore on the Haleiwa-side of Puula Road. As of 1990, water use was 2.37 MGD, with future commitments up to a total of 2.94 MGD. The allotment for this region is 2.73 MGD, therefore, the BWS allocation has been exceeded. Permission for additional pump capacity and withdrawal of water from this system must be granted to allow future development in this region.

Water supply facilities existing in the area and proposed for development at the project are discussed in Sections 2.2 and 5.13, and in Appendix D.

Expected Irrigation Use: Three different sources of supply will be used for irrigation: (1) the on-site brackish wells; (2) reclaimed water from the project's water reclamation facility; and (3) BWS' potable system. A monthly irrigation water balance as noted by ITC Water Management (September 1993, Appendix E) anticipates a year-round average irrigation requirement of 2,980 gallons per day per irrigated acre. This requirement was applied to the project's land uses and acreages to arrive at total irrigation use rates. By these calculations, the two brackish wells would draw an average of 0.57 million gallons per day (MGD); all of the project's reclaimed water, amounting to 0.180 MGD, would be disposed of by irrigation reuse; and 0.094 MGD from the BWS system would be used for irrigation of landscape. The total of all three sources is 0.844 MGD.

Irrigation Return Flow and Net Draft From the Aquifer: Irrigation rates by ITC Water Management assumes that no percolation would occur since irrigation application is assumed to exactly match plant uptake. In actuality, irrigation water is applied imperfectly and deep percolation does occur. Water balance computations in Giambelluca (1986) suggest that for low density development, such as proposed for Lihi Lani, recharge would be increased by development over natural conditions due to irrigation return. The change would be from an overall average of 13 inches to about 18 to 20 inches per year. Over the 480-acre area (maximum) to be developed, this would amount to a net increase in recharge of 0.21 MGD. Since a total of 0.844 MGD is estimated as the average irrigation rate, the computed percolation rate amounts to 25 percent of applied irrigation water, which is a reasonable approximation (TNWRE, September 1993).

The net draft from the aquifer would be 0.36, calculated as the difference between 0.57 MGD to be pumped from the two on-site wells and the expected increase in percolation of 0.21 MGD. The natural groundwater flow beneath the site is estimated to be 5 MGD in Mink (1988) and 6.35 in TNWRE (September 1993). The computed net draft rate would amount to 5 to 7 percent of this natural flow.

Fertilizer Application: When soluble nitrogen fertilizers are carefully applied, approximately 90 to 95 percent of the nitrogen is used by the plants. If only soluble nitrogen fertilizers are used at Lihi Lani, approximately 5 to 10 percent of the soluble fertilizer nitrogen could potentially leach below the root zone of plants, and eventually enter groundwater. Agriculture and common areas will primarily utilize slow-release nitrogen fertilizers instead of soluble nitrogen fertilizers, since they cause significantly less leaching of nitrogen below the soil profile. The use of the slow-release nitrogen fertilizers generally in place of soluble nitrogen fertilizers will reduce the loss of nitrogen through the soil profile to 1.5 percent. Soluble nitrogen forms will be used periodically in low growth periods, but only in small quantities that will be utilized almost completely by plants and the soil ecology.

The land uses involving fertilizer application will be developed on lands which range in elevation from approximately 450 to 750 feet above the basal aquifer. The vertical distance between the point of nitrogen application and the basal aquifer will allow for further dilution of nitrogen leaching below the root zone. Once contacting the aquifer, nitrogen dilution effects will again be substantial, considering the expansive volume of the underlying aquifer. As described earlier, groundwater concentrations in other Oahu aquifers have shown minimal degradation by fertilizer nitrogen application on agricultural lands. The quality and quantity of nitrate infiltration from the proposed land uses involving fertilizer application is not expected to degrade the basal aquifer.

Phosphorus will also be applied in the fertilizer mix. Unlike nitrogen, phosphorus generally becomes fixed to soil particles and is not expected to infiltrate to groundwater.

Reclaimed Water Application: A study of wastewater treatment and disposal for Lihi Lani has been prepared by Engineering Concepts, Inc. (September 1993) (Appendix C). At full development the proposed development is expected to generate approximately 180,000 gallons per day of wastewater, all of it classified as domestic. The wastewater will be treated by facultative stabilization ponds and marshes, which is a natural wastewater treatment system designed with assistance by Dr. Robert Gearheart of Humbolt State University, Arcata, CA. Marsh technology has been proven by Dr. Gearheart to be an effective method for treatment of domestic wastewater which is environmentally sensitive. This treatment will provide wastewater treatment at an advanced secondary level, to be followed by filtration and ultraviolet light disinfection.

The resulting reclaimed water will meet the highest quality criteria established by the Department of Health for R-1 Reclaimed Water. Reclaimed water will have the following characteristics: BOD - 2 to 5 milligrams per liter (mg/l); total suspended solids - 2 to 5 mg/l; nitrogen - less than 10 mg/l; phosophorus - 8 to 10 mg/l; and total coliforms - less than 1 per 100 milliliters (ml). Adequate disinfection will also insure that coliform counts do not exceed 4 per 100 ml in any sample. These levels are acceptable for advanced secondary treated effluent according to proposed Hawaii Administration Rules, Title 11, Department of Health, Chapter 62, Wastewater Systems.

Application of the reclaimed water to agricultural areas at Lihi Lani is regulated by the Department of Health, following the latest version of the Proposed Guidelines for the Treatment and Reuse of Reclaimed Water (Draft No. 7, 20 May 1993). Local disposal of the secondary treated effluent is technically possible by means of injection wells, land spreading, infiltration ponds, and land irrigation. Most of the project site lies inland of the Board of Water Supply "pass/ no-pass" line (which extends roughly along the base of the bluff), mauka of which injection wells and infiltration ponds are not permitted except by variance.

The most environmentally sensitive method of disposal of the reclaimed water is through land irrigation. This is a proven technique of effluent disposal in Hawaii, and its practicality has been demonstrated by field investigations conducted by the Water Resources Research Center of the University of Hawaii. Tests showed that percolate from irrigation water consisting of secondary effluent does not carry bacteria or viruses through the soil mantle. Carefully managed irrigation applications at the project will minimize infiltration of nitrates and other nutrients. In addition, use of reclaimed water will allow for conservation of groundwater resources which would otherwise be pumped to supply this portion of the irrigation needs of the project.

Phosphorus removal in wetland systems is not effective because of the limited contact opportunities between wastewater and the soil. When applied to plants and the ground surface, phosphorus tends to strongly fix itself to the soil particles. Because of the natural affinity for fixation and the small amounts involved, virtually no quantity of phosphorus is expected to infiltrate into the groundwater.

The presence of bacteria and viruses will be within allowable limits and will not reach the aquifers. Bacteria and viruses will essentially be removed from treated effluent during the final treatment steps through ultraviolet light disinfection. The remaining bacteria and viruses will generally be removed in contact with organic material and particles in the soil profile. The saprolite layer is a very effective filter that removes any particulate matter and biological material which may have escaped below the root zone.

Domestic wastewater does not normally contain concentrations of heavy metals and other contaminants in excess of EPA limits. Any heavy metals included in wastewater at the project are expected to be effectively captured in facultative pond/marsh treatment of effluent.

To minimize the possibility that return irrigation could have an effect on groundwater quality, effluent irrigation will be restricted to the agriculture areas which are most distant from the BWS Sunset Beach wells. The normal flow path of groundwater beneath the agriculture area is directly toward the coast. None of the water percolating from the effluent irrigated area would be expected to be pumped by the BWS Sunset Beach wells, if they were operating.

Pesticide Application: Pesticide is a loosely used term for chemical applied to control either pest insects or diseases of turfgrass and landscaping vegetation. Pesticides consist of herbicides (weed killer), insecticides (insect killer) and fungicides (fungus killer). Small amounts of these chemicals will be required to maintain agricultural lands, and to maintain landscaped vegetation in common areas and on private residential lots. The amount and frequency of pesticide use, and the types of chemicals used to control pests, are the concerns for potential impacts to groundwater quality in the aquifer underlying the proposed project. Pesticides applications are expected to be minimal and infrequent over both the agricultural and residential areas.

The approach to the controlled use of pesticides at Lihi Lani will involve a technique developed and utilized extensively in agriculture called Integrated Pest Management (IPM). IPM programs have been developed in the past by the agriculture industry for specific crops as a means to control waste and costs through unnecessary or excessive pesticide usage. The control of pesticide overuse is a major concern for the natural and human environment, to minimize the potential for pesticides entering surface water, groundwater and the air. The goal of the IPM program will be to use cultural, chemical and biological control measures to suppress pest populations to levels at or below the aesthetic or economic threshold which is set. The health of the plant is critical in keeping the pest populations down, and minimizing the need to apply pesticides. IPM does not eliminate the use of pesticides, rather it creates a high level of management and control over the use of pesticides, which results in less overall use of pesticides.

Different types of IPM programs have been instituted successfully at agricultural and golf course developments throughout the United States and also in Europe and Japan. Mitchell and Murdoch (December 1990) have developed a detailed Integrated Pest Management Program for the previously planned Lihi Lani Golf Course, including the Final EIS (Group 70, April 1991). Information from this report will be used in developing an IPM program for the agricultural and common areas of the current Lihi Lani project, with expanded data for the specific crops to be established.

Implementation of the IPM program at Lihi Lani is expected to result in a reduction of total pesticide usage as much as 30 to 40 percent, as compared to typical usage patterns on agriculture and landscaped areas. The reduced pesticide use, included with other control measures discussed later in this section, will greatly reduce the potential impact of pesticides affecting the quality of the groundwater aquifer below the site.

IPM involves extensive knowledge about the management of healthy plants, and the potential pests and diseases of the crop being cultivated. The keys to successful implementation of an IPM program are the experience and thoroughness of the management staff. Knowledge of the types of pests and diseases experienced at Lihi Lani will be crucial in identifying problems early before they become widespread. The frequency and area of pesticide applications are carefully controlled in this manner, and the result is an overall lower use of pesticides. The management staff must maintain the plants in healthy condition and monitor them constantly, identifying pest problems immediately and apply pesticides in a carefully controlled manner.

Pesticides will be applied in carefully controlled quantities, only as required, following the planned IPM program which will use pesticides less frequently and in less quantities than has traditionally occurred. The chemicals used will only be those approved for application in Hawaii, regulated by the U. S. Environmental Protection Agency and the State of Hawaii Department of Agriculture.

Many of the pesticides proposed for use are highly sorbed to organic matter in the turf and the high organic content soils which are found on the project site. Soils rich in organic matter will be utilized in sections of the property where organic content may be low, such as steep areas. Several feet of soil and subsoil constitute the surface, below which 25 to 100 feet of saprolite transitions into unaltered fresh Koolau basalt. No measurable amounts of the pesticide compounds are expected to be detected in groundwater as a result of management activities at Lihi Lani.

Studies conducted throughout the U. S. in much more permeable soil profiles than the Lihi Lani site show that very little of the applied chemicals passes below the soil profile and reaches the groundwater aquifer (Cape Cod; Cohen, 1988). Groundwater quality will not be adversely affected as a result of pesticides application at this project.

Pesticides use as proposed for the project is not expected to degrade the quality of the groundwater aquifer at the site due to: (1) the IPM measures taken to reduce and control pesticides application, (2) the capacity of on-site soils to uptake chemicals, (3) breakdown of chemicals in surface waters exposed to sunlight, and volatilization, (4) depth to groundwater and the dilution of leached liquid in its travel to the aquifer, and (5) the dilution capacity of the aquifer. Recharge water may contain residues of pesticides if these chemicals are improperly used, but by limiting pesticide types to those that break down during soil and saprolite passage, and controlling their application, the quantities reaching groundwater are expected to be non-detectable.

Change in Groundwater Quality: Water quality effects to consider are potential salinity intrusion caused by pumping of the two on-site wells and potential effects of percolating irrigation return water. Based on the computer modeling reported in TNWRE (September 1993), pumping the on-site wells at a combined total of 0.57 MGD is unlikely to cause salinity intrusion. A drop of water level on the order of 0.2 feet in the immediate vicinity of the wells is likely. At moderate distances away from the wells, however, the water level decline would be insignificant.

Constituents present in sufficient concentration in the irrigation return flow to effect the basal lens are chlorides and nitrate nitrogen. Potential impacts can be illustrated with mass balance calculations. Although lysimeter studies (Ekern et al., 1974; Handley and Ekern, 1981; and Lau et al., 1989) have generally shown modest to no increase in chlorides in leachate and effective uptake of nitrogen, significant increases in both of these constituents were assumed by TNWRE (September 1993) for purposes of illustration. Mass balance calculations for Lihi Lani were made two ways: mixing the percolate throughout the lens and mixing it only into the upper half. Reference values were based on pump tests and grab samples from the on-site wells.

Only moderate changes to chlorides and nitrates in the receiving groundwater were computed by TNWRE (September 1993). Results of the analysis showed a 1.2 to 8.0 percent increase in chlorides concentration, and a 7.1 to 15.7 percent increase in nitrate nitrogen concentration. Resulting groundwater concentrations for these parameters would be well below State drinking water quality criteria levels. It is reasonable to conclude that the impact to groundwater quality would be negligible.

C. Mitigative Measures

Several mitigative measures are recommended to minimize the potential for adverse effects on the quantity and quality of groundwater resources.

(1) Seasonality of Precipitation: Rainfall varies over the year at Pupukea, with wetter months being during the winter. Irrigation water demand from the on-site wells will typically be near it's estimated maximum during the summer months. Very little irrigation will be required during the wetter seasons. Pumping requirements stated earlier are calculated based on the maximum requirements for the agricultural areas, common areas and Country lots.

(2) Potable Water Conservation Practices: Extensive water conservation practices will be employed at Lihi Lani to reduce the requirement for potable water. Private residential lots will be required to install typical water conservation items such as low-flush toilets. Potable water will be conserved by the use of non-potable water for irrigation of the agricultural areas, common areas and residential lots. Country lots will have dual water systems, with irrigation systems installed for the non-potable irrigation water. This measure will reduce the potential maximum potable water requirement as much as 126,000 gpd for the Country lots alone.

(3) Xeriscape Plantings: Conservation of non-potable water will be accomplished by implementing a xeriscape plan for the landscape planting design and maintenance of common areas and private residential lots. Xeriscape is a method of landscape planting which uses plants which require less water than traditional landscape plantings. A xeriscape plan prepared for Lihi Lani (Weissich, 1990) which identifies the vegetation types which will be used in the landscaping of common areas, and Country lots. The xeriscape plan is expected to reduce non-potable water consumption by as much as 50 percent in these areas, as compared to standard landscaping irrigation water requirements.

(4) Irrigation Water Control: Irrigation water use will be strictly controlled to amounts that are necessary to maintain the agricultural areas and the common landscaped areas. Excess irrigation is never desirable because of the waste and extra costs created by pumping of water. Excess irrigation could also cause undesired "washing out" of fertilizer and pesticide below the intended turf root zone, as well as the potential degradation of groundwater quality by leached chemicals.

(5) Integrated Pest Management (IPM) Program: An IPM program will be instituted to minimize the frequency and amounts of pesticides being applied at the agricultural areas and common areas. The types of chemicals being utilized for treatments will be the lowest possible, in terms of toxicity and their persistence and mobility, and total amounts applied. When compared to traditional pesticides application rates, IPM programs typically reduce total pesticide usage from 35 to 50 percent. The reduction of the total amounts of pesticides being used will reduce the potential for their release to the groundwater and environment outside the property. Fertilizer and pesticides will also be applied under the supervision of the grounds manager, who will strictly control the amounts following the IPM program and avoid over-application.

(6) Management of Chemical Storage and Use: The maintenance area is the point on the site where the greatest quantities of toxic chemicals will reside. It is planned to contain the entire maintenance area within a chemical control area, where impermeable collection surfaces would be installed. Activities in and around buildings and maintenance areas will be prevented from releasing chemicals into the ground by accident. Mixing and storage areas for pesticides, fuel storage and loading areas, equipment maintenance areas, equipment washing areas and areas storing chemicals associated with maintenance would all be included in this chemical control area.

(7) Land Application of Reclaimed Water: As described earlier, reclaimed water will be disposed through dilution with irrigation water and application to the agricultural area. Nitrogen compound contributions to groundwater will be minimal under this method of wastewater disposal. Caution will be used in the irrigation scheduling to avoid over-irrigation, and this will minimize the infiltration of nitrate and other nutrients and allow their uptake by plants. Irrigation areas in the central and mauka portions of the property are planned to avoid potential adverse effects upon the BWS Sunset Beach Well.

(8) Slow-Release Nitrogen Fertilizer Use: Lihi Lani will utilize slow-release fertilizers on the agricultural areas, landscaped common areas and require its use on residential lots. The overall effect on groundwater quality in the aquifer underlying the project site due to nitrogen application is expected to be minimal because of slow-release nitrogen fertilizer use and aquifer dilution effects. A study by Brown et al. (1982) on highly porous sand golf greens in Texas compared the amount of nitrogen lost by leaching from various nitrogen sources, using liberal irrigation rates to encourage leaching. Results of their study over a five month period showed leaching of approximately 23 percent of nitrogen when applied as soluble nitrogen. Application of slow-release nitrogen fertilizers, which are commonly available and effective in use in agriculture and landscaping, showed only 1.5 percent nitrogen leaching. The use of the slow-release nitrogen fertilizers in place of soluble nitrogen fertilizers will reduce the loss of nitrogen through the soil profile to 1.5 percent.

(9) Groundwater Monitoring Program: As a precautionary measure to protect against adverse effects to groundwater quality, the State of Hawaii Department of Health reuse guidelines currently require all new water reclamation projects to conduct groundwater monitoring down-gradient of new projects. Obayashi will install and maintain monitoring devices (wells or lysimeters) as required by the State DOH in implementing the water reclamation program. The existing on-site brackish wells could also act as monitoring wells for the water reclamation areas. Existing groundwater quality measurements must be undertaken to determine background levels prior to operation. Periodic testing of groundwater samples will be undertaken to assess the quality of the groundwater aquifer. Should adverse parameter levels be detected in groundwater which are a result of the project operations, measures will be taken immediately to eliminate the source of the contaminants. The monitoring wells will provide an ultimate test of the effectiveness of the nitrate and chemical control programs instituted at Lihi Lani.

4.6 STORMWATER RUNOFF AND DRAINAGE

Drainage conditions within the project site, and potential project impacts on drainage, were evaluated by Engineering Concepts, Inc. (September 1993)(Appendix

F) and Tom Nance Water Resources Engineering (September 1993)(Appendix H). Their findings are summarized below.

A. Existing Conditions

The site spans three watersheds: the Paumalu Stream watershed, the Pakulena Stream watershed, and the Kalunawaikaala Stream watershed (Figure 4-5). A small, makai portion drains the bluff and coastal area, covering approximately 168 acres and has no connection to the ocean.

The Paumalu Stream watershed is the largest of the three watersheds affected by the project. It encompasses approximately 1,970 acres and stretches almost 3.5 miles inland from Kamehameha Highway to Pupukea-Paumalu Ridge. The Paumalu Stream watershed contains three sub-watersheds; Aimuu Gulch, Paumalu Stream and Kaleleiki Stream, none of which are perennial.

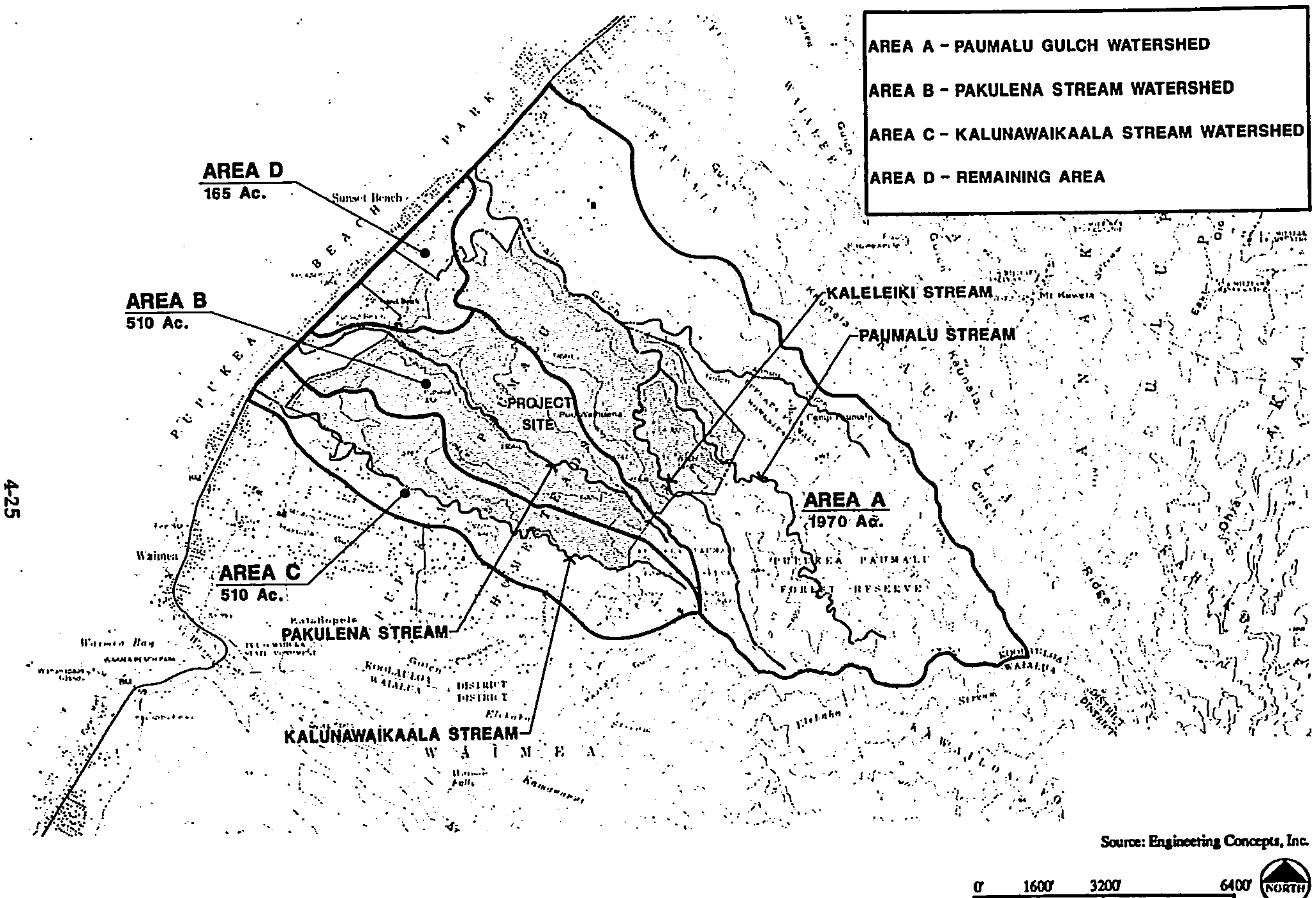
The Pakulena Stream watershed covers approximately 510 acres, most of which fall within the project site. The Pakulena Stream watershed extends approximately two miles inland from Kamehameha Highway at an elevation of 960 feet above sea level (Boy Scouts Camp Pupukea).

The third watershed, Kalunawaikaala Stream watershed, also covers an area of approximately 510 acres. Portions of the Sunset Hills and Pupukea Highlands subdivisions fall within this watershed. The Kalunawaikaala Stream watershed converges with the Pakulena Stream watershed approximately two miles inland from Kamehameha Highway.

The three watersheds are characterized by steep gulches bordering relatively flat to rolling plateaus. The plateaus are covered with tall grasses, scrub brush, and trees, with the gulches having generally dense tree cover and moderately thick underbrush.

Currently, there are no drainage improvements on the site. Runoff flows overland to the three gulches and is conveyed to existing culverts at Kamehameha Highway. The culvert serving the Paumalu Stream is located approximately 3,200 ft. from the Kahuku-side boundary of the site fronting Kamehameha Highway. Culverts serving the Pakulena Stream and the Kalunawaikaala Stream are located, approximately 2,200 ft. and 3,800 ft. respectively, from the Haleiwa-side boundary of this area. The runoff from the makai section flows overland, collecting on the property in the lowlands along the mauka side of Kamehameha Highway.

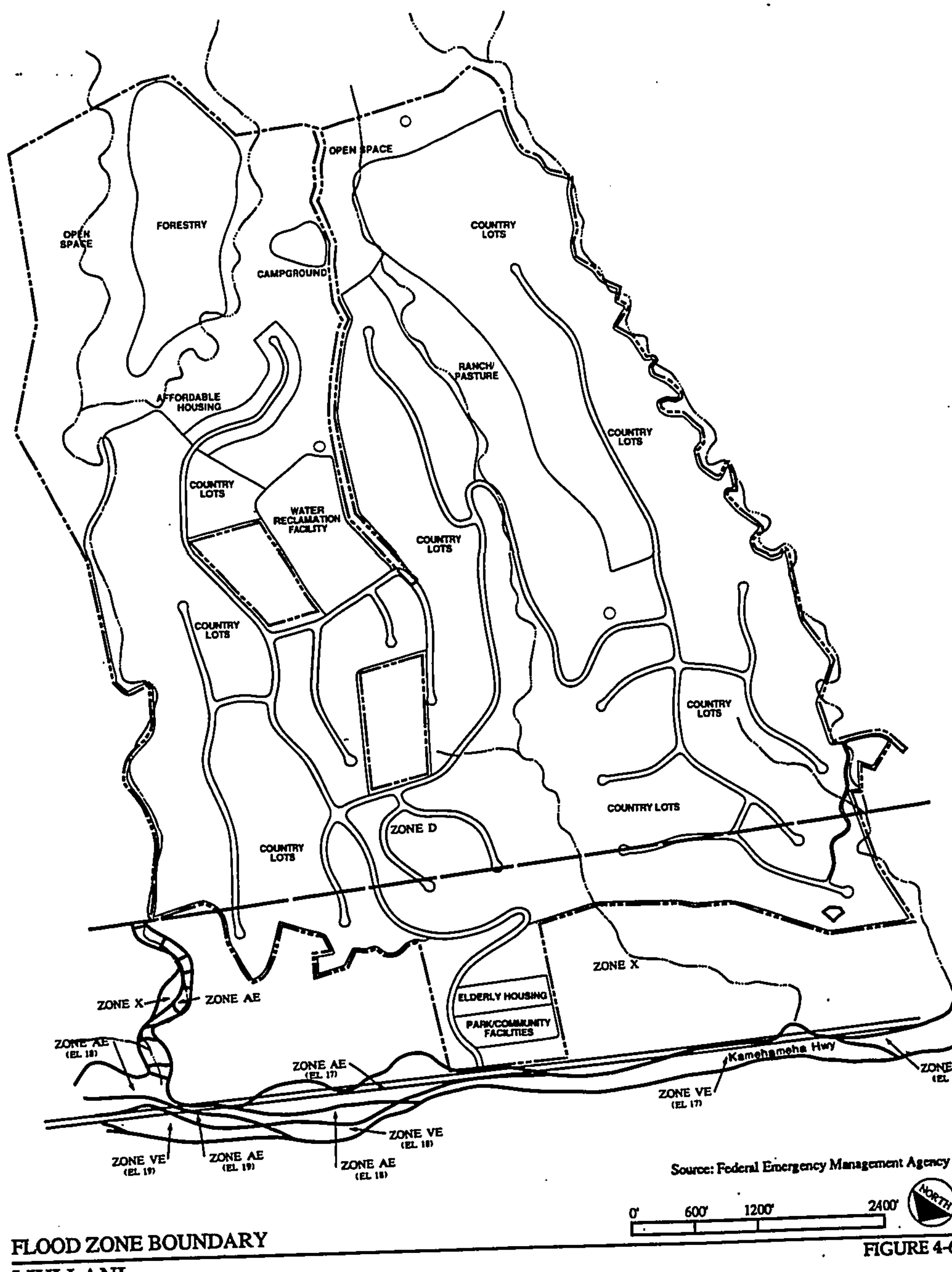
Flooding of the Sunset Beach area is known to occur during heavy rains. Much of the flooding can be attributed to the many sump areas along Kamehameha Highway between the Paumalu Stream and Pakulena Stream crossings. A flood insurance study for the City and County of Honolulu was prepared by the US Army Corps of Engineers in 1980 (Figure 4-6). This report included the Sunset Beach area and mentioned that the principal flood problem in the area is the lack of defined streams



WATERSHED BOUNDARIES

LIHI LANI

FIGURE 4-5



Source: Federal Emergency Management Agency

FLOOD ZONE BOUNDARY
LIHI LANI

FIGURE 4-6

adequate to convey storm runoff to the oceans. The report further mentions that flooding in the lower flat lands is due to the lack of adequate drainage systems and local depressions. Obstruction of the stream crossings at Kamehameha Highway may also contribute to the flooding of the area. The culverts were observed to be clogged with sand, rubbish, and vegetation, with the channels to the ocean filled with sand to the point of being barely discernible.

A recent study by the State Department of Land and Natural Resources (1992) entitled "A Study to Alleviate Chronic Flooding on Oahu's North Shore" addresses flooding in the low areas of Sunset Beach, and makes recommendations for remedial actions in these areas. One problem area is the flooding of Kamehameha Highway at the soccer field adjacent to Sunset Beach Elementary School. This project is expected to undergo construction by the State Department of Transportation.

Storm water volumes generated on the property under existing conditions (1993) are shown in Table 4-2.

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map, portions of Zone "X" and "D" fall within the project boundaries. Zone "X" refers to areas outside of the 500-year flood plain; Zone "D" refers to areas in which flood hazards are undetermined. There was a floodway study performed for Paumalu Stream, which terminates makai of the Obayashi property. Refer to Section 4.9, Natural Hazards, for additional discussion of potential flooding.

B. <u>Potential Impacts</u>

The Lihi Lani Master Plan shows approximately 900 acres in various land use designations, however, it is estimated that between 400 and 480 acres of the site would be affected by construction activities over the four phases of development. After full build-out, a total of 640 to 720 acres of the property will essentially be unaffected by construction activities.

It is assumed for this analysis that substantial clearing and grubbing of vegetation and grading would occur primarily in the first phase and especially in the first year of infrastructure development. This includes the construction of the access and main internal roadways and the water reclamation facility. Thereafter, grading, clearing and activities will be substantially reduced over the next ten years. Selective clearing and grading of this area is anticipated, which will allow for portions of this land to remain in natural vegetation. Much of the remaining undisturbed area consists of steep terrain along the slopes of the gulches and buffer strips separating the residences and other project elements. Drainage patterns are expected to remain similar to existing conditions, although some diversion of runoff is planned through detention basins in strategic locations throughout the site. The natural slopes and vegetation of areas unaffected by the construction of improvements will be retained.

TABLE 4-2

Comparison of Runoff Volumes for Existing and Developed Conditions

Basin	Developed Site Detention Storage (Acre-Feet)	RUNOFF VOLUMES 2-Year, 24 Hour Storm		RUNOFF VOLUMES 10-Year, 24-Hour Storm		RUNOFF VOLUMES 100-Year, 24-Hour Storm	
		Existing (Acre-Feet)	Developed (Acre-Feet)	Existing (Acre-Feet)	Developed (Acre-Feet)	Existing (Acre-Feet)	Developed (Acre-Feet)
Paumalu	58.2	166.20	153.39	521.36	496.76	1087.95	1060.28
Pakulena	62.0	59.94	37.93	165.54	136.33	323.21	302.96
Kalunawaikaala	17.4	68.34	65.31	179.22	171.78	342.52	332.68
Bluffs and Lowlands	24.3	9.66	0.00	25.27	8.14	48.57	28.63
TOTALS	**161.90**	**304.14**	**256.63**	**891.39**	**813.01**	**1802.25**	**1724.55**

Source: Tom Nance Water Resource Engineering (September 1993)

The proposed development will increase the quantity of peak runoff generated to various degrees, depending on storm conditions. Changes in land surface types will be made by the construction of impervious surfaces such as roads and buildings.

At higher rainfall intensities and durations, the difference between existing and developed conditions decreases, because soil saturation increases, and more runoff occurs regardless of the degree of development. For the 100-yr., 24-hr. storm, which was the greatest calculated incremental storm water runoff volume, the difference between existing conditions and the developed project is approximately four percent.

The runoff values presented (acre-ft./event) represent a volume of water and should not be confused with peak discharge rates, which represent the maximum volume of storm water runoff discharge per unit of time (e.g. cubic feet per second or million gallons per day). Peak discharge rates are required for engineering design of proposed drainage facilities and ascertaining the capacity of existing facilities, while total runoff provides a more realistic estimate of impact on water quality. Peak discharge rates will be calculated during the engineering design of grading and drainage plans for the areas to be altered for construction of the project's facilities. These rates will be calculated using City and County of Honolulu Drainage Standards.

As compared to existing conditions, the developed condition will create the same or less runoff volume and the same or less runoff rates to the affected watersheds. This is due primarily to the extensive detention features to be installed throughout the project. Approximately 162 acre-feet of storage will be created over 40 different detention basins. This commitment to reduce runoff rates and volumes from the site goes far beyond the standard required level of stormwater control. Not only will the rate of runoff from the developed project be the same or less than existing conditions, the volume of runoff will also be decreased through recharge and percolation in the holding ponds. Figure 4-5 shows the layout of the detention basins planned for the proposed project.

With respect to flooding, the proposed development lies outside flood hazard areas, as defined by the FEMA Flood Insurance Rate Maps. Also refer to Section 4.9 Natural Hazards for further discussion of flooding.

C. Mitigative Measures

Several measures will be implemented to insure the public safety at on-site and off-site areas with respect to runoff volume, off-site flow and its constituents. These measures are discussed as follows.

(1) Detention Ponds: The extensive open nature of the proposed development will allow the incorporation of detention basins and other mitigative measures into the project design, such that both on-site and off-site drainage impacts will be minimal. Specific measures will be taken to ensure that the maximum storm water volumes and flow rates in the intermittent streams crossing the site will be similar to or less than the volumes and rates which occur without the project. This will be possible through the 162 acre-feet of storage provided at 40 detention basins on the site, shown in Figure 4-7.

The on-site increase in runoff will result from the development of homes, roadways and other impervious surfaces. For many of the residential lots, and for major roadway sections, storm runoff will be routed through the detention basins sited in low areas to dampen the runoff rate.

Most of the remaining lots are steeply sloping over most of the area, with runoff sheet flowing to the three intermittent streams. The dense natural vegetation on these steep areas will be retained, and will continue to dampen the runoff intensity.

(2) Flow Rate/Erosion Controls: Because of the detention ponds, the runoff flow rate will be controlled and flow will be routed through swales at many locations. As a result, erosion in the intermittent stream gulches will be reduced from existing conditions. An approved Erosion Control Plan is required prior to commencement of construction from the Department of Public Works. Measures mentioned in Section 4.3 on soils erosion controls and runoff mitigation will be instituted, including applicable measures from EPA/NOAA (January 1993).

(3) Detention Basins and Recharge Basins Along Kamehameha Highway: Detention basins and recharge basins will be provided on the makai area fronting Kamehameha Highway, in order to mitigate the increase in peak runoff flows resulting from the construction of the access road to the project. Recharge basins are planned, similar to those installed along Ke Nui Road, to aid in dissipation of ponded runoff. The basin will be sized to contain approximately six acre-feet, which will ensure that the construction of the roadway and any other improvements on the site will not increase flooding problems on surrounding properties. The system will be capable of containing runoff from the 100-year design storm. Obayashi will comply with Department of Health Administrative Rules, Chapter 11-23, "Underground Injection Control" which requires UIC permits for the construction and operation of all injection wells.

(4) Construction Schedule and Phasing: Obayashi will endeavor to schedule the year long road construction periods to coincide with the lower precipitation periods. Phasing of the build-out of Lihi Lani to two years of infrastructure construction and four residential build-out phases will slowly implement the planned reduction in runoff from the site.

4.7 SURFACE WATER QUALITY

An evaluation of surface water quality conditions and the potential effects of development and operation of Lihi Lani was completed by Tom Nance Water Resource Engineering (TNWRE) (September 1993). The complete report is included in Appendix H.

DRAINAGE SUB-BASIN AREAS

LIHI LANI

FIGURE 4-7

A. <u>Existing Conditions</u>

Surface water bodies exist on the site as intermittent streams which flow during high precipitation periods. As shown in Figure 4-5, three intermittent streams extend through the lowland gulches. No perennial streams, ponds or lakes are found in the property.

Paumalu Stream is found in the gulch which forms the Kahuku-side boundary. Paumalu Stream is the largest of the three on-site intermittent streams, and it collects drainage from a tributary called Kaleleiki Stream (Figure 4-5). These two streams merge near the Kahuku-side boundary. Paumalu Stream passes through lowlands makai of the bluff, then under Kamehameha Highway (bridge), and discharges into the ocean at Sunset Beach.

Pakulena Stream extends across the center of the site through a lowlands valley between the two major plateau areas. This intermittent stream discharges into the lowlands makai of the bluff. During high precipitation periods, the lowland areas collect excess flows and the stream passes through a culvert underneath Kamehameha Highway, and discharges into the ocean south of Ehukai Beach Park.

Kalunawaikaala Stream is located in the lowland valley which forms the Haleiwa-side boundary. This intermittent stream extends across the lowlands makai of the site (off-site), crosses under Kamehameha Highway through a culvert and discharges onto the ocean at Ke Waena Beach.

The bluff and lowlands area of the property drain toward Kamehameha Highway. There is no connection from this drainage basin to the ocean and collected runoff dissipates through percolation into the ground.

There are no standing surface water bodies which regularly exist on the site. The source for any intermittent surface waters is primarily overland runoff that occurs during high precipitation periods. Runoff is contributed to these streams by the small watershed areas of the surrounding valleys. The groundwater contribution to the intermittent streams is negligible, as discussed earlier in Section 4.5.

The only major surface water bodies in proximity to the site include the Kamananui Stream/Waimea River located approximately two miles to the south, and the Pacific Ocean, located across Kamehameha Highway.

In 1993, water quality data was obtained at Paumalu Stream (near bridge) which is one of the intermittent streams that pass through the project. Additional runoff samples were collected from drainage facilities along roadways at the lower area of Pupukea Highlands to provide examples of runoff water quality from an existing Country lot area. Data for nutrients and suspended solids were obtained from these samples (Appendix H).

B. Potential Impacts

Potential impacts to the intermittent streams and surface water quality on-site and off (downstream), include both short-term, construction-related effects and long-term, operation-related effects.

Long-term operational activities are not expected to create significant adverse effects, primarily due to the 162-acre-feet of runoff storage capacity at 40 detention basins on-site. The commitment by Obayashi to provide this level of stormwater runoff control is unprecedented in this type of development. Creation of this stormwater control system will be accomplished at significantly greater expense to the developer. These basins will decrease the peak flow rate and volume of runoff during storm events. A corresponding improvement in water quality through a reduction in silt runoff will result from this very extensive drainage control system.

Activities which may create the environmental concerns with regard to surface water quality and quantity include: the application of pesticides and fertilizers; irrigation disposal of treated effluent; suspended sediments contained in storm water runoff; and the potential reduction in intermittent stream flow due to ground water withdrawals. These concerns are all addressed below. Tom Nance Water Resource Engineering (September 1993) completed a study of the potential sediment and nutrient loads into intermittent streams crossing the site. Nutrient and sediment concentrations for pre-development and post-development conditions are shown in Table 4-3, and discussed in the paragraphs that follow.

Modification of Stream Channels: Development of the project site as proposed will involve some modification of the channels of intermittent streams on-site for roadway construction and drainage improvements. Pakulena Stream will be crossed by the circulation roadway at the center of the site. The channel of this intermittent stream will be connected by a culvert under the roadway. A small branch of this stream will also be crossed by the roadway passing near an existing State Water Reserve parcel. A short branch of the Kalunawaikaala Stream will also be connected by a culvert where the stream will be crossed by the emergency/utility access road, connecting to Wilinau Road.

Short-term construction-related effects on intermittent streams and surface water quality include erosion and sedimentation due to construction area runoff, stream channel modifications for roadway construction, and the installation of culverts and retaining walls. The site will be cleared of vegetation over approximately 400+ acres. Detention basins developed for each phase of construction will serve to control suspended sediment loss.

Stream channel modifications will disturb the soils and rock lining the channel, causing the potential for added short-term water quality impacts from suspended sediments. Only small sections (up to 100 feet) of the intermittent streams channels are expected to be modified by the work, and the operations could be completed in a relatively short time period (four to six weeks).

TABLE 4-3

**Computed Nitrogen, Phosphorus and Suspended Solid Volumes
2-Year, 24-Hour Storm Event**

Basin	Runoff Volume (acre-feet)		Total Nitrogen (pounds)		Total Phosphorus (pounds)		Suspended Solids (tons)	
	Existing	Developed	Existing	Developed	Existing	Developed	Existing	Developed
Paumalu	166.2	153.4	406.6	364.4	40.7	40.4	203.3	180.8
Pakulena	59.9	37.9	146.5	80.0	14.6	12.7	73.3	39.1
Kalunawaikaala	68.3	65.3	167.1	152.3	16.7	17.9	83.5	76.6
Bluffs/Lowlands(1)	9.7	0.0	23.7	0.0	2.4	0.0	11.9	0.0

(1) No off-site runoff from this basin during 2-year, 24-hour storm event

Source: Tom Nance Water Resources Engineering (September 1993)

Fertilizer and Pesticides Applications: The development and maintenance of the property will require application of some fertilizers to supply essential nutrients to crops and ornamental plants. Pesticides will also be required in small quantities and infrequent applications to control the associated weed, disease and insect pests that affect grasses and plants. Fertilizer and pesticides applications are expected to be small quantities which will be closely controlled over the agricultural and commonareas. The large detention basin capacity on the property of 162 acre-feet at 40 basins will serve to trap and allow for natural uptake and degradation of fertilizers and pesticides in runoff.

Fertilizers may be subject to movement from the application point by runoff during high intensity storms, or by movement toward ground water. The primary fertilizer elements of concern for surface water quality are nitrogen and phosphorus. Under normal conditions of irrigation and precipitation, phosphorus attaches itself very tightly to iron and aluminum hydroxides which are plentiful in the soils. Phosphorus is expected to move little if any from the site of application. Under extreme storm conditions, where phosphorus may not penetrate the soil, the phosphorus concentration in runoff waters from the completed project could be several times higher than the concentration under existing conditions. This potential condition will be mitigated, however, because fertilizer applications would be timed to avoid severe weather conditions, otherwise the effectiveness of the application would be poor. In addition, routing of runoff through the detention basins and grassed swales will promote phosphorus removal by means of adsorption onto settled suspended solids, and an increase in contact with bare soil and/or nutrient uptake by vegetation in the drainage path.

The extensive system of detention basins will slowly release the collected storm water runoff to the intermittent streams, thus phosphorus is expected to accumulate within silt collected in these basins. Even if small amounts of phosphorus are carried in runoff waters, there should be no adverse effect on marine water quality (addressed in Section 4.8).

The fertilizer constituent of primary concern is nitrogen. Because of high nitrogen uptake by grasses, however, nitrogen will be used rapidly after application. Only under conditions where rainfall occurs soon after application of a soluble nitrogen source would there be excessive loss of nitrogen by surface runoff, or by leaching below the root zone. This nitrogen movement will be controlled at Lihi Lani by applying a slow-release nitrogen fertilizer. Runoff will be routed through the extensive detention basin system, waste areas and grassy swales, which contain plants that will utilize much of the nitrogen.

Pesticides application, including herbicides, insecticides and fungicides, will be required in small amounts at the project. Of the three pesticides types, the most frequently used in Hawaii are herbicides. The herbicides used on the agricultural areas and common areas will primarily be MSMA and metribuzin. MSMA is tightly sorbed on soil colloids, and metribuzin, though quite mobile in soils, is readily degraded in surface soils.

The potential for surface waters to receive pesticides will be minimal because of measures being implemented at Lihi Lani to significantly reduce the frequency and amounts of pesticides applied through an Integrated Pest Management (IPM) program. Detention ponds, waste areas and grassy swales will act as sinks for runoff and cut the concentration of pesticides in runoff ultimately reaching the intermittent streams. As a result, pesticides usage is not expected to cause adverse surface water quality impacts in the intermittent streams or in the receiving waters of the ocean.

Suspended Sediments in Runoff: The construction period will have the greatest potential for generating suspended sediments in runoff from the project site. As described in Section 4.3, extensive measures will be implemented to minimize soil erosion from the construction site. The largest potential erosion and suspended sediment loss from the site could occur during one part of the largest development phase in Phase 1 (Engineering Concepts, Inc., September 1993). This is the period when the first roadways are being established. During the 10-year, 24-hour storm, there would be potential for a 14 percent increase in silt runoff from the property (Tom Nance Water Resource Engineering, September 1993). The division of the project into smaller phases will allow for greater control during construction, and tend to minimize erosion and soil loss. Subsequent development phases following Phase 1 would result in much lower potential silt runoff losses.

Once Lihi Lani is developed, the incremental load of suspended sediment in runoff from the project site is expected to decrease for all storms considered. In addition, the interspersion of developed areas among undeveloped areas should tend to notably decrease the suspended sediment loads flowing from the project site. As compared to existing conditions, the suspended sediment concentration in runoff waters during a 10-year storm (24-hour duration) from the three watersheds is expected to be 22 percent less than present levels as a result of the developed project.

Detention basins to be developed within the project will retain a large percentage of suspended sediments generated by runoff. Approximately 162 acre-feet of storage over 40 detention basins will provide tremendous sediment retention capacity. The provision of this retention capacity will create a dramatic improvement in project site runoff water quality.

Runoff waters entering the intermittent streams will also deposit sediment within the stream channels on-site or in the lowlands stream channel makai of the project. During peak runoff conditions, the intermittent streams will continue to discharge into the nearby Pacific Ocean, although the suspended sediments in the discharged runoff water are estimated to become significantly lower (22 percent) as a result of the project. The potential effects of the reduced suspended sediment load into coastal waters is addressed in Section 4.8.

C. Mitigative Measures

A number of measures will be implemented on the project site to minimize potential effects on water quality in the intermittent streams passing through the site.

(1) Erosion Controls: Measures are proposed to minimize the short-term impact of soil erosion on stream water quality and suspended sediment input. Soil erosion mitigation measures recommended by the U. S. Environmental Protection Agency (January 1993), State DOH, City and County, and SCS are included in Section 4.3. Under the County Grading Ordinance, clearing of vegetation can only be done on 15 contiguous acres at a time. Diversion ditches will be constructed to divert overland runoff into collection/detention areas on the project site. In addition, soil stockpiling will be conducted to contain excavated earth in controllable areas prior to its use elsewhere on the site. Expedient revegetation of exposed areas on the site will also minimize erosion of soils.

(2) Irrigation Management: Agricultural area and common area irrigation management is critical to minimizing fertilizer and pesticide impacts on surface waters. If excessive irrigation water is applied, the likelihood of nitrate movement in surface waters or movement to ground water is increased. A U.S. Weather Bureau Class A evaporation pan and computer irrigation management will be used to measure evaporation and properly schedule irrigation application. This will especially be followed for the reclaimed water use. Likewise, fertilizer application schedules will be timed so that heavy applications of soluble fertilizers are not applied during the rainy months of this area (October through January). Slow-release nitrogen fertilizers will be applied in most cases, and especially during the rainy season; these fertilizers release nitrogen at a rate comparable to the rate which is used by plants.

(3) Integrated Pest Management: An IPM program will be instituted to minimize the frequency and amounts of pesticides being applied. The types of chemicals being utilized for treatments will be the lowest possible, in terms of toxicity and their persistence and mobility. When compared to traditional pesticides application rates, IPM programs typically reduce total pesticide usage from 35 to 50 percent. The reduction of the total amounts of pesticides being used will minimize the potential for their release to the environment outside the property.

(4) Detention Ponds, Swales and Waste Areas: In combination with the measures being taken to reduce fertilizer and pesticides usage, sinks for runoff will be developed at detention ponds, waste areas and grassy swales. Each of these areas will increase the time that fertilizers and pesticides in runoff will be exposed to water, sunlight, soils, vegetation and organic material. The sink areas will allow for dilution, uptake and breakdown of the nutrients, chemicals and suspended sediments in runoff before water is released into the intermittent streams. Sink areas will greatly minimize the potential for adding contaminants into the intermittent stream water and the nearshore ocean.

(5) Certification for Pesticides Management: A well-qualified grounds manager will be responsible for managing the agricultural and common areas of the project. Mitigative measures proposed above are also based on sound management practices that will be followed with regard to fertilizer and pesticide application and irrigation. The grounds manager will be thoroughly trained and experienced in the implementation of the IPM program and the management of chemicals on the site.

(6) Animal Wastes - Best Management Practices: The project will establish a minimum setback from stream channels of 100-feet for horse pasture areas. Natural vegetation will be retained between the Ranch and the stream channel, allowing for filtering of runoff from the Ranch. Horse droppings will be collected on a regular schedule within the horse ranch area, and removed from the ranch in a timely fashion. There will be no waste disposal or stockpiling at the Ranch. The operator will either compost the wastes to create mulch material for use on-site or dispose of the wastes at a government approved location off-site. The Department of Health's "Non-point Source Pollution Management Plan" will be followed for additional Management Practices.

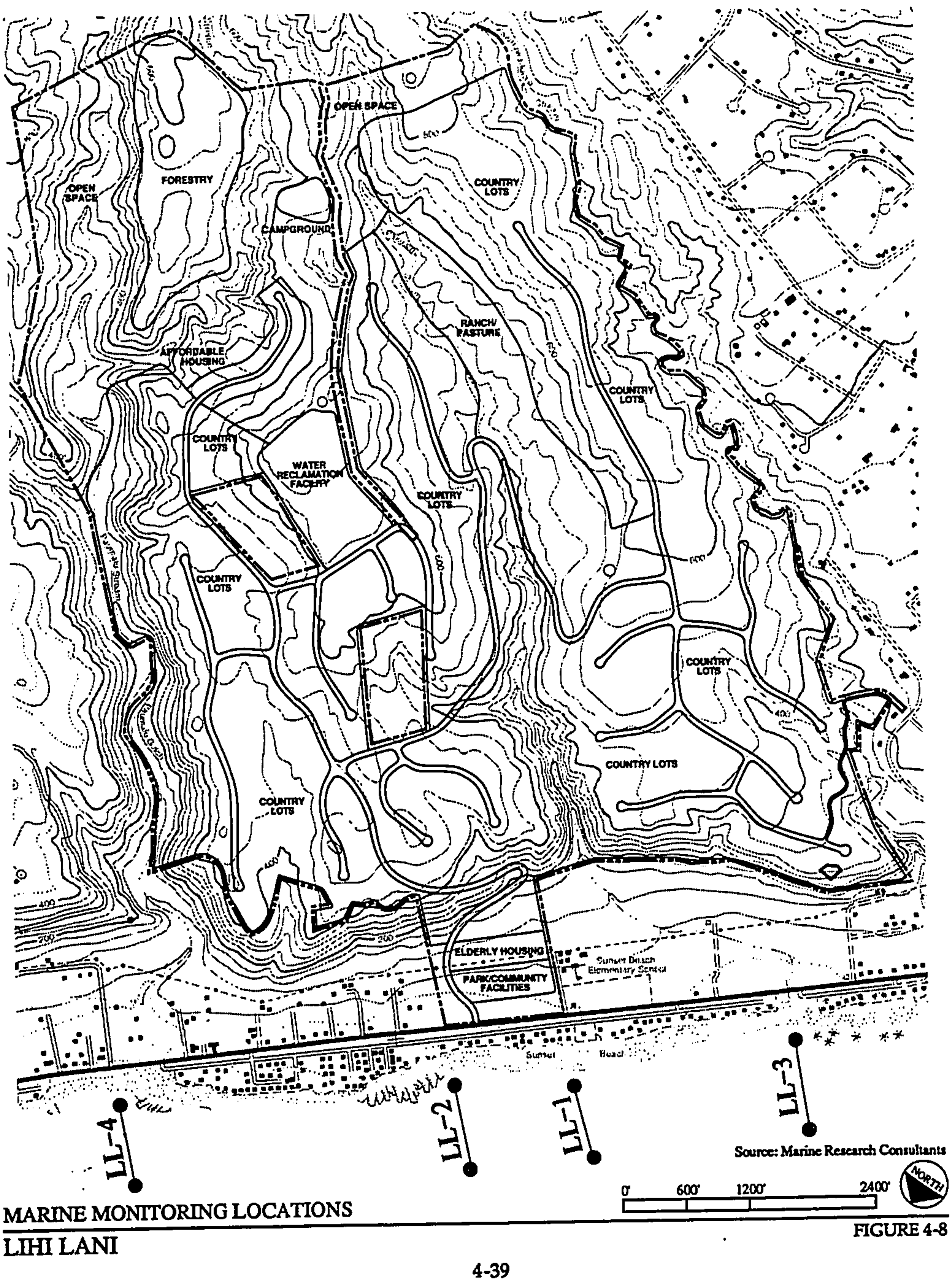
(7) Non-Point Source Pollution Management: Runoff from project areas will be released through natural vegetation swales, first passing through detention basins in some locations, to help trap suspended sediment and reduce fertilizer or pesticides concentrations through evaporation, sunlight breakdown, dilution and uptake of organic material. Mitigation planning for water quality control will utilize recommendations of the U.S. EPA/NOAA (January 1993) Guidance Specifying Management Measures for Sources of Nonpoint Source Pollution in Coastal Waters.

4.8 MARINE RESOURCES

This section includes a discussion of the existing marine environment along the shoreline near the project, and potential impacts to this environment as a result of development of Lihi Lani. A detailed study of the marine environmental resources of the area in relationship to the project was prepared by Marine Research Consultants (December 1990) and updated for the current project plans (September 1993). Findings of this study are presented in this section, and the complete report is enclosed in Appendix I. A marine water chemistry monitoring program is being instituted by Obayashi; the program parameters are summarized below and the full report is also attached in Appendix I.

A. Existing Environment

A baseline assessment of the near shore marine environment was conducted during June 1988, and annual water sampling has been repeated in 1991, 1992 and 1993. Ocean water sampling locations are shown in Figure 4-8. The primary objective of these assessments has been to develop a comprehensive qualitative and quantitative description of existing water chemistry parameters before commencing construction activities that can be used to evaluate the magnitude of possible changes that might



MARINE MONITORING LOCATIONS

LIHI LANI

FIGURE 4-8

result from construction and operation of the project. In addition, qualitative assessments of the near shore biological communities inhabiting the area were conducted in order to evaluate the potential for changes to biota from alteration of water chemistry.

An additional objective of the baseline assessment was to evaluate the degree of natural stresses (e.g. wave scour, freshwater input) that influence nearshore communities in the vicinity of the proposed development. Typically, thecomposition of reef communities is intimately associated with the magnitude and frequency of these stresses, and any impacts caused by the proposed development will be superimposed on natural environmental factors.

Water Chemistry: Potential alterations to marine communities could result from additions of dissolved nutrients from fertilization and sewage effluent, suspended solids from storm water runoff. In some marine environments, nutrient subsidies can result in environmental degradation by enhancing the growth of benthic algae and phytoplankton. Such a situation occurred in Kaneohe Bay during the 1970's when suspended sediment loading caused impacts to marine communities. Sewage was discharged into the Bay. However, Kaneohe Bay is a distinctively different type of marine environment than Pupukea. Kaneohe Bay in an enclosed estuary separated from the open ocean by a barrier reef. The ocean off Lihi Lani is an open coastal setting with no restriction on circulation. Hence, potential pollutants will be flushed from the nearshore system on the North Shore much more rapidly than in Kaneohe Bay. In addition, physical force from breaking waves will enhance mixing in nearshore waters in this area. Wave mixing is virtually non-existent in Kaneohe Bay.

Water quality was evaluated along two transects oriented perpendicular to the shoreline, directly offshore of the proposed project where it nearly extends to the shoreline (see Figure 4-8). At each transect, water samples were collected over the widest possible salinity range to evaluate the effects of ground water efflux and stream runoff. Samples were collected from the highest reaches of wave wash to a distance of approximately 200 meters (m) offshore, and taken at the surface and near the bottom at offshore locations. Samples of the tap water from Ehukai Beach Park and an irrigation well on the project site were also analyzed, as representative samples of ground water at the project site.

Water quality parameters that were evaluated in these samples included the 10 specific criteria designated for open coastal waters by the State of Hawaii Department of Health (DOH). Detailed results are presented in Appendix I. Summarized below is the evaluation of the nutrient parameters of nitrogen (nitrate + nitrite, ammonium nitrogen), phosphorus and silica.

Water chemistry analyses of samples indicated relatively high levels of nitrate + nitrite and silica. No distinct pattern was observed with respect to distance from shore for total nitrogen or ammonium nitrogen. However, sampling data showed that nitrate + nitrate and silica are found in near shore waters at higher concentrations than in offshore waters. In the absence of stream flow or surface runoff, influx of ground water in the near shore zone is the most likely source of nutrient subsidy to the receiving environment. Nitrate + nitrite and silica are nutrients that are present in high concentrations in groundwater.

Relatively small enrichment of phosphorus does occur in the coastal waters as a result of groundwater infiltration, but there was virtually no indication of increased levels either near the shoreline or in surface layers. This is apparently due to dilution and mixing processes.

Salinity is the best indicator of the degree of groundwater influence on near shore water chemistry. Decreases in salinity were found in the near shore zone, the result of mixing of fresh ground water with open ocean water.

At the present time there is an external dissolved inorganic nitrogen source within the near shore zone. The source is probably attributable to leaching from residential cesspools and septic systems near the shoreline. Thus, baseline conditions of water quality in this area are characterized by man-induced alterations to the existing environment. There is no indication, however, that the nutrient subsidy is resulting in negative biological impacts in the near shore zone.

Turbidity area chlorophyll a exhibit a slight increase in the nearshore area compared to further from shore with respect to distance offshore within the near shore zone. Temperature and pH measurements do not indicate any consistent variation with respect to distance from shore or depth.

Biological Community Structure: The marine environment off the proposed project location is characterized by seasonal intense wave activity which limits the development of reef biota to those assemblages which can withstand the impact of breaking waves. As a result, coral communities are limited compare to seas with lower wave stress. Reef fish communities (described in detail later in this section) are greatly limited owing to the lack of habitat shelter and apparent high fishing pressure. Community assemblages which are pre-adapted to high stress conditions may be less susceptible to alteration from additional man-induced stresses.

Because of the extremes in wave stress, in the nearshore area the bottom is not populated by well-established coral communities. Within the near shore boulder zone, the dominant benthic organisms are frondose and encrusting benthic algae; reef building corals and motile organisms are rare. It appears that the occurrence of frondose algae in the boulder zone is seasonal, with blooms occurring in the summer when wave stress is minimal.

Further offshore on the reef platform, the dominant benthos remains benthic algae. In this zone, however, hermatypic (reef-building) corals also occur with greater frequency. Because corals are essentially "permanent" features of the biotic community (in that they do not re-colonize an area seasonally), they must be able to withstand the full range of environmental stress inherent in the physical environment. Growth forms of coral observed in the study area were generally restricted to flat encrustations, an adaption that favors resistance to breakage from wave stress.

Nine species of coral were observed on the reefs off the Sunset Beach area. Bottom coverage by corals increases with distance offshore, grading from about one percent at the shoreward border of the reef to about 20 percent at 500 meters from shore. Porites lobata is the most abundant coral species, as on most Hawaiian reefs, occurring in a variety of growth forms. Observed coral and algae species are listed in Appendix I.

Motile benthos, such as sea urchins and sea cucumbers were generally rare off the project area. The most common urchin observed was Echinometra matheai, a species that bores into calcium carbonate surfaces and occupies depressions within the reef platform.

Reef Fish Communities: The reef fish community off the proposed development area is characterized by a low population density and generally small body size of most individuals. This is probably a result of both scarcity of shelter in the physically stressed habitat, and the effects of overfishing. Although a total of 49 species were noted, only a few species were common (Appendix I). In particular, the saddleback wrasse and small convict tang were the most abundant species observed. Schooling surgeonfish were common at some sites. Most other species were represented by only occasional or rare individuals.

In the shallow near shore boulder-sand zone, fish species were observed that are adapted to high surge habitats. These included the Christmas wrasse, blackspot sergeant, as well as the saddleback wrasse and convict tang.

Deeper water areas on the reef platform harbored a somewhat richer fauna, particularly in areas where bottom structure was dominated by large undercut grooves and depressions. When approached by divers, mixed-species schools of surgeonfishes quickly retreated to the shelter afforded by these features. Although these schools were dominated by convict tangs, other species included the whitebar surgeonfish, the orangeband surgeonfish and the ringtail surgeonfish.

High fishing pressure in the survey area is apparent by the virtual absence of some sought-after fish groups, such as goatfishes, jacks, squirrelfishes and parrotfishes. Species of surgeonfish commonly taken as food tended to be small, and nearly all fishes quickly retreated or took shelter as divers approached. Combined with the scarcity of shelter, this apparent overfishing has produced a significantly depleted fish fauna.

Threatened or Endangered Species: Three species of marine animals that occur in Hawaiian waters have been declared threatened or endangered by Federal jurisdiction. The threatened green sea turtle (Chelonia mydas) occurs commonly along the shoreline of the major Hawaiian Islands and is known to feed on selected species of macroalgae. The endangered hawksbill turtle (Eretmochelys imbricata) is found infrequently in waters off Hawaii. Several small green sea turtles were observed in the near shore area during the course of the present survey, and such sightings are common for the entire north shore of Oahu.

Populations of the endangered humpback whale (Megaptera novaeangliae) are known to spend the winter months in the Hawaiian Islands. The present study was carried out during the period when the whales were not present.

Physicals Conditions: Surveys of coral cover at the popular surfing reefs in the vicinity of Ehukai Beach Park indicate very little live coral cover in the surf zone. This lack of live coral is the direct result of wave stress. The surfing reefs are primarily composed of an eroded limestone platform which was established during the period of different sea level stage, aged at 3,000 to 4,000 years ago.

Sediment samples of the sand in the nearshore zone consist of a very small percentage (one percent) of terrigenous material. The remaining 99 percent of the sand along this coast is of calcareous origin, meaning it was once part of ocean dwelling organisms such as corals and algae. These findings show that although there is significant sediment input to the coastal waters during peak precipitation and runoff events, virtually none of the silt from land remains in the nearshore ocean sediment. The ocean is exceptionally well mixed at this location and fine particles such as silt are transported outside the surf zone to deeper offshore areas where water velocities are slower and settling can occur.

B. Potential Impacts

Lihi Lani will create some minor inputs to the marine environment in the form of small amounts of dissolved chemicals and suspended particles within storm water runoff and groundwater, as discussed in Sections 4.5 and 4.6. However, because of the system of detention basins, input of all constituents except phosphate will decrease compared to the present situation. Operation of the project will include fertilization with commercial mixes and reclaimed water application. Application of the reclaimed water will contribute a portion of the total necessary nitrogen fertilizer. Most of the fertilizers applied will be slow-release nitrogen sources which will not contribute appreciable amounts of nitrate to groundwater or surface water runoff. As shown in the runoff quality projections, nitrogen and suspended sediment concentrations will actually decrease in the developed condition. Nitrogen as nitrate is the nutrient of greatest concern in the marine setting.

Maximal nitrogen contributions to groundwater from the project, under a worst case scenario with use of soluble nitrogen fertilizers, would equate to less than 50 percent of the existing cesspool input at Sunset Beach makai of the project site. Actual nitrogen contributions will be a fraction of this amount due to use of slow-release nitrogen fertilizers (only 1.5 percent leaching to groundwater). Chemical and biological uptake processes during transit through soils and the aquifer will further reduce the potential nutrient subsidy to the nearshore marine environment.

Minute amounts of pesticides in runoff and groundwater could be contributed to the ocean.

Erosion during construction presents the greatest potential for changes in the near shore ocean. Such effects can be minimized by careful planning and management during the construction process. However, if erosion events do occur, the effects to water quality will be temporary, and not substantially different than siltation events that occur at present. Suspended sediments in runoff from the site will be much less under the developed condition due to erosion controls on-site.

Estimates of storm water runoff characteristics indicate that delivery of suspended solids to the ocean will decrease following construction of the development relative to existing conditions. Fresh water and phosphorus input will increase; but inputs will be episodic in nature and will not constitute chronic stresses. The high mixing regime of the receiving environment will likely disperse storm inputs rapidly.

C. <u>Mitigative Measures</u>

Several mitigative measures will be employed to minimize the effects of the project on the marine environment.

(1) Erosion Controls: Probably the greatest potential for detrimental impacts to the marine environment will arise from high intensity storms (rainfall) storms during construction. Where possible, construction phases involving exposed lands will be scheduled during the summer months, when rainfall is generally lowest. Erosion will also be minimized by compliance with governmental regulations and standards.

(2) Managed Fertilizer Applications: It has also been shown that there is a potential for nitrate enrichment in runoff and groundwater from fertilization. The realization of this potential is prevented through sound management practices. For example, timing of fertilization to avoid periods of heavy rainfall, and the use of slow-release fertilizers, will minimize nitrate percolation into groundwater. A large percentage of fertilizer material will be composed of slow-release mixes rather than reclaimed water with soluble nitrate. Because economics is an important aspect of grounds management, it is also unlikely that excessive amounts of commercial mixes will be applied. Nitrates in runoff and surface leachate on portions of the site will be trapped in detention basins, as discussed in Section 4.6.

(3) Managed Pesticides Usage: Pesticides are not expected to be introduced to the ocean from the project, largely as a result of controlled pesticide use on the project. The planned IPM program will minimize pesticides use. The program will avoid application during precipitation periods and avoid over-irrigating applied areas. As discussed in Section 4.6, pesticides will not travel off-site in amounts which could cause water quality impacts.

(4) Marine Environment Monitoring and Modeling: An ongoing marine environment monitoring program will be instituted to assure that the development will not contribute to environmental degradation. It will employ the same conservative mixing model employed in the present study. Initial phases of the monitoring plan will involve defining the "pre-development envelope" of water quality parameters. Such an envelope would take into account the present nutrient enrichment that is apparently a result of coastal area cesspool and septic system leachate. Repetitive sampling during each phase of construction and operation of the development will indicate if parameters remain within the envelope.

An advantage of using a mixing model as a modeling tool is that the method is sensitive enough to identify changes in water quality parameters at levels within the natural tolerance of the biological communities. Thus, water quality changes can be identified before environmental degradation occurs. If it is determined that operation of the development is causing environmental changes, further measures will be taken to eliminate the source of degradation.

4.9 NATURAL HAZARDS

A. Existing Conditions

Natural hazards are events such as tsunami, earthquakes, floods and volcanic hazards.

The entire project area lies outside the 100-year boundary for floods attributable to either storms or tsunami. According to the Flood Insurance Rate Map (FEMA, 1987) the project site falls within two flood hazard zones, Zones D and X (Figure 4-6). The zone dividing line runs approximately 1,800 feet mauka of Kamehameha Highway near the bluff's edge. The area mauka of the line is in Zone D, where flood hazards are undetermined. Flooding is not known to be a problem anywhere along the intermittent streams within the property.

The property is outside of any special or volcanic hazard areas as defined for other areas of the State. Although all of Hawaii occasionally experiences small earthquakes, the site is not considered to be a seismic hazard area.

B. Potential Impacts

The site is not part of a floodway or flood fringe area, nor within a designated tsunami inundation area. No part of the project is known to be subject to potential flooding. Storm drainage will be controlled by detention areas established throughout the project, which will minimize flooding both within and downstream of the site. Discharge of runoff (rates and volumes) from the project will be the same or less than existing conditions. Details of storm drainage control are discussed in Section 4.6 and Appendix F.

C. Mitigative Measures

(1) Drainage Improvements: Drainage improvements, as discussed in Section 4.6, will include adequate provisions to prevent any flooding problems in the uplands or on the portion of the project site near Kamehameha Highway, as well as on lands adjacent to the project. No mitigative measures are needed to avoid flood hazard areas since none exist within the project area.

4.10 VEGETATION

A detailed botanical survey of the project area was conducted by Kenneth Nagata (January 1988). Field studies to search for wetlands along the Paumalu and Kaleleiki streams were conducted by Char & Associates (March 1991). The complete reports of these surveys have been published in the Final EIS (Group 70, April 1991). Existing conditions on the site are discussed in this section, along with anticipated impacts on vegetation. Mitigative measures have been proposed to minimize effects on vegetation in some parts of the project.

A. Existing Conditions

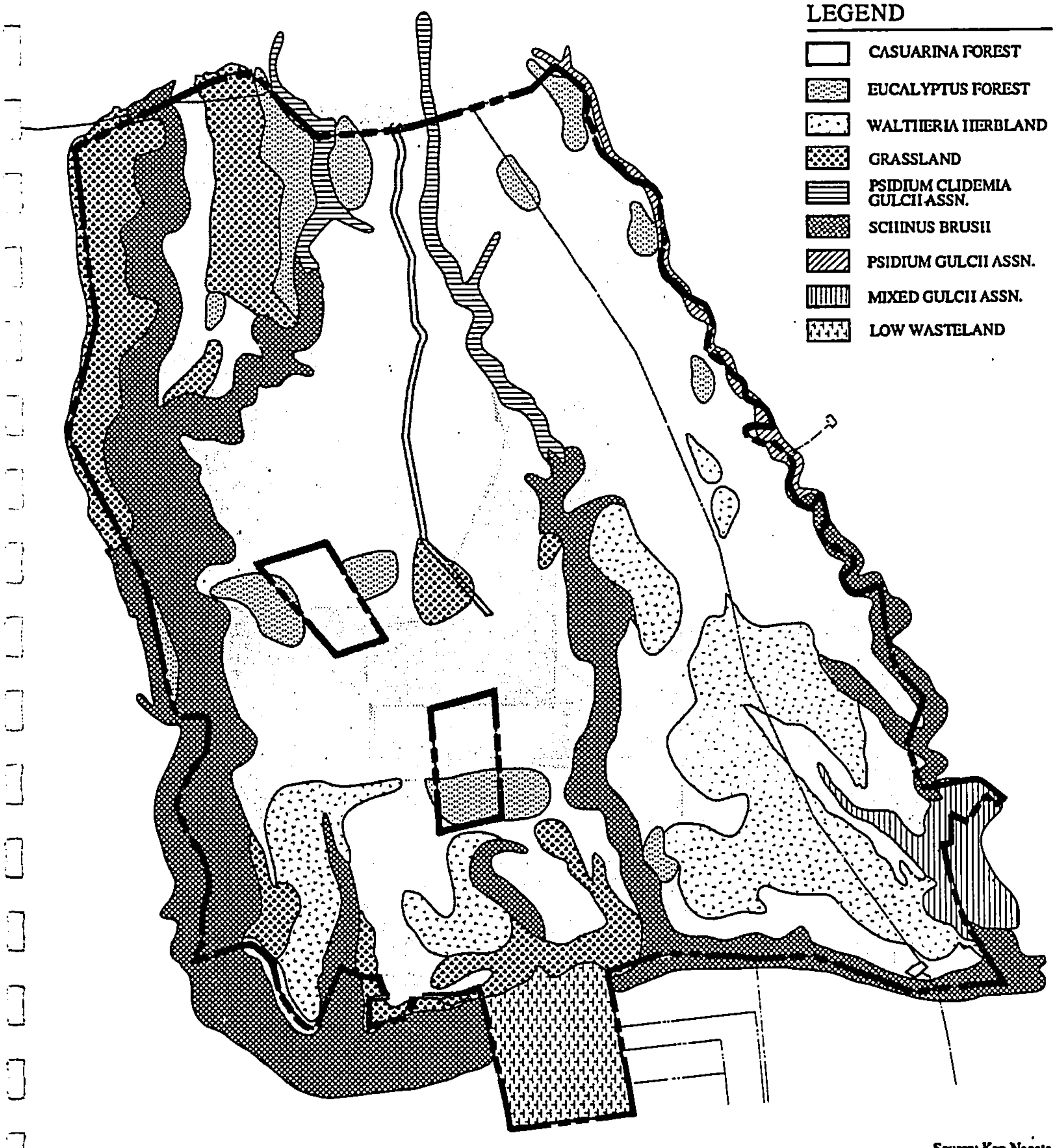
Nine broad vegetational communities were identified, as shown in Figure 4-9. A list of the vegetation species found on the site is included in Table 4-4. The general vegetation of the project site was found to be a complex of secondary forests consisting of ironwood and eucalyptus, grasslands, herblands and weedy brushlands. Four native species were found in significant number with *huehue* and *'ākia* being the most abundant. *'Ulei* and *pula'a* are also widespread throughout the site, generally restricted to sunny exposed areas on the upper slopes.

Four Koolau Eugenia trees were discovered on State property in a small moist ravine just mauka of the upper boundary of the project site. At this time, these trees are the only known Koolau Eugenia specimens in the world.

Vegetation communities are categorized according to the relative abundance of the vegetation type. A description of the nine vegetation categories is provided below.

1. Casuarina Forest (CF): The most prevalent vegetation type in the entire project site is the Casuarina Forest which is dominated by ironwood trees 20 to 50 feet tall. Many species are associated with this community, but in small numbers. The most abundant native plant *huehue* is common throughout the forest; occasionally spotted are the *'ākia, pukiawe, ūlei* and *'uhaloa*.

2. Eucalyptus Forest (EUC): Several large groves of swamp mahogany, a smaller grove of an unidentified species and a single extensive grove of Murray red gum are found within this plant community on the project site. Silk oak and ironwood are widely scattered throughout the forest. Several native species are also associated with the Eucalyptus Forest, and with the exception of occasional spots of *huehue* and *'ākia*, all are considered rare.



VEGETATION COVER TYPES

LIHI LANI

FIGURE 4-9

TABLE 4-4

LISTING OF VEGETATION SPECIES ON PROPERTY

COMMON NAME	SCIENTIFIC NAME
huehue (N)	Cocculus ferrandianus Gaud.
'akia (N)	Wikstroemia oahuensis.
'ülei (N)	Osteomeles anthyllidifolia Lindl.
pala'a (N)	Spenomeris chusana (L) Copel.
Koolau euginia (E)	E. Koolauenis Deg.
ironwoods	Casuarina equisetifolia
pükiawe (N)	Styphelia tameiameiae (Cham.) F. Muell.
'uhaloa (N)	Waltheria americana L.
swamp mahogany	E. robusta Sm.
Murray red gum	Eucalyptus camald ulensis
silk oak	Grevillea robusta A. cunn.
Jamaica vervain	Stachytar pheta jamaicensis (L.) Vahle
golden beard grass	Chrysopogon aciculatus
West Indian dropseed	Sporobolus indicus
Hilo grass	Paspalum conjugatum Berg.
three-flowered beggarweed	D triflorum (L.) DC.
partridge pea	Cassia leschenaultiana
Spanish clover	D. canum
Asiatic pennywort	Centella asiatica
Strawberry guava	Psidium cattleianum
Christmas berry	Schinum terebinthifolius Raddi
Koster's curse	Clidemia hirta
'öhi 'a-lehua (N)	Metrosideros collina
naupaka (N)	Scaevola gaudichaudiana
uluhe (N)	Dlicranopteris linearis
sensitive plant	Mimosa pudica var. unijuga (Duchass & Walp.) Griseb
ageratum	Ageratum conyzoides
perennial foxtail	Setaria geniculata (Poir.) Beauv.
lantana	Lantana camara
Formosa Koa	Acacia confusa Merr.
Java plum	Eugenia cumini
rose apple	Eugenia jambos
mango	Mangifera indica L.
avocado	Persea americana Mill
breadfruit	Artocarpus altilis (Parkins. exZ) Fosb.
coffee	Coffee arabica
banana	Musa x paradisiaca L.
coconut	Cocos nucifera L.
thatching grass	Hyparrhenia rufa (Nees.) Stapf
kiawe	Prosopis pallida (Humb. & Bonpl. ex Willd.) HBK.
sourgrass	Tricachne insularis

E = Endemic
N = Native

Source: Kenneth Nagata, (January 1988)

3. Waltheria Herbland (WH): Currently a portion of the plateau is being utilized as a pasture. The pasture consists of Waltheria Herbland dominated by the indigenous *'uhaloa*. In some sections it provides nearly 100 percent of the cover, in others, Jamaica vervain is co-dominant. The only other native species in this community besides the *'uhaloa* is the *'ūlei*. There are intensively grazed areas characterized by a larger grass component consisting largely of golden beardgrass, West Indian dropseed, Hilo grass and three-flowered beggarweed.

4. Grassland (G): Grassland communities are found on the plateaus often adjacent to the Waltheria Herbland communities and on the upper slopes of the gulches. Most of the Grassland community appear ungrazed and in certain places on the plateau the grasses attain heights of three to five feet.

   Common in the Grassland are Jamaica vervain, partridge pea, Spanish clover, and Asiatic pennywort. Several other species are found in smaller numbers.

   The Grassland community together with the Waltheria Herbland are remnants of former pasture lands. They are being invaded by strawberry guava and ironwood, reducing their original size by more than 50 percent. On the other hand, Grassland communities on the gulch slopes appear to have been quite stable in the past two decades. On the lower portions of the slopes, Christmas berry forms a transitional zone between the Grassland community above and the Schinus Brush community below.

5. Psidium-Clindemia Gulch Association (PCGA): This community type is found on the floor and lower slopes of the moist upper reaches of the major gulches in the project site. It consists of dense stands of strawberry guava 10 to 20 feet tall with an understory dominated by koster's curse.

   Numerous species are associated with this community type such as *'ohi 'a-lehua, naupaka, uluhe, pala'a, pukiawe* and *'ākia*. They are found in small to moderate numbers on the middle slopes transitional zone areas. Exposed sites on the gulch floors are occupied by common weedy species such as Jamaica vervain, Asatic pennywort, partridge pea, Spanish clover, sensitive plant, Hilo grass, and ageratum.

6. Schinus Brush (SB): The Schinus Brush dominates the middle and lower parts of the major gulches, the lower slopes of the seaward cliffs and most of the small ravines. This vegetation community is best developed on the floors of the ravines where moisture is more readily available. Associated with these moist sites are partridge pea, perennial foxtail, Asiatic pennywort and lantana.

   This vegetation type is characterized by dense stands of Christmas berry 10 to 20 feet tall with occasional emergent Formosan Koa, swamp mahogany and Java plum.

7. <u>Psidium Gulch Association (PGA)</u>: This community type is characterized by dense, stands of strawberry guava 15 to 25 feet tall with occasional ironwood, silk oak and rose apple. It is only found in the moist, upper half of the gulch which constitutes the southerly boundary of the project.

   Several large mango, avocado and breadfruit trees are found in the upper reaches of the gulch. In addition, coffee has become naturalized in one section and several banana plants and one coconut tree were found. This indicates that portions of the gulch were cultivated in the past.

8. <u>Mixed Gulch Association (MGA)</u>: The vegetation in the lower portion of the south boundary gulch is a mosaic of several community types. It is the smallest plant community in the project area, and it consists of small groves of strawberry guava, Christmas berry, Java plum, ironwood and small fields of thatching grass grasslands and Waltheria Herbland.

9. <u>Lowland Wasteland (LW)</u>: Another vegetational mosaic, this area consists of a patchwork of individual units too small to be feasibly mapped. The area borders Kamehameha Highway with a grove of ironwood and closed-canopied *kiawe*. Behind this are found a heterogeneous community of weedy species, with sourgrass being common throughout.

Numerous common native plant species are found on the project area, but they are generally few in numbers, and occur mostly as widely scattered individuals. Small pockets of native vegetation also exist, but they are degraded, scattered and Nagata (1988) does not interpret these as viable communities.

The Paumalu and Kaleleiki stream surveys (Char & Associates, 1991) did not find any wetlands in the survey area. Physically, the Paumalu and Kaleleiki streams do not broaden out on the property, thus providing areas where soil and organic matter may be unloaded and wetland species take root. The absence of wetlands corroborates the findings of Nagata's surveys in 1988.

B. <u>Potential Impacts</u>

Development of the project will involve transforming some portions of the existing site into a residential community. Approximately 400+ acres of vegetation will be cleared to allow development of the project. Several plant communities will be affected, primarily the Casuarina Forest, Waltheria Herbland and Schinus Brush areas. It should be noted that the various species associated with each plant community are exotic species and not considered rare or endangered, with the exception of the Koolau Eugenia trees, which are considered "localized" and "rare" by Fosberg and Herbst (1975). The Koolau Eugenia are located off-site on State property and would benefit from the cooperative management efforts by the State and Obayashi.

C. Mitigative Measures

Several mitigative measures will be implemented to minimize adverse effects on vegetation.

(1) Koolau Eugenia Trees: Obayashi is continuing its discussions with the State DLNR to participate in a cooperative effort with foresters from the Division of Forestry and Wildlife, to protect and monitor these rare trees. Measures may include the gradual elimination of threatening encroachment by exotic species. This could create better growing conditions for the trees and help to ensure their survival. Systematic monitoring of flowers and fruits for propagation experiments, with the long term goal of increasing the population, will be included. No actions will be taken with respect to these trees without the explicit direction and guidance from DLNR. As requested by DLNR, Obayashi will refrain from specifying the exact location of these trees.

(2) Erosion Control: Measures will also be taken to alleviate runoff and soil erosion effects on undisturbed vegetation throughout the project site. Steps will be taken during the construction phase to reduce erosion tendencies, as discussed in Section 4.3.

(3) Landscaping and Native Plant Introduction: Obayashi will identify and transplant some native species to an on-site nursery, for propagation and eventual relocation to select sites within the project. Extensive landscaping is planned for the site within residential and common areas.

(4) Conservation Area Establishment: Obayashi will also identify and maintain the majority of open space area as a "conservation area". The purpose will be to preserve and enhance, as possible, the native and endemic species in the North Shore area. The gulches and associated vegetation on this site are part of small watershed areas, which are integral to the water cycle for the immediate vicinity. The conservation area would include provisions for trails and interpretation.

(5) Other Significant Trees: Nagata (1988) and Weissich (1990) have conducted an extensive inventory of significant trees and groves of trees which are special, natural features on the property. These trees will be retained wherever possible, and integrated within developed areas.

4.11 WILDLIFE

A study of the existing wildlife (terrestrial vertebrate) populations on the project site, including amphibians, reptiles, mammals, and introduced and indigenous birds, was prepared by Andrew J. Berger Ph.D. (January, 1988). A preliminary survey of four streams on the project site: Paumalu, Kaleleiki, Pakulena, and Kalunawaikaala, was conducted by Anne M. Brasher (March 1991). The complete reports have been published in the Final EIS (Group 70, April 1991). Resident and migratory species were considered in Berger's study. This inventory is based on field studies of the project area and research of existing information regarding the area and its habitat types.

A. Existing Conditions

Terrestrial Vertebrates

As described in Section 4.10, the project site contains a variety of vegetation cover types and is generally uncleared except for some agricultural uses. This habitat diversity allows for some variety in wildlife types occurring in the area.

There are several species of birds inhabiting the area, but none are an endangered species. Because of the geographical mobility of birds, they can appear in the area at anytime. Table 4-5 presents a complete listing of wildlife in the project area, including introduced and indigenous birds.

Several of the bird species are considered as serious pests which cause damage to crop and flower gardens. These species include the Red-vented Bulbul and the Japanese White-eye. The House Finch is another destructive bird. It is also know as the Papaya Bird in Hawaii, but it is predominantly a seed-eater which prohibits the potential growth of such crops.

Cattle Egrets are common throughout the project site. At least one flock of pigeons also inhabits the area. Other birds often found in the area include: the Spotted or Lace-necked Dove; the Barred or Zebra Dove, which is a game bird; and the Melodious Laughing-thrush (Chinese Thrush). The Lesser Golden Plover is a migratory bird found in the area. This type frequents open areas such as lawns in residential areas.

Located in the project area are several mammal species, including the house mouse, various rat species and the mongoose. None of these mammals are an endangered species. With the possible exception of the house mouse, all of the smaller mammals prey on birds, their eggs and their young.

There are no endemic amphibians or land reptiles in the Hawaiian Islands. All have been introduced such as the common toad, frog, snake, skinks and geckos. These amphibians and land reptiles are in the project area, but none are rare, endangered or of any special significance.

Stream Survey

The stream surveys completed by Brasher for the Final EIS (Group 70, April 1991) investigated the presence of fish, insect and other invertebrates in the intermittent streams on the Obayashi property. Several benthic organisms were identified. One native "fish" was observed in a post-larval form in Paumalu Stream (Sicyopterus stimpsoni). These fish have an amphidromous life cycle, meaning that eggs are laid in the stream, hatch, then wash out to sea. After spending a larval phase as marine

TABLE 4-5

WILDLIFE SPECIES

COMMON NAME	SCIENTIFIC NAME
Amphibians	
Giant Neotropical Toad	Bufo marinus
American Bullfrog	Rana catesbeiana
Reptiles	
Blind Snake	Typhlops braminus
Skinks	Family Scinicidae
Geckos	Family Gekkonidae
Introduced Birds	
Cattle Egret	Bulbucus ibis
Rock Dove or Feral Pigeon	Columba livia
Spotted or Lace-necked Dove	Streptopelia Chinensis
Barred or Zebra Dove	Geopelia striata
Barn Owl	Tyto alba pratincola
Melodious Laughing-thrush	Garrulax canorus
Red-vented Bulbul	Pycnonotus cafer
White-rumped Shama	Copysychus malabaricus
Japanese White-eye	Zosterops japonicus
Japanese Bush Warbler	Cettia diphone
Common Indian Myna	Acridotheres tristis
Nutmeg Mannidin or Ricebird	Lonchura puntulata
House Finch	Carpodacus mexicanus frontalis
Red Jungle Fowl	Gallus gallus
Black-crowned Night Heron	Nycticorax n. noactli
Lesser Golden Plover	Pluvialis dominica fulva
Mammals	
House Mouse	Mus musculus
Indian Mongoose	Herpestes auropunctatus
Pig	Sus scrofa
Roof Rat	Rattus rattus
Polynesian Rat	Rattus exulans
Norway Rat	Rattus norvegicus

Source: Andrew J. Berger, (January 1988) plankton, the post-larvae return to the streams, where they spend the remainder of their life cycle.

The presence of these fish in Paumalu Stream is a random occurrence. The probable outcomes are, one, the stream channel will dry up and the fish will perish, or two, the fish may reach some permanent water in the upper reaches of the stream where, given adequate food and other requirements, they could survive through adulthood. There were no adults found in the survey, although the upper reaches of the stream (off-site), were not surveyed. No larval or adult damselfly were found in the insect survey.

B. Potential Impacts

None of the birds found in the project area are considered to be an endangered species, and some of them are destructive pests. Other species found on the project site provide pleasure for people through their song and beauty. The proposed project is not expected to have a significant adverse effect on the area's available habitat for the bird species found on the site.

Currently, there are no habitats found on the site for some species of birds, such as the Black-crowned Night Heron or the *Pueo* (Hawaiian Owl). However, the new landscaping might provide foraging habitat for these birds and allow their introduction to the area.

Long ago the native vegetation of the Pupukea area was almost totally cleared for forestry and agricultural purposes. The existing introduced vegetation on the project site does not, for the most part, provide suitable habitat for any of Hawaii's endemic forest birds. Disturbance to this on-site vegetation, over 400+ acres, and subsequent development and replanting, is expected to have no significant impact on available habitat for endemic birds.

All the amphibians and land reptiles that occur in the project area are introduced animals, and none are considered to be a rare or endangered species. Loss of some individuals or their displacement due to development of the property is not expected to be a significant environmental effect on amphibian or reptile species.

According to Berger (January 1988), all of the introduced species of mammals in Hawaii have proven to be highly destructive to man, its buildings, products, agricultural crops and/or the native forests and animal life. None of the mammals occurring in the project area is an endangered species, and none is of any concern as far as detrimental effects resulting from this project.

The fertilizers and pesticides used in grounds maintenance pose little or no hazard to birds frequenting the property. Fertilizers are relatively non-toxic unless ingested in large amounts, and all herbicides and fungicides used in grounds maintenance in Hawaii are of low to moderate toxicity. The only chemicals used in grounds maintenance which are highly toxic to birds are the organic phosphate insecticides, especially chloropyrifos. However, chloropyrifos are strongly adsorbed and move little from the site of application.

Because of the absorption of organic phosphate insecticides on organic layers and their rapid breakdown, there is little chance of their movement into the detention basins. Label instructions strictly prohibit their direct application to streams and ponds. In addition, other insecticides with reduced toxicity can be substituted for chloropyrifos with little loss of effectiveness. The threat to birds by pesticides application is expected to be minimal.

C. Mitigative Measures

No significant impact is expected to occur to any wildlife species on the property; however, several measures will be implemented that will minimize effects on wildlife due to project development. These will include: minimized clearing of vegetation, extensive re-vegetation and landscaping planting, establishment of aquatic habitat areas, and control of pesticide application.

(1) Minimized Vegetation Clearing: Vegetation may be cleared over approximately 400 to 480 acres of the 1,144-acre site. Existing vegetation will remain in the most steeply sloped areas along the ravines and between homes, roads, agriculture areas and other elements of the project. The majority of existing habitat areas (at least 65 percent) will remain unaffected.

(2) Re-Vegetation of Cleared Areas: Re-vegetation of many cleared areas will occur, with areas replanted with turf, agricultural crops and the remainder in natural ground cover and landscaping vegetation. Extensive ornamental and native landscape vegetation species will be planted for buffer and perimeter areas. These landscaped areas will again serve as habitat areas for some wildlife.

(3) Aquatic Habitat Creation: New aquatic habitat areas will be developed as part of the development of the water reclamation facility. Aquatic vegetation will become established at the constructed wetlands and wildlife, such as waterbirds, may be attracted and added to the faunal component..

(4) Pesticide Controls: Use of pesticides will be controlled on the site with special care to avoid impacts on wildlife. Only those pesticides which are allowed by law will be applied. Application will be supervised by a trained grounds manager.

(5) Paumalu Stream: Measures will be taken to detain runoff on the project site and minimize the amount of silt entering the Paumalu Stream, minimizing affects on potential fish populations and other stream biota.

(6) Non-Point Source Pollution Management: As stated in Section 4.3, mitigation Planning for runoff water quality control will utilize recommendations from US EPA/NOAA (January 1993).

SECTION 5

ASSESSMENT OF THE EXISTING HUMAN ENVIRONMENT, POTENTIAL IMPACTS AND MITIGATIVE MEASURES

5.0 ASSESSMENT OF THE EXISTING HUMAN AND SOCIO/ECONOMIC ENVIRONMENT, POTENTIIAL IMPACTS AND MITIGATIVE MEASURES

This section presents summary background information on the existing human environment. Subject areas such as archaeology, traffic, air, noise and visual conditions are addressed in this section. It also includes a presentation of demographic conditions in the project area, and the potential effects of the project on demographics. Economic factors, employment, government expenditures and revenues are also considered in this section. A brief discussion of lifestyles is also presented. In addition, the potential impact of the development on the public infrastructure and public services is evaluated. Technical studies and analyses have been undertaken to address the changed elements of the new Master Plan. Comparisons with the 1991 plan are also made in this section. Mitigative measures are recommended to minimize the potential short and long term impacts.

5.1 ARCHAEOLOGICAL AND HISTORIC RESOURCES

An investigation of archaeological and historic features was conducted on the project site by Paul H. Rosendahl, Ph.D., Inc. (PHRI) during the period January to March 1988. The findings of this report (PHRI, May 1988) are summarized in the following discussion, and the entire report has been published in the Final EIS (Group 70, April 1991).

A. Existing Conditions

Previous Archaeological Work: Over the past 15 years, a number of archaeological investigations have been conducted in the Pupukea and Paumalu area. However, most of the investigations have been specific to Waimea Valley, and only a limited amount of work has been done outside of the valley.

Archaeological work within Waimea Valley includes work by Mitchell (1976, 1977), Moore and Luscomb (1974), and Takemoto (1974). While all the past work in the valley is relevant to the present project, one valley site is of particular interest. This site was excavated in the 1970's, and has been identified as a former single-family habitation and farm, with agricultural terraces and small mounds thought to have been used for cultivating sweet potatoes (Mitchell 1977). Dated to about 1840, this site may be contemporary with a single-family farmstead tentatively identified on the project site.

Archaeological investigations outside Waimea Valley include studies by Dennison (1979), Rogers (1976), and Yent (1979). Rogers recorded a burial cave in a seaward cliff less than half a kilometer southwest of the project site. The cave, though only 8.4 square meters in area, contained the remains of at least nine individuals. Two individuals were in wooden coffins. One secondary burial was in a wooden canoe. Remains of other individuals were bundled in braids of sennit. A wide range of artifacts were found in the cave: a coconut bowl, gourd calabashes, glass bottles, and a wooden walking stick with a rubber tip. After the contents of the cave were inventoried, the cave's entrance was sealed by the Department of Anthropology, University of Hawaii. The cave, which was estimated to date to between the 1700's and the early 1800's, was interpreted as a burial cave for several generations of a single family (Rogers 1976).

During the study by Dennison (1979), a walled enclosure was identified a short distance southwest of the project area. This enclosure, which measured approximately 330 square meters, was interpreted as an historic animal enclosure of little significance. It has since been destroyed. During the 1979 study by Yent, two burials were identified just northwest of the present project area, in the sand dunes at Sunset Beach (Yent 1979). Exposed by winter storms, the burials (disarticulated male and female bones) were later reinterred in the more stable inland portion of the dunes. Apparently due to the method of interment, the burials were thought to be associated with the extensive prehistoric midden deposits preserved in the dunes at Sunset Beach.

The only site previously recorded within the project area (listed as Site T-34 in the present report) was first discovered by Gary McCurdy, a nearby land owner. McCurdy, who found the site a year or two before Hurricane Iwa struck the Islands, reported it to the Bishop Museum. According to McCurdy, Bishop Museum reported that the site consisted of a small cave containing two secondary burials: remains of an adult male and possibly a juvenile female. Present with the burials were several fragments of a burial canoe. Checks with Bishop Museum during March and April of this year, yielded no records of the site.

Historical Background: The earliest written descriptions concerning the lands of Pupukea and Paumalu coincide with early landings of European and American sailing ships at Waimea Bay. The earliest landing of a ship at Waimea Bay was by Captain Cook in 1779. Subsequently, other ships landed, encouraged by the abundance of fresh water in the area of the bay and the sheltered anchorage the bay afforded (Takemoto, 1974). Other than accounts of landings at Waimea Bay, there is little early historical written data on the lands of Pupukea and Paumalu. This is probably due to the land's remoteness from Honolulu and due to the agriculturally marginal nature of the lands, which did not attract many people.

Land Commission Awards allowed for several kuleanas to be established in Pupukea and Paumalu. These were comprised of small house lots, saltlands and sweet potato fields (Estioko-Griffith, 1986). The rest of Pupukea was owned by King Kamehameha III, and was used as grazing land for wild goats and cattle, which were common on Oahu by 1809 (Morgan, 1948).

During the early to mid-historic period (late 1700's to mid-1800's), cattle production began to replace agricultural cultivation uses of many lands. These livestock were uncontrolled in most areas and caused the destruction and abandonment of many small kuleanas, including some in Pupukea-Paumalu. In addition, sandalwood logging also caused the deforesting of much of Oahu, including sections of the project site.

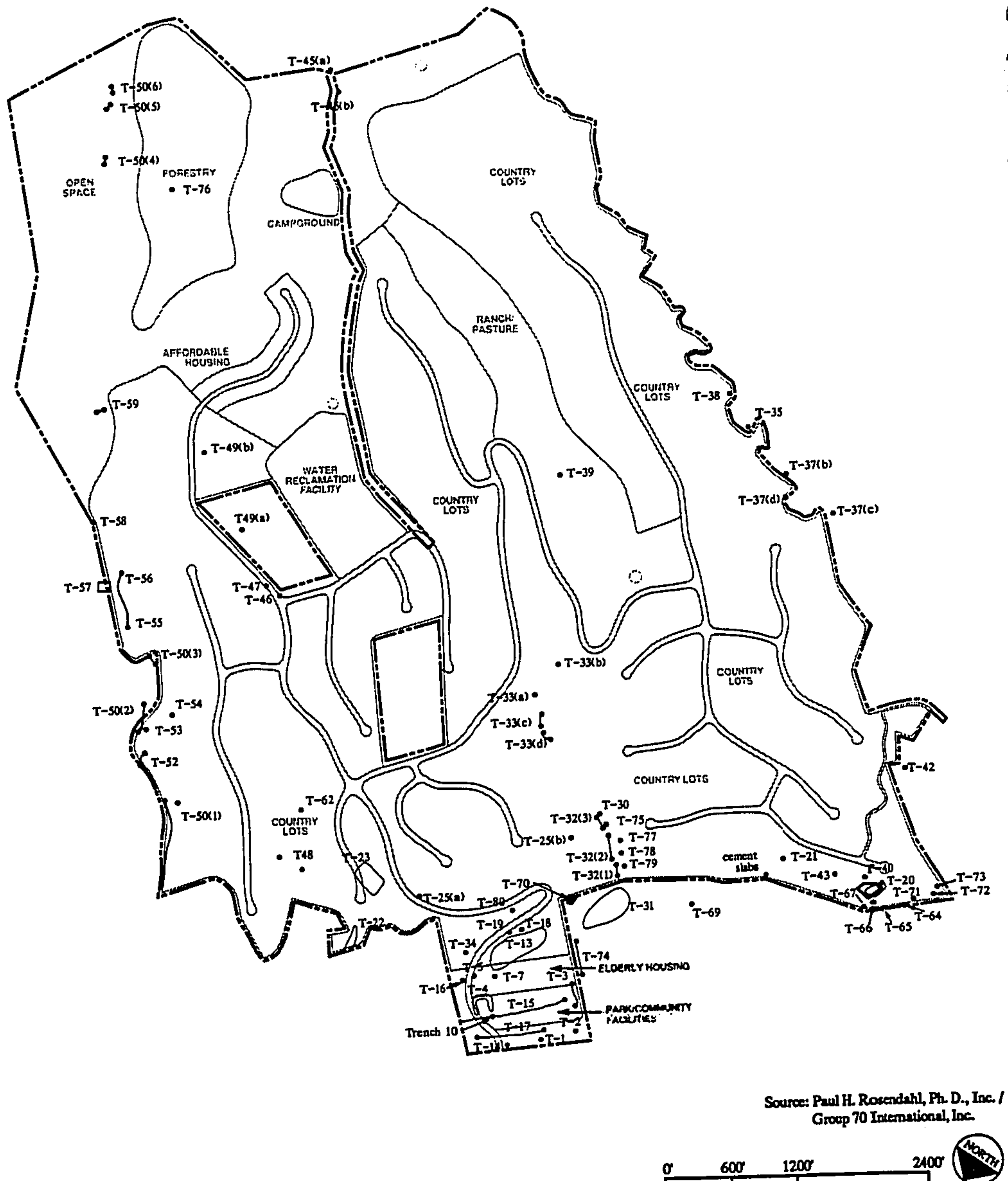
During the 1860's, small-scale farming in the Pupukea-Paumalu area gave way to large-scale plantation agriculture. Originally, sugarcane was produced in the coastal lowlands (Morgan, 1948). From 1900 to 1910 the coastal highlands of the North Shore (including the project area) were opened up for pineapple production (Estioko-Griffith, 1986). The plantations' greatest period of prosperity was 1920 to 1925 (Hungerford, 1963).

By 1928, many of the pineapple plantations in Pupukea were being replaced by avocado orchards. Gradually, agriculture in the area was reduced, and a major factor in the decline was the abandonment of the Oahu Railroad & Land Company lines in 1947. Turnover of agricultural land to residential communities has occurred on the North Shore since 1950 (Estioko-Griffith, 1986). At the property, the abandonment of plateau fields and avocado orchards has led to their being used as grazing land since the early 1960's (J. Hitch, pers. comm.).

Archaeological and Historic Findings on the Project Site: During the present reconnaissance survey of the project area, 60 previously unrecorded archaeological sites were identified. Of the 60 identified sites, 50 are totally within the project area, four are partially within its boundaries, and six are totally outside the area. The 60 sites are comprised of at least 112 features representing 15 feature types. Feature types include: terrace, retaining wall, free-standing wall, rockshelter, cave, pavement, enclosure, cairn, petroglyph, mound, and a variety of historic types including earthen, concrete, masonry, wood, and metal constructions. The general locations of the sites are indicated on Figure 5-1. Table 5-1 provides a detailed breakdown by site listing, component feature, functional interpretation and cultural resource management value mode assessment.

Six of the 60 sites identified in the study are located immediately outside of the project boundaries. The 54 sites within the project area appear to represent three temporal periods: 25 sites date to the late prehistoric and/or historic period; 22 sites date to about 1880 to 1920; and seven sites date to 1920 to 1970. Most of the sites reflect economic and subsistence activities; however, several sites are related to either military activity or mortuary/ceremonial activities. Most of the features within the project area are stone structures, and most of these have been damaged to varying degrees whether by cattle grazing, by agricultural clearing, or by natural occurrences such as landslides, alluviation, and stream erosion.

General Significance Assessments and Recommended General Treatments: To facilitate State and County review, general significance assessments and recommended general treatments for the 54 sites identified within or partially within the project area during the reconnaissance survey are summarized in



Source: Paul H. Rosendahl, Ph. D., Inc. / Group 70 International, Inc.

ARCHAEOLOGICAL RESOURCES SITE MAP

LIHI LANI

FIGURE 5-1

TABLE 5-1
Summary of Identified Sites
Pupukea - Paumalu Development Project Area

Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	*CRM Value Assess. R	I	C	Comments
T-1	Linear mound	Agricultural(?)/ ceremonial(?)	M	L	L	Possible disturbed terrace; coral offerings?
T-2	Alignment and basalt scatter	Agricultural(?)	L	L	L	Bulldozed/disturbed by cattle
T-3	Mod. outcrop	Agricultural(?)	L	L	L	Bulldozed
T-4	U-shaped earthen berm	Railroad siding(?)	L	L	L	Early 20th century(?)
T-5	Terrace	Agricultural	M	L	L	High, well-preserved terrace wall
T-7	Cairn	Trail or property marker(?)	L	L	L	Collapsed; early historic(?)
T-13	(Complex of 13 features)	Habitation; agricultural; rock art	M	L	M	Late prehistoric/ early historic
T-14	Well and foundation	Water source	L	L	L	Early to mid-20th century(?)
T-15	Ditch	Irrigation	L	L	L	Early 20th century(?)
T-16	Linear mound	Water diversion(?)	L	L	L	Poss. diverted water away from Site T-5; early historic or prehistoric
T-17	Ditch	Irrigation	L	L	L	Early 20th century(?)

*Cultural Resource Mgmt.--Nature: R = scientific research, I = Interpretive,
Value Mode Assessment C = cultural

Degree: H = high, M = moderate, L = low

SOURCE: Paul H. Rosendahl, Inc.1988

TABLE 5-1 (Continued)

Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Assess. R	I	C	Comments
T-18	Rockshelter	Temp. habitation; quarry	M	L	L	Short stone wall present near shelter
T-19	Rockshelters [2]	Temp. habitation	M	L	L	Artifacts include coral abrader, polished basalt
T-20	Reinforced concrete bunker	WII coastal defense	L	M	L	Outside project area
T-21	Retaining wall	RR or wagonroad bed	L	L	L	From early 20th century plantation
T-22	(Complex of 4 features)	WWII coastal defenses	L	L	L	Includes a tiered concrete bunker
T-23	(Complex of 9 features)	Poss. plantation manager's home	M	L	L	Early 20th century(?); in poor condition
T-25	Retaining walls [2]	RR or wagonroad bed	L	L	L	Road is on 1904 map
T-30	Rockshelters [3]	Temp. habitation(?)	M	L	L	Prehistoric with internal and external walls
T-31	(Complex of 6+ features)	Agricultural	M	M	M	Outside project area; early historic(?)
T-32	Retaining wall	RR or wagonroad bed	L	L	L	Road on 1904 map
T-33	(Complex of 4 features)	RR or wagonroad beds	L	L	L	Portions of site on 1904 map
T-34	Cave	Burial	H	L	H	Early historic/ prehistoric; previously recorded?

[#] Number of features

TABLE 5-1 (Continued)

Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Assess. R	I	C	Comments
T-35	Retaining wall	Indeterminate	L	L	L	Outside project area
T-37	(Complex of 4 features)	RR or wagonroad bed; retaining walls; water crossing	L	L	L	Early 20th century
T-38	Pumphouse	Water source	L	L	L	Operated 1950 to 1970
T-40	(Complex of 2 features)	WWII command post(?)	L	L	L	Includes collapsed shed, steps, concrete slabs
T-42	Dam	Agricultural	L	L	L	Outside project area; comprised of basalt boulders
T-43	Reinforced concrete bunker	WWII coastal defense	L	L	L	Part of system formed by T-20, -22, and -40
T-45	(Complex of 3 features)	Trench complex	L	L	L	WWII related; mostly outside project area
T-46	Retaining wall	RR or wagonroad bed	L	L	L	Early 20th century
T-47	Bottle and rubbish scatter	Trash dump	M	L	L	Early 20th century(?)
T-48	Mounds [2]	Agricultural clearing (?)	L	L	L	Early 20th century
T-49	Retaining wall	RR or wagonroad bed	L	L	L	Early 20th century (?)
T-50	(Complex of 3 features)	Wagon road	L	L	L	Road on 1904 map

TABLE 5-1 (Continued)

Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Assess. R	I	C	Comments
T-52	(Complex of 2 features)	Animal pen	L	L	L	c. 1900(?)
T-53	Retaining wall	RR or wagonroad bed	L	L	L	Early 20th century(?)
T-54	Rockshelter	Temp. Habitation(?)	M	L	L	Prehistoric/early historic(?)
T-55	Wall	Boundary(?)	L	L	L	c. 1900(?)
T-56	Retaining wall	RR or wagonroad bed	L	L	L	Early 20th century(?)
T-57	Enclosure	Animal control	L	L	L	Mostly outside project area
T-58	(Complex of 3 features)	RR or wagonroad bed	L	L	L	Road on 1904 map
T-59	Retaining wall	RR or wagonroad bed	L	L	L	Early 20th century(?)
T-62	Linear mound	Agricultural clearing(?)	L	L	L	Early 20th century(?)
T-64	Rockshelter with wall	Temp. habitation	M	L	L	Early historic/ prehistoric; volc. glass collected
T-65	Rockshelter with wall	Temp. habitation	M	L	L	Early historic/ prehistoric(?)
T-66	Rockshelter	Temp. habitation	M	L	L	Early historic/ prehistoric scatter of exotic basalt
T-67	Rockshelter	Burial/ temp. habitation(?)	H	L	H	Early historic/ prehistoric

TABLE 5-1 (Continued)

Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Assess. R	I	C	Comments
T-69	(Complex of 2 features)	Ceremonial(?); agricultural; heiau(?)	H	H	H	Outside project area
T-70	(Complex of 5 features)	Burials; temp. habitation; rock art	H	H	H	Prehistoric/ early historic
T-71	(Complex of 3 features)	Temp. habitation(?)	M	L	L	Prehistoric/ early historic
T-72	Rockshelter	Temp. habitation/ burial	H	M	H	Prehistoric/ early historic
T-73	Rockshelters [2]	Temp. habitation	M	L	L	Prehistoric/ early historic; may contain hearth deposit
T-74	Wall	Boundary	L	L	L	Outside project area
T-75	(Complex of 3 features)	Temp. habitation	M	L	L	Prehistoric/ early historic; internal walls present
T-76	(Complex of 4 features)	Agricultural	L	L	L	Early 20th century
T-77	Rockshelter with wall	Burial (?)	M	L	L/H	Probably prehistoric
T-78	Cave	Temp. hab./quarry	M	L	L	Prehistoric
T-79	Cave	Shrine (?)	M	L	L	Prehistoric
T-80	Cave	Burial	H	L	H	Disturbed

Table 5-2. Significance categories used in the evaluation process are based on the National Register criteria contained in the Code of Federal Regulations (36 CFR Part 60). The State Department of Land and Natural Resources-Historic Sites Section (DLNR-HSS) uses these criteria to evaluate eligibility for both the Hawaii State and National Register of Historic Places. Sites determined to be potentially significant for information content (Category A, Table 5-2) fall under Criterion D, which defines significant resources as ones which "...have yielded, or may be likely to yield, information important in prehistory or history." Sites potentially significant as representative examples of site types (Category B, Table 5-2) are evaluated under Criterion C, which defines significant resources as those which "...embody the distinctive characteristics of a type, period, or method of construction..., or that represent a significant and distinguishable entity whose components may lack individual distinction."

Sites with potential cultural significance (Category C, Table 5-2) are evaluated under guidelines prepared by the Advisory Council on Historic Preservation (ACHP) entitled "Guidelines for Consideration of Traditional Cultural Values in Historic Preservation Review" (ACHP, 1985). *The guidelines define cultural value as "...the* contribution made by an historic property to an ongoing society or cultural system.

A traditional cultural value is a cultural value that has historical depth" (1985:1). The guidelines further specify that "[a] property need not have been in consistent use since antiquity by a cultural system in order to have traditional cultural value" (1985:7).

Of the total 54 sites identified within or partially within the project area, 48 sites are significant solely for information content. For 31 of the 48 sites, no further work is recommended. For 16 of the 48 sites, further data collection is recommended. Of the remaining seven of the 54 total sites, six are assessed as significant for information content and for cultural value. Further data collection and preservation "as is" are recommended for these six sites; however, if preservation is not compatible with development plans, further data collection is recommended for these sites. After further data collection is completed, physical preservation of these sites would not be considered essential, although some might be considered for inclusion into development landscaping. The last site, T-70, is assessed as significant for information content, as an excellent example of a site type, and as culturally significant. Further data collection and preservation with interpretive development is recommended for this site.

In order to facilitate future decisions regarding site treatments, sites are further evaluated in terms of three value modes which are derived from the State and Federal evaluation criteria. The archaeological sites are evaluated in terms of potential scientific research, interpretive, and/or cultural values. <u>Research value</u> refers to the potential of archaeological resources for producing information useful in the understanding of culture history, past lifeways, and cultural processes at the local, regional, and inter-regional levels of organization. <u>Interpretive value</u> refers to

TABLE 5-2
General Significance and Recommended Treatment of Archaeological Sites

Site Number	Significance Category A	X	B	C	Recommended Treatment FDC	NFW	PID	PAI
T-2	–	+	–	–	–	+	–	–
T-3	–	+	–	–	–	+	–	–
T-4	–	+	–	–	–	+	–	–
T-7	–	+	–	–	–	+	–	–
T-14	–	+	–	–	–	+	–	–
T-15	–	+	–	–	–	+	–	–
T-16	–	+	–	–	–	+	–	–
T-17	–	+	–	–	–	+	–	–
T-21	–	+	–	–	–	+	–	–
T-22	–	+	–	–	–	+	–	–
T-25	–	+	–	–	–	+	–	–
T-32	–	+	–	–	–	+	–	–
T-33	–	+	–	–	–	+	–	–
T-37	–	+	–	–	–	+	–	–
T-38	–	+	–	–	–	+	–	–
T-40	–	+	–	–	–	+	–	–
T-43	–	+	–	–	–	+	–	–
T-45	–	+	–	–	–	+	–	–

General Significance Categories:

A=Important for information content, further data collection necessary (PHRI=research value);
X=Important for information content, no further data collection necessary (PHRI=research value, DLNR-HSS=not significant);
B=Excellent example of site type at local, region, island, State, or National level (PHRI=interpretive value); and
C=Culturally significant (PHRI=cultural value).

Recommended General Treatments:

FDC=Further data collection necessary (intensive survey and testing, and possibly subsequent data recovery/mitigation excavations);
NFW=No further work of any kind necessary, sufficient data collected, archaeological clearance recommended, no preservation potential;
PID=Preservation with some level of interpretive development recommended for consideration (including appropriate related data recovery work); and
PAI=Preservation "as is," with no further work (and possible inclusion into landscaping), or further data collection necessary.

SOURCE: Paul H. Rosendahl, Inc.1988

TABLE 5-2 (Continued)

Site Number	Significance Category				Recommended Treatment			
	A	X	B	C	FDC	NEW	PID	PAI
T-46	-	+	-	-	-	+	-	-
T-48	-	+	-	-	-	+	-	-
T-49	-	+	-	-	-	+	-	-
T-50	-	+	-	-	-	+	-	-
T-52	-	+	-	-	-	+	-	-
T-53	-	+	-	-	-	+	-	-
T-55	-	+	-	-	-	+	-	-
T-56	-	+	-	-	-	+	-	-
T-57	-	+	-	-	-	+	-	-
T-58	-	+	-	-	-	+	-	-
T-59	-	+	-	-	-	+	-	-
T-62	-	+	-	-	-	+	-	-
T-76	-	+	-	-	-	+	-	-
Subtotal: 31	0	31	0	0	0	31	0	0
T-1	+	-	-	-	+	-	-	-
T-5	+	-	-	-	+	-	-	-
T-18	+	-	-	-	+	-	-	-
T-19	+	-	-	-	+	-	-	-
T-23	+	-	-	-	+	-	-	-
T-30	+	-	-	-	+	-	-	-
T-47	+	-	-	-	+	-	-	-
T-54	+	-	-	-	+	-	-	-
T-64	+	-	-	-	+	-	-	-
T-65	+	-	-	-	+	-	-	-
T-66	+	-	-	-	+	-	-	-
T-71	+	-	-	-	+	-	-	-
T-73	+	-	-	-	+	-	-	-
T-75	+	-	-	-	+	-	-	-
T-78	+	-	-	-	+	-	-	-
T-79	+	-	-	-	+	-	-	-
Subtotal: 16	16	0	0	0	16	0	0	0
T-13	+	-	-	+	+	-	-	+
T-34	+	-	-	+	+	-	-	+
T-67	+	-	-	+	+	-	-	+
T-72	+	-	-	+	+	-	-	+
T-77	+	-	-	*	+	-	-	*
T-80	+	-	-	+	+	-	-	+
Subtotal: 6	6	0	0	6	6	0	0	6
T-70	+	-	+	+	+	-	+	-
Subtotal: 1	1	0	1	1	1	0	1	0
Total: 54	23	31	2	5	23	31	1	5

the potential of archaeological resources for public education and recreation. Cultural value refers to the potential of archaeological resources to preserve and promote cultural and ethnic identity and values.

B. Potential Impacts

The proposed project will have no different effects on archaeological sites as compared to the 1991 plan. These have been thoroughly discussed in the Final EIS (Group 70, April 1991). Figure 5-1 shows an overlay of the project master plan areas and archaeological sites on the property. Sixteen of the 54 archaeological sites identified by PHRI (May 1988) will be directly affected by the development of the proposed project. These sixteen directly affected sites are found within the entrance area (T-4, 5, 7, 10, 13, 14, 15, 17, 18, 19, 25(a), 80); the residential area (T-23) and the community facilities (T-1, 2, 3). Indirectly affected sites, which are those which could potentially be accessed by hikers and project residents, are discussed later in this section.

Of the 16 directly affected sites, nine sites (T-2, 3, 4, 7, 14, 15, 17, 20, 25(a)) PHRI recommends for no further work of any kind. Sufficient data were collected during the archaeological survey, during which it was determined that these sites have no preservation potential. Based on this information, the project's effect on these areas (destruction or alteration) will not constitute any significant impact on archaeological resources. Final concurrence with DLNR Historic Preservation Division (HPD) is required for this determination, prior to any disturbance of these sites.

Seven of the 16 directly affected sites (T-1, 5, 13, 18, 19, 23, 80) are significant sites and are recommended by PHRI for further data collection, including intensive survey and testing (Table 5-2). Construction activities at these sites will destroy or alter their present condition. These sites include: T-1, 5, 13, 18 and 19 at the entrance area; and T-23 in a residential area. They include individual sites and complexes which were used for habitation, agricultural or ceremonial, quarry or burial purposes. Burials on the site will be discussed with the State HPD and the Oahu Burial Council. Their recommendations will be followed. All planned site improvements will be carefully designed and located to avoid the most significant sites. This includes site T-70, a complex of five features including burials, temporary habitation and rock art. Site T-70 will be preserved and possibly developed for interpretive purposes. These sites have been described in detail in the Final EIS (Group 70, April 1991) and the complete archaeology report by PHRI (Appendix N of the Final EIS).

C. Mitigative Measures

Several mitigative measures have been proposed to minimize potential impacts to archaeological resources.

(1) Data Recovery and Mitigation Plan: Information gathering on the site to date has been extensive, and PHRI has produced an in-depth inventory of archaeological sites. Measures have been recommended by PHRI to minimize the effect of the project on existing archaeological and historic resources. An archaeological data recovery and mitigation plan will be prepared for the significant sites on the property. The plan must be reviewed and approved by DLNR prior to construction. The mitigation plan will include a site-specific data recovery plan and a preservation plan.

Through the PHRI method of site sensitivity classification, the most sensitive sites have been recommended for additional data collection and interpretation or preservation by accepted methods. For the seven significant sites directly affected by the project development, all are recommended for further data collection (intensive survey and testing, and possibly subsequent data recovery/mitigation excavations). Where possible, these sites will be preserved "as is", or will be included into the project's landscaping. This will be determined during the future detailed site planning for the project. Site specific data recovery tasks are shown in Appendix N.

(2) Data Collection for Significant Sites: Upon approval of the Data Recovery and Mitigation Plan by the DLNR-HPD, the 23 significant sites on the property are all planned to undergo further data collection. Of these sites, seven will be directly affected by the project. As committed to previously, further data collection will be conducted prior to construction at the seven directly affected sites, and at those of the 16 potentially significant sites which may be indirectly affected. These sites may become accessible to hikers and residents.

(3) Intensive Data Collection and Mitigation at Directly Affected Sites: At the seven significant sites which are not planned to be preserved, intensive data collection and mitigation excavations (if necessary) will be undertaken prior to construction, following the recommendations provided by the DLNR-HPD. These measures will provide for obtaining adequate archaeological data from these sites prior to their destruction. If possible, some of these sites (or portions of them) could be retained in the landscaping of the project, pending future detailed site planning.

(4) Treatment of Known and Potential Burial Sites: Human remains at the directly affected site T-80 will be treated according to the recommendations of the Oahu Island Burial Council and DLNR. The recommendation may involve either burial treatment (relocation to a preservation site) or a shift in the roadway alignment (if possible) to allow for in-situ preservation. Other burial sites will be preserved from potential indirect effects from hikers and residents, by routing the hiking trails away from these sites and, possibly, by fencing the sites and planting deterrent forms of landscaping.

(5) Preservation and Interpretive Development of T-70: One significant site (T-70) will undergo further data collection and preservation, and also has been recommended by PHRI for interpretive development. This site will not be affected by the project, and will be preserved "as is" in a section of the site which will not be disturbed by construction. If desired, interpretive development will be undertaken by Obayashi based on the recommendations of the Burial Council, DLNR and the local community.

(6) Monitoring and Notification Procedures During Construction: Where development activities for the project will involve extensive modification of the land surface, there is the remote possibility of encountering unknown or unexpected cultural features, deposits, or burials. In such a situation, work in the area of such remains would be suspended immediately until the monitoring archaeologist has the opportunity to inspect and evaluate the significance of the newly discovered remains. The Historic Sites Office of the State DLNR would be immediately notified to determine the appropriate course of action.

5.2 ROADWAYS AND TRAFFIC

This section includes a presentation of the existing roadways and traffic conditions at the project site and its surrounding area. The potential impact of the project on future traffic conditions is assessed in this section, as well as the recommended mitigative measures to minimize effects on traffic and transportation. A detailed Traffic Impact Assessment was prepared for the 1991 project by Pacific Planning and Engineering, Inc. (PPE) (January 1991). Updated traffic counts were completed by PPE in March 1993, and revised future traffic projections were made to reflect the current development plans for Lihi Lani (September 1993). A summary of this report is included in this section, and the entire report is included as Appendix J.

A. Existing Conditions

The proposed project is surrounded by a largely rural community consisting of residential homes, recreational and agricultural use. Vehicular access to the proposed development will be from Kamehameha Highway, which is the only highway in the area providing for through-traffic along the North Shore of Oahu. A paved access road is planned from the intersection with Kamehameha Highway to the project.

Roadway Conditions: There are only a few roadways in the area of the project, as shown in Figure 1-1. Kamehameha Highway is a rural highway connecting major population centers along the North Shore of Oahu such as Haleiwa, Pupukea and Kahuku. It is a State-maintained highway with a 50-foot wide right-of-way and a 22-foot wide pavement. There is one 11-foot wide lane in each direction.

The shoulders are grassed and vehicles park along both sides of this road. Paved pullouts are provided at most bus stops. The posted speed of Kamehameha Highway is 45 miles per hour (mph) along the project site. In the vicinity of Sunset Beach Elementary School, however, the posted speed is 25 mph when indicated by flashing yellow lights.

The intersection of Kamehameha Highway with the Sunset Beach Elementary School driveway is approximately 900 feet Haleiwa-side of the project access road.

This intersection operates as a stop-controlled "T" intersection. The school driveway is wide enough to permit both a left and right turn lane onto Kamehameha Highway, although it is not marked.

Pupukea Road connects to Kamehameha Highway as a "T" intersection. This intersection, however, operates as a cross intersection with the beach park driveway immediately opposite Pupukea Road providing the fourth or makai leg. The intersection is controlled by stop signs on the Pupukea Road and park driveway approaches. This intersection is approximately one and a half miles Haleiwa-side of the project access road. Pupukea Road has an exclusive left, and through/right turn lanes at the intersection with Kamehameha Highway.

Observed Traffic Conditions: A review of State Department of Transportation (DOT) traffic count data at the intersection of Kamehameha Highway and Pupukea Road (Station 25-A) indicated that the weekday commuter peak hours generally occur between 6:00 and 8:30 a.m. and between 3:30 and 5:30 p.m. The weekend peak period generally occurs between 1:00 a.m. to 4:00 p.m., with a Sunday peak hour between 1:00 and 4:00 p.m.

Manual counts taken by PPE in March 1993 at the intersection of Kamehameha Highway and Pupukea Road showed greater Sunday afternoon peak hour traffic volumes than the weekday afternoon peak hour. On Sunday during the peak hour, a total of 1,277 vehicles were recorded in both directions along Kamehameha Highway at Pupukea Road, in comparison to 1,026 vehicles during the weekday afternoon peak hour. Additional traffic volume counts and turning movements (where applicable) were taken by PPE in March 1993 at the intersection of Kamehameha Highway with the Sunset Beach Elementary School Driveway.

Traffic counts were taken for school day traffic entering and exiting Sunset Beach Elementary School between 7:15 to 8:15 am, 1:50 to 2:50 pm, and 3:30 to 4:30 pm on the study day. The peak hour for Sunday at this location was between 1:00 and 2:00 pm. Traffic flow along Kamehameha Highway near the proposed project access road was generally continuous and free-flowing. At the Sunset Beach Elementary School driveway, minor delays exist for all turning movements except for the longer delays experienced left turns onto the highway. A presentation of the existing Level-of-Service analysis for these roadways is included in the following sections.

Peak hour traffic counts were also conducted for Kamehameha Highway at the outer ends of the North Shore area in Haleiwa and Kahuku. Sunday afternoon peak hour traffic (1:00 to 2:00 pm) on Kamehameha Highway was counted at both the Kahuku Sugar Mill and the Haleiwa Beach Park on Sunday, 21 March 1993. Total peak hour vehicle counts on Kamehameha Highway totaled 1,225 in Haleiwa and 853 in Kahuku.

Several observations were made during the various field traffic counts. Many vehicles observed were tourist-related or had recreational equipment such as surfboards. Occasionally, long lines of vehicles were observed following a slow-moving vehicles, such as a bus. Bus stops exist at the Sunset Beach Elementary School, and at the Pupukea Road intersection with Kamehameha Highway.

Existing Level-of-Service: The intersections of Kamehameha Highway with Sunset Beach Elementary School driveway and Pupukea Road were analyzed to determine existing Level-of-Service (LOS) conditions. The results of the peak hour analysis are shown in Table 5-3. There is no project access road at present, therefore, no intersection analysis could be performed for existing conditions at this location.

The analysis shows that traffic movements at the intersection of Kamehameha Highway and the school driveway usually operate well. Right turns out of the school driveway experience long delays (LOS C) or better. Left turns out of the driveway onto Kamehameha Highway can experience long delays (LOS C) or better. Left turns into the driveway from Kamehameha Highway experience little or no delays (LOS A). The shared left and right turns from the school operates at LOS D or better, however, very few cars (about 30) make these movements.

On busy weekends at Ehukai Beach Park, the school parking lot is used for overflow beach parking and the driveway is used for U-turns off the highway. There is also a pedestrian crosswalk at the intersection that is frequently used at these times.

At Pupukea Road under weekend peak hour traffic conditions, left-turn movements from Kamehameha Highway experience little or no delay (LOS A). Left-turn movements onto the highway from Pupukea Road and the beach park parking lot currently experience long or very long delays (LOS D or E). Traffic crossing the highway at this intersection also experiences long delays (LOS D), but only a few vehicles attempt these movements. Right-turn movements from Pupukea Road onto the highway experience little or no delay (LOS A).

B. Potential Impacts

Assumptions are made in evaluating potential impacts to traffic conditions in the Sunset Beach area with the development of Lihi Lani. The residential build-out and occupancy of the project was, for the analysis, estimated to take place over twelve year period beginning in 1996 and ending by 2008. Four phases of development will take place with Phases 1 and 2 completed by 2002 and Phases 3 and 4 completed by 2008. This assumption provides a worst-case assessment of traffic conditions at two points in a reasonable time frame for build-out.

The Country lots will be offered in four phases over a 10 to 12-year period, and built out over a twenty year period. As stated earlier, actual buildout of the Country lots is anticipated to be only 65 percent built-out by 2008. Real estate experts predict a residential build-out of this lot sales project will extend over at least 20 years.

Analysis Methodology: The focus of the traffic impact analysis was to determine the impact of the project-generated traffic at the intersections of Kamehameha Highway with (a) the proposed access road, (b) Sunset Beach Elementary School driveway, and

TABLE 5-3

Level-of-Service for Unsignalized Intersection
Weekend Peak Hour (Sunday 3:00 - 4:00 PM)

Intersection	Movement	1993 Existing	2002 Without Project	2002 With Project	2008 Without Projecct	2008 With Project
Kamehameha Highway with Pupukea Road						
Kamehameha Highway						
Laie Bound	LT	A	A	B	B	B
Haleiwa Bound	LT	A	C	C	D	D
Pupukea Beach Park Dr.						
Mauka Bound	LT/TH/RT	B	D	E	E	E
Pupukea Road						
Makai Bound	LT	E	F	F	F	F
	TH/RT	A	D	D	E	E
Kamehameha Highway with Sunset Beach Elementary Driveway						
Kamehameha Highway						
Haleiwa Bound	LT	A	B	B	C	C
Sunset Beach Elem. Driveway						
Makai Bound	LT/RT	D	E	E	E	E
Kamehameha Highway with Project Access Road						
Kamehameha Highway						
Haleiwa Bound	LT	n/a	n/a	C	n/a	D
Project Access Road						
Makai Bound	LT	n/a	n/a	F	n/a	F
	RT	n/a	n/a	B	n/a	C

Notes: LT - Left turn
RT - Right turn
TH - Through

Source: Pacific Planning & Engineering, Inc. (September 1993)

(c) Pupukea Road. The two time points selected for analysis, Phases 1 and 2 in 2002 and the conclusion of Phases 3 and 4 in 2008. Future traffic forecasts with and without the project were estimated for these two points in time. Forecasts were made for the weekday morning, weekday afternoon, and Sunday afternoon peak hours.

The estimated traffic is calculated by adding the expected project traffic to the estimates of future traffic on Kamehameha Highway. The intersections of Kamehameha Highway with the project access road were then analyzed for conditions without and with the project-generated traffic in 2002 and 2008. The intersections of Kamehameha Highway with Pupukea Road and the Sunset Beach Elementary School were also analyzed without and with project-generated traffic for comparison purposes.

Future Ambient Traffic: The eventual expansion of the Kuilima Resort and other known North Shore projects, along with projected growth on other areas of the island, are expected to contribute to an increase in ambient traffic on Kamehameha Highway in the project area. Future ambient traffic for the study area was calculated considering development by 2002 and 2008 of the Kuilima Resort, Kahuku Villages, Laie Residential area and the Pupukea Shopping Village.

Trip generation rates for future regional developments in the area of the project are presented in Table 5-4 and Appendix J. This table shows the total estimated peak hour traffic from these completed projects at Kamehameha Highway during the weekday morning, weekday afternoon and Sunday peak hour. The analysis covers both 2002 and 2008 time points to reflect the additional growth projected to occur in the next decade. According to the existing traffic pattern and estimates of population and employment, these trips were distributed and assigned to the roadways. A 0.8 percent annual growth factor for traffic volumes on Kamehameha Highway was included. Details of the determination of future ambient traffic are included in the appended traffic study.

Trip Generation: Future traffic generated by Lihi Lani was derived based upon the land uses for the project, shown in the Master Plan (Figure 2-1). Estimates of the number of vehicles entering and exiting each land use were made based upon data provided in the <u>Trip Generation Report</u> (Fifth Edition) (Institute of Transportation Engineers, 1991). Table 5-4 shows the breakdown of vehicle trips generated by the Lihi Lani project.

A small portion of the vehicle trips generated by the development are expected to be "internal trips". The project will contain many attractions for the project's residents, such as the horse ranch, camping, community facilities and hiking trails will attract trips that would otherwise have left the project for external attractions. It was estimated that approximately 10 percent of the project-generated trips on weekdays would remain within the project, with 20 percent on weekends. Approximately 75 percent of the Country lot homes are expected to be full-time residences, with the

TABLE 5-4

Summary of Traffic Contribution along Kamehameha Highway for Years 2002 and 2008

Phases I & II - Year 2002 (1)

Development	Morning Peak Hour Percentage	Afternoon Peak Hour Percentage	Sunday Peak Hour Percentage
Lihi Lani Project			
Market Housing	2.2%	2.9%	2.0%
Affordable Housing	0.9%	1.3%	1.7%
YMCA	0.9%	2.2%	1.0%
Ranch Facilities	0.8%	0.8%	0.5%
Lihi Lani Subtotal	4.8%	7.2%	5.2%
Kamehameha Highway	45.6%	51.0%	57.5%
Other Regional Developments(2)	49.6%	41.8%	37.3%
Total Percentage	**100.0%**	**100.0%**	**100.0%**

Phases III & IV - Year 2008 (1)

Development	Morning Peak Hour Percentage	Afternoon Peak Hour Percentage	Sunday Peak Hour Percentage
Lihi Lani Project			
Market Housing	3.4%	4.7%	3.3%
Affordable Housing	0.8%	1.1%	1.4%
YMCA	0.7%	1.8%	0.8%
Ranch Facilities	0.6%	0.6%	0.5%
Lihi Lani Subtotal	5.5%	8.2%	6.0%
Kamehameha Highway	36.7%	42.6%	49.3%
Other Regional Developments(2)	57.8%	49.2%	44.7%
Total Percentage	**100.0%**	**100.0%**	**100.0%**

Note:
(1) Assumes 100% build-out of residential components.
(2) Includes Kahuku Villages, Laie Developments, Kuilima Resort Expansion, and Pupukea Shopping Village

Source: Pacific Planning and Engineering, Inc. (August 1993)

remainder part-time residences. All of the 50 on-site affordable homes and 80 elderly apartments will be full-time residences.
Of note, approximately 48 percent of the total vehicle trips generated by the project during the weekdays will be associated with the proposed affordable housing, elderly housing and community facilities. On weekends, approximately 52 percent of vehicle trips to and from Lihi Lani will be associated with the affordable housing, elderly housing and community facilities.

As compared to the 1991 plan for Lihi Lani, trip generation from the proposed project will be less for all peak periods. Trip generation for weekday mornings is anticipated to be two percent less than with the 1991 plan, and weekday afternoons are projected to have five percent less vehicle trips. Elimination of the golf course will have only a minor reduction (2 to 5 percent) on weekday peak period vehicles trips. The reduction of weekend peak period vehicle trips under the proposed project will be substantial, with 23 percent less vehicle trips as compared to the 1991 plan. Traffic from the project will be even lower than the PPE projection during the first 20 years of Lihi Lani due to slow buildout of the Country lots.

Trip Distribution: Trip distribution is the process by which trips from one area are connected with trips from another area, thereby linking origins and destinations. The distribution of trips generated by the project was estimated based on the location of attractions and jobs.

Many attractions lie in the direction of Haleiwa, including the closest shopping areas at Pupukea Foodland and the Haleiwa shopping areas. Trips towards Haleiwa from the project will also be caused by people traveling to popular beaches, such as Waimea Bay, and by people traveling to the H-2 Freeway (starting in Wahiawa) which provides the fastest route to Honolulu. In the Kahuku direction, there is Sunset Beach, the Kuilima Resort, and the Polynesian Cultural Center. It is estimated that 60 percent of the trips entering and exiting from the development will ingress/egress to and from the Haleiwa direction, with 40 percent entering/exiting to and from the Kahuku direction.

Traffic Assignment: Traffic assignment is the process by which trips are assigned to the roadway network in the project area. Traffic from the project was assigned to Kamehameha Highway which is the only access to the North Shore and connects the major population centers. From the assignment of vehicles to the local roads, traffic forecasts can be evaluated for the intersections of Kamehameha Highway with the (future) project access road, Sunset Beach Elementary School driveway, and Pupukea Road. Details of the traffic assignments are included in Appendix J.

Construction Traffic Impacts: Short-term traffic impacts will occur as a result of construction-related traffic entering and exiting the project. Trucks hauling construction materials such as cement, pipes, lumber, crushed rock and asphalt concrete will average one or two trips per day. For approximately two weeks during on-site roadway construction, up to 10 trucks per hour or 80 trucks per day will be hauling asphalt concrete to the project.

Traffic generated by construction workers will occur during the early morning hours and when workers leave the project in the afternoon. An estimated 60 workers are expected at the project each day, which are expected to generate approximately 20 vehicle trips during the morning and afternoon peak hours. Most of the workers will be transported to the project on company trucks from base yards in Honolulu. Construction-related traffic entering and leaving the project will decrease beyond 1998, when the estimated work force (involved mainly with residential and small scale infrastructure construction) is expected to drop to 50 to 60 workers daily. Preliminary plans call for most of the earth moving operations to be confined to the project site, therefore, few trucks are expected to haul fill material onto or remove excess excavated material from the site. This will further minimize truck traffic in and out of the project and along Kamehameha Highway.

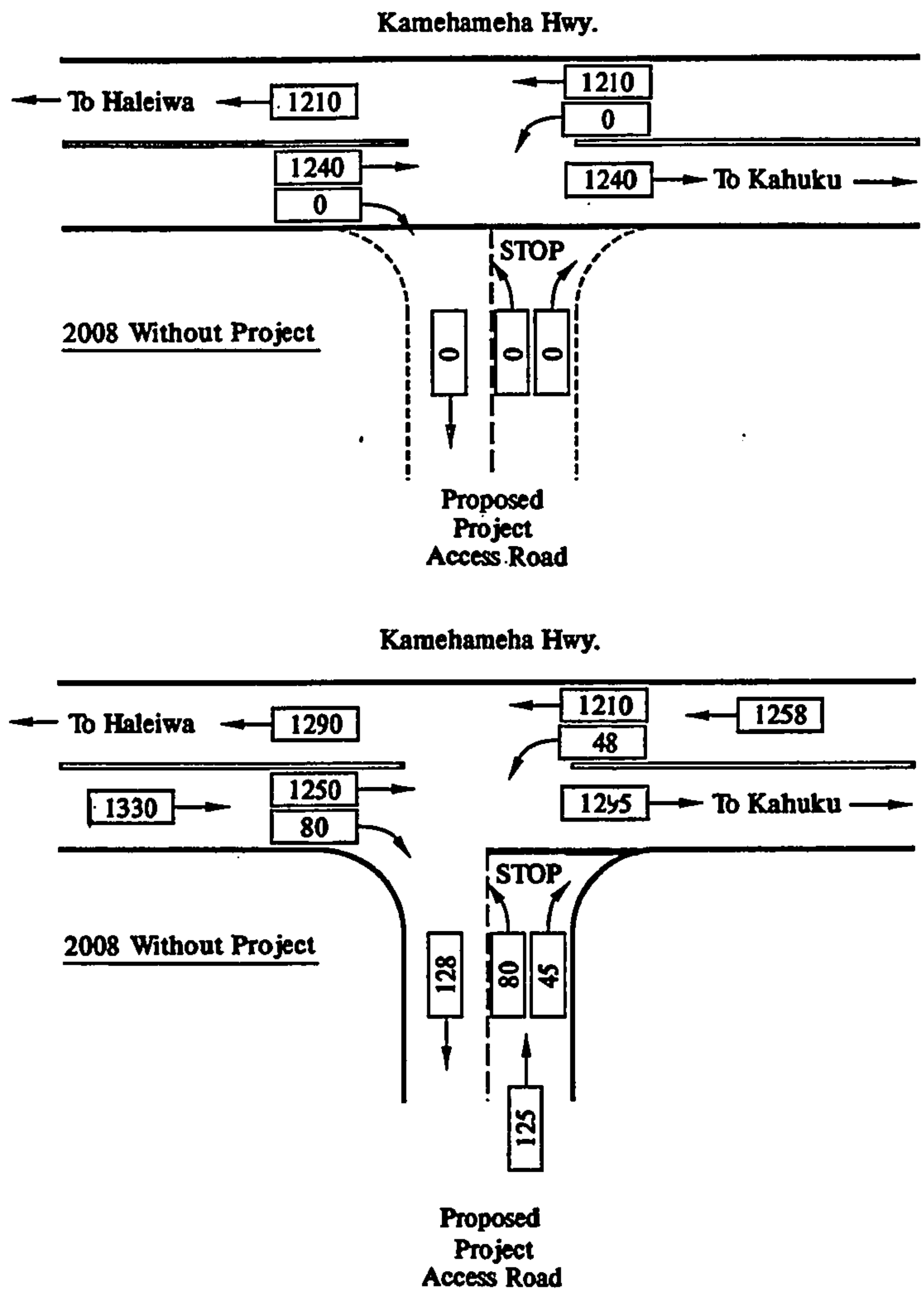
Traffic Impacts: Impacts of the forecasted increase in traffic were assessed by the change in Level-of-Service (LOS) at the three study intersections for two separate conditions: without the project traffic, and with the project traffic. The three study intersections (project entrance, Sunset Beach Elementary School and Pupukea Road) were analyzed as unsignalized intersections. Traffic flow at the project entrance is shown in Figure 5-2. The results of the LOS analysis for the project entrance intersection with Kamehameha Highway, and the intersections of Kamehameha Highway at Pupukea Road and the Sunset Beach Elementary School are shown in Table 5-3.

The results indicate that traffic in general along Kamehameha Highway will not be significantly affected by the addition of the traffic which will be generated by the project. The future increase in ambient traffic and new regional development traffic are the primary cause of changes in the Level-of-Service. The project's impact on the Level-of-Service along Kamehameha Highway at the study intersections is expected to be minimal. At the Pupukea Road intersection, traffic from the project will cause a slight reduction in the operation of the Beach Park driveway.

Table 5-3 indicates that the left turn movements from Kamehameha Highway into the project will experience some traffic delays (LOS C or D). The creation of left turn storage lane into the project for the Haleiwa-bound lane of Kamehameha Highway will minimize delays for through-traffic.

The primary traffic flow problem in the future years 2002 and 2008 will be with left turn movements out of side streets onto Kamehameha Highway, which will experience very long delays or extreme delays (LOS E or F). These results are due to the anticipated significant growth of traffic volumes along Kamehameha Highway from other regional developments and ambient growth.

Weekend peak hour traffic conditions at the project entrance will generally be poor with or without Lihi Lani. As indicated in Table 5-3, left turn movements into the project for traffic heading toward Haleiwa on Kamehameha Highway will generally operate at LOS C or D, which involve moderate delays. The right turn lane exiting



LEGEND

809 → FORECASTED NUMBER OF CARS AND DIRECTION OF TRAVEL DURING AFTERNOON PEAK HOUR BETWEEN 1:00 AND 2:00 PM ON SUNDAY

TRAFFIC FLOW DIAGRAM--PROJECT ENTRANCE

LIHI LANI

Source: Pacific Planning & Engineering, Inc.

FIGURE 5-2

the project will operate at LOS B to C. Long delays will also be experienced by vehicles making left turns out of the project access road (LOS E or F).

At the Sunset Beach Elementary School driveway, during the afternoon peak hour, the worst Level-of-Service rating is for the left turn movement out of the school. Even without the Lihi Lani traffic, the existing LOS B rating of the left turn movement, changes to LOS E.

Drivers turning left from Pupukea Road onto Kamehameha Highway are currently experiencing very long delays (LOS E) during the weekend peak hour. Should the current 0.8 percent growth rate for ambient traffic along Kamehameha Highway continue, the Level-of-Service at the Kamehameha Highway and Pupukea Road intersection will probably drop to LOS F by the year 1995. Through-traffic will operate at LOS D to E.

Therefore, even without the traffic from *Lihi Lani*, the Pupukea Road intersection may require signalization in the future. The State Department of Transportation (DOT) is responsible for conducting periodic traffic assessments to determine when traffic signals are warranted at this and other intersections. Lihi Lani will conduct traffic counts periodically to monitor the project access road intersection.

Area-wide Traffic Impacts: With respect to North Shore area-wide traffic conditions, weekend peak hour traffic flow at Haleiwa and Kahuku is expected to operate at LOS D or E without the addition of project-generated traffic. The future traffic volume increases will largely be due to the growth of ambient traffic and traffic generated by other region developments. Future traffic volumes on Kamehameha Highway without traffic from Lihi Lani is expected to increase over current 1993 levels.

Traffic from Lihi Lani will not change the Level-of-Service along Kamehameha Highway during the weekend peak hour. Of the total traffic on the highway in 2002, traffic associated with a fully developed project at Lihi Lani would represent 5.2 percent. Of the total weekend traffic on the highway in 2008, traffic associated with Lihi Lani (full development) would represent 6.0 percent. Highway traffic contributions from Lihi Lani (full development) during the weekday peak hour would be slightly higher, represent 7.2 percent in 2002 and 8.2 percent in 2008. Table 5-4 shows the relative contributions to total Kamehameha Highway traffic from each of the land uses at full development of Lihi Lani.

Comparison with 1991 Project Plan: The current plans for Lihi Lani are a significant modification of the previous plans, which called for an 18-hole golf course, 120 Country lots, 180 affordable homes, equestrian center, campground and community facilities. The current project is different in many ways, partly due to the removal of the golf course and in the of residential unit composition to 315 Country lots, 50 single-family affordable homes, and 80 elderly affordable rental apartments.

As compared to the previous project, the resulting vehicle trip generation generated by the current project at full development will be less during both the morning and afternoon weekday peak hour periods. Trip generation for the current project will be 98 percent of the morning peak hour and 95 percent of the weekday afternoon peak hour of the traffic estimated from the 1991 plan. These reductions in expected trip generation are slight, however, they are less than the traffic previously expected. The greatest change in trip generation is found during the weekend peak period (Sunday afternoon) when trip generation is 23 percent lower for the proposed project as compared to the 1991 plan. The change in the project to remove the golf course results in much less traffic during the weekend peak period than will the current proposal.

Removal of the golf course and residential development phasing will have another significant effect in reducing the potential traffic impact of the project. The golf course would have been built immediately under the previous plan, and the traffic impact associated with the golf course would be immediate. The housing development under the current plan is phased over 12 years or longer, so the trip generation will grow slowly over time and never reach the levels predicted under the previous plan. Overall, the change in project plans from the 1991 golf course project have caused a *significant* reduction in traffic from Lihi Lani.

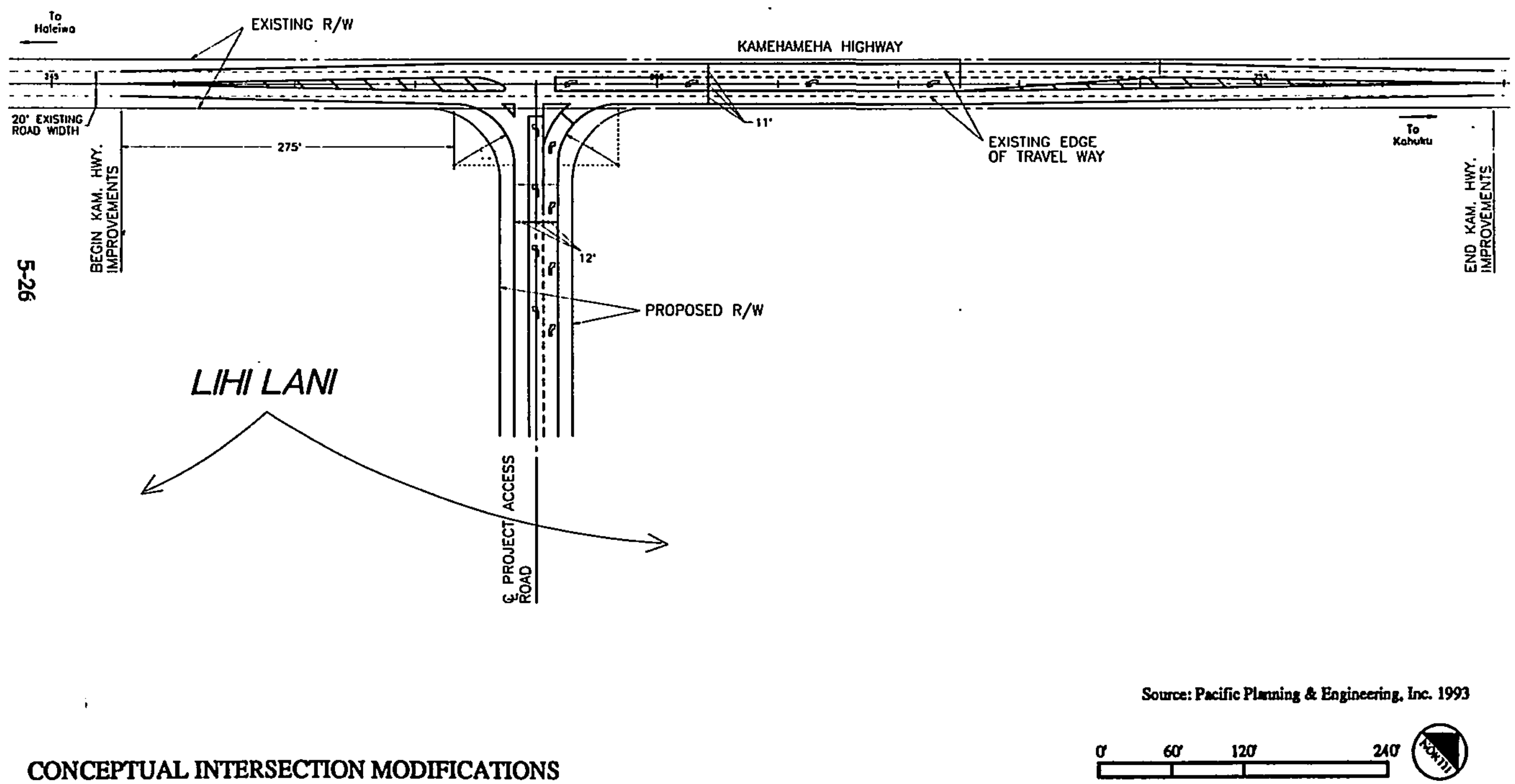
C. Mitigative Measures

Several mitigative measures are planned for implementation to minimize the impact of traffic generated by Lihi Lani, as discussed below.

(1) Phasing of Development and Residential Build-out Projection: Based on market projections and historical trends in development of lot sales projects, all 315 of the lots will be sold over a ten year period. Development of homes on 100 percent of the Country lots will take much longer, at least 20 years (2016). For this analysis, development of Lihi Lani was assumed to be 100 percent complete and occupied by 2008. As a result of the slower projected build-out of the individual homes, actual traffic impacts of Lihi Lani will be smaller in the first 20 years.

(2) Left Turn Storage Lane on Kamehameha Highway: An exclusive left turn storage lane will be constructed at the intersection of Kamehameha Highway and the project access road, as shown in Figure 5-3. This improvement will alleviate possible delays or back-ups on Kamehameha Highway caused by vehicles turning left into the project access road. This should also help minimize rear-end collisions with vehicles slowing down or stopping to turn left into the project access road.

(3) Turning Lanes Out of Project Entrance: Exclusive left turn and right turn lanes exiting from the project road will be provided so that left turning vehicles do not also delay those wanting to turn right onto Kamehameha Highway. This will help traffic flow and improve safety at the intersection.



Source: Pacific Planning & Engineering, Inc. 1993

CONCEPTUAL INTERSECTION MODIFICATIONS
LIHI LANI

FIGURE 5-3

(4) Signal Warrant Study: Due to the projected growth of through-traffic on Kamehameha Highway, Lihi Lani will periodically conduct a signal warrant study at the intersection of the project access road with Kamehameha Highway. A warrant study is required by DOT prior to installation of traffic signals at an intersection.

(5) Installation of Traffic Signals in Future, if Required: As traffic on Kamehameha Highway grows in the foreseeable future, it is likely that the intersection of the project access road and Kamehameha Highway will require traffic signals. It is not known how soon traffic signals will be required, and periodic warrant studies will provide the necessary data to determine their need. Lihi Lani will provide funding for monitoring this intersection as needed. Traffic flow along Kamehameha Highway would be interrupted by signals, allowing for vehicles to safely turn into or out of the project access road. The signals could be timed and traffic-actuated to allow for a short red phase (or flashing yellow) during low traffic periods. Lihi Lani will install the traffic signals to State DOT standards if and when they are required at the project entrance.

(6) Construction Traffic: The number of worker vehicles traveling to and from the site during the heavy construction period will be minimized by the use of company trucks and vans to carry workers from construction company base yards. Truck and heavy equipment travel on local roadways in Pupukea and Sunset Hills will be minimized by constructing the project access road in the earliest period of construction. Truck and heavy equipment travel to and from the site will be conducted during non-peak traffic hours to minimize the impact on local and commuter traffic. During construction phases of the project, special duty police officers shall be employed to assist in directing traffic and the movement of heavy equipment and supplies at the intersection of the project access road and Kamehameha Highway. As compared to the 1991 project plans, less construction workers are expected to be required during the first three years.

(7) Other Considerations: Alternate means of travel, such as express buses, shuttle vans and bicyclists, will be supported in order to reduce the number of vehicular trips to and from the Lihi Lani project. The YMCA is considering the acquisition of vans to shuttle children between the YMCA facilities/activities and their homes. A possibility exists that these vans could be utilized during the peak hours to shuttle Lihi Lani and other North Shore commuters to park-n-ride sites in Central Oahu. If sufficient demand exists, it may also be possible to develop shuttles to transport the elderly or to provide services to destinations, such as the beaches. In addition, the provision of bicycle facilities, such as bike routes and racks, will encourage the use of bicycles for local trips.

(8) Regional Traffic: Obayashi will work with the local community and State Department of Transportation to develop solutions to the existing and future traffic problems in the North Shore region.

5.3 NOISE

Existing noise conditions and potential future noise conditions at Lihi Lani (1991 plan) and its surrounding areas were evaluated by Darby & Associates (December 1990). This technical report was published in the Final EIS (Group 70, April 1991). The findings of the 1990 study are generally applicable to the proposed project, even with the changes to land uses which have been made in the current plans for Lihi Lani.

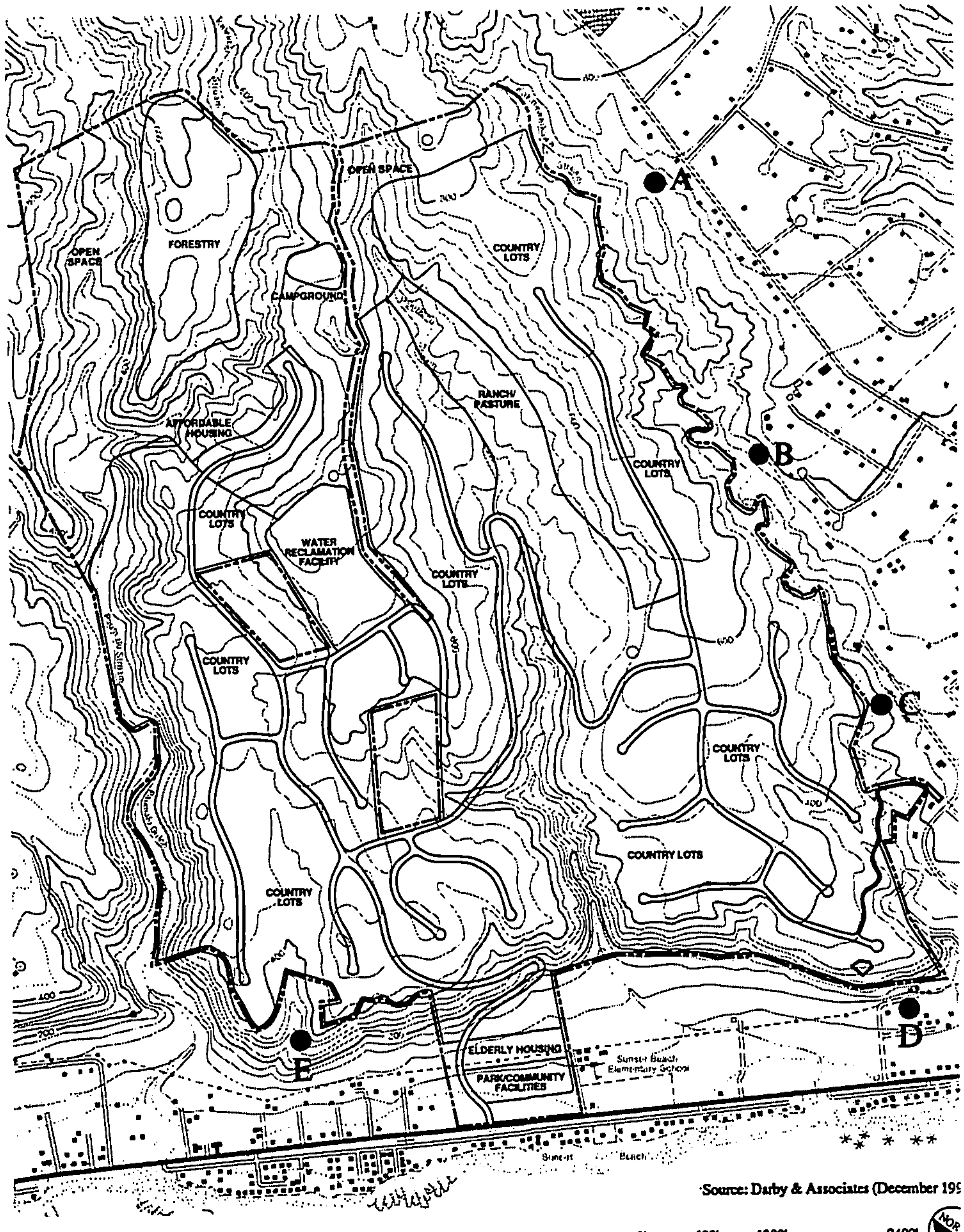
A. Existing Conditions

Noise from sources such as traffic is commonly measured in "A" weighted decibel units (dBA). The A weighting refers to the emphasis of certain sound frequencies over others to simulate the sensitivity of the human ear. The decibel scale is logarithmic, and a 10-fold increase in sound energy results in an increase of 10 dBA corresponding (approximately) to a subjective doubling of loudness. With an instantaneous change in noise, doubling of the sound energy results in an increase of three dBA, the smallest change in noise level considered to be noticeable.

Ambient noise conditions at the project site are generally quiet due to its rural setting. Ambient noise level measurements were performed at several locations surrounding the project site on 1 June 1988, shown in reference to the 1993 Master Plan in Figure 5-4. At locations A, B and C in the Pupukea Highlands residential area, the acoustical condition was dominated by natural sounds such as birds and wind in foliage, and neighborhood noise such as dogs barking. The average or mean ambient noise levels (those exceeded 50 percent of the time, and referenced as L50) ranged from 38 to 40 dBA. At locations D and E, just mauka of Kamehameha Highway, L50 was about 45 dBA and dominated by traffic on the highway, but birds and wind in foliage were also readily audible. Residences located closer to the highway have considerably greater levels of traffic noise. At all noise monitoring sites, an occasional light aircraft or helicopter could be heard. The ambient sounds at residences near or directly on the beach are often dominated by surf noise especially during winter months.

Traffic noise level estimates were also made on 1 June 1988 on the project site at a location approximately 170 feet mauka from the center of Kamehameha Highway, with the microphone positioned about six feet above the ground. The noise level at this location averaged 53 dBA over a 10-minute period. Traffic counts (including the mix of vehicle types) were also made during the noise sample periods in order to validate the FHWA Traffic Noise Prediction Model. Based on the traffic data, the model calculated an hourly noise level of 52.8 dBA, which confirmed the field noise measurements.

The existing residential areas located near Kamehameha Highway are estimated to be exposed to a current Day-Night average sound level (Ldn) as high as 69 dB.



NOISE MEASUREMENT LOCATIONS

LIHI LANI

FIGURE 5

B. Potential Impacts

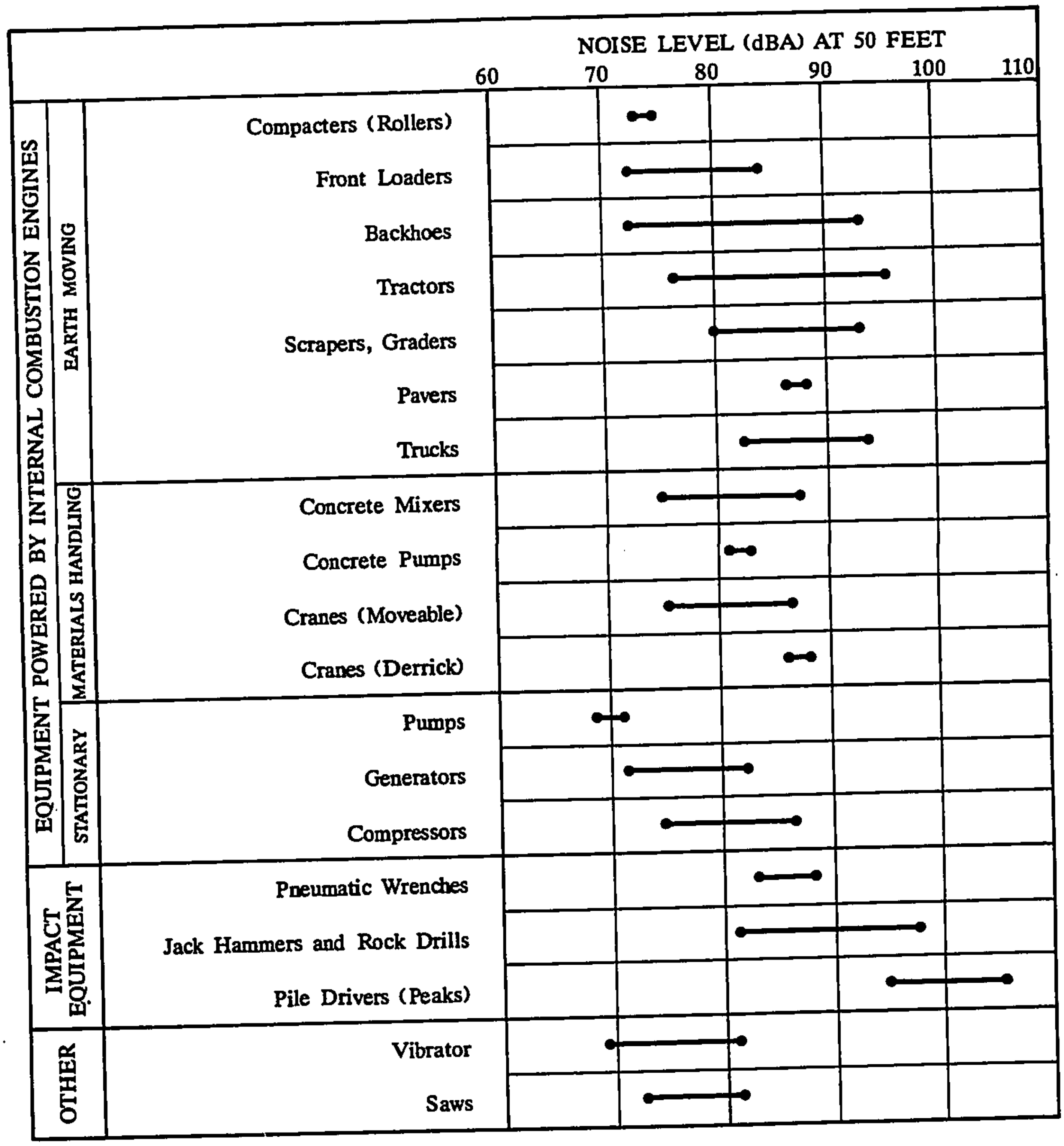
Future activities at the project that were evaluated include: construction activities, residential traffic, Ranch traffic, community facility activities, campground use and stationary equipment operation (such as air conditioners and pumps). Potential noise impacts to existing homes (off-site) and on new, proposed residences within the project were considered. In general, noise effects of the proposed project are comparable to those anticipated under the 1991 project. With less traffic on weekends, slightly less noise could result with the proposed project.

Construction Impacts: Development of the project will involve clearing, grubbing, grading, and the construction of infrastructure and buildings. The actual amounts of noise generated in construction are dependent on the methods employed during each construction phase. Earth moving equipment, such as bulldozers and diesel powered trucks, will probably be the loudest equipment used in construction. Typical construction equipment noise levels are shown in Figure 5-5.

The construction of the access road across the bluff face will require rock removal over a maximum of 1,200 feet of the roadway. Equipment typically used for rock removal include rock hammers and drills, as well as blasting equipment. Equipment using impact to break rock is noisy, as shown in Figure 5-5, where 82 to 98 dBA at 50 feet is typical of jack hammers and rock drills. The breaking of rock by explosion usually creates a muffled "thump" sound. Noise created during rock removal will affect the Sunset Beach Elementary School and residences located near the property in Sunset Beach. This impact will be short-term in duration, and the actual time period required for drilling and blasting will be assessed after final design and geotechnical studies for the access road are complete.

Traffic Noise: Federal Highway Administration (FHWA) highway traffic noise modeling results showed that the closest residences which are located about 40 feet from the center of Kamehameha Highway will have traffic noise levels in 1997 of approximately 72 to 73 dB LdN during the busiest hour of the week (worst case). Homes located further away from the highway will experience lower traffic noise levels, e.g., 65 dB at 125 feet, 66 dB at 100 feet, etc. The expected future traffic noise level increase along Kamehameha Highway will be due primarily to the projected increase in traffic volumes resulting from other developments and area growth. The potential traffic noise level increase at residences located along Kamehameha Highway due to the project will be less than 0.5 dBA, and is not considered to be a significant noise impact.

Traffic noise levels at the proposed residences in the project along the internal circulation roadways should not be excessive. Assuming that the traffic volumes are highest at the intersection of the project access road and the highway, the closest residences in the project are estimated to be exposed to sound levels well below acceptable standards. Traffic noise from the highway will not contribute significantly to the overall acoustical environment at any of the proposed residences.



Note: Based on Limited Available Data Samples

CONSTRUCTION EQUIPMENT NOISE RANGES
LIHI LANI

FIGURE 5-5

Residential Ground Maintenance Noise: Noise associated with ground maintenance equipment at the country lots on the Haleiwa side, such as gas-powered chain saws, lawn mowers, line trimmers and leaf blowers, could occasionally, be noticeable at times at nearby residences in Pupukea Highlands or Sunset Hills.

Ranch and Campground Noise: Depending upon the types of activities, noise levels at the campground are expected to vary widely. For example, there will be relatively quiet camping activities such as cooking, eating, hiking, sleeping and reading, which normally would not increase the ambient sound level significantly. A worst case scenario might be 20 persons singing (around the campfire), which could generate noise levels as high as 63 dBA at a distance of 50 feet.

Activities at the Ranch could occasionally involve small riding events with the use of a public address system. The central valley location of the Ranch will serve to contain the noise generated by the loudspeaker and small spectator group cheers or applause.

Even in the worst case, occasional campground or Ranch activity noise may be audible, but is not expected to be audible at nearby residents in Pupukea Highlands, due to the sound transmission loss over the approximately 2,500 feet between the campground and nearest residences on Pupukea Road. The Ranch is approximately 1,500 to 2,000 feet from the closest residences, and sound transmission losses would occur as a result of its valley location.

Community Facility Noise: Activities at the YMCA/community facility could include meetings, athletic or cultural events, and parties, some of which may utilize amplified sound systems. Noise generated by such systems could cause annoyance to the nearby Sunset Beach and elderly housing residents and, if occurring during the school hours, the occupants of the adjacent school.

Stationary Equipment Noise: Noise from air conditioning equipment, pool pumps, exhaust fans, trash compactors and any other stationary equipment at the residences or community facilities will not exceed the noise levels allowable by State and County noise regulations. Noise from equipment at the projects buildings will not be audible off-site, except possibly the community facilities. Trash pick-up and delivery vehicles are typically operated and scheduled to cause minimum disturbance to neighboring residential units. These operations are expected to meet the requirements of State and County noise regulations.

C. Mitigative Measures

Several measures will be implemented to minimize potential noise impacts at off-site receptors.

(1) Construction Noise Control: Compliance with existing regulations will mitigate construction noise generated by the project to acceptable levels. State and County regulations have been established to limit construction noise generation. Prior to construction, a permit will be obtained from the State Department of Health for operating construction equipment, power tools and vehicles which emit noise levels in excess of the allowable limits. Required permit conditions for construction activities include:

"No permit shall allow construction activities creating excessive noise... before 7:00 am and after 6:00 pm of the same day".

"No permit shall allow construction activities which emit noise in excess of ninety-five dB(A)...except between 9:00 am and 5:30 pm of the same day".

"No permit shall allow construction activities which exceed the allowable noise levels on Sunday and on...(certain) Holidays. Activities exceeding ninety-five dB(A) shall (also) be prohibited on Saturdays."

In addition, construction equipment and on-site vehicles or devices requiring an exhaust of gas or air must be equipped with mufflers. Construction vehicles using local roadways will satisfy the noise level requirements defined in Hawaii Administrative Rules, Title 11 (1981).

During rock removal, the immediate blast area is covered by a blast mat with the purpose of directing the explosive energy into the rock, muffling the airborne pressure pulse, and controlling flying debris. The actual blast will be perceived as a muffled "thump" sound and should cause minimal vibration through the ground to structures located below the bluff.

(2) Operations Noise Control: The design of the community facility will include noise mitigation measures in the planning of the location and orientation of the air conditioning equipment, exhaust fans, pool pumps and other equipment, such that local noise regulations will be satisfied.

Ground maintenance equipment will be powered by internal combustion engines with exhaust mufflers. Schedules for maintenance will be arranged so noisier operations do not occur near residences (on and off the project area) before 7:00 am or after 5:00 pm.

(3) Community Facility Noise Control: The site planning for the community facility shall incorporate adequate setback distances, respecting existing residential areas. Proper sound insulation measures shall be incorporated into the building design. Events at the community center that propose the use of amplified sound outside the building shall notify the community and be scheduled at hours which do not conflict with the adjacent elementary school session neighboring residential areas.

5.4 AIR QUALITY

An air quality study of the 1991 project plan was prepared by Neal (January 1991). The information provided by this study is summarized below, and the complete report was published in the Final EIS (Group 70, April 1991).

Results of the 1991 air quality survey are applicable to the current project plans because most air quality considerations relate to traffic generation. Traffic under the new project plan is anticipated to be lower than the former project plans with the golf course, and resulting air quality effects will be less.

A. Existing Conditions

Present air quality in the Pupukea area could potentially be affected by air pollutants from four different types of sources: natural, industrial, agricultural and vehicular. Natural air pollutant producers which could affect the area include the ocean sea spray, aero-allergens from plants, dust from bare soil areas, or perhaps distant volcanic emissions from the Island of Hawaii. Industrial and agricultural sources of air pollutants are located generally on the leeward and central portions of Oahu, which are generally down wind from the project. Upwind there are no industrial or agricultural air pollution sources for thousands of miles.

The only long-term State of Hawaii air monitoring station is located in Waimanalo. This monitoring site was selected to measure background levels of particulates. None of the other regulated air pollutants are measured at this station. For the period 1985-1989, the average annual Total Suspended Particulate (TSP) concentration at Waimanalo ranged from 20-29 micrograms per cubic meter, which is well within the State standard for TSP, and is probably typical of most locations on the Windward Coast. The maximum 24-hour average concentration was also well within the allowable limit.

Any air pollution currently affecting the project area is probably a result of either natural or vehicular sources. Since there are no nearby long-term measurements of vehicular-related pollutants, present concentrations of carbon monoxide in the project area have been estimated based on mathematical modeling of motor vehicle emissions. The results of this modeling are discussed below in association with the projected long-term impacts of the project.

B. Potential Impacts

Short-Term Air Quality Impacts: There will be two types of short-term direct air quality impacts from project construction: fugitive dust generation and on-site emissions from construction equipment. There will also be short-term indirect impacts occurring off-site from slow moving construction equipment traveling to and from the project, and from an increase in local traffic caused by commuting construction workers.

Fugitive dust emissions will arise from grading and dirt moving activities within the project. A rough estimate of uncontrolled fugitive dust emissions from construction activity has been provided by the U.S. EPA (1987), estimated at 1.2 tons per acre per month under conditions of "medium" activity and moderate climactic conditions. Uncontrolled fugitive dust emissions from construction at Pupukea would probably be lower than this because the area is relatively wet. State of Hawaii Air Pollution Control Regulations require that fugitive dust emissions be controlled to such an extent that no visible emissions of fugitive dust from construction activity should occur beyond the property line. Compared to the 1991 plan, less area will be affected at one time with the proposed project because the former golf course required large land clearing and earthwork. Less dust would be expected from the proposed project.

On-site mobile and stationary construction equipment will also emit some air pollutants in the form of engine exhausts. The larger types of equipment are usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines, on the other hand, are very low and should be relatively insignificant compared to normal vehicular emissions on nearby Kamehameha Highway.

Long-Term Air Quality Impacts: There will be a potential long-term indirect impact on air quality along the project area's roadways due to project-related traffic. Of note, because the proposed project will have less traffic than the 1991 plan, less air quality impact is expected. By serving as an attraction for increased motor vehicle traffic, the project is considered to be a potential indirect air pollution source. In order to evaluate the potential long-term indirect air quality impact of increased traffic associated with project development, a carbon monoxide modeling effort was carried out. Carbon monoxide was selected for modeling because it is both the most stable and the most abundant of the motor vehicle generated pollutants, and it is also the air pollutant with the greatest likelihood of violating Ambient Air Quality Standards (AAQS).

The three critical air quality receptor areas identified in the vicinity of the project coincide with the three key intersections along Kamehameha Highway identified in the traffic study. The three cross streets are Pupukea Road, the Sunset Elementary School access and the project access road.

Estimated peak-hour carbon monoxide concentrations (1991) were 1.5 milligrams per cubic meter (mg/m^3) along Kamehameha Highway at the proposed access road, 4.4 mg/m^3 at the school entrance, and 4.1 mg/m^3 at the Pupukea Road intersection. These estimated concentrations are well within State and National AAQS.

In 1997 without the previous (1991) project plan, the predicted maximum one-hour concentrations were expected to increase compared to 1991 levels. This is because traffic is expected to increase substantially, particularly during the morning.

Predicted peak-hour concentrations for the 1997 scenario with the previous project plan (full development of 300 homes and golf course) vary between 7.2 mg/m^3 at Pupukea Road, 8.6 mg/m^2 at Sunset School, and 13.2 mg/m^3 at the project access road intersection at the weekend peak.

Overall, it was predicted that with the 1991 project plans, worst-case carbon monoxide levels along roadways in the project vicinity would be higher near existing intersections compared to the without the project case, but should remain within State and National AAQS. At the new intersection along Kamehameha Highway created by the project access road, air pollution concentrations would increase substantially, but all should remain within Federal AAQS. Future eight-hour carbon monoxide levels were also predicted to be within Federal AAQS. State AAQS could be exceeded if peak traffic and worst-case meteorological conditions occur simultaneously.

As compared to the 1991 project plan, full development of the current project plan would generate two to five percent less vehicle trips during weekday morning and afternoon peak hour periods, and up to 23 percent less vehicle trips during the weekend peak hour period. As a result, the potential air quality impacts of the current project would be less. The year of full development for the new project, however, will be at some point beyond 2008. Traffic conditions on Kamehameha Highway are anticipated to build significantly during the next 20 years, and possibly reach the point where both State and National AAQS could be exceeded more frequently at local intersections. Project-related traffic in 2008, assuming full development, would represent between five and eight percent of the total number of vehicles on Kamehameha Highway.

It is important to note that the worst-case meteorological conditions used for modeling have a very low probability of occurrence. A slight increase in the assumed worst-case wind speed from two mph to four mph would reduce the predicted carbon monoxide concentrations to about one-half of the worst case 1997 levels.

Pesticides Applications: The pesticides planned to be used in the common landscaped areas and agricultural areas are at relatively low mammalian toxicity, ranging from hundreds to several thousand milligrams per kilogram of body weight. Because they are not highly volatile and are applied in dilute sprays (50 to 100 gallons of spray solution per acre) to open areas, there is little likelihood of toxic levels in the atmosphere. In addition, the use of ground spray equipment with low spray pressures (20 to 40 psi) and course spray droplets would further reduce the potential for creating airborne fine droplets. Spray applications would only be made during low wind speed periods, which will reduce the risk of exposure of people to airborne spray particles.

On-site long-term direct air quality impacts are not expected to be significant. Application of small quantities of chemical fertilizers and pesticides to maintain the common areas and agricultural areas will be required. The primary risk of using these chemicals is to the applicator rather than to individuals at possible receptor sites down wind. Individuals at down-wind sites should encounter airborne concentrations of these chemical substances only in greatly diluted form, if at all. Precautions will be taken in the application, as described in the following mitigative measures discussion.

Electrical Demand and Solid Waste Disposal: The annual electric demand of the project when fully developed is not expected to exceed about 3.0 to 4.0 million kilowatt-hours. As a consequence of electrical power usage, the proposed project will contribute to indirect air pollution emissions from power generating facilities, most probably provided by oil-fired generators on Oahu.

Solid waste generated by the project when fully developed is not expected to exceed three tons of refuse per day. If this refuse is not landfilled and all or part is burned at H-Power at Campbell Industrial Park, disposal of solid waste from the project will also result in emissions of particulate, carbon monoxide and other contaminants from the incineration facility.

Long-term, quantitative evaluations of these impacts were not made, but it is likely to be relatively small since the projected emissions will be much less than one percent of current Oahu emissions from power generating and waste incineration facilities. Several measures have been proposed to minimize potential air quality impacts.

C. <u>Mitigation Measures</u>

Several mitigation measures will be implemented to minimize potential air quality impacts, as listed below.

(1) Dust Control: During construction of the project, adequate fugitive dust control will be accomplished by establishing a frequent watering program to keep bare dirt surfaces in work areas from becoming significant dust generators. Control regulations also require that open-bodied trucks be covered at all times when in motion if they are transporting materials likely to give rise to airborne dust. Paving of parking areas and establishment of landscaping as early as possible in the construction process will also be done to lower the potential for fugitive dust emissions.

(2) Construction Equipment Transport: Indirectly, slow-moving construction vehicles on Kamehameha Highway can obstruct the normal flow of traffic to such an extent that overall vehicular emissions of carbon monoxide are increased. This impact will be mitigated by moving heavy construction equipment during periods of low traffic volume whenever possible.

(3) Roadway Traffic: Roadway improvements recommended by the traffic consultant will be implemented to move traffic efficiently through the project area and to help maintain good air quality.

(4) Odor Control: Odor control measures are not expected to be needed for the wastewater treatment facility, however, contingency provisions will be included in the design and the budget to incorporate odor abatement facilities, should the need arise.

(5) Pesticide Application Controls: There are certain precautions that must be followed by pesticide applicators in order to prevent significant down-wind drift when spraying. Primary among these are the use of a coarse rather than a fine spray and application under low wind speed conditions when the wind direction will not contribute to drift towards nearby residences. Low-wind period application scheduling and buffer establishment will also minimize pesticide effects on air quality. Provided that proper safety precautions are followed, the potential for air quality degradation from chemical spraying for maintenance will be minimal.

5.5 VISUAL RESOURCES

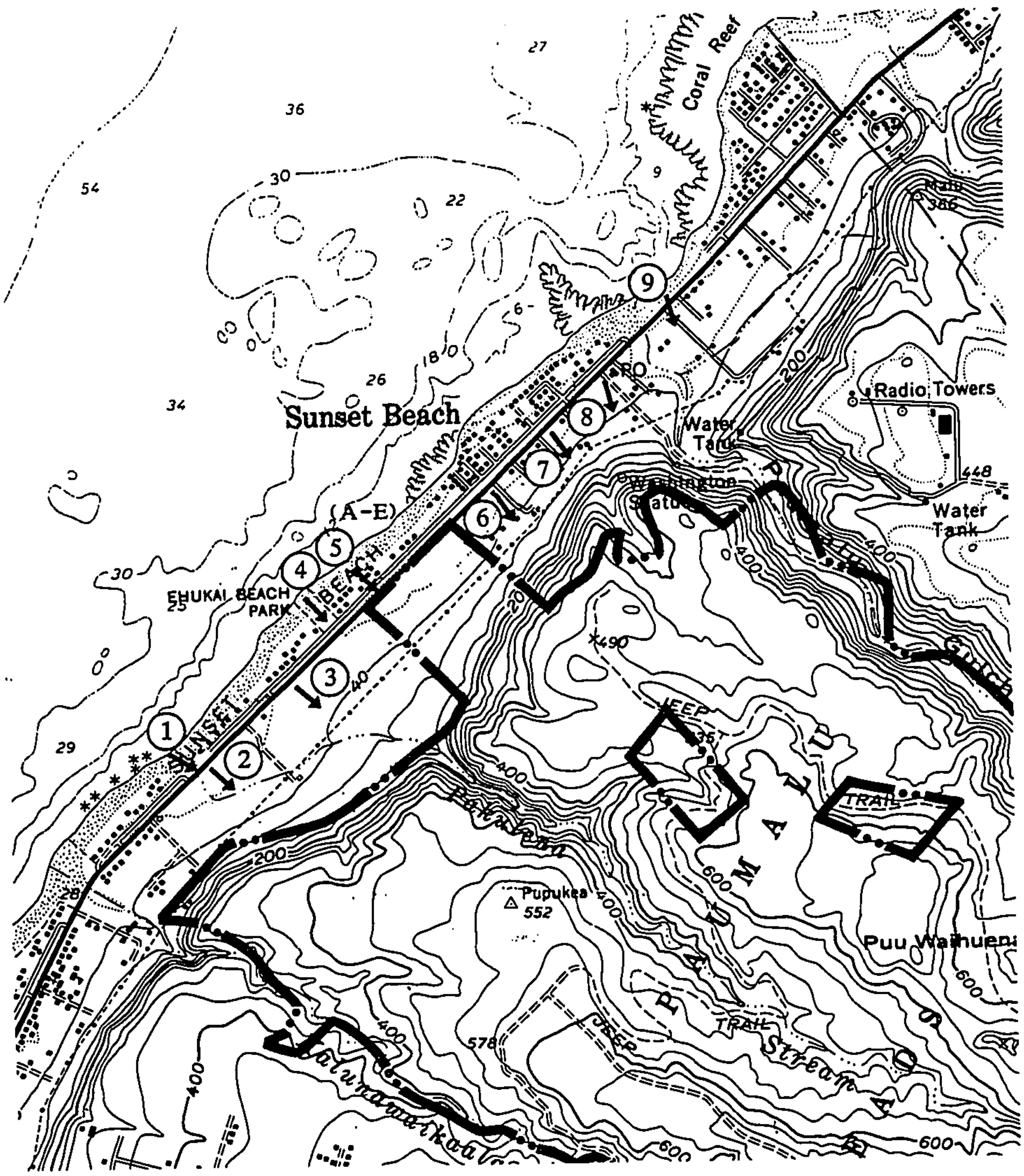
Existing views of the project site from the surrounding area have been inventoried in this section, both descriptively and by photographs. Short-term and long-term effects on views of the site which will result from development of this project are assessed, and measures are proposed to minimize adverse effects.

A. Existing Conditions

Views of the project site are presently available from the adjacent and nearby residential properties (in Sunset Hills and below the bluff in Sunset Beach), Kamehameha Highway, Sunset Beach Elementary School, several nearby beach parks and from nearshore ocean locations. Most views of the project area are of the dense vegetation on the makai section, and the steep bluff and dividing gulches along the makai boundary. A project site photograph key map (Figure 5-6) identifies photographs showing various views of the project site, included in Figures 5-6 A, B, C, D, and E.

Only the makai part of the project area and the bluff can be seen from Kamehameha Highway, adjoining and nearby residences, the school and Ehukai Beach Park. At distances farther from the makai section, people at residences along the highway and at Sunset Beach and Ke Waena (Banzai Rocks) Beach Parks can only see the bluff and ravine areas of the site. People at offshore locations, such as boaters, sailboard riders and surfers, may be able to view some sections of the project area above the bluff, as well as the bluff areas. Portions of the upper areas can also be viewed by people at some nearby residences in Sunset Hills and Pupukea Highlands, and at the COMSAT facilities site.

The project site lies within the North Shore Viewshed as defined by the Coastal View Study (Department of Land Utilization, 1987). The higher elevation lands are considered as an "important coastal land form", most likely relating to the views from the lowlands of the steep bluffs and ravines with their extensive natural



LEGEND

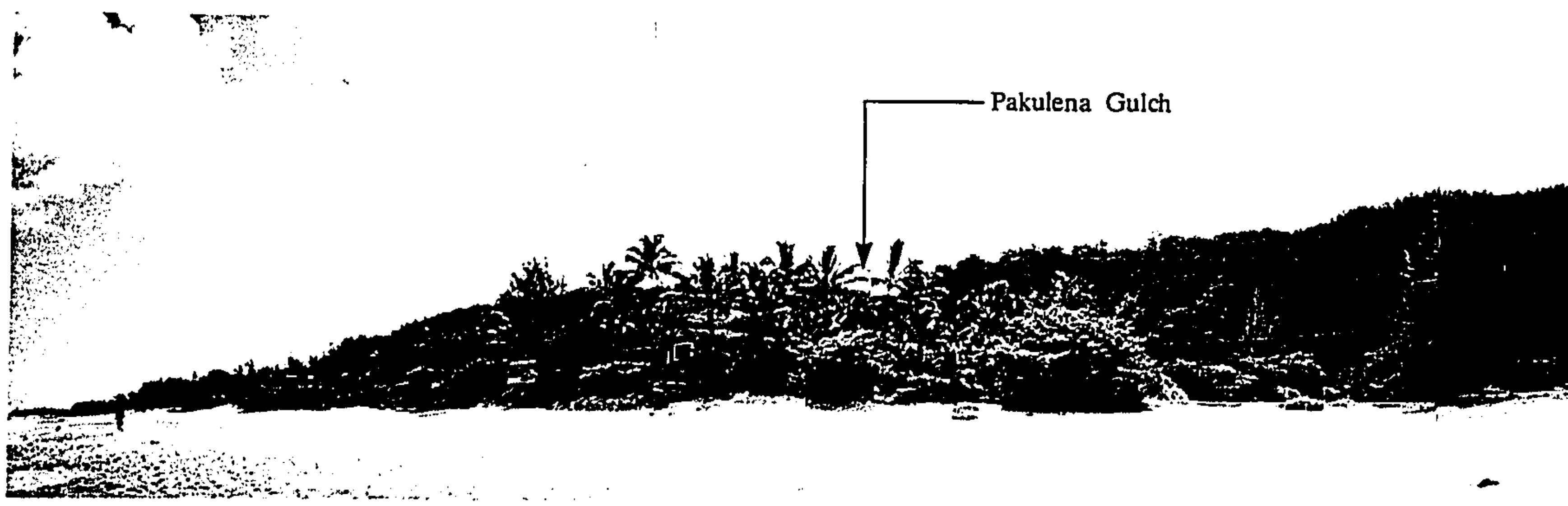
PROJECT BOUNDARY

0' 600' 1200' 2400' NORTH

SITE PHOTOGRAPHS KEY MAP

LIHI LANI

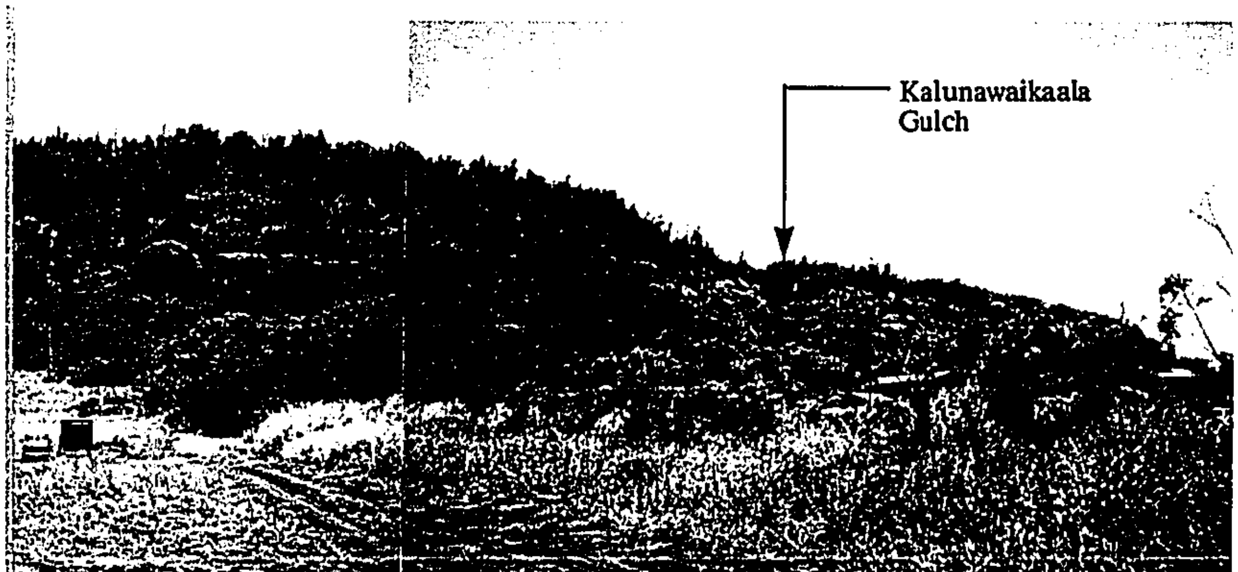
FIGURE 5-6



1. VIEW FROM KE WAENA BEACI

2. VIEW FROM KAMEHAMEHA HIGHWAY ACROSS FROM KE

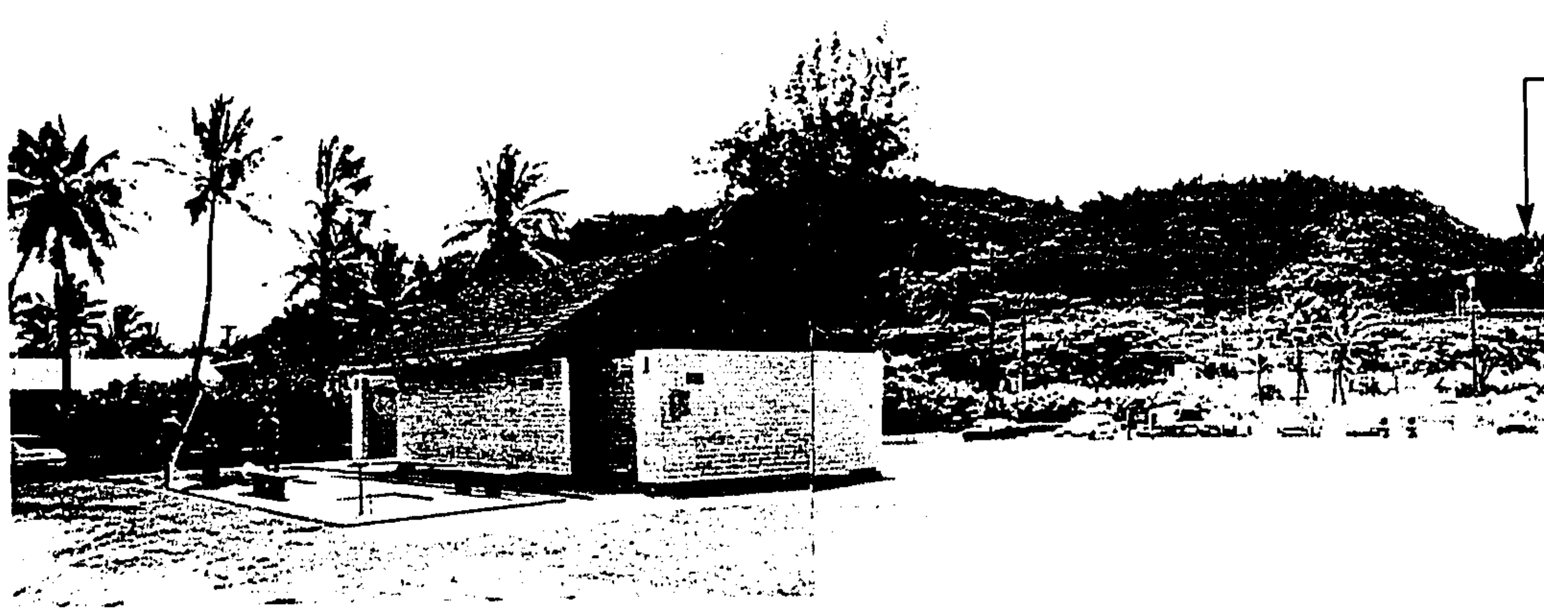
WAENA BEACH



ROSS FROM KE WAENA BEACH

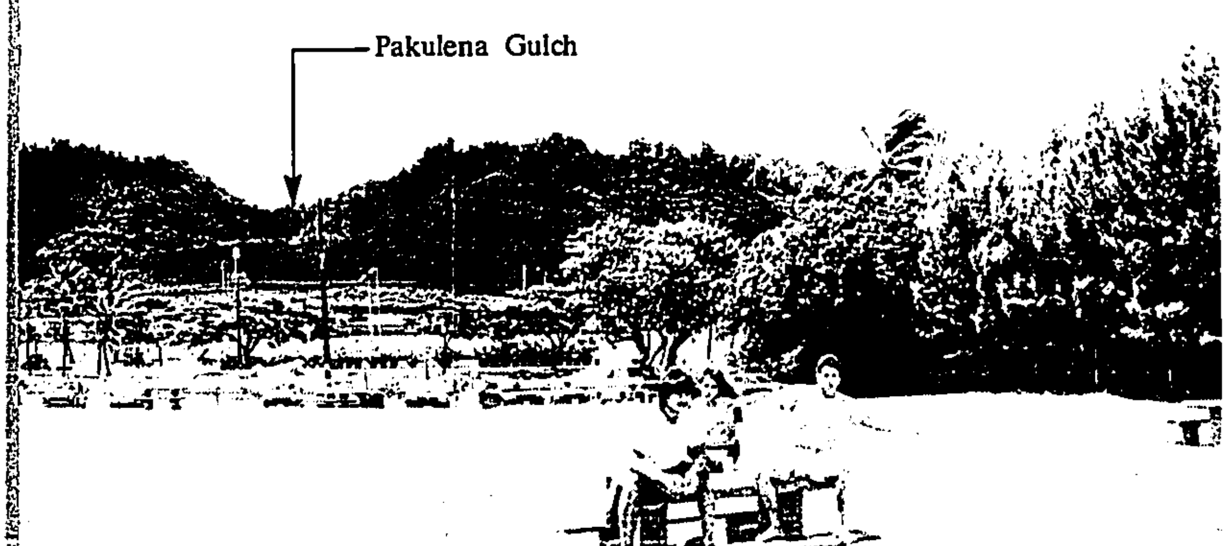
FIGURE 5-6A

3. VIEW FROM SUNSET BEACH ELEMENTARY SCHOOL ON SOCCER FIEL



4. VIEW FROM EHUKAI BEACH PARK

)L ON SOCCER FIELD AT KAMEHAMEHA HIGHWAY



KAI BEACH PARK

FIGURE 5-6B

5A. VIEW TOWARD KAHUKU ALONG KAMEHAMEHA HIGHWAY AT SUNSET BEACH ELEMENTARY SCHOOL DRIVEWAY

5B. VIEW TOWARD HALEIWA ALONG KAMEHAMEI HIGHWAY ≈300 FT. KAHUKU-SIDE OF SCHOOL DRIVEWAY

5D. VIEW TOWARD KAHUKU ALONG KAMEHAMEHA HIGHWAY AT PROPOSED PROJECT ENTRANCE

5E. VIEW TOWARD HALEIWA ALONG KAMEHAMEH HIGHWAY AT PROJECT ENTRANCE LOCATION

SITE PHOTOGRAPHS OF THE PROPERTY

ALONG KAMEHAMEHA
KU-SIDE OF SCHOOL

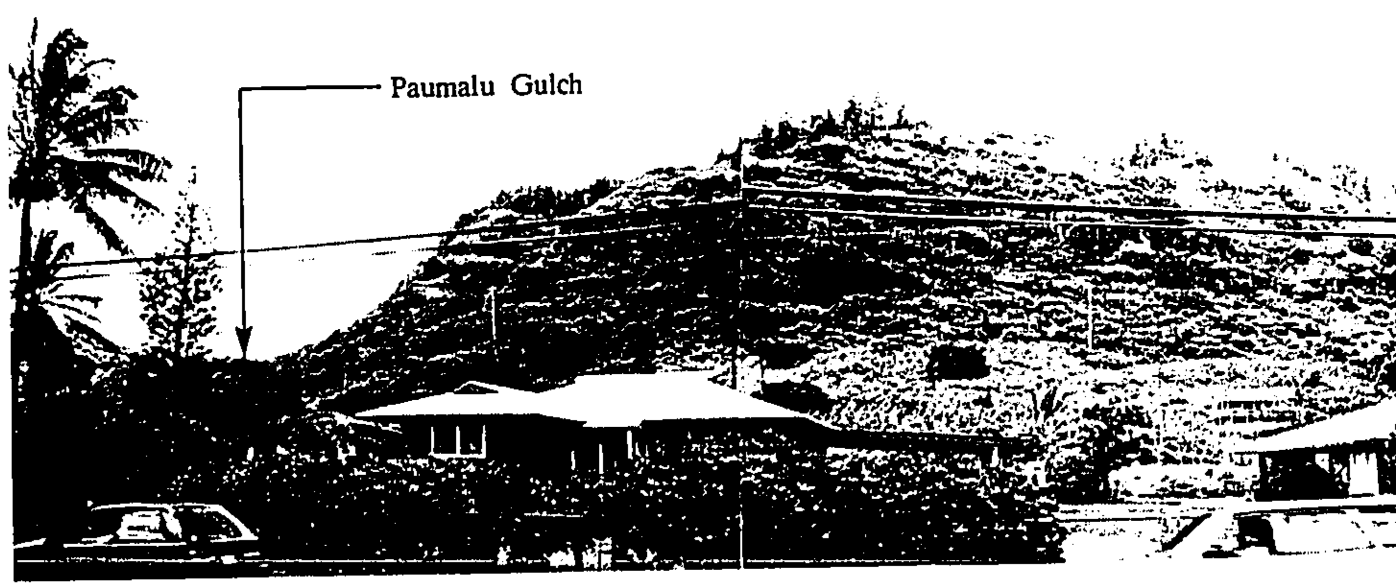
5C. VIEW INTO PROPERTY FROM KAMEHAMEHA
HIGHWAY ±300 FT. KAHUKU-SIDE OF SCHOOL
DRIVEWAY

ALONG KAMEHAMEHA
NTRANCE LOCATION

5F. VIEW INTO PROPERTY FROM KAMEHAMEHA
HIGHWAY AT PROPOSED PROJECT ENTRANCE

FIGURE 5-6C

6. VIEW FROM 59-254 KAMEHAMEHA HIGHWAY

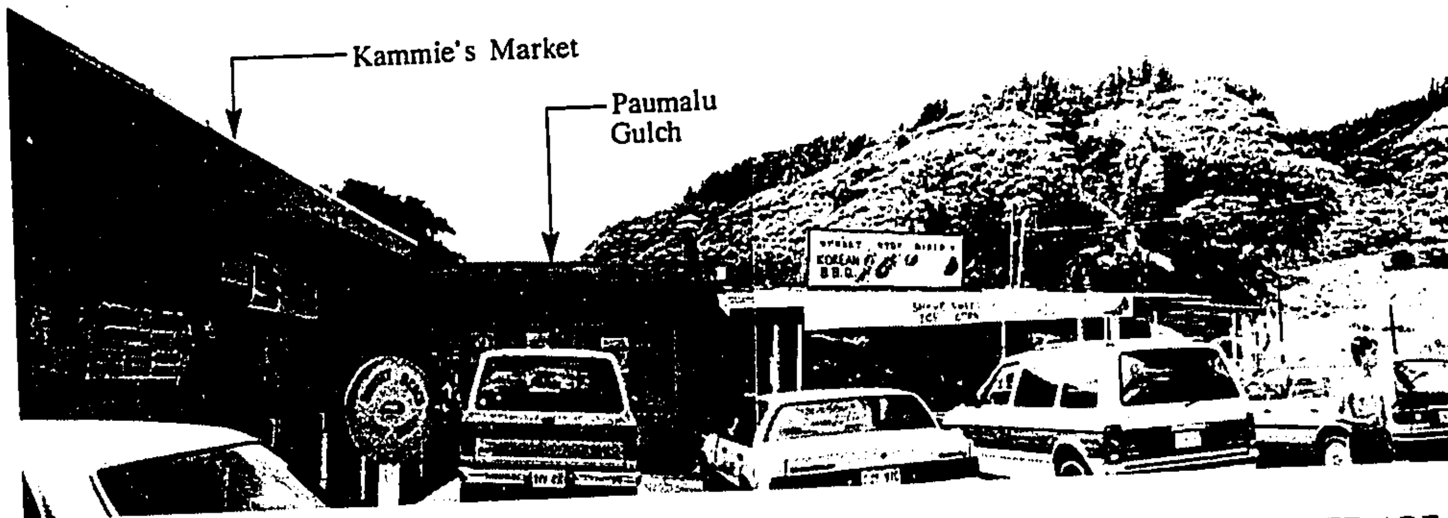


7. VIEW FROM 59-228 KAMEHAMEHA HIGHWAY

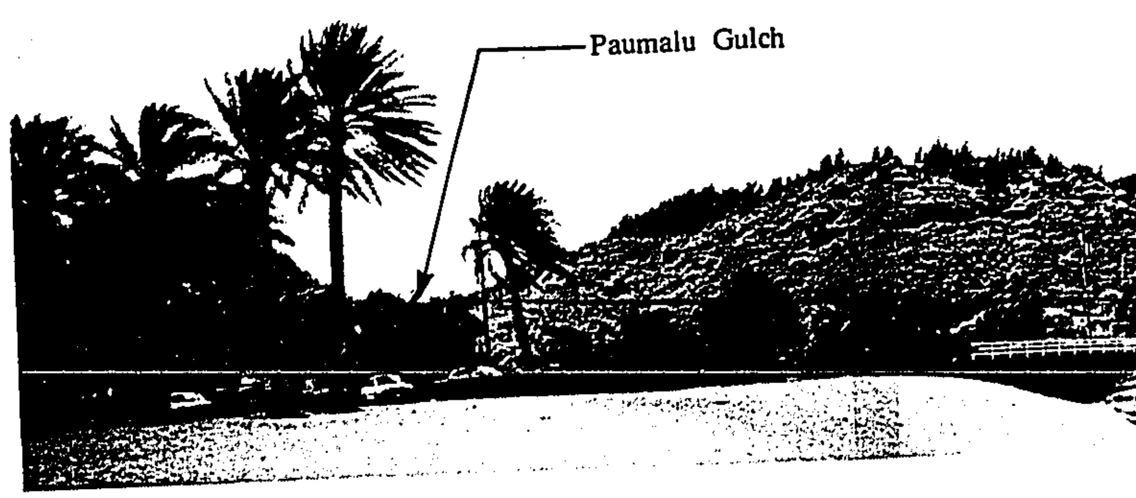
MEHA HIGHWAY (MAUKA SIDE)

MEHA HIGHWAY (MAKAI SIDE)

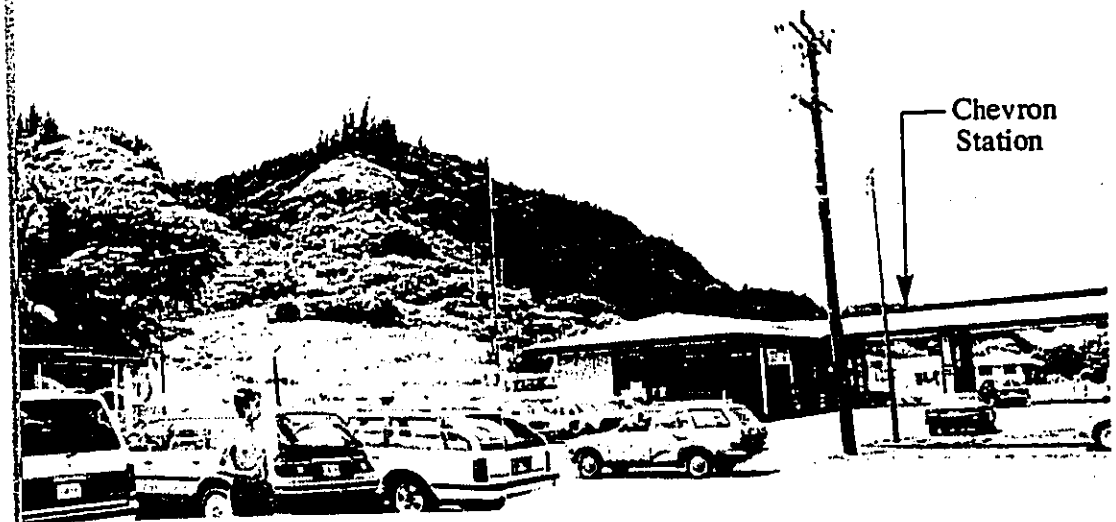
FIGURE 5-6D



8. VIEW FROM KAMMIE'S MARKET AREA



9. VIEW FROM SUNSET BEACH



MIE'S MARKET AREA

UNSET BEACH

FIGURE 5-6E

vegetation cover. Kamehameha Highway, at the makai section of this project, is considered by this study to be a "coastal roadway with intermittent coastal views".

From the project area, a variety of different views are available. Along the bluff edge, where breaks in the vegetation permit, spectacular views of the coastline are available, including Ehukai Beach and Sunset Beach, Ke Waena Beach, lowlands and residences, Mokuleia, Kaena Point, and the Waianae Range.

Within the project site, views of wooded ravines and grassed plateau areas are available. Nearby residences on Sunset Hills and Pupukea Highlands can also be seen from some areas. The COMSAT facilities property can be seen from the Kahuku-side highlands on the project. Currently, there are no light sources on the project area which are visible from off-site locations.

B. Potential Impacts

Short-Term Visual Impacts: Construction activities will create some adverse effects on the views of the project site. These potential effects are not expected to be different than those anticipated under the 1991 plan. Construction of the access road will be visible from Kamehameha Highway. Portions of some residences built on Country lots near the bluff edge, such as roof forms, may be visible from Kamehameha Highway, the residences makai of the property, the school and nearby beach parks. Vegetation clearing and grading involved with construction will be visible, as will the construction of buildings and the installation of utilities. Construction activities at some locations on the main portion of the site, such as the roadways and some Country lot residences, may be visible from some nearby residences in Sunset Hills and Pupukea Highlands. Because the development will be phased, future users of the site will also be exposed to views of construction activities.

The most apparent changes in the views of the project site will be the construction of the entrance, the access road across the bluff face and, some residences built near the edge of the bluff. These areas will be seen from most locations described earlier. The entrance construction will involve clearing a 60-foot wide path into the existing wooded areas on the makai parcel. Cleared vegetation, bare soils in graded areas and stored construction equipment will be evident at the entrance until it is completed.

The 40-foot roadway right-of-way (including pavement, shoulders, and rolled curbs) will extend into the project for a distance of about 800 feet, and then cross the bluff base (areas 100 to 200 feet above msl) for approximately 500 feet. A retaining wall up to 25 feet high will be constructed along 200 feet of this part of the roadway at the bluff base. The access road will have a 180° turn mid-way along the bluff face (areas 200 to 300 feet above msl), and extend approximately 400 feet to the bluff ridge. The access road will then extend across the bluff ridge (300 to 450 feet above msl) for approximately 1,200 feet, turning mauka into the Kahuku-side plateau area.

Vegetation, soil and rock will be removed along the roadway route. Drilling or blasting of rock could be necessary in some areas. Exposed soil and rock surfaces will be present until the roadway is completed and landscape plantings have been placed. Landscaping will screen views of the access road and bluff cuts, especially after several years of growth.

Long-Term Visual Impacts: Long-term visual effects will result from the completed entrance and the access roadway crossing the bluff. Homes on the Haleiwa-side plateau will be set back from the top of the bluff and will generally not be visible from below. The roofs of a few residences located close to the bluff edge along Paumalu Gulch (Kahuku-side) and the makai edge of the property may be visible from locations makai of the site. Building siting, heights, materials, colors and landscaping will be carefully considered in design to avoid adverse visual effects. The access road across the bluff will be carefully landscaped to blend with the rest of the bluff face. Views of vehicle traffic, an entry sign and some lighting fixtures will be associated with the entry road. These effects on public views are anticipated to be comparable to those generated under the 1991 plan.

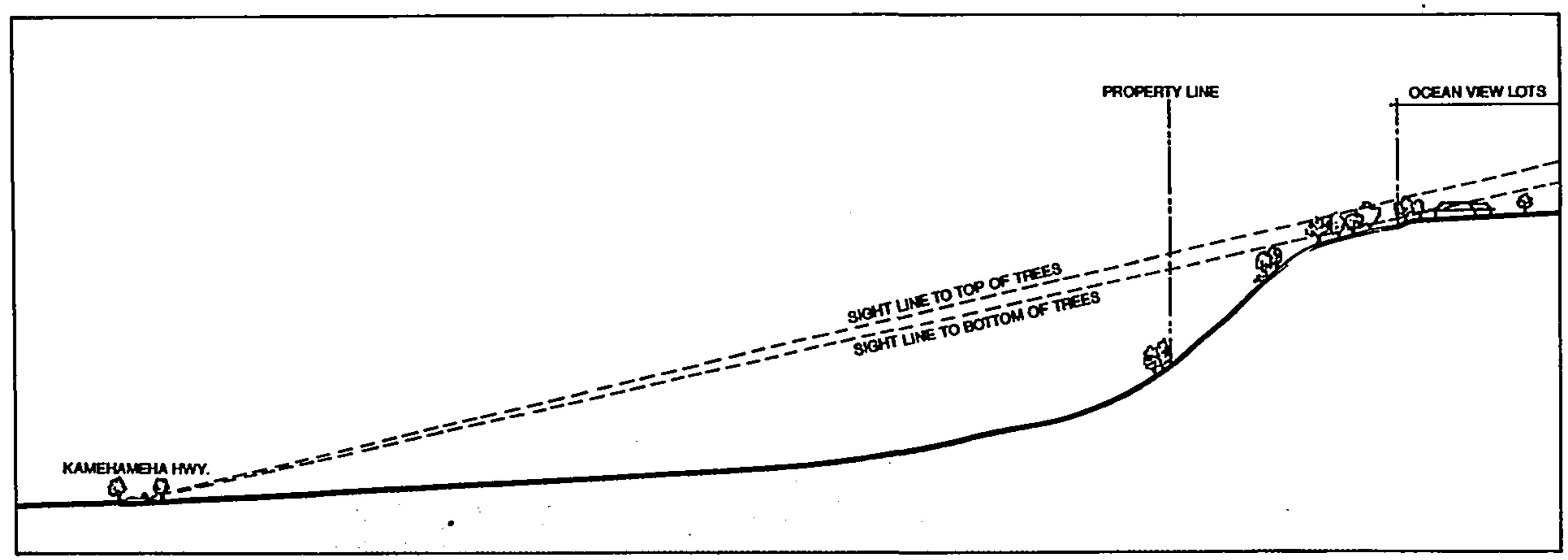
Figures 5-7 and 5-7A show a theoretical line of sight from Kamehameha Highway to the top of the bluff on the Pupukea side of the property near Banzai Rocks (Ke Waena) and the view of the top of the bluff from the Soccer Field. Figure 5-8 show the potential position of some bluff area homes and the extent of existing grade along the bluff area. As shown in this depiction, homes are positioned mauka of the bluff edge would generally be shielded from view from makai locations by the existing ironwood trees on the bluff. Some of the existing trees would be cut to establish view channels for these new homes.

Several new homes in Sunset Hills are examples of extreme building placement on the steep edge of the bluff which will not be repeated at Lihi Lani. It makes sense that the new bluff lot homeowners at Lihi Lani would desire a panoramic ocean view from these new homes, however, there will be siting constraints that will limit the placement of homes to areas mauka of the bluff edge. View channels will be created at each lot to enable substantial ocean views from these new homesites without requiring homes to be perched on the edge of the bluff. This setback will be studied carefully for the formal subdivision review process. This setback limitation will allow for natural vegetation to shield most views of the new homes from makai locations and preserve the public view integrity of these coastal features as identified in the Coastal View Study (DLU, 1983).

C. <u>Mitigative Measures</u>

Several mitigative measures have been proposed to minimize the impact on visual resources at this project.

(1) Construction Period Measures: During construction, equipment will generally be contained in storage areas which are generally out of sight from Kamehameha Highway. To minimize a variety of impacts including visual effects, work on the



VIEW STUDY SECTION FROM KAMEHAMEHA HIGHWAY

LIHI LANI

FIGURE 5-7

Appropriate setbacks will be established for house siting to preserve views of the pali from Kamehameha Highway. Homes will generally be hidden behind the existing vegetation on the bluff slope.

VIEW FROM SOCCER FIELD

FIGURE 5-7A

LIHI LANI

entrance area will be completed in the shortest possible time period. Access road construction, especially in the area of the bluff crossing, will also be completed as quickly as possible.

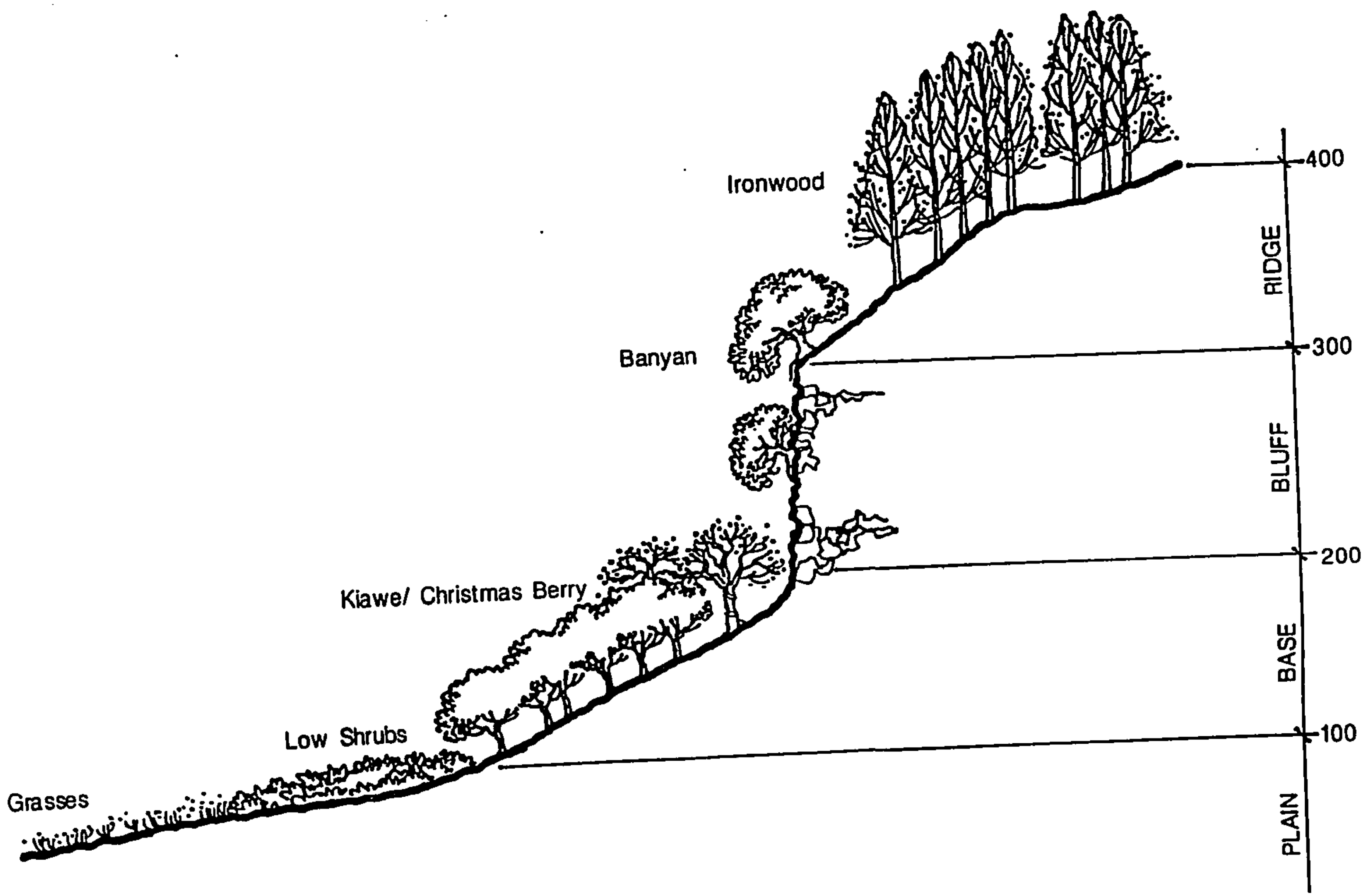
(2) Minimized Vegetation Clearing: To preserve existing views, vegetation clearing along the entrance, access road and bluff will be limited to only those areas which are necessary. Re-vegetation and new landscape planting will be accomplished as soon as possible to protect bare soils areas and shield rock face areas from view.

(3) Entrance Design: Design of the entrance will be tasteful and complement the existing country atmosphere and style. Lighting of the entrance, access road across the bluff face, and the clubhouse will also be subdued to avoid adverse glare and other lighting effects on nearby properties and night time visibility in the general area.

(4) Access Road Landscaping: As shown in Figures 5-8 and 5-8A to E, the access roadway will be built as predominantly depressed sections. Extensive landscaping will cover the exposed rock face of terraced areas, retaining walls, the roadway, guard rails and signs. A detailed planting plan has been prepared by landscape architects Walters, Kimura & Motoda (July 1988, Appendix R) which will cover most of the road and terraced areas. Lighting of the roadway will be subdued and will not create excessive glare at adjacent and nearby residences, Kamehameha Highway and other nearby locations.

(5) Public Access to Scenic Views of Highlands: Another visual-related measure that will be provided is the establishment of the public hiking trail system. This trail system will provide views of the completed development and natural/undisturbed areas of the project area.

(6) Project Design Considerations: The development of residences at some Country lots could potentially be visible from off-site locations. Obayashi intends to minimize adverse visual effects by locating facilities to fit the landscape not become prominent features. No structures will be built along the front of the coastal bluff, and buildings at these sites will be required to follow setbacks to minimize views from below. Building heights, locations, materials, colors and surrounding landscaping will be restricted through design standards established with participation by community representatives.

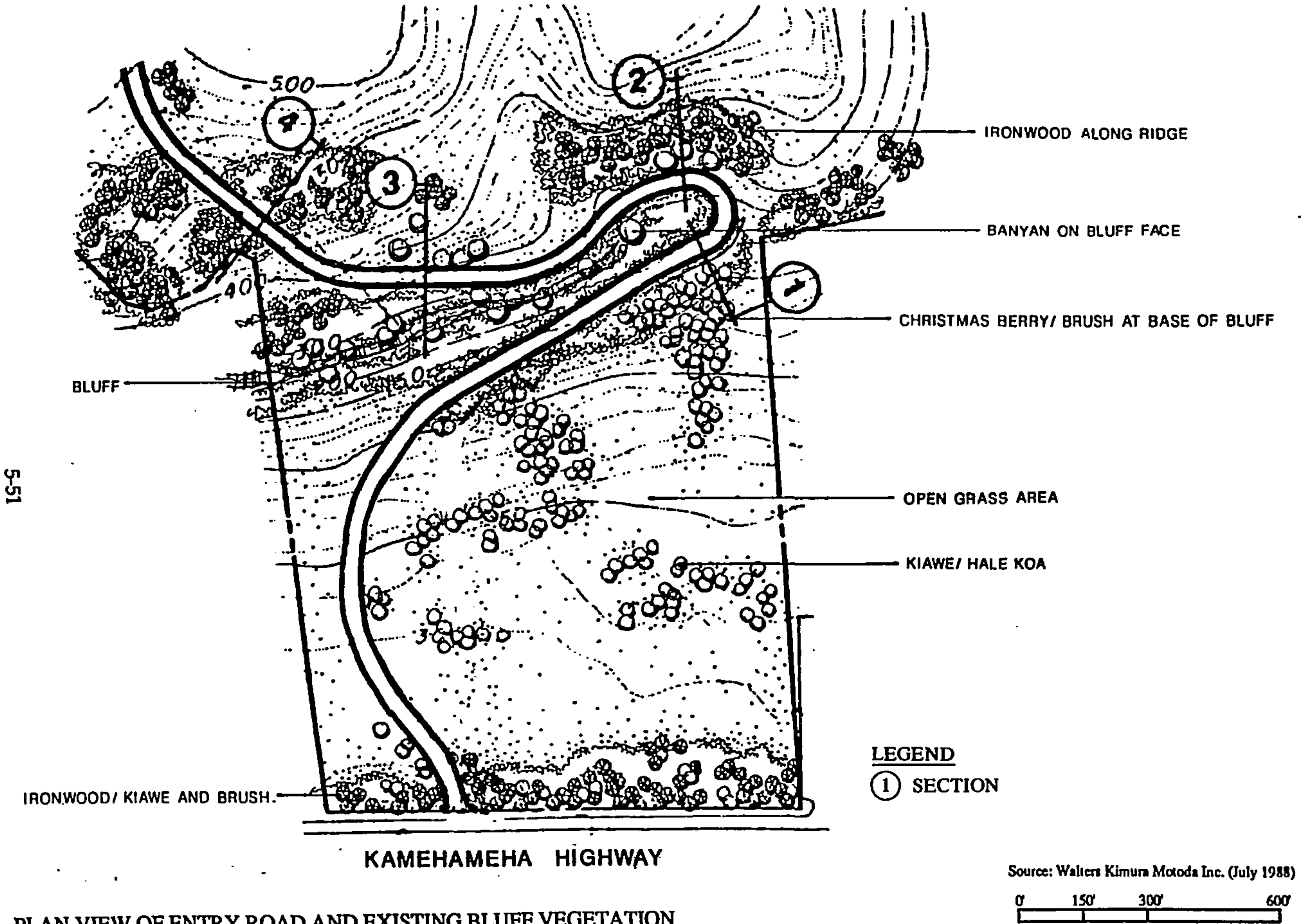


Source: Walters Kimura Motoda Inc. (July 1988)

EXISTING VEGETATION SECTION--PUPUKEA BLUFF

FIGURE 5-8

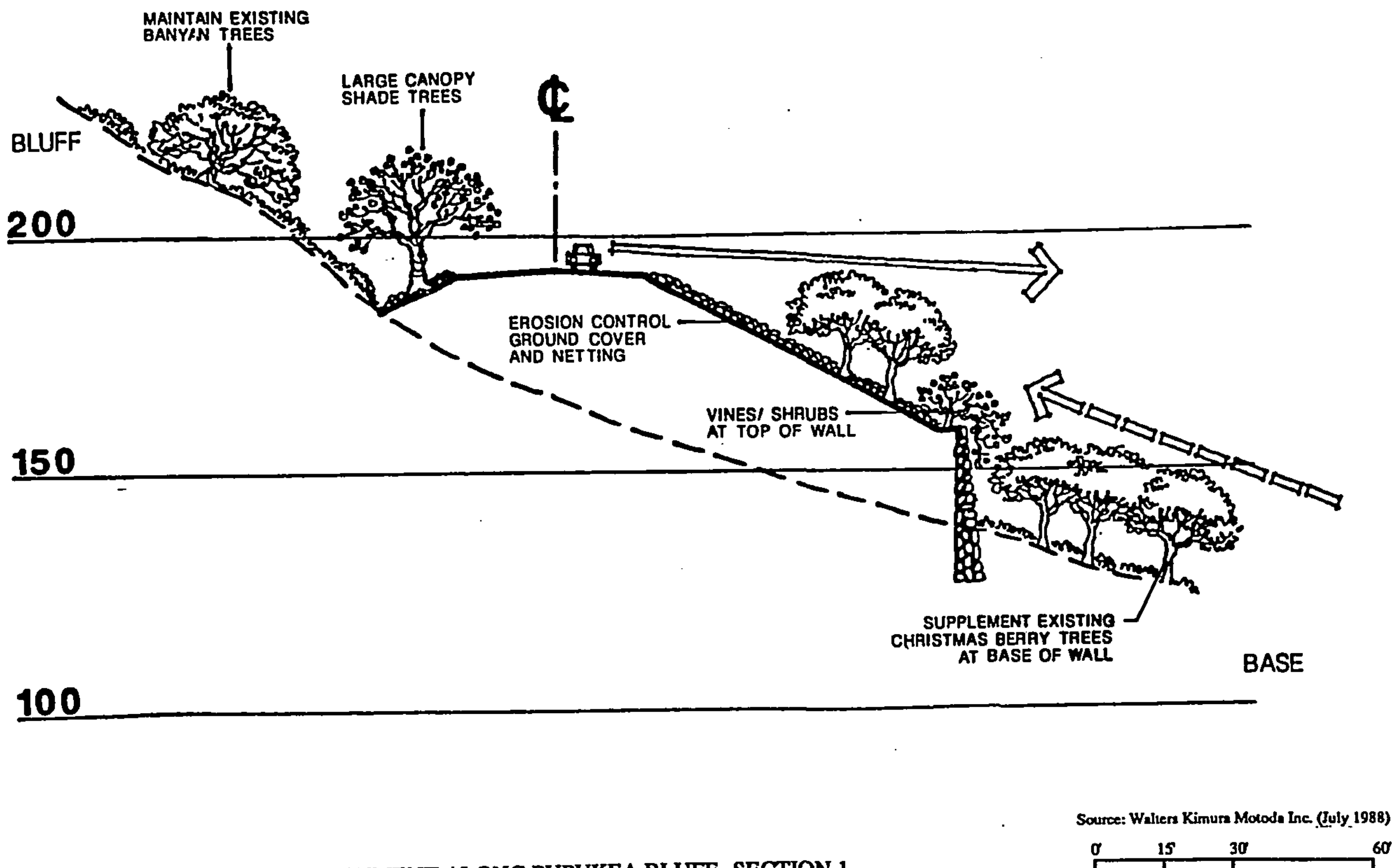
LIHI LANI



PLAN VIEW OF ENTRY ROAD AND EXISTING BLUFF VEGETATION

LIHI LANI

FIGURE 5-8A

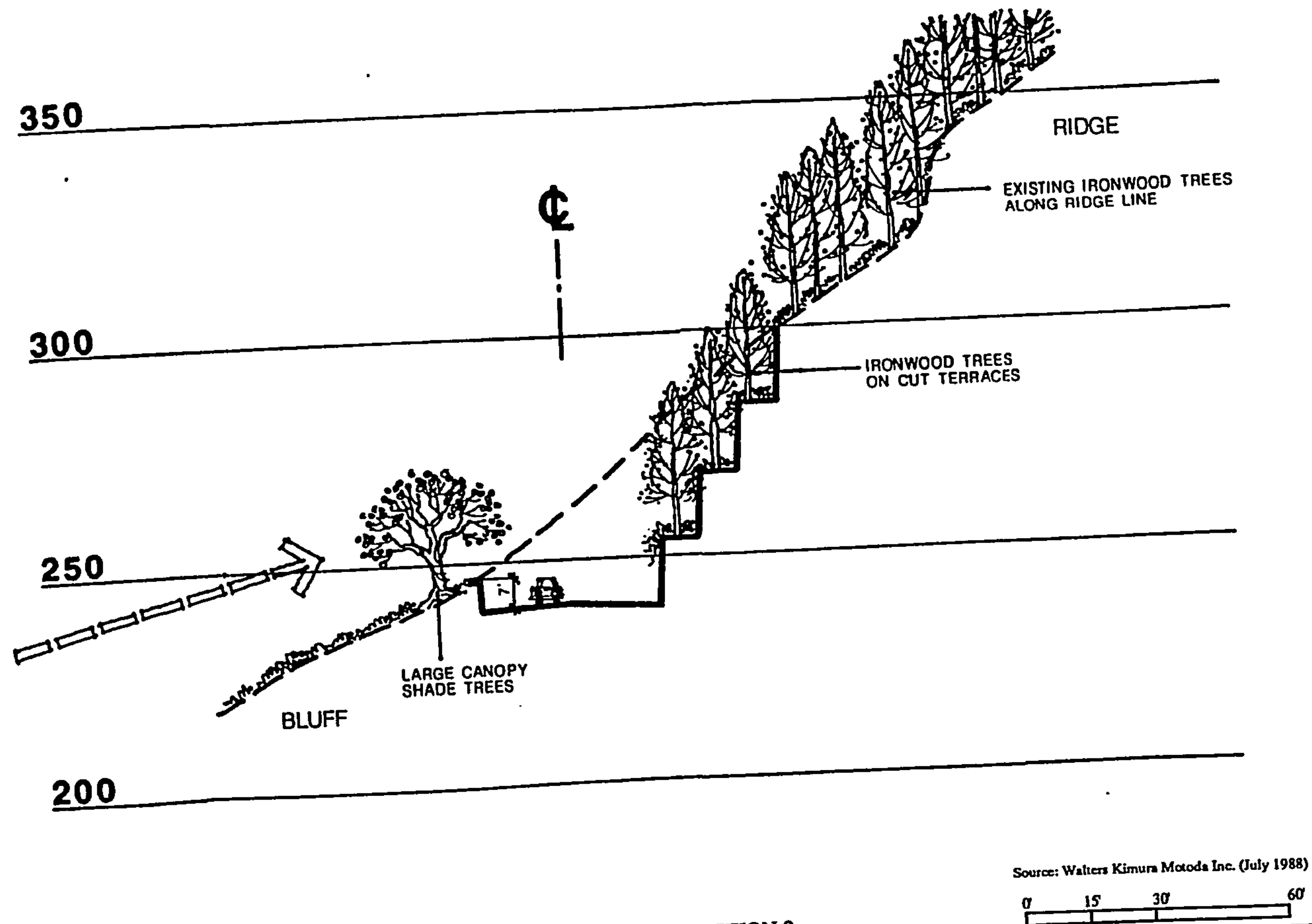


Source: Walters Kimura Motoda Inc. (July 1988)

CONCEPTUAL LANDSCAPE TREATMENT ALONG PUPUKEA BLUFF--SECTION 1

LIHI LANI

FIGURE 5-8B

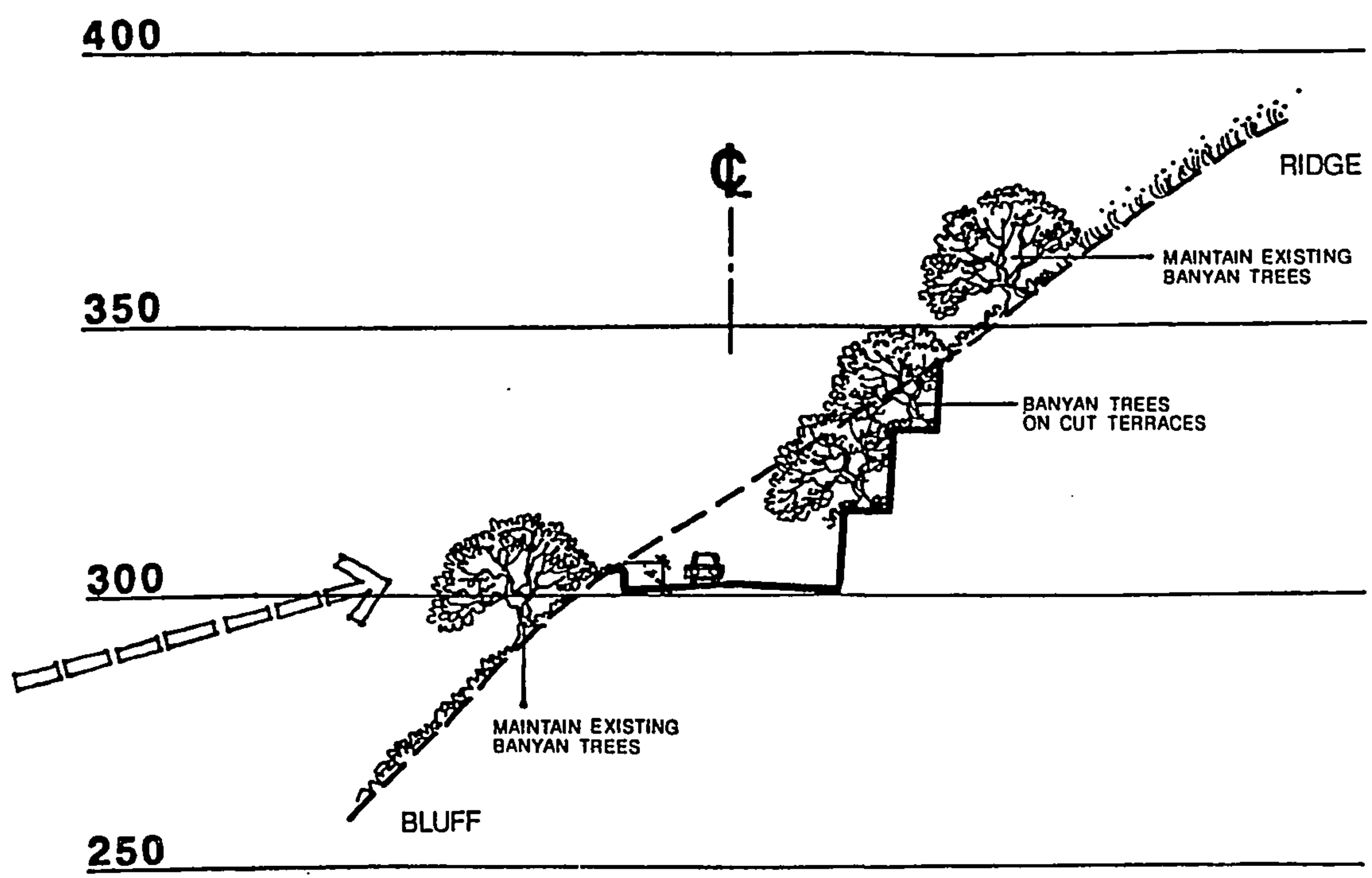


Source: Walters Kimura Motoda Inc. (July 1988)

CONCEPTUAL LANDSCAPE TREATMENT ALONG PUPUKEA BLUFF--SECTION 2

FIGURE 5-8C

LIHI LANI



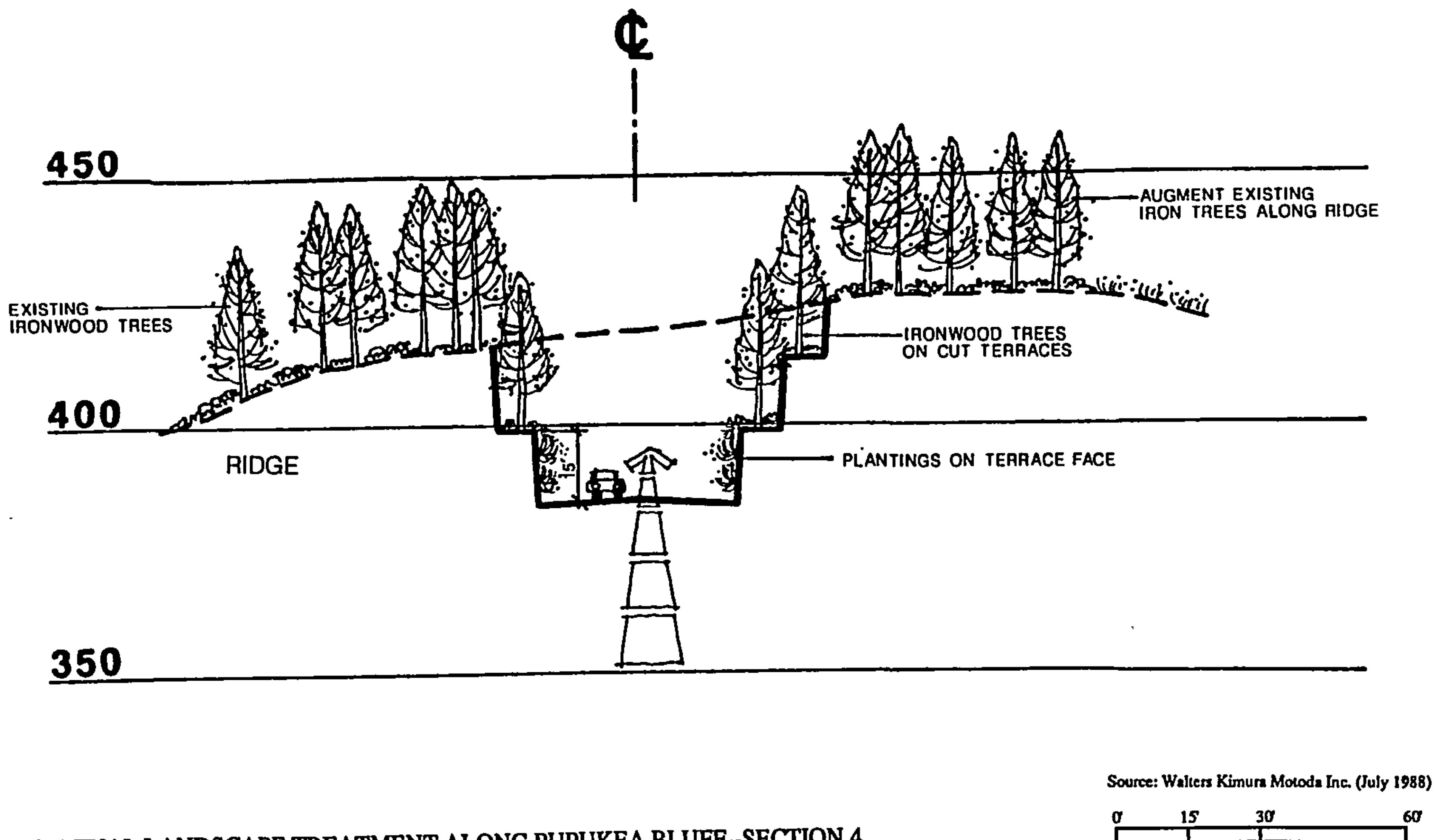
Source: Walters Kimura Motoda Inc. (July 1988)

0' 15' 30' 60'

CONCEPTUAL LANDSCAPE TREATMENT ALONG PUPUKEA BLUFF--SECTION 3

LIHI LANI

FIGURE 5-8D



Source: Walters Kimura Motoda Inc. (July 1988)

CONCEPTUAL LANDSCAPE TREATMENT ALONG PUPUKEA BLUFF--SECTION 4

LIHI LANI

FIGURE 5-8E

5.6 POPULATION

A detailed demographic study was conducted for the Final EIS (Group 70, April 1991) and has been updated by Community Resources, Inc. (September 1993). This report utilizes data from the 1990 census and projected population impacts derived from the Economic and Fiscal Impacts Report for Lihi Lani (KPMG Peat Marwick; Final Report, November 1993) and an Addendum Report (KPMG Peat Marwick, November 17, 1993). The updated reports are attached as Appendix L and M.

A. Existing Conditions

Lihi Lani falls within the Pupukea CDP (Census Designated Place), which includes an area between Waimea Bay and Kawela Bay, including residential areas in Waimea, Sunset Beach, and Pupukea. The Pupukea CDP is considered a part of the City's North Shore Development Plan (DP) Area and lies within the State's Koolauloa Judicial District. In 1990, 4,111 people lived in the Pupukea CDP which surrounds the project site. This represents an increase of nearly 900 persons or 28 percent since 1980. The wider study area - the combined North Shore/Koolauloa regions - had a population of 29,992 in 1990; nearly 3.6 percent of the County-wide resident population.

The average annual rate of population increase for the North Shore/Koolauloa region has been consistently two percent or higher, from 1951 to 1990. In the 1980's, population growth in the Primary Study Area (Pupukea CDP) averaged 2.5 percent annually, nearly as much as in Koolauloa. In this decade, the City and County rate of population increase slowed to 0.9 percent annually.

In all areas studied, the population is aging. The median age has increased to about 32 years for both the County and the Primary Study Area, compared to 28 and 27 years respectively in 1980.

Ethnically, the dominant group in the Pupukea CDP is Caucasian (over 64 percent), followed by Filipino (12 percent), Hawaiian (10 percent) and Japanese (6 percent) based upon 1990 census data. This is exceptional when compared to the North Shore/ Koolauloa region, where Caucasians account for only 36 percent of the population, with good representation by Hawaiians (18 percent) and Filipinos (18 percent).

In 1990, about 50 percent of the Pupukea CDP population was born elsewhere in the United States, and 40 percent was born in Hawaii. This is in contrast to the North Shore/Koolauloa region where over half the population is Hawaii-born. In a separate survey prepared for the Kuilima Resort, CRI found that over 60 percent of household heads surveyed in that small area were originally from the Mainland United States.

The current (1990) population of the North Shore Development Plan (DP) Area is 1.9 percent of the total island population. This is above the General Plan population guideline for 2010 which is 1.6 to 1.8 percent of Oahu island-wide populations. The Primary Urban Center, Koolaupoko, Koolauloa and Waianae areas also had 1990 populations that were higher than the 2000 guidelines.

B. Potential Impacts

The development of Lihi Lani will lead to a small population increase in the North Shore area, and to a much lesser extent, in the City and County of Honolulu and the State of Hawaii. The residential component of the project will create 445 housing units on-site in a mix of 315 Country lot homes, 50 affordable single family homes and 80 elderly housing rental units (City project).

Projections made by KPMG Peat Marwick (November 1993) for Lihi Lani's total resident and non-resident populations are based on assumptions regarding usage patterns of completed homes at the site. These assumptions are based on the number of homes completed, occupancy rates, and average household size. The number of residents at Lihi Lani are projected to reach 686 persons by 2008, when 65 percent of Country lots and 100 percent affordable residential units are assumed to be occupied. On-site resident population could reach 843 persons by 2014 at 80 percent Country lot buildout, and eventually reach approximately 977 persons at 100 percent of Country lot buildout, some time in the future.

For the evaluation of the population impacts, it is assumed that Lihi Lani experiences an accelerated buildout to a 20-year time period. This assumption is made to assess a realistic worst case situation of the potential population. Affordable housing on-site is to be built in Phase I (1996 to 1998) and is expected to fill rapidly. Country lots are likely to be occupied at a much slower pace. In Pupukea Highlands and comparable areas, eight percent or less of vacant lots are built out annually. In order to evaluate a maximal impact situation, a 12 percent buildout rate was assumed for Lihi Lani. (The traffic analysis in Section 5.2 uses even more extreme assumptions about project population to analyze the built-out conditions of Lihi Lani. However, the KPMG Peat Marwick calculations provide a more realistic estimate of project buildout.)

The average daily population of Lihi Lani will be comprised of two groups: 1) residents of the country lots, single family affordable homes and the elderly rental units, and 2) non-residents, such as day visitors to the Ranch and campground and Lihi Lani employees. Employees would include temporary construction workers and permanent operational workers involved with property management, Ranch and agricultural activities and staff of the YMCA. Additionally, the in-migrant population has been projected for the project. Relationship of Lihi Lani population with the City Department of Planning's 2010 General Plan Population Guidelines is also evaluated in the following discussion.

Lihi Lani Residents.
The development of approximately 315 country lots and 130 affordable residences within the proposed recreational community could add approximately 686 residents

by 2008. This assumes approximately 65 percent build-out of Country lots and 100 percent of on-site affordable homes. Resident population will increase to approximately 977 residents by its completion several decades later. Of this total, there could be approximately 408 full-time and 29 part-time residents at the Country lots, and approximately 143 residents at the single family affordable housing and 106 residents of the elderly housing. Affordable housing would represent about 36 percent of the full-time population at Lihi Lani by 2008.

At 100 percent build-out, total resident population at Lihi Lani would be 977 persons. Of this total, there could be approximately 680 full time and 49 part time residents at the Country lots, with 249 residents projected for the two affordable housing areas. Residents at affordable housing will represent 25 percent of the buildout population.

Full-time residents residing in the Country lots are assumed to constitute 75 percent of the residential population; while part-time residents are assumed to consist of 25 percent. Residents of the affordable housing (single family and elderly rentals) are assumed to be full-time residents.

Occupied single-family households at Lihi Lani are projected at 3.0 persons per household, and occupied elderly units are projected at 1.4 persons per unit. Not all households are occupied and when Country lot homes are held for part-time use, occupancy rates are quite low (25 percent as opposed to 95 percent for other units.) Hence, the average household size for all Country lots homes is 2.3 persons per household. For affordable units (including the elderly housing) the average is 2.4 persons per unit.

Country lots. Obayashi is proposing 315 Country lots which will be offered for sale in four phases. Lots are expected to be absorbed within 10 years, however, the population increase which will depend on home construction will be gradual over a 20-year time period, with the remainder of the build-out over the ensuing decades. The developer, Obayashi Hawaii Corporation, will likely build several homes in the early portion of each phase to establish design prototype and to stimulate lot sales.

An important perspective of the Lihi Lani Country lots is in understanding that lot absorption and home construction are on two inter-related but separate timetables. For comparison, lot sales projects at Pupukea Highlands, Hawaii Loa Ridge and on the neighbor islands have shown that home construction after twenty years would stabilize at 80 percent, with the remaining homes built out over the next 50 years. The Pupukea Highlands area, for example, still has 20 percent of its Country lots as vacant unbuilt parcels (90± lots). Similar to other lot sales projects, residential home completion at Lihi Lani is expected to reach a peak before tapering off in later years. Annual home completions have been estimated by KPMG Peat Marwick (July 1993) at 12 percent of the vacant lots sold.

Single family affordable housing. The 50 affordable housing units are projected to be developed by Obayashi in the first phase of the development and will be 95 percent occupied by an average of 3.0 persons per home. Approximately 143 full time residents are expected to live in the single-family affordable housing. Full occupancy is expected to occur by 1998.

Elderly rental affordable housing. The City's 80 elderly housing rentals are also expected to be fully occupied by approximately 1.4 persons per unit or 106 residents. The construction timetable will be established by the City Department of Housing and Community Development, however, for the purposes of analyzing the total project impacts, development is assigned to the first phase of the development.

Non-resident population.
Day visitors to Lihi Lani would primarily consist of non-residents including campground and Ranch facility. An average of 13 people will utilize the campground based on an average daily population of 25 persons during the summer months and an average daily population of 11 persons during the remainder of the year. Ranch facility guests are based on the assumption that 70 percent of the stable renters are Lihi Lani and North Shore residents. The visitor population to the area would constitute approximately 30 percent of the stable renters, who would visit the facilities at least twice a week. Based on these assumptions, the average daily visitor population at Lihi Lani is projected to be about 22 people by the year 2000 and stabilize thereafter.

The projected daily usage of the YMCA based on a 1,000 member facility is expected to be about 140. In addition, the people from the community are expected to use the ballfields.

Population Growth Impacts.
An estimated 20 percent of Country lot residents will originate outside the State. Therefore, about 120 Lihi Lani residents (at 80 percent buildout of the Country lots, sometime after 2010) might be new to Hawaii.

Construction employees for the development would presumably come from the State's resident population. A few operational employees could be in-migrants to Hawaii. As of the year 2000 and afterwards, about five workers and one dependent for each of those workers, are estimated to be in-migrants.

The above estimates show that Lihi Lani will have minimal population growth impacts on the North Shore and the County. Growth impacts on the North Shore Development Plan Area and the Primary Study Area cannot be estimated so precisely since some Lihi Lani residents will move there from nearby areas within the region.

The 2010 General Plan Population Distribution Guidelines are part of the policy for population distribution projected for Oahu over the next twenty years. For the North Shore, Development Plan (DP) area, this Guideline is between 1.6 and 1.8 percent of the total Oahu population. The projected 2010 population range for the North Shore DP area, which includes Lihi Lani, is 16,000 to 18,000. By 2010, Lihi Lani will have 750 residents. This figure is about 4 percent of the guideline's upper limit for the North Shore in 2010. (It is only 0.07 percent of the projected islandwide 2010 population - an amount much smaller than the units used to measure population impacts for the General Plan Guidelines.

The North Shore's share of the island population is already higher than the 1.6 to 1.8 percent range. Since the area has many young families and its natural beauty attracts many young people, further growth appears likely with or without new housing construction.

Lihi Lani's share of future Primary Study Area population is uncertain. If the Pupukea CDP population grows at the same rate, perhaps the Sunset Beach/Pupukea area will grow at the same rate as the island as a whole - about 19 percent between 1990 and 2010. In that case, the projected Lihi Lani population would amount to about 15 percent of the 4,894 people in the area.

However, the Pupukea CDP population has grown at a faster rate in the last decade. If growth continues at 2.5 percent annually, hence Lihi Lani would have only about 11 percent of the area population in 2010.

This amount of additional population equals 0.07 percent of the projected 2010 Oahu population, which is smaller than the smallest unit of measure used in the GP Guidelines. The population increase associated with Lihi Lani is of too small a magnitude to materially alter the degree of consistency of the North Shore's development capacity with its Population Distribution Guideline. As one of the many GP guidelines, the project will be evaluated in conjunction with other GP objectives and policies, such as affordable open space, housing and recreational facilities provision. If future development follows historical growth (1980) rates for the North Shore, population growth for 2010 is anticipated to be in excess of the GP guidelines with or without Lihi Lani.

For the North Shore, a feeling of open space and low residential densities have been identified as valuable. As the lowest density residential area on the North Shore, the proposed Lihi Lani development will be in line with these goals. This additional population will grow in phases over 20 years, and should not be perceived as a major change by most area residents.

C. Mitigative Measures

(1) Overall Consistency with GP Goals: The project has been designed in a manner consistent with the goals of the City and County General Plan. The relationship of the project to GP Population Guidelines is also discussed in Section 7, and will be evaluated by the Planning Department in conjunction with other General Plan Objectives and Policies during their comprehensive review of this project.

(2) Appeal to North Shore Residents: The project's design and low density and agricultural character is likely to appeal to North Shore residents desiring the country lifestyle, therefore providing housing opportunities for some North Shore residents. This may have less impact on the North Shore population than would a project appealing above all to people from other areas.

(3) Project Phasing: Phasing of the project and gradual buildout are anticipated to minimize the potential impact of the project on regional and local population. Build-out of Lihi Lani Country lots will be approximately 65 percent by 2008. Full build-out of the project will take several more decades, based on experience with other lot sales developments in Hawaii. As a result, the population impacts of the project will be spread over a 20 plus year period.

5.7 EMPLOYMENT, PERSONAL INCOME AND CONSUMER EXPENDITURES

This section includes a discussion of existing conditions, potential impacts and proposed mitigative measures regarding the relationship of the project to employment, personal income and consumer expenditures. A detailed economic and fiscal impact study was prepared for by KPMG Peat Marwick (1991) and has been updated (November 1993) to reflect the new Master Plan. An Addendum letter report has been prepared to address the impact of the single family affordable housing, the elderly rental apartments, YMCA and the water reclamation facility (KPMG Peat Marwick, November 17, 1993). Information from this report is summarized below, and the complete report is enclosed in Appendix L.

A. Existing Conditions

Existing conditions in the North Shore area for employment, personal income and consumer expenditures are reported below.

1. Employment

In 1990, 73 percent of the adults living in the Primary Study Area (Pupukea/Sunset Beach/Waimea or Pupukea CDP) had civilian jobs -- a figure higher than found in the surrounding district and island-wide. Thirty-seven percent of the area's workers commute more than 45 minutes for primary employment.

A high proportion, approximately 29 percent, of Pupukea CDP adults have "white-collar" or professional or managerial jobs. As many as eight percent are involved in agricultural activities, which is higher than the surrounding district and island-wide. Health and education professional, construction, service, retail trade, technical support are also strongly represented industries in the Pupukea CDP (Community Resources, Inc., September, 1993).

Unemployment rates in the total study area as of 1990, was five percent, which was near the unemployment level of the surrounding district, but a little higher than the island-wide average of 3.5 percent. However, the Kuilima Resort Socio-Economic Needs Assessment Study (Community Resources, Inc. 1990) indicated in its survey that the unemployment rate for the North Shore is higher, at between 5 percent to 12 percent.

The major employers in the North Shore and Koolauloa Regions are the Kuilima Resort, Waialua Sugar, and the Polynesian Cultural Center in Laie. In the Pupukea/ Sunset Beach/Waimea area there is minimal economic activity. The Foodland supermarket, located at Pupukea Road, is the largest retailer in the area. Waimea Falls Park, an Oahu recreation and visitor attraction, employs about 170 people, of which more than half are from the North Shore area. In addition, the Park's concessions such as the restaurant employ additional employees.

Several agricultural operations, service stations, and "cottage industry" businesses are located along in the vicinity and along Kamehameha Highway in the project area. Haleiwa has a variety of typical commercial activities such as grocery, restaurant, real estate and hardware. Specialty businesses such as surfboard sales and manufacturing also are found in Haleiwa.

2. Personal Income

Study area incomes were lower than island-wide figures, but costs were relatively high, especially in the Pupukea CDP. The median household income in the Primary Study Area was nearly $38,400 in 1989 (as reported in the 1990 census). This median was about 95 percent of the median reported for the entire County, but well above the medians for the Koolauloa and North Shore Districts.

The median household income for the Pupukea/Sunset Beach/Waimea area in 1990 was $38,382. This figure was slightly under the County's median income of $40,581 and slightly more than the North Shore area's median income at $36,841.

Median housing costs in the Primary Study Area were well above the island-wide medians for both homeowners and renters.

The share of the population living in poverty was 11 percent in the Total Study Area. In the Primary Study Area, this figure was lower at nine percent, which is still above the island-wide median of seven percent.

3. Consumer Expenditures

Due to the limited economic activities in the area, consumer expenditures are typical, being spent on items such as food, retail goods, household goods, and entertainment products, especially ocean-sports items.

B. Potential Impacts

1. Employment

Lihi Lani will generate short-term employment during the construction of its new facilities and long-term employment in the operation and support of those facilities. The updated economic and fiscal study by KPMG Peat Marwick (JNovember 1993) show that employment at the project will be smaller than in 1991 but continue over a longer period of time.

Two types of employment opportunities can be expected to be created by the project, including short-term construction jobs and long-term operational jobs. Employment effects may also be classified as being direct, indirect or induced. Direct employment effects would be those supported by construction and consumer expenditures generated by the project. Indirect or induced employment is a result of *the direct employment of other workers and is calculated by a ratio, which are* supported through spending multipliers throughout the the State. The total employment effects include the direct employment effects and the indirect and induced effects.

Total employment due to construction at Lihi Lani could amount to an average of 140 full-time equivalent positions per year during the initial twelve years of development.

Short-term, direct and indirect employment
In the short-term, implementation of the project will generate economic activity for the marketing and sales and construction sectors of the economy. Direct employment is that which could be supported directly by the construction of Lihi Lani. Such employment includes on-site laborers, operative and craftsmen, as well as the professional and managerial, sales and clerical workers whose whole place of employment may be elsewhere on the island or the State. Indirect and induced employment are jobs that are generated by the spending of employee's personal income produced by the project.

Direct construction employment could be highest between the years of 1996 through 1998 when a substantial amount of the infrastructure development and the affordable home construction is anticipated to occur. An estimated 140 full-time equivalent persons could be utilized during Lihi Lani's first year of construction. The overall direct employment due to construction after the initial intensive phase will stabilize at about 65 employees for the next ten years then decrease to about 30 full-time equivalent persons at 80 percent housing buildout (2014) and ten full-time equivalent persons until 100 percent buildout.

Indirect and induced construction employment could amount to 150 employees in the initial 12 years of development and stabilize at 50 full-time equivalent positions. The direct employment of construction at Lihi Lani will stimulate additional employment on the island and elsewhere in the State. Based on ratios derived from

DBEDT, an estimated 0.79 full-time equivalent positions are created in the State for every full-time equivalent job in the building construction industry. Lihi Lani is anticipated to generate about 80 percent of indirect and induced employment on Oahu, with the remainder occurring elsewhere in the State. As with direct construction, the greatest employment from indirect and induced laborers would occur in the first phase of development beginning in 1996 and could amount to about 270 new full-time equivalent positions.

<u>Long-term direct and indirect employment</u>
Long-term permanent employment in the agricultural sector in ranch and farming activities and in the operation of the YMCA will be generated by the project. Total full-time direct, indirect and induced, operational employment is estimated to represent about 100 full-time equivalent positions per year by 1996, and stabilize by 2000 with an estimated 90 full-time equivalent positions.

Direct operational employment is projected to reach 30 full-time equivalent employees at housing build-out. Direct operational employment at Lihi Lani will occur with the ranch and other agricultural activities, property management and the community facilities. Approximately 20 full time direct employees would include instructors, childcare workers, maintenance, administrative and management positions.

Indirect and induced employment due to Lihi Lani's operations could amount to 50 full-time equivalent positions at stabilization. Facility operations at Lihi Lani would also indirectly generate employment in the State. Thus direct, indirect and induced operational employment is estimated to amount to 100 full-time equivalent positions in the initial phase and stabilize thereafter.

2. Personal Income

According to KPMG Peat Marwick (November 1993), personal income paid to Hawaii residents employed in the construction of Lihi Lani could be expected to average about $6.6 million in 1996 and subsequently decline to $2.8 in 2008 as construction within the project is substantially completed.

Operational employment is expected to increase personal income to Hawaii residents by $740,000 in 1996 and 1998 and is expected to stabilize thereafter at $600,000 per year.

Lihi Lani's impact on total annual personal income for both construction and operational employment could total about $7.4 million in 1996, $3.5 million in 2008, and about $1.1 million by 100 percent housing buildout.

3. Consumer Expenditures

Residents of Lihi Lani would make direct expenditures in the community for purchases of standard household requirements and other goods and services. These expenditures would, in turn, require those establishments serving the direct demands to purchase goods and services from other establishments in the State. The latter expenditures are considered indirect effects of the original resident expenditures. Induced expenditures are those made by employees and proprietors with income derived from establishments benefitting from these new direct and indirect expenditures.

C. Mitigation Measures

The impacts of the project on employment, personal income, and consumer expenditures appear to be beneficial to the area residents and businesses. Consequently, no mitigative measures are needed or recommended.

5.8 HOUSING

An analysis of housing data and potential impacts of Lihi Lani is reported by Community Resources, Inc. (September 1993). This report updates housing data in the earlier study prepared for the Final EIS (Group 70, April 1991). The demand for residential housing was discussed in Section 2.3. This section provides a background of housing conditions in the area and the impacts associated with the proposed development.

A. Existing Conditions

Growth Rate. The number of housing units in the Koolauloa and Waialua District has increased at a faster pace than for the island of Oahu as a whole. The average percentage increase between 1980 and 1990 within the Koolauloa and Waialua districts were 2.3 percent and 1.6 percent, respectively. Between 1980 and 1990, the housing supply within the two districts has grown from a total of 7,900 units to a supply of 9,700, an increase of almost 1,800 units within the ten-year span. During that same time Oahu's average annual percentage increase in housing units was 1.1 percent.

Occupancy Rate. Residents of Pupukea/Sunset Beach/Waimea (Pupukea CDP) are more likely to own and live in their homes as compared to other parts of the district where residents are more likely to rent the homes in which they reside. Those living in the Pupukea CDP seem to have a significantly higher owner occupancy rate, with owner-occupied homes representing 89 percent and renter-occupied units representing only 11 percent. Within the Koolauloa and Waialua districts, owner-occupied units represent 46 to 47 percent and renter-occupied units consisted of 54 and 53 percent, respectively. The Island-wide owner-occupancy rate is 52 percent.

The majority of renter occupied units in the project area are priced above the average levels found island-wide and in the surrounding districts. The coastal and inland areas differ in terms of occupancy, with a greater percentage of the coastal units available for rent than those in Pupukea Highlands.

Vacancy Rate. The housing market on Oahu is generally characterized by high land costs and a pent-up demand for housing. Near the Lihi Lani site in the Pupukea, Sunset Beach and Waimea areas, vacancy rates (percentage of units available for sale or rent) have been equal to or tighter than island-wide rates (1990 Census). Both homeowner and rental vacancy rates within the Koolauloa and Wailua Districts have decreased between the years 1980 and 1990. In 1990, the homeowner vacancy rates for the two districts were 1.0 percent and 0.8 percent, respectively.

Higher Costs in Pupukea. CRI has found that housing costs are much greater in the Pupukea CDP, perhaps due to the more recent construction of many homes. This means many residents pay larger percentages of their incomes for housing. A solution has involved "doubling up" to share housing costs with other persons or families. It has been found that one out of every four Pupukea/Sunset households included non-relatives in 1990.

The average price of owner-occupied housing in the Pupukea/Sunset Beach/Waimea area is above the island average. The median value in the surrounding region is, however, much lower. Thus, the area near the project stands out as having both a high concentration of relatively high quality homes and, along the shore, numerous rental units.

Crowding. Island-wide, only 16 percent of households had more than one person per room in the unit. Comparable percentages were 22 percent for the North Shore Census Division and 28 percent for the Koolauloa Division. North Shore and Koolauloa households are also more likely than homes elsewhere to Oahu to include non-relatives, indicating "doubling up" to pay housing costs. High prices and a lack of available units help to explain why there appears to be widespread overcrowding and house sharing in the total study area (Community Resources, Inc., 1992).

Country Lots. The Pupukea area adjacent to Lihi Lani includes several large lot subdivisions including Pupukea Highlands, Sunset Hills, Pupukea Gardens, Lacy Subdivision and North Shore Heights. There are also several Country lot areas in the Sunset Beach lowlands on the mauka side of Kamehameha Highway. The average lot size range from 1.5 to 2.3 acres in the Pupukea area. Approximately 475 lots exist at Pupukea, of which approximately 20 percent are unimproved. Currently, an average of 19 homes are completed each year in Pupukea, at an average build-out rate of eight percent.

Single Family Affordable Housing. Affordable housing for low to moderate-income families is being constructed at Kahuku as part of two programs. The Kahuku Housing Corporation began construction of 289 units in 1987. Current construction is now overseen by the Kahuku Village Association. Approximately 177 units remain to be built by 1993. The bulk of these homesites are reserved for Kahuku residents.

The other housing development program planned in Kahuku involves the provision of up to 200 housing units as a condition of the City and County approval of the Kuilima Resort expansion (1985 approval). These are for low to moderate income families residing in Koolauloa or the North Shore.

A third housing development in the region is planned for Laie. A site for 450 homes, including approximately 270 affordable homes, received approval of a Koolauloa Development Plan Land Use Map amendment and is planned to be constructed between the years 1996 to 2000.

Elderly Affordable Rental Housing. The existing need for additional units of elderly housing is indicated by long waiting lists for units at the three existing North Shore facilities - Haleiwa Senior Citizen Housing Center, Kahuku Hauoli Hale, and Kupuna Home O Waialua. Applicants must now wait from one to two years before a vacancy becomes available. There are no City and County facilities in the area at the present time.

B. Potential Impacts

The on-site residential mix will include 80 elderly affordable rental units, (by the City and County Department of Housing and Community Development) 50 affordable single family houses (built by Obayashi) and 315 market Country lot homes (individual home development). The 315 one-acre minimum residential lots will be subdivided on the site, and offered at market price. Country lot homes will be constructed by lot owners; however, Obayashi intends to build some prototypical models to stimulate lot sales. All 50 of the single family affordable homes will be constructed by Obayashi. In addition, Obayashi will participate with the City for the construction of up to 50 off-site affordable housing units in conjunction with the Department of Housing and Community Development. This housing is also anticipated to be built in the North Shore region. As many as 495 housing units will be provided in the North Shore area, with Obayashi participating in development of about 180 affordable homes.

Country Lots/Market Homes. The 315 proposed Country lots will range in size from one to three acres and be sold at market prices comparable to similar lots available in the Pupukea/Sunset Beach area. Phasing of the development and a market study for lot absorption and home construction indicate that the Country lots could be absorbed within a nine to eleven year time period with 65 percent built out by 2008. The remaining Country lot homes will be built out over the next several decades. In addition, it is projected that approximately 75 percent of the market lots and homes will be occupied by full time residents, and 25 percent of the lots would be purchased as part time residences as either a second or vacation home.

Fulfillment of Affordable Housing Requirement. The developer will fulfill the affordable housing requirement prescribed by the City and County, which currently calls for 30 percent of the total number of on-site residential units to be provided as affordable housing. Lihi Lani proposes 315 country lots, 50 affordable single-family homes and contribution of land and infrastructure to the City and County for construction of 80 elderly affordable rentals, a total of 445 units on-site. The standard affordable requirement would be 30 percent of 445 units, or a total of 134 units. Obayashi will satisfy this requirement through (a) the 50 single-family affordable homes; (b) contributions of land and infrastructure for the City's elderly housing (on-site): and (c) participation in development of up to 50 off-site affordable housing units developed by the City and County. Obayashi will participate in development of 180 affordable units through this process.

Single Family Affordable Housing. The proposed single family affordable homes will be on a site in a mauka location of Lihi Lani. A small park will be included at the site along with roadways and other infrastructure. Homes will be three bedroom homes built on lots which will be minimum 5,000 square feet in area. The price range for the affordable units will match the requirements for affordability as set forth by the City and County of Honolulu for families earning between 100 to 120 percent of median family income.

Elderly Rental Housing. A six-acre site will be dedicated to the City for the development of 80 affordable rental units. Infrastructure connections for sewer collection, water supply and roadway access will be provided to the site by Obayashi. It is planned to be similar to the City's Manoa Gardens project with eight buildings containing ten units. The elderly housing will be owned and managed by the City following its guidelines for rental rates and tenant selection. Many residents of the elderly housing units could come from the study area or could have relatives in the study area. It is likely that the Lihi Lani elderly housing would mostly attract residents from the total study area, but would also house people from the rest of the island. According to CRI, the Kahuku Hauoli Hale project houses persons from all areas of Oahu, but preference is given to residents of Koolauloa.

The elderly housing site is situated adjacent to the Community Facilities/YMCA site on the makai portion of the site nearby Kamehameha Highway. This location is suitable for the elderly project as it would be in close proximity to bus lines, shopping areas and other services. Comparable to Manoa Gardens, this site represents a good opportunity for access to the facilities of the YMCA and support for elementary school programs from elderly volunteers.

C. <u>Mitigative Measures</u>

(1) **Interaction of Elderly Housing and Park/YMCA.** Potential views will be mitigated by landscape plantings which will buffer the elderly housing from the park and YMCA area.

(2) **Affordable Housing:** The applicant will fulfill conditions related to the provision of affordable housing which may be imposed in connection with project approval processes. Areas have been reserved for the provision of 130 affordable homes on-site, representing 30 percent of the total residential units to be developed at

Lihi Lani. In addition, Obayashi will participate in development of up to 50 off-site affordable housing units.

(3) **Maintain Rural Character:** The low density of homes designed for Lihi Lani will maintain the rural character of this area of the North Shore.

(4) **Phasing of Development:** All of the on-site affordable homes are expected to be built in the first phase of the project. The City will be responsible for the actual schedule for development of the elderly housing.

5.9 FISCAL IMPACTS/GOVERNMENT REVENUES

This section addresses potential effects of the project on employment, personal income and consumer expenditures. Fiscal issues relating to the project were studied for Lihi Lani by KPMG Peat Marwick (Final Report, November 1993), and their report is attached as Appendix L. Government revenues associated with the general excise tax, property taxes and income taxes increased by the economic activity are also addressed. An Addendum to the report addressing the fiscal impacts of the single family affordable housing, the elderly rental apartments and the YMCA is also attached (KPMG Peat Marwick, November 17, 1993).

A. Existing Conditions

The project site is currently vacant and Obayashi currently pays approximately $140,000 per year in City and County property taxes (KPMG Peat Marwick, November 1993). There are no current public expenditures being made for direct services to the site due to its inaccessibility and undeveloped nature.

B. Potential Impacts

1. Revenues

Development of Lihi Lani would bring additional tax revenues to the County and State governments. County government revenues would be principally in the form of real property taxes on the new assessments on subdivided properties and facilities. Revenues to the State government would be composed principally of General Excise Tax on construction expenditures and specific excise taxes and personal income taxes paid by additional employees and new State residents.

Net additional real property taxes were projected for Lihi Lani according to assessed values for other comparable developments and preliminary construction costs provided by Obayashi, less the current property taxes generated by the undeveloped site. Based on these rates and estimated assessed values, the proposed residential lots, affordable homes, horse ranch, campground and other community facilities could be expected to generate about $590,000 (1993 dollars) each year in new property tax revenues per year by 2008 for the City and County of Honolulu. This would grow to about $640,000 per year (1993 dollars) at 80 percent buildout and to $680,000 per year at buildout.

New revenues to the State government would be generated by the General Excise Tax (currently four percent) on direct expenditures by the few day visitors to the project. In addition, new residents attracted to the State by the employment or residential opportunities of the project would bring in additional excise sales taxes, individual income taxes and other State taxes such as liquor, tobacco, fuel, inheritance, estate and conveyance taxes. Thus, new total tax revenues to the State government attributable to the project's development could generate between $2.0 and $3.0 million in annual State revenues during the first three years of construction.

2. Expenditures

New visitors and residents attracted by the project would also necessitate additional expenditures of State and County public resources.

In-migrant residents would incur public costs in terms of public safety, maintenance of highways, recreational facilities and natural resources, health and sanitation measures, special cash capital improvements, education, retirement and pension funds, public welfare and other government functions.

The number of day visitors is expected to be approximately 22 persons visiting the Ranch and the campground per day. These people will slightly increase the average daily population of the community and also require public expenditures in terms of public safety, maintenance of highways, health and sanitation, recreation and special cash capital improvements.

Honolulu City and County government expenditures totaled about $800 and $560 per capita (1993 dollars) for residents and visitors, respectively. Based on these outlays and adjusting for inflation, public expenditures by the County on behalf of the service population for the development could be expected to reach $80,000 per year (1993 dollars) in 2008, and increase to about $120,000 (1993 dollars) at project buildout several decades later.

State government operating expenditures totaled about $4,160 per resident and $1,200 per full-time equivalent visitor in 1993. Based on these operating costs and adjusting for inflation, State government expenditures are projected to total about $410,000 per year (1993 dollars) by 2008 increasing to about $650,000 per year (1993 dollars) at project completion.

3. Net Fiscal Impacts

A comparison of projected public revenues and expenditures attributable to the project's development is given in Table 5-5 as shown, the County government could expect to net $510,000 (1993 dollars) per year by 2008, increasing to $560,000 per

TABLE 5-5

Comparison of Government Revenues and Expenditures

	(In millions - 1993 dollars)	
	2008	2020 (1)
County Government		
New Revenues	0.59	0.68
New Expenditures	0.08	0.12
Net Additional Revenues	0.51	0.56
Revenue/Expenditure Ratio (2)	7.5	5.5
State Government		
New Revenues	1.06	1.13
New Expenditures	0.41	0.65
Net Additional Revenues	0.65	0.48
Revenue/Expenditure Ratio (2)	2.6	1.7

(1) Full buildout of project will be 2020 or later
(2) New revenues divided by new expenditures

SOURCE: KPMG Peat Marwick (November 1993) year (1993 dollars) at project buildout. Additional County government revenues generated by the proposed project could be 7.5 times the operating expenditures incurred by the County government by 2008, and about 5.5 times these expenditures at full buildout.

Net additional fiscal benefits to the State government are projected to be about $2.0 million and $3.0 million during its first two years of development, decreasing to approximately $650,000 per year (1993 dollars) by 2008, and lower at $480,000 per year (1993 dollars) at full buildout. Additional State government revenues would be about 2.6 times the expenditures incurred in 2008, and about 1.7 times to the expenditures at full development.

C. Mitigative Measures

Future tax revenues that will be collected by the City and County and the State are expected to offset the costs of providing some public services. No additional mitigation measures are considered necessary with respect to government expenditures.

5.10 LIFESTYLE / CHARACTER OF THE COMMUNITY

The proposed project will provide new housing opportunities, including Country lots and much needed affordable and elderly housing. Recreational facilities which are presently unavailable to most North Shore residents will also be provided by the project. The low density development plan with the Ranch and agricultural areas will maintain the rural country character of the North Shore. The project will slowly be phased into the community over the next 10 to 20 years, similar to the development to Pupukea Highlands.

A. Existing Conditions

Nearly all residents of the North Shore/Koolauloa region prize country living. Different residents may emphasize different aspects of area lifestyles. For some, the magnificent surfing opportunities come first. For others, homes on the North Shore are prized as away from urban development, and provide a chance to experience a relatively independent lifestyle. Others live in small North Shore towns where all know each other, and where most residents either have been part of a community for generations or have felt accepted as a long-term resident.

Many area residents live in the vicinity of the project site to experience the variety of water-related activities such as swimming, sailboarding, surfing, snorkeling and SCUBA diving. Nearby are the Banzai Pipeline, Sunset Beach and Waimea Bay, which are among the most famous surfing locations in the world. Local amateur surfing contests and international professional surfing contests are held each winter season (October-March) on the North Shore at Sunset Beach, Ehukai Beach Park (Banzai Pipeline), Waimea Bay Beach Park, Chun's Reef in Kawailoa, and at Alii

Beach Park in Haleiwa. The winter surfing season draws a transient population which adds another special feature to life on the North Shore.

Nearly two-thirds of the study area population live in small towns with business centers and well-defined neighborhoods, such as Waialua, Haleiwa, Kahuku and Laie. Many of these communities are or were once "company towns", resulting in some clear lines of social organization. They are more subject to small-town pressures for cooperation and social cohesiveness. There is a history of third- and fourth-generation families seeking preservation of their particular community as a home for the next generation.

Thus, centralized employment centers and large-scale economic activity are (to a point) historically compatible with the lifestyles and values of the community dwellers of this region. Some of these residents have banded together in response to the closure of Kahuku Plantation, and the possibility of the closing of Waialua Sugar. This action has been reported as being inevitable without major changes in the economics of sugar production in Waialua.

Other residents who have in-migrated to the area for the country or ocean-sport oriented lifestyles are less conditioned or reliant upon employment within the greater North Shore/Koolauloa area. Non-traditional employment and income generating business practices are a trademark of the North Shore region. Even so, a large number of residents in the region commute long distances for employment in order to enjoy the benefits of living in the country.

B. Potential Impacts

Lihi Lani could potentially affect the lifestyles of some North Shore residents in two ways. Because of the varied recreational elements the project will offer, the development will supplement and expand the recreational activities available to residents of the area. New agricultural activities at Lihi Lani Lani will expand farming operations in the region, and possibly combine with existing uses in Pupukea to expand markets for certain crops. The presence of these new activities, however, will be perceived by some North Shore residents as a threat to the continuing existence of this relatively uncrowded rural setting. Development of the makai portion of the property, although planned for community facilities and elderly housing may be considered to detract from the existing visual setting of undeveloped vacant land.

A comparison of development density shows the existing gross density in the Pupukea Highlands subdivisions (725 acres total with 570 dwelling units or 0.78 units per acre) is higher than that being proposed for Lihi Lani project (1,143 acres total with 445 dwelling units or 0.39 units per acre). The overall affect on lifestyles on the North Shore with gradual buildout of the Lihi Lani project is expected to be a continuation of the current development patters and trends. Lihi Lani will also provide an enhancement of recreational opportunities and community facility resources.

C. Mitigative Measures

The design and operation of the development is planned to complement the existing country atmosphere of the North Shore. The intent is not for the new project to intrude on the community, but to blend into the surrounding area and become an integral part of the North Shore. Substantial agricultural operations and the varied recreational elements offered by the project will add to the rural and recreational-oriented lifestyle of the North Shore. New hiking trails provided on the site will add new public access and scenic views (at no fee) on lands which previously were inaccessible. A new community center/YMCA will provide a site for area residents to pursue recreation, social and cultural activities. In addition, Lihi Lani will continue to support community activities and educational programs, as it has for the past five years.

5.11 PUBLIC INFRASTRUCTURE

This section includes brief descriptions of the existing infrastructure on the project site and the surrounding area for water supply, wastewater collection, treatment and disposal, solid waste disposal, drainage facilities and roadways. Anticipated project impacts are evaluated along with mitigative measures proposed to minimize impacts on infrastructure.

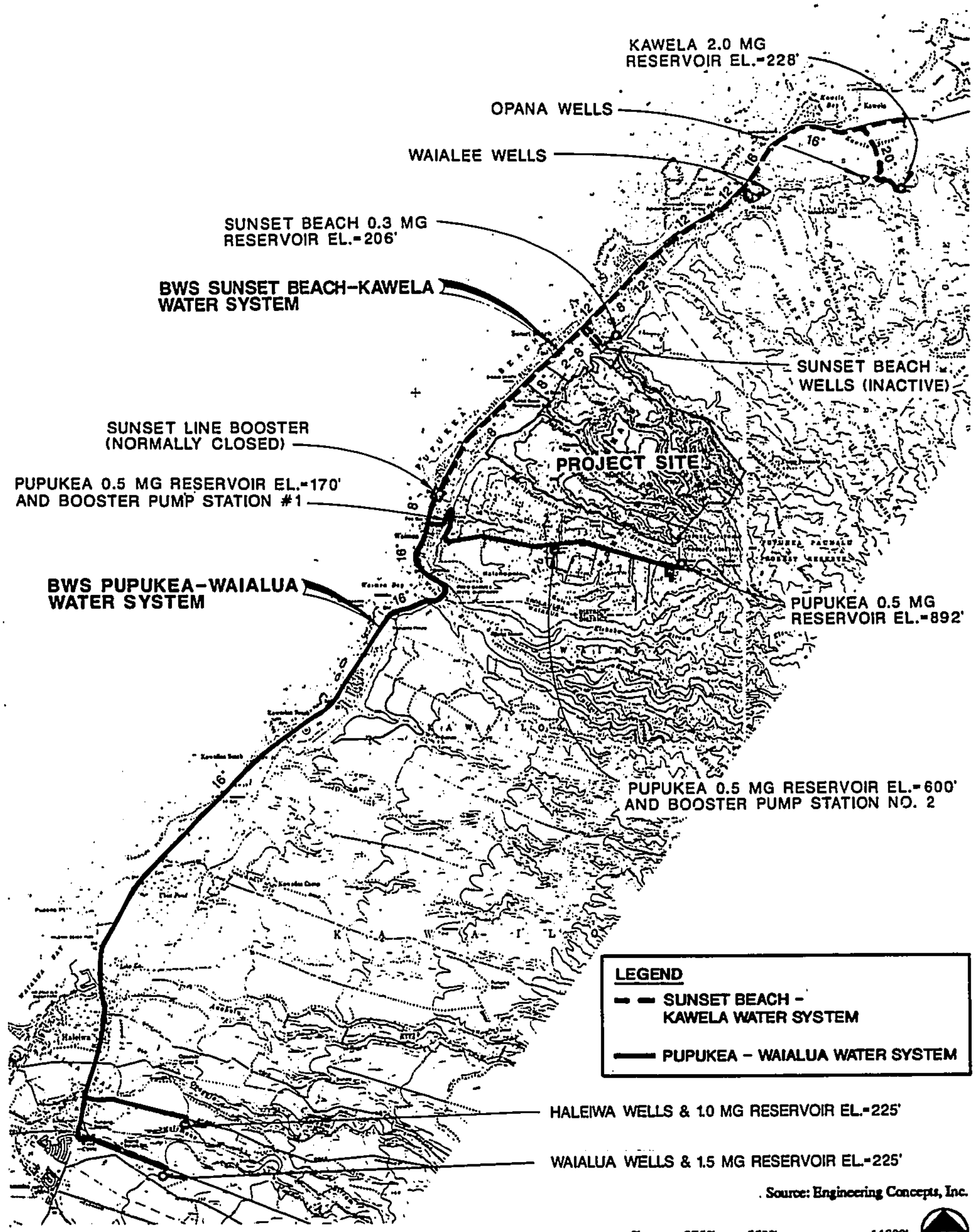
Engineering Concepts, Inc. (September 1993) has prepared technical studies of wastewater management, water supply and storm drainage for this project. The complete reports are included in Appendices C, D and F, respectively. Information from these reports is included in this section.

5.11.1 Water Supply Facilities

A. Existing Conditions

As discussed in Sections 2.2 and 4.5, water for areas Haleiwa-side of Puula Road in Sunset Beach is supplied from Board of Water Supply (BWS) wells in Waialua and Haleiwa via a 16-inch water transmission main in Kamehameha Highway. Figure 5-9 shows the existing water supply system to Sunset Beach and Pupukea Highlands.

For water supply to the Pupukea Highlands and Sunset Hills area (upper and lower areas), BWS has installed transmission lines (12-inch main), pump stations and three 500,000 gallon reservoir systems. There are three water service zones supplied by this system. There is a storage reservoir at 170 feet elevation on Pupukea Road. This reservoir provides water for the coastal areas on the Waialua-side of Puula Road up to an elevation of 70 feet. Two 800 gpm booster pumps transport water to the second reservoir, located on Pupukea Road at an elevation of approximately 600 feet, and serves areas from 70 feet to 500 feet elevation. Two additional 800 gpm booster pumps transport water to the third reservoir, also on Pupukea Road, located at an elevation of 892 feet, which serves areas from 500 feet to 792 feet.



Source: Engineering Concepts, Inc.

EXISTING BWS WATER SYSTEM

LIHI LANI

FIGURE 5-9

The Lihi Lani project will draw potable water off of two existing BWS systems. The makai development of the Elderly Housing and the YWCA/Community Facilities will utilize the Sunset Beach-Kawela System, and all areas above the bluff will utilize the Pupukea-Waialua System.

Water use from the Waialua and Haleiwa wells was estimated to be 2.37 million gallons per day (mgd) in 1990, with future commitments up to 2.94 mgd. The State Water Commission sets limitations on groundwater withdrawal. Currently, BWS' allocation is 2.73 mgd. Thus, the BWS allocation has been exceeded, and permission for additional pump capacity and withdrawal of water from this system must be granted to allow future development in the region.

Obayashi has water storage and transmission credits totalling approximately 485,000 gpd as a result of participating in the development of the BWS Pupukea Highlands water system (161,667 gpd at each of the three Pupukea reservoirs).

There is no water transmission system presently extending to the project area.

B. Potential Impacts

The project will require an average daily potable water demand of approximately 245,000 gpd (or about 0.245 MGD) to meet potable water needs. The BWS will need to apply to the State Water Commission for additional allocation and source development to meet the development needs of the project. Obayashi will need to participate in this added source development. As stated in Section 4.5, no negative effect on the water supply system and the aquifer is expected due to the project's water demand.

Service to the project will be extended from the "low" service zone (600 ft. reservoir). The planned Community Facilities will be served by the existing Sunset Beach-Kawela System. In terms of infrastructure impacts, the extension of water service will require installation of new water mains through parts of Wilinau Road in Sunset Hills and a new connection along Kamehameha Highway to serve the Elderly Housing and YMCA/Community facilities. Dust, noise and traffic disturbances will result from short-term construction activities along these local roadways.

Existing BWS consumers in the Pupukea Highlands and Sunset Beach subdivision who are serviced by the 892-foot and 600-foot reservoirs will not be adversely affected by the increase in water demand by the project. These water systems in Pupukea are currently operating well below their design capacity. The systems were designed to accommodate the additional water demand of the project.

Fire protection and domestic service pressure requirements within the project will be satisfied by the development of two 0.1 MG and a third 0.2 MG storage reservoirs on the site. These are relatively small reservoirs, requiring a minimum pad area of about; 100 ft. x 100 ft. (10,000 sq. ft.) located adjacent to the Water Reclamation Facility and makai of the Boy Scout Camp Pupukea, and makai of the Ranch/pasture. Construction of these reservoirs will involve some vegetation clearing and minimal grading.

Obayashi will build the new water system to BWS standards and anticipates dedication of the system to the BWS.

C. Mitigative Measures

There are several mitigative measures that will be implemented to minimize the impact on water supply infrastructure, as listed below.

(1) Off-Site Water Facilities Construction: The potable water system associated with the project will not adversely affect the existing infrastructure for water supply. Mitigation of nuisances during construction such as dust, noise and traffic disturbances will be accomplished by: limiting construction to weekdays during working hours when many residents are not at home; use of wind breaks or watering to reduce dust; and observance of approved traffic control plans.

(2) Water Source Development. Depending on potable water source limitations, Obayashi would either participate with the Board of Water Supply in drilling wells off-site at Waialua or Haleiwa, or be assessed a facility charge.

5.11.2 Wastewater Facilities

A. Existing Conditions

There is no area-wide wastewater collection, treatment and disposal system on the North Shore. The only existing facilities for wastewater collection treatment and disposal in the area of the project are individual cesspools, septic systems and holding tanks which exist on private residential properties. At present, there are no known plans for an area-wide wastewater collection/treatment system for the Sunset Beach and Pupukea area.

B. Potential Impacts

Development of the project will involve the construction of a private wastewater collection, treatment and disposal system that will only serve this project. On-site advanced secondary wastewater treatment will be conducted through the use of facultative stabilization ponds followed by a wetlands system. The advanced secondary treated wastewater will also be filtered and disinfected with ultraviolet light.

This natural treatment system is being proposed in direct response to a community preference over other "hard structure" facilities for wastewater treatment. This process is described in Section 2.2 and in Appendix C. The estimated wastewater volume at completion of the project will be approximately 180,000 gpd. The proposed system can hold treated effluent for up to 58 days without disposal, which is more than double the requirement of the Department of Health for storage capacity.

Treated wastewater effluent (reclaimed water) will be utilized for irrigation of the larger contiguous agricultural areas at Lihi Lani. Reclaimed water irrigation of the agricultural areas is discussed in Section 2.2 and Section 4.5. Adverse impacts to the groundwater aquifer due to effluent disposal by land application of reclaimed water are not foreseen.

C. Mitigative Measures

Because public wastewater facilities will not be affected by this project, there will be no mitigative measures required for public facilities. Obayashi will provide back-up measures for its on-site facilities.

(1) Back-up Features for Wastewater Treatment and Disposal: Back-up measures will be taken with wastewater treatment and disposal facilities to ensure the safety and environmental sanctity of the community in the case of a mechanical or electrical failure. The following are the safeguards proposed for the wastewater treatment facility and sewage pumping stations:

- Odor control measures are not expected to be needed however, contingency provisions will be included in the design and the budget to incorporate odor abatement facilities, should the need arise.
- Stand-by power will be provided to each sewage pumping station and the Water Reclamation Facility in case of electrical power outage. (Depending on location, some sewage pumping stations may share generators.)
- Storage vaults will be used for wastewater overflow and storage.
- Redundant or parallel sets of waste stabilization ponds, equal in capacity, will be constructed to provide operational redundancy during periodic instances for pond maintenance.
- Alarms and telemetering will be installed to provide warnings to indicate high/low liquid level conditions, equipment malfunction and other emergency conditions. Signals will be transferred through telephone lines by telemetry to the homes of key maintenance personnel as an additional safety measure during non-working hours.
- Alarms will be installed at each pump station indicating high/low liquid level conditions, equipment malfunction, and other emergency conditions.

- Pump stations, treatment ponds and the wetlands will be fenced to restrict public access. Additionally, these facilities will be landscaped or otherwise shielded from direct view.

- Water reclamation facilities, including piping and appurtenances, in areas subject to public access will have warning signs that irrigation water is not fit for consumption. Piping and appurtenances will be labeled to distinguish the product as reclaimed water.

The reclaimed water will be tested to meet criteria stated in the Proposed Guidelines for the Treatment and Reuse of Reclaimed Water (Draft No. 7, 20 May 1993).

5.11.3 Solid Waste Disposal Facilities

A. Existing Conditions

The small amount of solid waste generated on the project site is presently carried off-site by the farm helpers to transfer stations or public or private landfills.

B. Potential Impacts

At full development, the on-site residents, visitors and employees will generate approximately 2.3 to 4.0 pounds per capita of refuse daily. This will equate to a maximum of 4,000 to 6,000 pounds per day (2.0 to 3.0 tons per day) of refuse. Solid waste will be collected by private collection companies and disposed of at public and private landfills. This will place a small additional demand on City and County waste disposal facilities.

C. Mitigative Measures

(1) Recycling: Cleared trees that cannot be preserved on-site will be mulched for re-use within the project. Separation of garbage or other island-wide programs for recycling will be supported by Obayashi in the operation of recreational facilities.

(2) Solid Waste Disposal: It is expected that City and County revenues derived from the completed project will be sufficient to finance the project's fair share of the cost for major capital improvements, such as solid waste disposal facilities. The County operates a solid waste transfer station in Kawailoa. Solid waste collected at this transfer station will be hauled either to the H-POWER refuse-to-energy plant in Campbell Industrial Park.

5.11.4 Drainage Facilities

A. Existing Conditions

Public drainage facilities in the area of the project consist primarily of culverts passing underneath Kamehameha Highway. These culverts transmit waters flowing in the intermittent streams (during peak precipitation periods) into the ocean. Culverts have been installed at Kamehameha Highway for Paumalu Stream, Pakulena Stream and Kalunawaikaala Stream.

Drainage collection facilities and injection wells have been installed by the City and County of Honolulu along Ke Nui Road across from the Sunset Beach Elementary School. In the recent past, drainage from the soccer field and playground of the Sunset Beach Elementary School had contributed to flooding of areas along the Ke Nui Road area across from the school. The drainage improvements have served to alleviate some of the flooding problems in this area.

B. Potential Impacts

An increase in storm water runoff on the project site will be created by the development of paved areas and roofs, and this runoff will be controlled on-site. Details regarding drainage impacts are discussed in Section 4.6.1. As compared to existing conditions, there will be a reduction in the volume and rate of runoff from the project site under all sizes of future storm conditions.

Of note, the extensive drainage control measures at the Lihi Lani project will not solve the current flooding problems occurring in the lowlands of Sunset Beach. The flooding of these low areas must be addressed through public infrastructure improvement projects. A recently completed study, urged by local residents, has identified possible solutions to the flooding problems. Chronic flooding of Kamehameha Highway at the soccer field adjacent to the Sunset Beach Elementary School is planned to be alleviated by an upcoming design and construction project which was recently announced for bid by the State Department of Transportation.

C. Mitigative Measures

Mitigative measures for on-site drainage conditions is included in Section 4.6. Those relating to public drainage systems are repeated below.

(1) Storm Water Runoff Controls: Development of the project will not place any additional burden on public drainage facilities along Kamehameha Highway, or create any potential flood hazards for properties in the area. Control of runoff within the project will be achieved through the construction and operation of detention basins throughout the project. Storm runoff water will be detained during major storms which will effectively maintain existing runoff conditions. Future flooding that may occur in areas adjoining the project will not be the result of the project, because runoff will be controlled on-site.

It is expected that public drainage facilities will not be affected by the project, therefore, no additional measures are proposed beyond the planned on-site detention basins. Over 40 separate detention basins are planned at Lihi Lani, providing 162 acre-feet of storage, which is much more than the required runoff control.

(2) Construction Schedule: Obayashi will endeavor to schedule one-year road construction period to coincide with the lower precipitation period. Phased development of the project will minimize the extent of construction-related runoff.

5.11.5 Roadways

A. Existing Conditions

Significant public roadways in the area of the project include: Kamehameha Highway (State Highway 83) and Pupukea Road. Along Kamehameha Highway are numerous direct connections to residence driveways and smaller local roads, many of which are unpaved. Ke Nui Road parallels Kamehameha Highway along the ocean front residential areas near the project, as also do Ke Waena Road and Ke Iki Road. In Pupukea Highlands, side roads off Pupukea Road extend throughout the large-lot subdivision areas. Alapio Road is a neighborhood road connecting off Pupukea Road. Within Sunset Hills, Wilinau Road connects off Alapio Road to the Haleiwa-side boundary of the project.

The condition of most roadways in the area of the project is rough pavement, and in some areas, roadways are overdue for maintenance. Most roadways have grass shoulders and are paralleled by drainage ditches. Guide rails are present along some bends in the Highway. Lighting and signage are present on the more frequently traveled routes off the Highway.

B. Potential Impacts

The impact of project development on local roadways will consist of construction impacts and operational impacts. The short-term effects of the project will be due to construction activities, which are not expected to be significant. Delays on Kamehameha Highway will occur due to roadway improvements for the entrance to the project and turning lane addition. Construction of water mains to be installed in Alapio Road and Wilinau Road in Pupukea Highlands and Sunset Hills could also cause some minor traffic detours and delays.

Long-term operational impacts of the project will not cause a substantial adverse affect on roadway surface conditions. As compared to other traffic added to the area's roads by the project's completion, the vehicles added by the project will represent approximately five to eight percent of all vehicles. This traffic volume is not expected to create a substantial additional adverse wearing effect on the roadway facilities.

C. Mitigative Measures

Roadway surfaces affected by construction of the project entrance and the water main installation will be re-paved once construction is completed. Approved traffic control plans will be followed during the construction period to avoid unnecessary delays to traffic flow. A left turn lane will be added on Kamehameha Highway for the Haleiwa-bound traffic turning into the project. This storage lane will provide better safety to avoid rear-end collisions, and will allow unimpeded flow of through-traffic towards Haleiwa. Obayashi will monitor traffic flow conditions at this intersection periodically, to assess the need for traffic signalization in the future. If and when a signal is required, Obayashi will install signals to State DOT standards.

5.11.6 Electrical Supply

A. Existing Conditions

Hawaiian Electric Company (HECO) owns and maintains the existing electrical system which serves the project area. An existing 46 kV subtransmission line crosses the makai portion of the project site. A second 46 kV subtransmission line from Waialua to the Kuilima Substation is planned to be installed in the highlands mauka of the project by 1995 to increase the reliability of service to the North Shore.

B. Potential Impacts

The Lihi Lani project could require an electrical demand as high as 2,700 kVa, which may affect future plans for another sub-transmission line to the area. Given proper coordination w/HECO, the proposed project will not have an adverse impact on electrical supply facilities.

Development of the elderly housing area will likely require the relocation of the existing 46 kV subtransmission line crossing the makai portion of the property. Active coordination with the Distribution Engineering and Right-of-Way divisions of HECO should enable this relocation to be made, as long as a replacement easement which is acceptable to HECO can be identified on the Obayashi land.

C. Mitigative Measures

Obayashi will coordinate it's subsequent development planning efforts with HECO's planning efforts to supply power to the area. Obayashi will participate in providing necessary improvements to the electrical distribution system required to serve Lihi Lani.

5.12 PUBLIC SERVICES

Public services for education, police and fire protection, health care and recreational facilities are all addressed in this section. Existing conditions, potential impacts and mitigation were evaluated based on interviews or correspondence with representatives from each of the public service entities.

5.12.1 Schools

A. Existing Conditions

The nearest elementary school to the project is the Sunset Beach Elementary School (grades kindergarten to six) which is located adjacent to the makai section of the project site. Kahuku High and Intermediate School (grades seven to twelve) is located about eight miles from the project in Kahuku. According to the Department of Education, both schools are operating near capacity at the present (Letter from Charles T. Toguchi to Robin Foster, August 21, 1993).

B. Potential Impacts

The number of school children generated by the project during the next twenty years will be 30 to 40 percent less than was anticipated for the 1991 plan. At full buildout, which is anticipated sometime after 2020, the project could have about the same impact on schools as the 1991 plan.

The Department of Education (DOE) estimates that Lihi Lani (at full buildout) would increase public school enrollments by 154 students (Toguchi, DOE, to Robin Foster, Department of Planning, August 21, 1993). Understanding the anticipated buildout for the Country lots, the DOE estimate was converted into a near-term estimate by Community Resources, Inc. (September 1993), as shown in Table 5-6. By the year 1996, 55 homes (50 affordable homes and 5 Country lot homes) would generate 22 students. By 2000, a total of 40 children could be added by the project, and by 2010 a total of another 107 school children could be added. This calculation suggests that Lihi Lani could generate the equivalent of about one classroom's enrollment at Sunset Beach Elementary School by 2000. By 2010, the added 107 school children would represent about 70 percent of the enrollment projected by the DOE at full buildout of Lihi Lani.

The proposed project includes the phased development of 315 Country lots and 50 single family affordable homes. The 80 elderly rental units will not add any school aged children. Children from the 50 single family affordable homes are expected to account for most of the Lihi Lani students through the year 2000. By 2010, the affordable homes would account for about 20 percent of the project's single family units. The current schedule anticipates that the affordable housing could be completed and occupied by 1998. Home construction and occupancy of the country lots will be 70 percent by 2010, and full build out is not expected for at least another 10 years.

Upon completion, the project could produce an approximate enrollment of 92 students in grades kindergarten to six, 23 in grades seven and eight and 39 students in grades nine to twelve (Toguchi, State Department of Education, December 21, 1990). Enrollment increases due to Lihi Lani by 2010 are projected to be 70 percent of the DOE estimate of total enrollment by the completed project.

TABLE 5-6

Adapted DOE Estimate of School Impacts

		Enrollment (1)			
Year	SF Homes Built	K-6	7-8	9-12	TOTAL
1996	55	13	3	6	22
2000	102	24	6	10	40
2010	268	64	16	27	107

(1) Estimated by Community Resources, Inc. (after discussion with DOE personnel) using the following ratios for singe-family housing:

Elementary (K-6)	24 students per 100 houses
Intermediate (7-8)	6 students per 100 houses
High (9-12)	10 students per 100 houses

The DOE estimate of future school impacts from the project is based on enrollment levels in the Pupukea CDP area. This procedure may yield an overestimate, because of the trend, in Hawaii and nationwide, towards smaller family sizes. The DOE estimate also does not consider the possibility that household size at a new large-lot subdivision might be smaller than in Pupukea Highlands, where some residents have built homes with space for large two- and three-generational families. Without the project, enrollment at the Sunset Beach Elementary School is expected to be stable in the future. The added enrollment of students generated by the fully developed project would amount to an estimated 20 percent of the existing enrollment. Assuming steady growth in enrollment from non-project sources, these students could not be accommodated within the Elementary School's recently completed permanent facilities. Significant effects on enrollment and school capacity, however, are not anticipated to occur until after 2000.

Kahuku High and Intermediate School is currently operating beyond capacity with a severe shortage of classrooms. The added enrollment due to Lihi Lani at full development would constitute about 3.5 percent of the existing enrollment. The addition of any new students would further exceed the capacity of this school. Significant effects on enrollment and school capacity as a result of *Lihi Lani* are not expected to result until after 2000.

Based on the number of public school students generated by the Pupukea Highlands subdivision, the DOE estimates that Lihi Lani could eventually add 157 school-aged students to the local school system. This estimate assumes that all of the homes at Lihi Lani are occupied by full-time residents. Schools in the local system are near or at capacity. At a future point when enrollment is affected by the children added by the project, probably after 2000, new teaching space and instructors may be required to accommodate additional students. Anticipated future enrollment levels resulting from children living in the rest of the community must be considered in evaluating the potential future effect of Lihi Lani on local school capacities.

C. Mitigative Measures

Several measures are proposed to minimize impacts on school facilities.

(1) **Coordination with DOE:** Obayashi will continue to discuss and coordinate with the DOE regarding classroom facilities needs as warranted to support the project's added school children.

(2) **Educational Trust Fund:** Obayashi has offered to contribute $2,000 per Country lot sold to an Educational Trust Fund for scholarships and schools. With the increase in the number of Country lots in the project, the fund will ultimately contain $630,000, which is slightly larger than was proposed under the 1991 plan. Contributions plus interest would go to fund scholarships for graduating students of local high schools who plan to major in environmental studies or community relations programs.

(3) **Development Phasing:** The phased development of Lihi Lani will cause a slow growth of student enrollment in local schools. By 2017, enrollment increases will be approximately 70 percent of the student generation total predicted for the full buildout.

(4) **Operational Funds:** The proportion of projected State tax revenues generated by this project which will be allocated to education will more than cover any additional operational expenses.

(5) **Part Time Residences and Changing Demographics:** Some Country lot residences at Lihi Lani will be part-time residences. Recent trends in family sizes show that smaller family sizes are expected at Lihi Lani. Hence, it is expected that increases to the school age population will be somewhat less than the maximum figures indicated by the DOE.

5.12.2 Police Protection

A. Existing Conditions

The project site is located in the Honolulu Police Department's (HPD) District 2. HPD District 2 encompasses the area marked by the following boundaries: Kaena Point along the North Shore coast to Waialee Stream, down the Koolau Mountain Ridge to Kipapa Stream, across to Waiahole Ditch near Kunia, and up the Waianae Mountain Ridge back to Kaena Point. Police protection is provided to the project area from the Wahiawa Substation and routine patrols as well as normal police services are provided by for this substation.

The beat boundaries of the second District encompass an area of approximately 190 square miles. This area is covered by 71 field officers. Response time to the Pupukea area fluctuates over time, but was estimated to be 2 to 2.5 minutes (personal communication, Captain William Bennett, HPD Wahiawa Substation, December 11, 1990).

B. Potential Impacts

There will be occasional and sometimes unavoidable demand for police service at the project. The project is not anticipated to cause a significant increased demand on police services in the region. In addition, private security on-site will help to deter criminal activities on the property.

C. Mitigative Measures

The applicant will be taking measures to provide security on-site during construction. In addition, private security services will be provided within the project upon completion. County property tax revenues generated by the project should more than cover the costs of additional police services attributable to the development (Peat Marwick, September 1993).

5.12.3 Fire Protection

A. <u>Existing Conditions</u>

The Sunset Beach and Kahuku Fire Stations are nearest to the project; both are capable of providing engine, medical and marine rescue services. The Sunset Beach Fire Station is the closest to Lihi Lani, located approximately 1.4 miles from the project entrance. From this station, fire trucks are expected to be able to access the entrance of the community in less than five minutes. Back-up fire fighting support for the area could be provided by the Kahuku Fire Station, located approximately eight miles away (Personal communication, Assistant Chief Leonardi and Battalion Chief Nojiri, 3 September 1993).

B. <u>Potential Impacts</u>

The planned community facilities will require fire protection from the local municipal fire department. County property tax revenues generated by the project should more than cover the cost of additional services required of the local fire stations attributable to the development (Peat Marwick, September 1993).

The project buildout of Country lot homes is expected to reach 65 percent by 2008, full buildout at least 10 years later. A growing requirement for services will be spread over a twenty plus year build out period. The on-site single family affordable homes and the City's elderly housing is expected to be constructed in the first phase of the project. These 130 housing units and a small number of Country lot homes will require fire protection services prior to 2000.

Although there will be an additional demand placed on fire protection services as a result of this project, according to Fire Department Officials, the existing services provided by the City and County will be adequate. The Fire Department has determined that no additional facilities, equipment or personnel will be required as a result of this project.

Due to the terrain of Lihi Lani mauka residential areas above the bluff and the distance from Kamehameha Highway/Lihi Lani entrance to the residences on the mauka bluff areas, a delayed response for services is expected proportional to the distance between the resident and the entrance. Additionally, if a fire company is responding to a call at Lihi Lani, this could potentially cause a delayed response in the other parts of the community (and vice versa). Fire protection needs for Lihi Lani will continue to be evaluated in conjunction with the City and County of Honolulu Fire Department.

The additional potential demand on fire protection services is not expected to place an unusual burden on the existing fire department or require the provision of additional facilities or equipment. During subsequent planning phases, Obayashi will prepare a fire suppression plan to describe the proposed fire suppression accessways to the State Forest Reserve lands adjacent to the property.

C. Mitigative Measures

(1) **Water transmission for fire protection.** Water lines and storage with adequate fire fighting capacity will be installed by the applicant within the project and be designed to dedicable standards. The location of fire hydrants at Lihi Lani must be reviewed and approved by the Board of Water Supply and the Fire Department.

(2) **Design of roadways.** To minimize the delayed response to reach the mauka residences, roadways will have appropriate turning radius and grade to accommodate Fire Department vehicles. The access roadway to Lihi Lani are anticipated to be easier to negotiate than Pupukea Highlands Road. Design for this roadway will be offered for review to the Fire Department before being finalized. The project's entrance access roadway will be at 16 percent grade at its steepest point, which is within the Fire Department's maximum grade of 19 percent.

(3) **Fire protection standards.** Buildings and facilities within the project will be designed with adequate attention to the principles of fire safety. They will be built to follow necessary City and County fire protection standards. Safety precaution measures such as the installation of sprinkler systems and smoke detectors in public buildings will also be undertaken.

(4) **Fire break at the property boundary at the State Forest Reserve.** In conjunction with the DLNR Division of Forestry and Wildlife, a fire break is proposed to be established at the mauka boundary of the property. This fire break will be a protective measure for both Lihi Lani and the State Forest Reserve.

5.12.4 Health Care/Hospitals

A. Existing Conditions

Health care facilities within the area include the Kahuku Hospital, the Haleiwa Medical Clinic and the Wahiawa General Hospital. The nearest facility is the 26-bed Kahuku Hospital located approximately ten to fifteen minutes drive by car from the project site. This facility is also the site for one of the City and County ambulance and a helipad for medical evacuation helicopters. Kahuku Hospital offers comprehensive medical services on a 24-hour per day basis. Other facilities at the hospital include a private dental office and a medical office/clinic with three physicians in private practice. This facility has been upgraded over the past three years and is now encouraging patients to utilize their services, since the hospital is operating well below capacity.

B. Potential Impacts

The residents at the project's 445 homes that will eventually be constructed on-site, and visitors and workers at the various facilities in the project, can be expected to place a slight burden on the operation of the Kahuku medical facilities. The 80 elderly homes will accommodate approximately 106 residents who will sometimes require medical care. The elderly housing project is not intended to be a care facility. Medical screening will be provided within the City's program; however, the need for additional medical care will be required. The impact upon these facilities will be slight since the hospital has not been operating at full capacity.

C. Mitigative Measures

No mitigative measures are considered necessary for health care services as a result of this project. Obayashi will continue in it's support of Kahuku Hospital activities.

5.12.5 Recreational Facilities

A. Existing Conditions

There are several City and County and a State recreational facility located within the general area of the project. Private commercial recreational attractions are also located nearby. The beaches and ocean are the major recreational attractions in this part of Oahu.

The City and County of Honolulu has three lifeguard-protected beaches located in the immediate vicinity of the project at Sunset Beach, Ehukai Beach and Ke Waena Beach. There are two major ocean beach parks, at Waimea Bay and Alii Beach, in Haleiwa. All these ocean beaches are actively utilized, and restroom, showers, park benches and picnic areas are provided at Ehukai, Waimea and Alii. Sunset Beach has historically been heavily utilized, but has few support facilities. A marina with a boat launching ramp is also located at Alii Beach Park. Kaiaka State Park is located near Haleiwa, on the Waialua-side of town. This oceanfront park has bathing areas, showers, restrooms and picnic facilities.

Waimea Falls Park and the Polynesian Cultural Center in Laie are two heavily visited commercial recreational attractions that are located in the general area of the project.

B. Potential Impacts

Development of Lihi Lani will create new recreational facilities involving mauka areas for horseback riding, camping and hiking. All recreational facilities within the project will be available to the public at a fee, except for the hiking trails, which will be free of charge. Additionally, the proposed community facility will be developed as a branch YMCA facility and will provide opportunities for both active and passive recreational activities. Potential uses include, field sports for baseball and soccer, swimming, picnics, and indoor activities, such as martial arts, dancing, arts and crafts. The new facilities at the project will have a beneficial effect on recreational availability in the area, by providing more varied types of activities than presently exist on the North Shore.

Existing recreational facilities in the area will be affected by the development of residences at the project. Approximately 977 full-time residents will live at the project at full buildout. The primary recreational interest of the residents is likely to be satisfied by the new facilities within the development, however, these residents will also utilize the public beaches in the area.

C. Mitigative Measures

Overall, the project will have a positive effect on the availability of recreational opportunities on the North Shore. New recreational opportunities suitable for the rural North Shore will be offered at Lihi Lani. As discussed with the State Department of Land and Natural Resources, Obayashi will prepare a detailed map showing the planned trail system and public access to the State Forest Reserve land during subsequent planning phases. The plan will be submitted to the Division of Forestry and Wildlife and Na Ala Hele Advisory Committee for review.

SECTION 6

POTENTIAL CUMULATIVE IMPACTS AND UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

6.0 POTENTIAL CUMULATIVE IMPACTS AND UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

6.1 CUMULATIVE IMPACTS

Cumulative impacts are those associated with existing, approved, and reasonably anticipated future projects producing related or additive impacts. A reasonable list of "cumulative" or "related" projects for analysis of Lihi Lani would include existing, approved and proposed infrastructure or development projects in the vicinity of the proposed Lihi Lani project site. The analysis addresses primarily those development projects which could have additive effects on the environment and infrastructure systems in the general vicinity of the project site. Most categories of environmental effects which could potentially result from the proposed project are addressed for their cumulative potential.

Projects which have received some or all required land use approvals, or are presently under construction, could generate cumulative effects on the environment in the vicinity of the project site. Kuilima Resort Expansion and Kahuku Villages residential development qualify as projects in this category.

This cumulative analysis also considers projects which have been proposed, but for which none of the necessary government approvals have been granted. Other significant projects which have been discussed in at least some preliminary fashion include Bishop Estate's Master Plan for Haleiwa and the proposal recently made by the Mokuleia Land Company for their land around the Dillingham Airfield.

Except for those projects already granted approvals, there is no guarantee that any or all of these projects will be built as proposed. The following is an analysis of potential cumulative impacts of the Lihi Lani project, considering the fact that additional development will likely occur in some portions of the North Shore in the foreseeable future.

Ocean Water Quality: Lihi Lani will not create adverse ocean water quality impacts because very extensive measures will be implemented to control erosion, storm water and chemical use on the site. Treated wastewater (reclaimed water) will be disposed on-site through an ecologically sensitive method which will not impact ocean water quality. Other developments in the area will be required to follow standard practices for construction site erosion control, and some developers may choose to follow a similar program of strict controls on their sites. If these types of ecologically sensitive measures are followed at other projects in the area, and no ocean outfall is created to serve the region, ocean water quality should remain at current quality levels or possibly improve because of reduced soil erosion and silt input to the ocean.

Land Use Character: Portions of the North Shore are undergoing a gradual land use change from sugar dominated agriculture to more diversified rural activities. This is inevitable, with the economic difficulties of sugar. Lihi Lani, with its low-density residential, agricultural, recreational and community facility orientation, would contribute to this cumulative land use transformation. The country and rural qualities of the North Shore will be reflected in the low-density plan for Lihi Lani. If other future developments in the area follow a low-density approach with country-style qualities, these projects may also become acceptable. Open space is the key element of the country and rural feeling. The requirement for open space and protection of the environment are the dominant factors that guided the planning for Lihi Lani.

Traffic: Kamehameha Highway will be congested with traffic during peak hours in the near future, primarily due to ambient traffic growth and approved resort growth at Kuilima. Lihi Lani would add to the area traffic, however, it could represent at most five to eight percent of the 2008 traffic volumes (assuming full build-out). Future development on the North Shore would add even more vehicles to Kamehameha Highway. Roadway improvements will be likely be required in the future to accommodate new traffic growth, which will be addressed by the State DOT.

Potable Water: Lihi Lani will create a small additional demand for potable water which is within the capacities of the BWS Waialua-Pupukea and Sunset Beach-Kawela systems. Obayashi will participate in source development as required at the time of project development. Other future projects proposed for the North Shore will also require potable water. The Waialua aquifer has the capacity to accommodate growth in the area, as do aquifers in Koolauloa. Additional source development will be necessary to extract the new water for future projects.

Air Quality: Lihi Lani will unavoidably contribute to the increase in air pollutant concentrations in the area from increased motor vehicle traffic. Analysis of air quality concluded that predicted concentrations will remain within the National Ambient Air Quality Standards but occasionally may exceed the more stringent State standards. Occasional exceedance of the State standards is not unusual as they may be exceeded at many locations in the state that have even moderate traffic. Additional future growth will introduce additional air pollutants to the region. Air quality of the North Shore will not be noticeably reduced by the additional growth if roadway infrastructure is provided for individuals projects, and eventually Kamehameha Highway is upgraded.

Noise: Lihi Lani will not create adverse noise impacts, except during the short-term construction phase. Added traffic in the area created by other future projects could cause additional noise along Kamehameha Highway. Residences located close to the highway will experience greater traffic noise, exceeding the 65 dBA residential guidelines during peak traffic periods.

Socio-economic characteristics: Lihi Lani will make a small contribution to cumulative population, housing, employment and economic growth in the North Shore area. New residential, recreational and commercial projects will also add to these factors. Population growth for the North Shore must be considered, since the

City Council has created a policy to retain the country and rural character of the North Shore and Koolauloa areas.

Visual Resources: The visual character of the property at Lihi Lani will remain intact, with some changes due to an access road and project entrance. The coastal bluff will generally remain intact in terms of visual quality, once landscaping for the access road becomes established following construction. If future projects develop lands along Kamehameha Highway, this could cause additional visual impacts to the area. The City's SMA process will regulate impacts to coastal views, including the coastal bluff.

6.2 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

The Lihi Lani project will create limited adverse environmental impacts which cannot be fully mitigated by the measures planned to be implemented at the site. The following list includes those short-term and long-term impacts that are expected to be unavoidable, including those that are minor in significance.

6.2.1 Unavoidable Adverse Short-Term Impacts

1. Soils will be temporarily disturbed by grading, excavation and mounding activities at the site during construction.

2. Temporary increases in soil erosion will also result from construction operations, and minor amounts of soil will be carried off-site in surface runoff water.

3. Natural vegetation will be removed from 400 to 480 acres on the project site to allow for construction of project features and infrastructure.

4. Wildlife utilizing the site and immediate adjacent areas will be displaced by construction activities into nearby undeveloped lands. Construction operations will temporarily discourage wildlife from feeding at or migrating through the site.

5. Operation of construction equipment, trucks and worker vehicles may temporarily impede traffic in the area during the construction period.

6. Negligible releases of air contaminants will occur from construction equipment. Small amounts of dust may be generated during dry periods as a result of construction operations.

7. The visual character of the area will be slightly affected by construction activities and by the presence and operation of construction equipment.

8. Minor increases in noise levels may result from construction activities.

6.2.2 Unavoidable Adverse Long-Term Impacts

1. Modifications to the current topography will be made at the site to accommodate project development.

2. Portions of prime agricultural land will be used for housing and infrastructure, along with 160 acres of agriculture.

3. An average of 500,000 to 600,000 gallons of non-potable groundwater will be utilized each day for irrigation of the landscaped common areas and landscaping and agricultural portions of Country lots. An average of 245,000 gpd of potable water will be used for domestic purposes and reclaimed after treatment for agricultural irrigation.

4. Small contributions of nitrogen compounds will enter groundwater from reclaimed water (treated wastewater effluent) and fertilizer application.

5. Storm water runoff from the project site will contain some minor quantities of fertilizer nitrate.

6. Sixteen archaeological sites on the project site will be altered by construction.

7. Vehicles associated with the community using Kamehameha Highway and other local roadways will have a minor effect on traffic flow.

8. Some additional noise will be generated by the project which will cause a very slight increase in noise levels along Kamehameha Highway.

9. Air quality at area roadways will receive a minor addition of traffic-related emissions.

10. Views of the project site will be changed to include portions of some structures and the entrance road.

11. There will be an additional two to three tons per day of domestic solid waste generated by the project which must be accommodated by public solid waste management facilities.

12. Minor demand on public services will result from the development, including police and fire protection.

6.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The construction and operation of the proposed community will involve the irretrievable commitment of certain natural and fiscal resources. The most major resource commitment will be the 400 to 480 acres of land required for development of the residential, agricultural, recreational and infrastructure elements of the project. Money, construction materials, manpower and energy will all be expended to complete construction and operate these facilities. The impact of utilizing these resources should, however, be weighed against the economic, social and recreational benefits to the residents of the region, County and State.

Between 400 to 480 acres of the 1,144 acres at the site will be used for the project's residential, agricultural, recreational and infrastructure. The remaining 664 to 744 acres will remain unaffected as open space.

There would be a permanent commitment of private funds and resources to plan, design, construct and operate the project facilities. This will result in a permanent increase in jobs and other employment-related benefits and resources. It is expected that increased tax revenues will be generated along with increase in economic activity and appreciated value of the community.

Beyond the on-site improvements constructed and operated by the developer, there will be an increased usage of public facilities such as the Kamehameha Highway for project-related traffic and greater load on the City and County solid waste facilities.

The commitment of resources required to accomplish the project includes labor and materials, which are mostly unrenewable and irretrievable. The operation of the project will also include the consumption of potable water and petroleum-generated electricity which also represents irretrievable commitments of resources.

6.3 GROWTH INDUCING ASPECTS OF THE PROJECT

The project applicant requests the redesignation of portions of the site from agricultural to urban, park or other designations appropriate to the recreational and residential uses proposed. Development of the project would require the extension of water lines and electrical power to the site.

The extension of major infrastructure to an undeveloped or rural area (i.e. sewage collection and treatment facilities, highway expansion, water main lines) can sometimes facilitate future development on undeveloped lands. On the North Shore, this could increase the pressure on nearby lands presently designated as agriculture, to seek changes in land use.

The proposed Lihi Lani project will be primarily self-contained in terms of infrastructure. New facilities for roads, water and sewer will be developed only for Lihi Lani, and will not be capable of serving any adjoining lands. Solid and liquid wastes will be collected and treated with on-site facilities. Potable and non-potable water sources are currently available to meet the demands of the project. The project is of such a scale that the development of large scale infrastructure is not necessary. Lihi Lani in itself will not induce growth of the North Shore.

While the project will generate some long term employment opportunities, Lihi Lani could not be considered a major employment center that could induce significant residential growth in the area.

SECTION 7

RELATIONSHIP TO EXISTING POLICIES AND PLANS FOR THE AREA

7.0 RELATIONSHIP TO EXISTING POLICIES AND PLANS FOR THE AREA

This section includes a discussion of the relationship of the project to the objectives and policies of the Hawaii State Plan and Functional Plans, the City and County of Honolulu General Plan, the City and County North Shore Development Plan, the Hawaii Coastal Zone Management Program, and the Special Management Rules and Regulations of the City and County of Honolulu.

7.1 HAWAII STATE PLAN

This section includes an assessment of the conformity of the reclassification of a small portion of the Lihi Lani land from State Agricultural to Urban to the applicable goals, objectives and policies of the Hawaii State Plan, Chapter 226, HRS, and applicable priority guidelines and functional plan policies.

7.1.1 Objectives and Policies

Section 226-6: Objectives and policies for the economy - in general:

"(a)(1) Increased and diversified employment opportunities to achieve full employment, increased income and job choice, and improved living standards for Hawaii's people."

"(b)(10) Stimulate the development and expansion of economic activities which will benefit areas with substantial or expected employment problems."

"(b)(14) Promote and protect intangible resources in Hawaii, such as scenic beauty and the aloha spirit, which are vital to a healthy economy."

Discussion: The proposed Lihi Lani project is expected to generate approximately 80 full-time construction jobs in the first 12 years of development and approximately 30 full-time operational jobs upon its completion. Unemployment on the North Shore is at five percent, slightly higher than island-wide percentages (US Bureau of the Census, 1990).

The projected average annual personal income from direct employment is estimated at $600,000 per year at buildout. The income generated from the proposed development should raise the standard of living for some North Shore residents, as well as contribute to business revenues in the area. (Refer to Section 5.7).

Section 226-11: Objectives and policies for the physical environment - land-based, shoreline, and marine resources:

"(a)(2) Effective protection of Hawaii's unique and fragile environmental resources."

"(b)(1) Exercise an overall conservation ethic in the use of Hawaii's natural resources."

"(b)(3) Take into account the physical attributes of areas when planning and designing activities."

"(b)(4) Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage."

"(b)(5) Consider multiple uses in watershed areas, provided such uses do not detrimentally affect water quality and recharge functions."

"(b)(6) Encourage the protection of rare or endangered plant and animal species and habitats native to Hawaii."

"(b)(8) Pursue compatible relationships among activities, facilities, and natural resources."

"(b)(9) Promote increased accessibility and prudent use of inland and shoreline areas for public recreational, educational, and scientific purposes."

Discussion: The Lihi Lani Master Plan is designed as an environmentally sensitive development project. The site is a distinct physical environment including its topography and natural resources. The project has been designed as a low density development which emphasizes the natural features and where possible, proposes their preservation. Agricultural uses will be integrated with the residential and common areas of the project. Steeply sloped lands and intermittent streams will be avoided. By maintaining approximately 700 acres of open space, preservation of the natural environment on this site will be achieved. The Koolau Eugenia trees found on the State Forest Preserve land adjacent to the site is a rare tree species that will be preserved and protected, by DLNR with cooperation by Obayashi.

The compatible mixture of uses and activities will provide ample opportunity for the residents and public to enjoy and learn of the natural resources of Pupukea.

Section 226-12: Objectives and policies for the physical environment - scenic, natural beauty, and historic resources:

(a) "Enhancement of Hawaii's scenic assets, natural beauty, and multi-cultural/historical resources."

"(b)(1) Promote the preservation and restoration of significant natural and historic resources."

"(b)(3) Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features."

"(b)(4) Protect those special areas, structures, and elements that are an integral and functional part of Hawaii's ethnic and cultural heritage."

"(b)5) Encourage the design of developments and activities that complement the natural beauty of the islands."

Discussion: Planning with the environment has guided the design of Lihi Lani. The natural beauty of Pupukea and Paumalu is why a low density, open space oriented development is proposed. Scenic views and open space will be maintained and enhanced for the benefit of homeowners and the regional residents who will have access to the site for passive and active recreation purposes. Approximately 700 acres of open space will be preserved. The purpose will be to preserve and enhance, as possible, the native and endemic species in the North Shore area. The design of Lihi Lani will blend with the natural beauty of the North Shore.

There are a number of archaeological sites on the project site. Paul H. Rosendahl, Ph.D., Inc. (June 1988), has made recommendations concerning the treatment of affected archaeological sites. These recommendations are under review by the Department of Land and Natural Resources, Historic Preservation Division. Of the twenty-two sites recommended for further data collection, nine may be affected by the project. Where possible, these sites will be preserved "as is" or will be included in areas where they will be protected and buffered, such as in landscaped and other common areas. (Refer to Section 5.1).

Section 226-13: Objectives and policies for the physical environment - land, air, water quality:

"(a)(1) Maintenance and pursuit of improved quality in Hawaii's land, air, and water resources."

"(a)(2) Greater public awareness and appreciation of Hawaii's environment resources."

"(b)(2) Promote the proper management of Hawaii's land and water resources."

"(b)(3) Promote effective measures to achieve desired quality in Hawaii's surface, ground, and coastal waters."

"(b)(5) Reduce the threat to life and property from erosion, flooding, tsunamis, hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters."

"(b)(6) Encourage design and construction practices that enhance the physical qualities of Hawaii's communities."

"(b)(8) Foster recognition of the importance and value of the land, air, and water resources to Hawaii's people, their cultures and visitors."

Discussion: There will be 700 acres of open space maintained on the project site. Several miles of improved trails will be accessible to the public for either hiking, walking or horseback riding. The improved trail system will encourage higher usage and make for a better public awareness of this natural area. Homeowners in Lihi Lani will be restricted to certain types and quantities of landscaping and will utilize non-potable water for irrigation of landscaped area and agricultural uses. A xeriscape program will be incorporated in the project landscape design. Through such measures, Hawaii's residents are expected to become personally aware of the importance of water conservation.

The land and water resources of the project site will be properly managed. A host of mitigation measures will be designed and implemented to assure that land, air, and water are not significantly impacted by the project. Indeed, the project is expected to improve the quality of runoff water from the site to the ocean, since loading of suspended solids in the runoff will decrease with the full development in place. Additionally, storm water runoff will be controlled through the use of detention basins and other measures, so that the rate of runoff with the project will be the same or less than existing conditions. The project will not exceed the potable water resource capabilities of the aquifer. Fertilizer and pesticide application at the golf course will be professionally managed. An Integrated Pest Management (IPM) program will be instituted to employ strict management and overall reduced pesticide usage.

Noise and air quality levels at the project will be well within government standards. The architecture of the residential and recreational community will be a country style in recognition of the rural surroundings.

Section 226-15: Objectives and policies for facility systems - solid and liquid wastes.

"(a)(2) Provision of adequate sewerage facilities for physical and economic activities that alleviate problems in housing, employment, mobility, and other areas."

"(b)(1) Encourage the adequate development of sewerage facilities that complement planned growth."

"(b)(2) Promote re-use and recycling to reduce solid and liquid wastes and employ a conservation ethic."

"(b)(3) Promote research to develop more efficient and economical treatment and disposals of solid and liquid wastes."

Discussion: A water reclamation facility has been designed for the project which will adequately treat the wastewater generated by the project without reliance upon existing City and County facilities. Obayashi will employ a facultative oxidation pond and marsh treatment system which has been proven effective by Dr. Robert Gearheart. The facility is a low energy, ecologically sensitive system. The system will generate reclaimed water of a quality which will meet or exceed the highest treatment criteria of the State Department of Health criteria, for irrigation of common agricultural areas such as the Ranch, orchard and nursery areas (Refer to Sections 2.1.10 and 4.5).

Section 226-16: Objective and policies for facility systems - water.

"(b)(1) Coordinate development of land use activities with existing and potential water supply."

"(b)(3) Reclaim and encourage the productive use of runoff water and waste water discharges."

"(b)(6) Promote water conservation programs and practices in government, private industry, and the general public to help ensure adequate water to meet long-term needs."

Discussion: The potable and non-potable water needs of the project are within the available capacities according to Mink (1988; 1990). These findings were reinforced by Tom Nance Water Resources Engineering (September 1993). Reclaimed water will be used for irrigation of agricultural uses at Lihi Lani. A water conservation program will be established for the community, including design and operational guidelines for the use of non-potable water for irrigation and the use of drought tolerant landscaping (xeriscape program). (Refer to Section 4.5).

Section 226-19: Objectives and policies for socio-cultural advancement - housing.

"(a)(1) Greater opportunities for Hawaii's people to secure reasonably prices, safe, sanitary, livable homes located in suitable environments that satisfactorily accommodate the needs and desires of families and individuals."

"(a)(2) The orderly development of residential areas sensitive to community needs and other land uses."

"(b)(1) Effectively accommodate the housing needs of Hawaii's people."

"(b)(2) Stimulate and promote feasible approaches that increase housing choices for low-income, moderate-income, and gap-group households."

"(b)(3) Increase home ownership and rental opportunities and choices in terms of quality, location, cost, densities, style, and size of housing."

"(b)(5) Promote design and location of housing developments taking into account the physical setting, accessibility to public facilities and services, and other concerns of existing communities and surrounding areas."

"(b)(7) Foster a variety of lifestyles traditional to Hawaii through the design and maintenance of neighborhoods that reflect the cultures and values of the community."

Discussion: The choice of one-acre Country lot housing for the proposed project considers and reflects the density of the existing, adjacent residential communities. Country lot development will also provide the opportunity to conduct agricultural uses of the land in conjunction with the low-density residential uses. The provision of affordable housing by Obayashi will result in participation in the development of 180 units. This is in direct response to the State and County policies to increase housing availability for the people of Oahu and the State.

As a predominantly recreational community, including hiking and horse riding trails, Lihi Lani may foster an outdoor lifestyle consistent with the traditional lifestyle for Hawaii. The country character of the North Shore is valuable to the existing community and will be preserved in the open space oriented design of Lihi Lani.

Section 226-23: Objective and policies for socio-cultural advancement - leisure.

"(a) Planning for the State's socio-cultural advancement with regard to leisure shall be directed towards the achievement of the objective of the adequate provision of resources to accommodate diverse cultural, artistic, and recreational needs for present and future generations."

"(b)()2) Provide a wide range of activities and facilities to fulfill the cultural, artistic, and recreational needs of all diverse and special groups effectively and efficiently."

"(b)(4) Promote the recreational and educational potential of natural resources having scenic, open space, cultural, historical, geological, or biological values while ensuring that their inherent values are preserved."

"(b)(5) Ensure opportunities for everyone to use and enjoy Hawaii's recreational resources."

"(b)(6) Assure the availability of sufficient resources to provide for future cultural, artistic, and recreational needs."

Discussion: Lihi Lani is largely devoted to the fulfillment of the above objective and policies for recreation. The potential for recreation in an area of scenic, open space is maximized through the development of a horse ranch, campground, hiking and riding trails, and community facilities on the site. Ocean and mountain views will be part of the experience at these facilities which will be available for public use. Both passive and active recreational needs are satisfied through a system of hiking and horse riding trails, traversing the undeveloped, heavily vegetated, open space areas of the site. Portions of these areas will not only be preserved, but enhanced through the re-introduction of native or endemic plant species, eventually providing a valuable botanical resource.

An even wider range of activities will be served through the construction of a community facility. Currently proposed facilities include a swimming pool, pavilion, soccer/baseball field, picnic areas and parking. Discussions are ongoing regarding the final mix of facilities, however, the YMCA of Honolulu is interested in establishing the first North Shore YMCA at this location. Cultural, artistic and other leisure-time activities will be available to a diverse range of users within the greater North Shore area through the use of this facility.

7.1.2 Priority Guidelines

The purpose of the State Plan priority guidelines is to address areas of state-wide concern. The following discussion provides an assessment of how the proposed project conforms to the relevant priority guidelines.

Section 226-103: Economic Priority Guidelines:

(e)(2): "Encourage the improvement of irrigation technology and promote the use of non-potable water for agricultural and landscaping purposes."

Discussion: The project proposes to use up to 0.7 MGD of non-potable water at peak periods drawn from on-site wells for irrigation of the agricultural areas and other landscaping purposes. Refer to Sections 2.1 and 4.5. In addition, 0.18 MGD of water from the water reclamation facility will be used for irrigation Drip irrigation technology will be used on-site. This ensures efficient use and distribution of water, while minimizing runoff, deep percolation and soil erosion.

Land Resource Priority Guidelines: Section 226-104

(b)(2): "Make available marginal or non-essential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district."

Discussion: As previously noted, Lihi Lani will establish significant small-scale agricultural uses on approximately 160 acres of the property. This will make use of some marginal lands. Refer to Section 4.4 and Appendix A for additional discussion of the agricultural uses. The proposed "urban" uses are generally low intensity and appropriate to the rural character of the area.

(b)(6): "Seek participation from the private sector for the cost of building infrastructure and utilities, and maintaining open spaces."

(b)(13): "Protect and enhance Hawaii's shoreline, open spaces, and scenic resources."

<u>Discussion</u>: The applicant will build necessary infrastructure such as a highway left-turn lane, on-site roadways, potable and irrigation water supply systems, a water reclamation system, and drainage and erosion control systems.

A total of approximately 700 acres, or more than half of the land, will be undisturbed open space. The scenic views of and from within the site will be maintained and protected as a natural resource and asset. (Refer to Section 5.5).

The project itself is significantly mauka of the shoreline and will have no impact on littoral processes.

7.1.3 Functional Plans

The State Functional Plans, translate the broad goals and objectives of the Hawaii State Plan into detailed courses of action. The relationship of the proposed actions within the project site to the relevant State Functional Plan objectives is described below.

<u>State Agricultural Functional Plan - Land</u>

"B (5). <u>POLICY:</u> Provide greater protection to agricultural lands in accordance with the Hawaii State Constitution."

"B (5) (c). <u>IMPLEMENTING ACTION</u>: Until standards and criteria to conserve and protect important agricultural lands are enacted by the Legislature, important agricultural lands should be classified in the State Agricultural District and zoned for agricultural use, except where, by preponderance of the evidence presented, injustice or inequity will result, or overriding public interest exists to provide such lands for other objectives of the Hawaii State Plan."

<u>Discussion</u>: All soils classification systems (SCS, LESA, ALISH, LSB), rate the overall quality of most of the soils on the project site as poor. In addition, a study of the site by Frank S. Scott, Jr., Ph.D., Agricultural Economist, concluded that intensive commercial agricultural operations would be economically infeasible; however, with the development of roadway and water system infrastructure for the residential elements, both access and irrigation for agriculture will be subsidized, thus, improving the agricultural potential.

Agricultural uses of this property are planned to be expanded significantly, with on-lot agricultural uses and larger common area agricultural areas. Uses will include nursery, fruit tree orchards and grazing pasture.

State Housing Functional Plan

"A. (2). <u>POLICY</u>: Stimulate and promote feasible approaches that increase housing choices for low-income, moderate-income, and gap group households."

"A. (2) (c). <u>IMPLEMENTING ACTION</u>: Encourage the use of opportunities and incentives in State Land Use redistricting process to provide lands or homes for affordable or assisted housing development."

<u>Discussion</u>: Consistent with such policies, the applicant plans to participate in the development of up to 180 affordable units, with 130 units on-site and participation in development of up to 50 units off-site.

<u>State Recreational Functional Plan</u>

"A(2). <u>POLICY</u>. Ensure that intended uses for a site respect community values and are compatible with the area's physical resources and recreation potential."

"A(3). <u>POLICY</u>. Emphasize the scenic and open space qualities of physical resources and recreation areas."

"B (1) <u>POLICY</u>. Exercise an overall conservation ethic in the use of Hawaii's resources."

"C(1) <u>POLICY</u>. Maintain an adequate supply of recreation facilities and programs which fulfill the needs of all recreation groups."

"D(2) <u>POLICY</u>. Promote the securing of public access to resources with recreational value."

<u>Discussion</u>: In addition to residential development, the primary purpose of the project is to provide extensive recreational facilities, including a horse ranch, campground, hiking trails and community facilities. All facilities will be open to the public. The proposed recreation facilities are designed to emphasize the inherent scenic qualities of the site.

In the spirit of land and water conservation, over 700 acres of the site will be undeveloped open space. A water conservation program will be established to minimize the amount of water used for common area and residential yard landscaping.

State Transportation Functional Plan

None of the policies or implementing actions in this functional plan address specific developments such as the proposed project. The overall objective of the plan is to provide for the efficient, safe, and convenient movement of people and goods. The impacts of the proposed project on existing transportation facilities are addressed in Section 5.2.

State Tourism Functional Plan

The policies and implementing actions of this functional plan deal with tourism promotion, the development of visitor promotion, the development of visitor accommodations, employment and career development, and community relations. No references to the independent provision of recreational facilities are included. The proposed project is intended to provide recreational opportunities for both residents and visitors, without emphasizing services to any particular group.

State Health Functional Plan

The State Health Functional Plan focuses primarily on public health programs under the jurisdiction of the State Health Department. Several of the implementing actions relate to operating Department of Health permit programs to which the proposed project is subject. These include reviewing private water reclamation systems, discharges to the air or groundwater, new sources of drinking water, and air conditioning/mechanical ventilation systems for buildings that are used by the public. The proposed project will comply with all necessary permit requirements of the Department of Health.

State Historic Preservation Functional Plan

Almost all of the policies and implementing actions in the State Historic Preservation Functional Plan are directed at State agencies, especially the Department of Land and Natural Resources (DLNR). An archaeological survey of the project site has been conducted and the findings of the survey will be forwarded to DLNR for their review. The project proponent will comply with the recommendations in the archaeological report, pending DLNR approval of these measures (Refer to Section 5.1).

State Conservation Land Functional Plan

The project site does not include any conservation lands. Hence, the implementing actions of the State Conservation Functional Plan do not pertain to the proposed project.

State Water Resources Development Functional Plan

This functional plan primarily affects State operations. The proposed water system for this project is discussed in Section 2.1.11, 2.1.12 and 2.1.13.

The remaining functional plans - State Education Functional Plan, State Higher Education Functional Plan, and State Energy Functional Plan - are not directly relevant to the proposed project.

7.2 GENERAL PLAN FOR THE CITY AND COUNTY OF HONOLULU

The following discussion provides an assessment of how the proposed project conforms to and implements the objectives and policies of the General Plan.

7.2.1 Population

Objective C: *"To establish a pattern of population distribution that will allow the people of Oahu to live and work in harmony."*

Objective C, Policy 3: *"Manage physical growth and development in the urban-fringe and rural areas so that: a. An undesirable spreading of development is prevented; and b. Their population densities are consistent with the character of development and environmental qualities desired for such areas."*

Objective C, Policy 4: *"Seek a year 2010 distribution of Oahu's residential population which would be in accord with the following table:*

Distribution of Residential Population

Location	*% of Year 2010 Island-wide Population*
North Shore	*1.6% - 1.8%"*

Discussion: The 2010 GP Population Distribution Guidelines are part of the policy for population distribution projected for Oahu over the next twenty years. For the North Shore this Guideline is between 1.6 and 1.8 percent of the total Oahu population. The total projected Oahu population for 2010 is between 949,500 and 1,049,500.

Approximately 750 full-time and part-time residents will reside at Lihi Lani by 2010. A percentage of them will come from the North Shore DP Area. This amount of additional population equals 0.07 percent of the projected 2010 Oahu population, which is smaller than the smallest unit of measure used in the Guideline. Thus, the population increase associated with Lihi Lani is of too small a magnitude to materially alter the degree of consistency of the North Shore's development capacity with its Population Distribution Guideline. Furthermore, the City and County authorities have been considering the guidelines on a case-by-case basis. Please refer to the Section 5 discussion of population. This project will be reviewed with consideration of consistency of this and other General Plan Policies and Guidelines.

7.2.2 Economic Activity

Objective A: *"To promote employment opportunities that will enable all the people of Oahu to attain a decent standard of living."*

Objective A, Policy 1: *"Encourage the growth and diversification of Oahu's economic base."*

Discussion: Lihi Lani will generate two types of employment opportunities, those in construction and those in operations. An estimated 40 on-site operational jobs will be created during 1996 to 1998, which will decrease to an estimated 30 jobs after 1998. There will also be indirect and induced jobs generated by the project by the year 2000. Construction jobs over a ten-year period should result in approximately 110 to 150 positions during 1996 to 1998, tapering off to 50 to 70 jobs between years 1998 and 2008. This employment will contribute to the overall economy through additional income and resulting taxes and spending. Refer to Section 5.7 of this document.

Objective B: *"To maintain the viability of Oahu's visitor industry."*

Objective B, Policy 8: *"Preserve the well-known and widely publicized beauty of Oahu for visitors as well as residents."*

Discussion: The North Shore is known world-wide for its beaches, surf, rural setting and natural beauty. The proposed development will be tucked away atop the bluffs and give those who visit spectacular views of the shoreline from Sunset Beach to Mokuleia, including the Waianae mountain range and Kaena Point. The project's hiking trails and recreational facilities will also open up the beauty of the North Shore's hills and forests to greater public enjoyment. The proposed development will emphasize low-rise, low-density improvements interspersed between large expanses of undisturbed green space and will be designed in a way that will complement the area's rural setting.

7.2.3 Natural Environment

Objective A: *"To protect and preserve the natural environment of Oahu."*

Objective A, Policy 1: *"Protect Oahu's natural environment,m especially the shoreline, valleys, and ridges, from incompatible development."*

Objective A, Policy 3: *"Retain the Island's streams as scenic, aquatic, and recreation resources."*

Objective A, Policy 4: "Require development projects to give due consideration to natural features such as slope, flood and erosion hazards, water-recharge areas, distinctive land forms, and existing vegetation."

Objective A, Policy 6: "Design surface drainage and flood-control systems in a manner which will help preserve their natural settings."

Objective A, Policy 8: "Protect plants, birds, and other animals that are unique to the State of Hawaii and the Island of Oahu."

Objective A, Policy 9: "Protect mature trees on public and private lands and encourage their integration into new developments."

Discussion: Approximately one-half of the project is devoted to conservation of the site. The heavily vegetated ravines and a significant portion of the plateau will be preserved or utilized as it is currently, for horse pasture. Like many other areas of Hawaii, introduced plants have encroached and now dominate the open spaces of Lihi Lani. The project proposes to create a conservation area in which native and endemic Hawaiian plants may be re-introduced, thereby enhancing the bio-historical value of the site. The rare Koolau Eugenia trees on adjacent state land will be preserved and protected to enhance their changes for survival through a cooperative effort including DLNR and Obayashi. These efforts may help to increase the population of these trees.

Objective B: "To preserve and enhance the natural monuments and scenic views of Oahu for the benefit of both residents and visitors."

Objective B, Policy 4: "Provide opportunities for recreational and educational use and physical contact with Oahu's natural environment."

Discussion: The proposed development will offer a variety of amenities of a recreational and educational nature. Visitors to Lihi Lani can learn about the natural environment and enjoy spectacular scenery of the North Shore by hiking the trails. Horseback riding, hiking, and camping are recreational activities that will be available to the public by reservation and at a fee as a result of the project. These activities will put one into direct contact with Oahu's natural environment.

Objective B, Policy 8: "Protect plants, birds, and other animals that are unique to the State of Hawaii and the island of Oahu".

Discussion: Approximately 700 acres on the project site will be preserved as undisturbed open space. The Koolau Eugenia tree is a rare species found just outside the mauka boundary of the site on State Forest Preserve lands. To improve the chances for continued survival of these trees, Obayashi has entered into a cooperative management effort with DLNR to preserve and enhance the habitat of these trees.

7.2.4 Housing

Objective A: *"To provide decent housing for all the people of Oahu at prices they can afford."*

Objective A, Policy 10: *"Promote the construction of affordable dwellings which take advantage of Oahu's year-round moderate climate."*

Objective A, Policy 11: *"Encourage the construction of affordable homes within established low-density communities by such means such as "ohana" units, duplex dwellings and cluster development."*

Discussion: The on-site and off-site affordable homes developed in association with Lihi Lani, will contribute to the stock of decent, affordable housing on Oahu. If the affordable homes are constructed as proposed, it will serve the policy of encouraging landowners to build affordable homes in low-density areas, providing variety within the housing stock of any one area.

Objective B: *"To reduce speculation in land and housing."*

Objective B, Policy 3: *"Seek public benefits from increases in the value of land owing to City and State developmental policies and decisions."*

Discussion: The proposed Lihi Lani project includes public amenities and benefits, including affordable housing, which are proposed to meet the intentions of the General Plan. The project benefits themselves are substantial and should be considered in light of the amount and intensity of development being proposed.

7.2.5 Transportation and Utilities

Objective B: "To meet the needs of the people of Oahu for an adequate supply of water and for environmentally-sound systems of waste disposal."

Objective B, Policy 1: "Develop and maintain an adequate supply of water for both residents and visitors."

Objective B, Policy 3: Encourage the development of new technology which will reduce the cost of providing water and the cost of waste disposal."

Objective B, Policy 5: "Provide safe, efficient, and environmentally sensitive waste-collection and waste-disposal services."

Objective B, Policy 6: "Support programs to recover resources from sold-waste and recycle wastewater."

Discussion: The applicant will draw water from the Board of Water Supply's Waialua-Pupukea and Sunset Beach-Kawela transmission/distribution systems to meet the potable water needs of the proposed project. This demand can be met without adversely affecting supply to other users in the service area (Mink, December 1990).

If approved by the various regulatory agencies, wastewater from the project will be advanced secondarily-treated and used to irrigate the larger common agricultural areas of the project. This disposal technique has been proven safe and effective by the University of Hawaii. Although the process is not entirely new, further research has been promoted by this project in the area of marshland technology with respect to wastewater treatment.

7.2.6 Physical Development and Urban Design

Objective D: "To create and maintain attractive, meaningful, and stimulating environments throughout Oahu."

Objective D, Policy 5: "Require new developments in stable, established communities and rural areas to be compatible with the existing communities and areas."

Discussion: The Pupukea/Sunset Beach/Waimea neighborhoods have a rural setting, and an above-average median income level. The proposed project will be a development of a similar rural style and will maintain 700 acres of undisturbed open space, as well as other recreational uses. The project will be designed to complement the country environment, and will make use of the natural surroundings through its recreational activities of horseback riding, tennis, camping and hiking. Refer to Section 5.12.5 of this document.

7.2.7 Culture and Recreation

Objective B: "To protect Oahu's cultural, historic, architectural, and archaeological resources."

Objective B, Policy 1: "Encourage the restoration and preservation of early Hawaiian structures, artifacts, and landmarks."

Objective B, Policy 2: "Identify, and to the extent possible, preserve and restore buildings, sites and areas of social, cultural, historic, architectural, and archaeological significance."

Objective B, Policy 4: "Promote the interpretive and educational use of cultural, historic, architectural, and archaeological sites, buildings, and artifacts."

Discussion: A comprehensive archaeological survey of the project site has been done by a professional archaeologist. A program for data recovery, preservation and interpretive development, as approved by the State Historic Preservation Office, will be carried out. The most significant site will be preserved and possibly developed for interpretive purposes. Refer to Section 5.1 of this document.

Objective D: *"To provide a wide range of recreational facilities and services that are readily available to all residents of Oahu."*

Objective D, Policy 10: *"Encourage the private provision of recreation and leisure-time facilities and services."*

Discussion: Lihi Lani will provide various recreational activities for the project and North Shore residents. Horseback riding, camping and hiking will be available at different levels of access on the mauka lands above the bluff. The YMCA on the makai parcel will open up recreational opportunities which are currently unavailable in the North Shore. As planned, the facilities will include a swimming pool and space for multiple programs such as basketball, martial arts, swimming, dance, exercise and crafts classes.

7.3 CITY AND COUNTY OF HONOLULU NORTH SHORE DEVELOPMENT PLAN

The following discussion provides an assessment of how the proposed project will conform to and implement the Development Plan (DP) for the North Shore area.

7.3.1 Development Plan Common Provisions

Section 4. General Urban Design Principals and Controls:

4.1 Public Views: *"The design and siting of all structures shall reflect the need to maintain and enhance available views of significant landmarks. No development shall be permitted that will block important public views."*

Discussion: Views of parts of the North Shore from Sunset Beach to Mokuleia can be seen from atop the project site, and these views will now be made publicly available from the hiking trails. Homes on the Haleiwa-side plateau will be set back from the top of the bluff and will generally not be visible from below. The access road running across the bluff will be carefully landscaped to blend with the rest of the bluff face. Refer to Section 5.5 of this document.

4.2 Open Space: *"The City's mountains, hills, shoreline and streams, shall be considered as major scenic, open space and recreational resources. Adequate public access to these resources shall be incorporated as part of developments adjacent to them. Existing natural stream beds and drainage-ways shall be retained wherever possible. Where further channelization must occur, materials that are harmonious with the setting, such as stone, shall be used whenever feasible."*

Discussion: The project site will set aside 700 acres of undisturbed open space consisting of mountains, valleys and intermittent streams. Views of the North Shore and the Waianae mountain range will be available from the hiking trails.

This site was previously inaccessible to the public. A community center, a horse ranch, campground and trails for hiking and horseback riding will be available to the public for recreational purposes. Existing intermittent stream beds on the site will be for the most part left in their natural state except for one road crossing. No channelization is planned. Natural materials, such as stone, will be used where enhancement of the stream bed environment is desired in connection with the development of the project.

4.3 Vehicular and Pedestrian Routes: "Landscaping shall be provided along major vehicular arterials and collector streets as a means to increase the general attractiveness of the community and the enjoyment of vehicular travel for visitors and residents."

Discussion: The entry road connecting the project with Kamehameha Highway will extend across a portion of the bluff. Terraced landscaping of the road will have an aesthetic quality that corresponds with the style and character of the surrounding community. A left-turn lane off Kamehameha Highway into the project entrance will be added. Right-turn and left-turn lanes will be developed at the project entrance for access to Kamehameha Highway. Distinctive landscaping, lighting and signing will be installed at the project entrance. Refer to Section 5.2 of this document.

4.6 Existing Built-Up, Single Family Residential Areas: "New development in existing communities shall generally be limited to that which is compatible with or enhances the desired physical and social character and lifestyle. New residential development in rural areas shall be compatible with the general rural character of the area."

Discussion: The proposed market housing development is designed to blend in with the surrounding community's physical and social character. Spacious lots will maintain the open space and enhance the rural setting. On-site affordable housing will be designed to fit, aesthetically, with this country type of development.

Section 5. General Principles and Controls for Parks, Recreation and Preservation Areas:

5.1.b (3): Parks and Recreation Areas: "Suburban and new development areas shall include land for open space and recreation purposes at a minimum of two acres per thousand persons."

Discussion: A projected on-site resident population at the proposed project is estimated to be approximately 686 persons by 2008, and 977 persons by full buildout. Based on the above recreational land standard, about 1.4 acres would need to be provided for open space and recreational purposes. The proposed project will include approximately 700 acres of land for open space, plus will have the Ranch and community facilities.

Section 10. Social Impact of Development:

10.2 Social Impact Factors: *"In evaluating an proposed development, the [General Plan] objectives relating to the distribution of social benefits shall be considered. The following factors shall be examined as they pertain to such objectives:*

a. Demographic: Whether the development will:

(1) Increase or decrease the residential population.
(2) Increase or decrease the visitor population.
(3) Change the character or culture of the neighborhood.

b. Economic: Whether the development will affect:

(1) The rate and pattern of economic growth and development.
(2) The diversity of employment.
(3) The availability of jobs.
(4) The employment wage rate.
(5) The principal economic activities on Oahu.

c. Housing: Whether the development will affect:

(1) The availability of housing.
(2) The quality of housing.
(3) Speculation in land and housing.
(4) Property values of existing homes.

d. Public Service: Whether the development will affect:

(1) Medical facilities.
(2) Educational facilities.
(3) Recreational facilities.
(4) Transportation facilities.
(5) Police and fire protection.
(6) Public utilities facilities.

e. Physical; Environmental: Whether the development will affect:

(1) The natural environment.
(2) Existing natural monuments, landmarks and scenic views.
(3) Open space.
(4) The aesthetic quality of the area."

Discussion: The social impacts of the proposed development were studied by Community Resources, Inc. (January 1991) and updated (September 1993). An economic impact study was prepared for the project by KPMG Peat Marwick (January

1991) and updated (November 1993). The major findings of these studies are discussed in Section 5.7 of this report.

a. __Demographic__: Approximately 686 persons will be added to the full-time population as a result of this project by 2008, and 977 by full buildout. At least 20 percent of the resident population will be at the affordable housing. There will be many part-time residents of this community, thus reducing the feeling of "invasion" into the North Shore community. The North Shore is a rural country area known for its easy-going lifestyle, scenic beauty, beaches and surfing. The influx of population and jobs due to the proposed project should not alter these existing community characteristics, as it will be designed in accordance to these values. Refer to Section 5.7 of this document and Appendix L.

b. __Economic__: Lihi Lani will generate short-term employment during the construction of new facilities and long-term employment in the operation and support of those facilities. The project is expected to generate approximately 80 direct, indirect and induced jobs at buildout by operational employment. Construction employment will result in 2,670 annual person years of employment at full buildout (Peat Marwick, July 1993).

Personal income paid to Hawaii residents is reported in Section 5.7 of this document and Appendix L.

c. __Housing__: The project will offer a wide range of housing options: 1) Affordable single family homes and elderly rental apartments (a City project); 2) lower priced market lots on smaller lots with internal views; and 3) more expensive lots due to location and large lot size. A total of 445 units would be available in a wide range of prices from City affordable rates to competitive market prices. Lihi Lani's unique design (the only community on Oahu which integrates second and vacation home sites with recreational facilities) and geographic separation from existing nearby residential areas also indicate that it should have little if any impact on speculation and property values in the surrounding area.

d. __Public Services__: The effect of the development on public services in the area will be minimal, as expressed in Sections 5.11 and 5.12 of this document.

e. __Physical Environment__: As already discussed, the project will substantially preserve the natural environment, existing natural monuments, landmarks, scenic views, open space and aesthetic qualities of the subject area.

__Section 11. Social Impact Management System__:

"The objective of the social impact management system is: "to enable residents of an area who will be affected by a proposed development project to systematically examine the expected social impact of that development and, ...to identify alternative ways of managing or mitigating any expected negative social impacts."

__Discussion:__ Early in the planning and design stage of this project, the developer contacted the community to arrange informational meetings to explain the project's intent and to get their feedback. By working with the community, over a five year period Obayashi has changed its development plans significantly to reflect community concerns. Much of the land use theme, environmental controls, and community benefit aspects in the current Obayashi proposal have resulted from the efforts of the Sunset Beach and Pupukea Highland's Joint Planning Committee. Input from the residents has changed and refined the master plan in a symbiotic planning process. Extensive community benefits programs and a community facility have been proposed in response to desires of community representatives.

7.3.2 Development Plan Special Provisions

__Section 2. Urban Design Principles and Controls for the North Shore__:

__*2.1.b Specific Urban Design Considerations - Public Views*__: *"In order to protect and enhance the rural attractiveness of the North Shore, broad open space views from public places of the agricultural fields, and panoramic and continuous views from public places of the coast and the sea shall be protected whenever possible. Important views to be protected include:*

- *Panoramic view of Waimea Bay to Sunset Beach from Pupukea Highlands.*
- *View of the Pali mauka of Kamehameha Highway in Sunset Beach."*

__Discussion:__ Refer to the Common Provisions discussion of General Urban Design Principles and Controls - Public Views.

7.4 HAWAII COASTAL ZONE MANAGEMENT PROGRAM

The objectives of the Hawaii Coastal Zone Management Program, Section 205A-2, HRS, are to protect valuable and vulnerable coastal resources such as coastal ecosystems, special scenic and cultural values, and recreational opportunities. The objectives of the program are also to reduce coastal hazards and to improve the review process for activities proposed within the coastal zone.

Only a small part of the subject site (approximately 30 acres) is included in the City and County of Honolulu Special Management Area. The remaining 1,113 areas are located mauka of this parcel above the bluff. The project entrance and access road, community facilities/YMCA, and elderly housing are planned for this area.

The following are the applicable objectives of the Hawaii Coastal Zone Management Program and an assessment of how the proposed project relates to them.

A. <u>*Historic Resources Objective*</u>

"Protect, preserve and, where desirable, restore those natural and man made historic and pre-historic resources in the coastal zone management area that are significant in Hawaiian and American history and culture."

<u>Discussion</u>: As noted, a comprehensive archaeological survey has been done for the project site. Recommendations for data recovery, preservation and interpretive development will be reviewed by the State Historic Preservation Office. Appropriate actions will be taken to preserve significant resources.

B. <u>*Scenic and Open Space Resources Objective*</u>

"Protect, preserve and, where desirable, restore or improve the quality of coastal scenic and open space resources."

<u>Discussion</u>: The Master Plan for the proposed Lihi Lani project includes about 700 acres of undisturbed open space. This open and outdoor recreational area represents 61 percent of the total 1,144 acre site. See also the earlier discussion of General Plan objectives and policies related to the natural environment, and to culture and recreation.

C. <u>*Coastal Ecosystems Objective*</u>

"Protect valuable coastal ecosystems from disruption and minimize adverse impacts on all coastal ecosystem."

<u>Discussion</u>: Storm water runoff which drains from the project site into the Pacific Ocean is currently generated only during high precipitation periods. Drainage design for Lihi Lani will detain storm water runoff on the site and release runoff into streams at similar to or less than existing rates. Estimated surface runoff contaminant concentrations resulting from the developed condition were examined by Tom Nance Water Resources Engineering (September 1993) and were determined to have little potential for creating adverse water quality effects on the ocean. The amount of sediment in runoff will actually be less than under existing conditions. Refer to Section 4.6 of this document, and Appendix H.

If appropriate application procedures are followed, runoff concentrations of fertilizers and pesticides would not be detrimental to water quality in the intermittent streams and the ocean (when reached by runoff).

A marine resources assessment for this project was prepared by Marine Research Consultants (September 1993). This study involved an evaluation of the marine water quality affects potentially created by the project, and any short-term or long-term effects on the marine environment receiving runoff from the sites. This study determined that the project as proposed will create a negligible adverse effect on marine resources, although existing water quality degradation is occurring due to effluent from the area's private residential cesspool systems which currently leach into nearshore waters. Refer to Section 4.8 and Appendix I. The project is located mauka of the shoreline and Kamehameha Highway. There will be no direct impact on beach or littoral processes.

D. *Coastal Hazards Objective*

"Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion and subsidence."

Discussion: The project is located outside of the 100-year and 500-year flood hazard areas as defined by the Federal Emergency Management Agency, Flood Insurance Rate Map. Stream flooding of residential areas will not occur on the project site, nor will the site be affected by storm waves or tsunami. It is not necessary to undertake measures to avoid flood hazards at this development. Drainage improvements within the developed project will reduce the erosion of soils from the land compared to existing conditions, and will ensure that the project will not cause any stream flooding downstream. Refer to Section 4.4 and Appendix F.

7.5 SPECIAL MANAGEMENT AREA RULES AND REGULATIONS OF THE CITY AND COUNTY OF HONOLULU

The review guidelines of Section 33-3.2 of the Revised Ordinances of Honolulu are used by the Department of Land Utilization and the City Council for the review of developments proposed in the Special Management Area. Figure 3-5 shows the location of the project section that lies within the Special Management Area. These guidelines are derived from Section 205A-26, HRS. The consistency of the proposed project with the guidelines are discussed below.

"(1) *All development in the special management area shall be subject to reasonable terms and conditions set by the Council in order to ensure that:*

(A) *Adequate access, by dedication or other means, to publicly owned or used beaches, recreation areas, and natural reserves is provided to the extent consistent with sound conservation principles;*

(B) *Adequate and properly located public recreation areas and wildlife preserves are reserved;*

(C) *Provisions are made for solid and liquid waste treatment, disposition, and management which will minimize adverse effects upon special management area resources; and*

(D) *Alterations to existing land forms and vegetation, except crops, and construction of structures shall cause minimum adverse effect to water resources and scenic and recreational amenities and minimum danger* *of floods, landslides, erosion, siltation, or failure in the event of earthquake."*

Discussion: The proposed project will involve roadway and drainage facilities construction and utilities installation, community facilities and elderly housing in the 30-acre SMA. The project will generally be consistent with this policy because no public areas or wildlife preserves are affected by the project. Wastewater treatment and disposal will be conducted outside the SMA. Scenic resources will be only minimally affected by vegetation clearing for the access road development, drainage facilities construction, and utilities installation. The public will have access to the various recreational facilities on the project.

"(2) *No development shall be approved unless the Council has first found that:*

(A) The development will not have any substantial, adverse environmental or ecological effect except such as adverse effect is minimized to the extent practicable and clearly outweighed by public health and safety, or compelling public interests. Such adverse effect shall include, but not be limited to, the potential cumulative impact of individual developments, each one of which taken in itself might not have a substantial adverse effect, and the elimination of planning options;

(B) The development is consistent with the objectives and policies set forth in Section 33-3.1 and area guidelines contained in Section 205A-26, Hawaii Revised Statutes; and

(C) The development is consistent with the County General Plan, development plans, zoning and subdivision codes and other applicable ordinances."

Discussion: The activities of the project in the SMA will be limited. Unavoidable adverse environmental effects that will occur in this area include: topography modifications, short-term soils disturbance and erosion, vegetation clearing, short-term wildlife disturbance, archaeological resources disturbance, short-term traffic disruption, short-term construction noise, short-term air quality effects (dust and exhaust emissions), and short-term visual degradation. These adverse effects will be minimized to the maximum extent practicable through the implementation of recommended mitigative measures. The project will not eliminate planning options for this part of the SMA.

The consistency of the proposed development with the objectives and policies set forth in Section 205A-2, HRS, the area guidelines set forth in Section 205A-26, HRS, the General Plan for the City and County of Honolulu, and the Development Plan the North Shore, was described earlier in this section of this document. Upon receipt of requested zone change applications and subdivision approvals, the applicant will observe the applicable regulations of the LUO subdivision codes and other applicable Ordinances.

"(3) *The Council shall seek to minimize, where reasonable:*

(A) *Dredging, filling or otherwise altering any bay, estuary, salt marsh, river mouth, slough or lagoon;*

(B) *Any development which would reduce the size of any beach or other area usable for public recreation;*

(C) *Any development which would reduce or impose restrictions upon public access to tidal and submerged lands, beaches, portions of rivers and streams within the special management area and the mean high tide line where there is no beach;*

(D) *Any development which would substantially interfere with or detract from the line of sight toward the sea from the state highway nearest the coast;*

(E) *Any development which would adversely affect water quality, existing areas of open water free of visible structures, existing and potential fisheries and fishing grounds, wildlife habitats, or potential or existing agricultural uses of land."*

Discussion: For the most part, these review guidelines do not apply to the proposed project. With respect to water quality effects, the project has been studied in detail for its potential surface water quality effects due to silt, nutrients and chemicals contained in storm water runoff. Storm water runoff from the project which will enter the ocean during peak precipitation periods is not expected to contain substantial concentrations of contaminants which could adversely affect surface-water quality (TNWRE, September 1993; Marine Research Consultants, September 1993).

SECTION 8

ALTERNATIVES TO THE PROPOSED ACTION

8.0 ALTERNATIVES

Five alternatives for the project have been considered which would utilize the land for several different purposes. A No-Action Alternative was considered, which would leave the project site as it is presently being used. An Agricultural Alternative was evaluated for the site under existing zoning, which would initiate more intensive agricultural uses. Development of the site as an Agricultural Subdivision under existing zoning was also considered as a potential alternative. Two Residential and Recreational Alternatives were also considered, with either one or two golf courses developed in conjunction with residential and other open space recreational uses.

The four alternative concepts are evaluated in this section for each of the environmental factors addressed in Sections 4 and 5. These are the same alternatives included in the Final EIS (Group 70, April 1991), except one additional alternative is addressed, which is the previous project plan from 1991, which proposed one golf course, residential and recreational uses. Brief comparisons of each alternative with the proposed project are also included.

8.1 NO-ACTION ALTERNATIVE

The no-action alternative would involve no changes to the existing project area for the foreseeable future. The agricultural use of the site would be allowed to continue, which currently involves grazing for cattle and horses.

Access to the site would become more restricted under the no-action alternative. To avoid disturbance of agricultural grazing activities and to eliminate existing trespassing, no public access to the site would be allowed. The restricted access would also be necessary for safety reasons due to the many steeply sloped areas on the site, and to protect its existing native vegetation areas and sensitive archaeological resources. In addition, access restrictions would be important to minimize the possibility of illegal crop cultivation on the site. No community facilities would be created in this plan.

With respect to the environmental characteristics of the project site, its topography, soils, surface water, ground water, runoff, flooding, vegetation and wildlife would not change. It is possible that the rare Koolau Eugenia trees located on the State Forest Preserve lands mauka of the site could perish if selective clearing of nearby strawberry guava trees or other remedial actions are not performed, and habitat for these plants is not carefully protected. Other factors that would not be affected under the no-action alternative would include archaeological resources, traffic, noise, air quality, population, employment, government expenditures, infrastructure and public services.

The lack of a development on the project site would not create additional employment, personal income and recreational opportunities for residents of the North Shore. The generation of property taxes by the Obayashi land would continue at the existing levels ($140,000 per year). The no-action alternative would force the owner to continue paying property taxes (as he has since 1974) without gaining an offsetting income from the site. It is possible that the State or County could arrange to purchase this land for conservation purposes, however, there are no known plans for this to occur.

As compared to the proposed project, the no-action alternative would create environmental effects. Social and economic benefits, as well as recreational benefits, would not be generated by the no-action alternative.

8.2 AGRICULTURAL ALTERNATIVE

This section presents a discussion of the existing agriculture that occurs on the project site and the potential for establishing more intensive agricultural uses, instead of the proposed development. An agricultural feasibility study was prepared for the site by Frank S. Scott, Jr., Ph.D. (March 1988) and included as appendix in the Final EIS (Group 70, April 1991), and information from the report is contained in this section.

Current agricultural activity on the site is limited to grazing land for approximately 10 to 15 horses. A propogation nursery was built on the on the Pupukea plateau of the property. This facility is currently being used to propogate various plant and tree species which will be used for the erosion control program and agricultural plantings.

Soil analyses for agricultural purposes have identified soils on the project site as generally deficient for agricultural purposes. Most of the area is ecologically infeasible for any type of crop production or grazing. Approximately 801 acres (71 percent) of the project area consists of soil types in very low Soil Conservation Service (SCS) capability classifications for agriculture. These areas are badly eroded and mostly consist of steep, rocky gulches.

If irrigated, there are approximately 260 acres of soils that are adaptable to crop cultivation. These areas consist of small isolated plateaus surrounded by steep eroded gulches. This configuration would present problems of economies of scale, and would increase the cost of infrastructure for crop production. An additional 200 acres could be used for tree fruit crops, truck crops and pasture land. A total area of 460 acres could be considered usable for agricultural purposes. The proposed project currently plans for approximately 160 acres in agricultural use.

Existing (or undeveloped) water availability would further limit the actual agricultural potential of these areas. Because the seasonal distribution of precipitation is uneven, irrigation would be required in any month of the year. Assuming all 460 acres would be irrigated, the water system that would have to be established for this site would need to be capable of delivering 4,500 gallons per acre per day (approximately 2.1 MGD). The existing BWS Pupukea potable water supply system could only support about 25 percent of this amount. The remainder of irrigation water requirements would have to be satisfied by new project wells that would be costly to develop. Obayashi currently has two wells which could produce up to 1.0 mgd of non-potable water. The 250-300 ppt chloride content water could be used to irrigate many types of crops. Operation of pumps at these wells would need to be built into the operating expense budget for agricultural uses only Access roadways to the property are currently limited to Wilinau Road and the Boy Scout Camp Pupukea. Development of a new access roadway for a strictly agricultural project would be a large up-front cost burden.

Existing limited market potentials for many of the intensive agriculture crops that are ecologically adapted to the site's soils and climate would also constrain viability of expanded agriculture in this area. Intensive crops grown on this site would be at an economic disadvantage as compared to intensive crops grown at other locations. Some other smaller scale types of diversified agricultural crops could be viable.

<u>Potential Impacts</u>

It is estimated that approximately 460 acres of the project site are ecologically adaptable to agricultural production. Impacts of agricultural use on topography could be substantial because leveling of most of the 460 acres and benching of some slopes would be required for agricultural production and construction of access roadways. This impact would be comparable to that caused by the proposed project, which proposes an approximately 400 to 480 acres of cleared area over 10 to 12 years. The agricultural alternative would require much more rapid development of the area for agricultural use, posing a greater potential for construction phase erosion and runoff.

Vegetation clearing to allow for agricultural development of 460 acres would result in soil erosion over much of the project area. If intensive crops are developed in this alternative, there would be less long-term erosion and runoff control, as compared to the extensive controls with the proposed project. Total soil erosion would be substantial - much greater than would occur under the proposed development - because of the exposure of soils in agricultural activities. Suspended clay soil particles would be carried off the land by storm water runoff through intermittent streams and into the ocean. The very extensive detention basin system planned to control runoff for the proposed project would not be established for the agricultural alternative, therefore, silt runoff would be substantially greater.

Water use for irrigation of the 460 acres would be extensive, and development for that purpose may not be economically feasible, depending on the type of crops planted. The two existing project wells could be used to derive non-potable water would be required for the agricultural alternative, and water use would be expected to be approximately twice that required for the proposed project. Fertilizer and pesticide use would be three to four times greater for agricultural use.

Drainage conditions on the site would be affected by crop cultivation, and runoff would be increased due to the elimination of forest and ground cover vegetation over 460 acres. Drainage controls would not be as effective for the agricultural development as compared to the proposed project. Unless extensive measures would be taken to control runoff, lowland areas off-site and the ocean would be adversely affected by storm runoff. The potential effects on marine resources due to silt and nitrogen (from the use of fertilizers) contained in intermittent stream discharge waters would be significant under this alternative. The proposed project will reduce silt introduction to the ocean below existing conditions.

Vegetation clearing of 460 acres for the agricultural alternative would also eliminate wildlife habitat in those areas. Replanting of cleared areas would be done to accommodate crop production and grazing areas, and would not provide wildlife habitats. In comparison, planting of the proposed project will include indigenous plant species that will enhance wildlife habitats.

Development of intensive agricultural use on the property would have to consider the preservation of existing archaeological resources, and would probably have a similar effect on archaeological resources as would the proposed development.

With the agricultural alternative, the project entrance and access road would probably not be affordable. Overall traffic impacts on Kamehameha Highway travel due to the agricultural project would be substantially less than the proposed project, because only a small worker population and several trucks would utilize the project entrance each day. The access for the agricultural project would necessarily utilize the Wilinau Road access point, and occasionally may need access through the Boy Scout Camp Pupukea. Agricultural use of the project area would require heavy equipment operation during planting and harvest periods, which would generate noise during daytime periods. Truck operations on the project site and local roads would create some long-term noise effects. Agricultural truck traffic trough the residential area of Sunset Hills would cause noise and dust which would be undesirable. Heavy equipment noise, however, could occur regularly.

Fugitive dust, crop burning smoke (possibly) and heavy equipment exhaust emissions would be created by operations required for intensive agriculture. There would be few worker and resident vehicles added to local roadways and little related exhaust emissions as a result of the agricultural development. Air quality impacts in the vicinity of the project due to dust and (possibly) smoke would be greater for the agricultural land use than for the proposed project.

Development of agricultural uses would involve use of the entire makai section of the site, since development of community facilities would not be affordable and land could not be donated to the City for the elderly affordable project. Crop cultivation in this area would drastically change the existing wooded visual character of the site along Kamehameha Highway, which would not occur under the proposed project. In addition, level areas above the bluff would be cleared to the edge of the bluff where crops could be established. As compared to the proposal, the agricultural alternative would have a greater adverse visual effect due to the crop cultivation on the makai section of the site.

The agricultural use of the land would not increase the population of the area. It would provide employment and personal income to a relatively small number of people. The proposed project would generate more jobs and higher personal income than the agricultural development.

Few, if any, government expenditures and revenues would be involved with the agricultural development because no community services would be required. Although the proposed project would involve greater government expenditures than agricultural use, it will also generate greater revenues and produce a tax surplus. The tax surplus under agricultural use would be substantially less than that generated by the proposed project.

Some infrastructure would be required by the agricultural alternative. There could be a need for potable water supply (for irrigation) via municipal sources, however, irrigation water could be derived from on-site wells. Little domestic wastewater or solid waste would be generated by the agricultural development. Some minimal drainage facilities would have to be constructed to control runoff within the project as required by the City and County, and internal roadways would be created. As compared to the proposed project, less impact on infrastructure would occur as a result of agricultural use of the project area.

No impact on public services would be expected to result from the agricultural land use, as opposed to a small effect by the proposed project.

8.3 AGRICULTURAL SUBDIVISION ALTERNATIVE

Subdivision of the project site under the existing AG-2 General Agricultural District zoning classification would involve the creation of two-acre minimum lots. There would be a requirement for financially viable agricultural use on these lots, and farm dwellings would be constructed on each lot as allowed under the City and County of Honolulu Land Use Ordinance (LUO). No zoning change would be required for this alternative development. However, several other permit approvals would be required. No YMCA/community facilities would be developed in this scenario, nor would there be any affordable housing or elderly housing provided.

Areas which are planned for the agroforestry and ranch areas in the proposed project would all become subdivided in this alternative. To obtain the highest possible lot count yield for the project, agricultural lots would also need to be developed on the makai portion of the property, in place of the community facilities and elderly housing.

In support of the agricultural subdivision development, various infrastructure features would be constructed. The project area would be utilized for the construction of roadways and the installation of utilities. Because of land constraints, the pond and wetland system would not be used for wastewater treatment, rather a smaller package mechanical plant (5 acres) would be used to save space for agricultural lots. Water reuse on private subdivision lot agricultural areas would be planned for this alternative, which has not previously been approved in Hawaii. Water, sewer, drainage and road systems would be designed to City and County of Honolulu standards for agricultural subdivisions. Utility infrastructure would be dedicated to the City and County for ownership and maintenance.

Upon further analysis, the agricultural subdivision rules would probably be very difficult to satisfy at Lihi Lani. The most challenging requirement for an agricultural subdivision, as per the Land Use Ordinance, is the need to demonstrate financially viable agricultural use of each lot. The State Department of Agriculture is very strict about enforcing this, and is becoming more strict due to past abuses of the agricultural subdivision approval. It would also be very hard to comply (probably impossible) due to the marginal productivity potential of the soils at Lihi Lani. Obayashi could have pursued an agricultural subdivision of two-acre lots if there was a larger presence of prime agricultural soils of their land. Instead, Obayashi is proposing the minimum possible zoning change to achieve successful diversified agricultural activities. At the Country lots of Lihi Lani, agricultural uses are intended to gain revenues to help offset association maintenance fees.

To establish financially viable agricultural use of the 2-acre lots, the farming use would need to offset the cost of the individual lots. For these lots under the current Pupukea market, this would range from $285,000 to $550,000. Agricultural uses on these lots would need to produce net revenues of $20,000 to $40,000 per year, respectively, to offset costs for land payments, real property tax, insurance, utilities and association maintenance fees. The real limitation to economic viability is attributable to the marginal agricultural soils found on this property. Only 162 acres of B-rated soils (prime soils under the LSB rating system) are found on the Lihi Lani site, and these are in numerous isolated areas which makes it difficult to establish a viable agricultural subdivision of 2-acre farm lots. It is also unlikely that several hundred individual small farming businesses at this one location could be justified in the Oahu marketplace.

There are several other points which discourage establishment of an agricultural subdivision at Lihi Lani as mentioned briefly below:

- There are limited amounts of contiguous prime agricultural soils, with only 162 acre of B-rated soils under the LSB rating system, scattered in numerous locations. Our planners estimate that somewhere between 80 to 120 two-acre agricultural lots could be established using reasonably good rated agricultural land. This number of lots would not be viable for Lihi Lani due to the significant infrastructure costs (roads, sewers, water system, water reclamation facility, etc.) estimated at over $93 million.

- The project would lack community benefits because of reduced revenues and no City requirements for such. Because there would be no change in zoning, there would be no requirement from the City for affordable housing to be provided. There probably could be no use of the makai land for the YMCA or Elderly Housing, because there likely would be a need for agricultural lots or agricultural storage and processing facilities to be situated near the transportation corridor of Kamehameha Highway.

The alternatives analysis in this Final SEIS for Lihi Lani has been revised to reflect our recent understanding of the limitations to creating an agricultural subdivision on lands with marginal agricultural productivity potential.

Potential Impacts

Extensive topographic modifications would be required on over 400 acres to develop the agricultural subdivision and its support infrastructure. Topography changes for this alternative could be comparable to that required for the proposed project. Comparable soil disturbance would occur under the agricultural subdivision plan.

Water resources would be affected under the alternative. There are extensive potable water requirements for this alternative, estimated at 4,000 gpd per acre (BWS standard for agricultural lots) or potentially water use of over 1.0 MGD for the entire project. A portion of this amount could be provided by on-site brackish water wells, depending on suitability for agricultural crops grown on the site. This total water requirement would be greater than that required for the proposed project of 0.8 to 0.9 MGD (230,000 gpd potable/600,000 gpd non-potable).

In terms of water quality, fertilizers and pesticides would be applied to individual farm lots, and storm water runoff would include some amounts of these contaminants. Because of greater extent of agricultural use on these plots, and lack of some centralized management organization, fertilizer and pesticide use would be greater than for the proposed project. The agricultural subdivision would have less control over, and knowledge about, proper pesticides and fertilizer usage at individual agricultural lots. Agricultural activity at the individual lots, covering the entire project site, would be under the control of more individual lot owners than with the centralized agricultural program at the proposed project. This could lead to more problems with non-point pollution.

Having mostly narrow and long lots, many lot owners would possibly extend their agricultural use into steep valley areas. As a result, there would be the potential for much greater vegetation clearing and soil erosion loss in the valley areas, as compared to the proposed project.

The fewer homes in this alternative would generate less wastewater than the proposed project. On-site wastewater treatment would require effluent disposal via irrigation with reclaimed water onto individual lots. On-lot disposal has not generally been allowed by the DOH, because of concerns of potential exposure to humans. In addition, to conserve land area for the agricultural lots, the mechanical treatment plant would probably have less storage capacity (20 day minimum) as compared to the proposed project (58 days).

Runoff from the development would be expected to be greater due to less drainage control features (only the minimum required) provided in common areas. This development would have to include detention facilities during and after construction to help control runoff. However, it is not known whether the extra effort would be taken to establish as much detention volume capacity as planned for the proposed project.

Vegetation clearing involved with this alternative would be comparable to the proposed project due to the site clearing required for residential development, large agricultural areas, and extensive infrastructure development. Wildlife effects under this alternative would be expected to be comparable to the proposed project.

Archaeological resources could potentially be affected to a similar extent under this alternative, as compared to the proposed project. Greater potential disturbance of the valley slopes would be more conducive to the disturbance of existing archaeological remains.

Traffic generated by the agricultural subdivision is expected to be less than to the fully-developed proposed project since there would be fewer homes. Noise effects of the alternative would involve construction effects and operational effects from traffic and maintenance activities. Noise generated by the alternative would be similar to than that generated by the proposed project.

Air quality effects of the agricultural subdivision would involve construction and operational activities. Construction of this alternative project would affect a similar area as the proposed project in terms of equipment operations for clearing, grubbing, grading and building. Traffic from future operations would generate slightly less air quality effects as with the proposed project.

Visual resources would be affected to a greater extent under the alternative development, as compared to the proposed action. Lots with farm dwellings that would be located along the bluff in the alternative plan would not necessarily be set back from the bluff edge or screened by landscaping vegetation. Some views of homes and cleared tree areas from Kamehameha Highway could be expected under this alternative, along with less landscaped views of the access road across the bluff.

Full-time residential population of the development would be than for the proposed project. Few long-term employment opportunities would be created by this development beyond the construction phase. Infrastructure requirements of the agricultural subdivision would be substantial and comparable to the proposed project. Internal roadway development would be greater.

Public services that would be required by the alternative development would include schools, police and fire protection, health care and recreational facilities. The alternative plan would generate less school children and demand upon other public facilities and services than would the proposed project. An agricultural subdivision would generate much less property taxes to the City and County as that created by the proposed project. Government expenditures for this development would be less than the proposed project.

There would be no affordable housing developed at the site, as it would not be required by government for the agricultural subdivision under existing zoning. There would likely not be development of a community facilities complex on the makai portion of the property.

The agricultural subdivision alternative would produce some equivalent or less impacts than the proposed project, however, this alternative could not be built since it is economically infeasible. The agricultural subdivision alternative would have roughly the same infrastructure cost requirements with less than one-half the income potential. The agricultural feasibility of the soils on the property are limited, therefore, the number of financially viable two-acre minimum agricultural lots could not meet the required amount to offset infrastructure costs.

8.4 RECREATIONAL ALTERNATIVE

The Recreational Alternative considers the potential for developing exclusively recreational facilities within the project. The project would include similar recreational and community facility features as with the 1991 proposed project, eliminate all residential development, and add a private membership 18-hole golf course. Because no residential component would be included, this alternative would be viewed as a "stand alone" golf course project.

An extensive (and expensive) community benefits program would be required under current city guidelines for golf DP Amendments. Obayashi would be required to provide substantial community benefits, which would probably make the project unviable from the outset. The second golf course could generate substantial revenues, which could be applied to community priorities.

Potential Impacts

It is estimated that 586 acres of the project site would be developed to create the all recreation alternative. Impacts to topography would be greater than the proposed project, primarily due to grading of the additional golf course on the Haleiwa-side plateau.

Vegetation clearing to grade would likewise be greater than the proposed project. However, similar to the proposed project, soil erosion impacts would only be short-term, during construction. At completion of the development, soil erosion potential on the site would likely decrease.

As with the proposed project, this project would derive potable water from existing BWS Waialua water system although the estimated need for potable water would be roughly 1.5 times that of the proposed project. Similarly, ample non-potable water supplies would be available through two wells on the project site and this water would be used for irrigation of the golf courses. Anticipated impacts to the groundwater resources is expected to be minimal, assuming that effective golf course management practices are employed for both of the golf courses.

Potential surface water runoff, drainage and water quality impacts would be greater than the proposed project because of the greater cleared area and turf areas.

Impacts to existing vegetation and wildlife would be greater than the proposed project, due to the added grading required. The Kooloa Eugenia trees on the State Forest Preserve adjacent to the site would still be preserved and maintained under this alternative with cooperation by Obayashi. Impacts to archaeological and historic resources would be roughly the same as for the proposed project.

The project entrance and access road would be located in a fashion similar to the proposed project, including an entrance onto Kamehameha Highway. Traffic impacts on Kamehameha Highway due to the recreational alternative would be substantially less during the weekday morning and afternoon peak hours. Because the project would not include residential development, traffic generated during the weekend peak hour would be slightly less than the proposed project.

Air quality impacts would be somewhat less than the proposed project, following the reduction in traffic at the peak hours. Noise impacts from the either project would be slight, and possibly less due to reduced traffic.

The visual impacts of the all recreation alternative are quite similar to that of the proposed project. Long-term effects will result from the completed entrance road and the clubhouse facilities. A second clubhouse would probably be constructed for the recreational alternative, and portions of this structure could be visible from the makai areas.

The recreational alternative would create approximately 120 operational jobs. The number of day visitors to the mauka areas is expected to be approximately 32 percent higher than for the 1991 project, due to the additional golf course. Fewer day visitors are expected at the proposed project, mainly people using the ranch and trail system.

Short-term employment opportunities can be expected during the construction phase of the project. Approximately 100 operations jobs and 70 induced jobs in other areas would be created by the recreational alternative. This is over 1.6 times as many jobs as are expected to result from the 1991 project. Only 30 operational jobs will result from the proposed project.

Compared to studies for the proposed project, short-term personal income generated as a result of the project may be lower due to economies of scale resulting from building two golf courses. Long-term personal income resulting from operational jobs may be twice as much as with the proposed project.

The all recreation alternative makes no contribution to the island-wide need for housing. Employment opportunities and attractive recreational amenities would stimulate residential growth in the North Shore, however, the alternative does not contribute to the already limited supply of housing in the area.

This project could create less net government revenues through property and sales taxes than the proposed project, however, it would still create substantial revenues. The basic water supply and wastewater facilities necessary for the proposed project would also be required for the recreational alternative. The wastewater facilities would be smaller since there would be no on-site residential population. Reclaimed water would be used for irrigation of the golf courses and other landscaped areas. The roadway system would be similar in scope to the proposed project.

Due to the elimination of residential land uses in the recreational alternative, there would be very little impact on public facilities. There would be no impact on local area schools. Police and fire protection services would be needed for the project. Net government revenues would be sufficient to cover any additional protection required. As with the proposed project, this project would also make a significant contribution to the North Shore's recreational and community facilities.

In summary, the recreational alternative would create some advantages over the proposed project in terms of less traffic and on-site population. The project would, however, introduce two golf courses, with one private membership course. There would be no housing. Environmental impacts would be greater in some cases and less in others. The cost to Obayashi in required community benefits would probably create an insurmountable barrier to implementing this scenario.

8.5 1991 PROPOSED PROJECT - GOLF AND HOUSING

This alternative considers the potential for developing the 1991 planned project including 120 Country lots, 180 affordable homes, one 18-hole golf course and recreational facilities. Parts of this project received approval for Amendment of the North Shore Development Plan Land Use Map, including the golf course, wastewater facilities, affordable housing and community facility. Changes to the economy and golf course market, as well as government impact fee considerations and perceived environmental issues, caused the owner to change plans to the current project proposal.

An extensive (and expensive) community benefits program would be required under current city guidelines for golf DP Amendments. Obayashi would be required to provide substantial golf course impact fees, which would probably make the project unviable from the outset. Extensive on-site affordable housing caused rapid build-out of the project, rather than the phased build-out plan under the proposed project.

Potential Impacts

It is estimated that 360 acres of the project site would be developed to create the all recreation alternative. Impacts to topography would be greater than the proposed project, primarily due to grading of the golf course on the Haleiwa-side plateau. The proposed project involves 400 to 480 acres of land clearing over four development phases taking 10 to 12 years. The golf course would have to be built as part of one large development period required for the 1991 project plans.

Vegetation clearing to grade would likewise be slightly less than the proposed project, however, 160 acres of the proposed project will become agricultural and forestry land instead of turfed fairways of the golf course. However, similar to the proposed project, soil erosion impacts from the alternative project would only be short-term, during construction. At completion of the development, soil erosion potential on the site of the alternative project would likely decrease, as expected with the proposed project.

As with the proposed project, this project would derive potable water from existing BWS Waialua water system. The estimated need for potable water would be slightly less than that for the proposed project. Similarly, ample non-potable water supplies would be available through two wells on the project site and this water would be used for irrigation of the golf course.

Anticipated impacts to the groundwater resources and surface water quality from this alternative project is expected to be minimal, assuming that effective golf course management practices and the IPM program are employed. Of note, generally much less fertilizers and pesticides use is anticipated for the proposed project in the nursery, pasture, agroforestry and other agricultural areas.

Impacts to existing vegetation and wildlife would be greater than the proposed project, due to the added grading required. The Kooloa Eugenia trees on the State Forest Preserve adjacent to the site would still be preserved and maintained under this alternative with cooperation by Obayashi. Impacts to archaeological and historic resources would be roughly the same as for the proposed project.

The project entrance and access road would be located in a fashion similar to the proposed project, including an entrance onto Kamehameha Highway. Traffic on Kamehameha Highway due to the 1991 project alternative would be at least 25 percent greater than the proposed project during the weekend afternoon peak period. Traffic during the weekday morning and afternoon period would be slightly less than the 1991 project alternative.

Air quality impacts would be greater than the proposed project, following the increase in traffic at the peak hours. Noise impacts from the either project would be slight, and possibly greater under the 1991 plan due to greater traffic.

The visual impacts of the 1991 plan alternative would be quite similar to that of the proposed project. Long-term effects would result from the completed entrance road and the clubhouse facilities.

The 1991 plan alternative would create approximately 60 operational jobs, which is approximately twice that expected under the proposed project. The number of day visitors would be higher than for the 1991 plan, due to the golf course.

Short-term employment opportunities can be expected during the construction phase of the project. Approximately 63 operations jobs and 44 induced jobs in other areas would be created by the 1991 plan alternative. This is slightly greater job generation than expected to result from the proposed project.

Compared to studies for the proposed project, short-term personal income generated as a result of the project would be higher resulting from building of the golf course. Long-term personal income resulting from operational jobs in the 1991 alternative, which is much higher than for the proposed project.

The 1991 plan could create less net government revenues through property and sales taxes than the proposed project, however, it would still create substantial revenues. The basic water supply and wastewater facilities necessary for the 1991 project would also be required for the proposed project. The wastewater facilities would be same, and treated wastewater effluent would be used for irrigation of the golf courses and other landscaped areas, instead of agricultural areas at the proposed project. The roadway system would be similar in scope to the proposed project.

There would be very little impact on public facilities. There would be similar impact on local area schools, and police and fire protection services would be needed for the project. Net government revenues would be sufficient to cover any additional protection required. As with the proposed project, this project would also make a significant contribution to the North Shore's recreational and community facilities.

In summary, the 1991 plan alternative would create more traffic primarily due to the golf course operations. Environmental impacts would be the same or slightly greater than the proposed project. The cost to Obayashi in required golf course impact fees would probably create an insurmountable barrier to implementing this scenario.

SECTION 9

SUMMARY OF UNRESOLVED ISSUES

9.0 SUMMARY OF UNRESOLVED ISSUES

As a result of the assessment conducted for the Draft SEIS, several potentially unresolved issues exist with respect to the proposed project. These issues involve desires of some community members to see little further development of the North Shore, and particularly the Obayashi land. Another issue is the development of residential uses at densities greater than one unit per acre in the highlands, as proposed for the affordable units at Lihi Lani.

While "no development" is not an option for the owner who has carried the costs for this property since 1974 with no positive return on the investment, the new Master Plan no longer proposes a golf course. With the integration of agricultural uses and large open space areas, and essentially leaving 700 acres untouched out of 1,144 acres. Obayashi's plans for Lihi Lani could be considered a modest use of this land, and in keeping with the area's rural country charater.

The second issue, regarding density of affordable housing development in a low density rural setting, has also been addressed. As now proposed, the number of single-family affordable homes on-site in the mauka portion of the property has been decreased from 180 in the 1991 plan to 50 in the current plan. The 80 elderly homes, to be developed by the City, are proposed to be located in the makai portion of the site closer to Kamehameha Highway and public services and facilities. Obayashi will also participate in the development of an up to 50 affordable units with the City, at a location to be determined by the City and County Housing Department.

SECTION 10

REFERENCES

10.0 REFERENCES AND LIST OF PREPARERS

10.1 REFERENCES

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10.2 LIST OF PREPARERS OF THE FINAL SEIS

This Supplemental Environmental Impact Statement has been prepared by the planners and environmental analysts at GROUP 70 INTERNATIONAL, INC. Architects • Planners • Interior Designers, 924 Bethel Street, Honolulu, Hawaii 96813, Telephone (808) 523-5866. The staff involved in the preparation of this document included:

Francis S. Oda, AIA, AICP	Chairman, Principal in Charge
Jeffrey H. Overton, AICP	Chief Environmental Planner
Yukie Ohashi	Planner
Cookie Tsukano	Graphics
Kathy Hida	Graphics
Chad Asuncion	Graphics
Wendy Reeves	Production

Several key technical consultants were employed to provide specific assessments of environmental factors for this project. These consultants, their company affiliation (if any), and their specialty are listed below:

Kay Muranaka, P.E.	Engineering Concepts, Inc.	Civil Engineering
Ken Ishizaki, P.E.	Engineering Concepts, Inc.	Civil Engineering
Tom Nance, P.E.	TNWRE	Groundwater/Runoff
Steve Dollar, Ph. D.	Marine Research Consultants	Marine Environment
Conrad Higashionna, P.E.	Pacific Planning & Engineering	Traffic Assessment
Anne Bouslog, Ph.D.	KPMG Peat Marwick	Market Study
Susan Todani	KPMG Peat Marwick	Economics/Fiscal
John Kirkpatrick, Ph.D.	Community Resources, Inc.	Social/Schools
Winona Char	Char & Associates	Botany
Frank S. Scott, Jr., Ph.D.	Agricultural Economist	Agriculture
Paul Weissich	Consultant	Agroforestry

SECTION 11

CONSULTED PARTIES AND PARTICIPANTS IN THE SUPPLEMENTAL EIS PROCESS

11.0 CONSULTED PARTIES AND PARTICIPANTS IN THE SEIS PROCESS

11.1 CONSULTED PARTIES

The following list includes governmental agencies and community organizations who have been contacted as part of the pre-consultation process for the preparation of the Environmental Assessment and Notice of Preparation of Draft SEIS.

- City and County of Honolulu, Department of Planning
- City and County of Honolulu, Department of Land Utilization
- City and County of Honolulu, Dept. of Housing and Community Development
- Councilmembers of the City and County of Honolulu
- State Senator Gerald Hagino
- State Senator Michael McCartney
- State Representative Alex Santiago
- Office of State Planning
- State of Hawaii, Department of Health
- Department of Land and Natural Resources, State Historic Preservation Office
- Department of Land and Natural Resources, Division of Wildlife and Forestry
- North Shore Neighborhood Board No. 27
- Sunset Beach Community Association
- Pupukea Highlands Community Association
- Sunset Hills Community Association
- Haleiwa Community Association
- Waialua Community Association
- Kahuku Community Association
- North Shore Communities for Quality Development (NSCQD)

As part of its public information and community involvement process, Obayashi held a series of informational meetings during June 1993 to solicit comments on the revised project plans for the Lihi Lani.

This section includes lists of the various agencies, individuals, and organizations who have been consulted for the preparation of the Draft SEIS.

11.2 LIST OF AGENCIES AND INDIVIDUALS CONTACTED IN PREPARATION OF THE DRAFT SUPPLEMENTAL EIS

The following list includes governmental agencies, individuals, and organizations who have been contacted as part of the planning and analysis process for the preparation of the Draft SEIS.

City and County of Honolulu

- Planning Department
- Department of Land Utilization
- Department of Parks and Recreation
- Department of Housing and Community Development
- Board of Water Supply

State of Hawaii

- Department of Health
    - Wastewater Branch
    - Clean Water Branch
    - Safe Drinking Water Branch
- Department of Land and Natural Resources
    - Historic Preservation Division
    - Division of Forestry and Wildlife
    - Division of Water and Land Development
- Office of State Planning
- Land Use Commission (staff)
- Housing Finance and Development Corporation

Public Utilities

- City and County Civil Defense
- State Civil Defense
- Hawaiian Electric Company

Organizations

- North Shore Neighborhood Board No. 27
- Sunset Beach Community Association
- Pupukea Highlands Community Association
- Sunset Hills Community Association
- Haleiwa Community Association
- Waialua Community Association
- Kahuku Community Association
- North Shore Communities for Quality Development (NSCQD)

SECTION 12

COMMENTS AND RESPONSES RECEIVED DURING THE PREPARATION OF THE FINAL SUPPLEMENTAL EIS

12.0 COMMENTS AND RESPONSES

12.1 COMMENTS RECEIVED FOR NOP/EA AND DRAFT SEIS

Listed below are the agencies and organizations who responded during the public review period for the EA/NOP. The table indicates with an "X" those who submitted written comments or letters stating they have no comments. This is followed by their comment letters and the responses of the applicant's planning consultant.

	Comments on N.O.P.	Comments on Draft SEIS
A. FEDERAL AGENCIES		
U.S. Department of Agriculture, Soil Conservation Service	–	X
Department of the Navy	–	X
U.S. Department of the Interior Fish and Wildlife Service	–	–
Department of the Army, U.S. Army Corps of Engineers	–	X
B. STATE AGENCIES		
Office of State Planning	–	–
DLNR/Office of Conservation and Environmental Affairs	X	X
DLNR/Historic Preservation Division	X	X
DLNR/Division of Forestry and Wildlife	X	X
DLNR/Division of Water and Land Development	X	X
DLNR/Commission on Water Resource Management	X	X
DLNR/Division of Land Management	–	–
DLNR/Division of Aquatic Resources	X	X
Department of Agriculture	–	X
Department of Education	X	–
Department of Health	X	X
Department of Transportation	X	X
Housing, Finance and Development Corp.	–	–
Dept. of Business and Economic Development	X	X
Dept. of Business and Economic Develop./Energy	–	X
University of Hawaii, Environmental Center	X	X
Hawaii Air National Guard	X	–
State Public Works	–	X
Office of Environmental Quality Control	–	X
Department of Hawaiian Home Lands	–	–
Land Use Commission	–	X
Department of Defense, Civil Defense	–	X

	Comments on N.O.P.	Comments on Draft SEIS
C. CITY AND COUNTY AGENCIES		
Department of Land Utilization	X	X
Board of Water Supply	X	X
Department of Public Works	X	X
Departments of Parks & Recreation	X	X
Department of Transportation Services	X	X
Department of Housing and Community Development	–	X
Police Department	–	X
Fire Department	X	X
Building Department	–	–
Planning Department	X	X
D. COMMUNITY ORGANIZATIONS		
North Shore Neighborhood Board No. 27	–	X
Sunset Beach Community Association	–	X
Sunset Hills Community Association	–	–
Pupukea Highlands Community Association	–	–
Kahuku Community Association	–	–
Haleiwa Community Association	–	–
Waialua Community Association	–	–
Mokuleia Community Association	–	–
E. INDIVIDUALS		
Benjamin T. Hopkins	X	–
Ken Newfield	–	X
Jean L. Merlet	–	X
James Blattau and Peter V. Z. Cole	–	X
Kamuela Price	–	X
Kenneth A. Martyn	–	X
Larry McElheny	–	X
Bill Howes	–	X
Steven C. Poor	–	X
F. MISCELLANEOUS		
Hawaiian Electric Company	X	

*N.O.P. stands for Notice of Preparation

12.2 COMMENTS AND RESPONSES

The following section includes letters sent to the Department of Planning containing comments from government agencies, community organizations and individuals regarding the Draft SEIS for the Lihi Lani project. Response letters prepared by Group 70 International, Inc., on behalf of Obayashi Hawaii Corporation, are enclosed. Also enclosed are comment letters and responses issued by Group 70 on the Environmental Assessment/Notice of Preparation of a Draft SEIS.

United States Department of Agriculture

Soil Conservation Service

P. O. Box 50004
Honolulu, HI
96850-0001

November 19, 1993

Ms. Yukie Ohashi
Group 70 International, Inc.
924 Bethel Street
Honolulu, Hawaii 96813

Dear Ms. Ohashi:

Subject: Draft Supplemental EIS for Lihilani, TMK 5-9-05: 6, Por. 38,82 and TMK 5-9-06: 1, 18, 24, Pupukea and Paumalu, Koolauloa, Oahu, Hawaii

We have completed our review of the Draft Supplemental EIS and an onsite review of the development project. We have no resource concerns and were impressed by the project staff's attempt to incorporate the total environment into the development plan. In addition, it is equally obvious that the planning effort has involved the North Shore Community.

Thank you for the opportunity to review and provide comments to a noteworthy development project. Should you have any questions please contact Mr. Michael C. Tulang at (808) 541-2606.

Sincerely,

Nat Conner

NATHANIEL R. CONNER
State Conservationist

cc: Michael Bajingting, District Conservationist, Honolulu Field Office

"To lead the way in helping our customers conserve, sustain, and enhance Hawaii's natural resources through efficient service of the highest quality."

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO
11010
Ser N4(239)/3654
1 NOV 1993

Mr. Robin Foster
City and County of Honolulu
650 South King Street
Honolulu, HI 96813

Dear Mr. Foster:

REVIEW OF DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
FOR LIHI LANI PROJECT AT PAUMALU & PUPUKEA
OAHU, HAWAII

Thank you for the opportunity to comment on the subject Draft Supplemental Environmental Impact Statement (DEIS) dated October 1993. The Navy has no comments to offer at this time.

Our point of contact is Mr. Stanford Yuen, Facilities Engineer, at 474-0439.

Sincerely,

Stanford B.C. Yuen, P.E.
Facilities Engineer
By direction of
the Commander

Copy to:
Mr. Craig Yamagishi
Obayashi Hawaii Corporation
725 Kapiolani Boulevard, Fourth Floor
Honolulu, HI 96813

Mr. Jeffrey H. Overton
Group 70 International, Inc.
924 Bethel Street
Honolulu, HI 96813

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
FT. SHAFTER, HAWAII 96858-5440

REPLY TO
ATTENTION OF

October 14, 1993

RECEIVED
OCT 18 1993
GROUP 70

Planning Division

Mr. Robin Foster, Chief Planning Officer
Department of Planning
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Foster:

Thank you for the opportunity to review and comment on the Draft Supplemental Environmental Impact Statement for the Lihi Lani Project, Oahu (TMK 5-9-5: 6, por. 38, 82; and, 5-9-6: 1, 18, and 24). The following comments are provided pursuant to Corps of Engineers authorities to disseminate flood hazard information under the Flood Control Act of 1960 and to issue Department of the Army (DA) permits under the Clean Water Act; the Rivers and Harbors Act of 1899; and the Marine Protection, Research and Sanctuaries Act.

a. Roadway or utility line crossings of the streams and gulches may require a DA permit. Please consult our Operations Division at 438-8554 and refer to file number PO94-002.

b. The flood information provided on page 4-43 is correct.

Sincerely,

Kisuk Cheung, P.E.
Director of Engineering

Copies Furnished:

Mr. Craig Yamagishi
725 Kapiolani Boulevard, Fourth Floor
Honolulu, Hawaii 96813

✓Mr. Jeffrey H. Overton
924 Bethel Street
Honolulu, Hawaii 96813

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13 December 1993

Department of the Army
Mr. Kisuk Cheung, P.E.
Director of Engineering
U.S. Army Engineering District, Honolulu
Ft. Shafter, HI., 96858-5440

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Mr. Cheung :

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of October 14, 1993.

A. DA Permit Requirements

Our staff will be consulting with your Operations Division on DA permit requirements as they relate to project roadway or utility line crossings of streams and gulches. We will file applicable DA permits once the project requirements are determined.

B. Flood Information

Thank you for verification of flood information provided in the Draft SEIS.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

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JOHN WAIHEE
GOVERNOR OF HAWAII

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GROUP 70

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
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AQUACULTURE DEVELOPMENT PROGRAM
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CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

REF:OCEA:RHU

NOV 22 1993

File No.: 94-249
Doc. No.: 3758

The Honorable Robin Foster
Chief Planning Officer
Planning Department
City and County of Honolulu
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Mr. Foster:

Subject: Draft Supplemental Environmental Impact Statement (DSEIS): Lihi Lani (Master Plan Community), Pupukea, Oahu, TMKs: 5-9-05: 6, por. 38, 82; 5-9-06: 1, 18, 24

We have reviewed the DSEIS information for the proposed project transmitted by Mr. Jeffery Overton's letter dated October 1, 1993 and have the following comments:

Brief Description:

Obayashi Hawaii Corporation proposes to develop the Lihi Lani Master Planned Community on approximately 1,144 acres of Agricultural District land in the Sunset Beach/Pupukea Highlands area (mauka of Kamehameha Highway) of the North Shore.

The revised Master Plan is an latest iteration of the residential , agricultural, and recreational use community that is intended to blend with the rural lifestyle of the area.

A proposed golf course in an earlier version of the plan has been replaced with open park space and a native hardwood forest. The number of residential units has been increased from the previous plan from 300 to 445. The Kalunawaikaala and Paumalu Streams boarder the project site, and Pakulena Stream runs through it.

Historic Preservation Division

The Historic Preservation Division (HPD) comments that the DSEIS correctly notes that there are 23 significant historic sites at these parcels. The DSEIS makes a commitment on page 5-14 to prepare an archaeological data recovery and mitigation plan. This plan must be reviewed and approved by HPD prior to construction.

Division of Forestry and Wildlife

The Division of Forestry and Wildlife comments that they have been working very closely with the developers of Lihi Lani in terms of access to the Pupukea Forest Reserve as well as assisting with the trail development and public use of the trail system within this development.

Commission on Water Resource Management

The Commission on Water Resource Management's (CWRM) staff offers the following comments regarding water reuse and streams:

The DSEIS addresses the waste water reuse policies as it relates to the Department of Health's (DOH) waste water reuse guidelines. This document should also address policies regarding the proposal to use high chloride irrigation water on the project site. Possible adverse impacts to the underlying aquifer and existing wells cannot be addressed until chloride concentrations, quantities, frequencies of discharge, and specific locations of high chloride irrigation water are disclosed in the DSEIS.

There are no regulatory requirements in the Department of Land and Natural Resources or in the DOH which specifically address the use of high chloride irrigation water over aquifers. However, the possibility of ground-water contamination due to this practice is documented; therefore, this issue should be addressed in detail before any land use approvals are granted to this project.

A major provision of the State Water Code deals with the protection of streams. Section 13-169-22, Hawaii Administrative Rules (HAR), establishes an in stream use protection program designed to protect, enhance, and reestablish, where practicable, beneficial in stream uses of water. This program is implemented through a permit system which regulates the alteration of stream channels and maintenance of stream flow.

The DSEIS identifies several intermittent streams on the site of the proposed project. However, the document does not disclose whether stream channels will be affected by the proposed project and whether permits will be required.

Section 13-169-50, HAR requires approved Stream Channel Alteration Permits (SCAP) by the CWRM whenever the bed or banks of streams are altered. Intermittent streams are subject to these rules as long as there is enough flowing water to provide for the migration of aquatic life. Page 4-50 discloses the presence of a post larval "fish" (Sicyopterus stimpsoni) in Paumalu Stream. The presence of this fish may be indicative of the fact that Paumalu Stream provides sufficient water for the migration of aquatic life; therefore, this stream may be subject to Section 13-169-50, HAR, SCAP requirements. The upper reaches of the streams were not surveyed; therefore, this document does not fully disclose environmental tradeoffs as it relates to streams.

In addition to SCAP requirements, if water is proposed to be diverted from these streams into irrigation systems for detention basins, additional CWRM approvals may be required before the project can proceed. Section 13-169-32, HAR requires stream diversion works permits from the CWRM whenever water is diverted from streams. Furthermore, interim in stream flow standards have been adopted for all Hawaii streams, and Section 13-169-36, HAR requires an amendment to the interim in stream flow standard if stream flows are altered. Pages 4-22 to 4-29 describe proposals for the construction of many detention basins for flood control and possibly for irrigation. Although such proposals may not necessarily be detrimental to aquatic life, such proposals will probably alter the stream flow frequency and flow duration to the extent that the applicant must petition the CWRM to amend the interim in stream flow standard for affected streams.

CWRM recommends that the Final SEIS address the following concerns:

1) The applicant should identify the location, quantity, frequency, and chloride concentrations where high chloride irrigation water is proposed to be use.

2) The applicant should disclose site specific proposals for possible new sources of potable drinking water.

3) The applicant should disclose how the present stream flows in the affected streams will be altered, and whether the alteration will be more beneficial or more detrimental to anadromous aquatic life. There should also be description of the related permit requirements.

4) The applicant should disclose all proposals for alteration of stream channels and their related regulatory approvals.

We will forward our Aquatic Resources Division comments as they become available.

We have no other comments to offer at this time. Thank you for the opportunity to comment on this matter.

Please feel free to call Steve Tagawa at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions.

Very truly yours,

John P. Keppeler II

for KEITH W. AHUE

cc: Jeffery Overton, Group 70 Intl.
Craig Yamagishi, Obayashi Hawaii Corp.
Brian Choy, OEQC

JOHN WAIHEE
GOVERNOR OF HAWAII

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DEC - 8 1993
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REF:OCEA:RMB

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

Keith W. Ahue, Chairperson
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
John P. Keppeler, II
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AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
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CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

DEC 7 1993

File No.: 94-249a
Doc. No.: 3821

The Honorable Robin Foster
Chief Planning Officer
Planning Department
City and County of Honolulu
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Mr. Foster:

Subject: Draft Supplemental Environmental Impact Statement (DSEIS): Lihi Lani (Master Plan Community), Pupukea, Oahu, TMKs: 5-9-05: 6, por. 38, 82; 5-9-06: 1, 18, 24

The following are our Division of Aquatic Resources' comments for the subject project which supplement those forwarded by our previous letter dated November 22, 1993:

Division of Aquatic Resources

We recommended that longitudinal reconnaissance surveys for aquatic biota (fishes and macroinvertebrates, including Meglagrion damselflies) be performed after previous reviews of this project. A scoping meeting was held with the developer's consultant for that purpose, and an April 1991 survey by Anne Brasher is listed under references in the DSEIS. Based on the results of the survey, received directly from Group 70, we have no objections to the project from the aquatic biological resources standpoint.

We have no other comments to offer at this time. Thank you for the opportunity to comment on this matter.

Please feel free to call Steve Tagawa at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions.

Very truly yours,

KEITH W. AHUE

cc: Jeffery Overton, Group 70, Intl.
Craig Yamagishi, Obayashi Hawaii Corp.
Brian Choy, OEQC

GROUP 70
INTERNATIONAL

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Michael A. Garni
Eric G. Crispin, AIA
Danilo M. Herrera

13 December 1993

Mr. Keith Ahue, Director
Department of Land and Natural Resources
State of Hawaii
P. O. Box 621
Honolulu, Hawaii 96809

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI Response to Comments on Draft Supplemental EIS**

Dear Mr. Ahue:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of 19 November 1993.

1) Historic Preservation Division

Obayashi recognizes that the archaeological data recovery and mitigation plan must be reviewed and approved by HPD prior to construction.

2) Division of Forestry and Wildlife

Obayashi has been working very closely with the DOFAW representatives regarding access to the Pupukea Forest reserve, trail development, and public use of the trail system. We appreciate the assistance of your staff and look forward to continuing to work closely on these matters.

3) Chlorides in Irrigation Water

The requested analysis has been completed and is documented in Appendix H of the Draft SEIS and the Final SEIS. The information is also included in the Draft SEIS/Final SEIS in the section on Groundwater Resources (pp. 4-13 to 4-22.) Using conservative assumptions, this analysis shows that the impact of the irrigation return flow would be modest: an increase of 3.7 mg/l in chloride concentration if the return flow is averaged through the entire basal lens, or 15.9 mg/l if it is mixed only into the upper half. These would represent increases of 1.2 and 8.0 percent, respectively. It should also be pointed out that the source of this irrigation supply will be onsite wells. Although these wells produce brackish water (chlorides of approximately 300 mg/l), it will not be "high chloride" water in comparison to the underlying groundwater; it is identical to it. The reason why this use will have any affect at all is due to the concentration of salts in the irrigation return flow by plant evapotranspiration.

The only wells in the area which could potentially be affected are the BWS Sunset Beach wells (Nos. 4002-04 and 4002-05) which are located off the northwest corner of the project site. These wells, which have only a modest supply capacity, have not been used since 1983. However, if BWS elects to put these wells back in service and the project does have an adverse impact, the developer has agreed to make up any reduction in BWS ability to use these wells. This will be done by allocating a portion of the potable water supply developed for this project to BWS. Proposed sites for this source are in Haleiwa and Kawailoa.

4) Stream Channels

If the bed or banks of streams are proposed to be modified by the project, Obayashi will seek approval of a Stream Channel Alteration Permit (SCAP). At the time of project design, plans will be reviewed to address this potential requirement. Obayashi's representatives will work closely with the staff of the Commission on Water Resource Management to meet applicable requirements for this project. There is no plan to divert water from these streams. The only streams which could potentially be affected by the project could be Pakulena Stream and Kalunawaikaala Stream. The internal circulation roadways will cross these streams, and it is possible that a SCAP will be required if the bed or bank of these streams are affected. The action to use detention basins on the project site to control runoff is not expected to cause a significant change to intermittent stream flows.

Paumalu Stream, which showed the juvenile o'opu in the Brasher (1991) survey, is far outside planned development areas and will not be affected by the project. No adverse impacts to anadromous wildlife is anticipated to result from the proposed project.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
Commission on Water Resource Management
Honolulu, Hawaii
OCT 29 1993

NOV 0 2 1993

MEMORANDUM

TO: Mr. Roger C. Evans, Administrator
Office of Conservation and Environmental Affairs

FROM: Rae M. Loui, Deputy Director
Commission on Water Resource Management

SUBJECT: Comments to Draft Supplemental EIS for Lihilani, Pupukea, Oahu
(FILE NO. 94-249)

The following comments regarding water reuse and streams are offered for consideration by your office for the benefit of the applicant.

The Draft Supplemental EIS addresses the wastewater reuse policies as it relates to the Department of Health's wastewater reuse guidelines. This document should also address policies regarding the proposal to use high chloride irrigation water on the project site. Possible adverse impacts to the underlying aquifer and existing wells cannot be addressed until chloride concentrations, quantities, frequencies of discharge, and specific locations of high chloride irrigation water are disclosed in the EIS. There are no regulatory requirements in the Department of Land and Natural Resources or in the Department of Health which specifically address the use of high chloride irrigation water over aquifers. However, the possibility of ground-water contamination due to this practice is documented; therefore, this issue should be addressed in detail before any land use approvals are granted to the project.

A major provision of the State Water Code deals with the protection of streams. Section 13-169-22 establishes an instream use protection program designed to protect, enhance, and re-establish, where practicable, beneficial instream uses of water. This program is implemented through a permit system which regulates the alteration of stream channels and maintenance of streamflows.

The Draft Supplemental EIS identifies several intermittent streams on the site of the proposed project. However, the document does not disclose whether stream channels will be affected by the proposed project and whether permits will be required.

Section 13-169-50, HAR requires approved stream channel alteration permits by the Commission on Water Resource Management whenever the bed or banks of streams are altered. Intermittent streams are subject to these rules as long as there is enough flowing water to provide for the migration of aquatic life. Page 4-50 discloses the presence of a post larval "fish" (Sicyopterus stimpsoni) in Paumalu Stream. The presence of this fish may

OCT 29 1993

be indicative of the fact that Paumalu Stream provides sufficient water for the migration of aquatic life; therefore, this stream may be subject to Section 13-169-50, HAR, stream channel alteration permit requirements. The upper reaches of the streams were not surveyed; therefore, this document does not fully disclose environmental trade-offs as it relates to streams.

In addition to stream channel alteration permit requirements, if water is proposed to be diverted from these streams into irrigation systems or detention basins, additional Commmission approvals may be required before the project can proceed. Section 13-168-32 requires stream diversion works permits from the Commission whenever water is diverted from streams. Furthermore, interim instream flow standards have been adopted for all Hawaii streams, and Section 13-169-36 requires an amendment to the interim instream flow standard if stream flows are altered. Pages 4-22 to 4-29 describe proposals for the construction of many detention basins for flood control and possibly for irrigation. Although such proposals may not necessarily be detrimental to aquatic life, such proposals will probably alter the stream flow frequency and flow duration to the extent that the applicant must petition the Commission to amend the interim instream flow standard for affected streams.

We recommend that the final Supplemental EIS address the following concerns:

1) The applicant should identify the location, quantity, frequency, and chloride concentrations where high chloride irrigation water is proposed to be used.

2) The applicant should disclose site specific proposals for possible new sources of potable drinking water.

3) The applicant should disclose how the present streamflows in the affected streams will be altered, and whether the alteration will be more beneficial or more detrimental to anadromous aquatic life. There should also be a description of the related permit requirements.

4) The applicant should disclose all proposals for alteration of stream channels and their related regulatory approvals.

The opportunity to review and comment on this Draft Supplemental EIS is appreciated. Should you have any questions, please call David Higa at 587-0249.

DH:ko
c: Division of Aquatic Resources
Group 70 International

GROUP 70

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Danilo M. Herrera

13 December 1993

Rae M. Loui, Deputy Director
Commission on Water Resource Management
Department of Land and Natural Resources
State of Hawaii
P. O. Box 621
Honolulu, Hawaii 96809

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Ms. Loui:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of 29 October 1993.

1) Chlorides in Irrigation Water

The requested analysis has been completed and is documented in Appendix H of the Draft SEIS and the Final SEIS. The information is also included in the Draft SEIS/Final SEIS in the section on Groundwater Resources (pp. 4-13 to 4-22.) Using conservative assumptions, this analysis shows that the impact of the irrigation return flow would be modest: an increase of 3.7 mg/l in chloride concentration if the return flow is averaged through the entire basal lens, or 15.9 mg/l if it is mixed only into the upper half. These would represent increases of 1.2 and 8.0 percent, respectively. It should also be pointed out that the source of this irrigation supply will be onsite wells. Although these wells produce brackish water (chlorides of approximately 300 mg/l), it will not be "high chloride" water in comparison to the underlying groundwater; it is identical to it. The reason why this use will have any affect at all is due to the concentration of salts in the irrigation return flow by plant evapotranspiration.

The only wells in the area which could potentially be affected are the BWS Sunset Beach wells (Nos. 4002-04 and 4002-05) which are located off the northwest corner of the project site. These wells, which have only a modest supply capacity, have not been used since 1983. However, if BWS elects to put these wells back in service and the project does have an adverse impact, the developer has agreed to make up any reduction in BWS ability to use these wells. This will be done by allocating a portion of the potable water supply developed for this project to BWS. Proposed sites for this source are in Haleiwa and Kawailoa.

4) **Stream Channels**

If the bed or banks of streams are proposed to be modified by the project, Obayashi will seek approval of a Stream Channel Alteration Permit (SCAP). At the time of project design, plans will be reviewed to address this potential requirement. Obayashi's representatives will work closely with the staff of the Commission on Water Resource Management to meet applicable requirements for this project. There is no plan to divert water from these streams. The only streams which could potentially be affected by the project could be Pakulena Stream and Kalunawaikaala Stream. The internal circulation roadways will cross these streams, and it is possible that a SCAP will be required if the bed or bank of these streams are affected. The action to use detention basins on the project site to control runoff is not expected to cause a significant change to intermittent stream flows.

Paumalu Stream, which showed the juvenile o'opu in the Brasher (1991) survey, is far outside planned development areas and will not be affected by the project. No adverse impacts to anadromous wildlife is anticipated to result from the proposed project.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton, AICP
Chief Environmental Planner

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November 22, 1993

Mr. Robin Foster
Chief Planning Officer
Department of Planning
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Foster:

Subject: Draft Supplemental Environmental Impact Statement for
Lihi Lani Residential/Agricultural Community
North Shore Development Plan Amendment Application -
Agricultural to Residential, Park, and Public Facility
Obayashi Hawaii Corporation
TMK: 5-9-05: 6, por. 38, 82
5-9-06: 1, 18, 24 Pupukea, Oahu
Area: 266 acres of 1,144 acres

The Department of Agriculture has reviewed the subject document and offers the following comments.

The applicant proposes to amend the North Shore Development Plan Map for 266 of 1,144 acres from Agricultural to Residential (16 acres), Park (219 acres), and Public Facility (31 acres). The other proposed uses such as a horse ranch, pasture, 315 one-acre Country lots, and open space are permitted within the Agricultural District. The principal difference between the 1991 master plan and the current one is the elimination of the golf course and related development and the addition of the 315 Country lots.

Unique to the current master plan is the promotion and integration of small-scale agricultural uses into the Country lots (via easements of 6,000 square feet per lot to be managed by a single management company answering to the project's Homeowners' Association) and common areas for a total of 43 acres. Agricultural uses include field stock trees and/or fruit tree orchards (such as avocado), nursery (cut flowers and foliage) and grazing pasture. Revenues from leasing the land to farm businesses will be used to reduce homeowner costs. There will also be a mauka stock tree area (17 acres), orchard (10 acres), ranch (45 acres), and agroforestry area (43 acres). The grand total acreage to be put into agricultural uses is about 160 acres.

Tertiary treated wastewater for irrigation will be supplied by the on-site water reclamation facility. Total available water for irrigation will be 2,980 gallons per acre per day (annualized average). One concern we have is that the proposed use of reclaimed wastewater be carefully worked out with the Department of Health so as to avoid unforeseen problems and shortfalls in the amount of water available for irrigation use.

The implementation of the proposed restrictive covenants and conditions will help ensure long-term agricultural use. The design for and use of common areas for agricultural uses is a creative concept. If there will be multiple farm businesses within the agricultural designated lands of the project, a farming cooperative will be very useful, if not required, to better the chances for economic survival. The management of the farm businesses by the overall agricultural manager will have to be "on the ball" to prevent the agricultural concept from falling apart.

In conclusion, the Department of Agriculture finds the proposed development to be progressive and more clear in agricultural intent than most standard agricultural subdivision proposals. At this point in time, with the available information, and with the one particular concern regarding the use of reclaimed wastewater, we find that the document satisfactorily addresses our concerns.

Should you need to discuss this further, please call me at 973-9551, or Dr. Paul J. Schwind, Planning Program Administrator, at 973-9469.

Sincerely,

Yukio Kitagawa

YUKIO KITAGAWA
Chairperson, Board of Agriculture

c: Obayashi Hawaii Corporation (attention: Mr. Craig Yamagishi)
Group 70 International, Inc. (attention: Mr. Jeffrey H. Overton)
Office of Environmental Quality Control

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James I. Nishimoto, AIA
Jen-Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

13 December 1993

Mr. Yukio Kitagawa, Chairperson
Board of Agriculture
State of Hawaii
1428 South King Street
Honolulu, Hawaii 96814

Subject: Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI
Response to Comments on Draft Supplemental EIS

Dear Mr. Kitagawa:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of 22 November 1993.

1) Recognition of Agricultural Plan for Lihi Lani

The comments made on the Lihi Lani agricultural plan are very much appreciated. Obayashi is making an effort to undertake a new model for diversified agriculture made possible on typically marginal lands through an integrated combination with carefully planned low-density residential use. We are pleased that the Department has recognized these efforts.

2) Reclaimed Water Use

The area planned to receive reclaimed water for irrigation is only about 65 acres of ranch pasture lands and field stock nursery trees. The quantity of reclaimed water available for irrigation of these lands is anticipated to be sufficient, however, the system will be supplied with brackish water from onsite wells for "make-up water". The water reclamation will take place of lands located outside the individual Country lots. Agricultural uses on the Country lots will be irrigated with the brackish water derived from the on-site wells, with capacity to deliver up to 1.0 million gpd.

3) Farm Business and Management

Your comments regarding the issue of careful management of the agricultural uses is appreciated. We are working with individuals with expertise in several agricultural areas, such as the field stock trees, ornamental plants, cut flowers, and fruit trees. We continue to seek additional expertise in the different farming areas to ensure the best chance for successful operations. The use of an agricultural cooperative is also being

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pursued. Obayashi will continue to seek advice from your Department and other experts in the relevant agricultural disciplines.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

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In reply, please refer to:
91-083/epo

November 24, 1993

Mr. Robin Foster
Chief Planning Officer
Planning Department
City & County of Honolulu
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Mr. Foster:

Subject: Draft Supplemental Environmental Impact Statement for Lihi Lani, Pupukea & Paumalu
Koolauloa, Oahu
TMK: 5-9-05: 6, por. 38 and 82
5-9-06: 1, 18, 24

Thank you for the opportunity to review and comment on the subject document. We have the following comments to offer:

Wastewater

The water reclamation facility must conform to applicable provisions of the Department of Health's Administrative Rules, Chapter 11-62, "Wastewater Systems" and the Guidelines for the Treatment and Reuse of Reclaimed Water. We do reserve the right to review the final detailed wastewater plans for conformance to applicable rules.

If you should have any questions on this matter, please contact Ms. Lori Kajiwara of the Wastewater Branch at 586-4290.

Very truly yours,

[signature] for

JOHN C. LEWIN, M.D.
Director of Health

c: Wastewater Branch
Group 70 International, Inc.
Obayashi Hawaii Corporation
Office of Environmental Quality Control

JOHN WAIHEE
GOVERNOR

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
KANANI HOLT
JOYCE T. OMINE
AL PANG
CALVIN M. TSUDA

IN REPLY REFER TO:

STP 8.5648

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

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December 6, 1993

Mr. Robin Foster
Chief Planning Officer
Planning Department
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Foster:

Subject: Draft Supplement Environmental Impact Statement (EIS) for Lihi Lani
TMK: 5-9-06: 1, 18, 24

We have reviewed the draft EIS for the proposed Lihi Lani development and offer the following comments:

1. The developer should provide a left-turn storage lane and a right-turn deceleration lane on Kamehameha Highway at its intersection with the access road.

2. The access road should be provided with right- and left-turn storage lanes.

3. To accommodate future highway widening, a fifty (50) feet setback should be established along the mauka boundary of the Kamehameha Highway right-of-way. The setback area should not be designated for park use since Section 4(f) of the U.S. Department of Transportation Act prohibits highway encroachment onto parklands.

4. The developer should provide for traffic signals when warranted. The developer should conduct traffic signal warrant studies annually to determine when traffic signals need to be installed and submit the findings to our Highways Division for review. The developer should consider installing traffic signal conduits as part of the intersection improvements.

Mr. Robin Foster
Page 2
December 6, 1993

STP 8.5648

5. Construction plans for any work within the State highway right-of-way must be submitted for our review and approval.

6. Flooding on Kamehameha Highway in the proximity of the proposed development is a problem. Dry wells and detention basins should be of sufficient capacity and maintained properly to prevent aggravating the situation.

We appreciate the opportunity to provide comments.

Sincerely,

Rex D. Johnson
Director of Transportation

c: Group 70 International

GROUP 70
INTERNATIONAL

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Danilo M. Herrera

13 December 1993

Mr. Rex D. Johnson, Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Subject: Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI
Response to Comments on Draft Supplemental EIS

Dear Mr. Johnson:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of 6 December 1993.

1) Turning Lanes

Obayashi will provide a left-turn storage lane and a right-turn deceleration lane on Kamehameha Highway at its intersection with the project access road. In addition, the access road will be provided with right-turn and left-turn storage lanes.

2) Highway Widening

Obayashi would like to meet with the DOT to discuss accommodation of future highway widening and also consider potential timing of the widening.

3) Signalization of Access Road Intersection

Obayashi would also to like to meet with the DOT to address the needs for signalization of the project access road intersection. Obayashi will install the traffic signals to State DOT standards if and when they are warranted. Obayashi is concerned about the timing of such improvements, and would like to discuss this with the Highways Division.

4) Construction in Right-of-Way

In accordance with standard procedures, all plans for construction work within the State Highway right-of-way will be submitted to the Highways Division for review and approval.

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5) **Flooding on Kamehameha Highway**

The drainage facilities on the project site are currently planned to control runoff from the project site. The widening plans for the highway will conflict with the drainage facilities currently planned for the makai portion of the property. Obayashi would like to meet with the DOT to address specific needs for the widening and its effects on project drainage requirements.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

10/93 - 2403

JOHN WAIHEE
GOVERNOR

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
677 QUEEN STREET, SUITE 300
HONOLULU, HAWAII 96813
FAX (808) 587-0600

IN REPLY REFER TO:
93:PPE/4973

October 7, 1993

The Honorable Robin Foster
Chief Planning Officer
Planning Department
City & County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Foster:

Re: Draft Supplemental EIS for Lihi Lani

We have reviewed the draft supplemental EIS for Lihi Lani and offer the following general comments.

Policies A(3) and B(3) of the State Housing Functional Plan seek to ensure that (1) housing projects and (2) projects which impact housing provide a fair share/adequate amount of affordable homeownership or rental housing opportunities. We believe that the proposed housing project should address the affordable housing policies of the State housing plan.

Additionally, on page ES-5 of the Executive Summary, it states that "a monetary contribution will be made towards the development of up to 50 off-site affdordable units by the City in the North Shore region." We are interested in learning if the City has a particular site and project in mind.

Thank you for the opportunity to comment.

Sincerely,

JOSEPH K. CONANT
Executive Director

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13 December 1993

Mr. Joseph K. Conant, Executive Director
State of Hawaii
Department of Budget and Finance
Housing Finance and Development Corporation
677 Queen Street, Suite 300
Honolulu, HI. 96813

Subject: Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI
Response to Comments on Draft Supplemental EIS

Dear Mr. Conant:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of October 7, 1993.

1) State Housing Functional Plan

Policy A(3): Ensure that (1) housing projects and (2) projects which impact housing provide a fair share/adequate amount of affordable home ownership.

Policy B(3): Ensure that projects which impact housing provide affordable rental opportunities for employees.

Discussion: Lihi Lani will provide 130 on-site affordable housing units and participate in development of up to 50 off-site affordable homes. The 80 elderly rental homes to be built on-site by the the City will satisfy a portion of the rental market demand on the North Shore. The provision of on-site and off-site affordable homes will constitute 36 percent of the total amount of housing associated with the project.

2) City Development of Affordable Housing Units

As stated in the Executive Summary, the City will be making a contribution towards development of affordable housing units in the North Shore region. The specific size and location of the site has not yet been determined by the City. Ohbayashi will continue to work closely with the City's Department of Housing and Community Development, and we will continue to update your staff periodically.

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We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton, AICP
Chief Environmental Planner

University of Hawaii at Manoa

Environmental Center
A Unit of Water Resources Research Center
Crawford 317 • 2550 Campus Road • Honolulu, Hawaii 96822
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RECEIVED
NOV 23 1993
GROUP 70

Robin Foster, Chief Planning Officer
Planning Department
City and County of Honolulu
650 South King Street, 8th Floor
Honolulu, HI 96813

Dear Mr. Foster,

Draft Supplemental Environmental Impact Statement (DSEIS)
Lihi Lani
Pupukea and Paumalu, Koolauloa, Oahu

The referenced DSEIS proposes development of 315 one- to three-acre homesites, 50 affordable 5,000 square foot residential properties, an 80-unit elderly housing facility, and associated infrastructure. Ancillary amenities to the residential development include equestrian facilities, hiking trails, a wastewater reclamation and treatment facility, and a variety of agricultural and agroforestry land uses.

The Environmental Center has conducted a review of the referenced DSEIS with the assistance of Reginald Young, College of Engineering; Ed Murabayashi, Water Resources Research Center; Paul Ekern, Emeritus; Jacquelin Miller, Environmental Center; and Huilin Dong, Environmental Center.

GENERAL COMMENTS

Our reviewers commend the preparers of this DSEIS on a generally comprehensive and readable document. Certain of the appendices, particularly the assessment of potential marine impacts and the institution of a marine water chemistry monitoring program are highly commendable, as is the application of alternative wastewater treatment and reclamation technology. We do note an unfortunate prevalence of typographic errors which occasionally are distracting, and certain of the figure reproductions are not legible. However, the majority of the information presented is sufficiently detailed to provide decisionmakers an adequate basis for consideration.

We noted two general areas of concern which recurred throughout the document. Although the nature of the proposed action is somewhat preliminary, our reviewers found the lack of specificity in siting of actual construction on the "country lots" problematic, since impacts are likely to be strongly dependent on characteristics of terrain which are highly variable over relatively short distances. It is implied that guidelines will be provided as to location and design of houses, and more assurance that such guidelines would include restrictions on slope and grading requirements would be welcome.

Our reviewers also took exception to the repeated offering of development phasing as a predominant mitigation for project impacts. While phasing appropriately may diminish instantaneous effects of grubbing and grading, long-term and cumulative impacts ultimately are rendered no less severe through drawn out implementation. The impacts of the project on school capacity, police and fire protection, and regional traffic congestion are substantial regardless of whether it is implemented over three or thirty years.

The following specific comments were identified by our reviewers as areas of possible improvement for the DSEIS.

SOILS

Although the soil types in the project area are presented, there is no discussion of specific engineering properties of different soil classifications in relation to proposed land uses. In particular, where terrace forms are proposed for roadways or house sites, or where houses are constructed on sloping terrain, the drainage properties of the soils will be a crucial element in determining the stability of the proposed structure. We suggest that appropriate tables of engineering properties be reproduced for reference and that some discussion of the comparative stability of soils in areas of proposed construction be provided.

WATER RECLAMATION FACILITY

The proposed WRF seems well engineered. However, we were unable to find reference to any inlet grate which would strain out occasional refractory solids. Is such a structure needed? Also, what provisions are included for eventual removal and disposal of accumulated solids precipitated in the stabilization ponds? Are the dimensions of the ponds such that mechanized dredges can recover sediments as needed?

Our reviewers noted that the type of vegetation to be employed in the wetland cells was not specified. Appendix C suggests the use of bullrushes or reeds. Was California Grass considered? Also, regardless of the type of vegetation, there must be provision for harvesting and disposal or reuse of the accumulated biomass from the wetland cells. How will that be accomplished? What will be the method of treatment for the backwash effluent from the sand filters?

There should be some discussion in the DSEIS of management controls or protocol for assurance that cross connections are not made inadvertently between the reclaimed effluent and potable water lines.

DRAINAGE

We were unable to locate specific reference within the DSEIS to the exclusion of stormwater runoff from the WRF. Although this information was presented in Appendix C, our reviewers feel this is sufficiently important that it should be specified in the body of the EIS pursuant to Section 11-200-19 of the EIS Rules.

The quality of reproduction of Figure 4-7 and of Figure 4, Appendix E, was too poor to allow a reasonable assessment of the relationship between the proposed sites of the retention basins and the adjacent topography. Even had the contour lines been legible, the scale would have been inappropriate for meaningful interpretation. We can only guess at the extent of grading and filling which will be required to implement the cutoff swales needed to direct runoff into these basins, yet such grading could be nearly as extensive as that originally proposed for construction of the golf course. Are the detention basins considered infrastructure and thereby intended for construction in the initial phase of the project?

Our reviewers expressed curiosity over the management of the detention basins. What types of vegetation are to be found, and how long will water stand under extremely wet conditions? We noted that all modeling addressed 24-hour events. What will be the runoff behavior should a two year or ten year storm occur following a protracted series of smaller, yet cumulatively saturating events? If water stands for several days, won't mosquito problems be severe? Also, what provisions are considered for cleaning up debris and sediment from the detention basins following major events?

Finally, we noted the intention to route stormwater discharge to the nearest gully via overland flow or pipe outlet (Appendix E, p. 9). The recent tragic accident in which a boy was lost in a drainage culvert in Kailua following a heavy rainstorm suggests that such structures should be designed to prevent a recurrence of that circumstance.

POTABLE WATER

Our reviewers expressed concern that the storage capacity of potable water reservoirs proposed for this project seems inadequate. In the event of a power failure, gravity supply to the development would not last for two days at the expected consumption rate. By comparison, capacity at the neighboring Pupukea Highlands development appears to allow for over four days supply, assuming proportionate consumption relative to the number of housing units.

We appreciate the opportunity to comment on this DSEIS, and we look forward to your responses.

Sincerely,

John T. Harrison, Ph.D.
Environmental Coordinator

cc: OEQC
Roger Fujioka
Paul Ekern
Reginald Young
Jacquelin Miller
Huilin Dong

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13 December 1993

John T. Harrison, Ph.D., Environmental Coordinator
University of Hawaii, Environmental Center
Crawford 317, 2550 Campus Road
Honolulu, Hawaii 96822

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Dr. Harrison:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of 22 November 1993.

Thank you for recognizing the extensive marine water quality analysis and marine impacts assessment work presented in the Draft SEIS. Obayashi and Marine Research Consultants have dedicated tremendous efforts to carefully plan Lihi Lani to protect ocean water quality.

1) Siting of Construction on the Country Lots

The planned positions of homes on the Country lots are shown in Figure 2-2 of the Draft SEIS, entitled Conceptual Agricultural Plan. This figure shows homes on the gentle and moderate slope areas of the property, with home sites limited to slopes of less than 20 percent and most with slopes less than 10 percent. Guidelines to limit activities on private lands will be developed in the design process, and will be put forward in a Code of Covenants and Restrictions (CCR).

2) Phasing of Development

The intent of development phasing is to minimize the impact of both the construction activities (i.e. construction traffic, clearing, grading and erosion/runoff potential) and the effects of growth of population (i.e. traffic and schools). Letters from the Police and Fire Departments are enclosed stating their positions regarding the potential effects of the project. Obayashi strongly believes that phasing will minimize the impacts of construction, as you recognized. The effects of population growth will be softened by the phasing program. because the local community and roadways will not experience a tremendous short-term change as a result of Lihi Lani. Instead, the increase in local population and resulting traffic and school children will be experienced slowly over the period of 20 to 30 years. This slow growth will allow for careful planning and implementation of potentially necessary improvements, such as the project access road intersection signalization and

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school facilities expansion. As a result of the planned phasing, Lihi Lani's pace of growth will be more in keeping with the pace of growth recently experienced on the North Shore. This will differ dramatically from the change caused by a short and intense growth period with typical residential development projects.

3) **Soils**

A table showing soils engineering properties for soils located on the property site will be included in the Final SEIS. The stability of soils in the areas planned for Country lots will not prohibit the development of properly designed homes and supporting roads and utilities. Some areas on the site are better than others in terms of foundation properties. Obayashi will be prohibiting the construction of homes on the steep sides of the pali or internal hillsides through the CCR provisions.

4) **Water Reclamation Facility**

Solids (such as rags) in the wastewater collected from sources at Lihi Lani will be collected at the wet wells of pump stations in the collection system. These solids are removed from the pump stations during periodic maintenance.

The biosolids or sludge layer in the stabilization ponds are known to reach a "steady-state" level within about 20 years. The solid material is constantly being broken down by natural anaerobic degradation processes. Only very infrequently would solids be removed by floating suction dredge equipment. Ponds will be designed to provide storage for these accumulated biosolids.

The plants in the wetlands will likely be hardstem bulrushes (Scirpus sp.) Use of bulrushes has been proven to be effective in the treatment process. To our knowledge, there have been few if any application of California grass in a full scale wastewater treatment plant. For this reason, Obayashi is not considering the use of California grass. Periodic harvesting will take place to remove overgrown wetlands vegetation, and the material will be utilized in green waste composting performed onsite.

Backwash from the filters is recycled through the stabilization ponds and wetlands system. Reclaimed water distribution lines will avoid cross-connection with potable water lines by implementing procedures outlined in the DOH Reuse Guidelines (Draft No. 8; September 20, 1993).

5) **Drainage**

The text of the Final SEIS will mention that the WRF will not receive surface runoff from the surrounding lands.

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Figure 4-7 of the Draft SEIS is being revised to provide a better reproduction in the Final SEIS. The grading work to construct swales for directing runoff to the detention basins will be far less than that required for the previously proposed golf course. The detention basins in the Phase 1 construction area are planned to be built as part of Phase 1, and so forth through the remainder of the project.

Your comments considered control of runoff from a series of storms where soils would be saturated prior to the following storm events. A properly designed detention basin is designed to accommodate a storm of lower intensity following a peak 100 year storm.

The bottom of some detention basins will hold water for more than 24 hours, and vegetation to be planted in these areas will likely be those suited to wet soils and periodic inundation. We recognize this is a potential concern and detention basins will be designed and maintained to avoid vector problems. As indicated, periodic cleaning of debris and sediment will be required, especially after large storms.

Inlets to large drainage culvert pipes will likely be covered with metal bar grates to avoid entry by people and large debris.

6) **Potable Water**

Reservoir capacity for the project follows typical design standards for a residential community. Reservoir capacity in the BWS Pupukea system is based on the maximum daily demand, equal to 1.5 times the average daily demand. The storage and transmission capacity of the BWS Pupukea system was was originally designed and constructed to accommodate the future development of the land Obayashi owns. Current utilization of the BWS Pupukea system is approximately 25 percent of capacity.

Average daily demand at Lihi Lani will be approximately 245,500 gpd. The proposed potable water storage of 0.4 MG at Lihi Lani is more than the 1.5 times daily demand total of 0.386 MG.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton, AICP
Chief Environmental Planner

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GROUP 70

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OCT 6 1993

Planning Department
City and County of Honolulu
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Attention: Mr. Robin Foster

Gentlemen:

Subject: Lihi Lani
Paumalu and Pupukea
Oahu, Hawaii
Supplemental Draft EIS

Thank you for the opportunity to review the subject document. We have no comments to offer.

If there are any questions, please have your staff contact Mr. Ralph Yukumoto of the Planning Branch at 586-0488.

Very truly yours,

GORDON MATSUOKA
State Public Works Engineer

RY:jy
cc: Ohbayashi Hawaii Corp.
Group 70 International, Inc.
OEQC

JOHN WAIHEE
Governor
MUFI HANNEMANN
Director
JEANNE SCHULTZ
Deputy Director
RICK EGGED
Deputy Director
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STATE OF HAWAII 1959

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 PHONE: (808) 587-3800 FAX: (808) 587-3820

October 13, 1993

RECEIVED
OCT 15 1993
GROUP 70

Mr. Robin Foster, Chief Planning Officer
Planning Department
City and County of Honolulu
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Mr. Foster:

Subject: Draft Supplemental EIS for Lihi Lani
District: Koolauloa
Island of Oahu
Tax Map Key: 5-9-05:6, Por. 38, 82
5-9-06: 1, 18, 24

This is to inform you that we have no comments on the subject Draft Supplemental Environmental Impact Statement (SEIS). We are returning the SEIS with no comments.

Thank you for the opportunity to comment on the Draft SEIS.

Sincerely,

Maurice H. Kaya
Energy Program Administrator

MHK/hkeis96

cc: Director, OEQC
Mr. Craig Yamagishi, Obayashi Hawaii Corporation
✓Mr. Jeffrey H. Overton, Group 70 International, Inc.

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JOHN WAIHEE
GOVERNOR

BRIAN J. J. CHOY
Director

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
220 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185

November 24, 1993

Mr. Robin Foster
Department of Planning
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Foster:

Subject: Draft Supplemental Environmental Impact Statement for Lihi Lani, Koolauloa, Oahu

Thank you for the opportunity to review the subject draft supplemental environmental impact statement. We do not have any comments to offer.

Sincerely,

Brian J. J. Choy
Director

BC:jt

c: Obayashi Hawaii Corporation
Group 70 International, Inc.

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13 December 1993

Mr. John C. Lewin, M.D.
State of Hawaii , Department of Health
Director of Health
P. O. Box 3378
Honolulu, HI 96811

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Dr. Lewin:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of November 24, 1993.

The proposed water reclamation facility will conform to applicable provisions of the Department of Health Administrative Rules, Chapter 11-62, "Wastewater Systems" and Guidelines for the Treatment and Reuse of Reclaimed Water. Final wastewater plans will be submitted to DOH for review and conformance to applicable rules.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

JOHN WAIHEE
Governor
MUFI HANNEMANN
Director
BARBARA KIM STANTON
Deputy Director
RICK EGGED
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Deputy Director

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

Central Pacific Plaza, 220 South King Street, 11th Floor, Honolulu, Hawaii
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804 Telephone: (808) 586-2406 Fax: (808) 586-2377

October 18, 1993

RECEIVED
OCT 21 1993
GROUP 70

Mr. Robin Foster
Chief Planning Officer
Planning Department
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Foster:

The Department of Business, Economic Development & Tourism is pleased to submit the enclosed comments on the Draft Supplemental Environmental Impact Statement for Lihi Lani.

The comments were provided by the Land Use Commission. Questions regarding these comments may be directed to Esther Ueda, LUC Executive Officer, at 587-3826.

Thank you for the opportunity to comment.

Sincerely,

for Mufi Hannemann

Enclosure
cc: Mr. Craig Yamagishi
Mr. Jeffrey H. Overton

JOHN WAIHEE
GOVERNOR

ESTHER UEDA
EXECUTIVE OFFICER

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone: 587-3822

October 15, 1993

SUBJECT: Director's Referral No. 93-296-E
Draft Supplemental Environmental Impact Statement (SEIS) for Lihi Lani, TMK Nos.: 5-9-05: 6, 38 (por.), 82; 5-9-06: 1, 18, 24, Pupukea and Paumalu, Koolauloa, Oahu, Hawaii

We have reviewed the subject draft SEIS for the Lihi Lani project and have the following comments:

1) We confirm that the 1,143.6-acre project site as depicted in figure 1-1 of the draft SEIS is located within the State Land Use Agricultural District.

2) We note that a portion of the project site, approximately 813.6 acres, was the subject of a district boundary amendment petition filed with the Land Use Commission under LUC Docket No. A88-629/Ohbayashi Hawaii Corporation. The uses proposed at that time included two golf courses, a clubhouse, driving range, equestrian ranch, tennis center, 160 one-acre market lots, a helipad, and hiking trails. The petition was subsequently withdrawn by Order dated February 28, 1989.

3) Based on page 3-1 of the draft SEIS, we understand that a petition for district boundary amendment in connection with that portion of the project composed of the wastewater reclamation facility, the single-family affordable housing, buffer area, elderly rental housing, and community facilities will be filed with the Commission in the near future.

4) We suggest that the Final SEIS include a map showing the project site in relation to the State Land Use Districts.

We have no other comments to offer at this time.

EU:BS:th

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Jeffrey H. Overton, AICP
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Jen-Chih "Jack" Lee, AIA
Michael A. Garni
Eric G. Crispin, AIA
Danilo M. Herrera

13 December 1993

State of Hawaii
Department of Business, Economic Development & Tourism
Land Use Commission
Room 104, Old Federal Building
335 Merchant Street
Honolulu, HI 96813

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI
Response to Comments on Draft Supplemental EIS**

Dear Sirs:

Thank you for providing your comments on the *Draft SEIS for Lihi Lani*. We have prepared responses to the issues you raised in your letter of October 15, 1993.

1) Confirmation of State Land Use District

We have noted your confirmation of the project site's State Land Use Agricultural designation.

2) State LU District Boundary Amendment Petition Withdrawal

We are confirming the withdrawal (dated Feb. 28, 1989) of a previous district boundary amendment petition filed with the Land Use Commission under LUC Docket No. A88-629/Ohbayashi Hawaii Corporation.

3) Future State LU District Boundary Amendment Petition

A new petition for district boundary amendment for that portion of the project composed of the wastewater reclamation facility, the single-family affordable housing, buffer area, elderly rental housing and community facilities was filed with the Commission on November 26, 1993.

4) State Land Use District Map

The Draft SEIS has included a map showing the project site in relation to the State Land Use Districts.

Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

JOHN WAIHEE
GOVERNOR

MAJOR GENERAL EDWARD V. RICHARDSON
DIRECTOR OF CIVIL DEFENSE

ROY C. PRICE, SR.
VICE DIRECTOR OF CIVIL DEFENSE

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE DIRECTOR OF CIVIL DEFENSE
3949 DIAMOND HEAD ROAD
HONOLULU, HAWAII 96816-4495

PHONE (808) 734-2161

November 18, 1993

RECEIVED
NOV 22 1993
GROUP 70

TO: Robin Foster
Chief Planning Officer
Planning Department
City and County of Honolulu

FROM: Roy C. Price, Sr.
Vice Director of Civil Defense

SUBJECT: LIHI LANI, AT PUPUKEA AND PAUMALU; DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (DSEIS)

We appreciate this opportunity to comment on the DSEIS by Group 70 International Inc., for Obayashi Hawaii Corporation, on the island of Oahu, Pupukea and Paumalu, Koolauloa District, Oahu, Hawaii; TMK 5-9-05: 6, Por 38, 82, and TMK 5-9-06: 1, 18, 24.

State Civil Defense (SCD) does not have negative comments specifically directed at the DSEIS. However, the proposed area is not covered by an existing siren warning device. We propose that a siren and siren support infrastructure be purchased and installed by the developer to help alert residents of an impending or actual event that threatens the area. This siren must be solar powered, have a minimum output of 121 DB and be compatible with the existing civil defense siren system. The proposed siren requires a 250-foot radius buffer zone in which there is no residential building as shown in "Figure 2-83, Water Reclamation Facility Site Plan." The suggested location for such a siren would be along the entry road to the "Lab/Control Building." The approximate siren coverage area is shown on the "Lihi Lani Master Plan"; also shown is the location of existing sirens in the area.

Section 4.0, page 4-1, "Assessment of the Existing Natural and Physical Environment, Potential Impacts and Mitigative Measures," paragraph 4.1, "Climate," subparagraph A, "Existing Conditions," addresses wind and rain. Paragraph 4.2, "Topography," subparagraph A, "Existing Conditions," addresses elevation and slope. With the elevation ranging from 20 feet to

850 feet above mean sea level and with slopes ranging from level/ moderately sloped to extremely rugged, very steep, jagged and rocky, further evaluation is warranted. The impact of these terrain features on tropical cyclone/hurricane force winds and the resulting amplification of such winds should be addressed. The results of the investigation could dictate the type of facility structures necessary to withstand the winds that could result from orographic amplification. Structures within the project area should be designed and constructed to resist the potentially destructive winds resulting at the project site. These structures could then be surveyed for use as public shelters. Additionally, the intermittent stream, Pakulena, should be evaluated along with Paumalu and Kalunawaikaala Streams as potential hazards during rainy periods.

Section 5.0, "Assessment of the Existing Human and Socio/Economic Environment Potential Impacts and Mitigative Measures," page 5-1, paragraph 5.11, "Public Infrastructure," subparagraph 5.11.5, "Roadways," subparagraph A, "Existing Conditions," addresses roadways in the project area. There appears to be a single primary road for ingress and egress into the project area. This road as well as the numerous direct connections and smaller local roads need to be evaluated for safe evacuation routes for the residents in the event emergency ingress or egress is required.

Section 2.0, "Project Description," page 2-1, paragraph 2.1, "Goals and Objectives of the Lihi-Lani Master Plan," subparagraph 2.1.3, "Affordable Housing, On-Site Affordable Rental Housing," describes units for residents at least 62 years old. These units should be evaluated for design and construction requirements for both flood and wind.

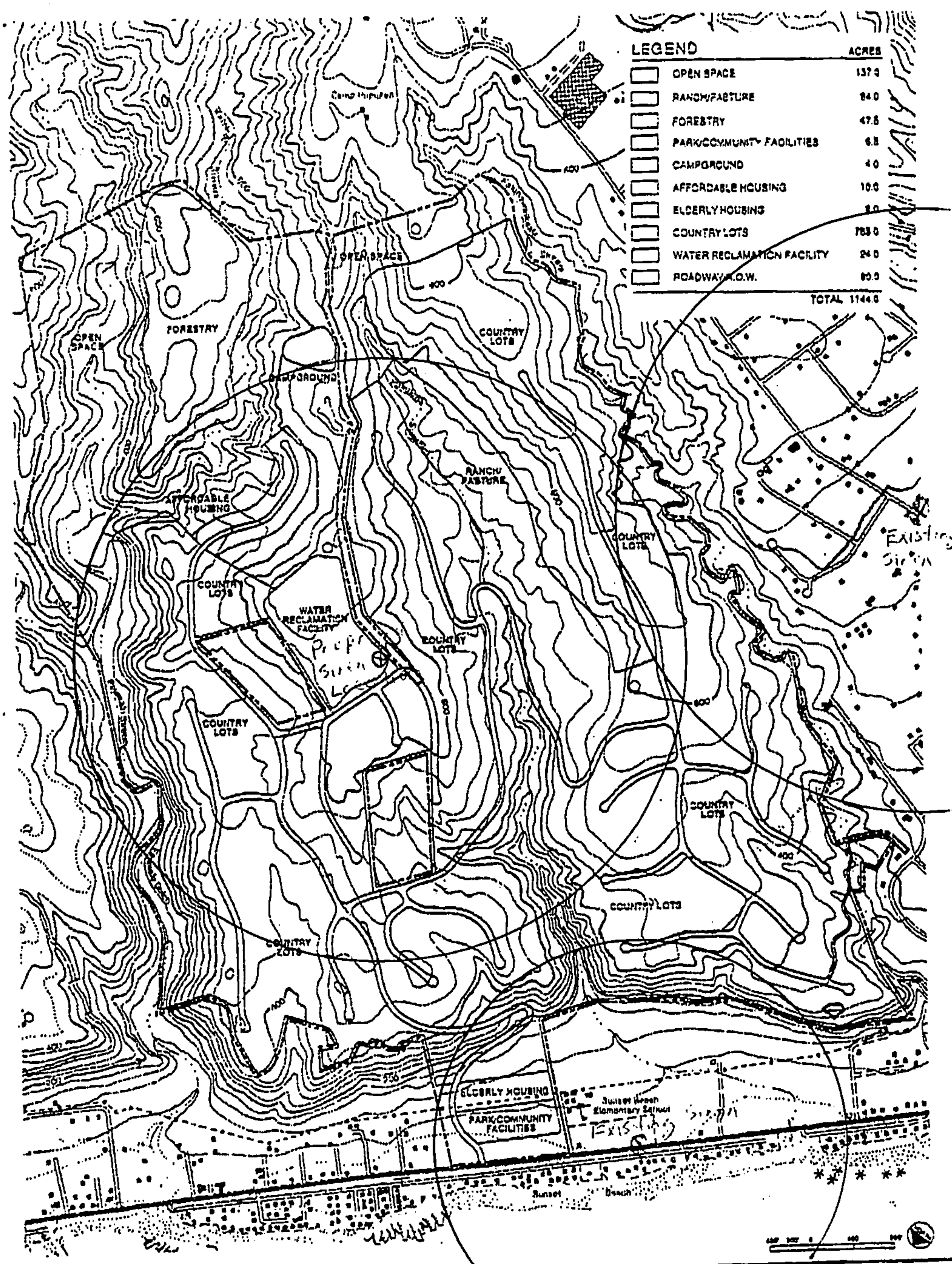
Our SCD planners and technicians are available to discuss this further if there is a requirement. Please have your staff call Mr. Mel Nishihara of my staff at 734-2161.

Enc.

c: Craig Yamagishi
Obayashi Hawaii Corporation

✓Jeffrey H. Overton
Group 70 International, Inc.

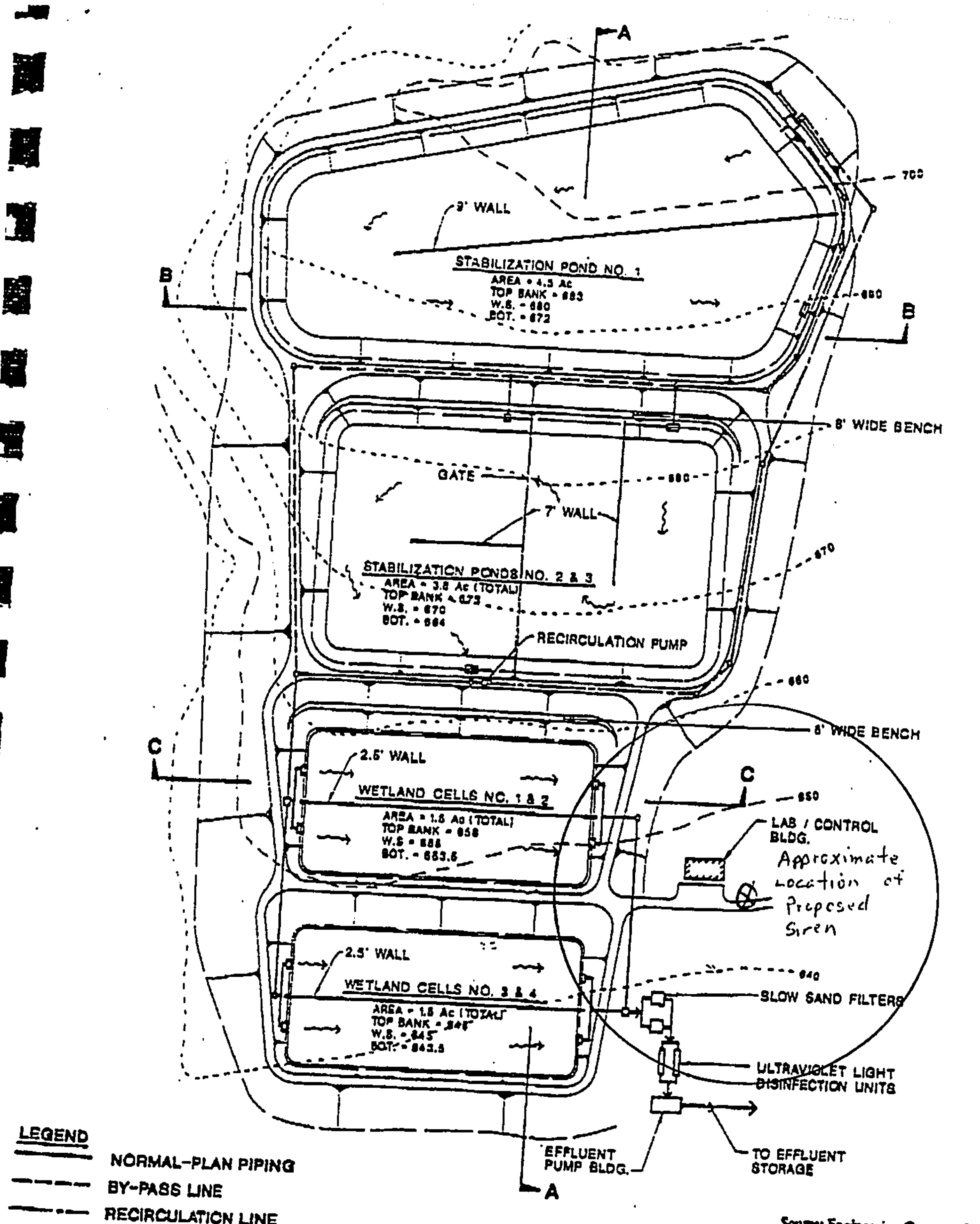
Office of Environmental Quality Control



LIHI LANI MASTER PLAN

Obayashi Hawaii Corporation

GROUP 70 INTERNATIONAL



Source: Engineering Concepts, Inc.

WATER RECLAMATION FACILITY SITE PLAN
LIHI LANI

FIGURE 2-8

GROUP 70

INTERNATIONAL

Francis S. Oda, AIA, AICP
Norman G.Y. Hong, AIA
Sheryl B. Seaman, AIA, ASID
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Jeffrey H. Overton, AICP
James I. Nishimoto, AIA
Jen-Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

13 December 1993

Mr. Roy C. Price Sr., Vice Director of Civil Defense
State of Hawaii
Department of Defense
Office of the Director of Civil Defense
3949 Diamond Head Road
Honolulu, HI, 96816

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Mr. Price:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of November 18, 1993.

1) Siren Warning Device

A siren and siren support infrastructure will be purchased and installed by Obayashi Hawaii Corporation to help alert residents of potential events that may threaten the area.

2) Wind/Flood Impacts

None of the projects are is currently indicated by FEMA Flood Hazard maps as being with in flood zones. However ongoing drainage studies for the project will further evaluate flood potential in the area as it relates to future developments. All sites and structures will be designed and constructed in conformance with the current building codes addressing wind/flood hazards. In addition the YWCA building construction is anticipated to be more resistant to destructive winds and would have the potential for use as a public shelter.

3) Evacuation Routes

The primary road in to the project as well as numerous direct connections to smaller local roads will be further evaluated as part of an overall evacuation program for residents in the event of an emergency. It is possible that emergency access for Pupukea residents could be provided through Lihi Lani.

4) Elderly Housing Construction Requirements

Affordable housing sites and buildings for the elderly will also be designed and constructed in conformance with the current building codes addressing wind/flood hazards.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

DEPARTMENT OF LAND UTILIZATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813 • (808) 523-4432

FRANK F. FASI
MAYOR

DONALD A. CLEGG
DIRECTOR

LORETTA K.C. CHEE
DEPUTY DIRECTOR

RECEIVED
NOV 23 1993

93-07987(JT)

November 22, 1993 GROUP 70

MEMORANDUM

TO: ROBIN FOSTER, CHIEF PLANNING OFFICER
PLANNING DEPARTMENT

FROM: DONALD A. CLEGG, DIRECTOR

SUBJECT: DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (SEIS) FOR LIHI LANI - PAUMALU & PUPUKEA, KOOLAULOA, OAHU
TAX MAP KEY: 5-9-05: 6, POR. 38, 82 AND
5-9-06: 1, 18, 24

Thank you for the opportunity to review and comment on the above referenced document.

The proposal includes dedication to the City of a 6-acre portion of the project site for the development of affordable elderly housing. A subdivision application will be necessary to subdivide the area to be dedicated to the City.

Should you have any questions, please contact Joan Takano of our staff at 527-5038.

Donald Clegg

DONALD A. CLEGG
Director of Land Utilization

DAC:ak
Enclosures
cc: Group 70 International, Inc.

G:deislihi.jht

GROUP 70
INTERNATIONAL

13 December 1993

Donald A. Clegg, Director of Land Utilization
City and County of Honolulu
Department of Land Utilization
650 South King Street
Honolulu, HI. 96813

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Mr. Clegg,

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of November 22, 1993.

The development proposal includes dedication of a 6-acre portion of the project site to the City for development of affordable elderly rental housing. Ohayashi Hawaii Corporation will be filing a Subdivision application as required, for dedication of this area to the City.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

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NOV 17 1993
GROUP 70

November 9, 1993

TO: ROBIN FOSTER, CHIEF PLANNING OFFICER
PLANNING DEPARTMENT

FROM: KAZU HAYASHIDA, MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

SUBJECT: APPLICATION FOR A NORTH SHORE DEVELOPMENT PLAN LAND USE AMENDMENT AND DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (SEIS) FOR THE LIHI LANI DEVELOPMENT PROJECT; TMK: 5-9-05: 6, POR. 38, 82 AND 5-9-06: 1, 18, AND 24; PUPUKEA AND PAUMALU

Thank you for the opportunity to review the Draft SEIS for the proposed Lihi Lani development project. We have the following comments:

1. Our previous comments of August 25, 1993 are still applicable and are included in Section 12.

2. The SEIS should provide justification for the decrease in the wastewater design quantity under the modified development plan. An increase in the number of residential units on-site should result in an increase in the wastewater volume.

3. We concur with the use of brackish and reclaimed water for irrigation with provisions for a groundwater quality monitoring program coordinated with the State Department of Health. The SEIS should address our requirement for the developer to make up any reduction in the sustainable yield of our Sunset Beach Well if pumping of the two on-site wells results in salinity intrusion, or percolation of irrigation water results in contamination of the underlying aquifer.

4. We reiterate that the developer is required to submit a water master plan for our review and approval. Estimated water requirements and proposed water facilities should be shown with supporting calculations for peak hour

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

Mr. Robin Foster
Page 2
November 9, 1993

pressures and fire flows at maximum day demand. A water source determination can be made after the water master plan is submitted. Water source development should be indicated as an unresolved issue in the SEIS.

If you have any questions, please contact Barry Usagawa at 527-5235.

cc: Group 70 International

GROUP 70
INTERNATIONAL

Francis S. Oda, AIA, AICP
Norman G.Y. Hong, AIA
Sheryl B. Seaman, AIA, ASID
Robert K.L. Wong, AIA
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Jeffrey H. Overton, AICP
James I. Nishimoto, AIA
Jen-Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

13 December 1993

Kazu Hayashida, Manager and Chief Engineer
City and County of Honolulu, Board of Water Supply
630 South Beretania Street
Honolulu, HI 96813

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI
Response to Comments on Draft Supplemental EIS**

Dear Mr. Hayashida,

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of November 9, 1993.

1) Response to August 25, 1993 Comments

A copy of our response letter to your August comments are included in Section 12 of the SEIS.

2) Decrease in Wastewater Design Quantity

The flows used in the 1991 Final EIS for residential wastewater generation were conservatively high at 600 gpd per unit. The 1993 assessment used a more accurate flow rate of 320 gpd per unit.

3) Sustainable yields

Provisions will be made for ongoing water quality monitoring in the area which will be coordinated with DOH along with monitoring of sustainable yield levels at the Sunset Beach Well. The developer will comply with DOH requirements should there be any reductions in sustainable yields or salinity intrusion into the well, resulting from the pumping of the two on-site wells or contamination of the underlying aquifer by percolation of irrigation water.

4) Water Master Plan

A Water Master Plan for the project will be submitted to the Board of Water Supply for review and approval. Estimated water requirements and proposed water facilities calculations for peak hour pressures and fire flows (max. day demand) will be provided. Water source development will continue to be studied for the project in order to make a final determination on this issue.

Group 70 International, Inc. Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

10/93 - 2354

DEPARTMENT OF PUBLIC WORKS

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

C. MICHAEL STREET
DIRECTOR AND CHIEF ENGINEER

KENNETH E. SPRAGUE
DEPUTY DIRECTOR

ENV 93-213

October 4, 1993

MEMORANDUM

TO: ROBIN FOSTER, CHIEF PLANNING OFFICER
DEPARTMENT OF PLANNING

FROM: C. MICHAEL STREET, DIRECTOR AND CHIEF ENGINEER

SUBJECT: DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (DSEIS), LIHI LANI
TMK: 5-9-05: 6, POR. 38, 82; 5-9-06:1, 18, 24

We have reviewed the subject DSEIS and have no additional comments to offer at this time.

Should you have any questions, please contact Mr. Alex Ho, Environmental Engineer, at Local 4150.

C. Michael Street

C. MICHAEL STREET
Director and Chief Engineer

RECEIVED
'93 OCT 6 AM 10:36
PLANNING DEPT.
C&C HONOLULU

DEPARTMENT OF PARKS AND RECREATION

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

RECEIVED
NOV 08 1993
GROUP 70

WALTER M. OZAWA
DIRECTOR

ALVIN K.C. AU
DEPUTY DIRECTOR

November 3, 1993

TO: ROBIN FOSTER, CHIEF PLANNING OFFICER
PLANNING DEPARTMENT

FROM: WALTER M. OZAWA, DIRECTOR

SUBJECT: DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (EIS)
FOR LIHI LANI
TAX MAP KEY 5-9-05: 6, POR. 38 & 82
TAX MAP KEY 5-9-06: 1, 18 & 24
PUPUKEA AND PAUMALU
KOOLAULOA, OAHU, HAWAII.

We have reviewed the draft supplemental EIS for the Lihi Lani development in Pupukea and offer the following comments and recommendations:

1. The development of residential units in the project will require compliance with Park Dedication Ordinance No. 4621. The requirements for complying with the ordinance are specified in the Park Dedication Rules and Regulations of the City and County of Honolulu.

2. Figure 2.6 shows an access road to the elderly housing going through the parking lots of Sunset Beach Elementary School and Sunset Beach Neighborhood Park. We are concerned about possible negative impacts this access road will have on public safety, parking and traffic flow through park land. This is not a City street, therefore, access to this development will not be permitted through our parking lot.

Thank you for the opportunity to comment on this proposal.

Robin Foster
Page 2
November 3, 1993

Should you have any questions about our review, please contact Bob Bevacqua of our Advance Planning Branch at extension 6316.

For WALTER M. OZAWA, Director

WMO:ei

cc: Obayashi Hawaii Corporation (Craig Yamagishi)
Group 70 International, Inc. (Jeffrey Overton)

GROUP 70
INTERNATIONAL

Francis S. Oda, AIA, AICP
Norman G.Y. Hong, AIA
Sheryl B. Seaman, AIA, ASID
Robert K.L. Wong, AIA
Hitoshi Hida, AIA
Roy H. Nihei, AIA, CSI

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Eric G. Crispin, AIA
Danilo M. Herrera

13 December 1993

Walter M. Ozawa, Director
City and County of Honolulu
Department of Parks and Recreation
650 South King Street
Honolulu, HI 96813

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Mr. Ozawa,

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of November 3, 1993.

1) Park Dedication

We understand that development of residential units in the project will require compliance with Park Dedication Ordinance No. 4621, and will meet these requirements as specified in the Park Dedication Rules and Regulations of the City and County of Honolulu.

2) Access Road through Sunset Beach Elementary School Parking Lot

The conceptual location of the access road (indicated in Figure 2-6) to the elderly housing passing through the parking lot of Sunset Beach Elementary School and Sunset Beach Neighborhood Park is not in response to a critical need. This route was proposed at one time by members of the community and school staff, and will be subject to further discussion and coordination.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

DEPARTMENT OF TRANSPORTATION SERVICES
CITY AND COUNTY OF HONOLULU
HONOLULU MUNICIPAL BUILDING
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

NOV 04 1993

JOSEPH M. MAGALDI, JR.
DIRECTOR

AMAR SAPPAL
DEPUTY DIRECTOR

TE-3915
PL93.1.387

November 1, 1993

MEMORANDUM

TO: ROBIN FOSTER, CHIEF PLANNING OFFICER
PLANNING DEPARTMENT

FROM: JOSEPH M. MAGALDI, JR., DIRECTOR

SUBJECT: LIHI LANI DEVELOPMENT - PAUMALU AND PUPUKEA
DRAFT SUPPLEMENTAL EIS
TMK: 5-9-5: 6, POR. 38, 82; 5-9-6: 1, 18, 24

This is in response to a letter from Group 70 International, Inc., dated October 1, 1993 requesting our comments on the subject development.

It is our understanding that the internal roadway system servicing this project will be privately owned and maintained. If this is the case, we have no objections to the proposed development at this time. Please note that a permit will be required from our department if there is a need to utilize a City maintained roadway by oversized/overweight vehicles.

Our comments to your office dated August 13, 1993 are also applicable to this submittal.

Should you have any questions, please contact Lance Watanabe of my staff at local 4199.

JOSEPH M. MAGALDI, JR.

cc: Group 70 International, Inc.

GROUP 70
INTERNATIONAL

Francis S. Oda, AIA, AICP
Norman G.Y. Hong, AIA
Sheryl B. Seaman, AIA, ASID
Robert K.L. Wong, AIA
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Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

13 December 1993

Joseph M. Magaldi, Jr., Director
City and County of Honolulu
Department of Transportation Services
650 South King Street
Honolulu, Hi. 96813

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Mr. Magaldi,

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of November 1, 1993.

1) Roadway System

As your department has previously noted, all internal roadways servicing this project will be privatelly owned, operated and maintained The project access road serving the YMCA and City's Elderly Housing will probably be dedicated to the City. The primary route to the project is Kamehameha Highway which is a State roadway. Should there be a need to utilize these roadways by oversized /overweight vehicles, the developer will coodinate with your department or the applicable authority for a permit.

Your previous comments of August 13, 1993 have been addressed in the SEIS.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

11/93-2667

DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 5TH FLOOR
HONOLULU, HAWAII 96813
PHONE: (808) 523-4427 • FAX: (808) 527-5498

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'93 NOV 26 AM 8:43
PLANNING DEPT.
C&C HONOLULU

FRANK F. FASI
MAYOR

E. JAMES TURSE
DIRECTOR

GAIL M. KAITO
DEPUTY DIRECTOR

November 23, 1993

MEMORANDUM

TO: ROBIN FOSTER, CHIEF PLANNING OFFICER
PLANNING DEPARTMENT

FROM: E. JAMES TURSE, DIRECTOR

SUBJECT: LIHI LANI PROJECT
DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (DSEIS)
PUPUKEA AND PAUMALU, KOOLAULOA, OAHU
TMK: 5-9-5: 6, POR. 38, 82 AND 5-9-6: 1, 18, 24

We have no comments to offer on the Draft Supplemental Environmental Impact Statement for the Lihi Lani Project located in Pupukea and Paumalu, Oahu.

We have reviewed the subject DSEIS and understand that the developer will provide up to 180 affordable housing units, which includes 50 on-site single family affordable homes built by Obayashi, land and infrastructure to the City to support development of 80 affordable elderly housing units on-site and monetary contribution to the City for development of up to 50 affordable units in the North Shore region.

The developer is currently in communication with the Department of Housing and Community Development regarding this project.

Should you have any questions, please contact Jason Ching of our Planning and Analysis Division at 523-4368.

Thank you for the opportunity to comment.

E. JAMES TURSE
Director

POLICE DEPARTMENT
CITY AND COUNTY OF HONOLULU
801 SOUTH BERETANIA STREET
HONOLULU, HAWAII 96813 · AREA CODE (808) 529-3111

FRANK F. FASI
MAYOR

MICHAEL S. NAKAMURA
CHIEF

HAROLD M. KAWASAKI
DEPUTY CHIEF

RECEIVED
NOV 18 1993
GROUP 70

OUR REFERENCE BS-LK

November 15, 1993

TO: ROBIN FOSTER, CHIEF PLANNING OFFICER
PLANNING DEPARTMENT

FROM: MICHAEL S. NAKAMURA, CHIEF OF POLICE
HONOLULU POLICE DEPARTMENT

SUBJECT: DRAFT SUPPLEMENTAL EIS FOR LIHI LANI, TMK 5-9-05: 6, POR. 38, 82 AND TMK 5-9-06: 1, 18, 24, PUPUKEA AND PAUMALU, KOOLAULOA, OAHU, HAWAII

This is in response to your request for comments on a draft supplemental environmental assessment for Lihi Lani.

The supplement requires no further comments from the Honolulu Police Department.

Thank you for the opportunity to review this document.

MICHAEL S. NAKAMURA
Chief of Police

By
EUGENE UEMURA
Assistant Chief of Police
Administrative Bureau

cc: OEQC
Obayashi Hawaii Corporation
Group 70 International, Inc.

FIRE DEPARTMENT

CITY AND COUNTY OF HONOLULU

3375 KOAPAKA STREET, SUITE H425
HONOLULU, HAWAII 96819-1869

FRANK F. FASI
MAYOR

RECEIVED
OCT 1 2 1993
GROUP 70

DONALD S.M. CHANG
FIRE CHIEF

RICHARD R. SETO-MOOK
DEPUTY FIRE CHIEF

October 11, 1993

TO: ROBIN FOSTER, CHIEF PLANNING OFFICER
PLANNING DEPARTMENT

FROM: DONALD S. M. CHANG, FIRE CHIEF

SUBJECT: DRAFT SUPPLEMENTAL EIS FOR LIHI LANI, TMK 5-9-05: 6, POR. 38, 82 AND TMK 5-9-06: 1, 18, 24, PUPUKEA AND PAŪMALU, KOOLAULOA, OAHU, HAWAII

We have reviewed the subject material provided and have no additional comments to those made in our letter dated October 1, 1993.

Should you have any questions, please call Assistant Chief Attilio Leonardi of our Administrative Services Bureau at 831-7775.

DONALD S. M. CHANG
Fire Chief

AKL:ny

Copy to: Obayashi Hawaii Corp.
Group 70 International Inc.
Office of Environmental Quality Control w/EIS Draft

FIRE DEPARTMENT

CITY AND COUNTY OF HONOLULU

3375 KOAPAKA STREET, SUITE H425
HONOLULU, HAWAII 96819-1869

FRANK F. FASI
MAYOR

DONALD S.M. CHANG
FIRE CHIEF

RICHARD R. SETO-MOOK
DEPUTY FIRE CHIEF

October 1, 1993

TO: ROBIN FOSTER, CHIEF PLANNING OFFICER
PLANNING DEPARTMENT

FROM: RICHARD R. SETO-MOOK, ACTING FIRE CHIEF

SUBJECT: APPLICATION FOR A NORTH SHORE DEVELOPMENT PLAN LAND USE AMENDMENT AND A SUPPLEMENTAL EIS FOR LIHI LANI, TMK 5-9-05: 6, POR. 38, 82, AND TMK 5-9-06: 1, 18, 4, PUPUKEA AND PAUMALU, KOOLAULOA, OAHU, HAWAII

On September 3, 1993 the Honolulu Fire Department met with members of Group 70 to discuss our concern on the above proposed project. The fire department wished to stress the fact that due to the size of this project and the topography of the proposed roads, we have strong concerns that our response time will be delayed.

The entrance road to the project will be of a very steep grade, as well as a few of the interior roads. This will in turn severely delay our response times to the interior of the project as well as our response time, if necessary, out of the project.

These concerns were conveyed to the developer, we also requested to review the final plans when they are completed.

The Sunset Beach Fire Station is located approximately 1.3 miles from the project entrance, second-in fire company will come from Kahuku which is located approximately 8 miles from the entrance.

Should you have any questions, please call Assistant Chief Attilio K. Leonardi at 831-7775.

Richard R. Seto-Mook

RICHARD R. SETO-MOOK
Acting Fire Chief

AKL:lm

GROUP 70
INTERNATIONAL

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Norman G.Y. Hong, AIA
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James I. Nishimoto, AIA
Jen-Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

13 December 1993

City and County of Honolulu
Fire Department
Richard R. Seto-Mook, Acting Fire Chief
3375 Koapaka Street, Suite H425
Honolulu, HI 96819-1869

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Mr. Seto-Mook,

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of October 1, 1993.

1) Response Time

Based on a meeting held with Assistant Chief Leonardi and Battalion Chief Nojiri on 3 September 1993, the project will have a small impact on Fire Department services. Response times for fire calls at the mauka portion of the project will be delayed slightly by the travel distance from the project entrance. The project is not anticipated to cause the need for additional fire equipment or station facilities, according to your officials.

2) Final Plans

Access for fire apparatus, water supply and building construction will be designed in conformance to all City and County codes and standards. Additionally, at the request of the State DLNR Division of Forestry and Wildlife, Obayashi will prepare a separate fire suppression plan to describe the proposed fire suppression access ways. Mitigative measures to this affect are included in the SEIS.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton
Jeffrey H. Overton, AICP
Chief Environmental Planner

Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

PLANNING DEPARTMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

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CHIEF PLANNING OFFICER

ROLAND D. LIBBY, JR.
DEPUTY CHIEF PLANNING OFFICER

RECEIVED
NOV 12 1993
GROUP 70

MM 10/93-2336

November 8, 1993

Mr. Jeffrey Overton
Group 70 International, Inc.
924 Bethel Street
Honolulu, Hawaii 96813

Dear Mr. Overton:

Draft Supplemental Environmental Impact Statement
Lihi Lani Development
TMKs: 5-9-5: 6, por. 38, 82 and 5-9-6: 1, 8, 18, 24

We have reviewed the subject Draft Supplemental Environmental Impact Statement (SEIS) and offer the following comments:

1. In response to our previous comments regarding the visibility of country lot homes from Kamehameha Highway, the Draft SEIS indicates that adverse visual effects will be controlled through siting and design guidelines. The SEIS should stipulate the parameters for the types of guidelines that are mentioned (e.g., give the range of building setback dimensions from the edge of bluffs) and how this would ensure the visual integrity of the bluff. Moreover, the SEIS should explain the means by which owners would be compelled to respect the guidelines proposed. Also, as previously requested, the SEIS should include "before" and "after" visual representations of the view from Kamehameha Highway.

2. Section 4.3 of the Draft SEIS addressed soils in terms of agricultural viability. The SEIS should also address soils in terms of suitability for residential buildings which are projected for residential and country zoned lots. The soils on site should be described and quantified in terms of slope, permeability, runoff and erosion hazard.

3. The extent of cut and fill for the project should be estimated. Although Figures 5-8 C to E are intended to

be conceptual, discussion should be included on the height of cuts and the depth of benches or terraces as shown. In addition, it should be further explained how the proposed extensive landscaping will be established on the rock faces.

4. We question whether the wastewater treatment proposed will be of adequate quality to permit the effluent to be reused. Given the high percolation of the soils and the fact that BWS wells are down-slope of the site, the SEIS should address the recommendation of the Department of Health that ". . . field data should be collected for verification of the suitability of effluent application."

5. The storm drainage plan includes tables showing soil erosion potential before and after development. The plan should also include a table showing soil erosion during development.

6. The market assessment estimates 80 to 85% of the lot buyers would be from Oahu. Of this total, how many would be for primary residences and how many would be for vacation use?

7. The SEIS should elaborate on the claim on page 8-8 that an ". . . agricultural subdivision would create greater adverse impacts than the proposed project. It would be expected to create comparably greater population, traffic, wastewater, water use, vegetation clearing, grading and runoff."

Should you have any questions, please contact Mel Murakami of our staff at 527-6020.

Sincerely,

ROBIN FOSTER
Chief Planning Officer

RF:js

cc: Office of Environmental Quality Control
Obayashi Hawaii Corporation

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Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

13 December 1993

Robin Foster, Chief Planning Officer
Planning Department
City and County of Honolulu
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Mr. Foster:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of 8 November 1993.

1) Visual Integrity of Bluff

Existing conditions at the property are shown in a series of photographs in the Draft SEIS. The Draft SEIS also includes a visual impact exhibit that shows the existing view of the property in a photograph, with a simulation of new homes shown overlaid on the photograph. The intent of the exhibit is that the existing vegetation growing on the hillside makai of the new homes constructed on the bluff lots will mostly shield views of these homes from makai locations such as Kamehameha Highway. Partial views of homes will still occur, but homes will not be perched on the bluff edge in full view from makai locations. The exhibit shows the trees intersecting the line of sight from makai locations.

Your comment requested additional information regarding the parameters to be followed in limiting the visual impact of homes along the bluff. Each of the individual lot owners at Lihi Lani will be restricted from activities and uses on their properties by the Code of Covenants and Restrictions (CCR). The CCR will identify general restrictions applicable to all properties, and specific limits on individual lots. The CCR's specific limits on bluff lots will limit the amount of clearing along the bluff edge and sloped land on the bluff face. As well, the CCR will also specify the distance for setback from the bluff edge, as applicable for different lots. The CCR will be strictly enforced by the Lihi Lani Homeowner's Association.

Each of the lots has individual characteristics that will differ in their off-site view potential, therefore, setbacks cannot be uniformly established across all bluff lots. At this time, the lots lines have not been set, and Obayashi is considering several potential configurations for the 315 lots. Obayashi is unable to provide a specific range in setback distances, because individual lots have not been studied at this "design level" of analysis. For the subdivision review process, the lot lines will be set, and the CCR will be completed and individual lots will have setbacks determined.

Before and after visual representations are included in the Draft SEIS. Section 5.5 of the Draft SEIS includes photographs of the property (Figure 5-6 A through E) from makai viewpoints, that shows existing views of the bluff area. Figure 5-7 and 5-7A show the view study section and an image of potential bluff lot homes overlaid on the existing photograph of one bluff area. This figure shows screening effect of the existing vegetation which occurs on the bluff slope. For the most part, homes located on bluff lots will be shielded by this vegetation. However, some portions of homes, such as roof forms. may be visible from makai locations. The CCR will dictate the limits of home siting to minimize views from makai locations, the design guidelines will limit the types of materials and colors allowed for homes at Lihi Lani. All of these measures combined will serve to minimize views of these homes from makai locations, and preserve the visual integrity of the bluff.

2) Soils

A table showing soils engineering properties for soils located on the property site will be included in the Final SEIS. The stability of soils in the areas planned for Country lots will not prohibit the development of properly designed homes and supporting roads and utilities. Some areas on the site are better than others in terms of foundation properties. Obayashi will prohibit the construction of homes on the steep sides of the pali or internal hillsides through the CCR provisions.

3) Construction Requirements

Grading at Lihi Lani will be for portions of the house lots and for the roadways, and a few single facilities (i.e. horse ranch facility and YMCA). There will be very selective grading, and the grading activities will be limited to the minimum extent possible.

The extent of cut and fill for the project has not been estimated because detailed design and resulting earthwork calculations will be completed as part of the project design process. Design for a project is not normally completed at the land use reclassification stage. Due to the substantial up-front commitment of time and cost for a developer to complete the project design process, it is first necessary to have all the required land use approvals granted.

The cut and fill for the previous golf course project involved over one million cubic yards of cut and fill alone in that area of the site. It is estimated that development of the current plan will require substantially less cut and fill in the same area to construct the affordable homes and Country lots.

It is currently planned for the roadway to have bench cuts of 15 feet in height and 8 feet in depth on the terrace. Multiple bench cuts will be required in places depending on the depth of cut. Each of the terraces will be planted with ironwood trees, which are known to grow rapidly. The ironwoods will rapidly grow to cover the exposed rock face in the bench cuts, estimated at 5 years to fairly dense coverage. Rock faces are not planned to be revegetated, however, several types of rock-climbing, flowering vines could be planted in these areas.

4) Wastewater Treatment

The suitablility of the reclaimed water produced by the Lihi Lani WRF is addressed in the reports by Engineering Concepts, Inc. (Appendix C), ITC Water Management (Appendix E), and Tom Nance Water Resource Engineering (Appendix H). Groundwater quality at the BWS Sunset Beach wells is not anticipated to be adversely affected by the land application of reclaimed water. The application of reclaimed water will be in conformance with State of Hawaii Department of Health guidelines for reclaimed water reuse (Draft No. 8, September 20, 1993). In addition, the BWS Sunset Beach wells have not been used since 1983. Potable water is provided to the Sunset Beach area from BWS wells at Wailee.

5) Soil Erosion During Construction

For the construction phase, the Universal Soil Loss Equation (USLE) was used to estimate average annual soil loss based on six predictive parameter values. Four of these parameters will be altered by development; the other two are meteorological and soil properties that will remain the same. The USLE result should be viewed only as a relative indication of sedimentation. It is not an evaluation of specific storm events.

6) Primary and Vacation Residences

The Country lots at Lihi Lani will mostly be primary residences. The market study estimates that approximately 75 percent of the Country lots will be second homes or vacation homes. The percentage of Country lots predicted to be second homes was increase from the previous project (with golf course) where the estimated number of second homes was 50 percent.

7) Agricultural Subdivision

The use of the site as an agricultural subdivision could potentially have more impacts than the proposed project if it included up to 500 2-acre lots in a less managed setting than is proposed for Lihi Lani. With 55 more homes, there would be more population and traffic than the current project. With more residents there would be more water used and wastewater generated. The amount of vegetation loss would be greater because of the need to clear most lot areas in an effort to maximize farming area to achieve agricultural viability. As a result of the larger cleared area, and lack of an extensive drainage detention (the currently planned project has more detention than required), the agricultural subdivision would result in more stormwater runoff and more erosion.

Your comments mainly reflected issues regarding the analysis of the agricultural subdivision alternative. We believe our analysis of the agricultural alternative (Section 8.2) was accurate.

With respect to the issue of the possibility for developing Lihi Lani without a change of zone, this has been something that has been considered for many years. This potential use of the property was considered in the accepted Final EIS (Group 70, April 1991) and the Draft SEIS (Group 70, September 1993). The Draft SEIS presents and evaluates an alternative plan for the project which involves an agricultural subdivision at the existing AG-2 General Agricultural District zoning. The agricultural subdivision analysis in the Draft SEIS assumes that the rules for approval of an agricultural subdivision would be satisfied in an application for up to 500 2-acre (minimum size) lots. Following the Neighborhood Board 27 meeting on November 9, we have reconsidered some of our analysis and find that even a strained attempt to come up with a feasible agricultural alternative is not realistic. We present these findings below.

Upon further analysis, the agricultural subdivision rules would probably be very difficult to satisfy at Lihi Lani. The most challenging requirement for an agricultural subdivision, as per the Land Use Ordinance, is the need to demonstrate financially viable agricultural use of each lot. The State Department of Agriculture is very strict about enforcing this, and is becoming more strict due to past abuses of the agricultural subdivision approval. It would also be very hard to comply (probably impossible) due to the marginal productivity potential of the soils at Lihi Lani. Obayashi could have pursued an agricultural subdivision of two-acre lots if there was a larger presence of prime agricultural soils of their land. Instead, Obayashi is proposing the minimum possible zoning change to achieve successful diversified agricultural activities. At the Country lots of Lihi Lani, agricultural uses are intended to gain revenues to help offset association maintenance fees.

To establish financially viable agricultural use of the 2-acre lots, the farming use would need to offset the cost of the individual lots. For these lots under the current Pupukea market, this would range from $285,000 to $550,000. Agricultural uses on these lots would need to produce net revenues of $20,000 to $40,000 per year, respectively, to offset costs for land payments, real property tax, insurance, utilities and association maintenance fees. The real limitation to economic viability is attributable to the marginal agricultural soils found on this property. Only 162 acres of B-rated soils (prime soils under the LSB rating system) are found on the Lihi Lani site, and these are in numerous isolated areas which makes it difficult to establish a viable agricultural subdivision of 2-acre farm lots. It is also unlikely that several hundred individual small farming businesses at this one location could be justified in the Oahu marketplace.

There are several other points which discourage establishment of an agricultural subdivision at Lihi Lani as mentioned briefly below:

- There are limited amounts of contiguous prime agricultural soils, with only 162 acre of B-rated soils under the LSB rating system, scattered in numerous locations. Our planners estimate that somewhere between 80 to 120 two-acre agricultural lots could be established using reasonably good rated agricultural land. This number of lots would not be viable for Lihi Lani due to the significant infrastructure costs (roads, sewers, water system, water reclamation facility, etc.) estimated at over $93 million.

- The project would lack community benefits because of reduced revenues and no City requirements for such. Because there would be no change in zoning, there would be no requirement from the City for affordable housing to be provided. There probably could be no use of the makai land for the YMCA or Elderly Housing, because there likely would be a need for agricultural storage and processing facilities to be situated near the transportation corridor of Kamehameha Highway.

The alternatives analysis in the Final SEIS for Lihi Lani has been revised to reflect our recent understanding of the limitations to creating an agricultural subdivision on lands with marginal agricultural productivity potential.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

NORTH SHORE NEIGHBORHOOD BOARD NO. 27

P.O. BOX 607 • HALEIWA, HAWAII 96712

November 29, 1993

Mr. Robin Foster, Chief Planning Officer
Planning Department
Honolulu Hale
650 South King Street
Honolulu, Hawaii 96813

Re: Lihi Lani Ranch Supplemental Environmental Impact Statement

Dear Mr. Foster,

This is to inform you that North Shore Neighborhood Board #27 held on November 9 a special informational meeting on the cited draft supplemental environmental impact statement submitted by Obayashi Hawaii.

About 60 people attended the meeting and asked a great many questions concerning the draft. It was apparent through the course of the evening that the questioners had studied the document and were well informed on its contents. They raised a number of issues which they felt should be clarified or more fully considered in the SEIS. Meeting minutes are enclosed.

Because our regular board meeting was not held until after the period designated for submitting comments on the draft, we were unable to respond officially. However, we note that the comments submitted by the Sunset Beach Community Association are based in large part on points brought out in the discussion at our informational meeting. We feel that the concerns expressed by the SBCA, whose members are those who will be most directly affected by the project, should be addressed in the final SEIS and not left unresolved.

We appreciate your careful attention to this matter.

Sincerely yours,

James L. Awai, Jr.

James Awai, Jr.
Chairman

CC: Sunset Beach Community Association
Craig Yamagishi, Obayashi Hawaii

GROUP 70
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Jen-Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

13 December 1993

Mr. James Awai, Jr., Chairman
North Shore Neighborhood Board No. 27
P. O. Box 607
Haleiwa, HI 96712

Subject: Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI
Response to Comments on Draft Supplemental EIS

Dear Mr. Awai:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of 29 November 1993.

Obayashi appreciated the opportunity to attend the Special Meeting of the Neighborhood Board on November 9, 1993 at the Haleiwa Elementary School. The meeting provided the community a chance to raise questions on the Draft SEIS for Lihi Lani, and also provided Obayashi a chance to respond directly to specific areas of interest regarding the proposed project.

In response to the issues raised at the meeting, Obayashi completed an 18-page document which addresses various issues, and elaborates on the responses offered at the Special Meeting. This document was provided to Neighborhood Board members at your regular meeting of November 23, 1993, and a copy is also attached with this letter.

Once again, thank you for holding the Special Meeting. We believe the meeting and our follow-up documentation has helped to complete a very thorough Final SEIS for the project.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton, AICP
Chief Environmental Planner

Responses to Questions and Comments Raised at the 11/09/93 Neighborhood Board No. 27 Special Meeting on Lihi Lani Draft SEIS

The purpose of the Neighborhood Board 27 Special Meeting was to comment on issues addressed in the Draft Supplemental Environmental Impact Statement (Draft SEIS). These discussions were held over several hours, and this interaction was part of the on-going community-based planning process for Lihi Lani. We consider any conclusions stated at this meeting on the acceptance of the overall project to be premature, since the project is in the Draft SEIS process at this time. Many issues were clarified at this meeting and updated information will be presented in the Final SEIS.

This document presents the individual questions and comments raised at the NB 27 special meeting, paraphrased and restated to summarize the individual question or comment. A summary of the responses offered by Obayashi representatives at the meeting are restated following each question or comment. A follow-up discussion is presented in most cases, where further analysis of the question and supporting information is warranted.

1) Peter Cole: Mr. Cole feels the phasing plan is misleading. He believes there is no guarantee that critical areas along the bluff will be controlled in regard to soil erosion, flooding and runoff, since 70 percent of the land is steep. There is a special concern about the Kahuku-side lots on Paumalu Gulch. A concern is the elimination of trees for better views causing erosion. He is not satisfied with Appendices F, H and I of the EIS. He is concerned about the issue of drainage and flooding.

Response: At the Subdivision application design and review level, individual lots will be designed for setbacks and land clearing limitations. This must be addressed on a lot by lot basis. A blanket condition for setback distance for all of the bluff lots cannot be fairly established due to varying conditions of slope and vegetation on different lots. Conditions will be established to limit clearing along the bluff edge. No-build and no-clear zones will be established on all lots with steep slopes.

Discussion: There will be vegetation clearing at the bluff lots to establish view channels. The clearing will be limited by restrictions on individual lots. The Visual Resources discussion in Section 5.5 of the Draft EIS addresses this concern.

As for the studies of drainage (Appendix F), water quality (Appendix H) and ocean water (Appendix I), these studies fully address the potential impacts of Lihi Lani. The project includes the following aspects: (1) integrated construction and long-term erosion controls, (2) more than four times the EPA-required drainage controls during construction, (3) runoff from the completed project will be equal to or less than existing conditions, and (4) silt runoff from the completed project will be 20% less than existing conditions. The studies show that drainage and flooding conditions will not be worsened as a result of the project, and that flooding conditions could improve slightly. In addition, the studies show there will be no significant effects on groundwater or ocean water quality as a result of the project.

2) Stuart Ring: Referring to slides 1 and 2 from the presentation by Craig Yamagishi, Mr. Ring noted that the quotations are not accurate.

Response: When the slide was made in May 1993, the quotations were taken from the current draft of the Task Force subcommittee report. The report was subsequently changed, and the quotations in the slides will be changed.

3) Larry McElheney: He presented the final Task Force report (October 1993) version of the statements quoted in the OHC slide show. He also presented a definition of the word pristine, and stated that 315 new homes would not keep the area pristine.

Response: Thank you for your comments.

Discussion: The quotation from the Draft Task Force Report was addressed under item 2). Mr. McElheney's comments regarding the pristine nature of the North Shore point to an important value. We believe that Lihi Lani has been planned to fit with and support North Shore values, including: low residential density; scenic views of the pali and the ocean; a clean environment, with clean ocean water; a relatively uncrowded setting (beaches, mauka trails, shopping, roads, etc.); a wide range of recreational opportunities; and use of land for diversified agriculture.

These common values of the quality of living and the environment on the North Shore will not be compromised by Lihi Lani, and likely will be enhanced. The project will be entirely compatible from a residential density perspective, being only 58 percent as dense as is Pupukea Highlands. This low density plan allows for extensive open space areas, with new hiking and horse riding trails for all of the North Shore community to enjoy.

Unlike the surrounding Sunset Beach and Pupukea community which utilizes individual cesspools or septic tanks with leach fields to treat wastewater, Lihi Lani will collect and treat all of its wastewater. Treatment to the highest level will allow the reclaimed water to be reused for agricultural irrigation, the most environmentally sensitive manner of disposal. The ocean water quality will not be adversely affected by the project due to the sophisticated water reclamation system, and the very extensive drainage and erosion controls. Actually, 20 percent less silt will enter the ocean with Lihi Lani built as compared to existing conditions.

People at Lihi Lani will add to the North Shore's traffic and population, but they will account for only part of the growth that's likely to occur. Because of its very low density, preserved open space, environmental controls, Lihi Lani represents everything that current North Shore residents consider pristine about their area.

4) Steve Poor: Mr. Poor asked for the position of two archaeological sites (T-13 and T-70) to be identified on the project site. He claimed that both T-13 and T-70 would be destroyed by the project, and recommended that the sites be "preserved as is". Mr. Poor believes the access road will destroy the petroglyphs and other features at sites T-13 and T-70, so he recommends moving the road. He also commented about drainage along the access road and lowlands flooding.

Response: The site T-13 represents an agricultural complex and T-70 represents a series of petroglyphs and a small cave. Only site T-13 would be partially affected by the project. access roadway. Site T-70 would not be affected. The Lihi Lani access roadway will be designed to current standards which require drainage controls to avoid runoff problems such as experienced on Pupukea Road, which was built several decades ago.

Discussion: The response offered at the meeting should be clarified as follows below. Mr. Poor has been interested in the preservation of archaeological sites at Lihi Lani since the inception of project planning in 1988. Through his work in attending site visits and communicating with the professional archaeologists from Paul H. Rosendahl, Ph.D., Inc., Mr. Poor has made significant contributions to the community's understanding of the features existing at Lihi Lani. His particular concern has been the preservation of rock art features known as petroglyphs.

Site T-70 is a complex of burials, temporary habitation and rock art, and this site will not be affected by the project access road and will be preserved as is. Site T-13 may possibly be partially affected by the access road construction and the elderly housing project. If affected by either the road or the housing, the extent of effect will be limited to as much as 20 to 30 percent of the site. Site T-13 is a former habitation and agricultural complex that extends over parts of about a one acre area in the makai part of the project site. The site has been affected substantially by historical period disturbances. One boulder in the complex was initially thought by the archaeologists to contain a very faint petroglyph. However, upon a return site visit by the archaeologist and community members (including Mr. Poor) no petroglyph could be identified on the same boulder. The subject boulder is located in the southern portion of the site complex, well outside of the potential area of disturbance from either the road or housing.

The preservation and data recovery mitigation of archaeological sites at Lihi Lani has been given the highest attention in project planning. Whenever possible, significant sites have been avoided. In the few situations where sites cannot be avoided, the archaeologists have proposed mitigation measures such as data recovery. The treatment of archaeological sites will proceed according to the recommendations of the Department of Land and Natural Resources, Historic Preservation Division.

Regarding the comment about the drainage along the new access roadway, the access road would be designed with a properly sized drainage channel along the route. Detention basins located above the bluff and in the lower parcel would also be sized to accommodate peak runoff events. There will be six acre-feet of storage in the lowland basins. The comparison of the planned Lihi Lani access road with Pupukea Road is not valid since Pupukea Road was designed and built over 30 years ago when roadway and drainage design standards were not as strict as today's requirements. The Lihi Lani access roadway will be much safer to transit than Pupukea Road, and the site and roadway will have drainage features which will control runoff during large storm events.

5) **David Lavarius:** Mr. Lavarius asked about the traffic impact of the project with consideration of the Haleiwa By-Pass and the need for a traffic signal at the Lihi Lani access road intersection.

Response: The Haleiwa By-Pass is designed to handle anticipated future traffic volumes and Lihi Lani will likely have little effect on its operation. The traffic impact of the project at full build-out was estimated to be 5 to 8 percent of the highway traffic. Actual traffic contribution will be only 3 to 5 percent by 2008, since the Country lots will be only 65 percent built-out. The most noticeable effect will be in Phase 1, with a rapid increase in vehicle traffic associated with the affordable housing and elderly housing. These homes are planned to be 100 percent occupied by the end of Phase 1.

6) **Bob Leinau:** Mr. Leinau asked a number of questions as listed below. He estimates that Lihi Lani will bring 900 to 1,000 people to the area, which is 20% of Pupukea. Who are these people going to be? He would like to see an itemized list of costs associated with ongoing expenses of Lihi Lani, such as wastewater treatment, liability insurance for the trails, road maintenance, etc. What will be the costs to the homeowners? What will Obayashi do with the vacant portions of the property? Who will be paying the bills for the property once Obayashi has sold its lots? Will Obayashi have a long-term interest in holding portions of the land?

Response: The projected market for the Country lots is 80 to 85 percent Oahu and Hawaii residents, with 15 to 20 percent from the U.S. mainland or foreign residents. Actual population of Lihi Lani by 2008 is projected to be less than 700 residents, with full build-out and occupancy by an estimated 977 people 10 to 20 years later. Costs for the Homeowner Association fees which are used to maintain the wastewater system, roads, etc. will amount to approximately $200 to 250 per month. This rate is somewhat higher than the association rate for Kuilima Estates, which is approximately $175 per month.

Obayashi is working with the State Department of Agriculture and several expert consultants to develop agricultural uses of the property. Agricultural uses on Country lots will generate revenues to help offset association fees.

Obayashi has been working with the State Department of Land and Natural Resources, Division of Forestry and Wildlife, to develop a master agreement which relieves Obayashi of liability for public use of their land for hiking, horse riding and mountain bike riding. The issue of long-term ownership of non-developed areas by Obayashi has not yet been decided. The ranch, agroforestry, campground and open space areas will remain in Obayashi ownership for the short-term, and may possibly be turned over to the Homeowners Association at a later point.

Discussion: Population issues are addressed under Item 17).

6) **Susan Fujioka:** Ms. Fujioka wanted further clarification of the "white areas" (undeveloped land) shown on the Lihi Lani Master Plan and Phasing Plan.

Response: The two white areas shown on the Lihi Lani Master Plan are State-owned parcels shown as water reserves on historical maps. These lands are currently vacant wooded parcels with steep slopes. The State has mentioned no plans for these lands, and Obayashi is discussing their possible acquisition. Lands shown in white on the phasing plan are generally outside development areas on the property, much of which is steep land within the Country lots which cannot be built upon. This would remain within the Country zoned area as privately-owned open space land. Obayashi may retain ownership of the open space areas outside the lots, or it may be transferred to the Homeowners Association.

7) **Lucky Cole:** Mr. Cole questioned whether the areas outside development areas ("white areas") would be zoned for conservation. He also questioned the commitment of Obayashi to follow-through with its plans and benefits to the community given that Group 70 and Quon•Yamagishi were consultants for Kuilima as well as Lihi Lani. Specifically, he mentioned that the park at Kawela Bay has yet to be developed. He also asked where was Prudential these days, giving it as an example of owners who gained approvals for the Resort and sold the project to others. Mr. Cole also questioned whether the traffic study included the Kuilima Resort expansion traffic.

Response: The undeveloped areas on the phasing plan would either be zoned Country or Agriculture and there are no plans for creating conservation district lands. Regarding the issue of commitment, Obayashi has demonstrated its commitment by holding the land since 1974. Obayashi Hawaii Corporation has been in Hawaii for over 25 years, and Obayashi Corporation has assets of $21 billion.

The issue of the Kuilima Resort project not moving ahead, especially its commitment to provide a public park at Kawela Bay, has to do with the failure to complete the first hotel at Kawela Bay. The Unilateral Agreement called for completion of the park by the first hotel opening. The park could not be opened until after the hotel was finished construction due to potential liability and public safety concerns.

For the traffic study, future planned and approved developments in the North Shore area were addressed in the Draft EIS. The planned Kuilima Resort expansion was included in the study.

Also in response to the issue of commitment and future economic strength of Obayashi, the issue of the article in Far Eastern Economic News was discussed. This article reported that Obayashi was pulling out of California and taking a $300 million loss. This article was not entirely accurate, in that Obayashi Corporation in Japan purchased an office building project from its California subsidiary. This action enabled Obayashi Corporation to write off the loss in Japan. Obayashi America maintains approximately 25 active properties and projects in California. This action demonstrates the economic strength of Obayashi to handle such a loss.

Discussion: To clarify part of the response, the undeveloped portions of the property would remain in the zoning categories currently planned for Lihi Lani, which include Country, AG-2 Agriculture, and P-2 Preservation. The P-2 Preservation areas would be for the mauka portions of the project, including the agroforestry and open space areas. Conservation is not a zoning category in the City and County of Honolulu. There is a State Conservation District which the City zones as P-1 but has no regulatory authority over. Obayashi will not be changing any of its land to State Conservation District designation.

8) **Ken Newfield:** The traffic analysis does not properly address the future traffic conditions because the 0.8 percent growth rate (as calculated by the DBEDT) is used for the community instead of the 2.5 percent annual growth rate shown for the Sunset Beach-Pupukea area. The actual future traffic conditions in the primary study area (Sunset-Pupukea) which is the background against which Lihi Lani's traffic should be added to, was significantly underestimated.

(Ben Hopkins interrupted the question and response on this issue by stating that Obayashi deliberately witheld information in the traffic study, and he feels this is a credibility issue.)

Response: The factor used for ambient traffic growth of 0.8 percent was a derived rate from the DBEDT population growth factors. This rate reflects the averaged growth in visitor traffic passing through the North Shore and growth in through traffic from Oahu residents not living on the North Shore.

Discussion: The projection of future traffic conditions for the Lihi Lani traffic study follows a methodology accepted by the State Department of Transportation for the preparation of traffic impact assessments in Hawaii. The traffic assessment of Lihi Lani estimates future traffic growth from many sources. When all these are taken together, the total traffic growth is projected at 10 to 15 percent annually. The traffic assessment did not try to underestimate growth, if anything, it tended toward an overestimate of future traffic. The traffic study estimated future traffic growth according to official schedules (DBEDT population projections), when actual growth may occur more slowly.

9) **Kamuela Price:** The elderly housing and YMCA will add to the infrastructure problem in the area, and suggests that these elements be moved to Haleiwa. He also requested indemnification of the property owners of lands makai of the Obayashi property due to possible silt runoff during roadway construction.

Response: (No question was asked and no response was made to the statement.)

Discussion: Infrastructure for the elderly housing and YMCA will be provided by Lihi Lani's water system, roadways, wastewater system and drainage facilities. Very little burden will be placed on the public infrastructure. Kamehameha Highway will be used to access and egress these facilities, and potential impacts to traffic are addressed previously in Item 8) of this document. Of note, many people using the new YMCA will use bicycle and walking as transportation modes. The new YMCA will actually allow some people to walk or bike to a recreational facility, whom may now drive to existing sites for recreation such as the Waialua High School swimming pool or the Mililani YMCA.

Silt runoff during construction is a significant issue which has been taken very seriously by Obayashi in their Draft EIS and current plans. The construction phase is when there is the greatest potential for erosion and runoff to occur. For this reason, the construction plan includes installation of siltation and detention basins for each phase of development. For example, in the first phase, which includes the road development, the amount of siltation/detention basin capacity planned to be installed is four times the volume required by the EPA. In addition, the Grading, Grubbing and Stockpiling Permit from the City and County and County of Honolulu and the National Pollutant Discharge Elimination System (NPDES) Permit from the State Department of Health will require adherence to strict limits on area to be cleared and erosion and siltation controls. No adverse impacts to off-site properties is anticipated to result during construction of Lihi Lani due to the careful planning to mitigate erosion and silt runoff.

10) **Rolf Esche:** Mr. Esche's question addressed the economics of the project, and specifically the cost for the market lots for Obayashi to make a profit. He also questioned the number of North Shore residents who could afford a lot and voiced concern about the sewage system, especially for the makai areas and its operation during a power outage.

Response: The prices of the affordable homes is slated to be similar to the City's affordable housing pricing guidelines. For a family of four on Oahu, the median family income (MFI) in May 1993 was $49,900. This equates to home prices of $175,000 to $220,000 for prices affordable to those earning between 100 to 120 percent of MFI. The 315 Country lots would be priced at the market rate, which in Pupukea and Sunset Hills ranges from $285,000 to $550,000. The market at the time of product delivery will dictate the costs of the Country lots.

The wastewater system serving the lowlands will use a force main which will pump the wastewater up the access road to the water reclamation facility. There are numerous safeguards in place to protect against a system failure and wastewater spill. Should there be a power failure, back-up power supply will be available at each pump station to continue the operation of the system without interuption. There is also a back-up pump at each pump station in case of pump failure. Each pump station also has a vault which is capable of handling a minimum of 8 hours of flow should there be a pump failure. Alarms are linked by telephone to the treatment plant and a back-up person to notify the operators when there is a system problem. With all these measures in place, there is little potential for a system failure.

Discussion: Mr. Esche's question about the economics of the project and others questioning the viability of the project all make an important point. Some have thought that Lihi Lani has been planned to maximize profits for the developer. The extraordinary benefits proposed for the first phase of Lihi Lani, considering today's difficult economic setting, are a good example of Obayashi's financial strength and their commitment toward the project and the local community.

Analysis of household income data from the 1990 Census (1989 incomes) sheds some light on the whole question of affordability of homes to be offered at Lihi Lani.

In 1989, the median household income in the Sunset Beach/Pupukea area was $38,382 -- while the islandwide median was $40,581. The 1993 island median household income has been estimated as $49,900, an increase of 23 percent over four years. If this income growth was also experienced in the Sunset Beach/Pupukea area, the current median household income would be $47,210.

For those earning the median annual income, the single family affordable housing at Lihi Lani will be an excellent opportunity for first time home buyers. These homes will be in a forest setting on lots of 5,000 sq. ft. minimum.

For elderly residents of the Oahu, and especially the North Shore, the elderly affordable rental housing to be built and operated by the City, will be affordable to many seniors. Affordable rents for studio units would be approximately $543 and $649 for one bedroom units, based on the current City housing pricing schedule (5/5/93).

The Country lots will be sold at market prices comparable to the Pupukea-Sunset Hills prices of $285,000 to $550,000 (1993). Because there is a range of Country lot pricing available that is comparable to Pupukea and Sunset Hills, there will be opportunities for people earning good incomes (not necessarily enormous incomes) to upgrade their current housing to a new home and big Country lot at Lihi Lani.

Of course, there will also be those individuals and families who have sizable incomes or assets which will allow them to select the finer home sites available at Lihi Lani. As in Pupukea and Sunset Hills, these more up-scale homes will fit nicely into a diverse low density residential and agricultural community.

So it should be clear to all, that Lihi Lani represents a range of housing opportunities, from elderly homes to affordable single-family homes, to lower priced Country lots, to some of the best mauka residential sites that the North Shore offers. The residential opportunities at Lihi Lani will serve a wide range of the North Shore's housing needs, while in keeping with the low density country character of the area.

11) **Randy Myers:** Mr. Myers' question addressed his concern about the reliability of the wastewater facility and that Obayashi should not experiment with this facility at this site. He also had concerns about the potential impacts of the construction noise and dust at the Sunset Beach Elementary School.

Response: The reliability of the wastewater system has always been an issue with the project since the beginning of planning in 1987. Community concern led us to be receptive to recommendations from the community for the most reliable type of system. Obayashi was introduced to Dr. Robert Gearheart of Humbold State University in Arcata, California, who is a proponent of the stabilization pond and wetlands cycling process for wastewater treatment. Over the past four years, Obayashi has carefully refined its plans for this facility to address all concerns of the State Department of Health. At this time, the system meets the DOH requirements for such a facility. Because of its minimal mechanized operations and its tremendous holding capacity (58 days without discharge), this system now meets the community's expectation of a safe, reliable and high quality wastewater treatment system.

The noise generated by construction activities is regulated by the Department of Health with noise level standards and time of day and weekend restrictions for certain noisy operations. The contractor must adhere to these rules or face stiff fines. In addition, Obayashi will make an effort to schedule the construction activities with the greatest potential for noise impacts to the school during the summer months.

The generation of dust from construction sites is another potential concern, which is also regulated under air quality regulations of the Department of Health. There will be an active on-going watering program at the construction areas to minimize the potential for dust generation, especially to avoid potential effects to the elementary school.

Discussion: The treatment system will have up to 58 days holding capacity without discharge under dry weather conditions, and up to 35 days holding capacity including a 100-year storm event.

12) **Ken Martyn:** The statement from Mr. Martyn, and he believes that he speaks for others in the Mokuleia area, considers his opinion that there is a strong consensus to support the position of Sunset and Pupukea in regards to Lihi Lani. Mr. Martyn feels Obayashi is a long way from strong support for the project and must address the concerns from Sunset and Pupukea. Mr. Martyn also stated that Obayashi should consider a project that does not require rezoning. He also questioned how Obayashi could obtain Country zoning without obtaining approval of State Urban District classification for the area. He asks this because the Mokuleia proposal requires State Urban designation for the Country lots, along with its two golf courses and hotel.

Response: The only question raised by Mr. Martyn was the issue of the need for State Urban District classification to gain Country zoning. The Land Use Ordinance has several guidelines for lands to be considered for Country zoning. Lihi Lani qualifies for consideration for Country zoning under the LUO guidelines, since the land to be requested for Country zoning is predominantly unclassified under ALISH. The difference of the Mokuleia Land Company proposal could be that the land proposed for Country zoning at Mokuleia is classified under ALISH as either Prime Agricultural Lands or Other Lands of Agricultural Importance.

Discussion: The purpose of the Neighborhood Board 27 Special Meeting was to comment on issues addressed in the Draft Supplemental Environmental Impact Statement (Draft SEIS). These discussions were held over several hours, and this interaction was part of the on-going community-based planning process for Lihi Lani. We consider any conclusions stated at this meeting on the acceptance of the overall project to be premature, since the project is in the Draft SEIS process at this time. Many issues were clarified at this meeting and updated information will be presented in the Final SEIS.

Several issues addressed at this point in the meeting require a more thorough analysis, as presented below.

Sunset-Pupukea Support: The concern of regarding community concensus for Lihi Lani is appreciated, since Obayashi has always wished for the community as a whole to speak out on their concerns with respect to Lihi Lani. A community-based approach to planning for Lihi Lani has resulted in a project that reflects the low density and agricultural aspects of the Pupukea community. Because of community concerns, the golf course and tennis center were removed from the project. The project is now essentially one of diversified agriculture. Most significant environmental issues raised by the community are now fully considered in the very sensitively planned project.

People from Mokuleia to Kaaawa have participated in this community-based process, because we feel that Lihi Lani brings opportunities to the whole North Shore, not just Sunset and Pupukea. Our focus in community meetings has been with our closest neighbors at Sunset and Pupukea, but we have not lost contact with our regional neighbors from Haleiwa, Waialua, Mokuleia, and Kahuku, Laie and other windward areas. We respect the views of all individuals in the community, as well as the organized viewpoint of a very energetic group of members in the Sunset and Pupukea community associations. It must be remembered, however, that these community associations do not speak for every individual in the entire Sunset and Pupukea community.

There are different viewpoints on the issues that face our community today, and many of the viewpoints are not heard publically because of the stressful and sometimes confrontational setting of the community association meetings. Obayashi has always taken the time and energy to meet with all people in the community, and over six years this has meant a lot of meetings. Many, many people in the Sunset-Pupukea area and the larger North Shore community support Lihi Lani because of the good things it will bring to the community. With the affordable homes, the trails, the YMCA, the Country lots, the education fund, the elderly housing, the Ranch, and even a few new jobs -- many see Lihi Lani as a good plan, bringing positive opportunities for the North Shore people to enjoy the land and helping the community. These people look to the future of the North Shore and Sunset-Pupukea and see this carefully planned use of the land as a positive change for their families and friends.

We do not think that one viewpoint on the North Shore is right, and another one is wrong. We have worked hard to learn from a wide range of people who love the North Shore, whether or not they like the project. Lihi Lani incorporates ideas that have been raised by many people. The result is not consensus -- but we hope it represents some of the best ideas in our community.

Country Zoning on State Agricultural District Land: The Land Use Ordinance has several guidelines for lands to be considered for Country zoning. These guidelines (paraphrased) include: a) State Urban District lands and designated either agricultural or residential by the City, b) lands which are not predominantly Prime, Unique or Other agricultural lands rated under the ALISH rating system, c) lands which are predominantly parcels of two acres or less, and d) lands where public facilities do not allow more intensive development. Lihi Lani qualifies for consideration for Country zoning under guideline b), since the land to be requested for Country zoning is predominantly unclassified under ALISH. It is not necessary for all or a majority of the guidelines to be met to qualify for consideration for Country zoning.

It is important to understand the intent of the Country zoning district and how it applies very well to the proposed Lihi Lani project. The Land Use Ordinance, 5.30 **Country District: Purpose and Intent**, states the following:

> "The purpose of the country district is to recognize and provide for areas with limited potential for agricultural activities but for which the *open space* or rural quality of agricultural lands is desired. The district is intended to provide for some agricultural *uses*, low density residential *development* and some supporting services and uses."

The agricultural potential of soils at Lihi Lani is marginal, except for some discontiguous pockets of better agricultural soils. Country zoning for Lihi Lani represents the minimum zoning change available to accomplish the planned goals of diversified agricultural uses and residential uses.

State Land Use Law allows for the minimum subdivision of State Agricultural District land at one-acre, which fits the Country zoning requirement. As well, Obayashi has sought to maintain the State land use district classification of Agricultural to be consistent with the adjoining Pupukea Highlands and Sunset Hills community.

If the Urban designation was required for Country zoning at Lihi Lani, it would create the potential for more intense future development of the property for residential or commercial use. The classification of the property for large amounts of Urban District land would be not be consistent with Obayashi's interest of satisfying community concerns about maintaining the country character at Lihi Lani.

<u>AG-2 Zoning:</u> With respect to the issue of the possiblity for developing Lihi Lani without a change of zone, our planners have looked into the possibility of this approach since the Neighborhood Board meeting. In fact, the Draft EIS presents and evaluates an alternative plan for the project which involves an agricultural subdivision at the existing AG-2 General Agricultural District zoning. The agricultural subdivision analysis in the Draft EIS assumes that the rules for approval of an agricultural subdivision would be satisfied in an application for up to 500 2-acre (minimum size) lots.

Upon further analysis, the agricultural subdivision rules would probably be very difficult to satisfy at Lihi Lani. The most challenging requirement for an agricultural subdivision, as per the Land Use Ordinance, is the need to demonstrate financially viable agricultural use of each lot. The State Department of Agriculture is very strict about enforcing this, and is becoming more strict due to past abuses of the agricultural subdivision approval. It would also be very hard to comply (probably impossible) due to the marginal productivity potential of the soils at Lihi Lani.

Obayashi could have pursued an agricultural subdivision of two-acre lots if there was a larger presence of prime agricultural soils of their land. Instead, Obayashi is proposing the minimum possible zoning change to achieve successful diversified agricultural activities. At the Country lots of Lihi Lani, agricultural uses are intended to gain revenues to help offset association maintenance fees.

To establish financially viable agricultural use of the 2-acre lots, the crops would need to offset the cost of the individual lots. For these lots under the current Pupukea market, this would range from $285,000 to $550,000. Agricultural uses on these lots would need to produce net revenues of $20,000 to $40,000 per year, respectively, to offset costs for land payments, real property tax, insurance, utilities and association maintenance fees. Most legal crops known to be produced in Hawaii are not known to produce such revenues per acre. The legal crops that may possibly be able to produce such revenues are typically intensive uses such as some cut flowers, ornamental plants and other nursery products. It is unlikely that several hundred individual small farming businesses at one location could be justified in the Oahu marketplace.

There are several other points which discourage establishment of an agricultural subdivision at Lihi Lani as mentioned briefly below:

- There are limited amounts of contiguous prime agricultural soils, with only 162 acre of B-rated soils under the LSB rating system, scattered in numerous locations. Our planners estimate that somewhere between 80 to 120 two-acre agricultural lots could be established using reasonably good rated agricultural land. This number of lots would not be viable for Lihi Lani due to the significant infrastructure costs (roads, sewers, water system, water reclamation facility, etc.) estimated at over $93 million.

- The project would lack community benefits because of reduced revenues and no City requirements for such. Because there would be no change in zoning, there would be no requirement from the City for affordable housing to be provided. There probably could be no use of the makai land for the YMCA or Elderly Housing, because there likely would be a need for agricultural storage and processing facilities to be situated near the transportation corridor of Kamehameha Highway.

The alternatives analysis in the Final SEIS for Lihi Lani will be revised to reflect our recent understanding of the limitations to creating an agricultural subdivision on lands with marginal agricultural productivity potential.

13) **Betsy Essoyan:** Ms. Essoyan inquired about the possible use of a security gate at the project entrance, leading to the potential establishment of a gated community with limited access.

Response: Obayashi was sent a letter from Councilmember Mansho asking if Obayashi would consider the Honolulu Police Department's recent inquiry into the possibility of residential areas establishing control over access to reduce the potential for criminal activity. Obayashi is considering placement of a security gate at the entrance to allow for a check-in system for visitors and hopefully restrict those with bad intentions. The control booth would not be established to constrain the normal daytime use of the trails and ranch facilities for the public, but it would require a check-in upon entry and departure. This aspect of the project has not been discussed much in the community meetings, therefore, Obayashi would prefer to continue evaluation of this measure before committing to such a plan.

14) **Rex Dubiel:** Comments by Ms. Dubiel included her concern about what she perceives to be misinformation. She feels that by showing pictures of the YMCA but not committing to paying for the entire cost of building the facility is misleading. She also commented about the North Shore News article and the misquote of the Task Force report.

Response: The strength and commitment of Obayashi was restated in response to these concerns. Obayashi will dedicate land, provide infrastructure, and a portion of the construction costs for the YMCA. This is far beyond what the normal YMCA project starts with, and the YMCA feels this offer is uniquely appealing. The Task Force report misquote will be updated.

Discussion: Mr. Don Anderson, President of the YMCA of Honolulu is responsible for managing the existing YMCA network, and is also responsible for looking into new opportunities for the YMCA to expand into untapped areas of the island where the demand for their services exists. He is willing to meet with the community representatives to discuss the future plans for the YMCA at Lihi Lani. It is unlikely that a YMCA could come to the North Shore without these commitments.

15) **Toni Sickler:** The question raised related to the proposed use of brackish water and reclaimed water for irrigation of the agricultural lands at Lihi Lani. This use could potentially affect the salinity of the Sunset Beach wells.

Response: The Board of Water Supply (BWS) Sunset Beach wells have not been actively used to supply water to Sunset Beach residents in the last 10 years. Water for the Sunset Beach users is provided from BWS wells located at Wailee beyond Crawford Convalescent Home. The water provided to Pupukea Highlands comes from BWS wells in Waialua and Haleiwa, and Lihi Lani will draw its potable water from this system. The BWS does not intend to activate the Sunset Beach wells in the future, however, water quality at these wells is definately a concern of Obayashi. The use of brackish water and reclaimed water is not anticipated to cause a significant increase in the salinity of the Sunset Beach well. The brackish water is actually quite low salinity. The estimated worst-case increase in chlorides in the groundwater beneath the site could be only 16 mg/l, which represents a minimal potential increase in salinity and no concern for public health

16) **Ian Sandison:** A concern he has is the economic viability of the project. He noted that the large up-front infrastructure costs would be only slowly offset by the planned phased sales and development of the Country lots. Long-term maintenance costs were another concern.

Response: The issue is the financial strength of Obayashi to follow-through with its development plan, which was addressed previously. Itemized long-term costs for maintenance will be presented in the future. Obayashi is confident that they can deliver the project as planned. Obayashi intends to follow through with its commitments to support the YMCA and City's elderly housing, and build the affordable housing all in the first phase. Therefore, the benefits to the community will be received as early as possible.

Discussion: Long-term maintenance costs are discussed earlier in this report.

17) **Ken Newfield:** Mr. Newfield's comment regarded population growth of the area as a result of the Lihi Lani project. He stated that the EIS points out that growth in the primary study area (2.5 percent from 1980 to 1990) has been roughly 3 times greater than the rest of Oahu, and he wonders whether the area can handle this growth. He noted that the EIS states that growth from the project will represent 0.07 percent of Oahu population, and he felt this would be significant for this area. He felt the EIS did not address the impact at the study area level.

Response: There is growth in this area, and growth is continuing. Young couples will continue to have children. There is a need for housing on the North Shore, and Lihi Lani will bring a range of housing opportunities. The General Plan Population Distribution Guidelines are strictly guidelines that the City Council updated in 1985. The guideline levels have been exceeded in many of the DP areas, especially Central Oahu where it has been far exceeded. It is up to the City Council to re-evaluate these guidelines since they are not being used as strict rules. If the Council feels a project offers features that will serve the needs of a community, such as affordable housing, then often they can look past the Guidelines and approve such a project.

Discussion: For this discussion, several questions are posed and answered to try to clear up the issue of population growth.

We've seen very fast population growth in the last decade, even though there hasn't been a major new development. Doesn't that mean we'll see <u>much more</u> growth with Lihi Lani included?

First, the population in the Sunset Beach/Pupukea/Waimea area grew by 2.5 percent annually between 1980 and 1990, while the island as a whole increased in population by 0.9 percent annually.

Next, there <u>has</u> been development -- infill in Sunset Beach, with increased density, and buildout of lots in Pupukea, that were first sold in the 1950's and 1960's. That lot buildout is the sort of gradual development, over more than twenty years, that you expect with large lot subdivisions.

We can expect more population growth. Families will grow; some people who left the North Shore area will want to move back; others will want to move to the country. The North Shore remains an attractive area. The population is young and, while many are single, there are plenty of young couples to have more children. Many may be looking for affordable housing to start their own homes.

We can't predict with certainty the pace of future growth over decades. One way to think about this is in terms of the growth projected by the State and the City for the island as a whole. The "M-K" Series model forecasts an Oahu population of about one million people in 2010. If the North Shore DP area continues to have 1.9 percent of the island's resident population (as of the 1990 census), by 2010, that would mean a total population of 18,900 -- an increase of 16.8 percent over 20 years. This would be a slower growth rate than the growth we've seen for the 1980 to 1990 period.

If we use the 1.9 percent figure for projections, then the resident population at Lihi Lani by 2010 (750 people) would be less than four percent of the total North Shore population, and less than one-quarter of the <u>increase</u> in population in the North Shore DP area. (We look at the North Shore DP area rather than the Sunset-Pupukea area for comparison at this point to address the GP Population Distribution Guidelines issue.) If we use the outer limit of the current General Plan figures, then Lihi Lani would still house less than five percent of the North Shore's <u>total</u> population, but would have about one-third of the <u>increase</u> in the North Shore's population by 2010.

With regional change like job growth at Kuilima (sooner or later), and with overall island population growth, we expect to see more people on the North Shore. Lack of money, traffic congestion, or even government rules won't stop that. Lihi Lani provides a low-density and fully compatible approach to provide for some of that growth.

Is Obayashi hiding the real impacts by presenting the population facts the way they did in the EIS?

No. The Draft SEIS is organized to answer questions asked by different audiences. The City's General Plan views population increase in terms of shares of the islandwide population -- so that's one way to estimate the impact of people living at Lihi Lani. People in the surrounding area are asking questions about the number of people nearby and the impact on the roads and schools. They want to know about local population and impacts on facilities.

In the local context -- we do not know how much additional population growth will occur specifically between Waimea and Kawela in the next twenty years. We are sure that there will be some growth. We think there are then two questions: How much? and Will growth fit in with community values or not? As a planned development, Lihi Lani will provide new housing for some people who already live nearby, and provides a low-density context for some type of growth that will come to the region in any event.

- Perhaps the Sunset Beach/Pupukea area will grow at the same rate as the island as a whole -- about 19 percent between 1990 and 2010. In that case, the projected 753 people living at Lihi Lani would amount to about 15 percent of the 4,894 people in the area, and a large part of the population increase anticipated in the areas.

- Perhaps the population in the Sunset Beach/Pupukea area will continue to grow at a rate faster than the City and County average. Then Lihi Lani would house a smaller fraction of the local population -- perhaps 11 percent if the area population kept growing at 2.5 percent annually.

We think that, with fewer lots available in Sunset Beach and Pupukea, the rate of population growth will go down somewhat. But the growth will not stop, even if there were no more lots available. Instead, we would see more crowding, and more illegal units.

This is a good point raised by Mr, Newfield. The Final SEIS will reflect this expanded discussed of potential population effects.

How can we keep the North Shore rural with a major new residential development in the Sunset-Pupukea area?

Lihi Lani will keep the North Shore rural, and will support the North Shore's community feeling, first by providing a low-density residential and agricultural community setting. (It will have a 42 percent lower density that Pupukea.) Next, the land and infrastructure provided for community facilities will help the community to have new recreational resources lacking in most rural areas.

Some population growth seems inevitable throughout Oahu, even on the North Shore. As a low-density area, Lihi Lani makes it possible for people to have homes in an open area, not in an increasingly dense and crowded coastal strip.

What about the Population Guidelines? Isn't Lihi Lani exceeding the limit?

The guidelines are part of the General Plan, that the City Council uses as a basis for specific policies. The Council has said that the percentages for different regions are guidelines, not hard and fast rules. Right now, the share of Oahu's population in <u>most</u> of the Development Plan areas is over the guideline share for 2010:

<u>General Plan Population Guidelines and 1990 Statistics</u>

Area	**1990%**	**2010 Range**
Primary Urban Center	51.6	45.1-49.8%
Koolaupoko	14.1	11.0-12.2%
Koolauloa	1.7	1.3-1.4%
North Shore	1.9	1.6-1.8%
Waianae	4.5	3.8-4.2%

The North Shore's share of Oahu's population is already over the guideline, although the actual number of of people is less than the number projected for the year 2010.

The Council has been considering the guidelines on a case by case basis. They have approved several planned developments in Central Oahu and in Koolauloa, even though these put future population estimates far over the guidelines, above all because the projects meet community needs for housing.

18) **Mike Dailey:** Mr. Dailey raised the question of the need to go through a change of zone for the project, when they could go for 500 agricultural lots under existing zoning. He also felt that the community is not satisfied with the project as it stands. He mentioned that Obayashi has split the community on this issue.

Response: The Land Use Ordinance requires agricultural feasibility requirement be met for an agricultural subdivision. This plan could not demonstrate feasibility because of the topography and the soils of marginal agricultural productivity.

Discussion: The question of the use of existing zoning is addressed under the discussion on Mr. Ken Martyn's comments.

The claim that Obayashi is splitting the community is a very sensitive issue that we would like to address openly. Obayashi and the Lihi Lani project are sometimes controversial subjects in our community. As mentioned previously, many people in our community have many different opinions about Lihi Lani. Some are unalterably opposed to any future growth of the North Shore, especially the Sunset Beach and Pupukea area. These people are very concerned about the project, since they believe it will cause a change in their lifestyle and their enjoyment of the community. Many of these people have experienced rapid growth in other areas, and left those areas to regain an uncrowded country living experience on the North Shore. Many of these people are discouraged with the growth of the area that has already occurred, and wish that so many people would stop coming to the North Shore to visit or reside. For some people, the changes that are already happening and more changes coming are being treated with an "enough is enough" attitude. This point of view is, however, not universally shared by all people living on the North Shore, and that is why some differing opinions have surfaced at public meetings on Lihi Lani.

Many other on the North Shore and Sunset Beach and Pupukea applaud the carefully planned positive changes that Lihi Lani will slowly bring to the community. The people that support Lihi Lani come from all sectors of the North Shore population. Some of the supporters may have needs that Lihi Lani will satisfy, such as housing, jobs, recreation, child care and elderly housing. Other people have a vision for the North Shore that looks to the future, recognize the changes that are coming to our agricultural lands, and appreciates the innovative but sensible approach toward integrated agriculture and residential uses at Lihi Lani. They believe this project is a model that will preserve the Country lifestyle, and the community and environmental character of the North Shore, especially the Sunset and Pupukea area.

With these divergent opinions and visions for the North Shore, it is apparent that Lihi Lani brings these viewpoints to the surface in public meetings. It is not Obayashi that is splitting the community, rather it is the issues of today that people have differing opinions about. The public meetings at which Lihi Lani has been discussed over the past six years have only served to bring out matters that people strongly believe in. It is unfair to label Obayashi as the reason for disagreements in personal beliefs and visions for the future of their community. We hope to take this opportunity, however, to bring the entire community together to discuss and work out common concerns, and bring a well planned future for this land and our North Shore community to a reality at Lihi Lani.

Sunset Beach Community Association

P.O. BOX 471
HALEIWA, HI 96712
638-5574

Mr. Robin Foster, Chief Planning Officer
Planning Department
Honolulu Hale
650 South King Street
Honolulu, Hawaii 96813

Re: Lihi Lani Ranch Supplemental Environmental Impact Statement

Dear Mr. Foster,

The Sunset Beach Community Association feels that the cited suppplemental EIS does not adequately address -- in data used, analyses applied and mitigation measures proposed -- the community's continuing major concerns, particularly in regard to Sunset Beach, the primary impact area. Among these concerns are:

1. Soil erosion, runoff and flooding during and after grading,
2. Lack of infrastructure to accommodate more than 400 new housing units,
3. The socio-economic impact of increased urbanization on the North Shore, and
4. Damage to petroglyphs and an agricultural terrace, known Hawaiian archeological sites, which will be caused by construction of the project access road.

For example, a few of the items that the document fails to consider fully or address thoroughly are:

1. The serious impact that at least two years of road construction will have on the quality of education and the health of students at Sunset Beach Elementary School, which is adjacent to and downwind of the proposed access road,
2. The recommendations and comments in both the Central Oahu/North Shore Regional Plan and the City-County General Plan aimed at directing growth to Central Oahu and the Ewa Plain,
3. The financial ability of the developer to follow through on promised mitigation measures should changing economic conditions render the project unfeasible,

GROUP 70
INTERNATIONAL

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Norman G.Y. Hong, AIA
Sheryl B. Seaman, AIA, ASID
Robert K.L. Wong, AIA
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13 December 1993

Mr. Ken Newfield, President
Sunset Beach Community Association
P. O. Box 471
Haleiwa, Hawaii 96712

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Mr. Newfield:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of 19 November 1993.

1) Soil Erosion, Runoff and Flooding

Given the concern expressed to these issues over the past six years of planning for Lihi Lani, Obayashi placed special emphasis on addressing these issues in their Draft SEIS. The technical reports included in the Draft SEIS reflect the high level of planning devoted to these issues. Of particular value is the stormwater management report by Engineering Concepts, Inc., included as Appendix F of the Draft SEIS. Also of note is Appendix H, the runoff water quality analysis completed by Tom Nance Water Resource Engineering. The ECI and Nance reports extend and expand upon the analysis presented in the 1991 Final EIS.

The ECI report identifies the extensive drainage control system planned for Lihi Lani. The detention basin system has been expanded to provide 164 acre-feet of runoff storage. This is the post-development completed storage capacity. Their report also presents the post-development erosion potential, which shows a 22 percent decrease in silt runoff from the property. The extensive detention basin system acts as a trap for suspended sediment, along with the developed property's erosion control plantings which will reduce soil loss.

The community has previously expressed concern about the construction phase, and the Draft EIS reports address these issues and Obayashi's mitigation efforts in detail. As an example, the stormwater runoff detention basin storage capacity installed during this part of construction would be 4 times the EPA minimum that will be required under the NPDES permit. As a conservative analysis, ECI and Nance address the worst-case situation, which is the roadway construction period in Phase 1. The analysis shows that silt runoff from the project site could potentially increase the suspended sediment load to the ocean from Paumalu Stream by 8 percent during the 10-year, 24-hr. storm. This amount of silt runoff would not significantly different from existing conditions, and the potential short-term increase would cause no adverse water quality effect. For the long-term, silt runoff from this land would decrease by over 20 percent.

(Of note, we have prepared a detailed response to the comments from Jim Blattau and Peter Cole, which is included in the Final SEIS.)

2) Infrastructure/Traffic

As we understand the term infrastructure, you probably mean the public infrastructure system, such as roadways, water supply, wastewater treatment/disposal and electrical supply. The availability and condition of roadways, water, sewer and electrical service are not issues raised in your letter or by agencies or the community as public facility concerns. There has been public comment on traffic conditions in relation to the project. According to engineering standards and government requirements, there is adequate infrastructure to support the new 445 homes and other facilities at Lihi Lani, due to the on-site and off-site improvements planned as part of the project.

The comment regarding lack of infrastructure addresses what we believe to be a perceived limit to the capacity of the area's public highway system. We focus our response on the highway capacity issue, as that is probably what is meant by using the term infrastructure. This issue is not a technical or public safety concern because the capacity of Kamehameha Highway will be adequate to serve traffic associated with Lihi Lani. The issue of traffic is one of aesthetics and the community's lack of acceptance of future traffic growth in the area, that will occur with or without Lihi Lani.

Future traffic conditions on Kamehameha Highway with and without Lihi Lani was studied carefully by Pacific Planning and Engineering, Inc. (PPE) as included in the Draft SEIS as Appendix J. The study used a very conservative analysis of potential future traffic conditions, with growth of traffic predicted to be 10 to 15 percent per year. PPE estimates Lihi Lani traffic to represent 5 to 8 percent by full build-out of the project. The PPE study used 2008 as the full build-out date for a worst-case assessment of impact. The actual traffic added to Kamehameha Highway as a result of Lihi Lani is anticipated to be 3 to 5 percent by 2008, with only 65 percent buildout of the Country lots. This is a small additional traffic volume increase which will not cause operational constraints to the highway facility.

The concern of the Association with future traffic conditions is warranted, however, because predicted future traffic volumes show a significant increase in traffic with or without Lihi Lani. Obayashi has heard these concerns, and has responded by planning mitigative measures such as a YMCA van pool, bike racks and bike paths, and encouragement of the "work at home" lifestyle. The introduction of over 400 new homes will result in a small additional traffic volumes to a highway facility that is anticipated to be reaching capacity around 2005 to 2010. The DOT and the North Shore communities must address the issue of long-term traffic conditions with or without consideration of Lihi Lani, because it will represent a very small part of the future traffic.

The DOT assumes that by approximately 2005, additional capacity will be needed to serve traffic on Kamehameha Highway along the North Shore. This conclusion is reached without consideration of traffic associated with Lihi Lani. We cannot ignore this future plan for the improvement of this facility, and standard practice for analysis of future traffic conditions requires it to be considered.

3) **Socio-Economic Impact of Urbanization**

Lihi Lani will bring some 445 homes to the North Shore, including 80 elderly homes and 50 affordable single family homes. The elderly homes will be built in the area adjacent to the existing State Urban District in Sunset Beach. Of note, the residential areas of Sunset Beach are currently classified by the State as Urban District.

Obayashi is concerned about the impact of urbanization. North Shore communities have become much more densely settled in recent years, especially on the coastal strip. In line with both community sentiment and governmental policy, Obayashi has planned Lihi Lani as a low-density area. It will be less densely settled than either Pupukea Highlands or coastal Sunset Beach are today. Exhibit F from Appendix K of the Final SEIS shows the density of Lihi Lani (2010) will be 58 percent of that in Pupukea Highlands.

The Draft SEIS does not dilute impacts by presenting Lihi Lani's population impacts in relation to island-wide figures. It is written to respond to different questions asked by various audiences in government and the community. The City and County General Plan views population increase in terms of shares of the island-wide population. The Draft SEIS discusses both the overall development policy and the specific population guidelines. People in the surrounding area ask questions about the number of people living <u>nearby</u> in the future. This number is hard to estimate with certainty.

In the local context, there is growth in this area, and growth is continuing. Young couples will continue to have children. There is a need for housing on the North Shore, and Lihi Lani will bring a range of housing opportunities. The General Plan Population Distribution Guidelines are strictly guidelines that the City Council updated in 1985. The guideline levels have been exceeded in many of the DP areas, especially Central Oahu where it has been far exceeded. It is up to the City Council to re-evaluate these guidelines since they are not being used as strict rules. If the Council feels a project offers features that will serve the needs of a community, such as affordable housing, then often they can look past the Guidelines and approve such a project.

For this discussion, several questions are posed and answered to try to clear up the issue of population growth.

We've seen very fast population growth in the last decade, even though there hasn't been a major new development. Doesn't that mean we'll see <u>much more</u> growth with Lihi Lani included?

First, the population in the Sunset Beach/Pupukea/Waimea area grew by 2.5 percent annually between 1980 and 1990, while the island as a whole increased in population by 0.9 percent annually.

Next, there <u>has</u> been development -- infill in Sunset Beach, with increased density, and buildout of lots in Pupukea, that were first sold in the 1950's and 1960's. That lot buildout is the sort of gradual development, over more than twenty years, that you expect with large lot subdivisions.

We can expect more population growth. Families will grow; some people who left the North Shore area will want to move back; others will want to move to the country. The North Shore remains an attractive area. The population is young and, while many are single, there are plenty of young couples to have more children. Many may be looking for affordable housing to start their own homes.

We can't predict with certainty the pace of future growth over decades. One way to think about this is in terms of the growth projected by the State and the City for the island as a whole. The "M-K" Series model forecasts an Oahu population of about one million people in 2010. If the North Shore DP area continues to have 1.9 percent of the island's resident population (as of the 1990 census), by 2010, that would mean a total population of 18,900 -- an increase of 16.8 percent over 20 years. This would be a slower growth rate than the growth we've seen for the 1980 to 1990 period.

If we use the 1.9 percent figure for projections, then the resident population at Lihi Lani by 2010 (750 people) would be less than four percent of the total North Shore population, and less than one-quarter of the <u>increase</u> in population in the North Shore DP area. (We look at the North Shore DP area rather than the Sunset-Pupukea area for comparison at this point to address the GP Population Distribution Guidelines issue.) If we use the outer limit of the current General Plan figures, then Lihi Lani would still house less than five percent of the North Shore's <u>total</u> population, but would have about one-third of the <u>increase</u> in the North Shore's population by 2010.

With regional change like job growth at Kuilima (sooner or later), and with overall island population growth, we expect to see more people on the North Shore. Lack of money, traffic congestion, or even government rules won't stop that. Lihi Lani provides a low-density and fully compatible approach to provide for some of that growth.

Is Obayashi hiding the real impacts by presenting the population facts the way they did in the EIS?

No. The Draft SEIS is organized to answer questions asked by different audiences. The City's General Plan views population increase in terms of shares of the island-wide population -- so that's one way to estimate the impact of people living at Lihi Lani. People in the surrounding area are asking questions about the number of people nearby and the impact on the roads and schools. They want to know about local population and impacts on facilities.

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The Council has been considering the guidelines on a case by case basis. They have approved several planned developments in Central Oahu and in Koolauloa, even though these put future population estimates far over the guidelines, above all because the projects meet community needs for housing.

The Final SEIS will reflect this expanded discussion of potential population impacts at the local level.

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4) Petroglyphs

The Draft SEIS and the 1991 Final EIS are exceptionally clear in the presentation of archaeological resources, following the research and findings of Paul H. Rosendahl, Ph.D., Inc. (PHRI). As well, Obayashi has extended their land and resources to the community to enable clear presentation of the archaeological findings on their property to interested member of the community in a 1990 field trip.

The reports and agency correspondence clearly point out how Obayashi intends to work with the Department of Land and Natural Resources - Historic Preservation Division (HPD) to address the preservation of historic sites. None of the known petroglyphs on the property will be affected by the construction. After extensive data recovery procedures, a portion of the T-13 agricultural complex will be affected by construction. Treatment of archaeological sites at Lihi Lani will be undertaken following DLNR-HPD recommendations. The Final SEIS presents the same language as presented ion previous documents regarding this commitment.

5) Road Construction

Access roadway construction, and construction of the elderly housing and the YMCA will all require careful consideration of the Sunset Beach Elementary School with respect to potential noise and dust effects. The Draft SEIS presents planned mitigative measures planned to minimize potential effects on adjoining land use activities. The Final SEIS will present more clear identification of the school as an important potential receptor for noise and dust. Applicable standards will be met during construction to minimize such potential noise and dust effects. Mitigative measures such as water trucks, soil stockpiling and ground cover vegetation are included in the Draft SEIS as measures to minimize dust generation. Noise generation will be limited by meeting applicable State standards, and by working closely with the contractor to minimize noisy activities near the school when in session.

6) Central Oahu/North Shore Regional Plan and City and County General Plan

The statement of recommendations in the CO/NSRP could be taken as an overall policy statement ("direct growth toward Central and Ewa") or it could be taken as a strict limit to any future growth of the North Shore. Obayashi participated in the Task Force that developed the CO/NSRP. In many ways, Lihi Lani is consistent with applicable portions of the CO/NSRP, especially aspects such as promoting agriculture and outdoor recreation, providing open space and preserving public views.

In terms of the General Plan. this document calls for continued rural country character on the North Shore. Lihi Lani will be the essence of this GP objective, with lower density than Pupukea and integrated agriculture, recreational uses and open space.

7) Financial Ability

Obayashi is one of the largest construction companies in the world, with assets of a $17 billion corporation. Their reputation is strong throughout the world. Community benefits such as the YMCA, trails, affordable housing and elderly housing will be provided in the first phase of the project. Agreements with the YMCA, the State and the City will be in place at the time of zoning approvals.

8) Traffic Growth

To elaborate on our discussion under 2) Infrastructure/Traffic, we further address the cumulative traffic estimate. The projection of future traffic conditions for the Lihi Lani traffic study follows a methodology accepted by the State Department of Transportation for the preparation of traffic impact assessments in Hawaii. The traffic assessment of Lihi Lani estimates future traffic growth from many sources. When all these are taken together, the total traffic growth is projected at 10 to 15 percent annually. The traffic assessment did not try to underestimate growth, if anything, it tended toward an overestimate of future traffic. The traffic study estimated future traffic growth according to official schedules (DBEDT population projections), when actual growth may occur more slowly.

9) YMCA Site

There has been a reduction in the size of the land area to be dedicated to the YMCA for development of the community facilities. Previously, there was no plan to establish the City's elderly housing project on the Lihi Lani site. There is a limited amount of gentle to moderately sloped land in the makai part of the property. In the previous plan, the YMCA was sited on a generous parcel because there was no other constraining use in the lowland area. With the inclusion of the elderly project, the YMCA site could no longer be kept at 10 acres. The same facilities are now planned for the YMCA site, however, the land area has been reduced to the minimum required to develop the facilities. The elderly housing site utilizes some of the former YMCA site, and extends further mauka into the hillside slope. To clarify Obayashi's commitment, the 6.5 acres of land (at an estimated value of $1.3 million) for the YMCA will be provided, along with $4.7 million to fund the facility development costs.

10) 1990 Census Data

(Refer to response under Item 3).

11) Effects to Public Views of the Pali

The potential effects on public views of the developed site from makai sites has been addressed in the Draft SEIS. There will be short-term visual impacts as a result of the road construction, however, the landscaping plantings along the road will eventually grow in and shield views of the rock cuts and roadway. Of note, the access road is planned to be in a cut for most of its path across the pali, therefore, the roadway and vehicles travelling on this road are generally not expected to be visible from most makai locations along most of the route. This will be especially true once the landscaping plantings are grown in, which will probably take 3 to 5 years.

The potential views of homes on Country lots has been the subject of significant analysis in the Draft SEIS. As an example, a line-of-sight study was completed for the bluff area on the Haleiwa-side of Lihi Lani. This analysis shows that with proper siting of homes along the bluff edge, homes will generally not be visible due to existing vegetation shielding and topographic interference in the line-of-sight. Setbacks for individual lots will be proposed at the time of subdivision application. Materials and colors for homes will be limited in the CCR for Country lots.

Overall, the public views of the pali will generally be unaffected by the access road and the new homes. The placement of homes will be nothing like the existing perched homes found on some lots in Sunset Hills. Homes will be tucked into vegetation and setback from the bluff edge such that they will be mostly shielded by vegetation and topography as viewed from makai locations . These homes will still be able to experience dramatic ocean views, and will not compromise the public enjoyment of the unaltered pali along this mile of coastline.

11) Broad Areas of Interest

We have received and responded to comment letters on the Draft SEIS from the following members of the community: Jim Blattau/Peter Cole, Jean Merlet, Ken Newfield, Larry McElheny, Bill Howes, Ken Martyn, Steven Poor and Kamuela Price. These letters and Obayashi's responses are enclosed in the Final SEIS.

12) Concluding Remarks

Over the past six years, Obayashi has always listened closely to the members of the SBCA, and Obayashi has encouraged an open dialogue with the community on issues of concern with respect to Lihi Lani. The detailed responses included in this letter, and the individual response letters sent to those community members participating in the EIS process, are indicative of the effort Obayashi has made to understand and resolve concerns about the project.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton, AICP
Chief Environmental Planner

RECEIVED
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GROUP 70

November 21, 1993

59-165 Ke Nui Road
Hale'iwa, HI 96712

BY HAND DELIVERY

Mr. Robin Foster, Chief Planning Officer
Planning Department
650 So. King St.
Honolulu, O'ahu, Hawai'i

Re: Lihi Lani Draft Supplemental Environmental Impact Statement

Dear Mr. Foster,

I am a resident of Paumalu (Sunset Beach), O'ahu and my residence has a full view of the Pali that the Obayashi Corp. proposes to develop. Although I am the current President of the Sunset Beach Community Assn. and a representative on the Neighborhood Board #27, I offer the following comments as my own opinion.

My comments focus on the inadequacies of the developer's analysis of the Socio-Economic impacts as presented in Appendix J (Traffic Impact Assessment Report) and Appendix K (Update of Socio-Economic Impact Assessment) of the Lihi Lani Draft Supplemental Environmental Impact Statement ("DSEIS").

1. Appendix J -- Projected Traffic Conditions

At page 22 of Appendix J, the consultants discuss "through traffic growth along Kamehameha Highway." Unfortunately, these two paragraphs are entirely convoluted and misleading. The consultants are discussing "through-traffic," which they describe as "without an origin or destination point near the project." They continue:

> The growth in through-traffic was estimated based on the growth trend of local resident and visitor de facto population forecasts by [DBED]. . . . . From the DBED projections, it was estimated that <u>daily traffic</u> along Kamehameha Highway would increase by approximately 0.8% annually. (Emphasis added.)

Is "through-traffic" the same as "daily traffic"? Is a "local resident" actually local or from anywhere on O'ahu? What defines a "destination point" near the project?

The data presented show that only 7% of the residents in the Primary Study Area are senior citizens. Most of them are homeowners. Fully 62% of the "affordable" dwellings are being offered to non-homeowner seniors who likely comprise less than 3% of existing renters in the area. Result? In-Migration. (This comment should not be misconstrued as a lack of concern for the inherent responsibility of society to assist our seniors to find affordable housing. Rather, my comment is made to point out the inadequacies of the planning analysis presented by the DSEIS.)

The consultants acknowledge in Appendix K, at page 15, that:

> any attempt to make population and housing in the Total Study Area conform to the (population) guidelines by 2010 would likely demand down-zoning and stringent controls on growth of any kind, lowering "population capacity" to levels within the guidelines.

Both the General Plan and the Central O'ahu/North Shore Regional Plan contain numerous entries pertaining to directing growth to central O'ahu and the 'Ewa plain and away from rural areas and the "urban fringe." This area is growing faster than anticipated. All of this evidence points, rather glaringly, to the inconsistencies within this entire document.

Ultimately, the questions avoided are: (1) How does this project purport to address housing needs in the area, when it does not, and when it primarily increases immigration that planning documents seek to curtail, and (2) How does a development that increases the need for infrastructure -- indeed assumes the inevitability of a four-lane highway -- claim to "enhance" the "rural" character of the area? These are a few of the "larger" questions that the document either fails to address or, unfortunately, conveniently dismisses.

The project will increase housing stock in the area by 30%. The developer claims that this will increase population by "only" 20%. This projection is entirely unsupported. A 30% increase in housing directly means a 30% increase in population. Period.

The consultants note that a survey indicated that more than 20% of "single family" units actually included more than one unit. They note that there is a "possibility" that households in their project "might" be smaller than Pupukea. They claim that the buildout of this project will be slower than anticipated and that many of the market lots will be second homes.

They "assumeth" too much. The reality is quite different. The trend in Pupukea in recent years indicates that most recent vacant lot resales in the area are built out immediately; real estate professionals describe this as a result of higher prices and much higher property taxes that force newer property owners to develop their land quickly. Many of these newer homes are built as multi-family units. The Lihi Lani project will continue these established trends. Larger multi-family homes will be built at a faster pace than before, especially given that the prices will certainly be even higher than today and the homeowner association fees will be substantial, given the private infrastructure that Lihi Lani will require.

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13 December 1993

Ken Newfield
59-165 Ke Nui Road
Haleiwa, Hawaii 96712

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Mr. Newfield:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of 21 November 1993.

1) **Traffic**

The factor used for ambient traffic growth of 0.8 percent was a derived rate from the DBEDT population growth factors. This rate reflects the averaged growth in visitor traffic passing through the North Shore and growth in through traffic from Oahu residents not living on the North Shore.

The difference between through-traffic and daily traffic is that through-traffic is a type of traffic movement represented by vehicles traveling through an intersection, and daily traffic represents the 24 hour traffic count. A local resident is defined as a resident of Oahu. A destination point is where traffic from nearby projects (resort, commercial and residential areas) could affect study locations.

The projection of future traffic conditions for the Lihi Lani traffic study follows a methodology accepted by the State Department of Transportation for the preparation of traffic impact assessments in Hawaii. The traffic assessment of Lihi Lani estimates future traffic growth from many sources. There is most definitely a discussion of cumulative impacts projected from the Primary Study Area All known approved or planned developments (land use approvals in place of applied for) were included in the traffic analysis. When all these are taken together, the total traffic growth is projected at 10 to 15 percent annually. The traffic assessment did not try to underestimate growth, if anything, it tended toward an overestimate of future traffic. The traffic study estimated future traffic growth according to official schedules (DBEDT population projections), when actual growth may occur more slowly.

The comments regarding the expansion of Kamehameha Highway to a four lane highway reflects very preliminary long-range DOT plans to complete such an improvement by approximately 2005. Traffic at the projected year of completion (2008) included that planned improvement of a four lane highway. Absolutely, in no way does Lihi Lani cause the need for such an improvement, rather the analysis was conducted with the planned improvement in place. Without the highway improvement in place, with or without Lihi Lani, the highway would be operating over critical volume. By 2008, assuming 100 percent occupancy of the Country lots, Lihi Lani will represent 5 to 8 percent of the highway traffic. Actually, the Country lots will only be 65 percent occupied, therefore the project will result in only 3 to 5 percent of the traffic on Kamehameha Highway. Lihi Lani will not cause significant future traffic -- other projects and the highway will cause this traffic problem.

The fact is that by 2008, with or without Lihi Lani, the highway will be operating over capacity during peak traffic periods without improvements. This is not a rosy scenario, and the facts are not hidden in the PPE report, rather they are appropriately presented by PPE using accepted analysis methodology. The North Shore communities will be facing a traffic problem in 15 to 20 years, and Obayashi is willing to be a strong member of your community team to help address the future traffic problem.

2) Population

Your letter raises questions about local growth that are addressed in response to your other letter, on behalf of the Sunset Beach Community Association. In your letter of November 21, you add an overall interpretation, that Lihi Lani will create immigration to the North Shore, and specifically to the Pupukea/Sunset Beach/Waimea area. This interpretation deserves close study.

A residential project does not create immigration. Housing availability is <u>one</u> factor, and only one factor, in people's decisions about where to live. North Shore residents have been attracted by the rural atmosphere, the world-famous surfing area, by friendships with others in the community, and so forth. Some time in the future, job growth at Kuilima will probably be another major force attracting adults to the North Shore and Koolauloa.

You assert that housing growth is the same as population growth. If that were so, then Hawaii would not have has a housing crisis over the past few years -- people would stop having children until they could afford better housing.

If housing is not built in planned communities, immigration and population growth still occur. Crowded housing, illegal rentals, and spiraling prices abound. Areas designed for smallholder farming are transformed into estates with no agricultural production.

You believe that the project will be built out quickly, based on your knowledge of recent resales. Consultant studies for the Draft SEIS analyzed recent trends in Pupukea Highlands and other large lot subdivision areas in terms of home completions as a share of vacant lots sold (including resales). The projection that 12 percent of these will be built out annually is higher than the historical buildout rate for Pupukea. In short, the Draft SEIS shows a fairly fast buildout for this sort of project -- historical data suggest a somewhat slower buildout.

Lihi Lani will provide low-density housing in the midst of open space and agriculture. Many residents will already be from the North Shore; many will be new to the region. It is possible that some would not come to the region if Lihi Lani were not built, but it's likely that many would live in the region, increasing the density of older residential areas.

Considering the substantial 2.5 percent population growth experienced in the Primary Study Area during the 1980's, the majority was absorbed by Pupukea Highlands lot buildout, infill along the coastal area, and also construction, with or without permit, of duplex units. Lihi Lani in 2010 will be 58 percent as dense as Pupukea is now. Population growth at Lihi Lani will be far slower than the regional growth seen in the 1980's. If the growth rate of the Primary Study Area is somehow maintained at 2.5 percent -- which seems very unlikely -- than the total growth in this area would be about 2,700 people. In this scenario, Lihi Lani would house about one-quarter of this growth. Continued growth at the 2.5 percent annual rate would involve crowding and many illegal units outside Lihi Lani to house the bulk of this population.

As you note, Lihi Lani is "a major residential development" in the North Shore context, but not in an island-wide perspective. We recognize that Lihi Lani will have local population impacts. However, it will provide housing in keeping with the rural atmosphere that you and we both value, and it will also bring to the North Shore recreational facilities that rural areas usually lack.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

11/93-2612

58-020 Maika Pl.
Haleiwa, Hi. 96712
Nov. 19 1993

Mr. Robin Foster, Chief Planning Officer
Planning Department
Honolulu Hale

Re: Lehi Lani Ranch Supplemental Environmental Impact Statement

Dear sir:

The Lehi Lani Supplemental EIS seriously underestimates the traffic growth and its consequences which will result from this development at the intended level.

The impact envisioned by Lehi Lani is based on a faulty premise: i.e., that the Sunset beach area is a normal area and can be looked at like any other site and that that many of the market priced lots will be purched as "second home" sites.

The second home concept is a relic of the past. Such homes as now exist are in reality fully occupied by owners or renters. In reality MANY MANY homes in the area have become illegal multiple dwellings or have an illegal number of roomers. For example, my own cul de sac contains 19 homes and has 51 cars, 2.68 cars per home. The next two streets have an even higher ratio, about 3 cars per home. This is typical of the area.

This is not a normal area in terms of traffic flow. We only have ONE THROUGH STREET in this area, the two lane Kamehameha Highway. Every residential street feeds directly or indirectly into it. All commuter traffic, school traffic and beach or circle island traffic must use this route. No detours exist. There are daily traffic backups at commuter time, school time and on weekends during the entire day. No other routes are possible or planned. No widening is possible without major construction and condemnation of existing housing.

When you have been delayed for several hours by traffic backed up from Sunset Beach Park to a point several miles Wahiawa side of the traffic circle you face the the prospect of traffic increases with a feeling of hopelessness. We cannot control the tourist and beach traffic, we cannot even control the illegal residence usage since the building department has no effective way of dealing with this, we cannot cut down the commuter traffic with the minimal bus service available, but we hope you will control the large development in this this area of inadequate infra-structure.

Sincerely,

Jean L. Merlet

Jean L. Merlet

13 December 1993

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Jean L. Merlet
58-020 Maika Place
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Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Mrs. Merlet:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of 19 November 1993.

Your concern about traffic generation form second homes is something that we have paid close attention to in our traffic study. First, Lihi Lani will have approximately 75 percent full-time residents, according to our market study, and this number could be high based on the occupancy of comparable areas. Second, there will be no duplex homes allowed on the Country lots, which happens frequently throughout Sunset Beach and Pupukea. There will be no illegal residences at Lihi Lani due to the rules of a Homeowner's Association.

The Pacific Planning and Engineering, Inc. (September 1993) traffic study is, therefore, not faulty in its presentation. The PPE study is a valid presentation of the estimated traffic from Lihi Lani, and the project's traffic will really just be a small part (5 to 8 percent) of the future traffic predicted for Kamehameha Highway.

The traffic flow of Kamehameha Highway is recognized to be congested at certain times, and all signs point to higher traffic coming in the future along this route. These future sources of traffic are somewhat predictable due to the known growth rate of traffic and known future developments in the region, such as Kuilima Resort. One possible solution you point out is expanded bus service to the North Shore, which is definitely considered in the long term plans of the City and State.

Lihi Lani is just a small part of the future traffic, and nearly half of its traffic is from community facilities and affordable housing. It is unfair to condemn these valuable parts of the North Shore's future (i.e., YMCA combined uses at the school, elderly housing and its volunteers to the school) for the sake of a few less cars. The North Shore communities must face the fact that, with or without Lihi Lani, the existing roadway system serving the North Shore is going to be inadequate in the future. Obayashi is now, and will continue to be, a very interested part of the community, and will participate in the community's future planning of highway improvements when warranted.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

Group 70's copy

Mr. Robin Foster, Chief Planning Officer
Planning Department
City and County of Honolulu
650 South King Street, 8th Floor
Honolulu, HI 96813

November 18, 1993

Re: Draft Supplemental EIS for Lihi Lani, TMK 5-9-05:6,Por.38,82
and TMK 5-9-06:1,18,24, Pupukea and Paumalu, Koolauloa,
Oawu, Hawaii

Dear Mr. Foster:

We have enclosed our comments regarding the Lihi Lani SEIS in terms of the environmental impacts of soil erosion, storm water runoff/drainage and Ocean Water quality. We are both longtime residents of Sunset Beach who reside on Ke Nui Road just below the Kahuku end of the project.

We hope that you will give serious attention to our concerns and that you workout a set of mitigative measures not adequately addressed in the SEIS to satisfy our concerns that Obayashi must implement before you or any other government agency would recommend approval of this project.

Sincerely,

Dr. James Blattau
59-199C Ke Nui Rd.
Haleiwa, HI 96712
Phone-6388427

Mr. Peter V.Z. Cole
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Soil Erosion, Stormwater Runoff/Drainage and Water Quality

An EIS is supposed to provide pertinent and complete information on the potential impacts of the development to the environment and the mitigative measures planned to minimize any negative impacts. The Lihi Lani SEIS does not provide sufficient information and rationale to support many of their major findings regarding the impacts associated with the soil erosion, stormwater runoff/drainage and water quality issues. We question the engineering and scientific research of appendices F, H and I which support the findings summarized in sections 4.3, 4.6 and 4.7. We realize that the developers, and their contracted consultants, will present data that support their project; it is our objective, as the ones who would be most adversely affected by the project, to present our major concerns with the SEIS regarding storm water runoff and other associated environmental impacts.

The most questionable finding stated throughout the report is the statement that the proposed project and mitigative measures would reduce the runoff from that existing today. The data and associated rationale presented in appendices F and H do not provide adequate information for such a broad statement favorable to the project.

The third paragraph of page 4-27 states that the percent of difference between runoff attributed to the project and that existing today is approximately four percent when considering the extreme 100-yr., 24-hr. storm, which gave the greatest calculated incremental storm water runoff volume. Tom Nance on page 6 of appendix H states that without the proposed 40 detention sumps, the runoff will increase 5 to 15 % with development, but that the sumps would somehow reduce this to zero, or even a negative number, thus implying an improvement with the project. Engineering Concepts makes similar statements backing an improvement with the project in Appendix F.

We were suprised to find that the 1993 SEIS has omitted some of Gordon Dugan's findings on page 14 of Appendix H to the 1991 EIS, which supported our prediction that the preparation of the land for construction, which involves significant grading and clearing of vegetation, would most definitely contribute to a significant increase in runoff volume. Dugan stated that if one were to consider a 2-yr., 1-hr. storm, the storm water runoff would increase 400% with the 1991 planned project which had significantly less ranch lots and associated roadways in the trouble-spot areas of the property than this 1993 plan. He also pointed out that if one chose storms that lasted longer, but had long times between recurrences, this percentage increase was not nearly so great, e.g., 11% for a 24-hr., 100-yr. storm. It appears that both Nance in Appendix H and Engineering Concepts in Appendix F have discovered how they can select data from infinite possibilities that would best present a favorable study for the Lihi Lani project. They also use numbers from big storms that occur rarely and plug these numbers into formulae that may have little to do with why we flood.

We will sumarize their very suspect methodologies below:

1) U.S. Soil Conservation service (Tom Nance, Appendix H)

$$Q=\frac{(P-0.2S)^2}{P+0.8S}$$

Where Q=runoff in inches
P=storm rainfall in inches
S=1000/CN-10 where
CN= "weighted curve number"

2) Soil Conservatoin Service TR-20 computer program (Engineering Concepts Appendix F)

The formulae used by the computer are not specified, but this program, we are told, "analyses the routing of flood waters through the proposed detention basins - ie. a computer model".

3) Universal Soil Loss Equation (Engineering Concepts, Appendix F)

A=KLSCP (see page 16 for "explanation" of each factor and assumptions about each factor).

Let us now see how these "scientific methods" are used to work the numbers:

1) 100 year, 24 hour storms are selected; they so happen to generate numbers that show less difference between existing and developed conditions. These storms, rare and isolated, are not what produce the flooding in our area. Rather, repeated, stacked, small, short storms in rapid succession produce the flooding (as observed by Dugan). The formulae do not use numbers from these storms and even if they did, they would not reflect the runoff accurately because there is nothing in the equations that assumes 100% saturated soil, ie. soil that acts like hard cement, absorbs nothing and just acts as the floor of a flume to conduct water downstream to our neighborhoods. How does formula 1) factor in both frequent, stacked storms and saturated soil? What is the weighted curve number (CN)?

2) Without knowing what the TR-20 software is calculating and what assumptions were made by the programmer, it is impossible to say whether the data generated is accurately reflecting either the true runoff situation or the advertised reduction produced by the placement of detention basins. There must be a clear understanding of what TR-20 is doing, before we stand in awe and belief of TR-20's results. This is a particularly important concern when it is this apparently random placement of detention basins, as presented in figure 4-7 on page 4-29, that is the most pertinent mitigative measure proposed by the developer. We need much more specific information about the placement, design and associated implementation costs of this detention basin scheme. We are particularly interested in why the basins are planned for certain locations, and what proof they have for their apparent success as a runoff deterent. We have noted that the overlaying of this figure 4-7 on top of the slope analysis figure 4-1 on page 4-3, the construction phasing figure 2-14 on page 2-25 and the master plan figure 2-1 on page 2-2 does not produce a logical plan of attack.

3) It is hard to imagine that the Universal Soil Equation says anything. Superfically it looks like a real formula, but when one learns that each of it's factors is quite subjective (eg. C="cover and management factors", P="erosion control practice factor", etc.) one sees that we are not dealing with hard data. (We like 0.025 for C as opposed to 0.022). We do not see any factor in this equation that represents our concern about the saturation of soils caused by our most common storms and about the effects of the significant construction activities involving the grading and clearing of trees and vegetation which our nature's way of detering runoff.

We our very much concerned with the short term impacts imposed by the road, infrastructure and residential developments planned for the first phase from 1996 though 1998, as described in section 2.4 on page 2-24. The construction of the access road extending from Kam Highway, up the face of the cliffs overlooking our elementary school and neighborhood parks as well as the famous Pipeline surfing area, and throughout the property above the cliffs, is one of our major concerns. Even Nance seems to admit that this is a very significant problem that lacks specific, effective mitigative measures in the SEIS (pages 15 - 17 of Appendix H).

Appendix I by Marine Environment Consultants presents unconvincing arguments using calculations from Appendices F and H to conclude that the runoff effects to the water quality of our beautiful ocean area would be nonexistent from the Lihi Lani project. The findings depend on the forecasting methodologies of Appendices F and H which we have questioned above. Our surfing areas known throughout the world are too precious to downplay the effects from runoff in such a cursory way. One extra day of brown, silt-abundant ocean water attributed to the project is one day too much to even consider the go ahead of this project. We expect much more thorough analysis on these environmental concerns than what we have reviewed in the SEIS.

The Last area of concern is not even addressed in the SEIS. This is the fact that many of the ranch lots to be marketed reside in and directly above the very steep portions of the project. Of the total 1,144 acres, slight slopes of 0 to 10% make up only 20% of the property. Moderate slopes of 10 to 20% make up only another 10% of the property. The remaining 70% of the property is either steep (20 to 30% slopes) or very steep (30% and greater). Lihi Lani proponents keep mentioning that their plan of ranch lots extends the existing Pupukea and Sunset Hills developments. However, the topography of their property is much more adverse and inaccessible. In otherwords, as stated previously by the City and County Planning Department in their recommendation of rejection to the Planning Commission in 1991, we have a questionable area for developing a project of Lihi Lani's magnitude.

Based on the Master Plan of Figure 2-1 and the previously planned subdivisions layed out in figures of the 1991 EIS over the same areas of interest, we have determined some significant results summarized below:

1) The Kahuku-Makai corner of the property overlooking the Paumalu Stream Gulch and Kammies Store is one of the very steep portions of the property and will contain 17 ranch lots that extend from the plateau where flooding and associated soil erosion have been a significant problem all the way down to the Paumalu Gulch. The existing ridge and abundant trees and vegetation along these slopes have not been an existing source of runoff. However, by selling these areas as picturesque ranch lots, there exists no assurance that the developed lots will not pose a new, formidable source of storm water runoff.

2) A similar very steep region exists on the Makai, Haleiwa side of the property where 30 ranch lots will extend from plateaus down very steep slopes overlooking the Kahenawikaala stream gulch.

3) In the middle of the property we have the Pukulena Gulch which will border the controversial access road, the Waste Water Treatment System and thirty planned ranch lots.

Each of the above gulch areas with associated very steep slopes pose a significant problem when constuction of roads, ranch lots and other facilities alter their existing environments. No specific details in the SEIS address these issues, and the SEIS should. Once the ranch lots are privately owned, and if the proposed mitigative measures of detention basins, retention ponds and new vegetation do not work, then the only means of corrective measures would require purchase of property, donation of property or condemnation of property, all privately owned, by the government to construct the proper drainage facilities at a tremendous expense to the tax payer. Similar situations have existed elsewhere where nothing has been done due to the unwillingness of private owners to give up any of their land. The ranch lots are an imposing problem unless a restrictive covenance is built into each ranch lot sale so that private grading, landscaping, animal pastuering and top soil deposition can not take place to undermine the effectiveness of the SEIS proposed mitigative measures pertinent to soil erosion, storm water runoff/drainage and our ocean water quality. Unfortunately, past attempts to implement and execute such covenants have proven unsuccessful and impractical.

The flood "data" selected for the SEIS by Lihi Lani is extremely weak, full of subjectivity and entirely unconvincing. They acknowledge on page 4-27 that runoff values presented should not be confused with peak discharge rates and that the latter are required for actual engineering design of proposed drainage facilities. One cannot help but note that the former (runoff values) are derived from questionably valid formulae. Further, one would hope that the latter (peak discharge values) would not be "dry labbed", but empirically measured on-site, before any permits or variances would be granted.

Finally, it is important to point out that those of us living in the frequently flooding flat land below this proposed project have been working for several years (as the NorthShore Flood Control Task Force), searching for solutions to our present flooding problems. We have been encouraged by a very helpful State House Representative, Alex Santiago who introduced H.C.R. 273 that created our task force. Our findings were published in a report to the 1993 legislature - "A Study to Alleviate Chronic Flooding on Oahu's North Shore" - prepared by the DLNR November 1992.

We would hope that the State and City/County departments would recognize the need for concrete plans that prevent runoff and flooding problems before granting permits and variances for future developments, such as Lihi Lani.

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13 December 1993

Mr. Peter V. Z. Cole
59-199D Ke Nui Road
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Dr. James Blattau
59-199C Ke Nui Road
Haleiwa, HI 96712

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Gentlemen:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of 18 November 1993.

1) **Drainage and Surface Water Quality Analysis**

Your letter expresses the several concerns and dissatisfaction with the drainage and surface water quality analyses in the Draft SEIS. These are summarized below along with our response.

- You commented that because the formulas in the TR-20 computer program and the parameter values elected by ECI in running the program are not presented, it is impossible to have confidence in the computed results.

- Another series of questions you had regarded the perceived "random" placement of detention basins, why the basins planned for certain locations and what proof is there of their success as a runoff deterrent.

- You comments noted that the Draft SEIS has omitted some of Gordon Dugan's previous findings (Appendix H of the 1991 FEIS). Specifically, you stated that storm durations and magnitudes analyzed in the 1993 Draft SEIS were purposely selected to present the project in a favorable light. You claim was that if shorter duration storms of lesser recurrence intervals were analyzed, particularly if these occurred in rapid succession ("stacked storms"), the beneficial effects of the detention basins would be less.

- In your comments, the accuracy of the Universal Soil Loss Equation (USLE) was also questioned, particularly its applicability to concerns about the saturation of soils prior to "common" storms and the "short term" impacts of construction activity within the steep slopes of the project site.

The degree of sophistication and level of detail in the analyses by ECI TNWRE were chosen to support a land use change application. It should be recognized that project planning and design are not at a stage where a grading plan has been created or alignments and profiles of roadways have been determined. As the comment letter received from Nathaniel Conner of the U.S. Soil Conservation Service (SCS) attests, the analytical approach used at this stage is appropriate. This comment comes from the agency which developed the formulas and computer program used by ECI and TNWRE.

The TR-20 computer program provides solutions to the runoff formula quoted in your letter. It allows the project site to be divided into numerous sub-basins, and ECI used 47 sub-basins for the developed condition). Runoff for each sub-basin is calculated and then routed downstream and combined with runoff from the next sub-basin. Where detention basins are constructed (ECI has identified 40 of these), the program accounts for the impoundment of runoff based on the detention basin's storage volume. Antecedent moisture conditions, referred to as "stacked storms" in your letter, are handled in the choice of the weighted curve number (CN value). This technique is widely used and accepted by the engineering community and government agencies, either in the form of the TR-20 program of the SCS or in the similar HEC-1 program of the Corps of Engineers.

At the present stage of the project's planning and design, it was necessary for ECI to make certain assumptions about grading and road profiles in order to locate the detention basins and perform the flood routing. Although the locations chosen are clearly not random, it should be recognized that these may not conform exactly to what is eventually constructed. From this perspective, ECI's analysis, as well as the TNWRE analysis which draws from ECI's results, should be viewed as a presentation of a development intent, not a final design. It is a statement of the developer's commitment to construct detention storage such as illustrated in ECI's plan and mitigate the effects of development. In fact, it is an unprecedented commitment for a development of this kind.

The comment letter also shows a misunderstanding of the comparative effects of the larger storms analyzed in the ECI and TNWRE studies and the short duration, less sever "common" storms which the comment letter says is the real source of flooding problems. Detention basins have a far greater mitigating effect on small-scale storms because the storage they provide represents is a larger portion of the storm's runoff volume. This is detailed in the TNWRE study which compares the retention basins' effects on 2, 10, and 100 year, 24-hour storms. Clearly, back-to-back successive storms mentioned in the comment letter will produce greater runoff and flooding that storms of similar magnitude but spaced out over time. However, this fact does not discount the beneficial effect of the basins. Although the beneficial effected is lessened, the improvement over existing conditions without detention basins is still valid. These basins are best means to mitigate runoff impacts for whatever magnitude or sequence of storms chosen for analysis.

Finally, use of the Universal Soil Loss Equation also seems to be misunderstood. The equation estimates average annual soil loss based on six predictive parameter values. Four of these parameters will be altered by development; the other two are meteorological and soil properties that will remain the same. The USLE result should be viewed only as a relative indication of sedimentation. It is not an evaluation of specific storm events as assumed in your comments.

2) **Marine Water Quality**

The conservative analysis presented in Appendices F and H are used to predict potential effects to ocean water quality off Sunset Beach. With the substantial construction mitigation measures in place, only slight increase in silt runoff may be experienced during major storm events occurring during the construction period. The increase in silt runoff during the most extensive construction period (Phase 1 roadways) is conservatively predicted at 8 percent for the Paumalu Watershed for the 10 year storm. Compared to existing natural suspended sediment input from the Paumalu Stream watershed, this temporary increase in silt runoff during large storm events will not be significantly different. The ocean water quality will not be adversely affected by this short-term event.

Your comments make it appear as if silt runoff to the ocean from construction at Lihi Lani will be a chronic occurrence, which is not true. As you are probably aware, the stream connections to the ocean at Paumalu, Pakulena and Kalunawaikaala only open up during major storm events a few times per year. These streams remain closed during most of the small and moderate rainfall events. During Phase 1 construction, there will be very few times when runoff from the site will enter the ocean. When these streams open to the ocean during the existing large storm events, tons of suspended sediment are released to the ocean from the entire 1920-acre watershed. During the few years of major construction in Phase 1, Lihi Lani may contribute a very small additional amount of silt runoff. Subsequent phases of construction will pose even less potential for silt runoff generation. Over the long term, when the project is in place, silt runoff from the property will decrease by over 20 percent due to erosion and drainage controls at Lihi Lani.

This is not a cursory treatment to downplay the effects on surfing areas. We have not ignored your comments! Obayashi has most definitely heard yours and others comments on the issues of erosion, drainage and ocean water quality. The intensive studies over six years, and the extensive refinements to our planning for erosion controls and drainage controls is in direct response to these concerns. The planning is now in place, and the detailed design effort and significant additional expense to accomplish the mitigation has been committed to by Obayashi. You have improved the plans in a very positive direction, and the project and the community will benefit greatly from your efforts.

3) **Steep Land and Country Lots**

The topography of Lihi Lani is more steep than the adjoining Sunset Hills and Pupukea Highlands. You are probably aware, however, that it is very difficult to built anything where the slope is over 15 to 20 percent. If you could refer to the conceptual agricultural plan (Figure 2-2 of the Draft SEIS and Final SEIS), you will get a better picture of the actual design approach to developing Lihi Lani. The homes are not perched on steep hillsides of 20 to 30 percent or greater, rather they are strategically limited to pads on gentle to moderately sloped lands.

You address a scenario where the Country lots are developed and managed in a haphazard fashion without respect for the natural features of the land. For six years, and throughout our documents, we have been describing the measures that will be put into place to limit the use of steep lands on private properties at Lihi Lani. This will be accomplished through a Code of Covenants and Restrictions (CCR) which will restrict individual lot owners from clearing, grading, grubbing, filling, construction and grazing use on steep lands within their lots. In effect, these lands would end up in a type of conservation status because of the strict limits on uses. Your concerns of uncontrolled erosion and silt runoff are addressed in these measures for the entire property. The Lihi Lani Homeowners Association will have the muscle to enforce such regulations. Nothing like this is in place at Pupukea or Sunset Hills, where lot owners can perform such activities within the existing legal limits.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

HAWAIIANA CONSULTANTS
PUBLIC RELATIONS & RESOURCE MANAGEMENT

Learn the Territory Before You Land

November 14, 1993

Mr. Mel Murakami
Department of General Planning
650 South King Street
Honolulu, HI 96813

Dear Mr. Murakami:

Please find enclosed comments relative to the Lihi Lani Paumalu and Pupukea Draft Supplemental Environmental Impact Statement dated October 1993.

As a Sunset Beach concerned citizen and property owner one has considerable at stake in what should and can be developed in the area's highlands.

We appreciate your department keeping everyone advised.

Respectfully yours,

Kamuela Price

cc: Jeffrey Overton
Obayashi Hawaii Corporation
Quon Yamagishi Partnership

59051 Pupukea Road, Haleiwa, Hawaii 96712 Bus: (808) 538-3511, Res: (808) 638-7841

KAMUELA PRICE
A Concerned Citizen of Sunset Beach
59-051 Pupukea Road
Haleiwa, Hawaii 96712

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GROUP 70

November 22, 1993

Mr. Mel Murakami
Department of General Planning
City & County of Honolulu
650 South King Street
Honolulu, HI 96813

RE: Application for a North Shore Development Plan Land Use Amendment and a Supplemental Environmental Impact Statement for Lihi Lani
Koolauloa, Oahu, Hawaii
TMK: 5-9-05: 6 Portion 38, & 82
5-9-06: 1, 18, 24

The following commentary by Kamuela Price, a Concerned Citizen of Sunset Beach and Sunset Beach property owner, responds to the six key differences in the original EIS enumerated on page ES-2 of the Supplemental Impact Statement of the Lihi Lani Paumalu Obayashi Hawaiian Development Project.

I. Deletion of the 18-hole golf course, driving range and clubhouse.

Possibly a step in the right direction. Ironically, the EIS clearly states on P. 8-12 last paragraph labeled «Golf and Housing» that environmental impacts would be the same or slightly greater than the proposed project. Not very comforting to the community unless the Lihi Lani developers are willing to make some additional well-thought-out environmental adjustments to the project.

II. Increasing the number of residential units on the site from 300 to 455 (80 by the City) while maintaining affordable housing by participating in the creation of up to 180 units.

It makes little sense from a «protect the environment» point of view for the City and County or the Obayashi Corporation to propose constructing density (affordable) housing in an inaccessible, currently protected, area designated «conservation, agricultural and watershed.» Unless, of course, it is a ploy to obtain a City and County permit allowing the construction on their adjoining Kam Highway property of an environmentally risky steep access road plus the building of an otherwise unnecessary costly experimental-type waste-water disposal system. One should keep in mind that a similar oxidation pond in Waimanalo recently burst, causing a sewage spill, unpleasant odors and rivers of unhealthy pollutants. The EIS fails to properly address this distinct spillage possibility.

III. Major focus on agricultural use in country lots and common areas over 160 acres of the property including grazing pasture within the horse ranch.

A rather self-serving statement not entirely true. Actually the major focus seemingly is on building a very expensive access road and waste water disposal plant to serve the density housing intended to fulfill the City's affordable housing requirements. In view of the ecological dangers to the Sunset Beach lowland community during the construction stage of the aforementioned road and possible spillage and seepage from the planned waste water system it would be much more prudent to eliminate the need for a road or experimental waste water disposal system by building the low-cost housing elderly home units and YMCA in the Haleiwa-Waialua area where they would more likely be welcomed by the community as a whole.

IV. Phased development into four phases of three years each divided into one year sub phase for infrastructure, homes, and agriculture area.

On the surface it sounds like this might resolve some traffic concerns. Actually though, it presents the distinct possibility that Kam Highway and the Sunset Beach Pupukea community will face intolerable truck traffic and noises for 12 years to come and according to the EIS all the way up to the year 2034 when the project purportedly may be completed. The EIS improperly addresses this new long-range building plan as a positive rather than a negative factor.

V. Smaller construction forces required to develop the first phase of the project equal to about 1/2 of workers in the 1991 project.

This may be a great boon to Obayashi, by cutting labor costs and allowing them to develop the project at their own pace all the way up to the year 2034. This accentuates what many of the Sunset Beach residents suspected all along: a costly access road, unneeded density housing calling for an expensive experimental waste water treatment system suggests that the developers, to get a return on their heavy investment, are cleverly setting the stage to eventually build a city in what is now and should remain a low density forest preserve watershed area. the EIS does not properly address what restraints the City and County would place on the project to prevent urban sprawl in the highlands of Sunset Beach.

VI. Larger buildout period for the project due to phasing and the project rate of individual home construction of the country lots (as witnessed at Pupukea, Hawaii Loa Ridge with only 65% buildout by 2008, 80% by 2014 and full buildout several decades later.

As previously stated, the EIS addresses this stretching out period as a positive point when it actually considerably prolongs the construction period through which the community must suffer. If the density (affordable) housing were moved to the Haleiwa-Waialua Town area or a Sunset Beach By-Pass road from Whitmore Village to the Polynesian Cultural Center constructed the project would begin to make sense. In the interim all (affordable) density housing in the Sunset Beach highlands Lihi Lani project should be put on hold until a way is found to eliminate the steep access road to the project currently being proposed by Obayashi.

VII. Assessment of the existing human and socio-economic environmental potential impacts and mitigative measures.

Section 5-2 Page 5-15 - Roadways and Traffic. Under section A (Existing Conditions) fails to address the bottleneck effect on traffic that the current road at Waimea Falls will have during the seemingly never-ending construction phases of the project. Section 5-2 also fails to address the effect the Haleiwa By-pass Road will have when its traffic reaches the narrow two-lane curved road at the Waimea bottleneck. Moreover, the Department of Transportation in its letter dated September 4, 1990 intimates that Kam Highway in Sunset Beach cannot possibly properly service a development the size of the proposed Lihi Lani Project. See attached letter.

On Page 5-82, Section 5.12 (Schools A Existing Conditions) states: «The nearest school to the project is the Sunset Beach Elementary School» which is located adjacent to the makai section of the project site. It fails, however, to address under «B Potential Impact», on page 5-83 that the school is located directly down wind from the project with potential harm to the school children from noise and dust pollution during the construction phase of the project. Furthermore, no alternative rout to mitigate those intolerable conditions is discussed.

On Page 5-72 under «A Existing Conditions #2» comments referring to scuba diving access ways and other important sites, particularly Shark's Cove and the Pupukea Marine Preserve have been deleted. One cannot help feeling that these specific sites where some of the writer's properties are located were left out because the law calls for an additional Federal EIS prior to the project's final approval.

In any event, the writer requests an explanation of what would happen if Shark's Cove filled up with sediment and/or if the Pupukea Marine Preserve's sea life were destroyed during the construction phase of the project.

Conclusion

The Supplementary EIS does not address any of the problems raised in the writer's comments to the original. Like the original, the Supplentary EIS does not properly cover the real infrastructure and environmental dangers facing the residents and visitors to the lowlands of Sunset Beach. The Supplentary EIS fails to properly elucidate the ecological and traffic impact problems that could actually wipe out the environmental integrity of one of the world's greatest surfing and water sports communities, Hawaii's Sunset Beach. As prescribed by law, the EIS should include a Federal EIS covering Shark's Cove and the Federally protected Pupukea Marine Preserve.

At the very least the supplementary EIS should be put on hold until there is a final disposition of the original EIS now on appeal before the Hawaii State Supreme Court.

Respectfully yours,

Kamuela Price

9498216

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

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CALVIN M. TSUDA

IN REPLY REFER TO:

HWY-PA
2.3283

SEP 4 1990

Mr. Kamuela Price
Spokesperson
Concerned Citizens of Sunset Beach
P.O. Box 1183
Haleiwa, Hawaii 96712

Dear Mr. Price:

Thank you for your letter of July 30, 1990, regarding a bypass for the North Shore of Oahu and the preservation of the Sunset Beach community.

Your proposed bypass, from Waimea Bay to Hauula, will be considered in our future studies to improve and/or realign Kamehameha Highway.

Many improvements are being proposed for properties along Kamehameha Highway and the North Shore will undoubtedly attract more traffic in the near future. Consequently, we expect Kamehameha Highway will be heavily-travelled even with a "bypass" facility.

We are participating in an islandwide traffic study conducted under the auspices of the Oahu Metropolitan Planning Office, which is expected to be completed this year. If it identifies a pressing need for more traffic lanes between Waimea Bay and Hauula, we will consider placing an improvement project in our Capital Improvements Program.

We hope that we have addressed your concerns and look forward to your continued support.

Very truly yours,

Edward

Edward Y. Hirata
Director of Transportation

GROUP 70
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Danilo M. Herrera

13 December 1993

Kamuela Price
59-051 Pupukea Road
Haleiwa, Hawaii 96712

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Mr. Price:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of 22 November 1993.

1) Deletion of the 18-hole Golf Course, Driving Range and Clubhouse

The deletion of these elements from the project was made for several reasons, one of which was the reduction of the large grading requirements to construct the golf course in two years. The new project is very different in that the grading requirements are much less than with the golf course. We believe that substantial "environmental adjustments" have been made in the new project plans, and the current project poses significantly less potential for environmental impacts.

2) Residential Units and the Wastewater System

The affordable housing project site is currently designated as Agricultural land for both the State land use classification and also the City's zoning district. This land is not "...an inaccessible, currently protected area designated conservation, agricultural and watershed." The provision of on-site affordable housing has been part of the project plan since 1990.

The proposed wastewater system is not an experimental wastewater treatment and disposal system. The planned system was introduced to Obayashi by members of the North Shore community, and this type of system has been used world-wide. Land application of reclaimed water is currently being conducted safely at over 20 sites in Hawaii. The Waimanalo pond is absolutely nothing like the system being planned at Lihi Lani. The planned system for Lihi Lani will have 58 days of storage capacity without discharge. The potential for spills from this system is highly unlikely since the most reliable type of system was selected with tremendous holding capacity. This type of reliability has a significant cost to Obayashi in the large land area and the extend of required facilities.

The access road will be built to acceptable standards for roadway construction, including allowable limits to roadway grade. Their is no environmental risk associated with the construction of the roadway because runoff will be controlled through on-site detention basins.

3) Agricultural Use

Your comment fails to address agricultural use. The wastewater issue is addressed in the previous response. The access road is needed to access the mauka portion of the property for the main portion of the development which will provide the revenue to offset costs borne by Obayashi to provide land and help develop the elderly housing and the YMCA.

4) Project Phasing and Traffic

The build-out of the project is planned in phases to allow for careful control of construction sites (erosion and runoff control) and allow for product delivery to meet market demands over a longer time period. Pupukea Highlands and Sunset Hills have been built-out over a longer time period because it too is a lot sales type of development. Homes are built as the individual buyers wish.

The intent of the phased development approach is also to soften the impacts of construction effects, and gradually experience growth in population and traffic. There will not be intolerable truck traffic and noises for 12 years to come. We do not believe there been such impacts occurring in Pupukea over the past twenty years. The residential density at Lihi Lani will be 58 percent of the Pupukea Highlands area. The development pace has been gradual, as is anticipated for Lihi Lani. This will serve to avoid such scenarios as you portray. It is not clear why you or anyone else in the community would wish a more rapid pace of development for Lihi Lani.

5) Eventual Construction of a City

There is no plan to develop more facilities or homes at Lihi Lani than is planned in the current Master Plan. This development limits built-out of the property to 315 Country lots, 50 affordable homes and 80 elderly homes. There is no plan for more homes or other more dense development. Urban sprawl is not possible at Lihi Lani since the project density is only 58 percent of that in Pupukea Highlands. The rest of the Pupukea/Sunset Beach community might then be considered urban sprawl in comparison to the low density setting planned for Lihi Lani.

6) **Prolonged Construction Period and Affordable Housing**

The prolonged construction period applies primarily to phased development of the Country lot areas. The development of the phases will not involve major construction such as experienced in Phase !. Phases after Phase 1 will involve some grading and development of circulation roads, sewers, water lines and drainage facilities to serve new homes in each phase. The scale of the subsequent phase heavy construction will be much less than in Phase 1. More importantly, the community is not expected to suffer at all during the construction of any part of Lihi Lani. Applicable regulations on development will be followed to avoid causing adverse effects such as construction dust, runoff and noise. Construction traffic will be carefully scheduled to avoid adverse effects on use of local roads.

The need for affordable housing is significant, and Obayashi is committed to delivering affordable homes as discussed in the EIS. The access roadway is needed to serve the project site.

The Department of Transportation has reviewed Lihi Lani plans and has never stated that Kamehameha Highway cannot properly service a development the size of Lihi Lani. Mr. Hirata's polite response in 1990 to your suggestion about a bypass road does not include any statement, insinuation or intimation about Lihi Lani.

7) **Traffic, Schools and Pupukea Marine Preserve**

Construction equipment and worker vehicles accessing the project site are not expected to cause bottleneck effects on traffic at Waimea Bay. Phasing will help to alleviate the potential for traffic effects due to construction vehicles. The DOT letter makes no reference to the relatively small increase in residences planned at Lihi Lani. Compared to major housing projects in the rest of Oahu, Lihi Lani is a small housing project.

Noise and dust generated during construction are important considerations for the project, and Obayashi plans to implement substantial mitigative measures during construction to control these factors. Noise generated during construction activities is regulated by the Department of Health, for which there are strict standards for noise levels and times. Construction of the access road, elderly housing and the YMCA will include necessary measures to minimize dust and noise, as discussed in the Draft and Final SEIS.

Ocean water and marine resources are addressed specifically in the Draft SEIS. The conclusion of this study was that Lihi Lani will not cause significant adverse effects to water quality or marine resources in the area. The study focused on the ocean immediately off the Lihi Lani site and the three drainage release points (intermittent streams) receiving runoff from the property. There is absolutely no potential for Shark's Cove to be filled with sediment from the construction of Lihi Lani, particularly with the extensive erosion and drainage control system proposed.

8) Conclusion

Your comments have been addressed in our many, many conversations, and all documents prepared for this project, including the 1991 Final EIS. The Supplemental EIS and our responses to comments show that your concerns about infrastructure and environmental dangers are unfounded. Obayashi has spent years of effort and expense to plan a very sensitive project at Lihi Lani, with all of your concerns addressed in the areas of infrastructure and environment. There is absolutely no chance that the project could "wipe out" the surfing and water sports areas off Sunset Beach. There is no factual foundation for posing these claims.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

Kenneth A. Martyn
Attorney at Law

Downtown Office:
1188 Bishop St., Suite 2304
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November 19, 1993

Department of Planning
Attn: Mr. Robin Foster, Chief Planning Officer
City and County of Honolulu
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Re: Comments to Draft Supplemental Environmental Impact Statement for the Lihi Lani Project

Dear Mr. Foster:

I reside in the North Shore area of Oahu. My residence address is 68-545 Crozier Drive, Waialua, Hawaii 96791. I have the following questions and comments in connection with the Draft Supplemental Environmental Impact Statement ("SEIS") for the Lihi Lani Project (Obayashi Hawaii Corporation, Applicant).

ANALYSIS OF THE AGRICULTURAL AND AGRICULTURAL SUBDIVISION ALTERNATIVES.

The analysis of the agricultural alternative, and particularly the analysis of the agricultural subdivision alternative (Section 8.3), do not appear to be genuine good faith analyses of the potential benefits and impacts of those alternatives. Rather, the analysis appears to be intentionally skewed so as to make those alternatives appear less attractive. This is particularly glaring with respect to the agricultural subdivision alternative. By way of example, the Draft SEIS projects over 500 possible agricultural subdivision lots, a number which is unrealistically high given the topography of the land. The analysis is also deficient in failing to consider the possibility of cooperative agricultural areas in such an agricultural subdivision, similarly to the way that the Draft SEIS projects such agricultural cooperative areas for the country lot alternative. In short, the analysis appears to be an attempt to overstate the impacts, and understate the potential benefits, of those potential alternatives.

POPULATION AND TRAFFIC GROWTH PROJECTIONS AND ESTIMATED IMPACTS.

Analysis of projected population growth and its impacts on traffic and other environmental impacts is inadequately considered. There is insufficient analysis of how the projected population per housing unit densities were estimated (2.8 per affordable house, 2.1 per country lot and 2.8 per Ag subdivision lot). Also, project-induced population growth figures should be prepared so as to make a comparison with the existing population and also consider cumulative impacts of total future area population increases from all sources compared to present population. Similarly, traffic projections should also be made as a percentage increase in existing traffic, since that is much more useful information in terms of allowing a feel for the actual increase that will be felt by local residents. Again, this should be done on both a project-induced, and a total-cumulative-increase-in-traffic-from-all-sources basis. Also, the attempt in the traffic study analysis to justify lower than normal trips per household for the project appears to have inadequate factual foundation for such a substantial deviation from standardized norms in the traffic analysis business.

The Draft SEIS attempts to gloss over and ignore the fact that the Honolulu General Plan guidelines for population in the various development plan areas will be further violated by the population increases projected by the Draft SEIS. The Draft SEIS seems to assume that since those population guidelines for the North Shore area will be slightly violated even if the Lihi Lani Project were not constructed, that it is therefore somehow inconsequential that the project's population increases will further exacerbate an already serious problem. In addition, the Draft SEIS appears to underestimate the total population increase from the project.

CONSTRUCTION DUST AND NOISE.

There appears to be inadequate consideration of the impact of construction dust and noise, particularly upon Sunset Beach Elementary School. In addition, increased dust, particularly during the construction phase, can further contribute to total sediment deposition on nearshore reefs, further compounding potential problems from storm water sediment runoff.

STORM DRAINAGE, SEDIMENT AND WATER QUALITY.

The analysis of the impact on the marine environment (Appendix I) seems inadequate. For example, it relies upon data prepared in Appendix F and Appendix H concerning storm water, sediment and chemical runoff. But those studies appear to underestimate (particularly during storm conditions potentially longer than 24 hours) the potential increased sediment runoff. In addition, the potential effects on the marine environment were considered primarily in terms of how it could potentially affect reef growth and the shape of breaking waves. Inadequate attention was placed on the potential effects on other aspects of the marine environment, such as fish and other marine life.

At several places in the Draft SEIS the new 1993 EPA recommended non-point source pollution guidelines are mentioned as possible mitigation measures. This is an excellent idea for reducing such impacts, however, the applicant should legally commit itself to following those EPA recommended guidelines if they are to be touted as a mitigation method.

Very truly yours,

Kenneth A. Martyn

KAM:ky

cc: Group 70 International, Inc.
Attn: Jeffrey Overton
924 Bethel Street
Honolulu, Hawaii 96813

c63\lihi.927

GROUP 70
INTERNATIONAL

13 December 1993

Kenneth A. Martyn
P.O. Box 1132
Haleiwa, Hawaii 96712

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Mr. Martyn:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of 19 November 1993.

1) **Analysis of the Agricultural and Agricultural Subdivision Alternatives:** Your comments mainly reflected issues regarding the analysis of the agricultural subdivision alternative. We believe our analysis of the agricultural alternative (Section 8.2) was accurate.

With respect to the issue of the possibility for developing Lihi Lani without a change of zone, this has been something that has been considered for many years. This potential use of the property was considered in the accepted Final EIS (Group 70, April 1991) and the Draft SEIS (Group 70, September 1993). The Draft SEIS presents and evaluates an alternative plan for the project which involves an agricultural subdivision at the existing AG-2 General Agricultural District zoning. The agricultural subdivision analysis in the Draft SEIS assumes that the rules for approval of an agricultural subdivision would be satisfied in an application for up to 500 2-acre (minimum size) lots. Following the Neighborhood Board 27 meeting on November 9, we have reconsidered some of our analysis and find that even a strained attempt to come up with a feasible agricultural alternative is not realistic. We present these findings below.

Upon further analysis, the agricultural subdivision rules would probably be very difficult to satisfy at Lihi Lani. The most challenging requirement for an agricultural subdivision, as per the Land Use Ordinance, is the need to demonstrate financially viable agricultural use of each lot. The State Department of Agriculture is very strict about enforcing this, and is becoming more strict due to past abuses of the agricultural subdivision approval. It would also be very hard to comply (probably impossible) due to the marginal productivity potential of the soils at Lihi Lani. Obayashi could have pursued an agricultural subdivision of two-acre lots if there was a larger presence of prime agricultural soils of their land. Instead, Obayashi is proposing the minimum possible zoning change to achieve successful diversified agricultural activities. At the Country lots of Lihi Lani, agricultural uses are intended to gain revenues to help offset association maintenance fees.

To establish financially viable agricultural use of the 2-acre lots, the farming use would need to offset the cost of the individual lots. For these lots under the current Pupukea market, this would range from $285,000 to $550,000. Agricultural uses on these lots would need to produce net revenues of $20,000 to $40,000 per year, respectively, to offset costs for land payments, real property tax, insurance, utilities and association maintenance fees. The real limitation to economic viability is attributable to the marginal agricultural soils found on this property. Only 162 acres of B-rated soils (prime soils under the LSB rating system) are found on the Lihi Lani site, and these are in numerous isolated areas which makes it difficult to establish a viable agricultural subdivision of 2-acre farm lots. It is also unlikely that several hundred individual small farming businesses at this one location could be justified in the Oahu marketplace.

There are several other points which discourage establishment of an agricultural subdivision at Lihi Lani as mentioned briefly below:

- There are limited amounts of contiguous prime agricultural soils, with only 162 acre of B-rated soils under the LSB rating system, scattered in numerous locations. Our planners estimate that somewhere between 80 to 120 two-acre agricultural lots could be established using reasonably good rated agricultural land. This number of lots would not be viable for Lihi Lani due to the significant infrastructure costs (roads, sewers, water system, water reclamation facility, etc.) estimated at over $93 million.

- The project would lack community benefits because of reduced revenues and no City requirements for such. Because there would be no change in zoning, there would be no requirement from the City for affordable housing to be provided. There probably could be no use of the makai land for the YMCA or Elderly Housing, because there likely would be a need for agricultural storage and processing facilities to be situated near the transportation corridor of Kamehameha Highway.

The alternatives analysis in the Final SEIS for Lihi Lani has been revised to reflect our recent understanding of the limitations to creating an agricultural subdivision on lands with marginal agricultural productivity potential.

For your information, we have also included a copy of the comment letter on the Draft SEIS provided by the State of Hawaii, Department of Agriculture.

2) **Population and Traffic Growth Projections and Estimated Impacts**

The estimates of population at Lihi Lani were developed by KPMG Peat Marwick, on the basis of census data, the market analysis, and knowledge of comparable markets in Hawaii. They show (in Appendix L, Exhibit 3-A) that the average household population figures cover full-time residential, part-time residential, and vacant units. The average household size for Country lot full-time residences is 3.0 (based on the average occupied household size for the Pupukea Census Designated Place). When part-time units and unoccupied units are included, the average household size for all units is lower. Similarly, the average household size for affordable units combines single family units @ 3.0 persons/household) and elderly units @ 1.4 persons per unit). Hence the average population per household -- including empty units -- is estimated as 2.3 persons for Country lots, and 2.4 persons for affordable housing.

Appendix L also supplied estimates of project-induced population growth in terms of the number of Lihi Lani residents, employees, and members of employees' households might be new residents of Hawaii. The total project-induced population growth is estimated as about 100 persons by 2008.

You are, I think, asking for the amount project-induced population growth on the North Shore. Such growth would be made up of project residents, employees, and employees' dependents who moved to the North Shore because of Lihi Lani. The figure cannot be calculated with certainly -- but it is probably smaller than the on-site population of the project. That is because (a) many Lihi Lani residents will come from the North Shore; (b) employees may live outside the North Shore area, and hence not add to the regional population. The future population of the North Shore, as a whole, is even harder to estimate. Many people will want to live on the North Shore. Where people actually live will depend on the island-wide housing market, job growth in and near the North Shore, and other factors.

You assert that the Draft SEIS "appears to under estimate" population increase from the project. For the reasons noted above, we expect that the approach taken in the Draft -- calculating on-site residential population and State-wide population growth impacts -- is a conservative approach to Lihi Lani's population impacts.

The Draft SEIS discusses the Honolulu General Plan population guidelines both in relation to City and County policy and in terms of impacts. The guidelines are part of a set of population policies aimed at concentrating dense urban development and keeping new developments in outlying areas consistent with the environment and atmosphere of these areas. Quantitatively, the Draft SEIS notes that while the guidelines are calculated in tenths of a percent of the island-wide population, Lihi Lani's population in 2010 will only be seven-hundreds of a percent of the island-wide population.

The guidelines were enacted by the City Council, and they are tools to help the Council make decisions. They are not laws which could be "violated". The City Council has been using the guidelines on a case-by-case basis. The Council has approved projects in Koolauloa and Central Oahu even though these put future population estimates over the guidelines, when the Council finds merit in the projects.

Your comments included a statement that the analysis included "lower than normal trips per household for the project". The traffic analysis utilized trip generation measured from the Pupukea Highlands subdivision, because this community has been used as model for Lihi Lani. The study of vehicle trip generation from Pupukea showed up to a 37 to 60 percent reduction as compared to the rate predicted for a typical subdivision, as calculated by the Institute of Transportation Engineers (ITE). Lihi Lani will be much different than the standard subdivision, and more like Pupukea. As a result of this study, the ITE trip generation rates were reduced by 30 percent to predict trip generation for Lihi Lani. This smaller reduction in trips was chosen as a conservative estimate, and if the project closely follows the Pupukea experience, actual traffic from Lihi Lani could be even lower than predicted.

3) **Construction Dust and Noise:** Your comment considers the potential for noise and dust generation during the construction period. Mitigative measures will be implemented during the construction of the YMCA and Elderly Housing facilities and the project access road to avoid dust generation. Noise generated during construction must fall within the established standards of the State of Hawaii Department of Health. Dust control measures are presented in the Draft SEIS, including an active construction site watering program to minimize dust generation. As a result of these controls, dust from the project poses little potential to contribute suspended sediment in ocean water and cause deposition on the reefs during construction. Erosion and runoff controls will also minimize silt runoff to the ocean and, as carefully documented in the Draft SEIS, no "potential problems" are anticipated.

4) **Storm Drainage, Sediment and Water Quality:** The analysis of marine water quality and marine environmental issues has been given the highest attention by Obayashi and their consultant, Marine Research Consultants. Four different years of baseline ocean water quality monitoring has been completed, in-depth ecological surveys have been completed, and a thorough impact assessment has been completed. The reliance on data generated in the reports by Engineering Concepts, Inc. (Appendix F) and Tom Nance Water Resource Engineering (Appendix H) is felt to be extremely conservative, since the drainage and runoff studies were also extremely conservative. Obayashi has recognized the serious concerns of the community with respect to control of soil erosion and silt runoff to the ocean. The depth of analysis in our technical studies and the extensive (and expensive) drainage detention basin

system both serve to demonstrate Obayashi's commitment to erosion and runoff control.

Comments received from the U. S. Soils Conservation Service affirm the very serious measures planned to control erosion at Lihi Lani. In addition, Obayashi is willing to commit to implementing applicable non-point source pollution control measures from the 1993 EPA guidance on measures to control non-point source pollution, also known as the "blue book". The measures are not yet required as the State has several years to develop their non-point pollution program. In addition, the measures are for activities that do not require a NPDES permit. Obayashi will need a NPDES permit. Nevertheless, as a show of Obayashi's serious concern for the marine environment, applicable measures from the EPA "blue book" will be implemented to provide additional protection to the coastal environment. The only legal measure that will be entered into by Obayashi will be the conditions of the Unilateral Agreement at the Change of Zone process.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

Attachment: Letter from Department of Agriculture

11/93 2651

Keep The North Shore Country

Several factors combine to make the North Shore of Oahu unique: 1. The relaxed rural atmosphere. 2. A diverse population. 3. Substantial fee simple ownership by small private landowners. 4. An incredibly beautiful blending of geographic elements (waves, reefs, beaches, mountains, bays, streams, etc.) that occurs nowhere else on earth.

This situation creates a fragile environmental and recreational resource for Oahu residents and visitors from around the world. A resource of this caliber is invaluable and must not be compromised.

Incredibly, developers and speculators such as Obayashi and Ameron are trying to convince us that their proposed projects will help keep the North Shore pristine. That adding almost 500 homes won't cause unbearable problems. (Traffic and infrastructure to name just two of many.)

Obayashi Hawaii Corporation recently purchased the first three pages (cover included) of The North Shore News in order to publish an advertisement disguised as a news story. The first two paragraphs radically distorted the position of The Central Oahu/North Shore Task Force. The obvious purpose of this highly questionable misrepresentation was to win support for Obayashi's Lihilani proposal. This was done as part of an ongoing public relations campaign.

Obayashi and their planning professionals would like us to think that approval of their proposed project has already been granted or is inevitable. This is simply not true. Existing land use laws prohibit this development. Zoning and other laws are designed to insure prudent land utilization. They protect the character and integrity of our neighborhoods.

Obayashi wants the zoning laws changed. They want to change the North Shore. We must not let this happen unless the net effect is positive.

What about economic growth ? Does economic growth mean actual sustainable benefits for all community members and visitors or does it mean profits for developers ?

What about property rights ? Who's rights prevail ? Those who purchase property expecting an area to remain essentially unchanged or those who purchase speculating on zoning changes that allow development for profit ?

How do we preserve and enhance this area and accommodate future growth at the same time ? Is it possible to encourage increased population and visitor numbers without suffering the effects of over use (ala Haunama Bay) ?

Traditional automobile based developments cause serious pollution and traffic problems and have no place on the North Shore. We need highly imaginative and creative planning solutions. Public relations rhetoric will not suffice.

A place as special as the North Shore deserves the very best thinking in leading-edge, twenty first century, community planning. "Distinguished architects and scholars are sketching visionary plans for self-sustaining cluster communities which would respect the land and Hawaiian Culture and at the same time provide meaningful jobs." This sounds encouraging but if we don't currently possess the planning wherewithal, development should wait.

Please join us in working toward a future that preserves the essential characteristics of this unique area.

Larry McElheny

Larry McElheny
59-272 Pupukea Rd.
Haleiwa, Hawaii 96712
638-8484

NOVEMBER 21, 1993
HALEIWA, HI

LIHI LANI E.I.S. (DRAFT)

① INCOMPLETE / INACCURATE ~~[illegible]~~ PROJECTION OF TRAFFIC INCREASE ON KAMEHAMEHA HIGHWAY.

② FAILS TO ADDRESS CUMLATIVE EFFECTS OF ALL DEVELOPMENTS ON NORTH SHORE (I.E. - EXISTING VACANT LOTS / APPROVED UNITS AT KUILIMA ETC.)

[signature]
L.K. McELHENY
638-8484

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Danilo M. Herrera

13 December 1993

Larry McElheny
59-272 Pupukea Road
Haleiwa, Hawaii 96712

**Subject: Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI
Response to Comments on Draft Supplemental EIS**

Dear Mr. McElheny:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letters of 21 November 1993.

1) Traffic

In your handwritten comments, you state that the Draft SEIS includes an incomplete and inaccurate projection of traffic increase on Kamehameha Highway. The projection of future traffic conditions for the Lihi Lani traffic study follows a methodology accepted by the State Department of Transportation for the preparation of traffic impact assessments in Hawaii. The traffic assessment of Lihi Lani estimates future traffic growth from many sources, including the approved units at Kuilima Resort. When all these are taken together, the total traffic growth is projected at 10 to 15 percent annually. This rate of growth would include traffic generated from the eventual buildout of existing vacant lots zoned for residential use in the community. The traffic assessment did not try to underestimate growth, if anything, it tended toward an overestimate of future traffic. The traffic study estimated future traffic growth according to official schedules (DBEDT population projections), when actual growth may occur more slowly.

2) Country Values and Public Relations

Obayashi has been working closely with the North Shore community over the past six years to create the best possible planning for its project at Lihi Lani. We believe that the values you express for the North Shore are carefully reflected in the plans for Lihi Lani. Lihi Lani contains nearly 700 acres of open space, integrated agriculture, agroforestry, hiking trails, campground, erosion controls, drainage controls, tertiary wastewater treatment, extensive recreational opportunities, community benefits, and a wide range of housing opportunities at density of 58% that in Pupukea. No existing or planned development on the North Shore or anywhere else on Oahu can make these claims.

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Obayashi strongly believes that this message should be heard throughout the North Shore, and this is why we placed our article in the North Shore News in September. We didn't radically distort the position of the Central Oahu/North Shore Task Force (made public in October) -- we quoted the position of the North Shore Task Force Subcommittee from the Draft Report.

Obayashi's consultants have estimated Lihi Lani's impact on traffic with serious concern for the ecology of the North Shore. The plans developed for Lihi Lani will have limited effects, as discussed in the Draft EIS, and not create unbearable problems. Lihi Lani has been planned to be in keeping with the environment and atmosphere valued by North Shore residents.

3) **Zoning Laws**

There has never been any statement made by representatives of Obayashi that the approval of Lihi Lani "...has already been granted or is inevitable." The existing laws do allow for private landowners to request changes in land use designation for their property. The laws provide a mechanism for careful agency and public review of proposals for land use changes. This process requires public input through hearings and review of applications and environmental documents.

The planned change of zone to Country for the Country lots is the minimum possible change to the property's zoning designation which will allow for diversified agricultural use of the property. The land cannot be used as currently zoned, because an agricultural subdivision under AG-2 zoning would not be agriculturally feasible due to the limited agricultural productivity of the soils.

It is important to understand the intent of the Country zoning district and how it applies very well to the proposed Lihi Lani project. The Land Use Ordinance, **5.30 Country District: Purpose and Intent,** states the following:

> "The purpose of the country district is to recognize and provide for areas with limited potential for agricultural activities but for which the *open space* or rural quality of agricultural lands is desired. The district is intended to provide for some agricultural *uses*, low density residential *development* and some supporting services and uses."

The agricultural potential of soils at Lihi Lani is marginal, except for some discontiguous pockets of better agricultural soils. Country zoning for Lihi Lani represents the minimum zoning change available to accomplish the planned goals of diversified agricultural uses and residential uses. The Country zoning will lock in a low density use of the land, bring meaningful community benefits to the North Shore, which will protect the character and integrity the neighborhood.

Obayashi does not want to bring negative change to the North Shore. The net effect of Lihi Lani will be positive for North Shore residents, with the wide range of beneficial aspects of the project. You may not be interested in the affordable or elderly housing opportunities, hiking and horse riding trails, horse ranch, YMCA facilities offered at Lihi Lani, but many of your neighbors have worked with us for the past six years to bring these features to their neighborhood. With the difficulties of sugar in Hawaii, and the possibility of sugar leaving the North Shore, Lihi Lani also brings new agricultural activities and new jobs. With all these community benefits in a project that is 58 percent as dense as Pupukea, it is no wonder that many people have a more positive feeling for the future of the North Shore with inclusion of Lihi Lani.

4) Economic Growth and Sustainable Benefits

Sustainable benefits for all community members will be provided by Lihi Lani. Obayashi has committed to bringing the YMCA facility to a reality, along with delivering affordable housing to the North Shore. Obayashi has committed to providing an Education Trust Fund for scholarships to benefit students of the North Shore schools. Obayashi has committed to developing hiking and horse riding trails throughout miles of its property. These can truly be considered as sustainable benefits for the North Shore community.

In terms of economic growth, Lihi Lani will provide significant employment in terms of construction jobs over the initial development phase, and fewer but still significant jobs over the later phases. You may not consider construction jobs to be sustainable, however, it is likely that many of your friends, neighbors and customers are construction workers. Many North Shore construction workers will be employed at Lihi Lani. During the 10 to 12 years development of Lihi Lani, there will be 140 direct jobs in the first 3 years. An average of 60 to 70 jobs will continue work over the following 7 to 9 year period, with an expected 20 to 30 workers over the following decade. The number of direct jobs created in the operation of Lihi Lani will be about 30. In addition, some of your friends, neighbors and customers in service-related businesses, such as landscape maintenance contractors, will benefit on a sustained basis from the additional homes at Lihi Lani. All of Oahu's community will benefit from the increased property tax revenues generated from the project. These are just a few examples of the sustained economic benefits expected to be experienced on the North Shore as a result of Lihi Lani. Of course, Obayashi would not be developing this land if it did not expect to make a profit.

5) Property Rights

You may have made some assumptions about your community and neighbors that may require additional consideration. First of all, lets discuss property rights. When you purchased your property, you may have assumed that no changes would take place on undeveloped land adjacent to your home.

It is your right to make your feelings heard in the process, but it is not your right to state that another property owner's does not have the constitutional right to request a legal change of zoning for a preferred use of their land. With any piece of undeveloped land which is not designated for perpetual conservation purposes, there is always the potential for that private land owner to request for development rights. It is the ethical responsibility of that developer, however, to attempt to meet community and environmental concerns in planning a use of their land. This responsibility has been met by Obayashi in its six years of community involvement in planning for Lihi Lani.

For your information, Obayashi purchased its property in 1974 and has since held its land at considerable expense ($140,000 per year in property tax in 1993) without gaining any offsetting income from its land. Obayashi has the right to pursue this request without causing adverse effects to your property. Your land and the enjoyment of your land is not expected to be affected by this project.

6) Preserve and Enhance the North Shore and Accommodate Growth

Larry, you have hit on the key issue for Obayashi and their planning team over the past six years. We have been working intensively during this period to reach a plan which meets these goals of preserving and enhancing the North Shore while meeting some of its growth needs. One thing that you recognize in your statement is that we will continue to experience growth on the North Shore. This is true either with or without Obayashi developing Lihi Lani. You now need to ask yourself if Lihi Lani -- with its low-density development plan, environmental safeguards and significant community benefits -- is an appropriate way to accommodate a part of growth on the North Shore. You might also ask yourself if another project or another developer is really likely to come closer to meeting the needs of the community's growth in the future.

Obayashi could have planned a more intensive use of its property, such as a 600 to 800 unit affordable housing development, and this may have better met the housing needs of the North Shore community. This type of project would have maximized profit potential from the land. You must realize that this was not even considered as an alternative during the previous six years of planning because Obayashi and the community agreed that it would create too large a burden on the community. Instead, a very modest and compatibly scaled project was developed for this 1,143 acre property. To date, we believe that a diversified agricultural use of the property made possible through a carefully planned Country lot subdivision is the best way to use this land.

The transportation scheme for Lihi Lani generally follows the existing model of Pupukea Highlands, which involves automobiles. The Lihi Lani traffic study is very conservative, and does not include certain other mitigative measures which are very likely to reduce traffic associated with the project and the surrounding community. For example, the YMCA will likely be instituting a shuttle system to move people to and from the YMCA. The YMCA owns a fleet of vans and would likely work in conjunction with the Lihi Lani Homeowner's Association (for a fee) to shuttle people to and from the facility. Depending on community interest, the shuttle system could possibly include the Sunset Beach area and the mauka areas of Pupukea and Sunset Hills. Another mitigative measure is Lihi Lani's plan to facilitate bicycle travel on the North Shore, by installing bike racks at the YMCA and including bike paths along the project roadway system. This effort toward encouraging bicycle travel will coincide with the Sunset Beach community's effort with the City and County of Honolulu to develop the Ke Ala Pupukea bicycle and pedestrian pathway. None of these mitigating factors were accounted for in estimating the future traffic of the area.

As you and the KTNSC group have recognized, some of the future employment and business activities will tend to move away from traditional commuter existence. With the expansion of communication technology, Lihi Lani will probably be the perfect place for this new mode of careers to be implemented. To be conservative, we could not count on this to happen in the Lihi Lani traffic study. Many Lihi Lani residents will likely work from their home without commuting regularly to Honolulu.

The North Shore is a special place, and we have included the leading professionals in the fields of land use planning and environmental design to help mold Lihi Lani into a modern diversified agriculture and low-density residential project. This is a vision for the future of Hawaii, where so much agricultural land will become available for other uses in the coming years. If we wish to preserve what is important to us in Hawaii -- continued agriculture, a quality and uncrowded place to live, clean air and water -- a carefully planned approach to combined diversified agricultural and residential use in will bring this vision to reality.

There will be other North Shore development proposals that come up in the future. It is likely none could match the features of Lihi Lani in terms of open space, density, integrated agriculture, a wide range of housing opportunities and substantial (and sustainable) community benefits. If you take an unbiased look at all the careful thought and community interest included in the current proposal, you will see that Lihi Lani will most definitely preserve the essential characteristics of the North Shore, especially Sunset Beach and Pupukea. This response to your comments is not rhetoric; it is just an explanation of the reality that you can either chose to ignore (and live with the result), or plan together carefully for the positive future of our community.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

11/93-[illegible]

NOV. 21, 1993
Bill HOWES
59-400 Pupukea Rd
HALEIWA HI 96712
638-7172

MR. Robin Foster, Chief Planning Officer
Planning Department
650 So. King St. Hono.

LIHI LANI -
Agricultural Plan -

- The overall agricultural Plan for Lihi Lani is flawed for many reasons.

1. - Field Stock Trees - a poor substitute for sustainable farming methods. Trees are removed every 5 to 7 years, soil is disturbed each time this occurs.

- Field Stock trees are strictly a market driven crop dependent solely upon large scale urban and or sub urban development. Thier only use being ornamental. They do not provide forage for humans or animals require irrigation and maintenance. ~~They~~ ~~As elements in a sustainable system~~. and are removed every 5 or 7 years, They Therefore fail as elements of a truly sustainable system.

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PLANNING DEPT.
C&C HONOLULU

Agroforestry -

~~There is no [illegible] detail~~

Although it is mentioned, agroforestry in the Lihi Lani plan does not take into account true long range planning for sustainability. These methods have been suggested to Obayashi Corp. several times by members of the community and have ~~have~~ never been fully realized.

Solid Waste -

- Solid Waste generated at this site could all be disposed of and utilized on site.
- There is no mention of the possibility of utilizing the solid waste produced on this site. Possible uses could include, composting of all green and food wastes, for fertilizer, biogas for feul, and the recycling of glass, metal and the re-use; repair of durable used goods.

Agricultural & Waste Water

- There is no mention in either the Agricultural or Waste Water Plan of how the treated efflent will be distributed and used as irrigation. Also the method of irrigation for efflent is not dealt with effectively, as drip irrigtion requires filters for top ~~efficiency~~ efficientcy. and the tertiary treated efflent will still contain suspended solids which could lead to irrigation system failure and ultimately back up of efflent in the holding ponds.

Waste Water

- This system relys too heavily on a system of pump stations which require large amounts of electricity (in the form of fossil fuels)
- There is no mention of the individual power requirements for each pump station as each one would be different in elevation and proximity to the treatment plant requiring more or less feet of head.
- There is no provision for weather-proofing and maintenance of back up generators. ANY engine left unattended requires constant maintenance and is highly suseptable to corrosion and untimely 3

Waste Water

There is no nention of the possible catostrophic consequences to our community in the event of a <u>major</u> sewage spill either from the Makai facilities or mauka.

Such a spill has the potential for contaminating adjoining private and or public property and polluting the ocean environment, and creating a sizable public health risk.

There is not enough information regarding the maintenance of the settling ponds, the treatment process:

Products produced by the treatment process: methane, bio-solids, and carbon dioxide are not fully utilized within a sustaible system. and fail as elements within a sustainable system.

Thank You for hearing my concerns,

Bill Howes

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13 December 1993

Bill Howes
59-480 Pupukea Road
Haleiwa, Hawaii 96712

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Mr. Howes:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of 21 November 1993.

As an active member of the Joint Planning Committee in 1990 and 1991, we have appreciated your involvement in the community-based planning for the Lihi Lani project. Your input to the project plans included significant emphasis on future use of the site for farming activities. We respect the success you have had in farming your Country-zoned lot in Pupukea, and see it as a model for potential uses at Lihi Lani. Thank you for your input and we would like to address some of your specific questions.

1) Field Stock Trees

The plan for agricultural uses of the agricultural easements at Lihi Lani are not primarily for food or forage crops, rather some less intensive uses such as field stock trees, grazing pasture, avocado orchard and other fruit trees, cut flowers and ornamental plants. However, on the individual Country lots, there is the potential for many different types of agricultural uses to occur. We expect people to grow some of their own food, such as your family does. Many people came to Pupukea for this exact reason, and we see it as a real plus for Lihi Lani.

The wide range of agricultural uses and crops grown at Lihi Lani will satisfy many different agricultural markets, as would any other agricultural crop. Only the field stock trees apply to demands from other developments. Many of the trees will be used for the landscaping of Lihi Lani, which is not a large scale urban or suburban development but rather a modest, diversified agriculture and low-density residential use. We recognize that field stock trees are removed every 5 to 7 years. Because of the limited frequency of soil disturbance, field stock trees represent one of these best types of agricultural uses for the land with respect to soil conservation.

Thanks to the input of people such as yourself, we are applying principles of sustainable development at Lihi Lani. Mr. Hopkins introduced us to the publications of Bill Mollison in Permaculture - A Designer's Manual (1988). This document is a source for some of the design approaches to be used at the project. We hope that you and your colleagues will continue to provide innovative ideas for agriculture at Lihi Lani.

2) Agroforesty

We fail to recognize your concerns about the agroforestry with respect to long-range planning for sustainability. This type of land use represents a sustainable source of woods for artisans and furniture and cabinetry people. We would think you appreciate this attempt to satisfy a future need without depleting natural sources of these woods. In a controlled setting at Lihi Lani, it is possible to raise this product with respect for the natural setting. As paraphrased from Mollison (1988), this will be consciously designed and maintained as an agriculturally productive ecosystem (as we interplant with a variety of species) to produce the diversity, stability and the resilience of natural ecosystems. Soils will be protected in this area and the use of chemicals or fertilizers will be minimized through IPM methods, which were also introduced to us by your environmentally-conscious friends. Again, we seek your guidance on bringing a true sustainable approach to agroforestry.

3) Solid Waste

Unfortunately, not all of the solid waste generated by residents of the new community can be properly disposed on-site unless approval of a new municipal solid waste disposal complex in granted. Green waste generated by the agricultural areas, common areas and residential properties will be composted. Glass, aluminum, paper and plastic materials will be collected at a central facility through an internal recycling program. The on-site disposal or recycling of other materials would require significantly different operations than currently planned.

4) Reuse of Reclaimed Water

There is an extensive discussion of reclaimed water application in the reports by Engineering Concepts, Inc. (Appendix C) and ITC Water Management (Appendix E). Filters are involved in the drip irrigation system. The suspended solids in the reclaimed water will be taken out by the filter system. As you note, the project will rely heavily on the operation of its only wastewater disposal system. For this reason, Obayashi has selected a very reliable system for treatment and disposal. The drip irrigation application of reclaimed water has been proven successful at many locations in Hawaii, and ITC Water Management of Haleiwa is the pre-eminent authority for implementation of such systems. We would recommend consulting the ITC report and contacting these people for further information on the system.

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5) **Wastewater Pump Stations**

The normal power supply for the pump stations is provided by the electrical distribution system at Lihi Lani, with back-up power from individual generators located at each station. These generators must be tested on a regular maintenance schedule. Very specific design issues such as the individual power requirements and the elevation and hydraulic requirements of individual pump stations will be addressed in the design phase. In the meantime, we could arrange for Obayashi's consulting engineers to provide answers to specific questions if you are interested.

6) **Wastewater System Reliability**

There are numerous safeguards in place to protect against a system failure and wastewater spill. Should there be a power failure, back-up power supply will be available at each pump station to continue the operation of the system without interruption. There is also a back-up pump at each pump station in case of pump failure. Each pump station also has a vault which is capable of handling a minimum of 8 hours of flow should there be a pump failure. Alarms are linked by telephone to the treatment plant and a back-up person to notify the operators when there is a system problem. With all these measures in place, there is little potential for a system failure.

The reliability of the wastewater system has always been an issue with the project since the beginning of planning in 1987. Community concern led us to be receptive to recommendations from the community for the most reliable type of system. Obayashi was introduced to Dr. Robert Gearheart of Humbold State University in Arcata, California, who is a proponent of the stabilization pond and wetlands cycling process for wastewater treatment. Over the past four years, Obayashi has carefully refined its plans for this facility to address all concerns of the State Department of Health. At this time, the system meets the DOH requirements for such a facility. Because of its minimal mechanized operations and its tremendous holding capacity (58 days without discharge), this system now meets the community's expectation of a safe, reliable and high quality wastewater treatment system.

Maintenance measures for the Water Reclamation Facility are discussed in the report by Engineering Concepts, Inc. (Appendix C). Again, if you have specific questions about the maintenance requirements for the oxidation ponds maintenance we would be glad to arrange for a meeting with the project engineers.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

11/15/93

It is imperative that you realize that the proposed access road to the Lihilani project will damage valuable Hawaiian petroglyphs. The road will go up the pali within 10 feet of two petroglyph sites. There is no way that this road can be built without damaging our Hawaiian historical heritage. I suggest that an alternate access route be found.

According to the book Hawaiian Petroglyphs, by J. Halley Cox, (page 7), there are only 9 sites on Oahu. The total number of figures being 150 units. At this area there are 8 figures-some human and some dog. This is about 5% of the total petroglyphs on this island.

The Supplemental EIS identifies these spots as T-13 and T-70. Table 5-2 of the Supplemental EIS makes these statements:

> These sites are "culturally significant".
> They are "important for information content-further data collection is necessary."
> T-70 is an "excellent example of a site type at the local, state, or national level."
> On site T-13, the recommended treatment is "Preservation-as is."

According to Group 70 planner, Jeff Overton, at the November 9, 1993 special meeting of the North Shore Neighborhood Board, "a portion of the T-13 archaeological site would be damaged by the access road."

As this island is currently growing in population, increasingly there is less remaining of the old Hawaiian culture. I say that we should act now, to stop any further destruction of our heritage. The Ohbayashi Corporation needs to find a spot for their access road where no archeological sites will be damaged.

Sincerely yours,

Steven C. Poor

Steven C. Poor
"Ilihune"

RECEIVED '93 DEC 3 PM 3:40 PLANNING DEPT. C&C HONOLULU

12/93-2724

GROUP 70
INTERNATIONAL

Francis S. Oda, AIA, AICP
Norman G. Y. Hong, AIA
Sheryl B. Seaman, AIA, ASID
Robert K. L. Wong, AIA
Hitoshi Hida, AIA
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George I. Atta, AICP
Jeffrey H. Overton, AICP
James I. Nishimoto, AIA
Jen-Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

13 December 1993

Mr. Steven C. Poor
59-056 Kupaoa Place
Haleiwa, HI 96712

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Draft Supplemental EIS

Dear Mr. Poor:

Thank you for providing your comments on the Draft SEIS for Lihi Lani. We have prepared responses to the issues you raised in your letter of 15 November 1993.

The site T-13 represents an agricultural complex and T-70 represents a series of petroglyphs and a small cave. Only site T-13 would be partially affected by the project. access roadway. Site T-70 would not be affected.

You have been interested in the preservation of archaeological sites at Lihi Lani since the inception of project planning in 1988. Through your work in attending site visits and communicating with the professional archaeologists from Paul H. Rosendahl, Ph.D., Inc., you have made significant contributions to the community's understanding of the features existing at Lihi Lani. Your particular concern has been the preservation of rock art features known as petroglyphs.

Site T-70 is a complex of burials, temporary habitation and rock art, and this site will not be affected by the project access road and will be preserved as is. Site T-13 may possibly be partially affected by the access road construction and the elderly housing project. If affected by either the road or the housing, the extent of effect will be limited to as much as 20 to 30 percent of the site. Site T-13 is a former habitation and agricultural complex that extends over parts of about a one acre area in the makai part of the project site. The site has been affected substantially by historical period disturbances. One boulder in the complex was initially thought by the archaeologists to contain a very faint petroglyph. However, upon a return site visit by the archaeologist and community members (including yourself) no petroglyph could be identified on the same boulder. The subject boulder is located in the southern portion of the site complex, well outside of the potential area of disturbance from either the road or housing.

The preservation and data recovery mitigation of archaeological sites at Lihi Lani has been given the highest attention in project planning. Whenever possible, significant sites have been avoided. In the few situations where sites cannot be avoided, the archaeologists have proposed mitigation measures such as data recovery. The treatment of archaeological sites will proceed according to the recommendations of the Department of Land and Natural Resources, Historic Preservation Division.

The preservation of the old Hawaiian culture is something of great interest to Obayashi, and that is why so many of the archaeological sites at Lihi Lani will be preserved as is. We welcome your continued involvement in the planning of Lihi Lani, especially with respect to historic sites.

We appreciate your review and comments on the Draft SEIS, and your concerns are addressed in the Final SEIS. Please contact us if you have any questions or require additional information.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Chief Environmental Planner

Hawaiian Electric Company, Inc. • PO Box 2750 • Honolulu, HI 96840-0001

11/93- 2567

November 5, 1993

William A. Bonnet
Manager
Environmental Department

Mr. Robin Foster
Department of Planning
City & County of Honollu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Foster:

Subject: Draft Supplemental EIS (DSEIS) for Lihi Lani
TMK 5-9-05: 6, Por. 38, 82 and TMK 5-9-06: 1, 18, 24
Pupukea and Paumalu, Koolauloa, Oahu

We have reviewed the subject EIS and have no comments on the proposed development project. HECO shall reserve further comment pertaining to the protection of existing power line facilities surrounding the project area until construction plans are finalized. Thank you for the opportunity to comment.

Sincerely,

Dan Fukuda

for William A. Bonnet

cc: Craig Yamagishi, Obayashi Hawaii Corp.
Jeffrey H. Overton, Group 70 International

RECEIVED
'93 NOV 9 PM 1:29
PLANNING DEPT.
C&C HONOLULU

PLANNING DEPARTMENT

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

RECEIVED
AUG 13 1993
GROUP 70

ROBIN FOSTER
CHIEF PLANNING OFFICER

ROLANDO LIBBY, JR
DEPUTY CHIEF PLANNING OFFICER

MM

August 11, 1993

Mr. Jeffrey Overton
Group 70 International, Inc.
924 Bethel Street
Honolulu, Hawaii 96813

Dear Mr. Overton:

Supplemental Environmental Assessment
Lihi Lani Development
Tax Map Keys 5-9-5: 6, Por. 38, 82 and 5-9-6: 1, 8, 18, 24

We have reviewed the subject Supplemental Environmental Assessment and have the following comments to offer:

1. It is our understanding that the project design will be adapted from rural development guidelines set out in the Connecticut River Valley study. The DEIS should state the design guidelines which would be incorporated into the zoning and/or property covenants that would explicitly cluster the placement of residences and retain large areas in permanent open space that could be used for agriculture, as shown in your Figure 4.

2. The DEIS should cite price ranges for both the affordable residential lots and the market country-zoned lots and should provide a market study demonstrating the feasibility of agriculture use, either by individual lot owners or by agricultural tenants leasing portions of multiple lots. Also the DEIS should provide a feasibility study for the "agricultural cooperative" and other infrastructure elements needed specifically to support proposed agricultural uses. The concept is a positive one, but its feasibility in Hawaii - especially at Hawaii's high land prices - has not been demonstrated.

3. The EISPN states that "country lot homes" will not be visible from Kamehameha Highway "except for partial views of those positioned near the makai edge of the

two plateau areas." Development of large luxury homes at the edge of adjacent plateaus on the North Shore has blighted views of these coastal land forms. The DEIS should discuss building siting and design guidelines for edge lots at Lihi Lani and show "before" and "after" visual representations of the view from Kamehameha Highway.

4. The applicant's extent of involvement and general intention with respect to the 50 off-site, single-family, affordable homes should be clarified. The Background section on page 4 indicates that the homes will be situated ". . . within the North Shore region, at a site acceptable to the Department of Housing . . ." but also indicates that Obayashi will ". . . contribute to the City's housing fund in return for credits covering 50 affordable units." The project description (page 10) indicates that these units "are being planned in conjunction with the Department of Housing and Community Development."

5. The cost of constructing the 80 on-site, elderly, affordable housing units should be discussed. What commitment of City funding would be required?

6. Based on the description of Community Park and Facilities on page 11, will all the listed programs or facilities be exclusively offered by the YMCA?

7. The extent of grading, clearing, grubbing, siltation and runoff from the project should be technically estimated and addressed in the appropriate sections of the SEIS.

8. Grading, drainage, erosion and sedimentation control plans should be discussed.

9. The applicant's plans to preserve significant archaeological sites should be discussed.

10. The project's impact on schools within the area should be addressed.

11. The project's impact on marine nearshore and offshore water quality should be estimated.

Should you have any questions, please call Mel Murakami of our staff at 527-6020.

Sincerely,

ROLAND D. LIBBY, JR.
Acting Chief Planning Officer

RDL:js

GROUP 70
INTERNATIONAL

28 September 1993

Robin Foster, Chief Planning Officer
City and County of Honolulu, Planning Department
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Mr. Foster:

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 11 August 1993.

1) Project Design

The current plans for Lihi Lani call for a low-density Country zoned project that will cluster residences to allow for contiguous agricultural easement areas and preserve open space areas in the bluff and gulch areas. One resource utilized in developing this concept is a report entitled Dealing with Change in the Connecticut River Valley: A Design Manual for Conservation and Development (Center for Rural Massachusetts; December 1990). This report identifies practical approaches utilized in this New England setting to conserve sensitive lands for natural habitat areas and allow for prime agricultural lands to be retained while accomodating development goals (unit count and floor space yields).

Lihi Lani adopts some of these design approaches in the overall concept plan to conserve lands which are open space and agricultural areas both in private Country lot areas and in common areas of the property. Actual design guidelines will be prepared and submitted to the Department of Land Utilization at subdivision level of project review.

2) Market Study

KPMG Peat Marwick (September 1993) has completed a Market Study which addresses the sales projections for Country lots at Lihi Lani, which will be included in the Draft Supplemental Environmental Impact Statement (SEIS). Price ranges for these lots are projected to be comparable to lots sales at Sunset Hills and Pupukea Highlands, which have recently ranged from $285,000 to $525,000.

Agricultural use of the easements on each of the Country lots is addressed in an Agricultural Plan for Lihi Lani, which compiles findings on a variety of small-scale agricultural uses of the property. Current plans are for a field

stock tree nursery and fruit tree orchard (avocado), along with grazing pasture and a long-term agroforestry timber raising project. The tree nursery and orchard crops are addressed for their feasibility, however, revenues from farm leases for these crops are intended to only offset a portion of the operation and maintenance fees for lot owners.

Lihi Lani is not intended to qualify as an agricultural subdivision, as defined under the Land Use Ordinance. Agricultural revenues support for these lot owners is not a concern with respect to viability of the project, however, initial projections show reasonable income potential for certain uses. Due to marginal lands and high infrastructure costs, small-scale agriculture is only possible on this site with the subsidy of land costs and infrastructure (roads and water) provided by the residential uses. The agricultural cooperative is a possiblity that could develop as a result of expanded individual lot agriculture such as fruit tree orchards or flower and foliage operations. A centralized agricultural processing facility could be developed, to encourage and assist cooperatives.

3. Views of Bluff Lot Homes

It is anticipated that partial views of some bluff lot homes at Lihi Lani will be experienced from makai areas such as Kamehameha Highway. We have recognized past and recent home construction projects in the Sunset Beach/Pupukea area that has caused adverse effects to public views of the coastal bluff from makai areas. The plan for Lihi Lani is to provide setbacks for homes along the bluff, to ensure that they are not perched on the steep edge and fully visible from sites below. Through site and design guidelines these homes will still enjoy ocean and shoreline views, however, there will be building setbacks and materials and color limits that will ensure the integrity of the bluff views from makai locations. The Draft SEIS includes a view study showing potential building locations and profiles with respect to existing views of the bluff ridge.

4. Off-Site Affordable Housing

Obayashi will participate in the development of up to 50 affordable homes by making an in-lieu fee payment for the balance of their affordable housing requirement. This fee will represent the amount required beyond the provision of on-site affordable housing and support for the elderly housing project. At this time, Obayashi has stated their intent to participate in development of up to 50 affordable homes off-site, with a desire for the City to locate this housing in the North Shore region. The actual amount of the in-lieu fee to be paid by Obayashi to support off-site affordable housing development will be determined by the Department of Housing and Community Development and the City Council.

5. **Elderly Housing Costs**

According to the City Department of Housing and Community Development (R. Lim, personal communication with J. Overton, 23 September 1993), development of the 80 elderly affordable rental housing units should cost approximately $10 million, not including land and infrastructure costs. Obayashi will be contributing the land and providing infrastructure connections to the site boudary.

6. **YMCA Programs**

The YMCA of Honolulu intends to develop a major facility at this site, and provide their typical range of community and atheletic programs Below is a partial list of the YMCA programs, most of which will apply to this facility.

Youth Development	Youth Activities	Adult Programs
Child Care	Swim Classes	Volunteer Leaders
Leadership Training	Basketball	Prenatal Exercise
Teen Drug Counseling	Performing Arts	Fitness testing
Resident Camping	Teen Dances	Adult Lap Swim
Teen Travel Camps	Field Trips	Resident Dorm (none)
Aikido	Gymnastics	Intenational Exchange
School Dropout Prevention	Game Room	Weight Training
Karate and Judo	Life Saving	Volleyball/Basketball
International Exchanges	Hula Dance Classes	Exercise Classes
Filipino Youth Project	Teen Exercise Classes	Parenting Skills
Korean Youth Project	Teen Weight Room	Y's Men Service Club
Youth Legislature	Summer Fun Club	Martial Arts

Actual programs to be included at the North Shore YMCA will depend on the community needs and desires for the range of programs and services. These will ultimately be decided by the YMCA and its community advisory committee.

7. **Grading, Drainage, Erosion and Sedimentation**

Lihi Lani will be developed in four 2 to 3 year phases extending over a total of 10 to 12 years. A total of 400 to 480 acres of the property will be affected over this period, broken up into pieces that are smaller areas of 50 to 60 acres in each subphase of cosntruction. These areas will be affected differently for the various land uses planned. Roadway areas and building sites will be cleared, grubbed and mass graded, while agricultural areas will be cleared and grubbed. By designing with the existing topography as much as possible, grading and excavation will be minimized.

For technical estimation of erosion and and silt runoff, a worst case situation was selected, which is the first development phase in which 185 acres are

disturbed for roadways, house lots and agricultural uses. With erosion control measures in place during construction, the property-wide potential increase in soil erosion could range from five to nine percent above existing conditions. Subsequent phases would involve smaller areas and lower soil erosion and silt runoff potential. Mitigation planning to control erosion and runoff will involve recommended techniques from the State Department of Health (1990) Best Management Practices and the U. S. Environmental Protection Agency (1993) Guidelines Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. The soils, drainage and runoff sections of the Draft SEIS address this issue, along with supporting documentation by Engineering Concepts, Inc. and Tom Nance Water Resources Engineering.

9. **Arcaheological Sites Preservation**

Obayashi maintains the same commitment to arcaeological sites preservation as stated in the Final EIS (Group 70, April 1991). There are 23 significant historical sites in the project area. Seven will be directly affected by the project. Further data collection will be conducted at these sites prior to construction, and at the 16 other significant sites which are considered accessible to hikers and residents and could potentially be indirectly affected. Archaeological data recovery and detailed preservation plans will be submitted to and approved by the Historic Preservation Division of the Department of Land and Natural Resources (SHPD).

10. **Schools**

The Department of Education estimates that 154 students could be generated by the full development and occupancy of Lihi Lani. Market consultants KPMG Peat Marwick estimate that by 2008, 65 percent of the Country lots will have homes built and occupied. By 2008, approximately 107 students are anticipated to reside at Lihi Lani. The potential impact on schools will need to address the phased development and occupancy of Lihi Lani. Full buildout of the Country lots is not anticipated until after 2020. Lihi Lani may have an impact on school facilities, however, it will not be immediate and would grow slowly over 15 to 20 years. Obayashi will continue to discuss with the DOE the regional school enrollment and facilities issues.

11. **Marine and Offshore Water Quality**

Marine Research Consultants has completed four years of baseline water quality data and has updated their evaluation of potential ocean water quality impacts of the Lihi Lani project. Short-term potential silt runoff from construction could be 5 to 9 percent above existing conditions, which is not considered to pose a significant adverse impact to ocean water quality. With the long-term erosion controls and detention basins on-site, erosion and silt runoff will decrease by 22 percent, which will have a small beneficial ipact on

Letter to Mr. Robin Foster, Chief Planning Officer
City and County of Honolulu, Planning Department
28 September 1993
p. 5

ocean water quality. Fertilizer and pesticides use on the property, and their potential to enter runoff, is not expected to cause adverse effects to ocean water quality. This report is include in the Draft SEIS.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forward to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Project Planner

Group 70 International, Inc. Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

DEPARTMENT OF LAND UTILIZATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813 • (808) 523-4432

FRANK F. FASI
MAYOR

DONALD A. CLEGG
DIRECTOR

LORETTA K.C. CHEE
DEPUTY DIRECTOR

RECEIVED
AUG 24 1993
GROUP 70

93-05106(JT)

August 23, 1993

MEMORANDUM

TO: ROBIN FOSTER, CHIEF PLANNING OFFICER
PLANNING DEPARTMENT

FROM: DONALD A. CLEGG, DIRECTOR

SUBJECT: ENVIRONMENTAL ASSESSMENT AND NOTICE OF PREPARATION OF A SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (SEIS) FOR LIHI LANI - PAUMALU & PUPUKEA, KOOLAULOA, OAHU
TAX MAP KEY: 5-9-05: 6, POR. 38, 82 AND
5-9-06: 1, 18, 24

We have reviewed the above referenced document and offer the following comments:

1. The project area, as shown in Figures 2, 3 and 4, is not contiguous. The SEIS should identify the parcels that lie within the outer boundaries of the project area which are not included in the project proposal, and explain their relationship to the project.

2. The SEIS should elaborate on the choice of location for the 50-unit affordable housing development. Why is it located so far from Kamehameha Highway and existing public transportation services?

3. Page 4, paragraph 3 states:

   "...The purpose of this document is to provide ... updated information to satisfy the requirements for a ... Change of Zone application..."

   The information provided is insufficient for a change of zone application. An application content guide is enclosed for your convenience.

4. The SEIS should include a map showing the proposed zoning districts.

5. The SEIS should address the compatibility of the proposed mix of zoning districts within the project area. For example, agricultural uses may generate noise and odors incompatible with residential uses. How will this be mitigated?

6. We concur that a portion of the proposed project is located within the Special Management Area and will require a Special Management Area Use Permit (SMP). Instructions for filing an SMP application is enclosed for your use.

7. The Urban Design Branch of our department has expressed concerns about the proposed circulation, road service and parking at the elderly housing complex, relative to Planned Development - Housing (PD-H) guidelines.

Thank you for the opportunity to comment on this matter. Should you have any questions, please contact Joan Takano of our staff at 527-5038.

Donald Clegg

DONALD A. CLEGG
Director of Land Utilization

DAC:ak
Enclosures
cc: Group 70 International, Inc.

G:seislihi.jht

28 September 1993

Donald A. Clegg, AICP, Director
City and County of Honolulu, Department of Land Utilization
650 South King Street, 7th Floor
Honolulu, Hawaii 96813

Dear Mr. Clegg:

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 23 August 1993.

1) Parcels Within Project Boundaries

There are several parcels within the project boudaries that are owned by the State of Hawaii, including 28 acres at two parcels listed on historic maps as water reserve areas. These are generally steep hillsides and are heavily wooded with no improvements. A mapped extension of Pupukea Highlands Road (50 ft. wide) enters the site from the mauka boundary and extends approximately 5,000 feet into the property. Another small parcel exists along the Pupukea side bluff, which includes a former military observation bunker. None of these lands are subject to land use reclassification proposed at the State or City level. Negotiations are in progress with DLNR to make arrangements for use of State land. However, none of the State parcels will affect the project as planned.

2) Location of Affordable Single-family Housing Area

The mauka location of the affordable single family housing project was selected due to several factors. First, the integration of affordable housing and market housing has been planned for several years. The site for the housing is a gently sloped area surrounded by ironwood forest with views of the mauka gulches and Koolau Ridge peaks. All of the public recreational facilities on the property will be available to the residents of the affordable housing. In addition, an internal shuttle van system is being considered to allow for transportation of residents from the mauka areas to the makai areas for the community facilities, elementary school and Kamehameha Highway bus stop area operated by the YMCA. The plan seeks to combine different levels of housing opportunities at Lihi Lani to create a diverse country community.

3) Zoning Application

We recognize that the Notice of Preparation did not provide adequate information for the Change of Zone application. Thank you for providing a copy of the application content guide. The Draft SEIS includes a map showing the proposed zoning districts.

4) Compatibility of Zoning Districts

The combination of agricultural uses and low-density residential areas planned for Lihi Lani is closely modeled after the existing community of Pupukea Highlands and Sunset Hills. Properties within this community combine a wide variety of small-scale agricultural uses within the one-acre minimum lots, while providing a country residential lifestyle. Certain types of agricultural uses are probably not compatible with residential areas, such as pig farms. Noise associated with farming activities planned at Lihi Lani will be limited, because there will be tree nursery and fruit tree orchard areas on the lots. These areas will only require periodic maintenance and harvesting activities.

5) Special Management Area Use Permit (SMP)

Thank you for providing instructions for filing an SMP application.

6) Elderly Housing and Planned Development-Housing (PD-H)

As planning for the elderly housing facility is advanced by the City Department of Housing and Community Development, it is recommended that DHCD consult with the Urban design Branch of DLU. Obayashi is currently consulting with DHCD regarding the approval process, and these comments will be passed on at our next meeting.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forward to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Project Planner

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU

COPY

August 25, 1993

RECEIVED
AUG 30 1993
GROUP 70

TO: ROBIN FOSTER, CHIEF PLANNING OFFICER
PLANNING DEPARTMENT

FROM: KAZU HAYASHIDA, MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

SUBJECT: APPLICATION FOR A NORTH SHORE DEVELOPMENT PLAN LAND USE AMENDMENT AND NOTICE OF PREPARATION OF A SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (SEIS) FOR THE LIHI LANI DEVELOPMENT PROJECT, TMK: 5-9-05: 06, PORTION 38, 82 AND 5-9-06: 01, 18 AND 24, PUPUKEA AND PAUMALU

Thank you for the opportunity to review the modified Lihi Lani development project. We have the following comments:

1. The draft SEIS should address the planned disposal of treated effluent from the water reclamation facility which will increase in volume under the modified plan. The effluent had been proposed for use in irrigating the golf course which has been eliminated from the revised master plan.

2. We reiterate our concerns of February 26, 1991, regarding the potential adverse effects from the use of wastewater effluent/brackish water mixture for irrigation over the underlying aquifer. The use of the water should be coordinated and approved by the State Department of Health.

3. The developer is required to submit a water master plan for our review and approval. Estimated water requirements and proposed water facilities should be shown with supporting calculations for peak hour pressures and fire flow at maximum day demand.

4. The developer may be required to provide a water source for the development. The Board of Water Supply (BWS) has a very limited amount of water available to allocate to new developments, and it appears that the approved developments' water requirement exceeds the amount that is available. This can be determined when the water master plan is submitted for our review and approval.

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU

COPY

5. The development will be subject to the BWS cross-connection and backflow prevention control requirements due to the use of a dual water system. BWS approved backflow prevention assemblies will be required immediately after all potable water meters serving lots containing a nonpotable system.

If you have any questions, please contact Roy Doi at 527-5235.

✓cc: Group 70 International, Inc.

GROUP 70
INTERNATIONAL

28 September 1993

Kazu Hayashida, Manager and Chief Engineer
City and County of Honolulu, Board of Water Supply
830 South Beretania Street
Honolulu, Hawaii 96843

Dear Mr. Hayashida:

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 25 July 1993.

1) Treated Effluent Disposal

The Lihi Lani project will be served by an on-site wastewater treatment and disposal system. Tertiary treated wastewater will be disposed on-site through water reclamation. The effluent will meet or be of higher quality than current DOH criteria for R-1 Reclaimed Water. Agricultural areas at Lihi Lani for 65 acres of grazing pasture and field stock tree nursery will be irrigated with the reclaimed water. Up to 180,00 gpd of reclaimed water will be generated at full buildout, anticipated sometine after 2008.

2) Water Master Plan

Obayashi will complete a Water Master Plan for review and approval by the BWS. Estimated water requirements and proposed facilities will be shown with supporting calculations for peak hour pressures and fire flow at maximum day demand.

3) Water Source

With current allocations exceeding the amount able to be withdrawn by the existing BWS facilities, it is understood that Obayashi will need to participate with BWS in source development in the Waialua or Kawailoa Aquifer areas.

4) Cross-Connection and Backflow Prevention

Lihi Lani will implement appropriate cross-connection and backflow prevention control measures with respect to the on-site potable and non-potable water systems.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forward to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton, AICP
Project Planner

DEPARTMENT OF PARKS AND RECREATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

WALTER M. OZAWA
DIRECTOR

ALVIN K.C. AU
DEPUTY DIRECTOR

RECEIVED
AUG 19 1993
GROUP 70

August 17, 1993

Mr. Jeffrey H. Overton, AICP
Senior Planner
Group 70 International, Inc.
924 Bethel Street
Honolulu, Hawaii 96813-4398

Dear Mr. Overton:

Subject: Supplemental Environmental Assessment and North Shore Development Plan and Land Use Map Amendment Application for Lihi Lani
Tax Map Keys 5-9-05: 6, Por. 38, and 82
Tax Map Keys 5-9-06: 1, 18, and 24
Pupukea and Paumala
Koolauloa, Oahu, Hawaii

Thank you for providing us with the opportunity to comment on your Development Plan (DP) and Land Use Map amendment application and environmental assessment (EA)/notice of preparation of a supplemental environmental impact statement for your Lihi Lani project.

We have questions and concerns about the 3.5 acres planned park area that will serve the affordable housing section of your project. The exact nature of the park is not specifically identified in your report. The report seems to indicate that it will be a private park. Will this park be maintained by the homeowners' association? Will it serve and be maintained by all of the homeowners in your project or only those in the affordable housing development?

In addition, the project description printed in the Office of Environmental Quality Control's Bulletin of August 8, 1993 seems to conflict with the information included in the material that you sent to us. The Bulletin states that "Obayashi will dedicate a 5.4-acre site with infrastructure improvements to the City who will construct the buildings and manage the project." However, both your EA and the DP amendment application state that the facility will be a branch YMCA facility.

Also, please clarify the size of the proposed facility. As noted above, the Bulletin indicated that the park area would include 5.4 acres, but the maps in the EA document and in the DP amendment application show the site as being 6.5 acres, and the written description in the DP amendment application states that Obayashi will provide 7 acres for the development of the YMCA.

Thank you for providing us with this opportunity to comment. We look forward to being a consulted party in the environmental impact statement process.

If you have any questions, please call John Morihara of our Advance Planning Branch at 523-4246.

Sincerely,

For WALTER M. OZAWA, Director

WMO:ei

GROUP 70
INTERNATIONAL

Francis S. Oda, AIA, AICP
Norman G. Y. Hong, AIA
Sheryl B. Seaman, AIA, ASID
Robert K. L. Wong, AIA
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James I. Nishimoto, AIA
Jen Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Dando M. Herrera

28 September 1993

Walter M. Ozawa, Director
City and County of Honolulu, Department of Parks and Recreation
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Ozawa:

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 17 August 1993.

1) Park at Affordable Housing Area

The park at the affordable housing area is planned to be a private park, to be maintained as part of the Lihi Lani Homeowner's Association. Most likely this park will primarily serve the affordable housing residents due to its proximity, however, it will be available to all residents of Lihi Lani.

2) Community Facility/YMCA

The YMCA will build the facilities with a significant contribution from Obayashi toward facility development. Approximately 6.5 acres of land will be provided for the project, along with infrastructure connections. The elderly housing site will be dedicated to the City, which is approximately 6 acres. We will attempt to make our future references to these areas consistent. Thank you for pointing out this discrepancy.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forward to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Project Planner

7/93-1828

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

C. MICHAEL STREET
DIRECTOR AND CHIEF ENGINEER

KENNETH SPRAGUE
DEPUTY DIRECTOR

ENV 93-164

July 27, 1993

MEMORANDUM

TO: MR. ROBIN FOSTER, CHIEF PLANNING OFFICER
DEPARTMENT OF PLANNING

FROM: C. MICHAEL STREET, DIRECTOR AND CHIEF ENGINEER

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)
LIHI LANI AT PUPUKEA AND PAUMALU
TMK:5-9-05:16, POR. 38, 82; 5-9-06:1, 18 & 24

We have reviewed the subject EISPN and have the following comments:

1. All roads to be dedicated to the City should be constructed in accordance with City standards.
2. Proposed private roads will be maintained by the owner.
3. Construction plans should be submitted to the City for review and approval.
4. The EISPN should address the impact of storm water discharge associated with construction activities on water quality of the receiving waters.
5. The EISPN should also state what structural or non-structural best management practices (BMP) will be provided to control and reduce the discharge of pollutants resulting from the construction and/or dewatering activities.
6. If dewatering activity is anticipated during the construction, construction dewatering permits will be required by the State Department of Health as well as the City Department of Public Works.
7. For your information, should the disturbed area, such as clearing and grubbing, grading and stockpiling activities, exceed five (5) acres or more, a storm water NPDES permit will be required by the State Department of Health.

MR. ROBIN FOSTER
PAGE 2
JULY 27, 1993

8. We suggest a copy of the subject EISPN be forwarded to the Department of Wastewater Management for their review and comment.

Should you have any questions, please contact Mr. Alex Ho, Environmental Engineer, at 523-4150.

C. Michael Street
C. MICHAEL STREET
Director and Chief Engineer

RECEIVED
'93 JUL 28 PM 3:35
PLANNING DEPT.
C&C HONOLULU

GROUP 70
INTERNATIONAL

Francis S. Oda, AIA, AICP
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James I. Nishimoto, AIA
Jen Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

28 September 1993

C. Michael Street, Director and Chief Engineer
City and County of Honolulu, Department of Public Works
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Street:

Subject: Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 27 July 1993.

1) Roadways

The Lihi Lani project will be served by a private roadway system. The roadway section serving the community facilities and City's elderly housing in the makai portion of the property may need to be designed and constructed to City standards for dedication.

Proposed private roads will be maintained by the owner, and eventually the Lihi Lani Homeowner's Association. Construction plans will be submitted to the City for review and approval.

2) Storm Water Quality and NPDES

Obayashi will be implementing numerous mitigative measures to minimize erosion and silt runoff during construction. Water quality of the nearby ocean will not be adversely affected by the construction of the project. State Department of Health (1990) Best Management Practices and U. S. Environmental Protection Agency (1993) Guidance Specifying Management Measures for Sources of Nonpoint Pollution of Coastal Waters are two of the many reference being used to develop mitigation measures for construction of this project.

Several structural and non-structural measures will be implemented to minimize erosion and silt runoff. A series of these measures are listed in the Draft SEIS and supporting technical study by Engineering Concepts, Inc. In addition, a detailed mitigation plan will be prepared in association with the clearing, grading and grubbing permit application and the NPDES permit application, using information provided in the references noted above as well as other sources. There is no construction dewatering anticipated, however, areas more than 5 acres will be affected during construction, and the NPDES permit will be sought from the State Department of Health for this activity.

A copy of the Draft SEIS will be provided to the Division of Wastewater Management for their review and comment.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forward to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Project Planner

SEP-13-93 MON 16:02 PLANNING DEPT C&C P.03/11

8/93-1938

DEPARTMENT OF TRANSPORTATION SERVICES

CITY AND COUNTY OF HONOLULU

TE-2748
PL93.1.287

August 13, 1993

RECEIVED
'93 AUG 13 PM 3:27
PLANNING DEPT.
C&C HONOLULU

MEMORANDUM

TO: ROBIN FOSTER, CHIEF PLANNING OFFICER
PLANNING DEPARTMENT

FROM: JOSEPH M. MAGALDI, JR., DIRECTOR

SUBJECT: LIHI LANI DEVELOPMENT - PAUMALU & PUPUKEA
ENVIRONMENTAL ASSESSMENT
DEVELOPMENT PLAN AMENDMENT
TMK: 5-9-5: 6, POR. 28, 82 AND 5-9-6: 1, 18, 24

This is in response to a letter from Group 70 International, Inc., dated July 13, 1993 requesting our comments on the subject development.

We have no objections to the modifications being proposed by the developer. We understand that the internal roadway system servicing this project will be privately owned and maintained. We will, however, require that the access roadway which provides a direct connection to Kamehameha Highway be completed during the initial phase of this development. It is intended that the new roadway will serve as the access for construction vehicles to the upper elevation area above the coastal bluff to minimize and/or eliminate the need to use Pupukea Road. Please note that a permit will be required from our department if there is a need to utilize a City maintained roadway by oversized/weighted vehicles.

A project schedule, including the anticipated dates of the completion of the roadway infrastructure, should be submitted to our office for review.

Should you have any questions, please contact Mel Hirayama of my staff at local 4119.

JOSEPH M. MAGALDI, JR.

GROUP 70
INTERNATIONAL

Francis S. Oda, AIA, AICP
Norman G. Y. Hong, AIA
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Jen Chih "Jack" Lee, AIA
Michael A. Gaml
Eric G. Crispin, AIA
Danilo M. Herrera

28 September 1993

Joseph M. Magaldi, Jr., Director
City and County of Honolulu, Department of Transportation Services
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Magaldi:

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 13 August 1993.

It is noted that a permit will be required from the Department of Transportation Services if there is a need to utilize a City maintained roadway by oversized/weighted vehicles. The project schedule is included in the Draft SEIS which will be provided to your Department in October.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forward to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton, AICP
Project Planner

Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu HI 96813-4304 • Phone (808) 523-5866 • FAX (808) 523-5874

FIRE DEPARTMENT

CITY AND COUNTY OF HONOLULU

3375 KOAPAKA STREET, SUITE H425
HONOLULU, HAWAII 96819-1869

FRANK F. FASI
MAYOR

DONALD S. M. CHANG
FIRE CHIEF

RICHARD R. SETO-MOOK
DEPUTY FIRE CHIEF

RECEIVED
AUG 20 1993
GROUP 70

August 17, 1993

TO: ROBIN FOSTER, CHIEF PLANNING OFFICER
PLANNING DEPARTMENT

FROM: DONALD S. M. CHANG, FIRE CHIEF

SUBJECT: APPLICATION FOR A NORTH SHORE DEVELOPMENT PLAN LAND USE AMENDMENT AND A SUPPLEMENTAL EIS FOR LIHI LANI, TMK 5-9-05: 6, POR. 38, 82 AND TMK 5-9-06: 1, 18, 4, PUPUKEA AND PAUMALU, KOOLAULOA, OAHU, HAWAII

We have reviewed the subject materials provided and foresee an adverse impact in Fire Department facilities or services now provided. A meeting with Ms. Yukie Ohashi of Group 70 International, Inc., is scheduled for September 3, 1993 to discuss this project.

Should you have any questions, please call Assistant Chief Attilio Leonardi of our Administrative Services Bureau at 831-7775.

DONALD S. M. CHANG
Fire Chief

AKL:ny

Copy to: Group 70 International, Inc.

GROUP 70
INTERNATIONAL

Francis S. Oda, AIA, AICP
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James I. Nishimoto, AIA
Jen Chih "Jack" Lee, AIA
Michael A. Gann
Eric G. Crispin, AIA
Danilo M. Herrera

28 September 1993

Donald S. M. Chang, Fire Chief
City and County of Honolulu, Fire Department
3375 Koapaka Street, Suite H425
Honolulu, Hawaii 96819-1869

Dear Mr. Chang:

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 17 August 1993.

Based on a meeting held with Assistant Chief Leonardi and Battalion Chief Nojiri on 3 September 1993, the potential impact of the project on Fire Department services will be minor. Response times for fire calls at the mauka portion of the project will be delayed slightly by the travel distance from the project entrance. The project is not anticipated to cause the need for additional fire equipment or station facilities, according to your officials.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forawrd to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton, AICP
Project Planner

Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

RENE MANSHO
COUNCILMEMBER
CHAIR OF TRANSPORTATION
COMMITTEE

CITY COUNCIL

CITY AND COUNTY OF HONOLULU
HONOLULU, HAWAII 96813-3085 / TELEPHONE 523-4000

August 19, 1993

Mr. Craig Yamagishi
Obayashi Hawaii Corporation
66-145 Kamehameha Highway
Haleiwa, Hawaii 96712

Dear Mr. Yamagishi, Craig

SUBJECT: COMMUNITY POLICING PROGRAM - LIHI LANI

I am writing to offer a suggestion for inclusion in your planning of the Lihi Lani project. The Honolulu Police Department has recently instituted a Community Policing Program which focuses on crime prevention. The program encourages communities to take control of their neighborhood by being alert and aware of unusual activities in their area and working with the police department to minimize opportunities to illegal activities.

Since control of entry into an area can be an effective way to deter criminal activity, the police have suggested that Obayashi consider making Lihi Lani a "Gated Community." With only one way to enter and exit Lihi Lani, it would appear that this may be a viable option.

A guard shack could be constructed to monitor vehicles entering the community. Lihi Lani residents could be required to have decals, while visitors would have their license number logged by a security guard. A portion of the Lihi Lani Homeowner's Fund could be used towards the maintenance of the guard shack and police protection for the community.

Although the Honolulu Police Department's 1992 Annual Report indicates that District II, which includes Mililani, Wahiawa and the North Shore, has the least number of crimes on Oahu, recent events have shown that all areas are vulnerable to criminal activity. We need to explore every option in making our neighborhoods a safe place in which to live.

Thank you for your consideration of this matter. I look forward to your response.

Sincerely,

Rene Mansho

RENE MANSHO
Councilmember-District I

RM:ly
cc: North Shore Neighborhood Board No. 27
Sunset Beach Community Association
Chief Michael Nakamura
Major Herbert Okemura

GROUP 70
INTERNATIONAL

Francis S. Oda, AIA, AICP
Norman G. Y. Hong, AIA
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James I. Nishimoto, AIA
Jen Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

28 September 1993

Honorable Councilmember Rene Mansho
City and County of Honolulu, City Council
Honolulu Hale
Honolulu, Hawaii 96813

Dear Councilmember Mansho:

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 19 August 1993.

We recognize the newly instituted Community Policing Program to help prevent crime. As part of its planning for Lihi Lani, Obayashi is very interested in minimizing opportunities for illegal activities. To this end, we will take a close look at the possibility of creating a gated community at Lihi Lani. As you point out, this would provide reasonable restrictions on access by the general public, especially at off-hours. Our biggest concern with this idea is the potential over-restriction on access for most well-meaning people from the community who wish to utilize the extensive ranch facilities and trails at Lihi Lani. Obayashi would be interested in further evaluating this concept with your office, the Honolulu Police Department and the local community.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forward to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Project Planner

Architects • Planners • Interior Designers • 925 Bethel Street • Honolulu, HI 96813-4307 • Phone (808) 523-5866 • FAX (808) 523-5874

OFFICE OF STATE PLANNING
Office of the Governor

MAILING ADDRESS: P.O. BOX 3540, HONOLULU, HAWAII 96811-3540
STREET ADDRESS: 250 SOUTH HOTEL STREET, 4TH FLOOR
TELEPHONE: (808) 587-2846, 587-2800

FAX: Director's Office 587-2848
Planning Division 587-2824

Ref. No. C-18S

RECEIVED
AUG 16 1993
GROUP 70

August 12, 1993

Mr. Robin Foster
Chief Planning Officer
City and County of Honolulu
Department of Planning
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Foster:

Subject: Application for a North Shore Development Plan Land Use Amendment and a Supplemental EIS for Lihi Lani, TMK 5-9-05: 6, Por. 38 82 and TMK 5-9-06: 1, 18, 24, Pupukea and Paumalu, Koolauloa, Oahu, Hawaii

We have reviewed the above referenced document for the Lihi Lani Project. We note that the Supplemental EIS is required because the proposal has been substantially revised. Previously, the Lihi Lani Recreational Community project included a golf course, driving range, clubhouse, tennis center, campground, horse ranch, and residential units. The current proposal excludes the golf course, driving range, and clubhouse, and increases the number of one-acre residential units from 120 to 315. Also, the types of affordable housing has changed from 180 on-site single and multi-family units to 50 on-site single family homes, 80 on-site elderly rental apartments, and 50 off-site single family homes.

We suggest that the Housing Finance and Development Corporation (HFDC) be consulted regarding affordable housing. Thank you for allowing us to review this document. If there are any questions, please contact the Land Use Division at 587-2886.

Sincerely,

Harold S. Masumoto

Harold S. Masumoto
Director

cc: ✓Group 70 International, Inc.

GROUP 70
INTERNATIONAL

28 September 1993

Harold S. Masumoto, Director
Office of State Planning, Office of the Governor
P. O. Box 3540
Honolulu, Hawaii 96811-3540

Dear Mr. Masumoto:

Subject: Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 12 August 1993. We will provide a copy of the Draft SEIS to the Housing, Finance and Development Corporation (HFDC) to allow them to comment on the proposed affordable housing at Lihi Lani. Earlier this year we attended a briefing of the HFDC with representatives of Obayashi.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forward to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Project Planner

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

RECEIVED
JUL 26 1993
GROUP 70
LIMITED

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
JOYCE T. OMINE
AL PANG
KANANI HOLT
CALVIN M. TSUDA

IN REPLY REFER TO
STP 8.5358

July 21, 1993

Mr. Robin Foster
Chief Planning Officer
Planning Department
City and County of Honolulu
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Mr. Foster:

Subject: Application for a North Shore DP Land Use Amendment and a Supplemental EIS for Lihi Lani, TMK 5-9-05:6, Por. 38, 82 and TMK 5-9-06:1, 18, 24, Pupukea and Paumalu, Koolauloa

Thank you for your letter of July 13, 1993, requesting our review of the subject application and supplemental EIS.

Our concern would be the access to Kamehameha Highway. We will defer further comment until we have had the opportunity to review the traffic study which is being updated.

Sincerely,

Rex D. Johnson

Rex D. Johnson
Director of Transportation

c: Mr. Jeffrey Overton, Group 70 International, Inc.

GROUP 70
INTERNATIONAL

28 September 1993

Rex D. Johnson, Director of Transportation
State of Hawaii, Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Dear Mr. Toguchi:

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 21 July 1993. The Draft SEIS includes an updated traffic study completed by Pacific Planning and Engineering, Inc. (September 1993) for Lihi Lani which should be of interest to your agency.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forward to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Project Planner

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

RECEIVED
SEP 22 1993
GROUP 70

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

In reply, please refer to:

September 17, 1993

91-083/epo

Mr. Robin Foster
City and County of Honolulu
Department of Planning
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Mr. Foster:

Subject: Application for a North Shore Development Plan Land Use Amendment and a Supplemental Environmental Impact Statement for Lihi Lani
Koolauloa, Oahu, Hawaii
TMK: 5-9-05: 6 Portion 38, & 82
5-9-06: 1, 18, 24

Thank you for allowing us to review and comment on the subject documents. We have the following comments to offer:

<u>Wastewater</u>

The project proposes to develop 1,143.6 acres into a park, affordable housing, community facilities and a water reclamation facility. The subject project is located above the Underground Injection Control (UIC) Line, in the "No Pass" Zone and in the critical wastewater disposal area as determined by the Oahu Wastewater Advisory Committee. No new cesspools will be allowed in the subject area.

As there is no existing sewer service system in the area, the Department of Health (DOH) concurs with the planned use of a wastewater treatment facility to be constructed and operated on-site which will provide near tertiary level treatment.

However, the Department of Health has the following concerns:

1. Areas surrounding potable water wells should be protected against all potential sources of ground water contamination. Potable and non-potable water systems must be carefully designed and operated to protect against cross-connections and backflow conditions.

2. All injection wells must comply with the Department of Health's Administrative Rules, Chapter 11-23, "Underground Injection Control." Chapter 11-23 requires Underground Injection Control permits for the construction and operation of all injection wells.

3. According to the Board of Water Supply, Pupukea would not be suitable for application of reclaimed water due to a high infiltration rate. The surface loading of total dissolved solids (TDS) due to evaporation and then subsequent infiltration by natural precipitation would increase the TDS of the existing groundwater, which is presently measured at 500 mg/l TDS. Field data should be collected for verification of the suitability of effluent application in that area.

4. Board of Water Supply wells are down gradient of the site.

All wastewater plans must conform to applicable provisions of the DOH's Administrative Rules, Chapter 11-62, "Wastewater Systems" and we reserve the right to review these plans.

If you should have any questions on this matter, please contact Ms. Lori Kajiwara of the Wastewater Branch at 586-4290.

Water Pollution

A National Pollutant Discharge Elimination System (NPDES) permit is required for any discharge to waters of the State including the following:

1. Storm water discharges relating to construction activities for projects greater than five acres;
2. Storm water discharge from industrial activities;
3. Construction dewatering activities;
4. Cooling water discharges less than one million gallons;
5. Ground water remediation activities; and
6. Hydrotesting water

Any person wishing to be covered by the NPDES general permit for any of the above activities should file a Notice of Intent with the Department's Clean Water Branch at least 90 days prior to commencement of any discharge to waters of the State.

Any questions regarding this matter should be directed to Mr. Denis Lau of the Clean Water Branch at 586-4309.

Nonpoint Source Pollution Concerns

The Lihi Lani Project is located on a site where 70 percent of the land has slopes of 20 percent or greater and an additional 10 percent of the land has slopes between 10 percent and 20 percent. Runoff from the subdivision drains to the coastal waters. Steps should be taken to minimize on-site erosion from construction activities which may become a source for nonpoint source pollution. Proper planning, design and use of erosion control measures substantially reduces the total volume of runoff generated, thereby decreasing sediment load. Additional measures that should be considered are:

a. Conduct grubbing and grading activities during the low rainfall months (April - October).

b. Grub area sequentially so that only a small portion of the site is bare at any one time.

c. Replant or cover bare areas as soon as grading or construction is completed. New plantings will require soil amendments, fertilizers, and temporary irrigation to become established. Use high seeding rates to ensure rapid stand establishment.

d. Use vegetation, mulch, gravel and porous pavement wherever feasible to minimize the increase of impervious areas.

e. Prevent concentrated stormwater flows on access roads through proper grading.

f. Maintain a minimum vegetative buffer strip of 25 feet along the edge of Pakulena Stream.

A major contributor to nonpoint source pollution is sediment erosion from agricultural land. Contact the USDA Soil Conservation Service to assist you in preparing and implementing a conservation plan to minimize erosion from your diversified agriculture, ranching, and grazing operations.

If you should have any questions on this matter, please contact Ms. Shirley Nakamura of the Environmental Planning Office at 586-4337.

Solid Waste

The discussion of solid waste includes a statement that the developer will chip and mulch greenwaste on site. This is a step in the right direction, however, the project is estimated to generate three tons of solid waste at full development and the application states that capacity at the landfill is not expected to be a problem. The Department of Health (DOH) would remind the developer of the State's waste diversion goals, established in 1991, by Act 324, targeting 25 percent waste diversion by 1995, and 50 percent diversion by the year 2000. Each new development in the state should include measures to encourage on site recycling and source reduction in order to conserve landfill capacity.

The DOH suggests the developer refer to the Proposed Standard Conditions for Solid Waste Concerns in land use district boundary reviews (attached).

If you should have any questions on this matter, please contact Ms. Carrie McCabe of the Office of Solid Waste Management at 586-4227.

Very truly yours,

JOHN C. LEWIN, M.D.
Director of Health

Attachment

c: Wastewater Branch
Clean Water Branch
Environmental Planning Office
Office of Solid Waste Management
Group 70 International, Inc.

LAND USE DISTRICT BOUNDARY REVIEW

PROPOSED STANDARD CONDITIONS FOR SOLID WASTE CONCERNS

* Petitioners for a Land Use District Boundary Amendment shall develop an overview of the solid waste impacts resulting from the proposed land use change, including a conceptual plan for minimizing the generation and disposal of waste during construction and operations, based on the State's waste management hierarchy and goals and any applicable county goals or conditions.

* The developer shall, based on the impact analysis, participate in the funding and construction of necessary solid waste disposal and diversion facilities, on a pro-rata basis, as determined by the State's Department of Health and the County's Department of Public Works.

* A further condition of any boundary change amendment should require, at the time of local zoning approval, the Submittal of a detailed Integrated Waste Management Plan for the development to the County's Department of Public Works, which would address specific waste diversion programs necessary to assist in meeting State and county reduction goals.

* The developer shall investigate the use of secondary resources (recycled materials) whenever possible in the construction of the project; including but not limited to the use of crushed glass as an aggregate substitute in road paving and the use of locally produced greenwaste compost as a soil amendment in landscaping.

GROUP 70
INTERNATIONAL

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Jen Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

28 September 1993

John C. Lewin, M. D., Director of Health
State of Hawaii, Department of Health
P. O. Box 3378
Honolulu, Hawaii 96801

Dear Dr. Lewin:

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 17 September 1993.

1) Cross-Connection and Backflow Prevention

There are no potable water wells existing or planned for Lihi Lani. The brackish water wells on-site will serve irrigation needs on residential lots and common landscaped areas. Appropriate design and construction measures will be taken to avoid cross-connection with the potable water system. Backflow prevention will also be integrated into the potable water system.

2) Drywells Regulated as Injection Wells

The drainage sumps planned for the makai portion of the property will have recharge sumps or drywells to aid percolation of detained water. Because these drywells are deeper than they are wide, they will be regulated as injection wells under DOH Administrative Rules, Chapter 11-23. These structures are only planned for stormwater recharge.

3) Water Reclamation and Total Dissolved Solids

The potential impact of percolated reclaimed water on the underlying groundwater quality is evaluated on pp. 21-24 of the groundwater study for the Draft SEIS, preared by Tom Nance Water Resource Engineering (September 1993). Based on irrigation return from the brackish water wells, reclaimed water application and landscaping irrigation from the Board of Water Supply (BWS) system, the chlorides concentration could potentially increase by 1.2 to 8.0 percent. The potential increase in nitrate concentration is estimated at 7.1 to 15.7 percent. These increases in groundwater parameters are considered to be realtively modest. Nitrate levels in groundwater will remain well below the State drinking water standard. The quality of potable groundwater at the BWS wells located down gradient of the property is not anticipated to be adversely affected by the application of brackish water and reclaimed water.

4) Wastewater Plans

All wastewater plans will conform to applicable provisions of the DOH Administrative Rules, Chapter 11-62, "Wastewater Systems". System plans will be provided to the Wastewater Branch for review.

5) Stormwater Discharge

Obayashi will obtain a National Pollution Discharge Elimination System (NPDES) permit for discharge to water of the State relating to construction activities involving more than five acres. A Notice of Intent will be filed with the Department's Clean Water Branch at least 90 days prior to the commencement of any discharge to waters of the State.

6) Nonpoint Source Pollution Concerns

Steps will be taken to minimize on-site erosion from construction activities which may become a source for nonpoint source pollution. The Draft SEIS addresses erosion control measures planned for the site, utilizing several references to develop effective mitigation of soil erosion and silt runoff. These references include the DOH (1990) Best Management Practices and EPA (1993) Guidance Specifying Management Measures for Sources of Nonpoint Pollution to Coastal Waters. Measures listed in your letter are included in these manuals, and there will be special attention made to maintaining buffers along the intermittent stream channels crossing the property. Obayashi will also contact the USDA Soil Conservation Service to prepare a conservation plan to minimize erosion from the agricultural areas on the property.

Obayashi and their consultant team absolutely recognize the importance to minimize erosion on the property and silt runoff entering the stream channels and ocean waters. The Draft SEIS has several detailed technical studies that address extensive drainage controls and erosion controls. Estimates of worst-case long-term silt runoff from the property indicate a 22 percent reduction in silt runoff as compared to the existing undeveloped condition.

7) Solid Waste and Recycling

Obayashi plans to institute a materials recycling program to assist solid waste diversion efforts State-wide. Recycling collection areas will be included in the project plans and educational programs will be implemented to educate homeowners to separate wastes at the source and participate in recycling programs.

Obayashi is currently studying the document entitled "Proposed Standard Conditions for Solid Waste Concerns". Because this information was received on 22 September 1993, approximately one month after the conclusion of the comment period and days before printing of the Draft SEIS, Obayashi is not able to formulate a position at this point. Several points raised in the conditions are reasonable, however, it is premature to commit to these at present.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forward to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Project Planner

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF EDUCATION
P. O. BOX 2360
HONOLULU, HAWAII 96804

CHARLES T. TOGUCHI
SUPERINTENDENT

OFFICE OF THE SUPERINTENDENT

SEP - 3 1993

August 21, 1993

Mr. Robin Foster
Chief Planning Officer
Department of General Planning
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Foster:

SUBJECT: Lihi Lani Project - Obayashi Hawaii Corporation Application for Development Plan Use Amendment and Environmental Assessment and Preparation Notice for Supplemental Environmental Impact Statement (EIS) Pupukea and Paumalu TMK: 5-9-06: 1, 18, 24

The Department of Education (DOE) has reviewed the two documents and has the following comments due to the revision of the conceptual master plan of the project:

Development Plan Land Use Amendment

1) The residential component of the project will be increased from 300 units to 445 units on-site. There will be 50 units for off-site development and 50 units for off-site development rather than 180 on-site affordable units. It is our understanding that there is no golf course in the revised plan and that 80 unit elderly housing rental apartments will be adjacent to Sunset Beach Elementary School.

The sustained enrollment impact of the development at buildout will be as indicated below:

School	Grades	Projected Enrollment
Sunset Beach Elementary	K-6	92
Kahuku Intemediate	7-8	23
Kahuku High School	9-12	39
TOTAL		154

Both schools are operating near capacity at present. Since the proposed development timeline indicates completion of the 50 single-family affordable homes will be about 1998 there will be an impact on enrollment.

The projections do not include the 50 off-site units. Since the location of the off-site units is not clear, a separate projection will be required to determine impact on the public schools. The DOE requests that we be apprised of the location of the off-site units as soon as possible after the City makes a decision on the matter.

2) The DOE will be requesting a fair-share contribution for the development of school facilities during the request to the State Land Use Commission for reclassification of approximately 50 to 60 acres of land. The fair share will include the 50 off-site units in the calculation.

3) In Figure 9, the driveway to the elderly housing units connects with the school parking lot. Additional discussion must occur with the City regarding access through the school driveway and conditions permitting cooperative use of the entire driveway.

Environmental Assessment and EIS Prep Notice

1) The enrollment impact and requirement for a fair-share contribution from the project are addressed above.

2) The park/community facilities and elderly housing will create traffic problems in the school driveway and parking lot which are not discussed in Section 4.9 on Page 19 (Roadways and Traffic). There is no determination that the school will be open to through traffic, especialy during school hours. This matter must be discussed with the DOE prior to assuming that the driveways can be connected.

3) The proposed community facilities in the first document are described briefly in Section 2.1.7 (Page 11). However, in Figure 9 of the DP Amendment Application, there is no parking next to the playfields. The DOE recommends that adequate parking be addressed within the Lihilani property. No assumptions should be made that the DOE will allow the parking lot to be used for playfield users until the conditions of use are discussed. A joint use agreement might be considered.

4) Any construction noise exceeding Department of Health (DOH) standards and educational specifications resulting from the construction of adjacent facilities must be mitigated by the developers to the satisfaction of the DOH and DOE.

5) Air quality impacts such as dust should also be mitigated to DOH standards.

6) We concur with the statements in Section 4.15.5 relating to schools. We will respond to any updated analysis of potential impacts after the Draft SEIS is prepared.

Should there be any questions regarding our response, please call the Facilities Branch at 737-4743.

Sincerely,

Charles T. Toguchi
Superintendent

CTT:hy

cc: A. Suga, Assistant Superintendent
J. Sosa, Windward District Superintendent
J. Overton, Group 70 International

GROUP 70
INTERNATIONAL

28 September 1993

Charles T. Toguchi, Superintendent
State of Hawaii, Department of Eduction
P. O. Box 2360
Honolulu, Hawaii 96804

Dear Mr. Toguchi:

Subject: Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 21 August 1993.

1) Enrollment Projection

We appreciate your projection of enrollment impacts caused by the development of residential areas at Lihi Lani. It is important for the Department of Education (DOE) to recognize that development of the housing will take place in phases, with 107 students anticipated by 2010 and full buildout at least 10 years later. As a result, the growth in student generation from homes at Lihi Lani will be gradually felt. The 154 student total is not anticipated to occur in the forseeable future.

Obayashi will make additional contributions toward off-site affordable housing, to participate in development of up to 50 units. The location of this housing is unknown, however, a preference has been stated for the North Shore region. Children associated with these new homes were not addressed in the Draft SEIS

2) Development of School Facilities

The fair share contribution for new school facilities should reflect an accurate projection of the impact of students from Lihi Lani over the next 20 years. In conjunction with projections for Lihi Lani, the other parts of the service area for these schools should also be evaluated for their future enrollment trend, and the projected total demand for classroom space at the time students from Lihi Lani will enter the system.

Obayashi will participate with the City in the development of 50 off-site affordable homes. The exact amount of the in-lieu contribution and location for these homes have not been determined.

Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

3) Circulation Road Connection to Elementary School

Our conceptual plan for the community facilities and elderly housing area shows a circulation road which connects to the Sunset Beach Elementary School (SBES) parking lot. Our purpose in showing this in our concept was to allow for a contiguous public facilities area, which integrates the school facilities with the new YMCA and elderly housing area. The original plan to connect the school and community facilities was based on earlier discussions with SBES representatives. The intent was to alleviate a portion of the traffic congestion now experienced at the school driveway.

We recognize that certain issues such as parking overlap and added traffic could adverly affect the DOE facilities and operations. This possible configuration has been raised for preliminary discussion purposes, since it offers some potential benefits to all associated land uses. It is understood by Obayashi and the City Department of Housing and Community Development that this roadway connection may need to be deleted if school operations are predicted to be adversely affected by traffic and parking. Detailed planning studies and discussions with DOE and elementary school representatives are anticipated in the future to resolve this issue.

4) Noise and Air Quality During Construction

Noise and dust generated by construction activities could possibly exceed Department of Health (DOH) standards and education specifications, however, attempts will be made for construction activities to operate within current specifications. Construction of the elderly housing by the City, the community facility by the YMCA, and the access roadway, utilities and drainage facilities by Obayashi will all need to address this concern. Noise and air quality will be periodically monitored so that there are no exceedences of State regulations.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forward to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Project Planner

Group 70 International, Inc. Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

REF:OCEA:SKK

File No.: 94-037
DOC. ID.: 3368

AUG 23 1993

RECEIVED
AUG 24 1993
GROUP 70

The Honorable Robin Foster
Chief Planning Officer
Planning Department
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Foster:

Subject: Application Report and Supplemental Environmental Impact Statement Preparation Notice (SEISPN) for the Modified Lihi Lani Master Plan Community, Pupukea, Oahu, TMKs: 5-9-05: 6, por. 38, 82; 5-9-06: 1, 18, 24

We have reviewed the application and SEISPN information for the proposed project transmitted by Mr. Jeffery Overton's letter dated July 13, 1993, and have the following comments:

Brief description:

The applicant, Obayashi Hawaii Corporation, proposes to develop the Lihi Lani Master Planned community on approximately 1,144 acres of Agricultural District land located in the Sunset Beach/Pupukea Highlands area (mauka of Kamehameha Highway) of the North Shore.

The revised Master Plan is an latest iteration of the residential, agricultural, and recreational use community that is intended to blend with the rural lifestyle of the area.

A proposed golf course in an earlier version of the plan has been replaced with open park space and a native hardwood forest. The number of residential units has also been increased from the previous plan, from 300 to 445. The project site is bordered by the Kalunawaikaala and Paumalu Streams and is bisected by the Pakulena Stream.

Division of Aquatic Resources

The Division of Aquatic Resources (DAR) comments that they have no information about aquatic biota in the Kalunawaikaala, Paumalu, and Pakulena Streams, and longitudinal reconnaissance surveys for aquatic biota (fishes and macro-invertebrates, including Meglagrion Damselflies) should be performed for the SEIS.

Although DAR believes these streams are intermittent, recent discoveries have shown that many seemingly dry streams, in fact, retain perennial habitats which support important native aquatic species populations, particularly at higher elevations.

DAR is willing to assist in scoping these surveys. DAR's other concerns are related to potential impacts from increased nutrient input from fertilizers or from the herbicide/pesticide toxins on nearshore marine waters, which already have been sensitized by long-term leakage from old domestic septic tanks in the region.

Because the project is very extensive, a description of the approach to be used to limit erosion and sediment/fertilizer/toxin loading of the streams and marine waters, both during and after construction, should be included in the SEIS.

Historic Preservation Division

The Historic Preservation Division (HPD) comments that the SEISPN and report contains in Section 4.8, on page 19, an incorrect summary of the historic properties at these parcels. In addition, this section neglects to review the mitigative measures to which the developer committed to in April, 1991.

The following statements correctly summarize the historic properties at these parcels, and the mitigative measures that the developer has agreed to complete:

There are 23 significant historic sites in the project area. Sixteen of the significant sites will undergo archaeological data recovery, and the remaining seven sites will be preserved. Archaeological data recovery and detailed preservation plans will be submitted to and approved by the HPD of the Department of Land and Natural Resources.

The Environmental Assessment and SEISPN should be revised to include both the correct summary of the historic properties at these parcels, and the developer's commitment to complete the historic preservation review process. HPD recommends that any action on a Development Plan Land Use Map Amendment be deferred until these changes have been completed, and a revised document is reviewed and approved by HPD.

Division of Water and Land Development

The Division of Water and Land Development comments that the SEIS should clearly address the concerns of increased flooding downstream of this project. The impact of sediment movement into the gulch, floodplain, beach and coastal waters during construction should also be addressed.

Commission on Water Resource Management

The Commission on Water Resource Management's (CWRM) staff comments that they
are concerned about the proposed location of the wastewater facility for the project and the possibility of contamination of the underlying ground water in that area.

The Honolulu Board of Water Supply's water well located makai of the facility will likely be affected by any percolating effluent from the wastewater facility. CWRM strongly recommends adherence to the Department of Health's requirements relating to the location and construction of any such wastewater facility.

Also, Stream Channel Alteration Permits (SCAP) will be required if any work is to be performed in, or on the banks of the Pakulena, Paumalu, or Kalunawaikaala Streams, or other streams on the project site.

Office of Conservation and Environmental Affairs

The Office of Conservation and Environmental Affairs (OCEA) comments that the Master Plan area abuts the State Conservation District at its eastern (mauka) most boundary. OCEA suggests that the developer consult with the State Land Use Commission on the precise location of the Conservation District Boundary in this area prior to the initiation of any development activity.

We have no other comments to offer at this time. Thank you for the opportunity to comment on this matter.

Please feel free to call Steve Tagawa at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions.

Very truly yours,

Keith W. Ahue
KEITH W. AHUE

cc: Jeffery Overton, Group 70, Intl.
OEQC

GROUP 70
INTERNATIONAL

28 September 1993

Keith W. Ahue, Chairperson
State of Hawaii, Department of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Ahue:

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 5 August 1993.

1. Division of Aquatic Resources (DAR)

Mr. Bill Devick of DAR was involved in addressing a scope of work for a survey of streams crossing the Lihi Lani site, conducted by Anne Brasher in April 1991. Findings of this study indicated some post-larval o'opu (gobies)(Sicyopterus stimpsoni) were present, however, no adults were found in the survey. Sampling was also conducted for Damselflies but none were caught or observed. For your information, we have enclosed a copy of the Brasher (1991) report.

Potential impacts on the marine environment are addressed extensively in the Draft SEIS, as are extensive mitigative measures proposed to minimize silt runoff and fertilizer nutrient and pesticide runoff. Of note, Obayashi will be implementing measures recommended by both the Department of Health (1990) Best Management Practices and the U.S. Environmental Protection Agency (1993) Guidance Specifying Management Measures for Sources of Nonpoint Pollution of Coastal Waters.

2. Historic Preservation Division (HPD)

We have recieved comments directly from HPD which have corrected the language for inclusion in the Draft SEIS. Normally, a Notice of Preparation does not undergo revisions as a result of public review. These issues are picked up as part of the review process since it is already decided that an SEIS was to be prepared. Land use application review will be subject to the information compiled in the SEIS and not the introductory document. Thank you for the correction.

3. Division of Water and Land Development

We have responded to comments from DOWALD issued in a letter of 9 August 1993 to Mr. Craig Yamagishi of Obayashi Hawaii Corporation. Their concerns regarded trails access and maintenance issues.

There will be no increase in flooding downstream as a result of the project. Detention basins will control runoff on-site such that the rate and volume of runoff will be equal to or less than existing conditions. Please refer to the Drainage section of the Draft SEIS and technical study by Engineering Concepts, Inc.

4. Commission on Water Resource Management

A study by Tom Nance Water Resource Engineering (September 1993) addresses groundwater quality issues for the Draft SEIS. Water reclamation at agricultural areas within Lihi Lani is not expected to pose a significant effect on the potable drinking water quality at the BWS well. The BWS wells at Sunset Beach are not active and have not been used in the last 10 years, however, the BWS classifies them as operable. Obayashi will provide appropriate reports and plans to the Department of Health for review of the Water Reclamation program at Lihi Lani.

Thank you for informing us of the Stream Channel Alteration Permit (SCAP) requirement for any work in or on the banks of the intermittent streams crossing the site.

5. Office of Conservation and Environmental Affairs

Prior to the initiation of development activity, Obayashi will consult with the State Land Use Commission on the precise location of the Conservation District Boundary in this area.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forward to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Project Planner

Preliminary Survey of four streams: Paumalu, Kaleleiki, Pukulena, and Kalunawaikaala, located in the Pupukea Paumalu area of Oahu's North Shore.

by

Anne M. Brasher

Prepared for Group 70, Limited

Project #8763-14

Submitted

April 5, 1991

Introduction

A preliminary survey of four streams: Paumalu, Kaleleiki, Pukulena, and Kalunawaikaala, located in the Pupukea Paumalu area of Oahu's North Shore, was conducted from 27 March to 30 March, 1991. (See Figure 1.) These streams are reported to be intermittent (Hawaii Stream Assessment, 1980), flowing primarily during heavy rainfall. This survey was conducted following more than a week of heavy rainfall. Flows had decreased considerably by the time we began our survey. On Kaleleiki Stream (Site I), flow was merely a trickle (less than 0.5 meters across) but evidence of recent flow 8.5 meters across could be seen; and on Pakulena Stream (Site P) all that remained of the flow (estimated to be 7.11 meters wide) were small puddles in the mud.

Methods

A total of 20 sites, each chosen to reflect typical habitat in that region of the stream, were selected for sampling (See Figure 2). Substrate type, riparian cover, and width and depth of water were recorded at each site. Dip nets and a surber sampler were used to collect benthic invertebrates. Samples were collected both from the water and the substrate below the water. Post-larval gobies were noted through visual observations and collected from three sampling sites for confirmation of species identification.

Flow Characteristics

Of the streams surveyed, Paumalu Stream was the only one with water flowing continuously throughout the survey area (See Figure 3). The upper limit of our survey on Paumalu Stream (Site K) was determined by dense forest and tree roots that prevented further movement upstream. Several human made rock walls were observed along the lower stream channel. The two tributaries to Paumalu Stream, Aimuu Gulch and Kaleleiki Stream consisted primarily of mud with small pools of water. Kaleleiki Stream was completely dry from below Site J to where it joins Paumalu Stream (and is nearly impassable due to thick vegetation).

The lower portion of Pakulena Stream was mostly mud and small pools while the upper portion flowed continuously. A large landslide had recently occurred between Sites A and B and the stream was full of debris, although water still flowed through. Kalunawaikaala Stream was essentially dry during this survey, with some mud and pools in the upper and lower reaches.

Sampling Results

Nine sampling sites were chosen on Paumalu Stream and one (Site Q) on its tributary, Aimuu Gulch. Gobies were collected at Site P, Site R, and Site S (See Figure 4). Benthic samples for invertebrates were collected at the remaining sites. Four samples were taken from Kaleleiki Stream, also a tributary to Paumalu Stream. On Paukulena Stream five sampling sites were chosen. No samples were taken on Kalunawaikaala Stream as there was insufficient water.

Site Q, Aimuu Gulch. This site is as far upstream as we were

able to survey on Aimuu Gulch because of dense vegetation. The area was very overgrown, with riparian cover 85%. Water in this area consisted of shallow pools and some trickle flow. In the pools the water was barely moving, was cloudy in color, and appeared stagnant. The substrate of the channel was large boulders and rocks. At our sampling site the pool was 1.92m wide and 10cm deep. A large toad was observed just downstream of Site Q, but no insects or other invertebrates were found in the benthic sample.

Site K, Paumalu Stream. Riparian cover was 100%, with the canopy 1 to 3 meters above the stream. The substrate was mud, roots, and fallen branches. At Site K the stream width ranged from 1.18m to 4.75m, with an average depth of 16cm. The deepest spot at this site was 68cm. Thiarid snails and amphipods were collected in the benthic sample.

Site L, Paumalu Stream. Site L is near the upper boundary of the property. Riparian cover was approximately 80% and the canopy relatively low. Water flowed over two cascades at this site. Large boulders and roots of a large tree in the middle of the flow made up the substrate. The width of the stream was 3.6m, the height of the first cascade, 0.75m and the height of the second cascade, 1.5m. Average stream depth at this site was 23cm. No organisms were found in the benthic sample.

Site M, Paumalu Stream. Riparian cover at Site M was 75%. The substrate consisted mostly of dirt with rocks, boulders, and roots interspersed. The width of the stream channel in this area was 2.2m and the water was 30cm deep. Amphipods and the introduced riparian Cynidae, _Geotomus pygmaeus_, were observed at Site H.

Site N, Paumalu Stream. At Site N the riparian cover was 50%, and the stream banks low and flat. The substrate was hard mud with roots and branches also on the stream bed. The water was shallow (17cm) and flowing quickly. Width of the stream in this area was 2 meters. No organisms were found in the benthic samples.

Site O, Paumalu Stream. Site O had low sloping banks, and many branches had fallen over the stream channel. Riparian cover was 75%. Stream substrate consisted of large boulders, rocks, and mud. Width of the water was 2.41m and depth was 20cm. The only organism collected at this site was the introduced riparian Cynidae, _Geotomus pygmaeus_.

Site P, R, and S: Paumalu Stream. Post-larval gobies were observed in the lower portion of Paumalu Stream (See Figure 4). Gobies (_Sicyopterus stimpsoni_) were collected at Sites P, R, and S. All gobies collected or observed were less than 2cm standard length. Site R was typical of the habitat in which gobies were observed. The substrate had many large boulders which the gobies perched on (8 to 10 gobies per boulder were observed). The water was 4m wide at Site R and 1m deep. At Site P, the water was 2.5m wide and 0.75m deep.

Site T, Paumalu Stream. The jeep trail crosses Paumalu Stream at Site T. Riparian cover in this area was 60%. Substrate consisted of boulders, roots, and dirt. The width of flowing water was 2.32 meters and the depth was 17cm. No organisms were found in the benthic sample at this site.

Site F, Kaleleiki Stream. Site F is the uppermost point surveyed on Kaleleiki Stream. Riparian cover was 60% at Site F and the substrate consisted of gravel and dirt. Stream width here was 1.28 meters and depth was 17cm. The only organisms collected at this site were flatworms.

Site G, Kaleleiki Stream. At Site G there was a small cascade (1.5 meters) falling into a small deep pool (depth, 94cm; diameter, 3.1m). Riparian cover was 75% in this area and the canopy was very low. Recently fallen leaves covered the bottom of the pool. Benthic organisms found at this site included amphipods, isopods, thiarid snails, and tadpoles.

Site H, Kaleleiki Stream. This site was located just upstream of the jeep trail. Riparian cover here ranged from 25% to 50%. Water was mostly small isolated pools surrounded by mud. Substrate consisted of mud, dirt, and gravel. Width of the pool at the sampling site was 1.2m and depth of water was 5.75cm. Thiarid snails were collected at this site.

Site I and Site J, Kaleleiki Stream. Below the jeep trail which crosses Kaleleiki Stream, flow is minimal. Water was primarily small isolated pools surrounded by mud. The introduced riparian Cynidae, _Geotomus pygmaeus_ was collected in this area. Below Site J, the stream dries completely and vegetation is very thick.

Site A, Pakulena Stream. Site A is at the headwaters of Pakulena Stream. Riparian cover here was thick (90%), with tall trees, vines and branches crossing the stream channel. Substrate of the stream channel was hard mud. A small waterfall was formed by bedrock and tree roots. The pool below the waterfall was 1.3 meters wide and 40cm deep. Water flowed out of the pool and downstream in a trickle (30cm wide, 2cm deep). Organisms collected at this site included the introduced riparian Cynidae Geotomus pygmaeus, an endemic Veliidae (Microvelia vagans), an endemic Dytiscidae (Rhantus pacificus), the introduced mayfly Caenodes nigropunctatus, flatworms, and thiarid snails.

Site B, Pakulena Stream. Upstream of Site B on Pakulena Stream is a large landslide. Downstream of Site B, flow ceases to be continuous. At Site B, riparian vegetation was very dense (100% cover) and the canopy low. The stream channel is narrow with high steep banks, and substrate is mud on bedrock. Width of the water here was 90cm and depth was 10cm. No organisms were found from the benthic sample at this site.

Site C, Pakulena Stream. Site C was a little puddle of water. Riparian cover here was minimal (0%). The substrate was grass and mud. No organisms were found in the benthic sample.

Site D and Site E, Pakulena Stream. Very little water remained in the lower reaches of Pakulena Stream. Isopods were collected from a small pool of standing water at Site D. Isopods and the endemic Dytiscidae Rhantus pacificus were found in the benthic sample at Site E.

Discussion

Hawaiian stream gobies have an amphidromous life cycle

(McDowall,1988). Eggs are laid in the stream, larvae then hatch and wash out to sea. After spending a larval phase as marine plankton, the post-larvae return to the streams where they spend the remainder of their life cycle (Kinzie, 1988). Gobies appear to base return migrations from the sea by cuing on the high flows that occur during spates (Manacop,1953; Erdman,1968; Kinzie and Ford, 1982). In order for a viable population of gobies to become established, the fish must have access between the stream and sea.

The Sicyopterus stimpsoni that we observed in Paumalu Stream during this survey may have responded to the fresh water flowing into the ocean from Paumalu Gulch. There are two probable outcomes for these post-larval gobies. One, the stream channel will dry up and the gobies will perish, or two, the gobies may reach some permanent water in the upper portion of the stream where, given that adequate food is available and other requirements are met, they could survive through adulthood.

Summary

Benthic organisms collected from the Paumalu Watershed (Paumalu and Kaleleiki Stream) included isopods, amphipods, cynids (Geotomus pygmaeus), thiarid snails, flatworms, and tadpoles. Benthic organisms collected from the Pakulena Watershed included the organisms listed above, plus waterstriders (Microvelia vagans), beetles (Rhantus pacificus), and mayflies (Caenodes nigropunctatus). Post-larval gobies (Sicyopterus stimpsoni) were present in the lower reaches of Paumalu Stream, the only place they were observed during this survey.

As these streams are intermittent, water will be flowing primarily during heavy rainfall. Kalunawaikaala, and the lower portions of Pukalena and Kaleleiki were mostly mud and small evaporating pools just days after more than a week of heavy rainfall. It is possible however, that in the upper reaches of these streams some water remains throughout the year.

Acknowledgements

William Barnum provided assistance during the field survey. Dan Polhemus and Arnold Suzumoto generously assisted in species identification.

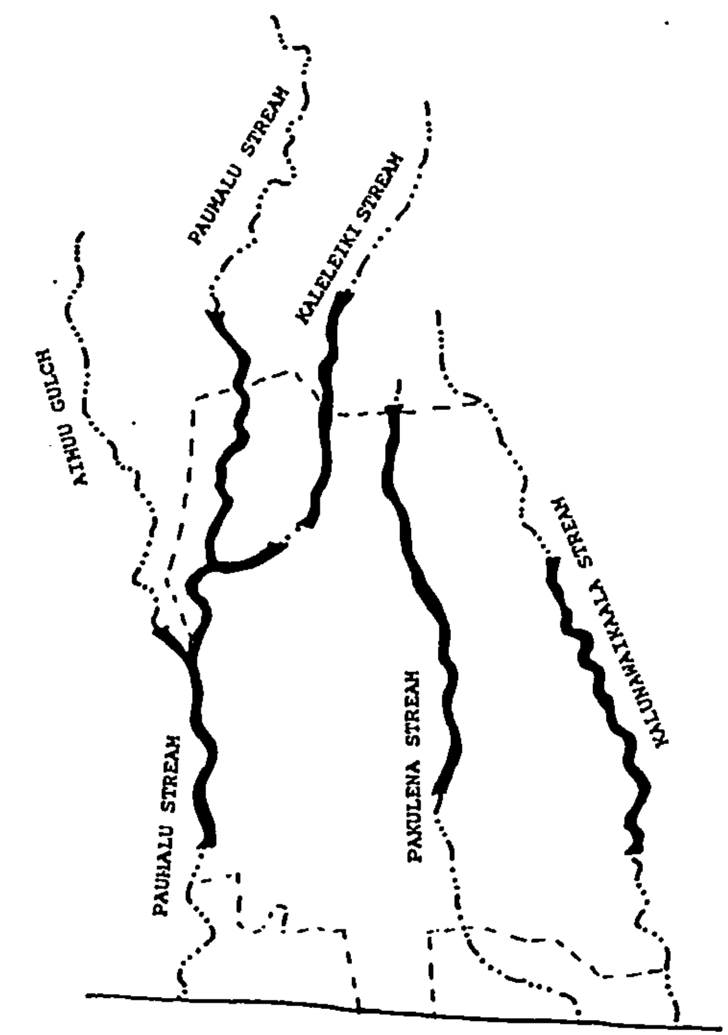

Figure 1. Area covered during survey (indicated by bold). Dashed line is property boundary.

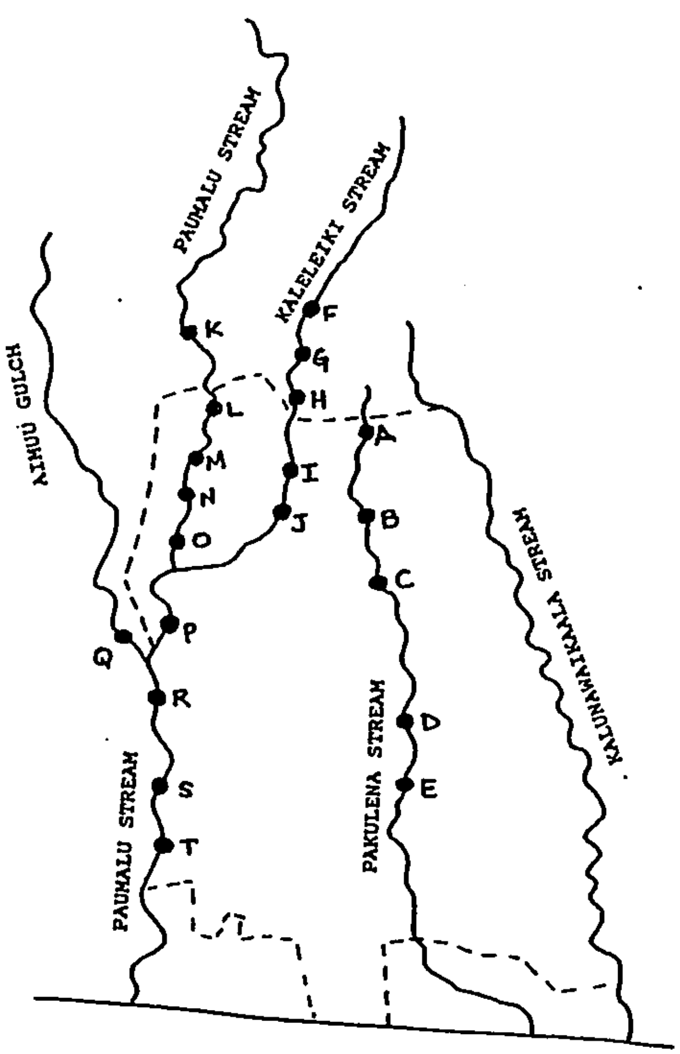

Figure 2. Sampling Sites. (Dashed line is property boundary.)

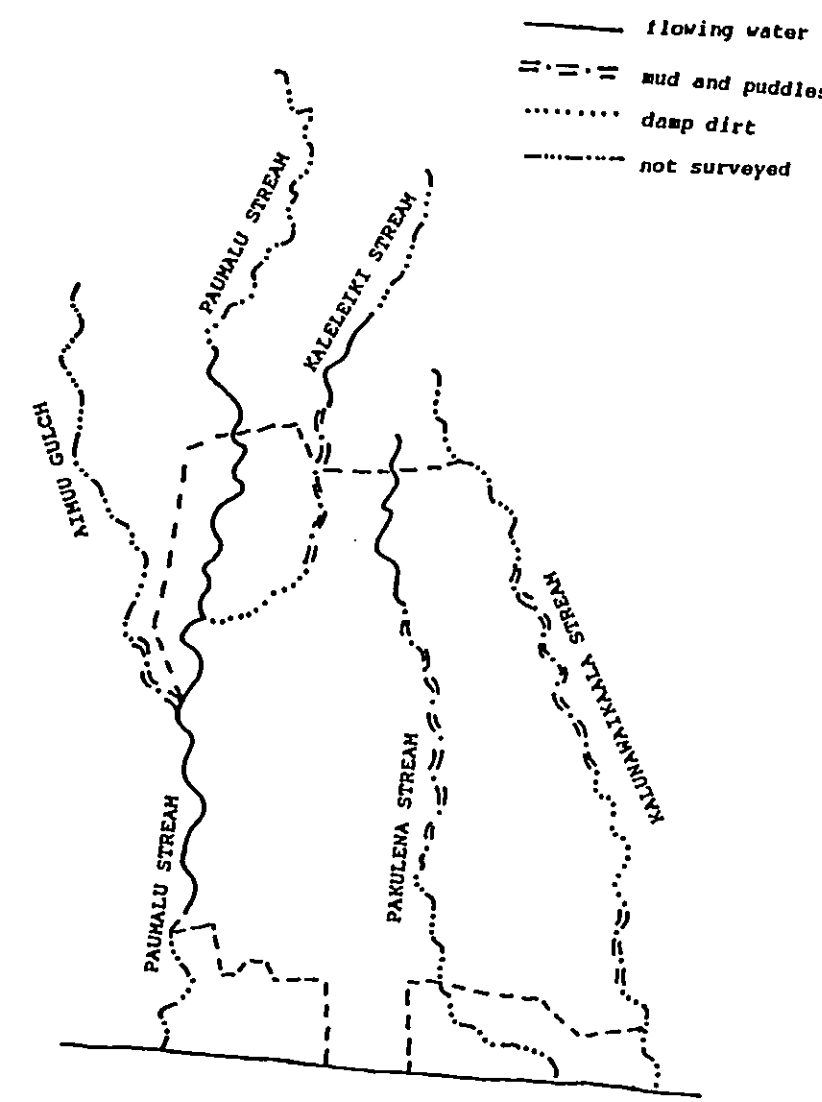

Figure 3. Flow characteristics. (Dashed line is property boundary.)

COPY

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

August 9, 1993

Mr. Craig Yamagishi
Project Manager
Lihilani Ranch
66-145 Kamehameha Highway
P.O. Box 848
Haleiwa, HI 96712-0848

Dear Mr. Yamagishi:

Mr. Wayne Ching and I met with Mr. Pat Lee of your firm on July 30, to discuss Lihilani Ranch's (LR) present proposal to develop the area mauka of Sunset Beach between the Boy Scout camp and Camp Paumalu. Mr. Lee informed us that LR had changes made to its original plan of several years ago, specifically the exclusion of the proposed golf courses. He also reiterated to us that the plan to have an equestrian trail within LR's planned community is still viable. That is good news for the equestrian community. We believe that this is a win/win situation.

Having met with Mr. Lee, we discussed the following:

1) Access into the Pupukea-Paumalu Forest Reserve from LR's planned community. We prefer the access into the forest reserve to proceed from Kamehameha Highway through the area designated as a "forestry area" on page 9 of the Lihilani Environmental Assessment, and eventually tying into the existing Kaunala trail.

2) The equestrian trail within LR's planned community is for public use. How this will be controlled is still up for discussion.

3) An agreement between LR, DOFAW and the Hawaii Equestrian Trails Association (HETA) needs to be established in determining the management and maintenance of the equestrian trail.

4) Liability to LR can be covered under HRS Chapter 520- Landowner Liability and as well as Chapter 198D, Hawaii Trail and Access System. This needs further discussion.

We have also reviewed LR's North Shore Development Plan Land Use Map Amendment Application and the Environmental Assessment and Notice of Preparation of a Supplemental Environmental Impact Statement that was sent earlier to this Department. The only comments we have at this time is that the EIS will need to specifically address the equestrian use of the area and the access to the forest reserve.

We commend Obayashi Hawaii Corporation in working with the local community. It is through this effort that a win-win situation can be accomplished. Should you have any questions, please feel free to call me at 587-0166. Thank you.

Very truly yours,

Herbert H. Kikukawa
Branch Manager - Oahu

cc: Wayne F. Ching

GROUP 70
INTERNATIONAL

Francis S. Oda, AIA, AICP
Norman G.Y. Hong, AIA
Sheryl B. Seaman, AIA, ASID
Robert K.L. Wong, AIA
Hiroshi Hida, AIA
Roy H. Nihei, AIA, CSI

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George I. Atta, AICP
Jeffrey H. Overton, AICP
James I. Nishimoto, AIA
Jen Chih "Jack" Lee, AIA
Michael A. Gami
Eric G. Crispin, AIA
Danilo M. Herrera

28 September 1993

Herbert H. Kikukawa, Branch Manager, Oahu
Division of Forestry and Wildlife
State of Hawaii, Department of Land and Natural Resources
1131 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Kikukawa:

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 9 August 1993. Obayashi representatives appreciated meeting with you on 23 September 1993 to discuss forestry issues.

1) Acess to Pupukea-Paumalu Forest Reserve

As discussed at the meeting, access to the Forest Reserve for DOFAW and the public can be provided through the Lihi Lani project. The most logical route may be via the internal access roadway system, and the paved road will terminate at the water reclamation facility in the central area of the property. From this point dirt roads would lead to the access point you desire to the Forest Reserve, through the planned agroforestry area in the northeastern corner of the property. The initial route connecting to the Kaunala Trail was cut by Dick Davis around 1990, however, this trail has not been maintained. We will probably need to have Dick come back and help us re-establish (find) this route when Obayashi is ready to commit resources to maintain it.

2) Horseback/Hiking Trail

In the 9/23/93 meeting, it was concluded that a Master Agreement would be drafted between Obayashi and the State that would outline how the trails would be built and operated.

3) Liability Issue

Based on our converstaions, public access to the trails on Lihi Lani and associated liability issues have appear to be managable. Since the passage of HRS Chapter 520 - Landowner Liability, and understanding Chapter 198D, Hawaii Trail and Access System, we believe that many of the liability issues associated with public access to the on-site trails can be addressed. Obayashi will continue to work closely with DOFAW on this issue.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forward to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Project Planner

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

LOG NO: 8912
DOC NO: 9307td51

August 5, 1993

Robin Foster, Chief Planning Officer
City and County of Honolulu
Department of Planning
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Mr. Foster:

SUBJECT: **North Shore Development Plan Land Use Map Amendment Application and Supplemental Environmental Impact Statement for Lihi Lani**
Paumalu and Pupukea, Ko'olauloa, O'ahu
TMK: 5-9-5: por. 38; 5-9-6: por. 1, 18, 24

The Environmental Assessment and Notice of Preparation of a Supplemental Environmental Impact Statement contains in section 4.8 on page 19 an incorrect summary of the historic properties at these parcels. In addition, this section neglects to review the mitigative measures to which the developer committed in April 1991.

The following statements correctly summarize the historic properties at these parcels, and the mitigative measures that the developer has agreed to complete.

There are 23 significant historic sites in the project area. Sixteen of the significant sites will undergo archaeological data recovery and the remaining seven sites will be preserved. Archaeological data recovery and detailed preservation plans will be submitted to and approved by the Historic Preservation Division of the Department of Land and Natural Resources (SHPD).

The Environmental Assessment and Notice of Preparation of a Supplemental Environmental Impact Statement should be revised to include both the correct summary of the historic properties at these parcels and the developer's commitment to complete the historic preservation review process. We recommend that any action on a Development Plan Land Use Map Amendment be deferred until these changes have been completed and a revised document is reviewed and approved by SHPD.

If you have any questions please call Tom Dye at 587-0014.

Sincerely,

DON HIBBARD, Administrator
State Historic Preservation Division

TD:jt

cc: Group 70 International, Inc., 924 Bethel Street, Honolulu, Hawaii 96813, Attn. Jeffrey Overton, Senior Planner

GROUP 70
INTERNATIONAL

28 September 1993

Don Hibbard, Administrator
Historic Preservation Division
State of Hawaii, Department of Land and Natural Resources
33 South King Street, 6th Floor
Honolulu, Hawaii 96813

Dear Mr. Hibbard:

Subject: Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 5 August 1993.

As noted in your letter, we need to restate in the Draft Supplemental Environmental Impact Statement Obayashi's commitment to completing mitigative measures with respect to significant historic sites. There are 23 significant historic sites in the project area. Sixteen of the significant sites will undergo archaeological data recovery and the remaining seven sites will be preserved. Archaeological data recovery and detailed preservation plans will be submitted to and approved by the Historic Preservation Division of the Department of Land and Natural Resources (SHPD).

Normally, a Notice of Preparation does not undergo revisions as a result of public review. These issues are picked up as part of the review process, since it is already decided that an SEIS was to be prepared. Land use application review will be subject to the information compiled in the SEIS and not the introductory document. Thank you for the correction.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forward to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Project Planner

Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813-4398 • Phone (808) 523-5866 • FAX (808) 523-5874

Hawaiian Electric Company, Inc. • PO Box 2750 • Honolulu HI 96840 00

William A. Bonnet
Manager
Environmental Department

September 13, 1993

RECEIVED
SEP 16 1993
GROUP 70

Mr. Robin Foster
Chief Planning Officer
City and County of Honolulu
Department of Planning
650 South King Street, 8th Floor
Honolulu, HI 96813

Dear Mr. Foster:

Subject: **Application for North Shore Development Plan Land Use Amendment and a Supplemental EIS for Lihi Lani Pupukea and Paumalu, Koolauloa, Oahu, Hawaii**

Hawaiian Electric Company (HECO) is currently working on several projects designed to upgrade load demand in areas of need along the North Shore. Future North Shore transmission lines will be positioned mauka of the proposed development as part of this upgrade.

HECO will reserve further comment pertaining to construction of future electric facilities within the development area until construction plans are finalized.

Sincerely,

for William A. Bonnet

cc: Jeffrey H. Overton, Group 70

An HEI Company

GROUP 70
INTERNATIONAL

28 September 1993

William A. Bonnet, Manager
Environmental Department
Hawaiian Electric Company, Inc.
P. O. Box 2750
Honolulu, Hawaii 96840-0001

Dear Mr. Bonnet:

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 13 September 1993.

Group 70 and representatives of Obayashi have maintained close communication with HECO's Distribution Engineering Department regarding the proposed second 46 kV subtransmission line planned for the North Shore. We would like to continue our coordination with HECO regarding facilities improvements in the North Shore area.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forward to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Project Planner

BENJAMIN T. HOPKINS
59-528 Aukauka Place
Haleiwa HI 96712
tel 808-638-7089/5640 fax

CRAIG YAMAGISHI
c/o Lihilani Project
66-145 Kam Hwy
Haleia HI 96712

September 1, 1993

Dear Craig:

Since meeting with you last week about the current Ohbayashi master plan I have had some additional thoughts about it and have also discussed it with the Planning Committee of Keep the North Shore Country. My/our preliminary (and unofficial) observations are set out below, for such value as they may have at this stage of your planning process.

We believe that most of our suggestions, if adopted, would increase community support, product marketability, and profit.

1. TRANSPORTATION/TRAFFIC. No major development should occur on the North Shore that would significantly worsen the existing traffic problem. Therefore your master plan should (and probably can) be modified so as to minimize the use of autos. There are at least four ways to do this:

a) Provide for more on-site employment, services, and amenities--a small eco-spa/retreat, an agro-forestry school, an eldercare/childcare facility, a pre-school, tennis courts, picnic areas, music/dance pavilion, meeting rooms, built-in telecommunication lines, copy center, small office rentals;

b) Provide good jitney service to and from Kam Highway so project residents (especially commuters and youngsters) can use The Bus, the beaches, Sunset School, and all the community facilities on Kam Highway--without driving;

c) Provide a network of off-road bicycle/pedestrian paths that are attractive, interesting, and convenient;

d) Limited commercial activity (e.g., a small store) at the bottom of your access road;

e) Reduce the number of lots.

See pp. 168-77 of the "Sustainable Cities" book. See also Unterman, Richard K., "Accomodating the Pedestrian: Adapting Towns and Neighborhoods for Walking and Bicycling".

2. ACCESS ROAD. Entering through Paumalu gulch would preserve the pali viewplane and would probably be less expensive than going up the cliff.

3. SEWERAGE. Pumping large quantities of sewage (or sewage effluent) from Kam Highway uphill to the main site would be energy consumptive and failure-prone. Another system should and can be devised--or the elder housing relocated.

4. CONSERVATION LANDS. These should be permanently dedicated, and managed by an organization like the Nature Conservancy--to ensure wise maintenance and preclude future development.

5. **SURFACE WATER.** To protect makai land from flooding and to maximize economic value, it is essential to keep surface water on site for use in agriculture and forestry. This can best be done by means of--

a) increased vegetative density--especially trees--throughout the site, and

b) a carefully designed system of contoured road construction, swales, and natural terraces ("constructed" with lines of high grass or trees) that redirect and distribute converging waterflows toward ridges and into natural ponding areas.

This approach would be greatly facilitated by laying out roads on gentle gradients along contour lines. Steep roads serve as sluiceways that move water rapidly downhill instead of keeping it in place or spreading it for eventual percolation into the ground.

See pp. 119-125 of "Sustainable Cities". Also pages 161, 236, 242, 249, and 259 of "Permacaulture".

6. **CLUSTERING AND COMMON AREAS.** Homesites should be clustered, and the back of each lot should adjoin an off-street "greenway" common area that is carefully designed for optimal water management, productive agroforestry, childrens' recreation, and social interaction. These greenway common areas should be owned and managed by one or more community associations. (Possibly the best example of this concept is the Village Homes development in Davis, California.)

See pp. 212-18 of "Sustainable Cities".

7. **COMMERCIAL AGRICULTURE.** The emphasis should be on diversified, community-supported, "sustainable" agroforestry--which provides the best erosion control, water management, productivity, and neighborhood sociability.

8. **PHASED CONSTRUCTION.** To minimize erosion, flooding, and the scale of unforseen hazards/difficulties, construction should be undertaken in several phases instead of all at once.

No doubt these suggestions call for a wider range of planning expertise and more intensive design work than a conventional subdivision. They do have profit potential, however; and our very special community--which provides a unique set of resources to thousands of people from all over Oahu and the world--deserves nothing less than the best of contemporary planning, design, and technology.

New development on the North Shore must not only protect our resources and our quality of life from degradation of any kind; it must go further and enhance what is already here. This can be done--but only with extra effort, creativity, and state-of-the-art methods.

Our future hangs on this, unlike Ohbayashi's.

Sincerely,

Ben

cc: Norman Quon, Peter Cole, Ken Newfield, Mike Barnett

GROUP 70
INTERNATIONAL

28 September 1993

Benjamin T. Hopkins
59-528 Aukauka Place
Haleiwa, Hawaii 96712

Dear Mr. ~~Hopkins~~: Ben

Subject: **Lihi Lani, Obayashi Hawaii Corporation, Pupukea, Oahu, HI**
Response to Comments on Notice of Preparation of Draft SEIS

Thank you for providing your comments on the EA/NOP for Lihi Lani. We have prepared responses to the issues you raised in your letter of 1 September 1993. Since 1990, Obayashi Corporation has dropped the "h" from its former corporate name Ohbayashi Corporation.

1) Transportation and Traffic

The Lihi Lani project will be developed in phases to minimize the impact of traffic on local roadways. The total impact of vehicle trips associated with the project, assuming full development by 2008, would be 5 to 8 percent of the total number of vehicles on the roadway. This small relative amount of traffic could still be considered significant, however, the bulk of the highway traffic will be due to other regional developments and ambient traffic growth over the next 15 years.

We appreciate your recommendations for on-site employment and believe that many residents of Lihi Lani, as witnessed in Pupukea, will have alternative methods for employment and income generation. There YMCA may operate an on-site service to shuttle residents between the community facilities, beach and mauka areas, if such a service is warranted. There will also be bicycle and walking paths integrated with the raodway and open space system. At present there are no plans for on-site commercial operations such as a small store at the highway. Such a use would require a Change of Zone for commercial activity at this location, which Obayashi has no intention of pursuing.

Because the project is low density and will be built in phases the traffic associated with the 315 lots will grow slowly over 15-20 years. Thank you for the references on town and community planning.

2) Access Roadway

Obayashi has completed extensive studies of alternative access routes, including Paumalu Gulch. This route would be more expensive than the currently planned route, and would involve property not owned by Obayashi. In addition, potential impacts to the water quality and drainage characteristics

of Paumalu Stream as a result of access road development and operation at this location would not be desirable. Views of the property and new road from the Sunset Beach surfing beach and Sunset Point communty area would also be affected.

3) Pumping of Wastewater from Makai Areas

Pumping of wastewater to treatment facilities is a common practice, and appropriate measures must be taken to prevent failures of pump stations and force mains in the makai portion of the Lihi Lani system. Any other system would involve wastewater disposal in the makai location which would have much greater potential for ocean water nutrient loading, which will be avoided by the tertiary treatment and water reclamation planned for the main portion of the project.

4) Conservation Lands

Lihi Lani will manage its lands privately as do other private proerty owners in the Pupukea area. With over 700 acres of open space expected to remain in the final plan, large areas will need to be managed for erosion control and vegetation/wildlife control. Obayashi intends to accomplish this privately, however, recommendations from other recognized conservation groups for appropriate management approaches would be appreciated.

5) Surface Water

In many ways, Lihi Lani will be following your recommendations to prevent flooding of makai lands. With development of the project, the rate and volume of runoff to makai areas will remain the same or decrease. The development of some roadways on steep lands will, however, be unavoidable due to the extent of steep lands on this property. Obayashi, through their planners and engineers, are making attempts to minimize affects to steep areas. Current plans for the project show this sensitivity through clustering homes and running roads along the contours where possible.

6) Clustering and Common Areas

Your recommendations for greenways and clustered homes fits well with our current concept of agricultural easements and trails. Agricultural easments and open spcae areas will provide extensive green space linkage throughout the project. Non-potable water systems will be used to irrigate common and agricultural areas, with undeground drip systems planned for optimal conservation of the resource. The arrangements for common onwership and management must be carefully worked out, and we are pleased to see that other project can be examined as working examples of these ideas.

7) **Agroforestry**

The planning of agroforestry areas at Lihi Lani is underway, as you might have noticed in the Prep Notice. A large area in the mauka portion of the property is planned to include agroforestry. Please refer to the Draft SEIS and Agricultural Plan for more details on the plans to control erosion, manage watershed lands and produce forestry products through the agroforestry area. The State Division of Forestry and Wildlife (DOFAW) is being consulted in planning the agroforestry project.

8) **Phased Construction**

As mention in the NOP, the plan for development of Lihi Lani is to build in four 2 to 3 year phases over a total development period of 10 to 12 years. This phased approach will, as you suggest, minimize erosion and flooding. As compared to the previously planned project, development will be much more spread out to allow for careful control throughout the building process. This will help safeguard the environment and result in less potential impact to the community and the ocean.

Lihi Lani has never been planned as a conventional subdivision, and with the current information and expertise available for planning and environmental management, Lihi Lani will become an example of environmentally-sensitive development. Thanks to interested citizens in the North Shore community as yourself, our nearly six years of community-oriented planning has helped to shape this into a model project for Hawaii.

We appreciate your review and comments on the Notice of Preparation, and your concerns are addressed in the Draft Supplemental EIS. Please contact us if you have any questions or require additional information, and we look forward to receiving your comments on the Draft SEIS.

Sincerely,

GROUP 70 INTERNATIONAL, INC.

Jeffrey H. Overton

Jeffrey H. Overton, AICP
Project Planner

APPENDICES

APPENDIX A

Conceptual Agricultural
Plan for Lihi Lani

AGRICULTURAL PLAN FOR LIHI LANI
15 September 1993

Prepared by Quon • Yamagishi Partnership
In association with:
Group 70 International, Inc.
Frank S. Scott Ph.D., Agricultural Economist
Fred Lau, Hawaiian Landscape Co.
Paul Weissich, Botanical Consultant

I. Overview and Statement of Purpose

The Pupukea area of the North Shore has historically supported agricultural activities such as sugarcane and pineapple, avocado orchard, grazing pasture, nursery operations and small diersified agriculture. The existing Pupukea Highlands subdivision area continues to support many small agricultural uses such as grazing and ranching, tree and plant nursery operations, fruit tree orchards and various vegetable crops.

Farming of the 1,144 acres of land at Lihi Lani for large intensive uses has historically been unsuccessful. Previous attempts for pineapple and avocado on this property were not successful. Steep lands and the lack of an irrigation supply made this a difficult site to utilize effectively for intensive agriculture. Grazing use of the land for cattle and horses has occurred over the past 20 years. Grazing pasture is mostly overgrown, with current use of a small area by a few horses owned by local residents who have been granted permission by the owner.

Lihi Lani is planning to retain and expand the agricultural uses at the Obayashi property in Paumalu and Pupukea in a manner that will be compatible with the other planned uses such as residential areas, recreational uses and open space areas. A variety of agricultural uses are possible for this land, however, their location must be planned to conform to the land's capability for crops. The agricultural soils ratings established by the State fo Hawaii and the U. S.

Department of Agriculture classify most of the land as marginal for agricultural uses.

Scott (1988) completed an agricultural feasibility study for these lands concluding that large scale agricultural use of these lands would be limited. Prime agricultural soils are only found on 160 acres of the site, and steep slopes over 70 percent of the property divide the 300 to 350 acres of potentially usable land into isolated non-contiguous pockets. These physical conditions, plus the expense of developing new access roadways and an extensive irrigation system, limit the potential for an agricultural enterprise to succeed alone on this property. With another income-generating use of the land to offset the land and infrastructure costs, however, there would be greater potential for selected agricultural uses to be feasible at this site.

In the current plans for Lihi Lani, 315 one to three acre Country lots will be developed in a series of phases. The development costs for the new access roadways and water supply for these homes will be covered through the sales of the Country lots. Land will be made available for agricultural use on portions of each of the 315 Country lots and also in larger common areas. These lands would be leased to organized agricultural businesses. New agricultural uses at Lihi Lani would not be burdened by the huge up-front capital costs for roads and water. For these reasons, several types of carefully planned agricultural uses could become viable at Lihi Lani.

Another important aspect of the overall agricultural plan will be the implementation of water reclamation on various crops in the common agricultural areas. With the removal of a golf course from the project plans, agricultural areas will serve as the disposal site for reclaimed water generated by the project residents. Tertiary-treated wastewater effluent (reclaimed water) of the highest quality will be used in agricultural lands irrigation.

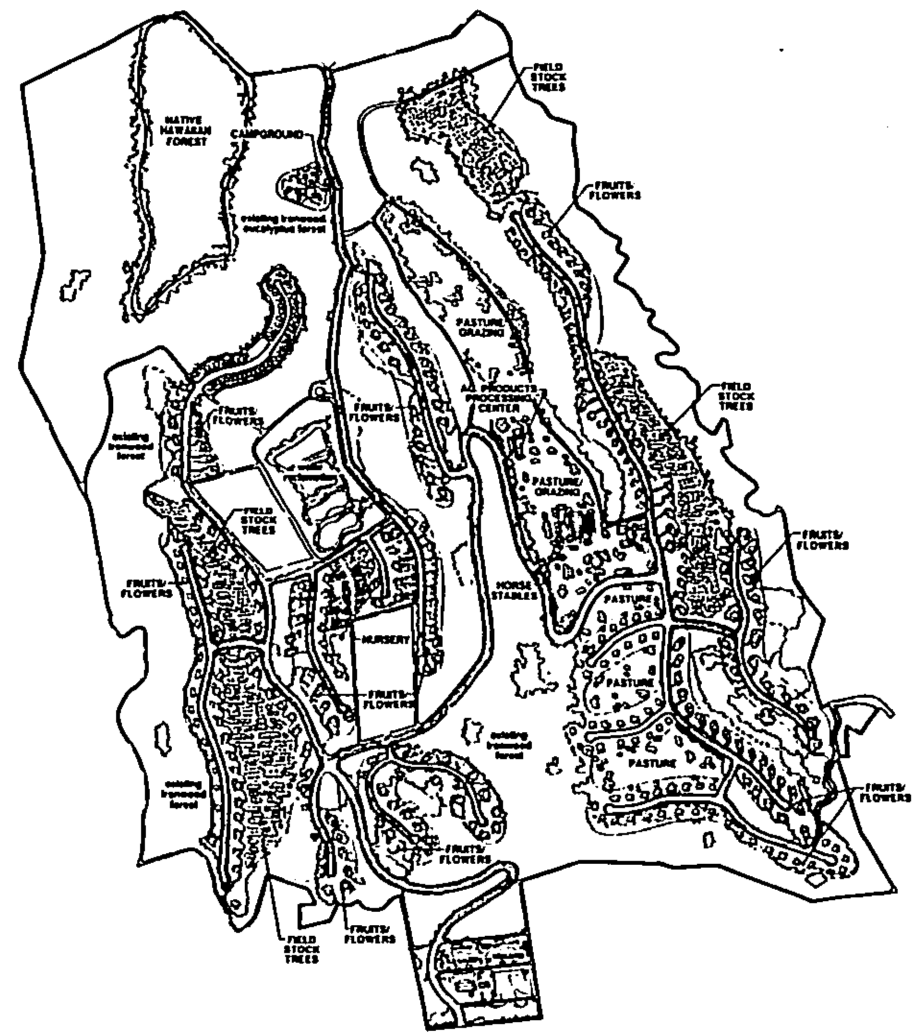
II. Elements of the Agricultural Plan for Lihi Lani

Several types of organized agricultural activites are planned at over 150 acres of Lihi Lani, including grazing pastures, a field stock tree nursery, fruit tree orchards and an agroforestry area. Figure 1 shows the Conceptual Agricultural Plan for Lihi Lani. This concept plan identifies potential agricultural uses over the property in the Country lots and in larger common areas. Agricultural uses property-wide will be phased into production in conjunction with the development phasing program. The Concept Plan shows several

Other promising agricultural uses may also be introduced by individual lot owners such as flower and foliage nurseries and various types of vegetable crops. Agricultural uses of individual lots must be allowable uses under the Code of Covenants and Restrictions (CCR) on the Country lots and the Homeowner Association rules. Generally non-compatable or noxious uses such as pig farms would not be allowable agricultural uses.

The operational character of the farm areas will include portions with individual Country lots and larger common area agricultural uses. Each of the individual country lots will have agricultural uses, with contiguous uses planned to form a larger crop management area. On-lot areas will constitue approximately 45 acres of agriculture. Larger common area agricultural uses will include pasture (40+ acres), nursery (17 acres), orchard (10 acres) and agroforestry (40+ acres). Overall management of these areas would be under control of the Homeowners Association, with leases made to farm businesses to conduct the day-to-day farming and product marketing operations.

Areas for the grazing pasture, field stock tree nursery, fruit tree orchards and the agroforestry area are planned for irrigation with reclaimed water. The crop areas will gain the benefit of free irrigation water containing nutrients which will satisfy a portion of the crop fertilization requirement. None of the on-lot agricultural areas are planned to receive reclaimed water, and will be irrigated through the project's brackish water irrigation system.



CONCEPTUAL AGRICULTURAL PLAN

FIGURE 1

The financial viability of part of the planned agricultural uses is addressed in this report, specifically for the field stock tree nursery and fruit tree (avocado) orchard production. The key to establishing these agricultural uses as viable and sustainable business operations will be a recognition that future flexibility will be necessary. Due to changing market conditions, crop types that appear attractive for Lihi Lani in the present planning period may need to shift at some future point to other agricultural uses that are proven more successful.

Basic implementation requirements for agriculture at Lihi Lani are summarized as follows:

1. Obayashi continue operations at the on-site propogation nursery facility to provide stock material for initial planting program, and act as a base for agricultural activities.

2. Establish on-lot agricultural areas on all 315 country lots for either field stock tree nursery and/or fruit tree orchards, with phased expansion following the overall development phasing plan.

3. Create legal easements for agricultural areas on Country lots to assure a perpetual land base for on-lot agricultural use.

4. Provide linkage of agricultural areas in Country lots to create contiguous strips of similar use or compatible agricultural uses.

5 Establish larger common agricultural areas in phases for grazing pasture, fruit tree orchard, field stock tree nursery and agroforestry.

6 Provide access and a central operations center for the farm management organization for maintenance and product processing operations.

7 Provide water supply for the brackish irrigation system on Country lots, with reclaimed water application in the larger common agricultural areas.

The following sections address the specific agricultural crop types proposed for Lihi Lani, including the management requirements and marketing issues.

III. Field Stock Tree Nursery

A major portion of the agricultural use area at Lihi Lani is proposed to used as nursery area for the propogation of field stock trees. Technical advisor to Obayashi for the production of field stock trees is Fred Lau, owner of Hawaiian Landscape Co., which is one of the largest field stock tree operations in Hawaii. A preliminary analysis of the potential for developing a field stock tree nursery at Lihi Lani has been completed by Mr. Lau, and is included as Exhibit A.

Field stock trees are typical landscaping materials used for street trees which are planted at new projects such as residential developments, golf courses, parks, office and retail sites, and other locations. These trees include a wide range of palm tree varieties, shower trees, monkeypod, royal poinciana and other common Hawaii landscape trees. A preliminary list of field stock trees to be planted at Lihi Lani is included as Table 1.

Field stock trees are grown in a nursery setting to a marketable size, approximately five to seven years depending on the species, and then sold as part of the landscaping materials to be transplanted to a new permanent site. Due to high land costs and lack of usable areas with adequate water supply, there is demand on Oahu for sites to grow field stock trees. Land costs and infrastructure costs typically prohibit nursery operations from becoming successfully established. Lihi Lani will have the infrastructure in place to supply water for irrigation, plus there will be adequate land available for this use.

A field stock tree nursery is planned to be established over approximately 30 to 40 acres of the agricultural easments in Country lots. The proposed physical layout for agricultural easements on the Country lots is described in Section VIII. Another 10 to 15 acres of field stock trees could be raised on common lands outside the Country lots. For the purpose of this study, it is assumed that 43

TABLE 1

FIELDSTOCK NURSERY TREE LIST

Aleurites Moluccana	Kukui
Artocarpus Incisus	Breadfruit
Bauhinia Blakeana	Hong Kong Orchard
Bauhinia Monandra	Saint Thomas Orchid
Bauhinia Variegata	Ali Bang Bang
Callistemon Viminalis	Weeping Bottlebrush
Cassia Javanica	Pink and White Shower
Cassia Javanica X Fistula	Rainbow Shower
Cassia Javanica X Fistula	Queens White Shower
Chrysophyllum Oliviforme	Satin Leaf
Citharexylum Spinosum	Fiddlewood
Clusia Rosea	Autograph
Cocholospermum Vitofolium	Buttercup Tree
Conocarpus Erectus	Silver Buttonwood
Cordia Sebestena	Kou Haole
Cordia Subcordata	Kou
Delonix Regia	Royal Poinciana
Eleodendron Orientale	False Olive
Erythrina Crista-Galli	Coral Tree
Erythrina Variegata Var. Orientalis	Indian Coral Tree
Erythrina Variegata Var. Sandwichensis	Native Coral Tree
Erythrina Variegata L. 'Tropic Coral'	Vertical Wiliwili
Ficus Benjamina	Weeping Banyan
Ficus Retusa	Chinese Banyan
Fucus Retusa '	'Green Gem' Banyan
Filicium Decipiens	Fern Tree
Fragraea Berteriana	Pua Kenikeni
Hernandia Sonora	Jack in the Box
Jacaranda Mimosifolia	Jacaranda
Lagerstroemia Speciosa	Giant Crepe Myrtle
Messerschmidia Argentea	Beach Heliotroph
Metrosideros Collina	Ohia Lehua
Noronhia Emarginata	Madascar Olive
Pandanus Odoratissimus	Hala
Pimenta Dioica	Allspice
Plumeria Obtusa	Singapore Plumeria
Plumeria Var	'Grave Yard Yellow' Plumeria
Ravenea Madagascariensis	Travelers Palm
Samanea Saman	Monkey Pod

FIELDSTOCK NURSERY TREE LIST
(Continued)

Spathodea Campunulata	African Tulip Tree
Spathodea Campunulata Aurea	Gold African Tulip Tree
Tabebuia Argentea	Silver Trumpet
Tabebuia Donnell Smithii	Gold Tree
Tabebuia Pallida Var. Moir	Moirs Pink Tecoma
Terminia Catappa	False Kamani
Thespesia Populnea	Milo

PALMS

Archontophoenix Cunninghamiana	Queen Palm
Archontophoenix Cunninghamiana	King Palm
Chrisalidocarpus Lutescens	Areca Palm
Cocos Nucifera	Coconut Palm
Cycas Circinalis	Queen Cycas
Cycas Revoluta	Sago Palm
Latania Loddigesii	Blue Latan Palm
Livistonia Chinensis	Chinese Fan Palm
Neodypsis Decaryi	Triangle Palm
Phoenix Canariensis	Canary Isl. Palm
Pritchardia Pacifica	Fiji Fan Palm
Ptychosperma Macarthurii	McArthur Palm
Roystonea Regia	Royal Palm
Vetchia Merrillii	Manila Palm
Vetchia Winen	Winen Palm
Washingtonia Robusta	Washingtonia

acres of the total field stock tree nursery area that would be developed over the phased development of the project.

An advantage of growing field stock trees is that they require less maintenance than other types of agricultural activities. In addition, the trees will be visually attractive and will enhance the surrounding area. Pesticides and fertilizer use will be kept to a minimum, and could be done through granular applications which avoids air drift. Organic pest control measures will be applied, as feasible, and the project-wide Integrated Pest Management (IPM) program will be applied at the field stock tree areas.

The field stock trees nursery planned for 10 to 15 acres in common areas will be irrigated with reclaimed water from the Lihi Lani Water Reclamation Facility. Nutrients included in the reclaimed water would help to supply a portion of the fertilizer required for these trees. The agricultural easments in the Country lot areas will be irrigated with brackish water from the on-site wells.

Assuming 43 acres of field stock trees, at a density of approximately 300 trees per acre, this would amount to 12,900 trees in varying stages of maturity on the property at given time. Depending on the variety of trees being raised, this density of trees could vary by 10 to 15 percent either smaller or larger. The value of the field stock trees at maturity varies with the different tree species, ranging from $500 to $1,000 per unit (higher with some species).

Assuming production from the entire 43 acres, total value of field stock trees raised in the five to seven year grow-out cycle would be expected to be between $6.45 to $12.9 million. Annual operational and material costs are estimated at approximately $9,000 per acre, or $2.3 million for the 43 acre field stock nursery over the five to seven year cycle. Based on these projections, net revenues from the operation could be $2.6 million or higher over the five to seven year cycle. Early years of the operation will involve only a portion of the total 43 acre nursery area planned at buildout, however, the feasibility of smaller areas will still be substantial.

Demand for the trees varies with the pace of development by both private sector projects (i.e., subdivisions, shopping centers, office buildings, golf courses, etc.) and publically-sponsored projects (i.e., government centers, parks, roadways, etc.). An active nursery must stock a wide range of species, since most major landscaping contracts call for several dozen tree species. Lihi Lani would have a large enough size and proper climate to raise most popular species of landscaping trees. The proceeds of the lease rent for agricultural easements supporting field stock trees are planned be used by the Homeowners Association at Lihi Lani to offset maintenance costs typically assessed through Association fees.

IV. Fruit Trees

The Pupukea setting is an ideal place to grow numerous varieties of fruits such as banana, papaya, avocado, mango, orange, grapefruit, lime, lemon and others. Exotic tropical fruits such as star fruit and lychee could also be raised successfully on this property, as do many property owners in Pupukea. Markets for most of these crops are generally limited, however, a local market could be tapped to support small-scale operations at Lihi Lani.

Approximately one-third of the Country lots would contain agricultural easements used to grow fruit trees. Other areas within the property sould also be developed as fruit trees orchard areas. In the Country lots, rows of fruit trees could be planted in the agricultural easements of each lot, with access provided for maintenance and harvesting. These trees would also contribute to the aesthetic quality of the landscape. Depending on the success of various fruit trees currently being tested at the on-site nursery, Lihi Lani could have a variety of fruit crops grown for commercial enterprise.

Historically, avocado production has been proven to be relatively successful in the Pupukea area. For the planning of initial fruit tree production at Lihi Lani, the feasibility to grow and market avocados was evaluated.

Scott (September 1993) considered the feasiblity of 23-acre avocado orchard at Lihi Lani, and this analysis is reported as Exhibit B. Avocado orchards are planned for Country lots and other orchard areas in common areas at Lihi Lani. Up to one-third of the agricultural easements on the Country lot area (10 to 15 acres) is planned for avocado production, and another 8 to 13 acres would be included in other orchard sites.

The avocado orchard sites would require LSB B and C rated soils to raise avocados, and provide adequate drainage which minimizes the potential for root rot. Water from the on-site brackish water wells would be adequate for raising avocados.

Avocado trees require careful maintenance, and these crops would require the use of pest controls. As feasible, Lihi Lani plans to implement organic pest controls through its IPM program to minimize chemical pesticides application. In addition, a trapping program for rats would need to be regularly conducted in the avocado orchard areas.

Avocados grown at Lihi Lani would also be marketed by the farming tenant, and most likely serve the local Oahu market. Several avocado varieties could be grown which ripen at different time of the year. This plan would provide a seasonal uniformity of avocado production. Refer to Exhibit B for more information regarding the recommendations of Dr. Scott for avocado varitles.

Market analysis indicate an additional sales potential for Hawaii avocados considerably in excess of that required for the output of a 23-acre orchard. Assuming correction of some seasonal and quality problems in Hawaii avocado production, there is a potential to displace a large portion of imports, which totaled over 700,000 lbs. between 1986 and 1990.

Scott (September 1993) completed a budget analysis based on current input-output data and an estimated yield at orchard maturity of 12,000 pounds per acre. This projection indicates that the proposed enterprise would be economically viable and would yield income to the operator. At maturity, the

aggregate orchard enterprise could provide a modest annual gross income of $118,700 and a net income of $33,000.

The development of a farmer's market is anticipated somewhere in the North Shore region in the near future. Production from the avocado orchards at Lihi Lani could also help to support such a market.

Some of the individual Country lot owners will have substantial areas of high quality agricultural soils, and these owners could pursue the establishment of fruit tree crops for commercial production. At the time of this report, specific data on other types of fruit tree production and market potential was not compiled.

V. Grazing Pasture

The property has previously been utilized for grazing activities for horses and cattle, and is currently being used for grazing for a few horses. The previous farming tenant (Mr. Aoki) grazed over 200 head of cattle on this land until 1988.

The Conceptual Agricultural Plan (Figure 1) shows areas that could be used for grazing lands at Lihi Lani, including a large common area at the Ranch. Lihi Lani will include development of a horse ranch with stables and grazing areas extending over a 68 acre area. Horse riding trails would extend into other undeveloped open space areas of the property.

About 50 horses are planned to be boarded at the ranch facilities, with some horses expected to be kept at private facilities on individual lots. Grazing lands would be used for turnout areas, with supplemental feed provided as needed. The entire grazing pasture would be irrigated with reclaimed water, which is expectd to produce excellent grazing grass cover.

Owners of horses boarded at the Ranch facilities would be charged for feed, and some revenues for grazing lands would be accounted through the boarding fees at the Ranch. Grazing does not normally satisfy the entire feed requirement for these animals, and supplemental feed would likely be provided for most horses at the stables. Potential revenues from grazing activities are expected to be minimal, with current rates for grazing leases only in the area of $100 to $120 per acre per month. The actual value of grazing use of the 40 to 50 acres of pasture at the Ranch will be accounted for in the total feed requirement for boarded horses.

In some areas, Country lots will have large gently sloped land outside of the established agricultural easements. Grazing areas could also be established over approximately 25 acres on Country lots planned for the makai portion of the Pupukea plateau. A part of this area is currently used as grazing lands.

The Conceptual Agricultural Plan shows grazing use occupying large portions of the rear yard areas of Country lots in this former pasture area. The intent of the Concept Plan is to show how groups of individual lot owners could join together to establish a contiguous pasture.

VI. Flowers and Foliage

Many properties in Pupukea are currently being used to raise ornamental plants and flowering plants in nursery settings. The use of the land for ornamental plant nursery or cut flowers would be an intensive use of the land, possibly linked as a contiguous area along the lot frontages. Because the intensity of this type of agriculture, flower/foliage production is expected to be limited to specific areas of the project.

The cut flower/nursery operation would likely require formation of a cooperative organization (co-op) to share the cost of maintenance, processing, storage, refrigeration, marketing and shipping operations. An agricultural products processing facility is proposed to ultimately to be established in the central valley of the Lihi Lani site. This facility could be operated as the flower/foliage nursery co-op facility.

Several country lots in the central plateau area of the site would be developed with specific emphasis on intensive nursery use. Owners in this location would either operate their own nursery business, or provide agricultural easements for nursery operations on their land.

No market analysis has been completed for this crop, although certain areas of the State such as Hilo have many profitable businesses of this type. In addition, studies for State Agricultural Parks in Hawaii have shown significant future potential for this type of agriculture. Lihi Lani will likely consider this use more actively in the next phase of agricultural planning.

VII. Agroforestry

As shown in the Conceptual Agricultural Plan (Figure 1), approximately 40+ acres in the mauka portion of the property is planned for establishment of an agroforestry project. Agroforestry is a term used to characterize a forestry program which is focused on raising harvestable trees for timber and hardwood product, generally within a 15 to 30 year grow-out period. The proposed site at Lihi Lani is a large plateau area bordering the State Forest Reserve.

Several proposed tree species for this project have been compiled by Paul Weissich, Botanical Consultant (September 1993) as a result of his research into viable tree types for this site. To develop the list, Weissich has met with University of Hawaii forestry scientists and repsrentatives of the State of Hawaii Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife (DOFAW). Table 2 lists the different tree species currently being considered for establishment of the agroforestry program at Lihi Lani.

The agroforestry area would be cleared of existing ironwood vegetation in phases, and replanted with 10 to 15 tree species, including native Hawaiian species and several exotic species. Locally known species such as milo, kamani and kou would be raised. Native Hawaiian hardwood species such as acacia koa and sandalwood could also be grown as a smaller component of the

Table 2
Agroforestry Trees

common name	scientific name	spacing	probable first harvest
Bibla	Pterocarpus marsupium	12' x 12'	30 yrs
Giant Crepe Myrtle	Lagerstroemia speciosa	12' x 12'	30 yrs.
Gold Tree	Tabebuia donnell-smithii	15' x 15'	30 yrs
Indian Rosewood	Dalbergia latifolia	12' x 12'	30 yrs
Kamani	Calophyllum inophyllum	15' x 15'	30 yrs
Kou	Cordia subcordata	10' x 10'	25 yrs.
Milo	Thespesia populnea	10' x 10'	25 yrs
Pheasant Wood	Cassia siamea	12' x 12'	30 yrs.
Pink Trumpet Tree	Tabebuia rosea	12' x 12'	30 yrs.
Roble	Platymiscium pinnatum	12' x 12'	30 yrs
Tipu	Tipuana tipu	10' x 10'	25 yrs.
W.Indian Mahogany	Swietenia mahogani	15' x 15'	40-50 yrs

agroforestry project. Exotic species such as Narra, Pheasantwood, Indian Rosewood, Bibla and Gold Tree are being considered for planting in the agroforestry project. These trees have had an excellent record of success in similar tropical climates around the world. If necessary, the new introduction of exotic trees would be accomplished in close coordination with DOFAW and the State Department of Agriculture.

All of the planned tree species have been selected due to their excellent potential for high value (cost per board foot). These species are specialized woods that are anticipated to be used to supply local demand for furniture production and other ornamental wood products. The volume of logging from the agroforestry project is anticipated to be relatively small on an annual basis.

Native trees such as acacia koa, ohia lehua and sandalwood are also being conseidered for portions of the agroforestry area. Most of these trees take from 15 to 25 to mature, or more than 50 years to mature for some species. Establishment of the agroforestry project will require a long-term commitment to maintain and nurture these trees. Most of the tree species can be grown in areas with some slope, but not on steep slopes. The agroforestry area will require continuous access and regular clearing to eliminate competing vegetation. The IPM controls will be followed to minimize pesticides use in this area.

Reclaimed water could also be applied as irrigation for these trees, although it is not planned as part of the initial reuse areas (pasture and field stock tree nursery) for the project. The mauka location of the agroforestry area is the wettest location on the property, receiving up to 10 inches of additional rainfall as compared to the makai portions of the property.

Ultimately, individual trees could be harvested from this land to provide hardwoods for use by craftsmen and woodworkers in Hawaii. The demand for these hardwood products is anticipated to remain high. Once harvested and sold, new trees would be planted at the same location. Another purpose in establishing the native tree forest is education for youth groups, who could follow the development of the agroforestry area.

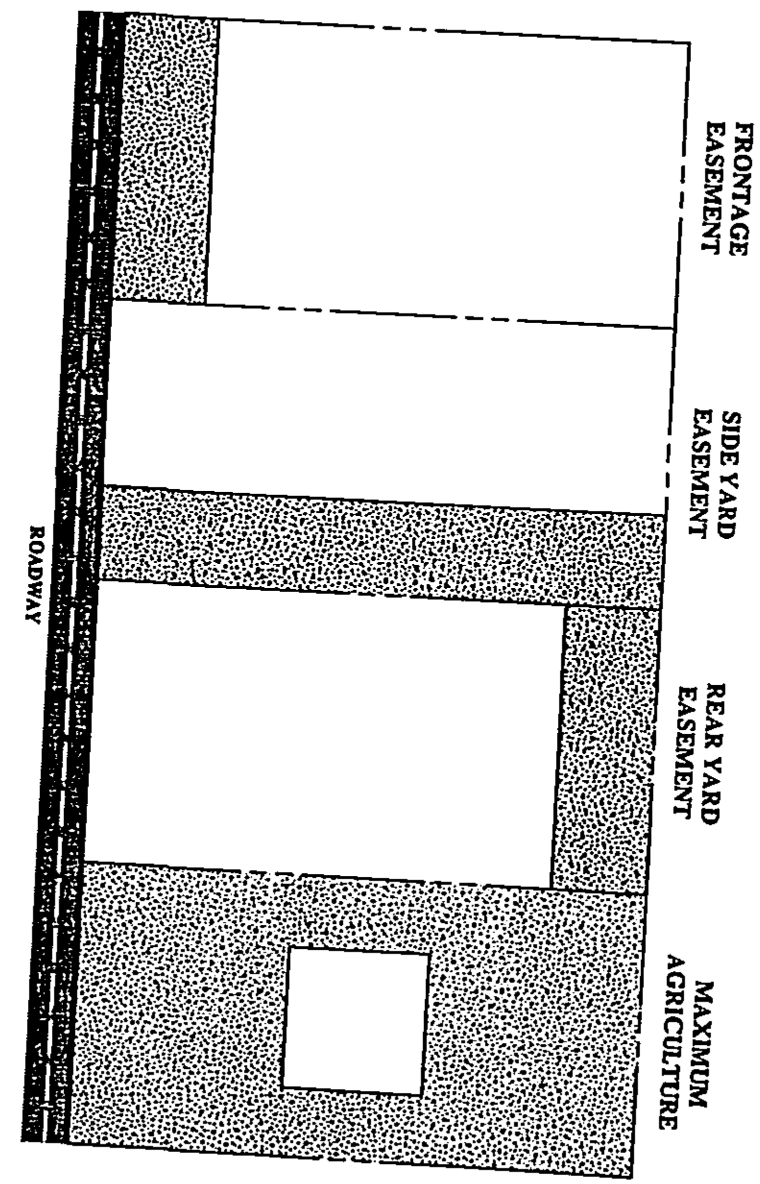
VIII. Agricultural Use of Country Lots

Agricultural use of the Country lots would be accomplished through the establishment of agricultural easements on each of the 315 individual Country lots at Lihi Lani. A minimum of 6,000 sq. ft. of agricultural easement area would be provided at each lot, the majority through a frontage easement, and some through a side yard or rear yard easement. Access to the easement area would need to be assured for crop management activities.

The key to the success of the on-lot agricultural uses, currently planned as either field stock tree nursery or avocado orchard, will depend on: (1) the quality of the land (slope and soil type) at the agricultural easement area, (2) the ease of maintenance for farmers to operate for access and operations, and (3) the minimized disturbance to the owner's use and enjoyment of the non-farm area on the lot. Obayashi wishes to offer a reasonable amount of flexibility to lot owners in selecting the position for the agricultural easement on their lot. In general, the plan would seek to join agricultural easements to develop contiguous crop management areas.

It is expected that many lot owners will establish larger agricultural use of their lots beyond the 6,000 sq. ft. minimum, in accordance with the limits on agricultural uses at Lihi Lani. These lots would still be required to establish agricultural easements on a minimum of 6,000 sq. ft. of the lot for the organized commercial agricultural operation. The additional agricultural uses on individual lots would not be linked to the larger agricultural operation.

The agricultural easements would be positioned at various locations on the Country lots, such as front yards, side yards or rear yards. Figure 2 shows some of the possible configurations for agricultural easements. Many of the Country lots at Lihi Lani will have steep lands beyond the house pad area and, therefore, would only be able to conduct agricultural activities in the side or



ALTERNATIVE CONFIGURATIONS FOR COUNTRY LOT AGRICULTURAL EASEMENTS

Figure 2

front yard areas. Final positioning of the easements will depend on the detailed site planning and design of the subdivision areas at Lihi Lani.

Depending on the crop type, soils and topography in the agricultural easement areas, different easement positions will be considered. The field stock tree nursery use or the fruit tree orchard uses are considered to be generally non-intrusive to lot residents. For reasons of site conditions, side yards or rear yards may be favored as positions for agricultural easements. As long as access through the easement can be accomplished for maintenance and transplanting and removal activities, the side yard and rear yard positions would be suitable. Because of the small but significant economic benefits of the on-lot agricultural uses, lot owners will look favorably and encourage the agricultural activities in their easement area.

IX. Conclusions

The feasiblity of establishing a variety of small-scale agricultural uses at Lihi Lani is reasonably viable. The planned introduciton of field stock tree nursery, avocado orchard and agroforestry will greatly expand the agricultural use of the site beyond the current grazing pasture use. Flexibilty of the agricultural plan will be necessary as the implementation of the project proceeds. It is uncertain that all of the proposed crop types will succeed at Lihi Lani, however, it is very likely that several of the crop types will show success.

The viability of the field stock nursery shows the greatest promise for the site, and grazing pasture and avocado production are anticipated to be viable at this location. Through the Homeowner's Association and the lease agreements, a substantial portion of operating expenses at Lihi Lani should be offset, so that Country lot owners will have an incentive to ensure the success of the agricultural enterprise.

Other types of crops may find future success at Lihi Lani, such as other fruit tree crops or the flower and foliage nursery use. Pupukea Highlands residents have demonstrated the success of small-scale nursery businesses on Country

lots. Very likely, some individuals will establish larger uses of their lots to form viable small agricultural businesses. All lot owners will participate in the larger agricultural enterprise through the use of their agricultural easments.

Overall, we predict that the expanded agricultural use of the Lihi Lani property will set a new direction for small-scale agricultural use of Hawaii's land in association with low density residential uses and recreational uses that provide the basic infrastructure needed to support smaller agricultural enterprises.

DATE: June 7, 1993

TO: Mr. Craig Yamagishi
Project Director
Lihi Lani

FROM: Mr. Fred Lau
Hawaiian Landscape Co.

SUBJECT: **Field Stock Tree Nursery Project for the Lihi Lani Site**

Mr. Yamagishi:

Through our previous discussions we have come to the decision that a tree nursery on the Lihi Lani project site would fit into the agricultural development being planned. I feel that a field stock nursery project would be ideal for the area for the following reasons:

1. A field stock tree nursery is one of the least obtrusive forms of agriculture.

   a. Trees take five to ten years to mature, harvesting therefore, is not continuous, and equipment activities are kept to minimum.

   b. Spraying of pesticides is also at a minimum, therefore not invading the lifestyle of the residents.

   c. Much of the fertilizer and insecticide applications can be done by granular applications thereby eliminating aerial polutants.

   d. During the growing period, the trees can be planted to enhance the surrounding areas.

2. The trees need water, and the effluent from the Lihi Lani Sewage Treatment Plant would be an ideal source of irrigation for these trees in areas off the residential lots.

3. The Lihi Lani project site has many topographically logical areas for a fieldstock nursery.

   a. Although level ground would be preferable, with minimum grading, most gentle and moderate slope areas in the agricultural easements could be used for growing trees.

   b. Fieldstock material require large land areas for production, and the Lihi Lan site will provide large undeveloped areas on lots and in the common areas.

4. Trees which are not used for landscaping the site could be sold in the future for profit or possibly to benefit the Haleiwa, Kahuku and Waialua Communities.

I am currently considering several nursery sites on the project, including the agricultural easement areas on the residential lots. We are able to grow approximately 300 trees per acre (depending on the variety of trees). This quantity may be smaller or larger by 10% - 15%. Our operation could ultimately use 35 to 45 acres on-site yielding 10,500 to 13,500 trees in various stages of maturity.

Gross value of these trees would average between $500.00 to $1,000.00 per unit. Again depending on the variety of tree. Total value in the five to seven year cycle, would be somewhere between $4.9 to $10.5 million.

I will finalize cost and profit projects as we decide where the trees will be planted and the exact amount of acreage that can be used. It is understood that the project will be developed in phases, so we anticipate phased expansion of the field stock nursery over time.

I anticipate a great number of these trees will be used in the landscape of the Lihi Lani project, and therefore will be realized in terms of cost savings to the owner rather than gross profit.

The tree list which I have prepared is a combination of the list of trees needed for typical residential, park and resort landscapes. These are standard trees being used throughout the state on all major developments.

Our company has many years of experience in providing trees to major private developments and government project in the state. Demand for these trees varies with the pace of development in Hawaii. However, government projects have filled market gaps during low periods of private building.

I look forward to participating in the planning for this project. If you need more information on the field stock operation, please call me.

TABLE 1

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Citharexylum Spinosum	Fiddlewood
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Lagerstroemia Speciosa	Giant Crepe Myrtle
Messerschmidia Argentea	Beach Heliotroph
Metrosideros Collina	Ohia Lehua
Noronhia Emarginata	Madascar Olive
Pandanus Odoratissimus	Hala
Pimenta Dioica	Allspice
Plumeria Obtusa	Singapore Plumeria
Plumeria Var	'Grave Yard Yellow' Plumeria
Ravenea Madagascariensis	Travelers Palm
Samanea Saman	Monkey Pod

FIELDSTOCK NURSERY TREE LIST
(Continued)

Spathodea Campunulata	African Tulip Tree
Spathodea Campunulata Aurea	Gold African Tulip Tree
Tabebuia Argentea	Silver Trumpet
Tabebuia Donnell Smithii	Gold Tree
Tabebuia Pallida Var. Moir	Moirs Pink Tecoma
Terminia Catappa	False Kamani
Thespesia Populnea	Milo

PALMS

Archontophoenix Cunninghamiana	Queen Palm
Archontophoenix Cunninghamiana	King Palm
Chrisalidocarpus Lutescens	Areca Palm
Cocos Nucifera	Coconut Palm
Cycas Circinalis	Queen Cycas
Cycas Revoluta	Sago Palm
Latania Loddigesii	Blue Latan Palm
Livistonia Chinensis	Chinese Fan Palm
Neodypsis Decaryi	Triangle Palm
Phoenix Canariensis	Canary Isl. Palm
Pritchardia Pacifica	Fiji Fan Palm
Ptychosperma Macarthurii	McArthur Palm
Roystonea Regia	Royal Palm
Vetchia Merrillii	Manila Palm
Vetchia Winen	Winen Palm
Washingtonia Robusta	Washingtonia

September 17, 1993

Agroforestry at Lihi Lani

"Agroforestry is a land use that involves deliberate retention, introduction or mixture of trees... with crop/animal production fields to benefit from the resultant ecological and economic interactions". This text book definition, as applied to Lihi Lani, provides for the planting of useful timber crop trees combined with an equally useful understory crop, either plant or animal life. It provides both for the planting of an understory of foliage or flower crop species or for animals such as horses, cattle or chickens or other appropriate non-competitive fauna.

While the formal discipline of "agroforestry" was established in 1978, the actual practice is age-old with examples world wide of a mixture, both primitive and sophisticated, of the mixing of fruit trees, vegetables and herbs with domesticated animals in country gardens as well as great estates. In this century agroforestry has become a world-wide science with promise of tremendous economic benefit, especially in third world countries. The most modern gardener, however, can harvest benefits from its concepts.

Lihi Lani's agroforestry management objective is to utilize non-residential and non-activity acreage for the long term production of timber and understory from carefully selected tropical tree and herbaceous species for local consumption by cabinet makers and artists and the flower market. Selection is based on appropriateness to site conditions, environment, growth rate and, for trees, current value per board foot and flower market values.

The agroforestry concept is compatible with other long term Lihi Lani goals that seek to make maximum, environmentally sound and income producing uses for all lands not primarily engrossed in residential use.

Twelve tree species have been selected for the first plantings. It is important to note that Hawaiian koa, currently in great demand, is not included on the list due to the presence of some as yet unknown disease which is responsible for the death of koa trees throughout Oahu. Once the koa die-out is understood and countermeasures delineated, koa would be a prime agroforestry subject for Lihi Lani: it is rapid growing, a nitrogen fixer, totally adapted to the soils and climate of Lihi Lani and demands a high price in local markets.

common name	scientific name	spacing	probable first harvest
Bibla	Pterocarpus marsupium	12' x 12'	30 yrs
Giant Crepe Myrtle	Lagerstroemia speciosa	12' x 12'	30 yrs.
Gold Tree	Tabebuia donnell-smithii	15' x 15'	30 yrs
Indian Rosewood	Dalbergia latifolia	12' x 12'	30 yrs
Kamani	Calophyllum inophyllum	15' x 15'	30 yrs
Kou	Cordia subcordata	10' x 10'	25 yrs.
Milo	Thespesia populnea	10' x 10'	25 yrs
Pheasant Wood	Cassia siamea	12' x 12'	30 yrs.
Pink Trumpet Tree	Tabebuia rosea	12' x 12'	30 yrs.
Roble	Platymiscium pinnatum	12' x 12'	30 yrs
Tipu	Tipuana tipu	10' x 10'	25 yrs.
W.Indian Mahogany	Swietenia mahogani	15' x 15'	40-50 yrs

Tree spacing, while appearing extremely close, is designed to force straight, unbranched trunks. Spacing indicated above is actually slightly greater than that traditionally employed by the Division of Forestry, Department of Land and Natural Resources but will provide working space for maintenance crews and an enhanced understory condition for secondary crops. Agroforestry in Lihi Lani is seen as a carefully tended crop managed to produce maximum results in the shortest possible time. This requires control of weed species, watering and fertilizing, pruning and monitoring for pest control. These actions are critical for the realization of management goals.

Understory crops may include such herbaceous material as various clumping, semi-shade tolerant, non-invasive Heliconias and gingers and foliage crops such as common green and hybrid ti, aroids and even Hawaiian tree ferns, palai and pala'a. The market potential at the time of initiation of the project will dictate the direction of understory species selection.

Potential exists for the combining of pasture lands with tree crops in an informal "landscape" approach which would enhance the visual attractiveness of Lihi Lani while providing long term income potential. Trees under this condition would require special protective measures against animal disturbance during the first five years of growth.

There is a large measure of experiment and evaluation involved in Lihi Lani's proactive agroforestry concept inasmuch as the tree species selected have not before been grown for harvest purposes in Hawaii. All species have known woodworking qualities and board foot value, however, and expectation is high for their success. It is planned to augment the basic list of twelve with additional selections for future planting. There is a long list of probable tropical tree agroforestry candidates, a number of them difficult to obtain at this time. An import and evaluation program is envisioned.

Paul Weissich

Paul

ORCHARD FEASIBILITY ANALYSIS FOR LIHI LANI

Prepared For

OBAYASHI HAWAII CORPORATION

Coordinated by Group 70 International

By

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Agricultural Economist

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SUMMARY AND CONCLUSIONS

This report addresses the feasibility of establishing avocado orchards in conjunction with country lots of one acre or more in size at Lihi Lani. The study concludes that avocado production would be both economically viable and provide an unobtrusive enterprise which readily lends itself to economies of scale under common management.

The development plan for Lihi Lani consists of on-lot orchard plots for one-third of the 315 country lots. Production and marketing of avocados for the orchard plots will be contracted to an agricultural management firm. The aggregate land area of on-lot orchards will encompass approximalely 13.7 acres. An estimated additional 9.3 acres of off-lot common orchards will result in a total of 23.0 acres of avocados under contract management.

All criteria considered in the analysis indicate agricultural feasibility of the proposed orchard development plan. Land Study Bureau B and C soils designated for the orchard plots are of adequate depth and texture for optimal root growth and the land provides the necessary drainage, which is crucial for avocado trees because of extreme sensitivity to root rot. Water and roadway infrastructures designed to serve the entire residential, agricultural and recreational community make the otherwise isolated common orchards economically feasible as a combined unit.

Median annual rainfall at the project site is a substantial 52 inches. In spite of some deficiencies because of irregular seasonal distribution, 83 percent of modal water requirements would be supplied by natural rainfall. Required supplemental irrigation, although essential is relatively minor. Water to be otained from wells on the project site contains significant amounts of salts, expecially chloride. But tolerance analysis, considering leaching by natural rainfall, suggests no adverse effects on growth and production of avocado trees.

Market analyses indicate an additional sales potential for Hawaii avocados considerably in excess of that required for the output of 23.0 acres at Lihi Lani.

A budget analysis based on current input-output data and an estimated yield at orchard maturity of 12,000 pounds per acre indicates that the proposed enterprise would be economically viable and would yield substantial income to the project. At maturity, the aggregate orchard enterprise would provide and annual gross income of $118,700 and a net income of $33,000 in 1992 dollars.

ORCHARD FEASIBILITY ANALYSIS FOR LIHI LANI

By

Frank S. Scott, Jr.

Agricultural Economist

This report investigates the feasibility of avocado orchard development as a permitted activity under country zoning for Lihi Lani Project. The proposed orchard development includes on-farm orchards for lots containing usable amounts of lands classified as C or better by the University of Hawaii Land Study Bureau. The remaining country zoned lots are designated for field stock tree nursery production, addressed in another report.

As a basis for determining feasibility of establishing avocado orchards, the study evaluates eclological adaptation, sales potentials, economic feasibility and lot configuration. Related considerations are rainfall, irrigation requirements, quality of irrigation water, orchard budget analysis, and labor and management requirements.

SIZE AND CONFIGURATION OF ORCHARDS

The county lot development consists of 315 lots with a total land area of 765 acres or 2.43 acres per lot. These lots are shown in relation to the overall plan for the entire project in figure 1. Most of the lots range in in size from 1.0 to 3.5 acres, except for a small number of larger lots. The larger lots generally consist of land infeasible for agriculture. Approximately one-third of the lots have sufficient areas of B or C soils to be designated for on-site orchard production.

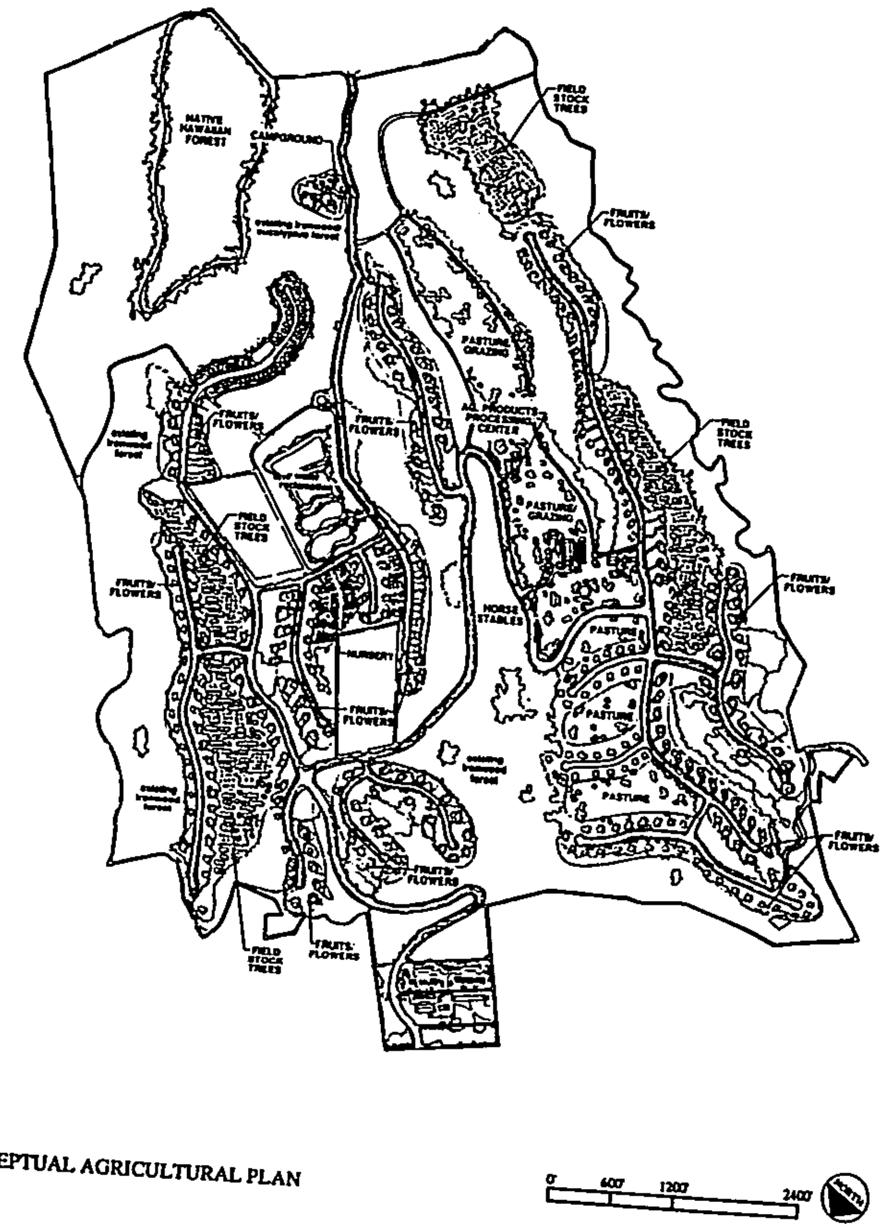
A mininimum of 6,000 square feet in each lot will be allocated to orchard production. This would allow 8 avocado trees per lot at a density of 72 trees per acre. Location of the orchards on each lot would allow for aggregation into larger parcels, which would facilitate cultural practices and harvesting by joint management. Consolidation of all plantings on the 100 lots that are feasible for avocado production will constitute an orchard of approximately 13.7 acres. The orchards on individual lots would generally be located near the roadway, along side yards or below the homesite on sloping lots to permit orchard cultural and harvesting activities with minimal disturbance to occupants of the dwellings.

Additional avocado orchards will be established in off-lot areas, totalling approximately 9.3 acres. These orchards will consist primarily of Class B and C lands. Country lot and avocado orchard layouts are shown in Figure 1.

LAND CLASSIFICATIONS

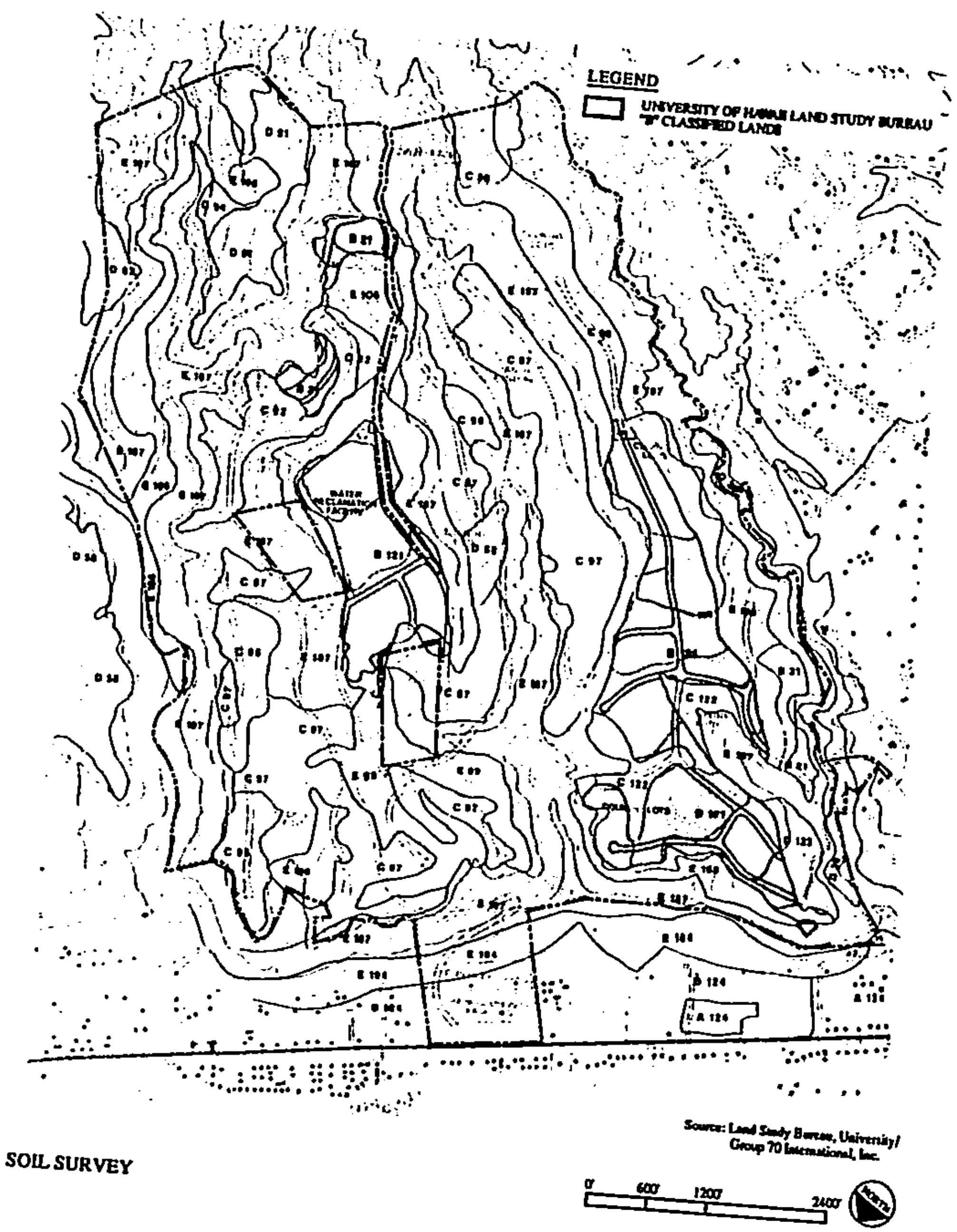
This analysis of orchard feasibility is concerned only with lands designated for country lots and for the three jointly owned orchards. Comprehensive land classifications for the entire Lihi Lani Project are included in a report by Scott entitled "Agricultural Feasibility and Need for Ohbayashi Pupukea Project Lands" prepared for Ohbayashi Hawaii Corporation in March, 1988. With respect to ALISH (Agricultural Lands of Importance to the State of Hawaii) classifications, most of the country lots designated for on-site orchards will be located on prime agricultural land.

Land capability classifications by the University of Hawaii Land Study Bureau (LSB) are superimposed on the project in Figure 2 and those of the Soil Conservation Service (SCS) are shown in Figure 3. Only LSB lands



CONCEPTUAL AGRICULTURAL PLAN

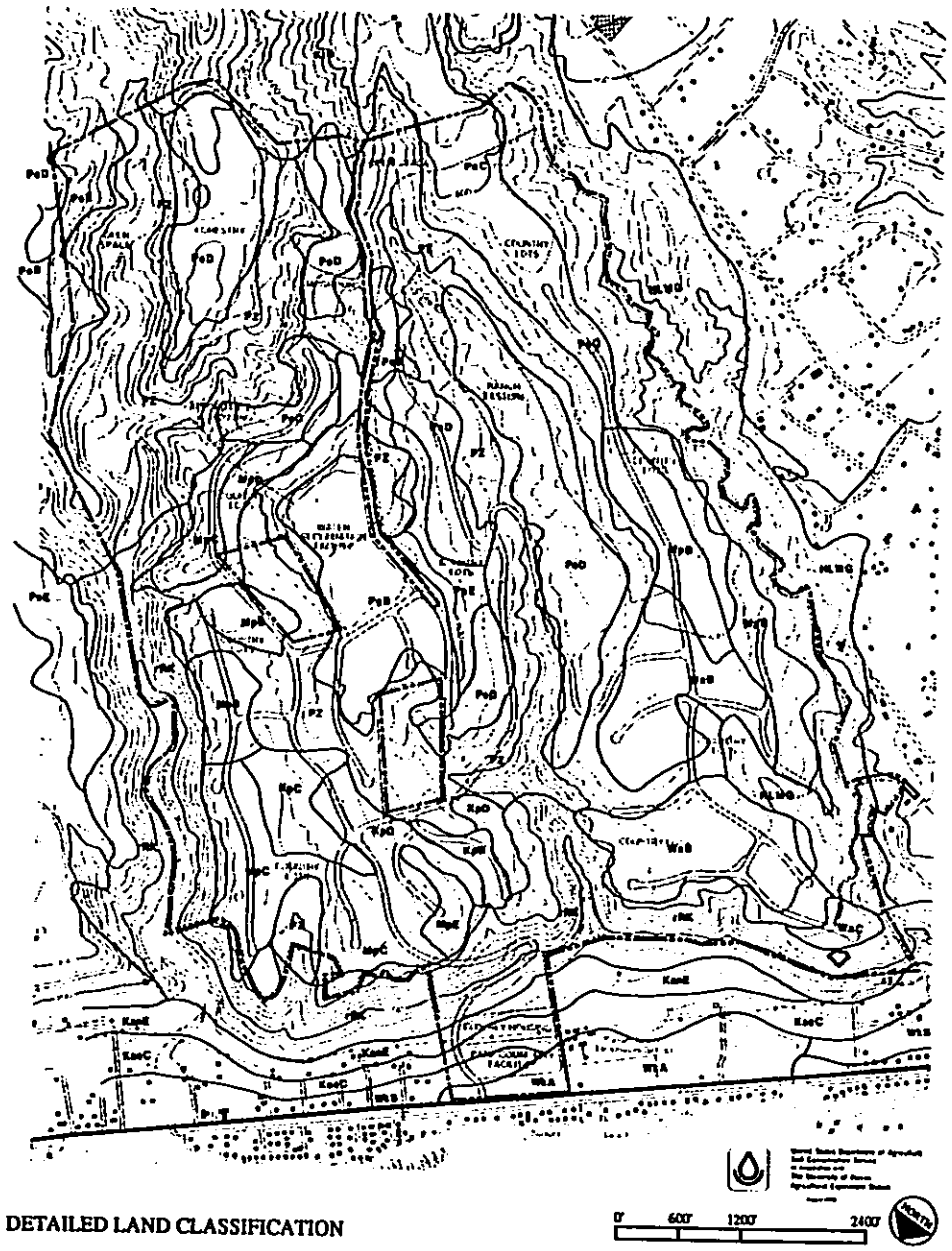
FIGURE 1



SOIL SURVEY

Source: Land Study Bureau, University/ Group 70 International, Inc.

FIGURE 2



DETAILED LAND CLASSIFICATION

FIGURE 3

classified as C or better are considered feasible for orchard development in this analysis. SCS designations are comparable to those of LSB and may be referred to either in the 1972 Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai and Lanai - State of Hawaii by SCS, USDA and the University of Hawaii Agricultural Experiment Station or in the 1988 report on the Ohbayashi Pupukea Project by Scott.

ECOLOGICAL ADAPTATION

LSB B and C lands in the project are of moderate to minimal slope, moderate erosion hazard, adequate drainage and sufficient quality and depth of soil for avocado trees. These characteristics of the soils are addressed more in depth in SCS classifications, but generally SCS classifications are comparable to those of LSB. The LSB letter classifications provide a quick, simple reference to soil capabilities. Good drainage is crucial because of the extreme vulnerability of avocado trees to root rot (Phytophthora cinnamomi). Many parcels of good soils in the project are isolated by eroded gulches or other steep slopes, which limits their usefulness for agricultural production. This problem is minimized in the configura-

tions of on-site and separate common orchards in the production plan for the country lot development.

RAINFALL AND IRRIGATION REQUIREMENTS

Water requirements in this analysis are based on recordings of State Weather Station 896.00 (Pupukea Farm). The station is located at 670 feet elevation and is considered the best appoximation for the mean elevation of the better soil types. Mean rainfall during the recorded period of 1932 to 1948 was 51.7 inches, with an annual maximum of 75.5 inches and an annual minimum of 41.6 inches (Table 1). During 75 percent of the time, annual rainfall did not exceed 68.2 inches and was less than 48.9 inches 25 percent of the time. Median seasonal distribution is uneven and rainfall for any given month is extremely variable from year to year.

Avocados would require effective use of 4,073 gallons of water per acre per day or a gross delivery of 4,500 gallons per acre per day (5.0 acre-inches per month) on B soils in the project area. Only January, February, July and December provide the required amount of water in the form of natural rainfall. Supplemental irrigation needs relative to the natural rainfall can

Table 1. Rainfall Recorded at SKN 896.00, Pupukea Farm, 1932 to 1948

Month	Max	75% Max a/	Median	Mean	25% Min b/	Minimum
			(inches)			
Jan	9.9	7.5	5.8	5.3	2.4	0.7
Feb	14.7	7.4	5.0	5.7	3.3	1.3
Mar	13.3	9.8	4.8	6.3	3.9	1.3
Apr	13.4	6.0	4.4	4.8	3.2	0.4
May	9.1	5.5	4.2	4.2	2.4	0.2
Jun	7.3	4.1	3.6	3.7	2.6	2.0
Jul	9.1	5.1	4.9	4.8	2.9	2.3
Aug	10.9	6.6	4.1	4.8	2.9	1.1
Sep	5.5	3.9	3.6	3.2	2.1	1.3
Oct	17.9	8.5	3.7	5.5	2.4	0.9
Nov	9.5	5.3	3.8	3.9	2.4	0.3
Dec	10.0	7.8	5.4	5.5	2.7	2.2
Annual	75.5	68.2	51.7	56.7	48.9	41.6

a/ 75% of recordings did not exceed amounts indicated.

b/ 25% of recordings were below amounts indicated.

Source: State of Hawaii, Division of Water and Land Development, Department of Land and Natural Resources

only be approximated because of the uneven distribution within months as well as the extreme variation by month and by year.

The water requirement of 60.0 acre-inches annually for avocados exceeds median rainfall of 51.7 acre-inches at SKN 896.00 by 8.3 acre-inches. To compensate for irregular monthly distribution, an upward adjustment of this requirement by a factor of 1.25 results in a supplemental requirement of 10.4 acre-inches or 282,000 gallons annually. This, in effect, would amount to the average annual supplemental irrigation requirement per acre. But 25 percent of the time annual rainfall amounts to only 48.9 inches, which is 11.1 inches below the avocado water requirement or 13.9 acre-inches (377,000 gallons) below the requirement, considering the 1.25 adjustment factor. During the driest year, only 41.6 acre-inches of rainfall were recorded, which is 18.4 acre-inches (23.0 acre-inches or 624,500 gallons adjusted) below the specified requirement for avocados.

Since any month may have negligible rainfall, the delivery system would need to be able to supply the full monthly requirement of 4,500 gallons per acre per day (5.0 acre-inches or 135,000 gallons) per acre per month.

WATER QUALITY

Various tests of water quality for proposed wells in the Lihi Lani project indicate the presence of several salts, with chloride predominating. The tests suggest a mean chloride content of about 300 mg/l (Mink). Since chloride is indicated to pose the most serious salt problem for avocados, this analysis is concerned with chloride rather than total salt content of the potential irrigation water.

A number of divergent research findings on the effects of chlorides on crop production follow in this report. Probably the most conclusive research to date on salt tolerance of agricultural crops in general was conducted by Maas and Hoffman. These researchers developed a means of classifying the effects of salinity on crop yield based on salt tolerance of the various crops considered. The subject paper is appended to this report. In the subject study, the avocado tree is classified as sensitive out of four categories of sensitive, moderately sensitive, moderately tolerant and tolerant. Salt concentration is based on the accumulation of salts in the soil, which in the case of full dependence on irrigation of clay soils may be 3.8 times

the concentration in the irrigation water.

In the case of Lihi Lani, 83 percent of the mean annual water supply for avocados is expected to come from rainfall. This would have a leaching effect, with expected minimal accumulation of salts in the soil. Based on the predominance of rainfall as the source of water for orchard production, there is a reasonable basis for assuming that the eventual accumulation of salts in the soil would not exceed 1.5 times the salt content of the irrigation water, but no test results are available to confirm this. Based on this assumption, the chloride content in the soil of potential avocado orchards in the project would not exceed 450 mg/l (0.73 millimho/cm). Based on the Mass-Hoffman chart, this concentration would have no adverse effect on the growth (and probably the yield) of avocado trees.

The State of California Water Control Board uses guidelines developed by the University of California for interpretation of water quality for crop production. Relative to these guidelines, Freeman and Hayward specify the following tolerances of sensitive crops, such as avocados, to chlorides:

(1) Less than 142 mg/l = no problem.

(2) 142-354 mg/l = increasing problem.

(3) In excess of 354 mg/l = severe problem.

These guidelines must be considered in proper perspective with respect to Pupukea soils. Based on the 1 to 3.8 ratio of salt concentration in irrigation water to heavy clay soils under conditions predominating in California, an irrigation water salt content of 354 mg/l converts to a concentration of 1,345 mg/l in the soil. In Pupukea, based on the foregoing assumptions, a 354 mg/l concentration in the irrigation water converts to only 531 mg/l concentration in the soil or 39 percent of that under California conditions. Thus, whereas 354 mg/l may pose a serious problem in California, it might be expected to pose a minimum problem at most in Pupukea.

Another comparative source of information on chloride tolerance is the producing McMahan avocado orchard near San Diego, where the chloride concentration of the irrigation water is 280 mg/l and which converts to a concentration in the heavy organic clay loam soil of 1,064 mg/l. This compares to a chloride content of 300 mg/l in water from the proposed irrigation water in Pupukea. Further, the chloride content in the Pupukea irrigation water converts to only 450 mg/l in the soil or half of that at the McMahan orchard, based on the foregoing assumptions.

A final example is that of the MacFarms macadamia orchard in South Kona, where 900 mg/l of choride in the irrigation water has shown no adverse effect on macadamia trees, which are assumed to be almost as sensitive to salts as avocado trees. In this instance, rainfall tends to leach the salts through the porous a'a soils.

Based on the above analysis, there is a good basis for concluding that the chloride content of the irrigation water designated for the proposed avocado orchards on Lihi Lani would not adversely affect growth and yield of avocado trees.

SALES POTENTIALS

Several considerations must be addressed in estimating the sales potential for further production of avocados in Hawaii and, in particular, on the project site.

Displacement of imports provides a likely potential for increased Hawaii production. During the 5-year period from 1986-90, Hawaii imported 700,600 pounds of avocados from California. Produce buyers for Honolulu supermarkets indicate their preference for Hawaii avocados, but find it necessary to import large quantities to offset seasonal shortages of Hawaii avocados and, to some extent, to supply the needs of consumers who prefer small California avocados regardless of price. This situation could change materially if Hawaii producers were able to market an adequate supply of quality avocados throughout the year, without seasonal shortages. This suggested effort conforms with the plan to moderate seasonality of avocado production on Lihi Lani through planting a composite of varieties with different seasonal bearing habits.

Assuming correction of seasonal and quality problems in Hawaii avocado production, there would appear to be a good possibility of displacing a large proportion of the 700,600 pounds in imports. This would require an additional 58 acres of Hawaii production at the projected Lihi Lani yield of 12,000 pounds per acre.

Another consideration is that there is reason to believe that Hawaii production of avocados might realize a substantially expanded local market through correction of seasonality and quality problems.

Consideration should, of course, also be given to potential increases in consumption over time as population increases. At an estimated de facto increase in Hawaii population of 1.5 percent, the 1986-90 annual

average marketings of 1,709,000 pounds of avocados in Hawaii could be expected to increase by 260,000 pounds in 10 years (26,000 pounds per year), not considering compounding of the population increase. This would require an additional 22 acres of Hawaii production during the next 10 years at the projected yield indicated for the project.

With improvement in seasonal distribution and quality of Hawaii avocado production over time, there should be opportunity for considerably expanding sales in Alaska and Canada. Also, if clearance for shipments were reinstated, there may be a very substantial market in sales to the U. S. mainland. Mainland shipping clearance with respect the Sharwil variety is addressed in the following section of the report. An important consideration in this regard is that Hawaii could be very competitive pricewise, because of much lower irrigation costs and because of the absence of damage from occasional freezing weather that occurs in California.

The foregoing market assessment in perspective indicates a positive outlook for marketing the output from 23.0 acres of quality, seasonally adjusted avocado production for Lihi Lani.

AVOCADO ENTERPRISE ANALYSIS

<u>Varieties</u>

Planting of different varieties of avocados would be expected to contribute to seasonal uniformity in production and result in more efficient use of production factors, particularly labor, management and equipment. Provisional recommendations of varieties include the following:

(1) <u>Murashige</u> production is harvested during Spring and Summer. This variety is pyriform in shape, 14-30 ounces in size and green in color when ripe. It has a very good flavor and a small seed.

(2) <u>Sharwil</u> produces in Winter and Spring. It is pyriform in shape, 10-18 ounces in size and green when ripe. It has a very good flavor and a small seed. It is the favorite variety of Hawaii producers and supermarket produce managers. Approximately two-thirds of the 500 acres of avocados in Hawaii are planted to this variety. Hawaii producers ship the Sharwil to Alaska and Canada, where tropical fruit flies are not problematic. The Sharwil was recently cleared for shipment to the U. S. mainland after tests indicated that green picked fruit did not harbor fruit fly eggs. Unfortunately, some eggs

were discovered in fruit destined for shipment in 1991 and shipments to the mainland were temporarily banned. Producers are hopeful that shipments to the mainland can eventually be revived.

(3) <u>Ohata</u> is a Spring-Summer variety. It is Obovate and very large, weighing 24-40 ounces. It is purple when ripe, has a very good flavor and a small seed.

There are several other good varieties of avocados that would adapt well to the better soils in the project area and which bear at different times during the year.

The configurations of the proposed orchards in the project are amenable to concentrating specific varieties in given areas. Each of the three orchards proposed for joint ownership might be planted to a separate variety of avocados, thus contributing to seasonal equalization in production. Aggregates of on-lot orchards could likewise be separated into different varieties. Size and shape of tree as well as seasonality could be considered in varietal selections. In segregating varieties, excessive proliferation by variety should, of course, be avoided so that production and marketing inefficiencies will not result.

A more detailed planting program by varieties would be expected to evolve in the planning stage for the project following consultations with University of Hawaii horticultural extension specialists and commerical nurseries.

Budget Analysis

The feasibility analysis for avocado production on Lihi Lani assumes that all avocado units will be under common management. For the combined operation of all orchard units, an analysis of costs and returns was developed for a 23-acre orchard.

Tho analysis of costs and returns for the study determines profitability on the basis of a maturo orchard which has essentially attained maximum yield per tree. Such a procedure requires an annual charge for depreciation and interest on orchard development.

For most varieties of avocados, the first marketable or commercial output is realized during year 4, although the trees will likely bear a small amount of fruit in year 3. Yield and age of maturity varies considerably by variety. Average yields in marketable fruit for the varieties suggested for Lihi Lani might reasonable amount to 2,000 pounds per acre for year 4 and 5,000 pounds per acre for year 5, with a gradual increase in production to 12,000 pounds at maturity, which would be expected to occur during years 10-12. These yields reflect alternate

year bearing habits of the trees, losses from rats, insects and disease and other probable conditions. Higher yields might be realized during years of peak bearing and optimal growing conditions. Projected yields for the project assume good management and are not comparable to average yields obtained for the state, which reflect neglected orchards, orchard immaturity and other factors.

The subject budget analysis as presented in Table 2 is designed specifically for avocados, with input-output data reflecting current costs and returns, with the following exceptions: Depreciation and interest on buildings and equipment, equipment and building repair costs and depreciation and interest on orchard investment are adapted to the avocado orchard from recent studies of other tree fruit crops conducted by the author of this report. These data closely appoximate what could be expected for avocados and suffice for the budget analysis until more specific data are required in the planning stage. Yield is projected on the basis of the composite of avocado varieties recommended for the project. Input-output values are expressed in terms of 1992 dollars.

The analyis projects gross returns at $5,160 per acre based on the prevailing farm price of 43 cents per

Table 2. Costs and Returns Per Acre, Mature 30-Acre Avocado Orchard

Item	Unit	Value/unit	Quantity	Value
GROSS RETURNS	pounds	$ 0.43	12,000.00	$5160.00
ITEMIZED COSTS				
Weed Control				
Glphosate (3 app)	gallons	75.00	1.50	112.50
Atrazine (1 app)	pounds	1.80	4.00	7.20
Paraquat (1 app)	gallons	40.00	0.50	20.00
Pickup/Sprayer (4)	hours	7.00	3.00	21.00
Labor, driver	hours	8.00	3.00	24.00
Labor, field	hours	7.00	3.00	21.00
Rat Control				
Materials	pounds	0.60	50.00	30.00
Labor	hours	7.00	2.00	14.00
Fertilizing (3 app)				
16-16-16	pounds	0.22	864.00	190.00
Pickup, fuel/oil	hours	7.00	1.50	10.50
Labor, driver	hours	8.00	1.50	12.00
Labor, field	hours	7.00	7.00	49.00
Irrigation				
Water (1,000)	gallons	0.25	282.00	70.50
Labor, field	hours	7.00	4.00	28.00
Pruning				
Pickup, fuel/oil	hours	7.00	1.00	7.00
Labor, driver	hours	8.00	1.00	8.00
Labor, field	hours	7.00	6.00	42.00
Harvesting				
Picking	hours	7.00	100.00	700.00
Pickup, fuel/oil	hours	7.00	2.00	14.00
Labor, driver	hours	8.00	2.00	16.00
Equip & Bldg repair				225.00
Labor, indirect	hours	7.00	20.00	140.00
TOTAL OPERATING COST				1761.70
TAX, GROSS INCOME (0.5%)				22.50
INTEREST ON OPERATING CAPITAL (10%/2)				88.09
DEP & INTEREST ON BLDGS & EQUIP				250.00
DEP & INTEREST ON ORCHARD DEVELOPMENT				1200.00
TOTAL COSTS EXCEPT LABOR, MGT & LAND				2268.29
NET RETURNS TO LABOR, MGT, LAND & RISK				2891.71
LABOR COST				1054.00
TOTAL COSTS EXCEPT MGT & LAND				3322.29
NET RETURNS TO MGT, LAND & RISK				1837.71
MANAGEMENT CHARGE, 7% OF GROSS RETURNS				361.20
TOTAL COSTS EXCEPT LAND				3683.49
NET RETURNS TO LAND & RISK				1476.51
LAND CHARGE				00.00
NET RETURNS TO RISK				1476.51

pound and an orchard yield at maturity of 12,000 pounds per acre. The budget provides a net return to risk of $1,431 per acre before land cost. The study assumes that land cost will be absorbed by other activities on the ranch. Under the above assumptions, the aggregate 23-acre avocado orchard would provide a gross return of $118,700 and a net return to risk of approximately $33,000. Interpretation of this analysis should consider that supply-demand relationships for avocados vary appreciably from year to year because of the alternate year bearing pattern of the crop, particularly in California, which dominates the U. S. avocado supply and provided about 40 percent of the supply in the Hawaii market during the 1986-90 period. Such volatility is not unique to avocados, but is typical of agricultural production in general. In spite of anticipated alternating of profitable and non-profitable years, there is good indication that avocado production on the project site would be economically viable in the long run.

Labor and Management Requirements

Common management and operation of the proposed Lihi Lani avocado units would permit economies of scale and operational efficiencies not possible with smaller units. The 23 acres under consolidated management would require the full time equivalent (FTE) of 1.80 labor personnel and 0.25 FTE of management. The management position would be that of full time working manager, with 0.25 FTE in management and 0.75 FTE in labor. The remaining labor requirment would then amount to 1.05 FTE.

Orchard Ownership

Common ownership and integrated management is recommended for the three off-lot orchards as well as for orchards on dwelling sites, which would permit maximum efficiency of orchard operations. The exact form of common ownership and management will be determined at a later stage of project development.

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APPENDIX

12993 JUNE 1977 IR2

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Crop Salt Tolerance—Current Assessment[a]

By E. V. Maas[1] and G. J. Hoffman,[2] M. ASCE

Introduction

Crop salt tolerance has usually been expressed as the yield decrease expected for a given level of soluble salts in the root medium as compared with yields under nonsaline conditions (7,20,26,28,61,152). However, salt tolerance is a relative value based upon cultural conditions under which the crop was grown. Salt tolerance lists published by the U.S. Salinity Laboratory (7,26,28,152) represent relative tolerances when crops are grown under conditions simulating recommended cultural and management practices for commercial production. Absolute tolerances that reflect predictable inherent physiological responses by plants cannot be determined because many interactions among plant, soil, water, and environmental factors influence the plant's ability to tolerate salt. Useful quantitative salt tolerance data must account for these interacting factors and be based upon appropriate measures of soil salinity and plant response.

A literature review reveals that a myriad of experimental procedures have been used for determining salt tolerance. Experiments have been conducted in soil, sand, and water cultures; in fields, small plots, greenhouses, and growth chambers; and under nearly every conceivable environmental condition. Salination methods vary as do ways of measuring and reporting salinity levels in the root medium. Likewise, plant response to salinity has been measured in several ways and at various stages of growth and development. In many experiments, important variables were either not controlled or not measured or reported.

Despite these problems, we have attempted to compile and normalize all

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available salt tolerance data from the past 30 yr to present our best current assessment of the salt tolerance of agricultural crops. Included are only those data correlating plant response to the total soluble salts in the root medium. Sodic soil conditions, specific ion toxicities, and nutritional effects are not considered herein, but, if present, they must be taken into account.

Plant Response to Salinity

Although salinity affects plants in many ways physiologically, overt injury symptoms seldom occur except under extreme salination. Salt-affected plants usually appear normal, although they are stunted and may have darker green leaves which, in some cases, are thicker and more succulent. Woody species are an exception since toxic accumulations of Cl or Na may cause leaf burn, necrosis, and defoliation. Most herbaceous plants do not exhibit leaf injury symptoms even though some accumulate Cl and Na to levels as high as those causing injury in woody species. Occasionally, nutritional imbalances caused by salinity produce specific nutrient-deficiency symptoms.

The most common salinity effect is a general stunting of plant growth. As salt concentrations increase above a threshold level both the growth rate and ultimate size of most plant species progressively decrease. Not all plant parts are affected equally, however, and any correlation between growth response and soil salinity must take this into account. Top growth is often suppressed more than root growth (17,47,64,120). Salinity also increases the leaf-stem ratio of alfalfa, thereby influencing forage quality (94).

The only agronomically significant criterion for establishing salt tolerance is the commercial crop yield. Too often vegetative growth response to salinity is not a reliable guide for predicting fruit or seed production. Grain yields of rice (131) and corn (102) may be greatly reduced without appreciably affecting straw yield. With some other crops, e.g., barley, wheat, cotton and some tolerant grasses, seed or fiber production are decreased much less than vegetative growth [15, unpublished U.S. Salinity Laboratory (USSL) data]. For root crops, storage-root yields may be decreased much more than that of tops or fibrous roots (15,96).

Although most plants respond to salinity as a function of the total osmotic potential of soil water without regard to the salt species present (24), some herbaceous plants and most woody species are susceptible to specific ion toxicities. Because of these toxicities, yield losses of fruits and nuts are generally greater than those predicted from osmotic effects alone. Detailed data on Cl and Na tolerances of these crops are not available but tolerable levels causing yield reductions of 10% or less are published (27,132).

In some cases, salinity induces nutritional imbalances or deficiencies causing decreased growth and plant injury for which osmotic effects alone cannot account (25,44). Blossom-end rot of tomato and pepper (64,78), blackheart of celery (77), and internal browning of lettuce (25) are all symptoms of Ca deficiency which may occur in saline soils characterized by high sulfate and low Ca levels. Magnesium deficiencies, also caused by high sulfate levels, have been observed on several varieties of table grapes (65).

Obviously, the relationship between osmotic potential of the soil solution and crop yield is invalid under conditions in which specific ion effects are

significant. Accordingly, corrections must be made for the additional detrimental effects.

Methods of Salinity Measurement

The parameter chosen to relate salinity to plant tolerance must correlate closely with plant growth and yield. Without specific ion effects, growth reduction is primarily related to the osmotic potential of the soil solution in the root zone (44). Osmotic potential can be measured directly by freezing-point depression, vapor-pressure osmometers, or thermocouple psychrometers, as is often done for sand and solution culture studies; but generally these methods have not been adopted for soils.

The most common method of measuring soil salinity is to determine the electrical conductivity of saturation extracts, EC_e, from the active root zone. Electrical conductivity, EC, is directly related to the concentration of soluble salts in the soil solution and within limits of osmotic potential ψ_o by the relationship, $\psi_o = -0.36$ EC. Using EC_e was recommended because the saturation percentage is easily and reproducibly determined in the laboratory and is related to the field-moisture range of soils varying widely in texture (152). For many soils, the soluble salt concentration of the soil solution at field capacity is about twice that at saturation. Nevertheless, salinity measurements obviously would be more reliable if made on soil solutions in the field-moisture range.

Some recent developments in instrumentation now permit direct determinations of electrical conductivity of soil water EC_{sw}. Two devices that allow rapid, reliable, and nondestructive measurements are salinity sensors and four-electrode probes. Salinity sensors permit in-situ measurement of EC_{sw} at a given location in a soil profile (129,143). They function throughout the range of soil matric potential normally encountered in irrigated fields and respond adequately to salinity changes in the soil solution typically found in the field (157). The four-electrode probe can also be used for assessing in-situ soil salinity but requires a knowledge of water content, temperature, soil texture and cation-exchange-capacity. Rhoades and Ingvalson (142) suggested that the relationship between soil conductivity and soil salinity be determined for each soil type at a known water content and soil temperature. Once this relationship is established, no further soil samples or laboratory analyses are required. In field practice, they recommend measuring soil conductivity just after an irrigation when water content is reasonably reproducible. The method is simple, rapid, and can be used for diagnosis, survey, and management practices (141).

As important as measuring the primary parameter to which the plant responds, is knowing where and when to make the measurement. Salt distribution in the soil usually varies in both space and time. Depending upon leaching fraction, salinity profiles may be rather uniform and change relatively little with depth or they may be highly nonuniform with salinities varying from concentrations approximately that of the irrigation water near the soil surface to concentrations many times higher at the bottom of the root zone. As a result of evapotranspiration and drainage, the salt concentration also changes with time between irrigations; consequently, irrigation frequency influences the magnitude of these changes. To minimize the ambiguity of interpreting results from nonuniform salinity profiles, the salt tolerance data derived at this Laboratory (26,28,152) were obtained from experiments in artificially salinized field plots where salinity was maintained essentially uniform with depth throughout the root zone by irrigating with different saline waters at high leaching fractions.

Applying these data to field conditions, where salinity distribution is neither uniform nor constant, requires knowledge of plant response to salinity that varies with time and depth. Several studies support the hypothesis that plants respond to the mean salinity of the root zone (53,54,106,146,147). Ingvalson, Rhoades, and Page (98) found that alfalfa yields correlated better with time-integrated EC_{sw} than with the mean EC_e. Others studies indicate that the effective salinity level must be weighted in favor of the least saline zone. Lunin and Gallatin (113) found that salination of up to two-thirds of the root zone with synthetic sea water had little effect on corn and tomato growth. Water uptake increased from nonsaline zones and decreased as salinity in saline zones increased. In another zonal salination experiment, Bingham and Garber (50) reported similar results for corn salinized with NaCl and concluded that plants can tolerate excessive salinity levels if an adequate part of the root zone is relatively salt free.

Bernstein and Francois (41), in a comprehensive leaching-requirement study, found that alfalfa responded primarily to a weighted-mean salinity based upon the amount of water absorbed with depth in the root zone. Because water uptake is inversely related to salt concentration, more water is absorbed from the upper root zone and consequently, the weighted-mean salinity is influenced far more by the concentration of the irrigation water than by the higher concentration of the drainage water.

If the response of all plants is governed primarily by the salinity of the irrigation water rather than the average soil salinity, salt tolerance data obtained from uniform salinity profiles could be applied directly to nonuniform conditions by using soil water salinities measured in the zones of maximum water uptake.

Factors Influencing Salt Tolerance

Perhaps the most difficult task in assessing crop salt tolerance is accounting for the many factors that may influence the plant's response to salinity. Although the following sections present the salt tolerance of many crops as a simple function of EC_e, the relationship does not always hold. Salt tolerance depends upon many plant, soil, water, and environmental variables. Hopefully, an analysis of these interacting variables will caution both those using these data and those conducting salt tolerance investigations.

Plant Factors

Stage of Growth.—Salinity affects plants at all stages of development and, for some crops, sensitivity varies from one growth stage to the next. Cereal crops seem particularly variable. Several studies show that rice is tolerant during germination, becomes very sensitive during early seedling growth, and then becomes increasingly more tolerant with maturation (100,131,133,134). Some disagreement exists as to the sensitivity of rice during the flowering stage; Pearson and Bernstein (134) found that rice becomes sensitive again during pollination and fertilization, whereas Kaddah, et al. (103,104) did not. Barley,

wheat, and corn are also more sensitive to salinity during emergence and early seedling growth than during germination and later stages of growth and grain development (14,15,102). In contrast, sugar beet and safflower and relatively sensitive during germination (18,70,71). Soybean tolerance may increase or decrease from germination to later growth depending upon variety (2). Of course, separating effects due to growth stage from those due to duration of salination is important. The data of Lunin, Gallatin, and Batchelder (114), Kaddah and Fakhry (101), Kaddah and Ghowail (102), and Meiri and Poljakoff-Mayber (120) showed that plant response was directly related to duration of exposure to salinity. Most USSL salt tolerance data were obtained from salinity treatments imposed after seedlings were established in nonsaline plots and do not necessarily apply to germination and early seedling stages.

Varieties and Rootstocks.—Varietal differences, while not common, must be considered in evaluating crop salt tolerance. In studies conducted over the past 30 yr at USSL (26,28,152), significant varietal differences were found for bermudagrass (see also Ref. 158), bromegrass, and birdsfoot trefoil. Recently, varietal differences among several other crops have been reported by other investigators. The tolerance of rice varieties varies widely according to Akbar, Yabuno, and Nakao (5) and Datta (60). Youngner, Lunt and Nudge (159) found substantial differences among varieties of creeping bentgrass in their response to saline nutrient solutions. Variation may also exist among cultivars of barley (79) and wheat (151). Although most known varietal differences occur among species within the grass family (Gramineae), some variation has been noted among the legumes (Leguminosae). Besides birdsfoot trefoil, varieties of soybean (2) and of berseem clover (121) respond differently to salinity. Varieties of many crops today are developed from a much more diverse genetic base than in the past and this may lead to greater variability.

Rootstock differences are an important factor in the salt tolerance of fruit tree and vine crops. Fruit crops are not only sensitive to salinity per se but are particularly susceptible to toxic effects of Na and Cl. Varieties and rootstocks that differ in the absorption and transport of these ions have different salinity tolerances. Cooper (58,59) found that the salt tolerance of avocado, grapefruit, and orange is closely related to the Cl accumulation properties of the rootstocks. Similar effects of rootstocks on salt accumulation and tolerance have been reported for stone-fruit trees (35). Large differences in the salt tolerance and grape varieties have been linked with rootstock effects on Cl accumulation (36,65,81,145).

Soil Factors

Fertility.—Apparent salt tolerance may vary with soil fertility. The types of salinity-fertility interactions affecting interpretations of salt tolerance data have been illustrated by Bernstein, Francois, and Clark (43). Crops grown on infertile soils generally have abnormally high apparent salt tolerance as compared with crops grown on fertile soils because yields on nonsaline soil are severely limited by inadequate fertility (111,139,140). Because salinity is not the limiting variable governing growth, the data are of limited value. Obviously, proper fertilization would increase absolute yields even though apparent relative salt tolerance is decreased. Salt tolerance data may be desired for suboptimal conditions, however, where fertilizers are either uneconomical or unavailable.

Published lists of crop salt tolerances based on data from USSL (7,26,28,152) were obtained under optimum fertility for nonsaline conditions. Unless salinity causes specific nutritional imbalances, additional fertilization generally has little effect or reduces salt tolerance. Apparent decreases in salt tolerance with excess N applications have been reported for corn and cotton (105), rice (127), wheat (110,127), and spinach (109). No significant change in relative salt tolerance was found for bean (112) or millet, berseem clover, and corn (139,140), when excess N was applied. Bernstein, et al. (43) concluded from sand culture studies that high N levels do not increase the salt tolerance of wheat, barley, corn, or six vegetable crops (garden beet, broccoli, cabbage, carrot, lettuce, and onion).

Rarely, if ever, are P levels excessive in soil, even with heavy applications because P is adsorbed or precipitated in the soil. High P levels in sand or water cultures, however, may aggravate salt injury and decrease salt tolerance. Bernstein, et al. (43) reported a decrease in the salt tolerance of corn grown in sand cultures at soluble P levels of 16 mg/l and 64 mg/l as compared with 1.6 mg/l. The high P level (16 mg/l-24 mg/l) in the water culture study of Torres and Bingham (151) may account for the decreased salt tolerance they reported for wheat. In soil, most studies have verified that excess P applications have no effect on salt tolerance (69,105,110,112). Ravikovitch and coworkers (138,139,140), however, observed that high P levels can influence salt tolerance for some crops.

Fewer studies have been conducted on the influence of excessive K levels on salt tolerance, but high K levels do not seem to have a significant effect (43,111,139).

Soil Water and Aeration.—Immediately after irrigation, soil water content is maximum and soluble salt concentration is minimal. As water is lost from the soil by evaporation and crop transpiration, most of the salts are excluded by the plant and left behind in a reduced volume of soil water. The drier the soil becomes before the next irrigation, the higher the average salt concentration for the irrigation cycle. Since plants tend to respond to the sum of the osmotic potential of the soil solution and the soil matric potential, the more saline the soil water, the more frequent the irrigations must be to minimize plant water stress. Also, since osmotic potential is such a large factor in saline soils, the available water in a given soil generally decreases as salinity increases. Frequent irrigation minimizes the influence of soil matric potential in salt tolerance studies. Matric potential, of course, is not a factor in properly irrigated water and sand-culture studies. However, extrapolating the data obtained under steady salinity conditions in these cultures to fluctuating soil water contents in the field can be a major source of error.

Another problem in evaluating salt tolerance studies conducted on field soils may develop from a shallow water table. Deep-rooted plants may extract water from a shallow water table and, depending upon the quality of water, plants may respond much differently than expected from salinity levels in the soil profile.

Excessive irrigation can cause poor soil aeration, particularly in fine-textured soils. Low oxygen levels have interacted with salinity to affect shoot growth of tomato (10) and wheat germination (3).

Environmental Factors

Climate may significantly influence plant response to salinity. Temperature, atmospheric humidity, and air pollution have markedly influenced salt tolerance. Many crops seem less salt-tolerant when grown under hot dry conditions than under cool humid ones. On the other hand, air pollution increases the apparent salt tolerance of oxidant sensitive crops. Since all crops are not equally affected, these environmental factors must be considered when assessing salt tolerance.

Magistad and coworkers (118) found that relative yields of alfalfa, bean, beet, carrot, cotton, onion, squash, and tomato were depressed more in warm than in cool climates. Ahi and Powers (4) found similar results for alfalfa, strawberry clover, and saltgrass. The salt tolerance of bean grown in a cool climate is significantly higher than when grown under hot conditions (95). High atmospheric humidity tends to increase the salt tolerance of some crops (95,96,97). High humidity generally benefits salt-sensitive crops more than tolerant crops because increases in salt tolerance result in greater yield increases.

A strong interaction between the effects of ozone, a major air pollutant, and salinity has been found in pinto bean, garden beet, and alfalfa. At ozone concentrations often prevalent in several agricultural areas, alfalfa yields may be increased by maintaining moderate but not detrimental salinity levels (94). Salinity also reduced ozone damage in pinto bean and garden beet, but effects are beneficial at salinity and ozone levels too high for economical production (93,126). These initial results indicate that the salinity-ozone interaction is commercially important for leafy vegetable and forage crops. Because some crops are affected more by air pollutants when grown under nonsaline rather than saline conditions, such crops may seem more salt-tolerant in areas with high air pollution.

Salt Tolerance Evaluations

Our current evaluation of the relative salt tolerance of agricultural crops is given in Table 1. The alphabetical crop list provides two essential parameters sufficient for expressing salt tolerance: (1) The maximum allowable salinity without yield reduction below that of the nonsaline control treatment; and (2) the percent yield decrease per unit salinity increase beyond the threshold. All the salinity values are reported as EC_e, in millimhos per centimeter at 25° C, and rounded to two significant digits. A qualitative salt tolerance rating is also given for quick relative comparisons among crops. These ratings are defined by the boundaries shown in Fig. 1. The literature references upon which these evaluations are based are also listed in Table 1.

The information for preparing this salt tolerance list was obtained by reviewing: (1) Salinity related references listed in the Bibliography of Agriculture from 1950-1975; (2) all available published and unpublished information at the USSL including the Laboratory's Collaborators' Reports; (3) the references listed in individual salt tolerance papers; and (4) results requested from research personnel in the western United States. Generally, only those papers reporting measurements of both root-media salinity and crop yield were considered. Unfortunately, growth response had to be used for some tree and vine crops because of the lack of yield data. Experiments without adequate control of the factors influencing

TABLE 1.—Salt Tolerance of Agricultural Crops

Crop (1)	Salinity[a] at initial yield decline (threshold), *A* (2)	Yield decrease per unit increase in salinity beyond threshold, *B* (3)	Salt tolerance rating[b] (4)	References (5)
Alfalfa *Medicago sativa*	2.0	7.3	MS	21, 46, 53, 56, 75, 94
Almond[c] *Prunus dulcis*	1.5	19	S	35, 57
Apple *Malus sylvestris*	—	—	S	99
Apricot[c] *Prunus Armeniaca*	1.6	24	S	35, 57
Avocado[c] *Persea americana*	—	—	S	13, 82
Barley (forage)[d] *Hordeum vulgare*	6.0	7.1	MT	63, 84
Barley (grain)[d] *Hordeum vulgare*	8.0	5.0	T	15, 84
Bean *Phaseolus vulgaris*	1.0	19	S	31, 95, 118, 125, 128
Beet, garden[e] *Beta vulgaris*	4.0	9.0	MT	43, 96, 118
Bentgrass *Agrostis palustris*	—	—	MS	159
Bermudagrass[f] *Cynodon Dactylon*	6.9	6.4	T	39, 40, 108
Blackberry *Rubus spp.*	1.5	22	S	66
Boysenberry *Rubus ursinus*	1.5	22	S	66
Broadbean *Vicia Faba*	1.6	9.6	MS	17
Broccoli *Brassica oleracea botrytis*	2.8	9.2	MT	29, 43
Bromegrass *Bromus inermis*	—	—	MT	119
Cabbage *Brassica oleracea capitata*	1.8	9.7	MS	29, 43, 128
Canarygrass, reed *Phalaris arundinacea*	—	—	MT	119

TABLE 1.—Continued

(1)	(2)	(3)	(4)	(5)
Carrot *Daucus Carota*	1.0	14	S	32, 43, 107, 118, 128
Clover, alsike, ladino, red, strawberry *Trifolium spp.*	1.5	12	MS	11, 39, 75, 144
Clover, berseem *T. alexandrinum*	1.5	5.7	MS	9, 16, 139, 140
Corn (forage) *Zea Mays*	1.8	7.4	MS	85, 138, 139
Corn (grain) *Zea Mays*	1.7	12	MS	30, 102
Corn, sweet *Zea Mays*	1.7	12	MS	30
Cotton *Gossypium hirsutum*	7.7	5.2	T	22, 23, 38
Cowpea *Vigna unguiculata*	1.3	14	MS	139
Cucumber *Cucumis sativus*	2.5	13	MS	128, 137
Date *Phoenix dactylifera*	4.0	3.6	T	72, 73, 74
Fescue, tall *Festuca elatior*	3.9	5.3	MT	54, 55
Flax *Linum usitatissimum*	1.7	12	MS	89
Grape[c] *Vitis spp.*	1.5	9.6	MS	81, 124, 150
Grapefruit[c] *Citrus × paradisi*	1.8	16	S	86, 91, 135
Hardinggrass *Phalaris tuberosa*	4.6	7.6	MT	55
Lemon[c] *Citrus limon*	—	—	S	64
Lettuce *Lactuca sativa*	1.3	13	MS	19, 43, 128
Lovegrass[f] *Eragrostis spp.*	2.0	8.4	MS	39
Meadow Foxtail *Alopecurus pratensis*	1.5	9.6	MS	55
Millet, Foxtail *Setaria italica*	—	—	MS	139
Okra *Abelmoschus esculentus*	—	—	S	6, 122, 130
Olive *Olea europaea*	—	—	MT	48, 150
Onion *Allium Cepa*	1.2	16	S	33, 43, 96, 128

TABLE 1.—Continued

(1)	(2)	(3)	(4)	(5)
Orange *Citrus sinensis*	1.7	16	S	51, 83, 92, 136
Orchardgrass *Dactylis glomerata*	1.5	6.2	MS	35, 156
Peach *Prunus Persica*	1.7	21	S	35, 57, 88
Peanut *Arachis hypogaea*	3.2	29	MS	147
Pepper *Capsicum annuum*	1.5	14	MS	21, 128, U[h]
Plum[e] *Prunus domestica*	1.5	18	S	35, 57
Potato *Solanum tuberosum*	1.7	12	MS	34
Radish *Raphanus sativus*	1.2	13	MS	96, 128
Raspberry *Rubus idaeus*	—	—	S	66
Rhodesgrass *Chloris Gayana*	—	—	MS	1, 76
Rice, paddy[d] *Oryza sativa*	3.0	12	MS	68, 123, 131, 154
Ryegrass, perennial *Lolium perenne*	5.6	7.6	MT	55
Safflower *Carthamus tinctorius*	—	—	MT	70
Sesbania[c] *Sesbania exaltata*	2.3	7.0	MS	23
Sorghum *Sorghum bicolor*	—	—	MT	U
Soybean *Glycine Max*	5.0	20	MT	2, 45, 46
Spinach *Spinacia oleracea*	2.0	7.6	MS	109, 128
Strawberry *Fragaria spp.*	1.0	33	S	67, 128
Sudangrass *Sorghum sudanense*	2.8	4.3	MT	54
Sugarbeet[e] *Beta vulgaris*	7.0	5.9	T	52, 155
Sugarcane *Saccharum officinarum*	1.7	5.9	MS	42, 62, 149
Sweet potato *Ipomoea Batatas*	1.5	11	MS	80, U
Timothy *Phleum pratense*	—	—	MS	144

TABLE 1.—Continued

(1)	(2)	(3)	(4)	(5)
Tomato *Lycopersicon Lycopersicum*	2.5	9.9	MS	49, 87, 166, 148
Trefoil, Big *Lotus uliginosus*	2.3	19	MS	11, 12
Trefoil, Birdsfoot narrowleaf[i] *L. corniculatus tenuifolium*	5.0	10	MT	11, 12
Vetch, common *Vicia sativa*	3.0	11	MS	139
Wheat[c,j] *Triticum aestivum*	6.0	7.1	MT	8, 15, 90
Wheatgrass, crested *Agropyron desertorum*	3.5	4.0	MT	37
Wheatgrass, fairway *A. cristatum*	7.5	6.9	T	37
Wheatgrass, slender *A. trachycaulum*	—	—	MT	119
Wheatgrass, tall *A. elongatum*	7.5	4.2	T	37
Wildrye, Altai *Elymus angustus*	—	—	T	119
Wildrye, Beardless *E. triticoides*	2.7	6.0	MT	55
Wildrye, Russian *E. junceus*	—	—	T	119

[a]Salinity expressed as EC_e, in millimhos per centimeter at 25° C.
[b]Ratings are defined by the boundaries in Fig. 1.
[c]Tolerance is based on growth rather than yield.
[d]Less tolerant during emergence and seedling stage. EC_e should not exceed 4 mmho/cm or 5 mmho/cm.
[e]Sensitive during germination. EC_e should not exceed 3 mmho/cm for beet and sugarbeet.
[f]Average of several varieties. Suwannee and Coastal are about 20% more tolerant, and Common and Greenfield are about 20% less tolerant than the average.
[g]Average for Boer, Wilman, Sand, and Weeping varieties. Lehmann seems about 50% more tolerant.
[h]Unpublished USSL data.
[i]Broadleaf birdsfoot trefoil seems less tolerant than narrowleaf.
[j]Tolerance data may not apply to new semidwarf varieties.
Note: Col. 2 given in millimhos per centimeter; Col. 3 given in percent per millimho per centimeter.

salt tolerance and papers that failed to mention these factors were not considered in the salt tolerance evaluations. Some crops listed in Table 1 have only a qualitative salt tolerance rating because of insufficient data for quantitative evaluation. For ease in interpretation, all salinity values were converted to the same measure, EC_e, and all yield data were placed on a relative basis with the yield of the control treatment assigned a value of 100%.

After evaluating the data for the various crops it became apparent that, in general, yield was not decreased significantly until a threshold salinity level was exceeded, and that yield decreased approximately linearly as salinity increased beyond the threshold. With some crops, e.g., bean, onion, clover, and pepper, yield approached zero asymptotically; with a few others, yields decreased linearly as salinity increased to a point above which the plants died and yields dropped sharply to zero. These deviations from linearity are of little concern, however, because they occur only in the lower part of the curve where yields are commercially unacceptable. Nevertheless, salinity values may be extrapolated for zero yield to estimate the maximum salinities that plants can tolerate for calculating leaching requirements (41,153).

To obtain the numerical evaluations presented in Table 1, least-squares linear equations were fit to the data for each experiment for values beyond the threshold salinity. In some cases, inclusion or exclusion of data required subjective

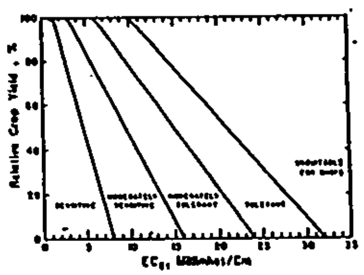


FIG. 1.—Divisions for Classifying Crop Tolerance to Salinity

judgment. When more than one experiment was considered for determining the salt tolerance of a crop, the slope and intercept values for the various experiments were averaged. Because the salinity range studied in some experiments was poorly chosen, data from some experiments could only be used to establish threshold salinities and from others only to determine slope. From the average regression coefficients, the salinity levels at initial yield decline and the yield decrease per unit salinity increase were computed. Relative yield, Y, for any given soil salinity exceeding the threshold, $EC_e > A$, can be calculated by

$$Y = 100 - B(EC_e - A) \quad (1)$$

in which A = the salinity threshold, in millimhos per centimeter; and B = the percent yield decrease per unit salinity increase. For example, alfalfa yields decrease approximately 7.3% per mmho/cm when the soil salinity exceeds 2.0 mmho/cm; therefore, at a soil salinity of 5.4 mmho/cm, the relative yield, $Y = 100 - 7.3(5.4 - 2.0) = 75\%$.

Division boundaries for the salt tolerance ratings defined in Fig. 1 were chosen to approximate the family of linear curves that represent the majority of the crops reported. Four divisions were labeled to correspond with previously published terminology ranging from sensitive to tolerant. With few exceptions the linear salt tolerance curves for each crop remained within one division. Where the linear salt tolerance curve for a crop crossed division boundaries, the crop was rated based on its tolerance at the lower salinity levels where yields are commercially acceptable.

A comparison of our salt tolerance evaluations with previously published data from USSL (26,28) revealed no major changes among the crops even though many evaluations included new and additional experimental data. Only the tolerance of garden beet and bermudagrass changed significantly and both seem less tolerant than previously reported. The threshold salinities of field corn, grape, and spinach dropped slightly as compared with extrapolated values from Bernstein's evaluations (28); whereas threshold salinities of cotton, soybean, and wheat increased about 1 mmho/cm. Several new crops were added to the list but quantitative evaluations of a few others were not included because substantiating data were lacking.

The accuracy and reliability of these evaluations are no better than the data used to make them and can only be refined by further observation, experimentation, and continued improvement of our experimental techniques. Hopefully, these comments will promote well-conducted and controlled experiments that will provide additional salt tolerance data to improve and expand this list.

Summary

An extensive literature review of all available salt tolerance data was undertaken to evaluate the current status of our knowledge of the salt tolerance of agricultural crops. In general, crops tolerate salinity up to a threshold level above which yields decrease approximately linearly as salt concentrations increase. Our best estimate of the threshold salinity level and yield decrease per unit salinity increase is presented for a large number of agricultural crops. The methods of measuring appropriate salinity and plant parameters to obtain meaningful salt tolerance data and the many plant, soil, water, and environmental factors influencing the plant's ability to tolerate salt are examined.

APPENDIX B

YMCA Correspondence

Young Men's Christian Association of Honolulu
METROPOLITAN OFFICE
1441 Pali Highway • Honolulu, Hawaii 96813 • Phone: (808) 531-3558 • FAX: (808) 533-1286

September 4, 1992

Mr. Craig N. Yamagishi
Project Manager
Lihi Lani
66-145 Kamehameha Hwy.
P. O. Box 848
Haleiwa, HI 96712-0848

Dear Craig:

The YMCA of Honolulu is very excited about the possibility of creating a community YMCA at Lihi Lani on the North Shore of Oahu. This is a part of the island that is growing. It deserves quality programs for children, adults and seniors but has been an area beyond our resources to construct a YMCA. The generosity of the Ohbayashi Hawaii people to provide land, infrastructure development and some construction would place the possibility of a dynamic Y center serving the North Shore within reach.

We fully understand that governmental, community and citizen support for this concept will need to be secured before this can become a reality. We stand ready to meet with all groups in order to learn of community needs and help design programs that will be beneficial and successful.

We further understand that to provide a complete and strong YMCA center will require more funds than can be provided within the project budget and that it will be our responsibility to secure those funds. It is our opinion that to more fully serve community needs the YMCA will also need to secure United Way funding and other private contributions to subsidize the operating budget. We stand prepared to do that.

I think the credentials to fulfill our obligations of the YMCA are strong. We currently have 10 YMCA locations operating more than 100 different programs with 600 staff, 2000 volunteers and an annual budget of $13,500,000. We have been a stable force on the island for 123 years. Here are some of our current credentials:

- We are the largest private operator of childcare program in Hawaii with more than 4000 children each day.

- We operate 6 swimming pools with 5230 people enrolled in our swimming programs this past year.

- 4988 youth at risk were served in our gang prevention, immigrant youth, dropout prevention and substance abuse projects. Our YMCA is the largest provider of counseling to teenagers with drug and alcohol problems in the State of Hawaii.

- A total of 64,039 seniors, adults and children participated in our programs in 1991.

- We teach young people how to be effective leaders and we provide avenues for adults to be of service to others. In this way we bring far reaching and positive change to the entire community.

- YMCA volunteers raise $750,000 to add to our $500,000 United Way allocation to subsidize programs for children and low income participants.

Below is a partial list of our YMCA's programs:

YOUTH DEVELOPMENT	YOUTH ACTIVITIES	ADULT PROGRAMS
Child-care	Swim Classes	Volunteer Leadership
Leadership Training	Basketball	Prenatal Exercise
Teen Drug Counseling	Performing Arts	Fitness Testing
Resident Camping	Teen Dances	Adult Lap Swimming
Teen Travel Camps	Field Trips	Resident Dormitories
Aikido	Gymnastics	International Exchanges
School Dropout Prevention	Game Room	Weight Training
Karate & Judo	Life Saving	Volleyball & Basketball
International Exchanges	Hula Dance Classes	Exercise Classes
Filipino Youth Project	Teen Exercise Classes	Parenting Skills
Korean Youth Project	Teen Weight Room	Y's Men Service Clubs
Youth Legislature	Summer Fun Club	Martial Arts

The YMCA has a special style. It gives meaning to human values through the principle that individuals are unique and worthy of respect, and that individuals are responsible for their own lives and actions. The Y promotes development of good interpersonal relations and a sense of a shared community among people through participation in YMCA programs. The Y gives children, young adults, men, women and senior citizens opportunities for personal growth in a positive receptive environment. It is basic to the functioning of the YMCA that it serves the young, the old, the rich, the poor, men and women, all races, all faiths, and those of divergent political views. The YMCA policy is to charge those who can afford to pay for programs and to help subsidize those who cannot pay for services.

We believe we can be a very strong partner in making a creative and dynamic center come to life that will serve and enhance the quality of life on the North Shore for decades to come. We want to be there!

Sincerely,

Don Anderson
President

Young Men's Christian Association of Honolulu
METROPOLITAN OFFICE
1441 Pali Highway • Honolulu, Hawaii 96813 • Phone: (808) 531-3558 • FAX: (808) 533-1286

June 12, 1992

Craig Yamagishi
Partner
Quon-Yamagishi
46-387 Hololio Street
Kaneohe, HI 96744

Craig, I really enjoyed seeing the site and hearing more about the Obayashi plans. The designated site would be perfect for a YMCA unit to serve the Northshore. We would be excited and honored to be selected for such a project.

We also can bring to the project a 122 year record of successful operations on Oahu and a great deal of practical experience. We will cooperate in every way to help Obayashi and the various citizen groups examine our suitability.

I have enclosed a space budget that would represent what I feel would be an "optimum facility" for the Northshore. We may need to scale back for practical reasons or consider several development phases to eventually achieve a complete facility.

Let us know what the next steps are.

Sincerely,

Don Anderson
President

Enclosures

cc: Dr. Michael J. Chun
Maile Kanemaru
Mits Ikeda

A Member of Aloha United Way

Serving the People of Honolulu Since 1869

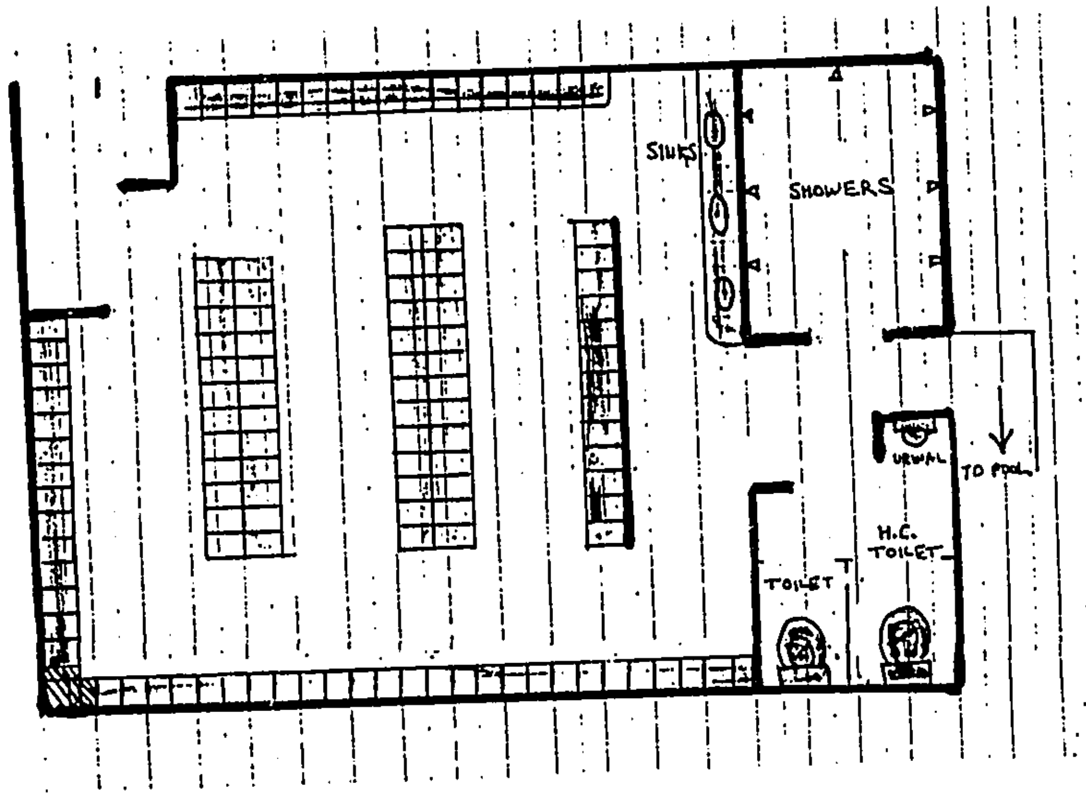
ESTIMATED SPACE BUDGET FOR OPTIMUM NORTHSHORE YMCA

PROGRAM SPACE:	DIMENSIONS	SQ. FT.
Boys/Men's Locker Room	24 x 36	864
Girls/Women's Locker Room	24 x 36	864
Multi Purpose Room	40 x 52	2080
Exercise Center	32 x 52	1664
Meeting Room 1	16 x 24	384
Meeting Room 2	18 x 24	432
Meeting Room 3	20 x 24	480
Child Care Center	32 x 32	1024
	Program Sub Total	7792
ADMINISTRATION SPACE:		
Reception Desk & Lobby		240
Office Worker 1		100
Office Worker 2		100
Director's Office	10 x 14	140
Program Office	10 x 12	120
Program Office	10 x 12	120
Part-Time Staff Office	12 x 18	216
Work Room	10 x 14	140
	Administration Sub Total	1176
SUPPORT SPACE:		
Mechanical	12 x 20	240
Kitchen	12 x 15	180
Boys/Men's Restroom	10 x 12	120
Girls/Women's REstroom	10 x 12	120
Storage Closets		400
	Support Total	1060
	Total Space Requirement	10028
	Add 15 Percent Planning Factor	1468
	Grand Total	11496 sq. ft.

LOCKER ROOM CONCEPT (24 X 36 = 864 SQ. FT.)

120 LOCKER COLUMNS, 3 SINKS

7 SHOWER HEADS, 2 TOILETS, 1 URINAL



POOL SPECIFICATION

Length: 25 meters

Width: 42 feet (six 7 ft. lanes)

Depth: 3 ft. shallow end; 3½ ft. deep end (see below)

Deck: 10 to 12 ft. on 3 sides; 20 ft. on shallow end

PRIMARY USES OF A SHALLOW POOL

- Instruction for children
- Lap swimming for exercisers
- Aqua fitness classes for adults
- Competitive swimming for children and adults

EXCLUSIONS BY HAVING SHALLOW POOL

- Diving
- Scuba classes
- Life saving classes

FACILITIES NOT INCLUDED IN SPACE BUDGET BECAUSE COST IS HIGH FOR BENEFITS:

Gymnasium

Racquetball/handball courts

Sauna/steam room

Jacuzzi

TV lounge area

APPENDIX C

Wastewater
Management Plan

WASTEWATER MANAGEMENT PLAN
FOR THE
PROPOSED LIHI LANI PROJECT

Pupukea and Paumalu, Koolauloa, Oahu, Hawaii

Prepared for:

Obayashi Hawaii Corporation
Honolulu, Hawaii

Prepared by:

Robert Gearheart, Ph.D.

and

Engineering Concepts, Inc.
250 Ward Avenue, Suite 206
Honolulu, Hawaii 96814

September 1993

TABLE OF CONTENTS

FIGURES

TABLES

SECTION 1

INTRODUCTION

The Obayashi Hawaii Corporation is proposing to construct a residential development on the North Shore of Oahu at Pupukea (TMK: 5-9-05: por. 38, 82 and 5-9-06: 1, 18, 24). The 1,144 acre site is located inland of Kamehameha Highway and Sunset Beach, surrounded by the COMSAT facility, State Forest Reserve, Sunset Beach Elementary School, and the Pupukea Highlands and Sunset Hills subdivisions (Figure 1).

The objective of this report is to present engineering information on the proposed wastewater collection and reclamation facilities for the project development. This report is also intended to update the information contained in the report entitled "Wastewater Management Plan for the Lihi Lani Recreational Community", dated December 1990. Specifically, this report will:

1. Provide more detailed information for the Supplemental Environmental Impact Statement (SEIS) and future land use approval process;
2. Provide detailed information on the proposed reclamation processes: stabilization ponds, constructed wetlands, coagulant addition, filtration, and ultraviolet light disinfection;
3. Provide site specific descriptions of the proposed wastewater collection and reclamation systems; and
4. Provide a site specific description of the anticipated impacts of effluent disposal by irrigation.

The proposed wastewater infrastructure presented in this report is intended to be privately owned and operated. In addition, future expansion of the proposed facilities is not expected.

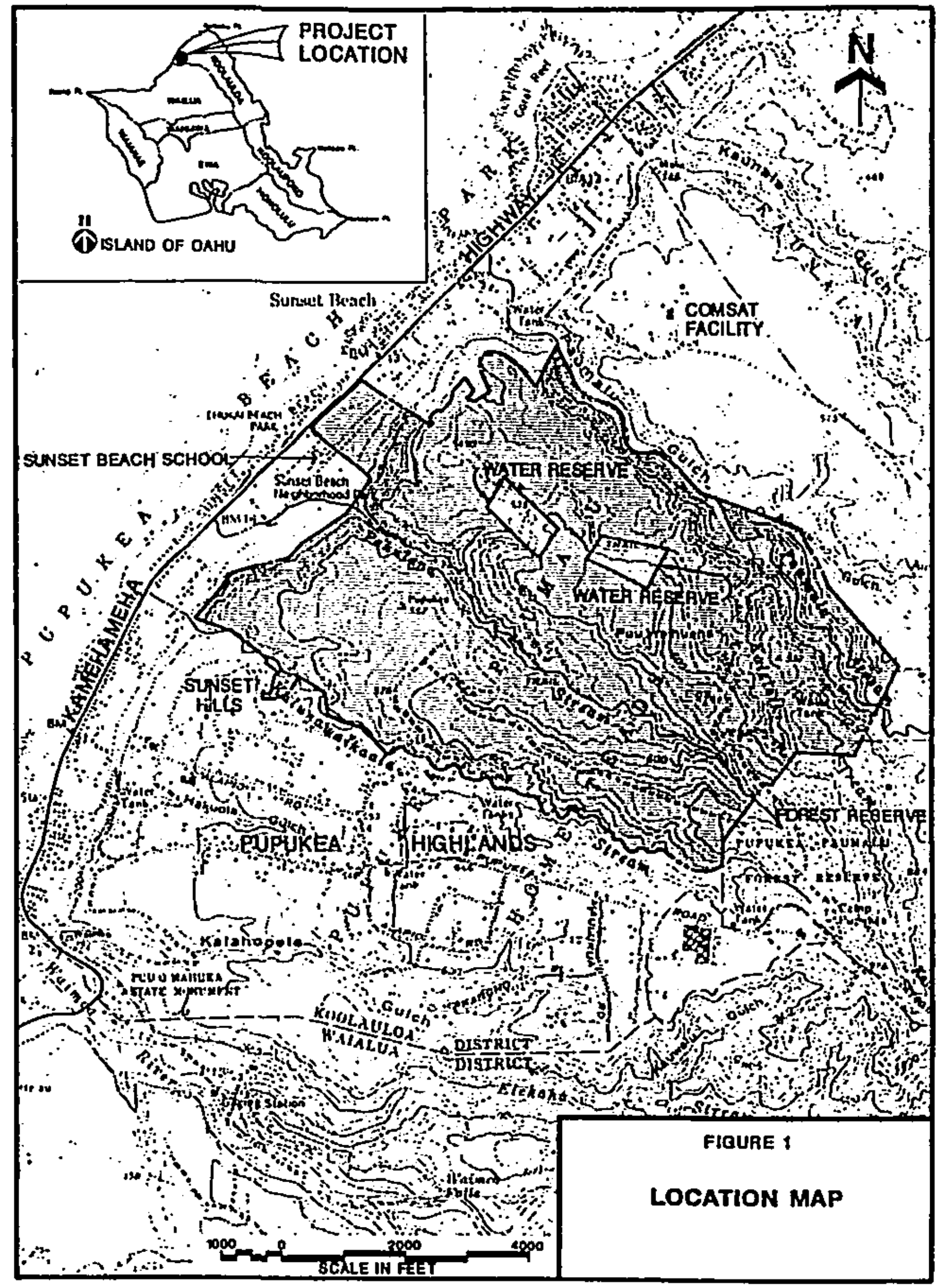


FIGURE 1

LOCATION MAP

SECTION 2
PROJECT BACKGROUND

2.1 Proposed Project

The proposed Lihi Lani Project Master Plan designates new land uses involving approximately 900 acres within the 1,144-acre site (Figure 2). The proposed development will consist of 315 country lots of one acre or larger; 50 single family affordable homes; 80 elderly housing units; a ranch with pasture; stables and riding trails; a campground; agriculture and agri-forestry land; and park/community facilities. Actual development will affect between 400 to 480 acres, with the remaining 664 to 744 acres remaining as unaffected open space.

Approximately 18 acres of the project site are situated below the bluff along the coastal plain inland of Kamehameha Highway and northeast of Sunset Beach Elementary School. The remaining 1,126 acres are located on an expanse approximately 6,000 feet wide and 8,000 feet in depth, separated from the coastal plain by a 200- to 400-foot high bluff.

2.2 Existing Conditions

The site is isolated from neighboring properties on Kamehameha Highway by the bluff, and from neighbors on the northeast and southeast by the valleys of Paumalu Stream and Kalunawaikaala Stream, respectively. Pakulena Stream bisects the site interior. The three streams experience intermittent flow, occurring only during periods of heavy rain.

The elevation of the coastal parcel varies from 20 feet to 75 feet, while the elevation of major portions of the site varies from 200 feet at the bluff to 840 feet at the inland forest reserve region. Approximately 30 percent of the site slopes at less than 20 percent.

At present, there are no public sewers servicing the site or surrounding areas. The neighboring communities of Sunset Beach and the Pupukea Highlands and Sunset Hills subdivisions are all serviced by individual wastewater systems (cesspools or septic tank/leachfield systems).

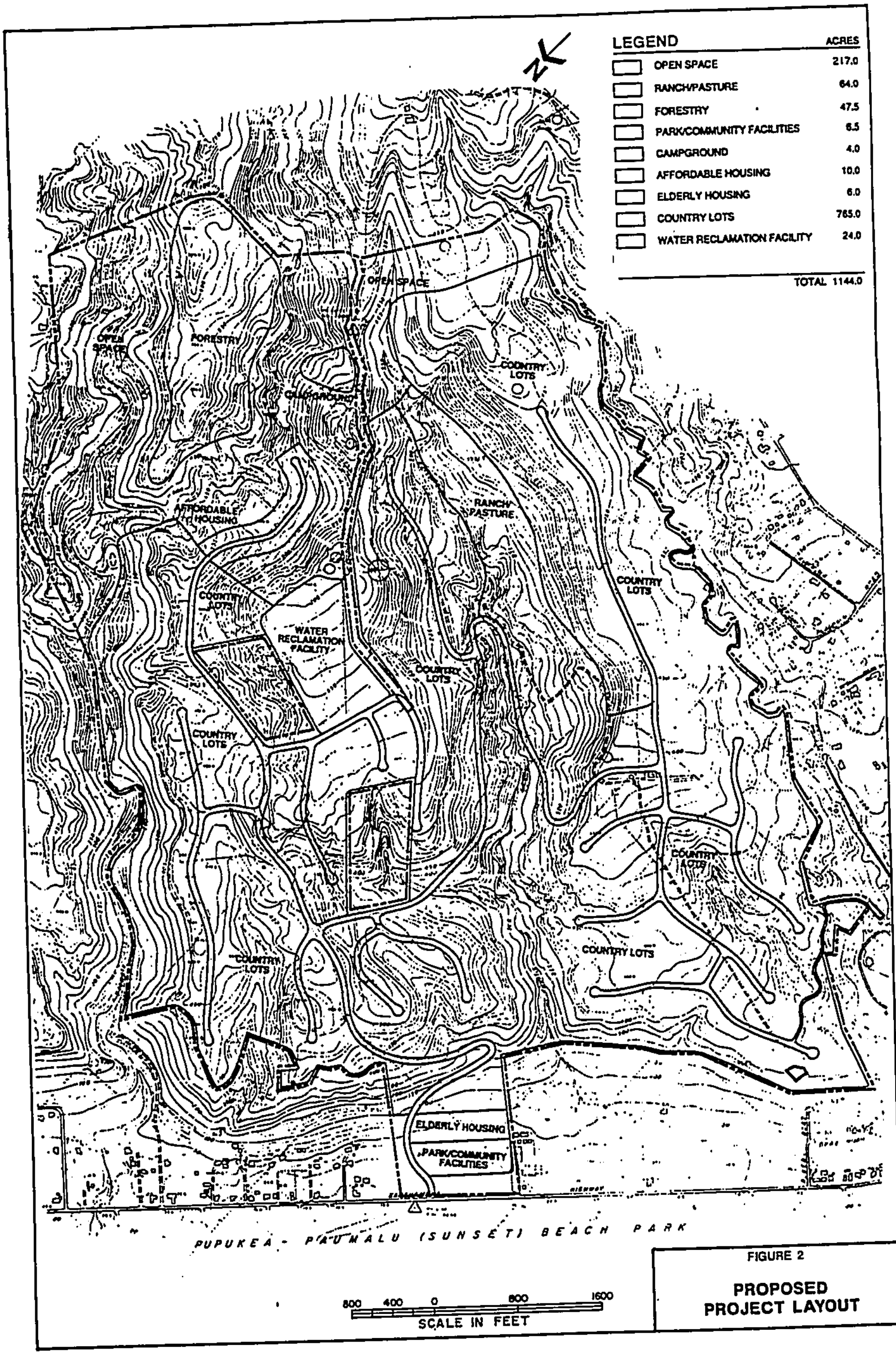


FIGURE 2

PROPOSED PROJECT LAYOUT

SECTION 3
DESCRIPTION OF THE WATER RECLAMATION PROCESS

The proposed method of wastewater treatment (water reclamation) at Lihi Lani will consist of the following processes: 1) stabilization ponds, 2) constructed wetlands, 3) coagulant addition, if required, 4) filtration, and 5) ultraviolet light disinfection. The stabilization ponds/constructed wetlands system is a land intensive, low energy, ecological system which differs significantly from the typical conventional treatment plants found in Hawaii which are energy and technology intense. The treated effluent (reclaimed water) will be conveyed to a central storage/distribution facility and used for irrigation. A schematic layout of the proposed water reclamation process is shown on Figure 3, and a description of the reclamation process follows.

3.1 Stabilization Ponds

Stabilization ponds will be used to provide the first level of treatment. These ponds utilize the processes occurring in nature to decompose waste matter. A stabilization pond generally consists of a large, relatively shallow body of water enclosed by earthen berms. In Hawaii, the sides and bottom of the pond are usually lined with an impermeable material or clay to prevent seepage of the liquid to the substrata. The average water depth within this type of pond ranges from about 2 to 8 feet. A 2- to 3-foot freeboard is usually added to the design water level as a precaution against pond overflow. Stabilization ponds are usually sized according to detention times ranging from 5 to 30 days.

Stabilization ponds can be classed according to the type of biological activity within the pond. An aerobic pond operates with the presence of oxygen, which is generally supplied to the pond through mechanical mixers or blowers. Conversely, an anaerobic pond operates under conditions absent of oxygen.

The type of stabilization ponds proposed for Lihi Lani operates under both aerobic and anaerobic conditions, and is known as a facultative pond (Figure 4). In general, the upper portion of the pond functions aerobically, while the lower portion of the pond functions anaerobically. With facultative ponds, oxygen in the upper portion is usually provided by photosynthetic algae and

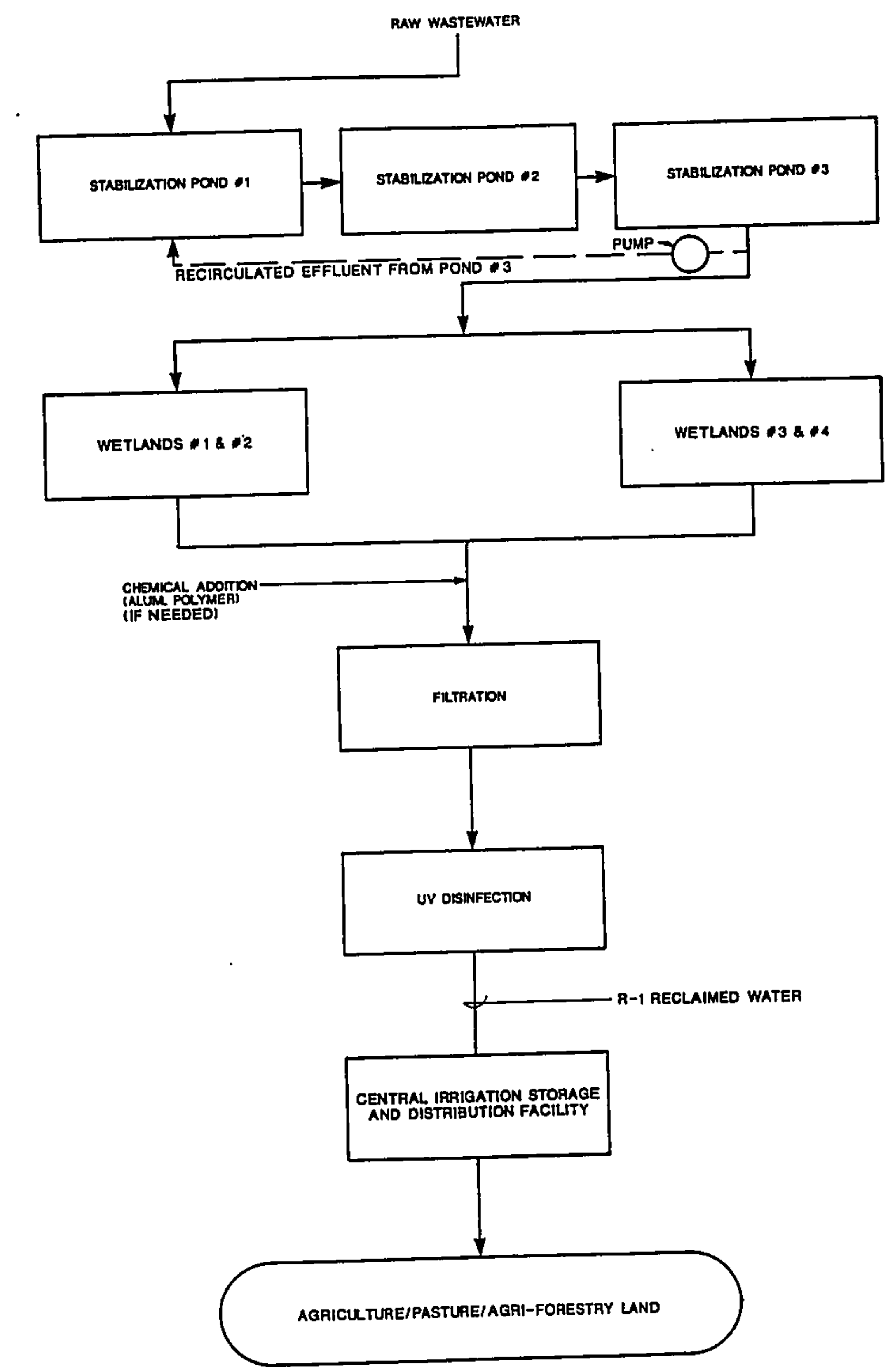


FIGURE 3

SCHEMATIC FLOW DIAGRAM FOR PROPOSED RECLAMATION SYSTEM

reaeration from winds instead of by mechanical means (mixers or blowers). The upper aerobic layer serves as a buffer to odor-causing constituents generated in the anaerobic portion of the pond. The bottom portion of the pond contains a layer of settled biosolids, where anaerobic organisms would utilize the biosolids as food sources. These solids are continually reduced to carbon dioxide, methane, and trace amounts of hydrogen sulfide. A residual amount of detrital organic material is accumulated in the pond.

The advantages of a facultative pond include: 1) capital cost is usually lower than a conventional treatment plant, 2) operational costs are minimal when compared with energy-intense conventional treatment plants, 3) organics in the wastewater are converted to algae, 4) the sizing requirements for a pond system allow for the regulation of effluent, 5) the process is reliable and can handle hydraulic overloads, 6) the operation of a pond system requires minimal maintenance, 7) the process is simple and can be operated by less skilled personnel, 8) occurrence of bacteria die-off due to long detention times, and 9) no separate solids treatment/disposal processes are needed due to the anaerobic organisms decomposing the biosolids.

In general, there are some potential disadvantages of a facultative pond, which could include: 1) extensive land is required for siting, 2) poor assimilative capacity for certain industrial wastes, 3) potential odor problems, which are usually caused either by BOD overloads to the system, incoming flows which contain industrial wastes, or inflow of salt water along low-lying coastal areas (which contain high levels of sulfates), 4) limitations on expansion of towns and new developments surrounding treatment site due to pond site encroachment, and 5) pond effluent quality (without filtration) sometimes cannot meet the 30 mg/l limit for suspended solids. Although these are potential disadvantages, several points are clarified for the system proposed for Lihi Lani. First, the relatively low amount of flow (approximately 180,000 gallons per day) precludes the need for large areas of land. Approximately 24 acres of land is required for the reclamation facility, which can be accommodated within the total project area of 1,144 acres. Secondly, it is expected that wastewater generated by Lihi Lani will be of typical domestic composition, and no light or heavy industries are proposed. Thus, the pond system is not expected to process any type of industrial flows. Third, with provisions for recirculation of pond #3 effluent back to pond #1 and only domestic sources, BOD overloads and related odor

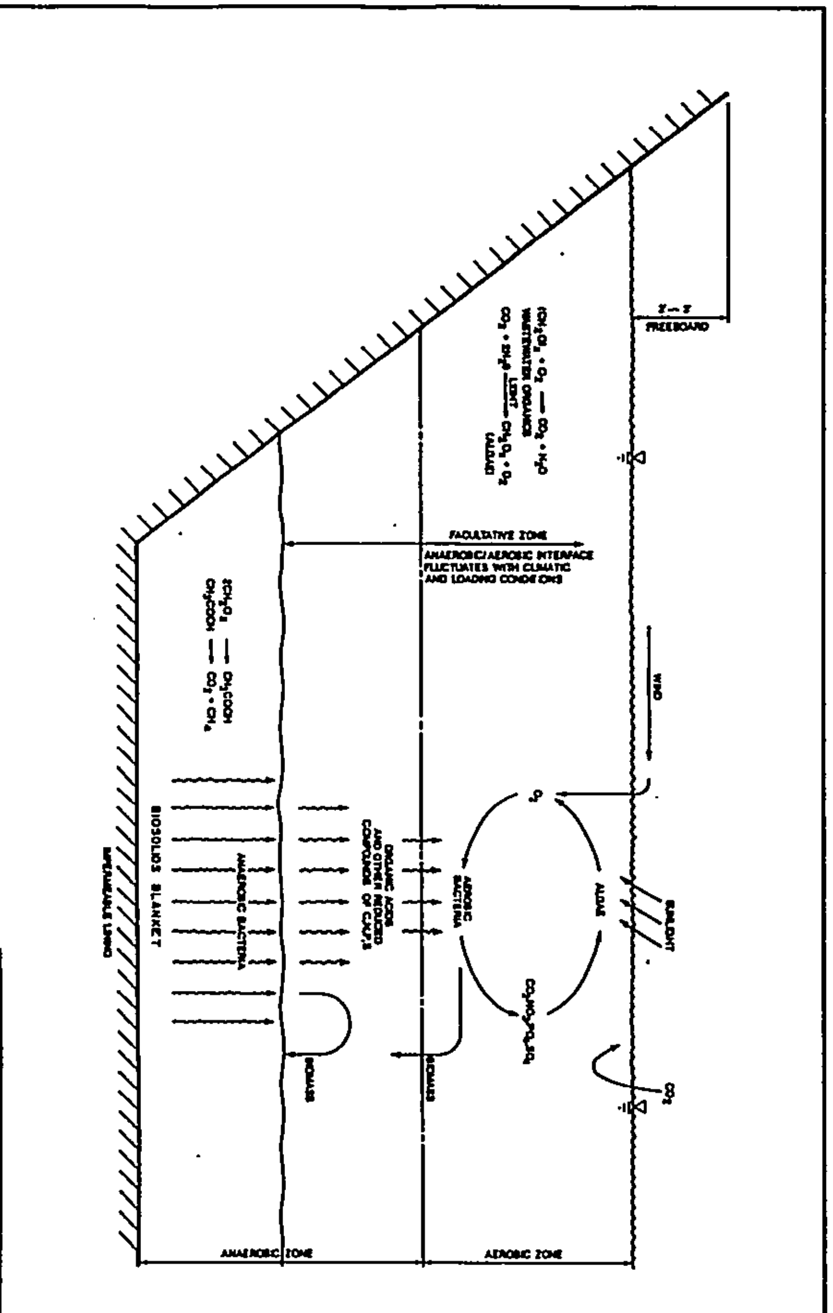


FIGURE 4

TYPICAL FACULTATIVE POND PROCESS

problems should be absent. Also, the tropical climate would preclude the generation of odors normally associated with spring ice melts and non-algal activity in cold regions. In addition, the absence of seawater (which contains high levels of odor-causing sulfate) intrusion into the collection and reclamation system would be non-existent due to the elevation of the project. Fourth, the reclamation facility is being planned for the project's full development and further expansion and/or additional future development is not anticipated. Finally, the use of the wetlands system as an advanced secondary treatment process should provide adequate shading to prevent any excessive algal growth, thus reducing the effluent suspended solids content. Filtration at the end of the treatment process will reduce suspended solids to a very low concentration (3 to 5 mg/L).

The microbiological processes occurring within the aerobic upper portion of a facultative pond generally consist of bacteria and saprobic protozoans, which serve as the main feeders of waste materials (organics) contained in the wastewater. The chemical processes involved in the aerobic zone include:

Respiration: $(CH_2O)_X + O_2 \text{ --> } CO_2 + H_2O$

Here, the biological community utilizes the oxygen present in the ponds to metabolize the organic matter, releasing carbon dioxide and nutrients. The carbon dioxide and nutrients are then utilized by algae cells to further oxygenate the pond as well as produce more cells in a process known as photosynthesis:

$$CO_2 + 2H_2O \text{ --light--> } \underset{\text{(new algae cells)}}{CH_2O_X} + O_2$$

The respiration and photosynthesis processes are cyclical in nature and symbiotic. Other protozoans and higher animal forms such as rotifers and microcrustaceans serve as secondary feeders on the bacteria and algae, further "polishing" the effluent.

On the lower anaerobic portion of the pond, biological activity consists mainly of the digestion of the settled solids. The anaerobic process can be described as the biological conversion of

organic material, in the absence of oxygen, to end products such as carbon dioxide and methane. The anaerobic process usually consists of three steps: 1) hydrolysis, which is the conversion of higher molecular compounds into sources of energy and cell carbon, 2) acidogenesis, which involves the conversion of the first step compounds into lower molecular mass compounds, and 3) methanogenesis, which is the bacterial conversion of these compounds into the end products mainly consisting of methane and carbon dioxide. The two primary classes of organisms include the acid formers and the methane formers. The acid formers are responsible for the hydrolyzation of organic polymers and lipids to basic structural building blocks. The anaerobic chemistry involved is:

$$2CH_2O_X \text{ --> } CH_3COOH$$

Acid/alcohol conversion to carbon dioxide and methane is stoichiometrically depicted:

$$CH_3COOH \text{ --> } CO_2 + CH_4$$

The treatment efficiencies of a stabilization pond system can be improved by connecting several ponds in series. With this configuration, reductions in the biochemical oxygen demand (BOD, which are oxygen-demanding substances) can be realized by preventing short-circuiting of the liquid waste, and offer optimal biological use of the pond reactor.

Facultative stabilization ponds are not found in widespread use on Oahu due to two factors: 1) limited land area confines application mainly to rural areas (due to the large amount of pond area required to treat waste generated in heavily populated areas), and 2) most rural areas are currently served by individual wastewater systems such as cesspools and septic tanks.

Facultative stabilization ponds are used on the island of Lanai to process wastewater generated from Lanai City. Owned and operated by the County of Maui, the two 3-acre ponds currently provide treatment for an average daily flow of 210,000 gpd. Influent BOD and suspended solids average about 201 and 99 mg/L, respectively, while effluent values average about 46 and 164 mg/L (the high effluent SS values are due to algae growth within the ponds). Aside from being very simple to operate and maintain, the ponds have not experienced any odor problems or significant operational problems since their startup in the late 1970's.

3.2 Constructed Wetlands

The use of constructed wetlands is a relatively new concept within the wastewater treatment field. A constructed wetland system utilizes all of the applications found in conventional wastewater treatment processes, such as sedimentation, biological oxidation, nutrient incorporation, adsorption and precipitation. A constructed wetland usually offers an advanced secondary level of treatment in terms of BOD, suspended solids, and total inorganic nitrogen (TIN) removed.

Constructed wetlands can be classified into two separate systems: a free water surface system or a subsurface flow system. A free water surface system, which will be used at Lihi Lani, contains one or several basins which may be lined with natural or artificial barriers to prevent seepage (Figure 5). A subsurface flow system contains a bed of media which supports the growth of emergent vegetation. This media bed is underlain with a layer of impermeable material to prevent seepage of the wastewater. The bottom of the system is usually sloped from inlet to outlet to facilitate the collection of the treated effluent. Within these basins, emergent plants such as cattails (Typha), rushes (Scirpus), and reeds (Phragmites) are grown.

Cattails are commonly found in marshy areas across the United States. It is a very hardy plant which easily multiplies and is capable of generating large amounts of biomass. Cattails can provide some nitrogen and phosphorus removal, but only when regular harvesting is practiced.

Reeds are tall annual grasses that have extensive perennial rhizomes. Treatment systems which use reeds are usually more efficient in oxygen transfer due to the plant's extensive perennial rhizomes.

Bulrushes are perennial, grasslike herbs that grow in clumps. They are generally warm to temperate weather plants (50 to 80 degrees F) that grow in a diverse range of inland and coastal waters, brackish and salt marshes, and wetlands. Bulrushes are capable of growing satisfactorily

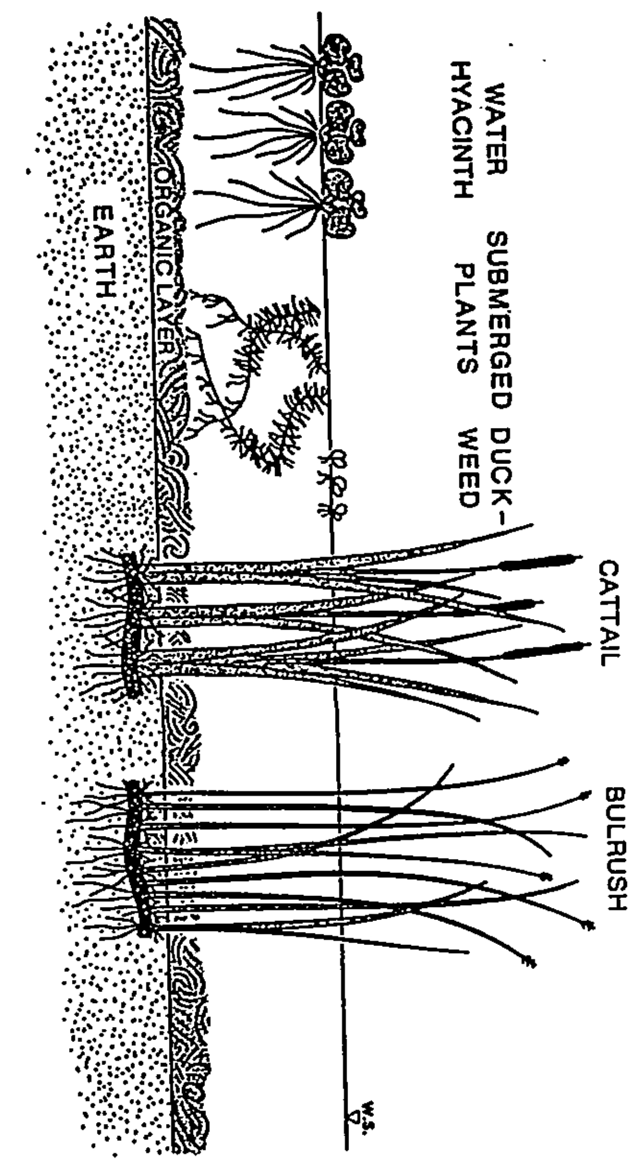


FIGURE 5

TYPICAL WETLANDS TREATMENT SYSTEM

in water depths ranging from 2 inches to 6 feet. Bulrushes also offer a relatively greater specific surface area for bacteria, fungi, and actinomycete to attach.

In a free water system, there are several functions of the vegetation: 1) to provide a substrate for microbial growth, 2) to provide shading of sunlight on the water surface, and 3) to transfer oxygen to the rhizosphere for supporting aerobic decomposers. The microbial growth is responsible for removing much of the oxygen-demanding materials within the wastewater. The shading of the wastewater prevents the growth of algae, which is the primary cause of high levels of suspended solids in stabilization pond effluent.

The removal of suspended solids within the constructed wetlands is attributable to two processes. At the influent end, suspended matter is filtered out by the mass of emergent plants. The filtered solids are then either consumed by microorganisms attached to the vegetation or settle to the bottom of the pond. Within the open areas between plants, autoflocculation and settling are the main mechanisms of solids removal.

The generation of mosquitos can be controlled through biological means. The most common method is stocking the wetlands system with mosquito fish (Gambusia affinis), an indigenous insect larvae eating fish. A dissolved oxygen level of 1.0 mg/L or more is required for fish survival. Surface reaeration due to wind and oxygen added to the system from the emergent plants would maintain aerobic conditions, aiding in the survival of the fish. Other types of biological control available include dragonflies, damselflies, birds, and parasite fungi.

In addition to biological means of mosquito control, the design of the wetlands can incorporate the ability to have the water surface elevation of the system lowered periodically. This would result in the concentration of both mosquitos and predators, promoting the elimination of mosquitos.

Larvicides can be used as a last resort method of mosquito control. Larvicides are organic chemicals which are selective for a specific insect and lifestage. However, the use of larvicides is not anticipated for the Lihi Lani system due to the use of mosquito fish and the capability to

lower the wetland water surface. Thus, mosquito populations at the Lihi Lani Water Reclamation Facility are not expected to cause a pest problem to surrounding areas.

3.3 Coagulant Addition

Portions of the suspended particles in wastewater have densities similar to water. The use of coagulants to facilitate particle removal is commonly practiced as an advanced level of treatment. Coagulant addition causes minute suspended particles to combine into larger, heavier pieces, which settle out more readily. Coagulants such as aluminum sulfate (alum), ferrous sulfate, lime, ferric chloride, and ferric sulfate are commonly used.

Small particles have an electrostatic charge which repels other particles of similar charge and in turn hampers the settling process. This surface charge must either be reduced or overcome to allow individual particle aggregation. Adding coagulants will allow one of the following processes to occur: 1) react with the particle's surface to reduce the surface charge, thus facilitating the aggregation process, 2) add long chained organic molecules (polymers) which will aggregate particles through adsorption and bridging, or 3) form hydrolyzed metal ions.

The two basic mechanisms in the precipitation process are coagulation and flocculation. Coagulation is the reduction of the net electrical repulsive forces at the particle surface by electrolytes in solution. Flocculation is the mechanism in which aggregation by chemical bridging between particles occurs. Both of these actions aid in the removal of solids by separation from the liquid medium.

Coagulants may be added to the wastewater stream either in dry or wet form. Rapid mixing usually follows coagulant addition to allow interaction with the wastewater stream. After mixing, the wastewater is typically sent to a settling tank to separate the formed precipitates. An alternative process can include conveying the mixed effluent directly into a filtration system in which flocculation occurs within the filter media.

3.4 Filtration

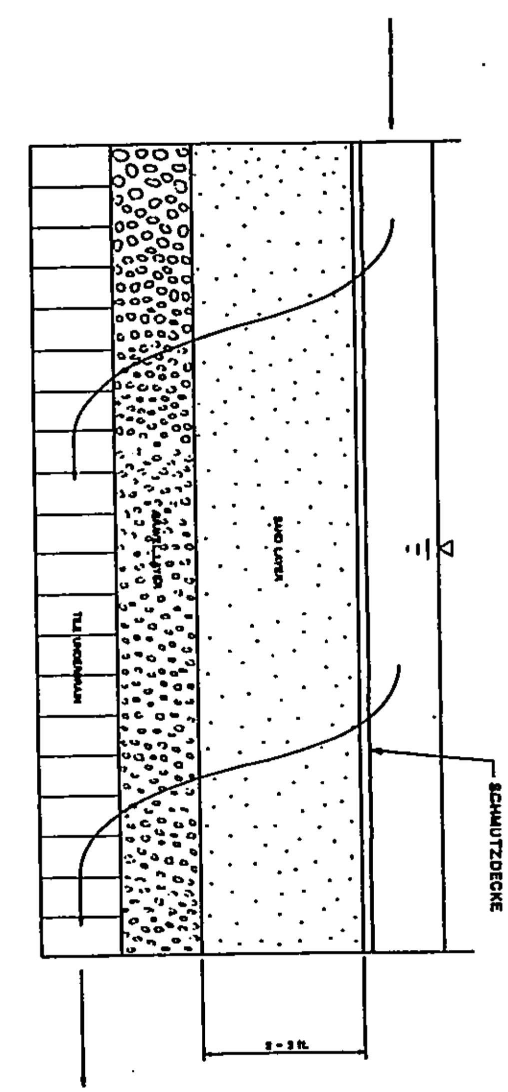
Filtration is a well-established method of treatment for potable water. However, the use of filtration on wastewater effluent is a relatively recent practice. Filtration is used to achieve supplemental removals of suspended solids (including particulate BOD) from wastewater effluent of biological and chemical treatment processes. The mechanisms involved in the removal of particulates include interception, straining, flocculation, impaction, and sedimentation. The different types of filtration available include dual-media, mixed media, rapid sand, and slow sand.

The operation of a filtration unit usually consists of two processes: filtration and backwashing. The filtration process involves the passing of wastewater through a bed consisting of granular material with or without the addition of chemicals. Once suspended solids begin to break through the media at effluent levels beyond what is acceptable, or when a head loss limit is reached, the backwashing process is required to clean the filter media. The backwashing phase usually consists of reversing the flow through the filter. The flow of the backwash water is increased until the filtration media begins to fluidize (expand). This then causes the accumulated solids within the media to be carried away with the backwash liquid.

In the slow sand process, fine sand with an effective size of about 0.2 mm is used to fill the sand bed at a depth ranging from 2 to 3 feet (Figure 6). A mat of highly active biological material, known as the schmutzdecke, is allowed to develop at the water/sand interface and aids in the filtration process. The mat, where a major portion of removals occur, consists of algae and other forms of life including diatoms, protozoa, rotifers and bacteria. When the resulting headloss from the mat becomes excessive, the filter media is cleaned using a scraper to remove the top layer of sand.

3.5 Ultraviolet Disinfection

The use of ultraviolet (UV) light radiation to provide disinfection of potable water supplies has occurred on a limited basis since the early 1900's. However, only recently has UV light generated widespread interest on its use as a wastewater disinfectant. A proper dosage of UV light has been proven to be a successful bactericide and virucide while concurrently not



TYPICAL SECTION THROUGH SLOW SAND FILTER

FIGURE 6

TYPICAL SECTION THROUGH SLOW SAND FILTER

generating toxic by-products. The advantages of using a UV light system include: 1) no need for chemicals, 2) short treatment period (30 seconds compared with 15 to 30 minutes needed for chlorination), 3) greater safety for plant operators and surrounding community, 4) lower capital and operating costs, and 5) ease of operation. Ultraviolet light is usually generated by means of a low pressure mercury arc lamp. The mercury lamp is used because its light output is within the optimum range (250 to 270 nanometers) for germicidal results. The UV light is produced from mercury vapor contained in the lamp, which is charged by striking an electric arc. The excitation of the mercury vapor emits UV radiation.

A typical UV system consists of a row of long thin lamps placed either horizontally or vertically within the wastewater stream (Figure 7). These lamps are usually placed in open channels to facilitate periodic cleaning of the bulbs.

The UV light works by either killing microorganisms or rendering them incapable of replicating. This is accomplished by altering the microorganisms' genetic material (DNA and RNA). The DNA molecule is usually considered the prime target of the UV light radiation and the main component where most damage occurs. Exposure to the UV radiation creates new bonds between adjacent thymine monamines such that a dimer (double thymine molecule) is formed. It is the formation of these dimers along a DNA strand that makes further cell replication very difficult.

In order for the UV system to be effective, the effluent should be relatively turbid-free. This is due to the possibility of the UV light being absorbed by suspended solids in the medium. Thus, disinfection systems designed with UV lamps are usually designed with a polishing process upstream to remove excess suspended matter. Wastewater effluent with suspended solids less than 5 mg/L and turbidities less than 2 NTU are considered as the upper limit for the use of UV light.

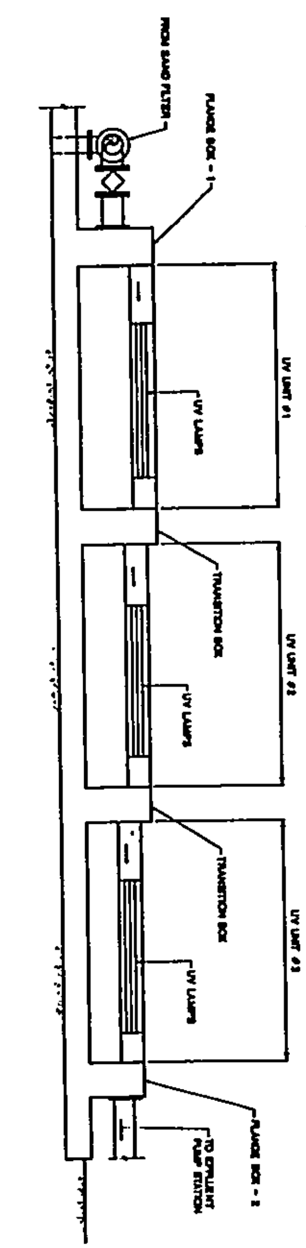


FIGURE 7

CROSS SECTION OF TYPICAL ULTRAVIOLET LIGHT DISINFECTION UNIT

SECTION 4

PROPOSED DESIGN OF THE LIHI LANI WASTEWATER SYSTEM

4.1 Wastewater Quantity

The wastewater design quantity was derived from estimates of wastewater generation from different types of establishments as contained in Chapter 62 of Title 11, Hawaii State Department of Health's (DOH) Administrative Rules on "Wastewater Systems." Design criteria for sewage infrastructure are based on the City and County of Honolulu, Department of Public Works' "Design Standards of the Division of Wastewater Management," Volume 1, dated February 1984. Wastewater contributions from the proposed facilities as determined in the December 1990 report entitled "Wastewater Management Plan for the Lihi Lani Recreational Community" are listed in Table 1.

4.2 Wastewater Characteristics

Wastewater generated at the project site is expected to be of typical domestic composition. The stabilization pond-wetlands treatment system will be designed to achieve the effluent levels as shown in Table 2.

A mass diagram showing the expected constituent levels is shown on Figure 8. The effluent will meet criteria stated in the proposed DOH's Hawaii Administrative Rules, Title 11, Chapter 62, Wastewater Systems.

4.3 Wastewater Collection System

The proposed collection system will consist of gravity sewers which will convey wastewater to a network of sewage pumping stations for transmission to the wastewater reclamation facility (Figure 9). Line sizing for the gravity system ranges from 8 to 10 inches in diameter. The gravity system will be laid on slopes ranging from about 0.6 to about 13.0 percent.

A system of 17 pump stations will be used to convey wastewater collected by the gravity systems to the reclamation facility. Force main sizing for these pump stations varies from 1-1/2 to 8 inches in diameter. The pump stations will be either submersible or of the drywell type (Figures

Table 1

Anticipated Wastewater Flow Rates from Lihi Lani Facilities

		Average Design Wastewater Quantity (gpd)
315 Country Lots [1]		100,800
50 Affordable Housing Lots [1]		16,000
80 Elderly Housing Units [2]		12,800
Campground		3,000
Community Facilities		8,000
	Sub Total	140,600
Dry Weather Inflow (5 gal/Cap-day)		10,000
	Total	150,600 [3]

Notes:

(1) - Flows based on 80 gal/cap x 4 cap/lot
(2) - Flows based on 80 gal/cap x 2 cap/unit
(3) - For planning purposes, the total average wastewater quantity for the project is estimated to be 180,000 gpd.

Table 2

Expected Effluent Constituent Levels from Proposed Lihi Lani Water Reclamation Facility

Constituent*	Influent	Pond	Wetlands	Filter	UV
1. BOD (mg/L):	200-250	30-90	7-12	2-5	2-5
2. SS (mg/L):	200-250	40-100	5-10	2-5	2-5
3. TIN (mg/L):	35	25	10-15	10-15	10-15
4. P (mg/L):	12	12	8-10	8-10	8-10
5. FC (CFU/100 ml):	10^4	10^4-10^5	10^2-10^3	10^1-10^2	0
6. Turbidity (NTU):	30-50	20-40	2-10	0.5-1.0	0.5-1.0

*Constituent Key:

1. BOD = Biochemical Oxygen Demand
2. SS = Suspended Solids
3. TIN = Total Inorganic Nitrogen
4. P = Phosphorus
5. FC = Fecal Coliform

*Units Key:

(mg/L) = Milligrams per Liter
(CFU/100 ml) = Colony-Forming Units per 100 milliliters
(NTU) = Nephelometric Turbidity Units

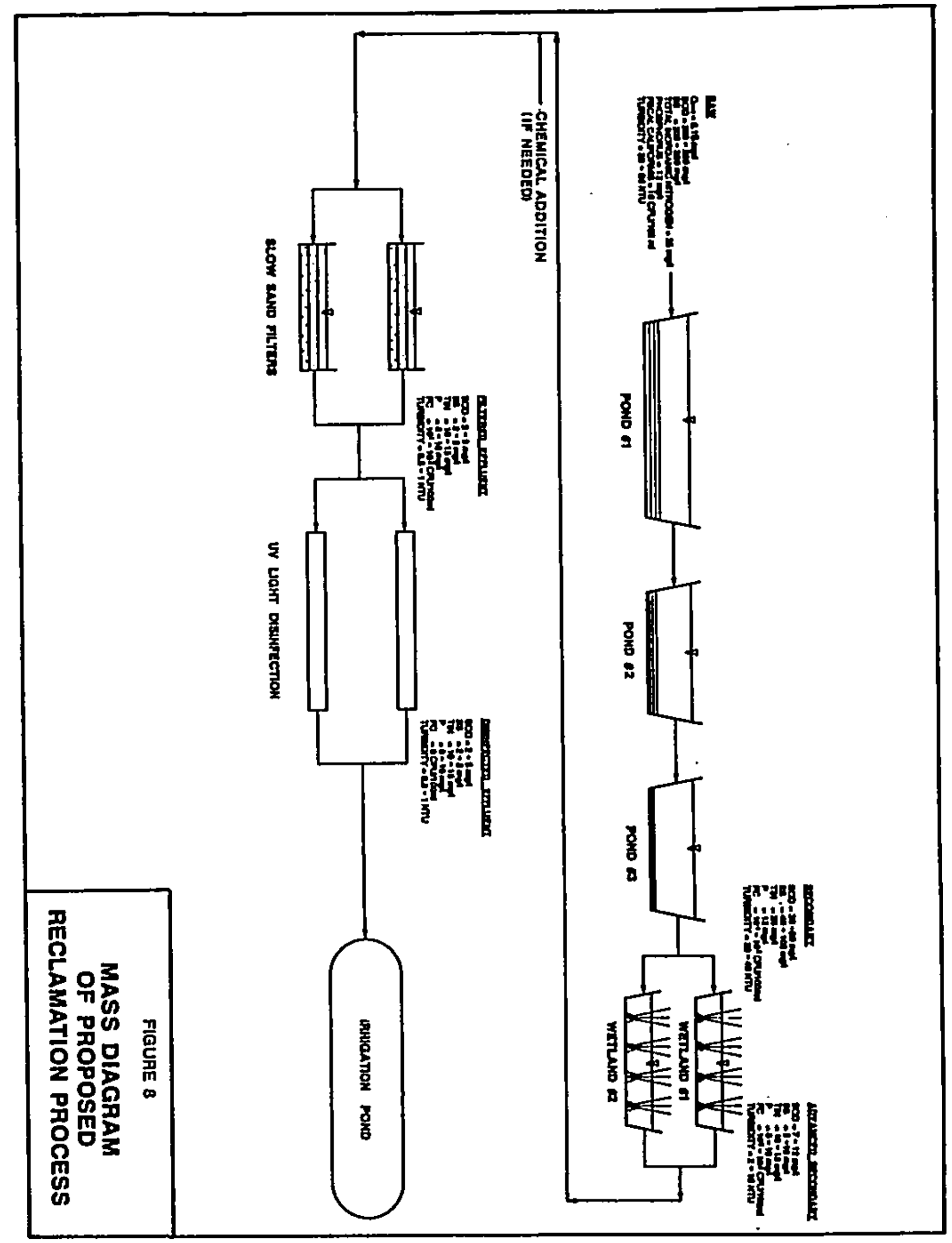
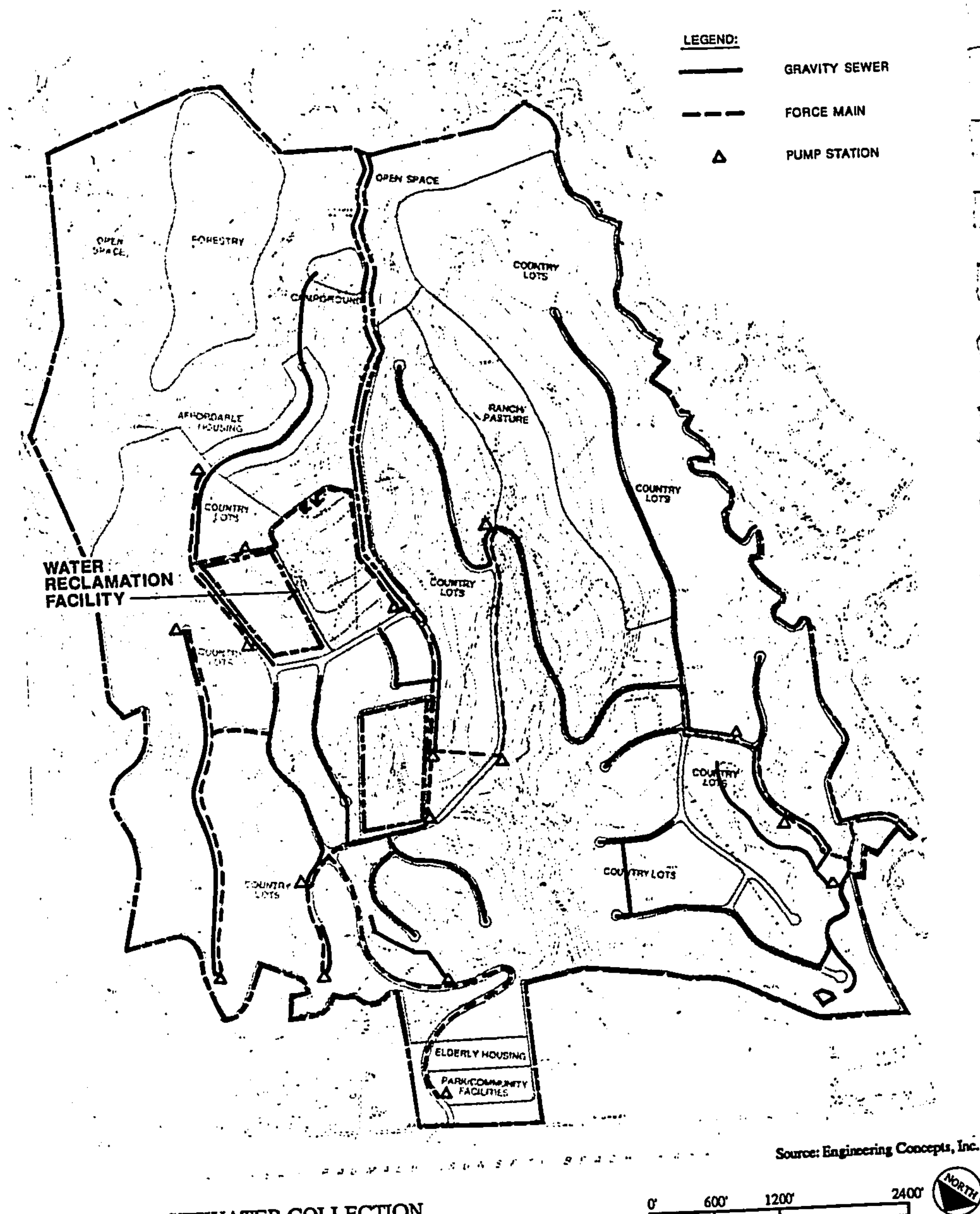


FIGURE 8

MASS DIAGRAM OF PROPOSED RECLAMATION PROCESS



PROPOSED WASTEWATER COLLECTION AND RECLAMATION SYSTEM LAYOUT

LIHI LANI

10 and 11). For ease of construction and maintenance, sewers and pump stations will normally be located along the proposed roadways, to the extent that terrain and site layout will allow.

4.4 Water Reclamation Facility

The water reclamation facility requires about 11 acres of water surface area, which includes about 8 acres of stabilization ponds and 3 acres of constructed wetlands. In addition, another 13 acres will be required to accommodate the reclamation facility buffer, berms, perimeter and access roads, disinfection facilities, pumps, piping, appurtenances, and laboratory/control. Thus, an approximate total of 24 acres will be required in the proposed reclamation system. A layout of the proposed water reclamation facility is shown on Figure 12, while a cross section through the site is shown on Figure 13.

4.4.1 Stabilization Ponds

Based on a projected wastewater flow rate of 180,000 gpd and a system organic loading rate of 50 lbs BOD/ac-day, a total of about 8 acres of pond surface area will be required. Three cells will be connected in series, the first cell consisting of 4 acres and the second and third consisting of 2 acres each. To alleviate any potential odor problems, a pump will be installed at the outlet end of the third pond to recirculate effluent back into the first pond.

The first cell will have a design water depth of about 8 ft to allow for the settling of solids, as well as 3 feet of freeboard (Figure 14). Based on the 4 acre size, the first cell's organic loading rate will be less than 107 lbs BOD/ac-day. For the second and third cells, a design water depth of 5 to 6 feet will be used, also with allowances for 3 feet of freeboard.

The detention time for the first pond will be about 58 days, while the second and third pond will have detention times of about 18 to 22 days, depending on the operating depth (5 or 6 feet). The total detention time through all three ponds will range from 94 to 102 days, which will be beneficial for bacteria die-off.

For all three ponds, a partition will be placed at the center to allow a U-shaped flow configuration. Encircling the three ponds will be a 10-feet (minimum) wide road to provide

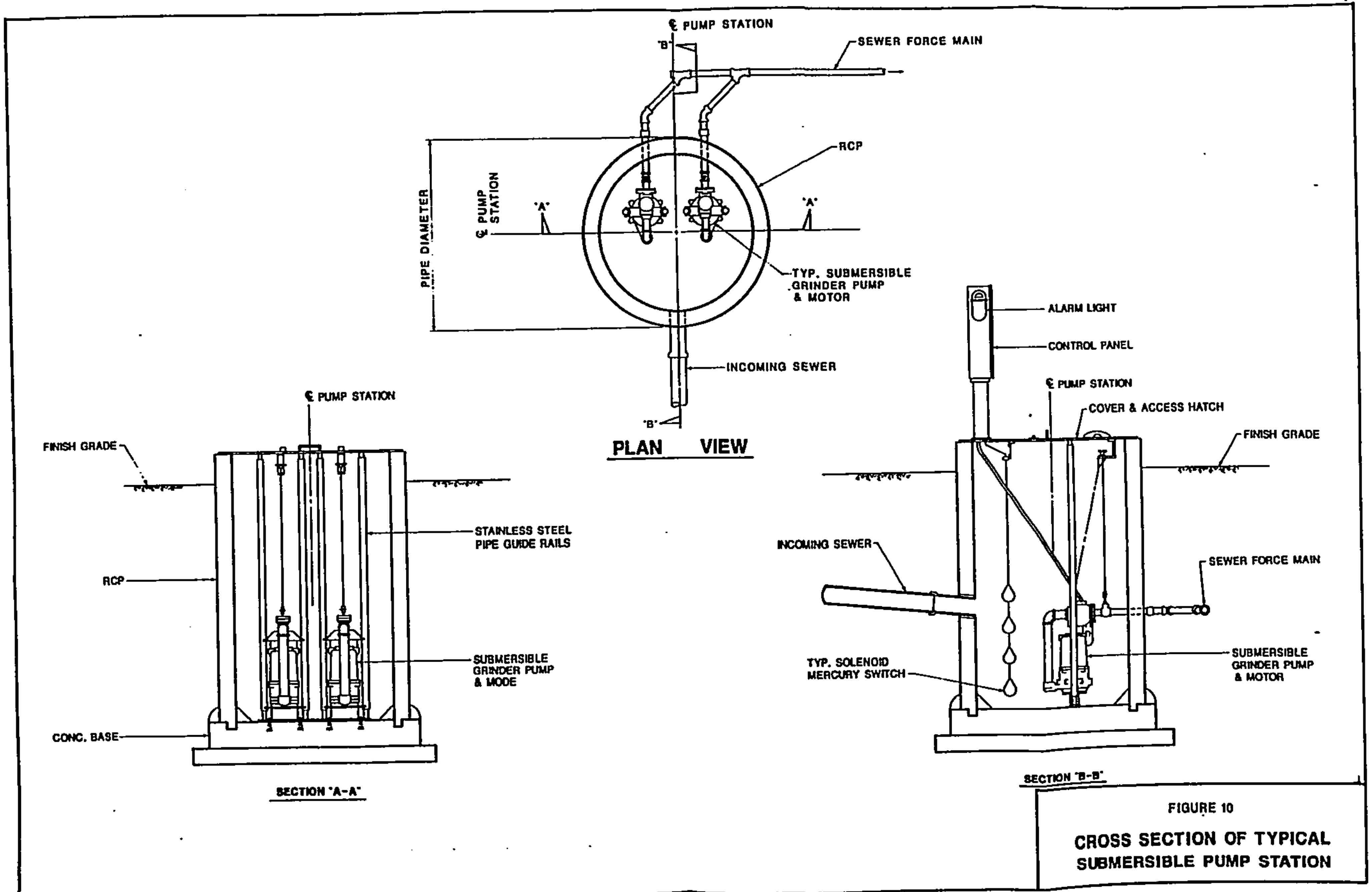


FIGURE 10

CROSS SECTION OF TYPICAL SUBMERSIBLE PUMP STATION

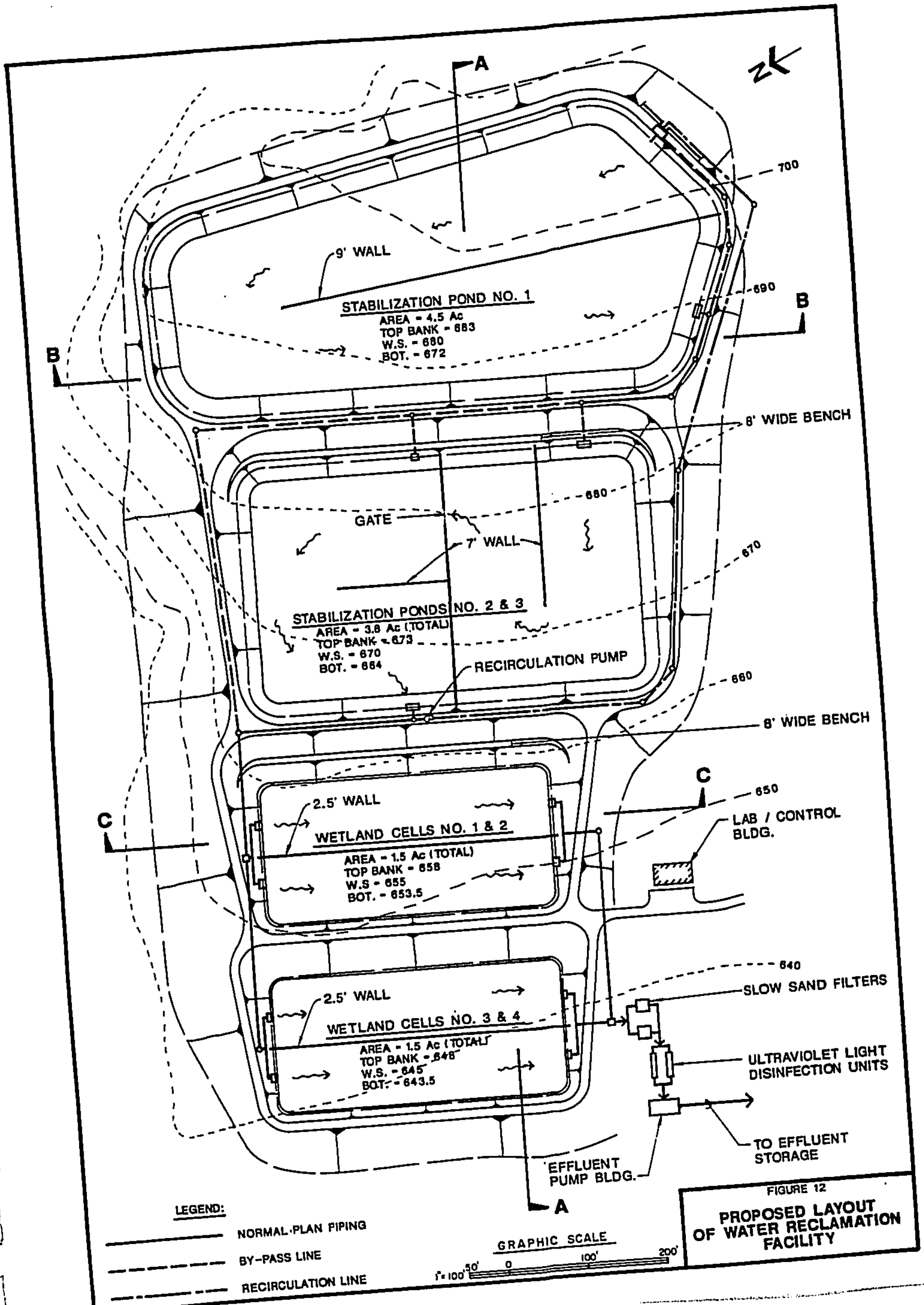


FIGURE 12
PROPOSED LAYOUT OF WATER RECLAMATION FACILITY

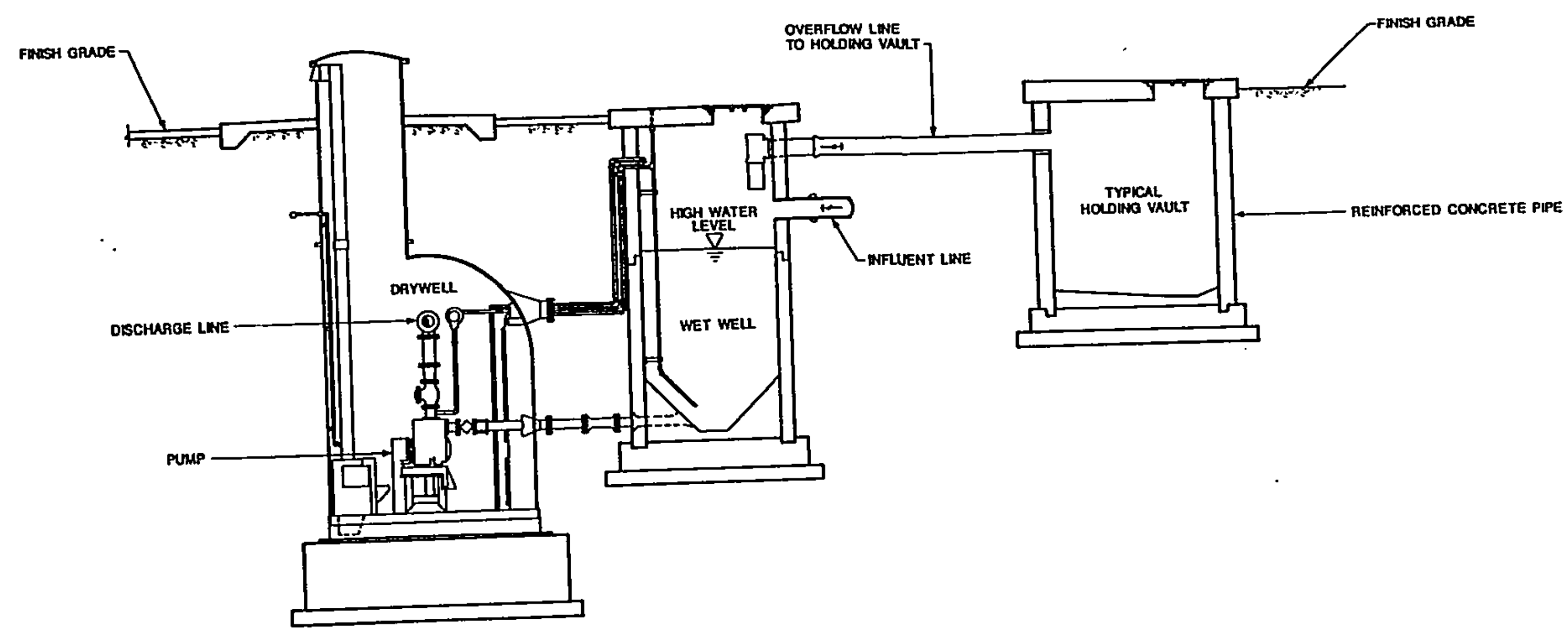


FIGURE 11

TYPICAL DRYWELL PUMP STATION WITH EMERGENCY HOLDING VAULT

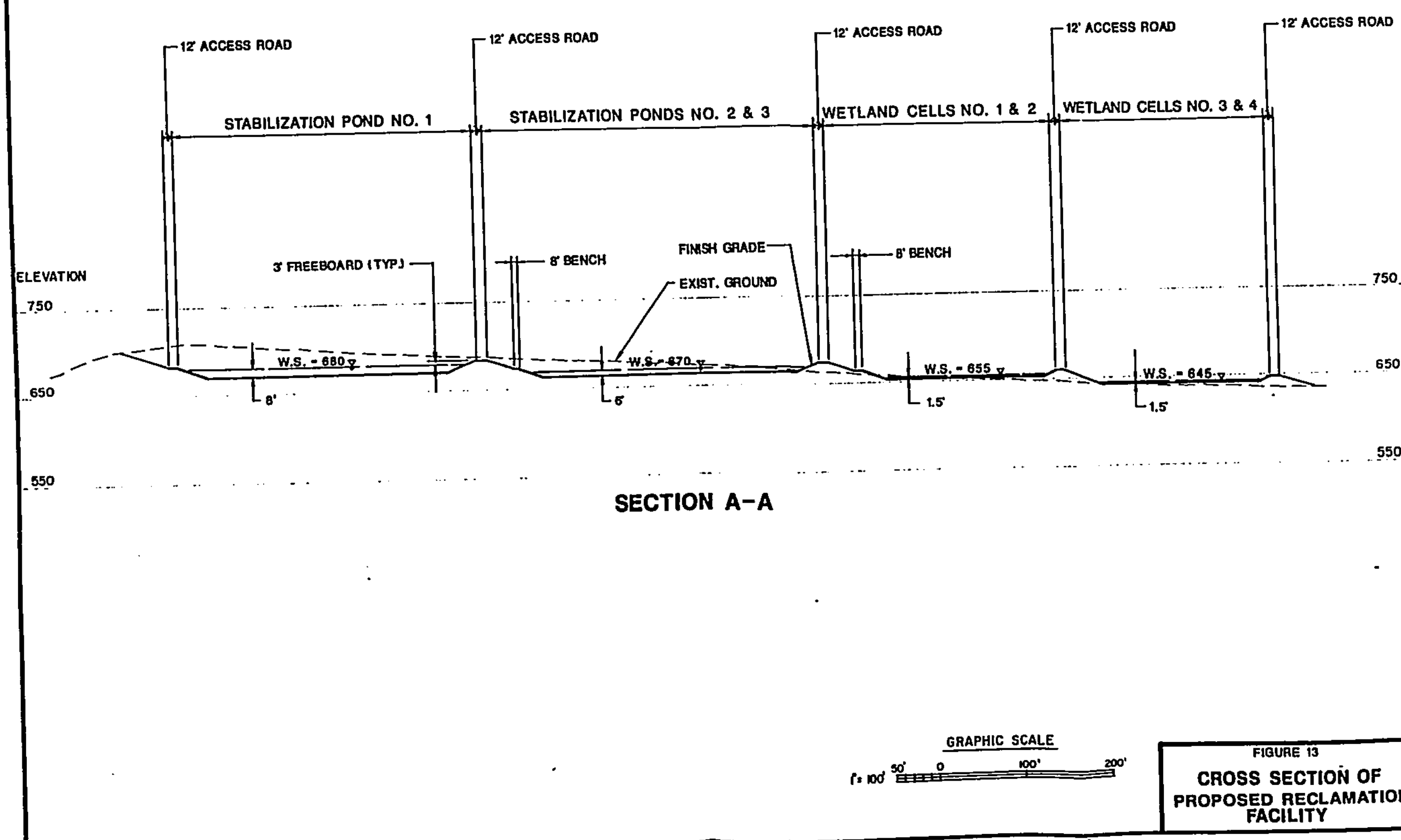


FIGURE 13

CROSS SECTION OF PROPOSED RECLAMATION FACILITY

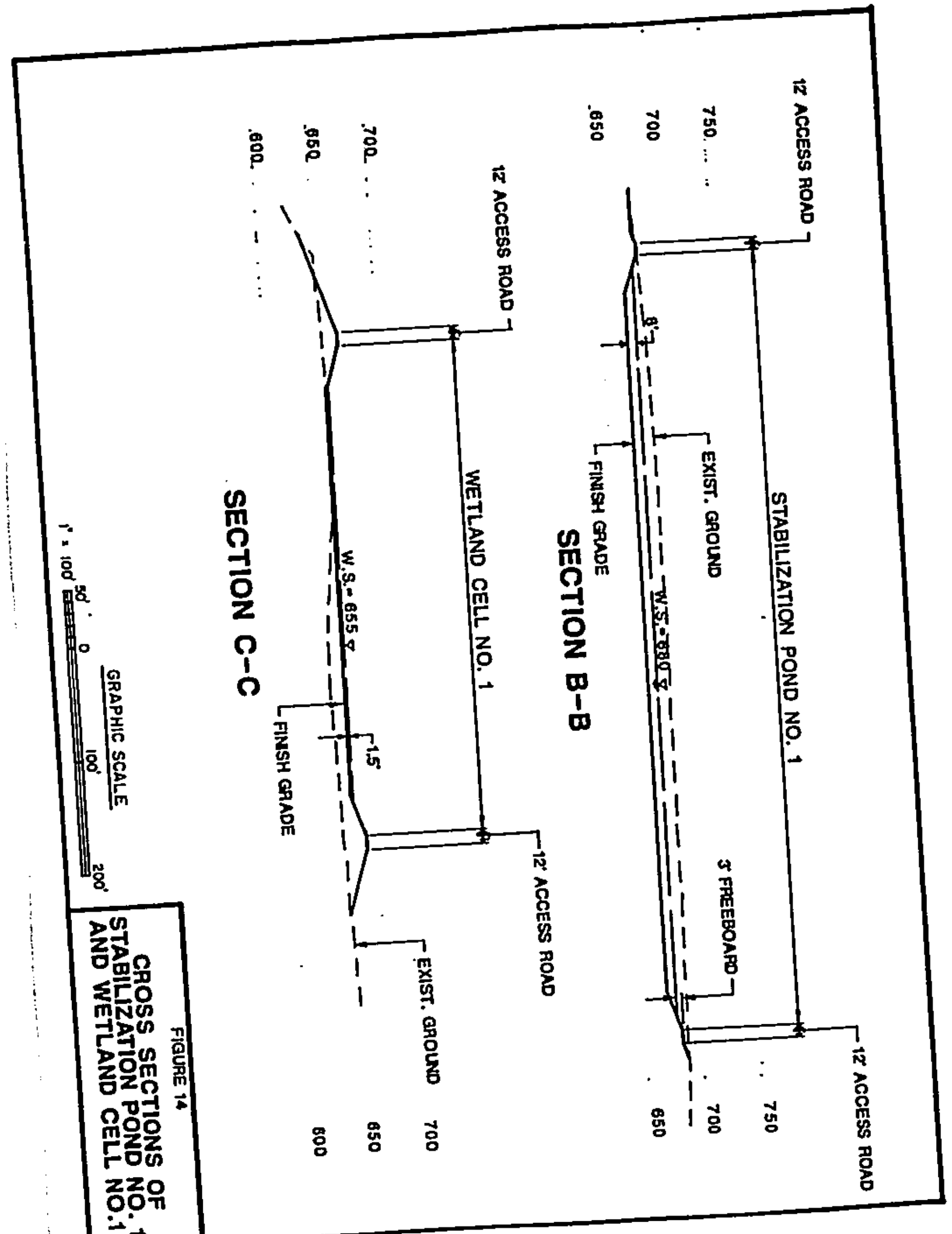


FIGURE 14
CROSS SECTIONS OF STABILIZATION POND NO. 1 AND WETLAND CELL NO.1

sufficient access for maintenance vehicles.

To facilitate site drainage, a cut-off swale will be located at the top of the first stabilization pond to prevent excess stormwater runoff from flowing into the ponds. Wall slopes of 3 horizontal to 1 vertical will also be incorporated in the pond design to safeguard against pond structural failure.

4.4.2 Constructed Wetlands System

The constructed wetlands system will be built on a site with no naturally occurring wetlands. The wetlands will function as a "polishing" step to improve the quality of effluent delivered to the effluent storage tank. The design criteria includes a BOD loading rate of 30 lb/ac-day at a water depth of 1.5 feet (Figure 14). Two 1.5-acre wetland cells will operate in parallel for flexibility in flow control. Effluent from the stabilization ponds will be proportioned and delivered to the individual cells according to the assimilation characteristics of the growing vegetation and biota. Bulrushes or similar grasslike plants such as reeds will be cultured in the wetland system. The wetland cells will be stocked with mosquito fish for mosquito control. In addition, the cells will allow adjustment of the water surface elevation to encourage greater contact between mosquito larvae and predators.

4.4.3 Coagulant Addition

Wetlands effluent will be collected in a common sump for coagulant addition. The intent of coagulant addition prior to filtration is to achieve a filter effluent turbidity level of less than 2 NTU. Reducing the effluent turbidity maximizes the effectiveness of the UV light disinfection. Coagulant dosages will amount to approximately 8 to 10 mg/L of alum and about 2 mg/L of polymer. This would correspond to a daily alum dosage of about 14 lbs/day and a daily polymer dosage rate of about 3 lbs/day. It should be noted that these coagulants are environmentally benign materials and even more so at the low doses required for Lihi Lani.

The provision for coagulant addition is considered a standby feature at the Lihi Lani Water Reclamation Facility. Coagulant addition will be operated only in the event the wetland system does not reduce effluent turbidity levels to less than 2 NTU. Should this occur, the direct filtration method will be utilized, where the rapidly mixed effluent is sent directly to the sand filters. However, the reclamation facility will be designed to satisfy the areal and hydraulic requirements of a rapid mix process, flocculation tank, and settling basin, should they need to be implemented.

4.4.4 Sand Filtration

According to the proposed DOH standards for reclaimed wastewater, the filtration rate for effluent cannot exceed 5 gpm/ft^2. The Lihi Lani system will use a maximum design hydraulic loading of 0.5 gpm/ft^2. Based on an average flow rate of 180,000 gpd, the required surface area for the filter is about 250 square feet. Two 17-feet by 17-feet (one standby unit) filters will be used. The filter's media will consist of a 1-foot layer of gravel covering the underdrain system, overlain by 2-feet of sand.

4.4.5 Ultraviolet Disinfection

Given a peak flow rate of about 400,000 gpd, wetland system effluent suspended solids of 5 mg/L, and a required total coliform count of 2.2/100 ml, the proposed UV light disinfection system will consist of three units of UV lamps laid in series. Each lamp unit will be approximately 8-feet long and consist of 16 lamps. A 2-feet wide by 1-foot deep prefabricated stainless steel channel will convey the effluent past the UV lamps. A depth of 6 inches through the channels will be maintained by a weir located at the end of the third UV unit.

While UV systems have been installed in wastewater treatment plants nationwide, the UV process is still undergoing review by the DOH. Thus, in the event that the UV process is not approved by the DOH, an alternative disinfection process such as chlorination will be used.

4.4.6 Laboratory/Control Facility

A support facility will be included in the construction of the water reclamation facility. The main function of this building will be to perform simple water quality analysis. In addition, telemetering equipment will be connected to this building to warn plant operators of any problems occurring at any of the collection system's sewage pumping stations. Space within the building will also allow for the storage of coagulants and maintenance equipment.

4.5 Design Safeguards

Special measures will be taken to safeguard public health in case of power failures or equipment malfunctions. Safeguards proposed for the water reclamation facility and sewage pumping stations (SPS) are as follows:

1. Generators. Standby power will be provided to the reclamation facility and each SPS to provide emergency power in the event of electrical power outage. Thus, pumping operations and disinfection can continue uninterrupted.

2. Pond storage capacity. Ample capacity within the pond system will allow for emergency storage of wastewater in the event of either power failure or during periods of effluent quality noncompliance. In the event that effluent quality does not meet discharge permit requirements, plant operators can store effluent within the ponds to allow supplemental treatment with coagulants and filtration. The ponds have an estimated storage capacity of about 58 days. If desired, disposal could be suspended for this long of a period.

3. Storage vaults. A storage vault will be constructed at each SPS as a backup wet well in the event equipment failure results in wastewater overflowing the primary wet well. Typical storage time capacity of the vaults would range from 1 day for the smaller pump stations to 8 hours for the larger stations.

4. Redundancy. Three waste stabilization ponds (in accordance with City & County requirements for pond systems) and parallel wetland cells will be constructed to provide operational redundancy during periods of maintenance. The process piping will allow the influent to temporarily bypass any individual pond or wetland unit without bypassing the entire reclamation system. The sand filters and UV light disinfection system will be capable of 100% backup to prevent any effluent bypassing the disinfection system. In addition, pump stations will be equipped with dual pumps, each capable of handling the entire flow entering the station.

5. Odor abatement. Due to the limited expanse of the sewer system and the relatively high velocities in the steeply sloped gravity sewers, the detention time of the sewage in the sewer system should be relatively short, thereby minimizing the emission of odors. Odor control measures within the reclamation facility include pumps at facultative pond #3 to recycle effluent back to pond #1. In addition, provisions will be made for chemical addition and supplemental aeration if necessary.

6. Alarms and telemetering. Alarms indicating high/low liquid level conditions, equipment malfunction, and other emergency conditions will be installed at each SPS. Visual and audio alarms will be mounted in the reclamation plant's control facility. Signals will also be transferred through telephone lines by telemetry to the homes of key maintenance personnel as an additional safety measure during nonworking hours.

7. Restricted public access. All pump stations and the entire reclamation facility will be fenced to restrict public access. Also, these facilities will be either landscaped and/or located away from direct public view.

8. Warning signs and special precautions. Effluent reuse facilities, including piping and appurtenances, in areas subject to public access will have warning signs stating that irrigation water is not fit for consumption.

SECTION 5
EFFLUENT DISPOSAL

5.1 Proposed State of Hawaii Department of Health Guidelines

In accordance with the Hawaii State DOH, Wastewater Branch, "Proposed Guidelines for the Treatment and Reuse of Reclaimed Water", Draft No. 7, May 1993, the wastewater effluent will be treated to the level of "R-1 water (virtually pathogen free reclaimed water)". This is the highest level category for reclaimed water in the state. The proposed guidelines define "R-1 water" as reclaimed water that is at all times oxidized, then coagulated, then flocculated, then clarified, then filtered, and then exposed, after the filtration process, to a disinfection process that:

A. Have been shown to the satisfaction of DOH to reliably reduce the number of plaque-forming units of F-specific bacteriophage MS2 per unit volume of water, added to the filter effluent in a demonstration project, to one ten-thousandth (1/10,000) of the initial concentration in the filter effluent throughout the range of qualities of effluent that will occur at the reclamation facility and that might influence efficacy of disinfection, or have been shown to the satisfaction of DOH to likewise reliably reduce the number of plaque-forming units of other virus added to the filter effluent, to one ten-thousandth (1/10,000) of the initial concentration when such other virus has been shown to the satisfaction of DOH to be at least as resistant to the form of disinfection being demonstrated as F-specific bacteriophage MS2;

B. Limit the concentration of fecal coliform bacteria to the following criteria:

(1) The producer may designate any location in the water reclamation treatment process from which all samples will be taken;

(2) The sampling procedure shall conform with the approved laboratory methods and may encompass either the membrane filter (MF) or equivalent most probable number (MPN) methods. Results using MF shall be reported as confirmed colony forming units (CFU). Results using MPN shall be reported as confirmed MPN;

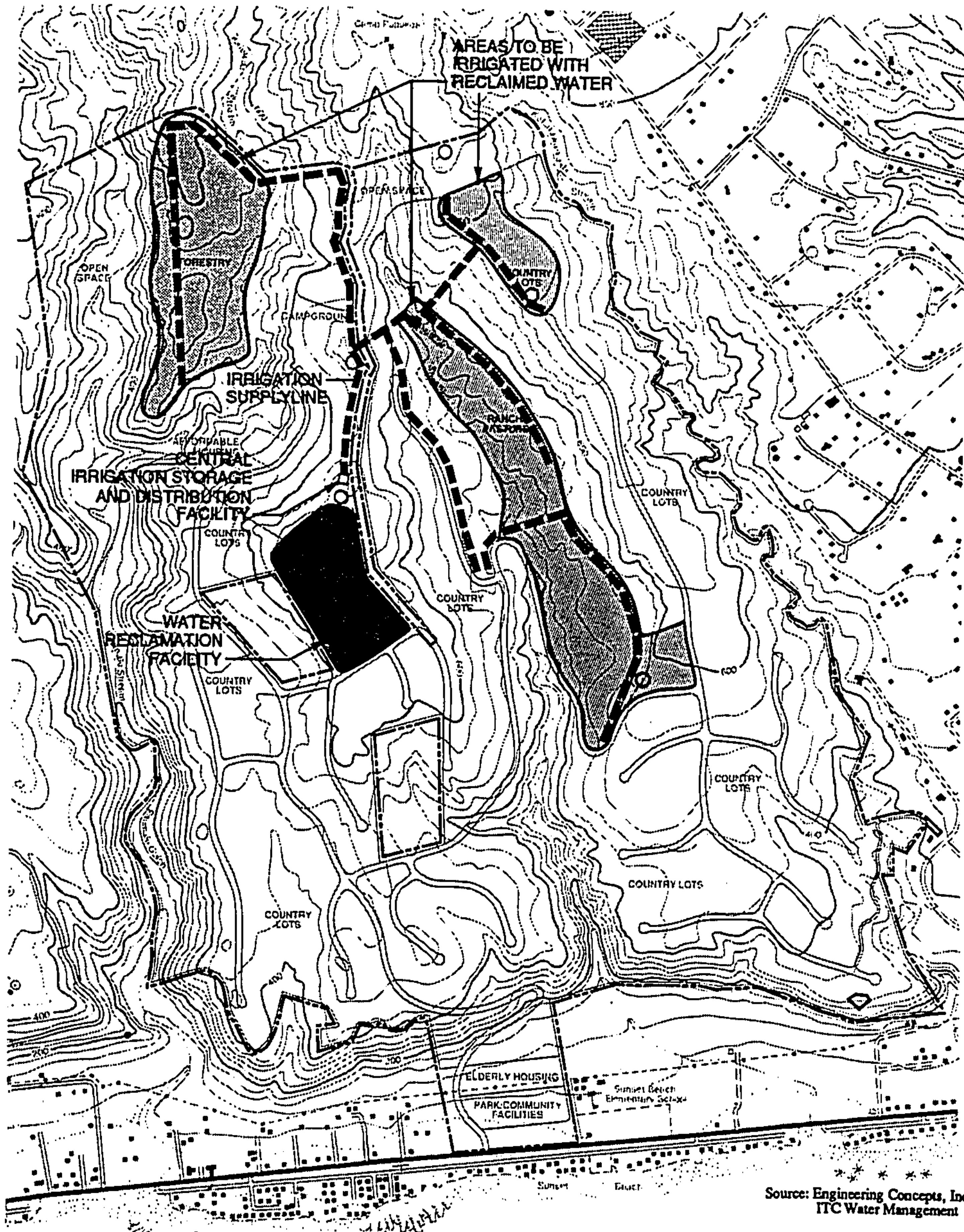
(3) The median number of fecal coliform values shall not exceed 1 per 100 milliliters as determined from the bacteriological results of the last seven days for which analyses have been completed; and

(4) Any one sample shall not exceed a fecal coliform value of 4 per 100 milliliters; and

C. Treated under the process conditions that have been demonstrated to the satisfaction of DOH to consistently provide a degree of treatment equal to "best practicable technology" for the removal of pathogenic protozoan cysts and oocysts, by providing multibarrier treatment which achieves a total of 99.0 percent (2 log) removal of particles greater than 4 microns in diameter in order to be equivalent with the minimum 2 log removal requirement.

5.2 Method of Effluent Disposal

The proposed method of ultimate effluent disposal is through irrigation of up to 126 acres of ranch, pasture, and forestry lands (Figure 15). Preliminary findings by ITC Water Management show that 65 acres of agricultural areas will be required to handle disposal of the total 0.180 MGD of reclaimed water. Disinfected effluent from the wastewater reclamation process will be conveyed to a Central Irrigation Storage and Distribution Facility (CISDF), where it will undergo further disinfection and filtration. Transmission lines will convey effluent to the irrigated sites.



Source: Engineering Concepts, Inc./ ITC Water Management

PROPOSED RECLAIMED WATER SYSTEM

LIHI LANI

5.3 Public Health Impacts

Due to infiltration of excess irrigation water, effluent disposal has the potential to leach to the groundwater and coastal waters. Therefore, irrigation management will be strictly controlled to avoid over-watering turf. An evaluation of three elements of concern (nitrogen, phosphorus, and biological organisms) will be discussed further.

5.3.1 Nitrogen

The three most common forms of nitrogen found in wastewater are organic, ammonia, and nitrate. Ammonia nitrogen is the principal form, with levels typically ranging from 5 to 40 mg/L. The organic form, which may be soluble or particulate, is readily convertible to ammonia through the action of microorganisms in the wastewater. The organic portion is usually no more than half of the total nitrogen present. Nitrate concentrations may range from 0 to as much as 30 mg/L. The concentration of nitrates is of concern if it enters the drinking water supply in significant concentrations, since consumption of water containing high nitrate levels can cause "blue baby" syndrome (methemoglobinemia).

When nitrogen is applied to soil, three basic types of transformations occur: 1) mineralization, 2) nitrification, and 3) denitrification. The mineralization process is described by:

$$\text{organic N} \dashrightarrow NH_4^+$$

This transformation involves both aerobic and anaerobic bacteria, and converts most of the applied nitrogen into ammonium. The nitrification process occurs next, forming nitrate as an end product. The nitrification process can be stoichiometrically described by:

$$NH_4^+ + 3/2\, O_2 \dashrightarrow NO_2^- + H_2O + 2\, H^+$$

and

$$NO_2^- + 1/2\, O_2 \dashrightarrow NO_3^-$$

The first reaction is accomplished through Nitrosomanas species bacteria, while the second reaction occurs through the Nitrobacter species bacteria.

The third transformation occurring is denitrification. While nitrate is the end product of the nitrogen transformation process in aerobic soils, it can be reduced to N_2O and N_2, where oxygen is limiting and organic material is available in the surrounding soil to supply energy for the process. Facultative anaerobic bacteria are responsible for the denitrification process, which can be described by:

$$NO_3^- \dashrightarrow NO_2^- \dashrightarrow N_2O \dashrightarrow N_2$$

Research conducted by the University of Hawaii's Water Resources Research Center (WRRC) has proven that the use of bermudagrass when applied with secondary treated sewage effluent can remove vast quantities of nitrogen. Results from a January 1972 to January 1975 study at the Mililani Sewage Treatment Plant (STP) indicated an average total nitrogen being applied to a 5-foot deep soil lysimeter ranged from 12 mg/L to 25 mg/L, with a nitrite and nitrate concentration of about 10-11 mg/L. With the exception of the first four months from initial application, percolate samples consistently showed low levels of total nitrogen, many times below 1 mg/L.

Based on typical secondary treatment effluent data, an inorganic nitrogen concentration of 25 mg/l is expected from the Lihi Lani stabilization ponds. At a flow rate of 180,000 gpd, approximately 38 lbs/day of nitrogen will remain in the stabilization pond effluent. The wetland systems, through the nitrification/ denitrification process, are expected to remove from 60 to 90 percent of the nitrogen. Artificial wetlands managed with short detention times of 2 to 7 days will produce effluent with less than 10 mg/l nitrogen.

Typically, 5 to 10 percent of applied soluble nitrogen eventually infiltrates the groundwater; the other 90 to 95 percent is utilized by plant uptake. Thus, it is estimated that no more than 1 to 2 lbs/day of nitrogen attributable to the reclaimed effluent will eventually percolate to the groundwater. Of note, less than 1.5 percent of the nitrogen in slow-release fertilizers is expected to escape plant uptake and infiltrate through the soil layer.

Therefore, the impact of nitrogen should not be detrimental to the groundwater or coastal water quality due to the following factors:

1. The quantity of percolate and its corresponding quantity of nitrogen is extremely small compared to the volume of groundwater receiving leached reclaimed water and eventually discharging to the ocean.

2. The immense mixing characteristics of the coastal waters fronting the project is expected to significantly dilute the reclaimed water in groundwater entering the coastal waters. Further, the net transport characteristics of the coastal water will prevent any detrimental effects to the coastal ecosystem.

5.3.2 Phosphorus

Phosphorus removal in many wetland systems is not very significant because of the limited contact opportunities between the wastewater and the soil. Thus, for the purpose of this assessment, it is assumed that an effluent phosphorus concentration ranging from 8 to 10 mg/L is delivered to the effluent storage reservoir. Thus, approximately 10 to 15 lbs/day of phosphorus will be applied to the irrigated areas.

Removal pathways for phosphorus include plant utilization and accumulation by the soil structure through sorption and precipitation reactions. In Hawaii, phosphorus has been found to usually become attached to many types of Hawaiian soils, including the iron and aluminum hydroxide-containing soils found on the project site.

Researchers at the University of Hawaii's WRRC found in their Mililani STP study that a 5-foot soil lysimeter consistently withheld a high percent of applied phosphorus. Results from January 1972 to January 1975 indicated that the effluent phosphate ranges of 8 to 11 mg/L were being reduced to a percolate range of less than 1 mg/L.

Thus, due to the relatively low amounts of phosphorus being applied to the proposed reclamation areas and the affinity that the applied phosphates have for the soils on the site, it is anticipated

that the application of phosphorus contained within the reclaimed effluent will not degrade the local groundwater.

5.3.3 Bacteria

The main public health concern associated with the reuse of reclaimed effluent is the potential health hazard resulting from exposure to pathogenic microorganisms. This concern is substantiated by the fact that many pathogens can survive modern wastewater treatment processes. In addition, health studies have shown that there is a correlation between direct contact of pathogenic organisms and incidents of gastrointestinal and urogenital infections. However, these types of infections require a direct fecal-to-oral transmission route, and there is very little evidence to suggest that the use of disinfected wastewater for irrigation poses an increased health risk.

Stabilization ponds with long detention times are expected to reduce the fecal coliform population three to four-fold, while the wetlands system should lower the fecal coliform level to an approximate range of 100 to 1,000 CFU/ 100 ml. Furthermore, the sand filtration system is expected to reduce the fecal coliform levels to 10 to 100 CFU/100 ml. Finally, the UV light is expected to reduce remaining bacteria levels to 0. In the event that any pathogenic bacteria survive the UV light disinfection process, "natural" bacteria removal mechanisms in the storage, transmission, irrigation and discharge processes are expected to further eliminate the remaining bacteria.

Once the disinfected effluent is applied to the soil, several factors influence the survival rate of pathogenic bacteria. These include soil moisture content, temperature, sunlight, and season of the year. Past research had indicated that bacteria survival rates were higher in soils that were moist as compared with dry soils, and that bacteria survival rates were lower in sandy type soils when compared with soils with higher water-retaining capacities. However, the use of storage within the pond system will prevent over-watering of the course during periods of inclement weather.

The temperature can also influence the survival rate of the bacteria, as colder temperatures seem to prolong survival. Conversely, an increase in temperature tends to decrease the survival rates of bacteria.

Sunlight can also cause reductions in bacterial population. This may be due to UV light exposure and desiccation. UH WRRC research has shown that effluent irrigation soil plots directly exposed to the sun had higher die-offs of bacteria compared with plots that were covered with shading.

The season of the year can also influence the survival of bacteria, as survival rates seem to correlate with the seasonal fluctuations in moisture and temperature. It has been found that in temperate regions, both the autumn and spring months favor the survival of fecal coliforms and fecal streptococci, while experiencing die-off during the dryer, hotter summer months.

The factors that contribute to prevention of pathogen migration in soil are similar to those found in the filtration process, such as straining, sedimentation, and adsorption. The soil matrix acts as a filter, straining out fine particles which include the removal of bacteria. It has been reported that a soil particle's size is inversely proportional to the amount of bacteria removed through a given depth.

In addition, past research has also determined that infiltration rates of a particular soil affect the removal of bacteria. Lower application rates allow a greater amount of retention within the soil structure, preventing migration of bacteria. However, if the effluent is applied continuously to a particular plot, then clogging problems due to microbial growth may develop.

In summary, the application of reclaimed effluent should not cause the migration of bacteria to the groundwater due to the following reasons:

1. The use of technologically simple stabilization ponds and constructed wetlands to remove high levels of bacteria and suspended solids.

2. The high bacteria die-off rate due to the use of a UV light disinfection system. The system is expected to reduce bacteria levels to near zero.
3. The exposure of the effluent in the treatment and irrigation ponds to sunlight.
4. The soil mantle provides "filtering" of bacteria.

5.3.4 Viruses

The ability of viruses to move within the soil matrix is usually influenced by factors such as the viral protein coating, the cation exchange capacity, pH, hydraulic conductivity, surface area, organic matter content, and the texture of the soil. In addition, the characteristics of the percolating fluid also influence the migration of viruses, such as pH, ionic strength, and flow rate of percolating fluid.

The removal of viruses within the soil matrix is primarily dependent on the adsorption process. Research has shown the level of virus removal within soil was dependent on soil conditions and hydraulic flow rates within the soil matrix.

Several local bacteria and virus migration studies have been conducted by the University of Hawaii's WRRC at the Mililani STP during the early 1970's. Secondary treated effluent was used to irrigate plots of sugarcane and bermuda grass. Over a two-year period, researchers found that percolate collected from field lysimeters did not contain viruses. In addition, survival rates of poliovirus were low in samples taken from fields which were exposed to direct sunlight, high temperatures, and desiccation.

The possibility of virus migration to the groundwater is remote for the proposed reclamation areas due to several reasons:

1. The reclamation system provides substantial reduction in the virus population.
2. The soil mantle precludes the transmissibility of viruses to the groundwater.

SECTION 6
CONCLUSIONS

The proposed Lihi Lani Water Reclamation Facility has been conceptually designed to offer the following desirable features:

1. Use of technologically simple, highly reliable energy-conserving types of reclamation.
2. Use of a wetlands system with a low failure rate compared to the standard mechanical activated sludge technology.
3. A reclamation system with adequate freeboards to allow up to approximately 58 days of emergency storage of reclaimed water.
4. Use of a system which combines liquid and solids treatment processes and eliminates the need for costly biosolids disposal.
5. Use of earth fill for construction of the ponds rather than the reinforced concrete or steel tanks usually used in conventional treatment systems (less failure potential).
6. Safety features on construction of the ponds such as the use of 3:1 embankment slopes and 8-foot wide benches for embankments or excavations over 15-feet high.
7. Use of a non-toxic UV light disinfection system, with no residual chemicals in the reclaimed water.
8. Re-use of the reclaimed water for irrigation of the ranch, pastures, and forest lands.

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APPENDIX D

Water Supply Report

WATER SUPPLY REPORT
FOR THE
PROPOSED LIHI LANI PROJECT
PUPUKEA AND PAUMALU, KOOLAULOA, OAHU, HAWAII

Prepared for:

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Honolulu, Hawaii

Prepared by:

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September 1993

TABLE OF CONTENTS

FIGURES

TABLES

SECTION 1

INTRODUCTION AND PROJECT BACKGROUND

Obayashi Hawaii Corporation is proposing to construct a residential development on the North Shore of Oahu at Pupukea (TMK: 5-9-05: por.38, 82 and 5-9-06: 1, 18, 24). The 1,144-acre site is located inland of Kamehameha Highway and Sunset Beach, surrounded by the COMSAT facility, Forest Reserve, Sunset Beach Elementary School, and the Pupukea Highlands and Sunset Hills subdivisions (Figure 1).

The objective of this report is to present planning and engineering information on the proposed potable and nonpotable water infrastructure to meet domestic and irrigation water requirements for the project development. Specifically, this report will address:

1. Background information on the proposed project;
2. Existing water supply infrastructure;
3. Projected water requirements; and
4. Proposed water supply and distribution system.

1.1 Proposed Project

The proposed Lihi Lani Project Master Plan will result in the designation of new land uses involving approximately 900 acres within the 1,144-acre project site. Included is the proposed development of 315 country lots of one acre or larger; 50 single family affordable homes; 80 elderly housing units; a ranch with pasture; stables and riding trails; a campground; agriculture and agri-forestry land; and park/community facilities. Actual development will affect between 400 to 480 acres with the remaining 664 to 744 acres remaining as unaffected open space. The proposed project layout is shown in Figure 2.

1.2 Topographic Features

Approximately 18 acres of the project site are situated below the bluff along the coastal lowlands inland of Kamehameha Highway and northeast of Sunset Beach Elementary School. The

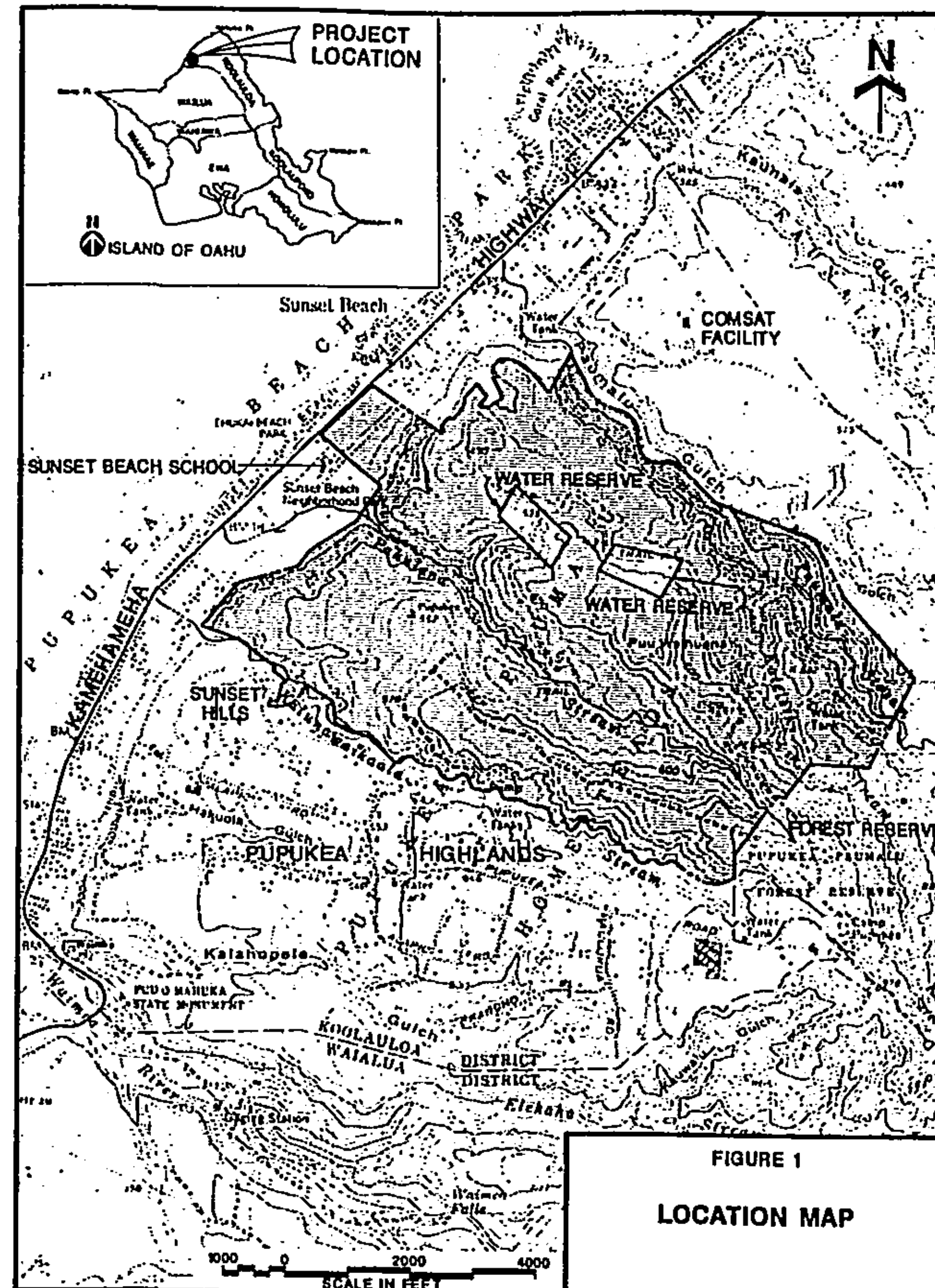


FIGURE 1

LOCATION MAP

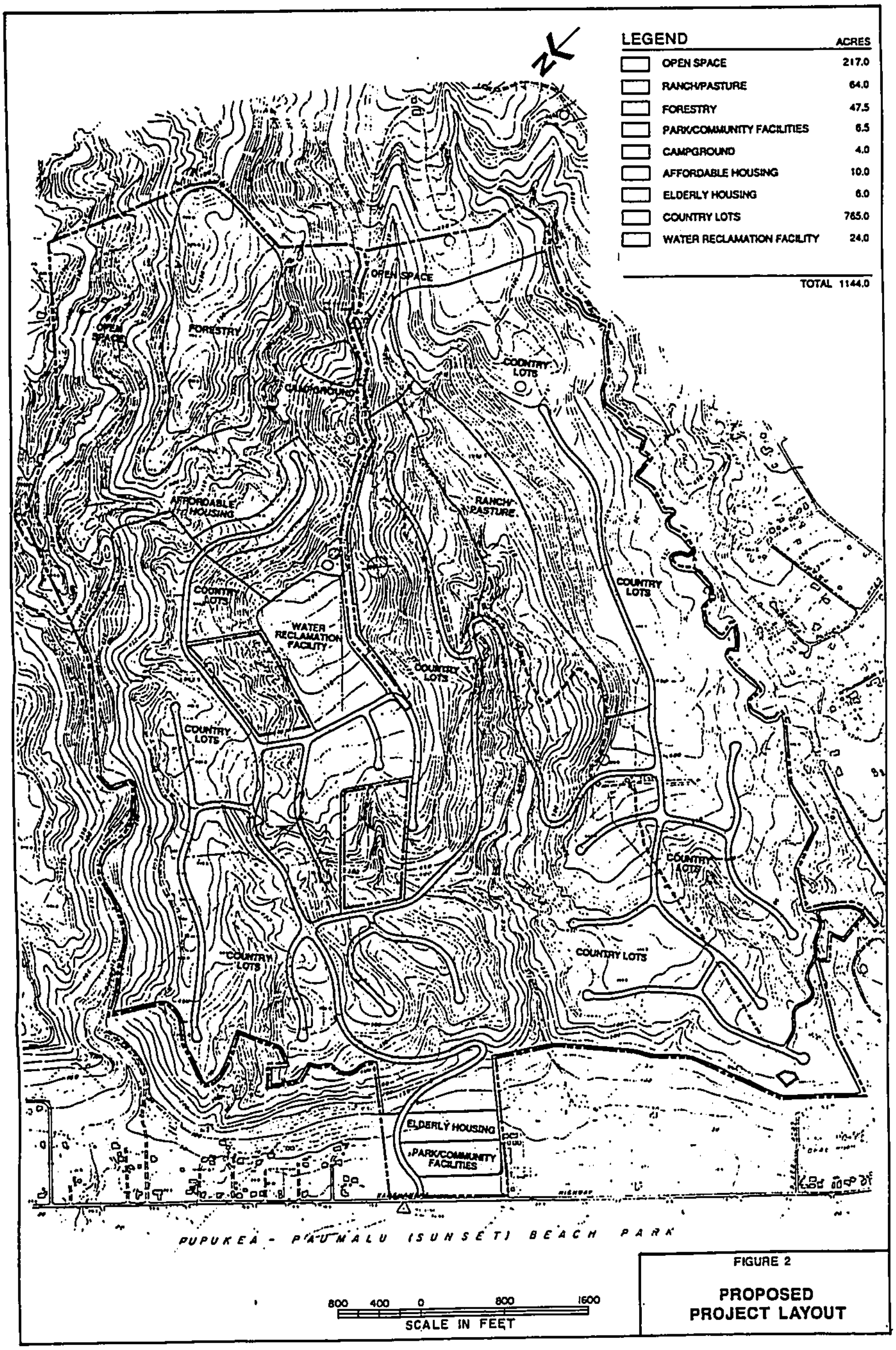


FIGURE 2

PROPOSED PROJECT LAYOUT

remaining 1,126 acres are located on an expanse approximately 6,000 feet wide and 8,000 feet in depth, separated from the coastal lowlands by a 200- to 400-ft high bluff. This area is isolated from neighboring properties on Kamehameha Highway by the bluff, and from neighbors on the northeast and southwest by the valleys of Paumalu Stream and Kalunawaikaala Stream, respectively. Pakulena Stream bisects the site interior. The three streams flow intermittently, only during periods of heavy rain.

The elevation of the coastal parcel ranges from 20 feet to 75 feet while the elevation of major portions of the site ranges from 200 feet at the bluff to 840 feet at the forest reserve boundary. Approximately 30 percent of the site slopes at less than 20 percent.

1.3 Climate

The median annual rainfall recorded at the Pupukea Farm Weather Station 896.00 is 51.7 inches. Tradewinds from the northeast average 8.9 mph, blowing slightly stronger during the day. The average temperatures in the summer are 83 degrees Fahrenheit (F) during the day and 69 degrees F at night, while winter temperatures average 77 degrees F during the day and 64 degrees F at night. Relative humidity averages 74.6 percent during the day.

SECTION 2
EXISTING INFRASTRUCTURE

The portion of the project site above the bluff is located within the Board of Water Supply's (BWS) Pupukea-Waialua system, while the remaining 18 acres of coastal property is located within the Sunset Beach-Kawela system. Groundwater resources for the Pupukea-Waialua system are tapped at the Waialua and Haleiwa wells, while the Waialee and Opana wells serve the Sunset Beach-Kawela system. The BWS has a third Sunset Beach-Kawela system source located near the Sunset Beach 206-ft Reservoir. However, these wells have been inactive since 1983. Storage facilities for the Pupukea-Waialua system are located in Waialua, Haleiwa, and Pupukea, while storage for the Sunset Beach-Kawela system are located at Sunset Beach and Kawela. The Pupukea-Waialua and Sunset Beach-Kawela systems are illustrated in Figure 3.

2.1 Source

The Waialua and Haleiwa wells are located in the Waialua Water Management Area (WMA), designated by the Commission on Water Resource Management. There are two wells each at the BWS Waialua and Haleiwa 225-ft Reservoir sites. Although the four wells have a combined capacity of 6.0 million gallons per day (MGD), limitations on groundwater withdrawal, established and controlled by the commission, restrict the draft rate. Currently, the BWS allotment from the Waialua and Haleiwa wells totals 2.73 MGD. The actual water use rate in 1990 was 2.37 MGD. With future commitments up to 2.94 MGD, the BWS allocation from the Waialua and Haleiwa Wells have been exceeded. Permission for additional pump capacity and withdrawal of water from this system must be granted to allow future development in this region.

The Waialee wells I and II are located adjacent to the Crawford Convalescent Home, and are situated above the Kawailoa aquifer. However, the wells are not located within the Waialua WMA portion of the aquifer, which extends from Anahulu Stream to Waimea Bay. It is estimated that the sustainable yield of the entire Kawailoa aquifer is about 39 MGD (12.5 MGD for the portion outside of the Waialua WMA). For the BWS fiscal year 1990-1991, the two sources had mean pumpage rates of 0.44 and 0.35 MGD, respectively.

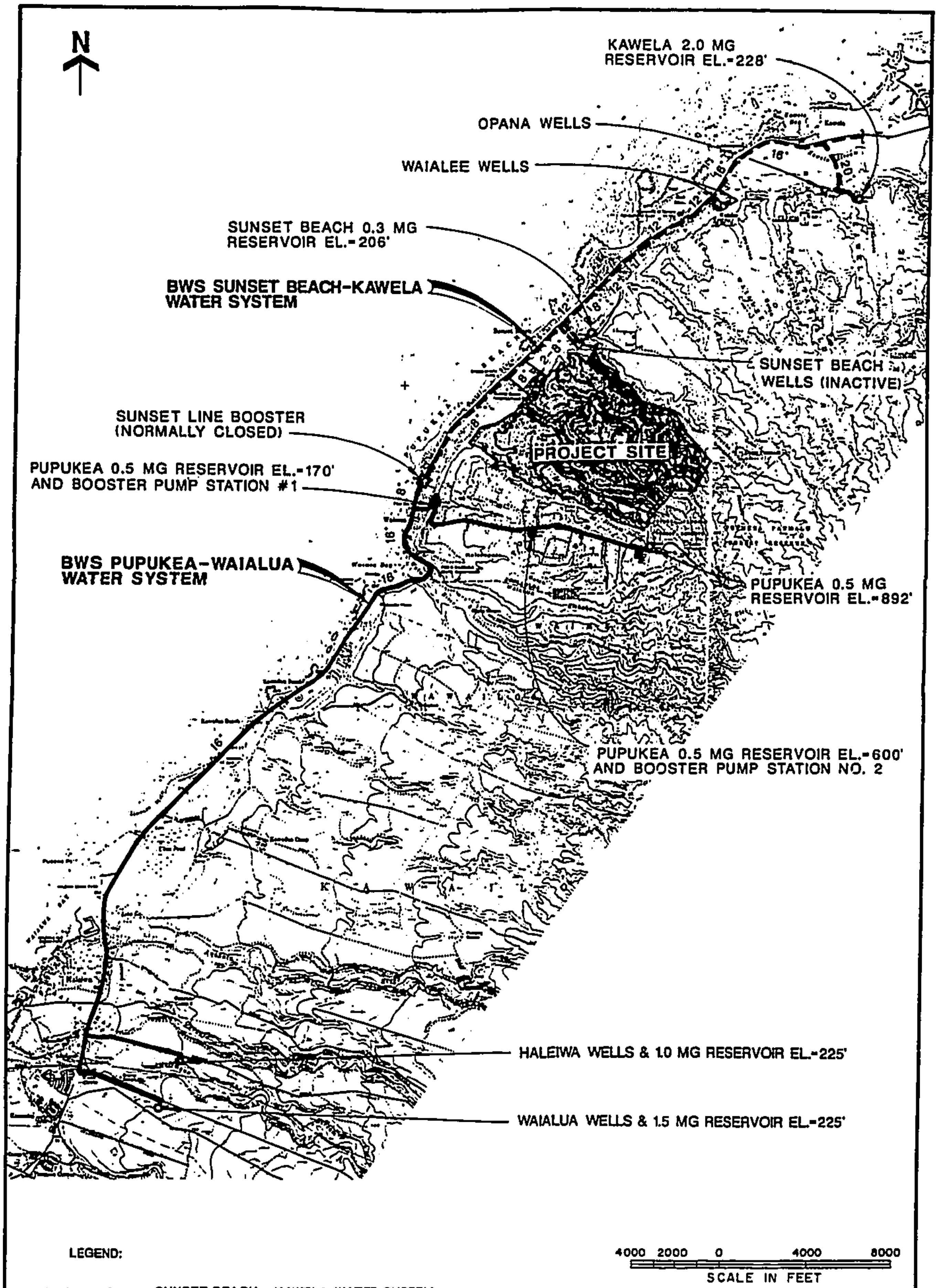


FIGURE 3

EXISTING BWS WATER SYSTEM

The Opana Wells are located on a hillside overlooking Kawela Bay and are adjacent to a BWS easement which extends from the Kawela 228-ft Reservoir to the Kamehameha Highway. The wells are situated above the Koolauloa aquifer system, which is a non-designated WMA. The Koolauloa aquifer system has an estimated sustainable yield of 35 MGD, with a 1990 withdrawal rate of about 13.6 MGD.

2.2 Storage

Within the Pupukea-Waialua system, three 0.5 MG reservoirs are located adjacent to the project site in Pupukea Highlands. Areas located below an elevation of 70 feet are serviced by the Pupukea 170-ft Reservoir no. 1. Areas between elevations 70 and 500 feet are serviced by the Pupukea 600-ft Reservoir no. 2. The Pupukea 892-ft Reservoir no. 3 services areas located between elevations 500 and 792 feet.

The Sunset Beach-Kawela system consists of a 0.3 MG reservoir with a spillway elevation of 206 ft at Sunset Beach and a 2.0 MG reservoir with a spillway elevation of 228 ft at Kawela. Because the two reservoirs are interconnected, their differing spillway elevations create problems in utilizing the full capacity of the Kawela Reservoir.

2.3 Transmission

Water within the Pupukea-Waialua system is transported from the Waialua and Haleiwa wells via a 16-inch main starting near Weed Circle along Kamehameha Highway. The 16-inch main transports water to Kawailoa and Waimea. An 8-inch main branches off parallel to the 16-inch main to service portions of the coastal area. The 8-inch main along Kamehameha Highway begins approximately 2,000 feet before Pupukea Road (on the Waimea side) and continues along Kamehameha Highway to the Sunset line booster pump, located about 1,400 feet north of Pupukea Road. The Sunset line booster was installed to satisfy BWS fire flow requirements to the Sunset Beach elementary school. A valve on the Sunset line booster bypass line is normally closed, separating the Pupukea-Waialua and Sunset Beach-Kawela systems.

Two 800 gallon per minute (gpm) pumps at booster station no. 1 (at Pupukea Reservoir no. 1 site) transport water via a 12-inch main along Pupukea Road to the Pupukea 600-ft Reservoir.

Two 800 gpm pumps at booster station no. 2 (at Pupukea Reservoir no. 2 site) transport water via a 12-inch main along Pupukea Road to the Pupukea 892-ft Reservoir.

The Sunset Beach-Kawela transmission system consists of a series of pipes ranging in size from 8 to 20 inches. At Kawela, the Opana wells are connected to the Kawela 228-ft Reservoir 20-inch influent-effluent pipe. This pipe runs down to Kamehameha Highway where it branches into two 16-inch pipes, one heading northeast towards the Turtle Bay Resort and the other southwest towards Waialee. This 16-inch pipe reduces to a 12-inch line in vicinity of the Crawford Convalescent Home, where the Waialee wells are connected via an 8-inch line. The 12-inch line continues along Kamehameha Highway towards Sunset Beach. In the vicinity of Kahauola Street, the 12-inch line branches into 12- and 8-inch lines along Kamehameha Highway. The two lines run along the highway approximately 2,800 feet before connecting into a single 8-inch line at the intersection of Kamehameha Highway and the access road to the Sunset Beach 206-ft Reservoir and well site. Two 8-inch lines connect the Sunset Beach Reservoir to the 8-inch line along Kamehameha Highway. The single 8-inch line then continues along Kamehameha Highway towards the Sunset line booster.

SECTION 3
PROJECTED WATER DEMAND

3.1 Design Criteria for Potable Water

The projected potable water demand for the proposed development is based on the BWS Water System Standards (1985) and on the book Wastewater Engineering: Treatment, Disposal, Reuse (1991) by Metcalf & Eddy, Inc.

An average potable water demand of approximately 245,500 gallons per day (gpd) is estimated for the entire project site based on the following projections:

	Average Water Demand (gpd)
315 Single-Family Residences	157,500
80 Elderly Housing Units	32,000
50 Affordable Housing Lots	25,000
Campground	4,000
Park/Community Facilities	25,000
Ranch	2,000
Total	245,500

Average water demand for residential home sites is based on 500 gpd per lot using the BWS standard for a single family residence and 400 gpd per unit for multi-family dwellings.

3.2 Fire Demand

The BWS Water System Standards require the following fire flow rates for the various land uses:

	flow rate (gpm)	duration(hours)
Non-residential: (community facility)	2000	2
PUD Townhouses and Low-Rise Apartment	1500	1
Residential	1000	1

The water distribution system and storage reservoirs will be designed to deliver the fire flow rates prescribed by the BWS Water System Standards.

3.3 Storage and Transmission Credits

Storage and transmission rights have been credited to the Obayashi Property by BWS. These credits include:

170-ft system: 242,500 gallons at Pupukea 170-ft Reservoir

600-ft system: 242,500 gallons at Pupukea 600-ft Reservoir; two 390 gpm capacity at Pupukea booster station no. 1 (one standby capacity)

892-ft system: 242,500 gallons at Pupukea 892-ft Reservoir; two 390 gpm capacity at Pupukea booster station no. 2 (one standby capacity)

Reservoir capacity is based on the maximum daily demand, equal to 1.5 times the average daily demand. The storage credits reflect maximum rather than average quantities. Thus, the corresponding storage volume is 242,500 divided by 1.5, or 161,667 gallons on the average for each of the three systems.

3.4 Source Development

Because the project does not have any source credits, the developer will be responsible for implementing a new well source to satisfy the projects' demands. One potential new well site is located between the two existing well sites at the Waialua and Haleiwa 225-ft Reservoirs. This proposed well would become part of the Waialua-Haleiwa Well system.

3.5 Nonpotable Water

To reduce potable water demands, landscape irrigation for the 315 country lots will be achieved with nonpotable brackish water from on-site wells. The average landscape irrigation rate for these lots is conservatively estimated at 1,000 gpd/lot or 315,000 gpd.

SECTION 4
PROPOSED DEVELOPMENT

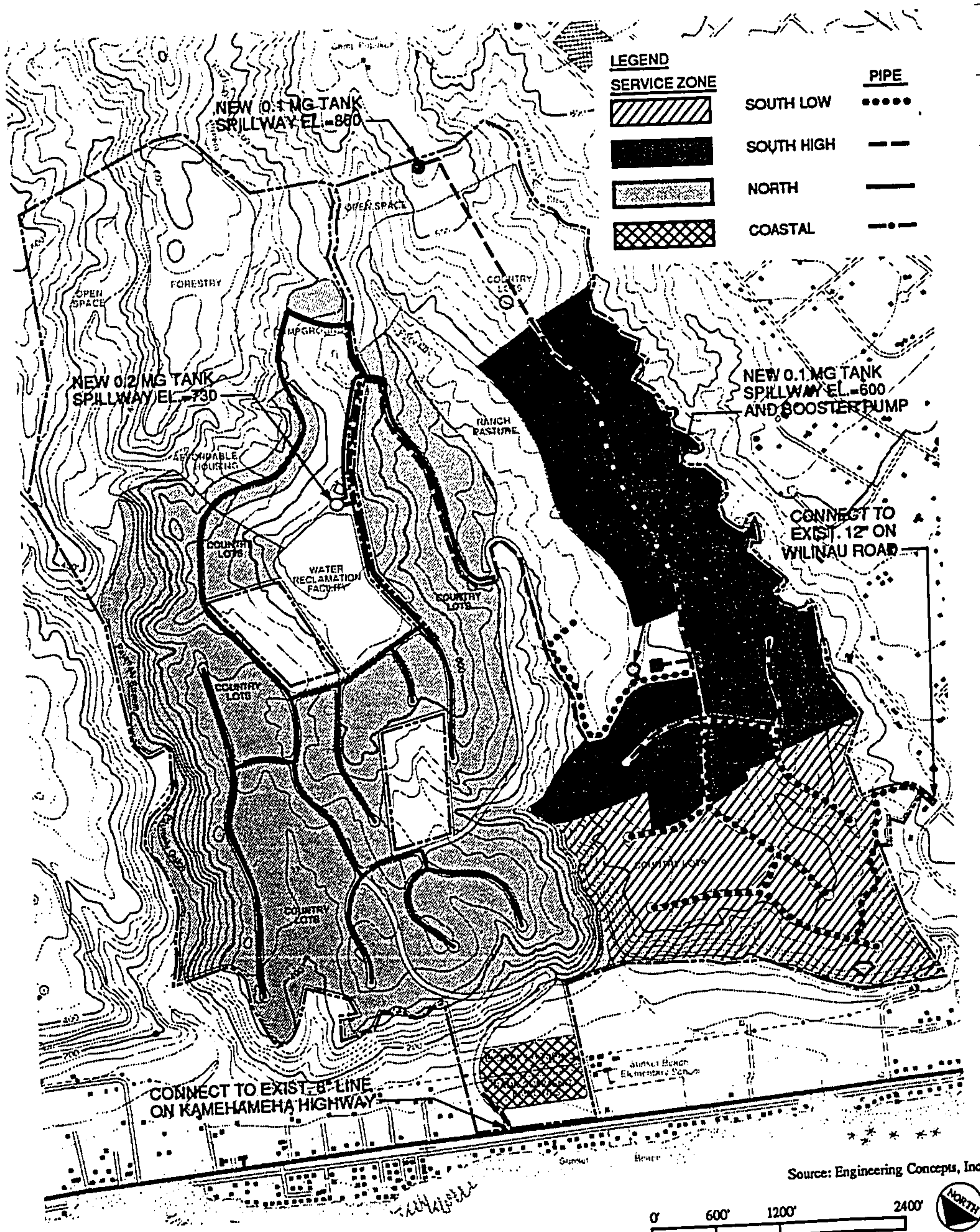
The Lihi Lani Project will have separate potable and nonpotable water systems. The proposed potable water system will utilize the BWS systems presently serving the Pupukea Highlands/Sunset Hills residential areas, and the Sunset Beach area. The proposed nonpotable water system will utilize onsite wells as its source.

4.1 Potable Water System

The proposed potable water system will be separated into four service zones within the project site: south low, south high, north, and coastal (Figure 4). The portion of the project above the bluff (south low, south high, and north) will draw it's water from the south low service system by tapping off an existing 12-inch line along Wilinau Road within the Sunset Hills subdivision. From this connection, the waterline will connect to a new onsite 0.1 MG reservoir with a spillway elevation of 600 ft. In addition to conveying water from the existing system to the new tank, this line will also serve as a distribution line for the ranch and about 63 country lots located below the 500-ft elevation in the south low service zone.

From the new 600-ft reservoir, a booster pump will transmit water to: 1) a second new 0.1 MG reservoir with a spillway elevation of 860 ft. located adjacent to the Boy Scouts of America camp and 2) a new 0.2 MG north service zone reservoir with a spillway elevation of 730 ft. The new 860-ft tank will serve about 59 country located above the 570-ft elevation, and about 30 lots below the 570-ft elevation. For areas located below the 570-ft elevation served by the 860-ft tank, pressure reducing valves will be installed at each lot to reduce pressure to levels in accordance with the BWS standards. The north 730-ft tank will service about 163 country lots, the campground, and 50 affordable housing lots.

The planned Park/Community Facilities and elderly housing units located on the coastal plain will be connected to an existing 8-inch line along Kamehameha Highway. A summary of the water demands by service zones is shown in Table 1.



PROPOSED POTABLE WATER SYSTEM

LIHI LANI

Table 1
AVERAGE DAILY POTABLE WATER DEMAND FOR THE PROJECT SERVICE ZONES

EXISTING PUPUKEA 600-ft RESERVOIR		
South Low Service Zone		
63 Country Lots	31,500 gpd	
Ranch	2,000 gpd	
	33,500 gpd	
South High Service Zone		
89 Country Lots	44,500 gpd	
	44,500	
North Service Zone		
163 Country Lots	81,500 gpd	
Campground	4,000 gpd	
50 Affordable Housing Lots	25,000 gpd	
	110,500 gpd	188,500 gpd
EXISTING 8-INCH WATERLINE ON KAMEHAMEHA HIGHWAY		
Coastal Service Zone		
Park/Community Facilities	25,000 gpd	
Elderly Housing	32,000 gpd	
	57,000 gpd	57,000 gpd
Total, Average Daily Demand =		245,500 gpd

The average water withdrawal from the existing Pupukea 600-ft service zone will be about 188,500 gpd and 57,000 gpd from the existing 8-inch waterline on Kamehameha Highway.

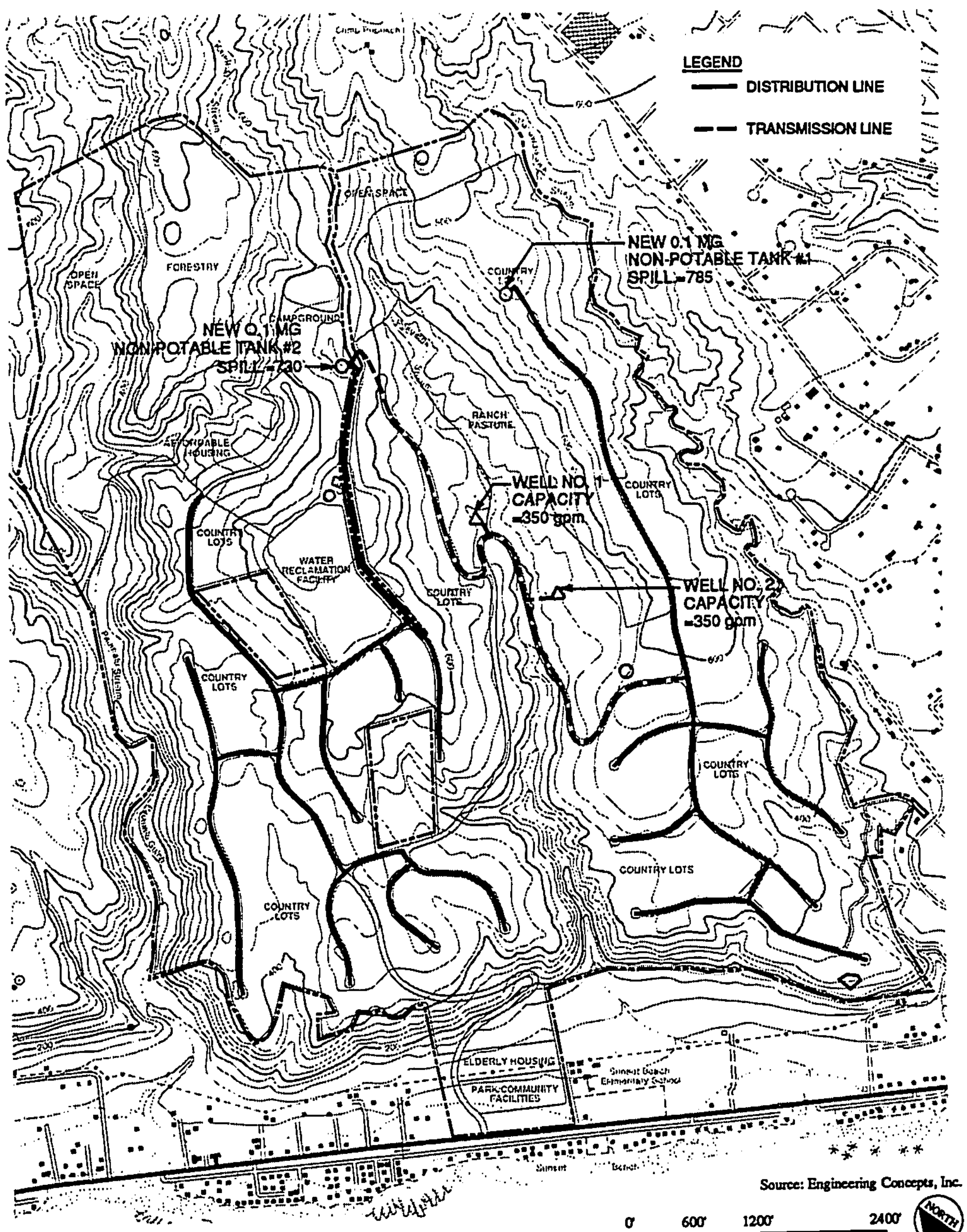
4.2 Nonpotable Water System

The nonpotable water system will be privately owned and maintained. Two onsite nonpotable wells will provide water required for landscape irrigation of the 315 country lots (Figure 5).

Two existing nonpotable wells which were drilled to depths below sea level have a potential to yield 0.5 MGD each, which is sufficient to meet irrigation water requirements. For additional information on groundwater conditions and well development, refer to the report "Groundwater Conditions, Pupukea Paumalu, Oahu" by Mink (June 1988) and an updated report by Nance (1993).

Pumps located at the well sites will convey the water to two new 0.1 MG irrigation tanks. Tank no. 1 will be located on the southern side of the project and have a spillway elevation of 785 ft. Tank no. 2 will service the northern side of the project and have a spillway elevation of 730 ft. A nonpotable water distribution system consisting of polyvinyl chloride (PVC) pipe will transmit irrigation water to the country lots. The lots will have an underground piping system with sprinkler heads for lawn and landscaping watering. Hose bibb connections will not be permitted to any part of the nonpotable water distribution system. Lots located in areas having high pipeline pressures will be fitted with pressure reducing valves.

In addition to the use of the brackish nonpotable wells for irrigation, reclaimed wastewater effluent will be used to irrigate portions of the project site designated as forestry, pasture, and ranch land. However, the reclaimed effluent storage/transmission system will be completely separate from the brackish nonpotable water system, and no country lot will be connected and/or be allowed to use the effluent for irrigation. For additional information, refer to the report entitled "Wastewater Management Plan for the Proposed Lihi Lani Project" by Bob Gearheart and Engineering Concepts, Inc., 1993. In addition, ITC Water Management (September 1993) has completed a preliminary report on water reuse and proposed irrigation with reclaimed water.



PROPOSED NON-POTABLE WATER SYSTEM

LIHI LANI

SECTION 5
POTENTIAL IMPACTS AND MITIGATION

5.1 Short-Term Impacts

Short-term impacts are construction related and may include dust, noise, and traffic disturbances in the Pupukea Highlands and Sunset Hills residential communities due to installation of water lines. Mitigation of these nuisances can be accomplished by limiting construction to weekdays during working hours when many residents are not at home; use of wind breaks or watering to reduce dust; and observance of approved traffic control plans.

5.2 Long-Term Impacts

1. Impact on the Waialua and Kawailoa Aquifer systems. The sustainable yield of the aquifer systems is 79 MGD, and current allocations were recently reported at about 59 MGD by the DLNR. Thus, groundwater resources are available and additional development of resources should not adversely affect the aquifer systems. In all likelihood, an additional well, whether developed by the BWS or by the developer, will be required to meet the water demand for the project. Lihi Lani will only require an additional 0.246 mgd of withdrawal.

2. Impact on Existing Water Users. Existing BWS consumers in the Pupukea Highlands and Sunset Hills subdivisions should not be adversely affected by the increase in water demand by the project's proposed water systems. Informal discussions with the BWS revealed the water systems in Pupukea are currently operating at one-fourth of their capacity. The systems were designed to handle the estimated additional water demand of the future residential development of the land owned by Obayashi.

3. Impact of the Nonpotable Water Wells. In his report, "Groundwater Conditions, Pupukea-Paumalu, Oahu", dated June 6, 1988, John Mink reports that groundwater flow beneath the property is directed toward the coast. The report also states that operation of the two wells proposed for nonpotable water

development should have little, if any, adverse impacts on the BWS Sunset Beach wells. Percolation of irrigation water, consisting of nonpotable brackish water and reclaimed effluent, is not expected to affect the quality the groundwater aquifer. An additional follow-up study by Tom Nance Water Resources Engineering (September 1993) further confirms the initial findings by Mink (June 1988) showing no adverse impact on water quality and quantity at the Sunset Beach wells.

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APPENDIX E

Water Reclamation Plan
for Lihi Lani

WATER RECLAMATION PLAN for

LIHI LANI

Pupukea and Paumalu, Koolauloa, Oahu, Hawaii
TMK: 5-9-05: 6, Por. 38,82
TMK: 5-9-06: 1, 18, 24

SEPTEMBER 1993

PREPARED FOR:

Obayashi Hawaii Corporation
Honolulu, Hawaii

PREPARED BY:

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WATER RECLAMATION PLAN

for the

PROPOSED LIHI LANI DEVELOPMENT

Pupukea and Paumalu, Koolauloa, Oahu, Hawaii

Prepared for

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725 Kapiolani Boulevard, Fourth Floor
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SEPTEMBER 1993

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TABLE OF CONTENTS

LIST OF FIGURES

SECTION 1

INTRODUCTION

1.1 GENERAL

The Obayashi Hawaii Corporation proposes to develop a country residential community on the North Shore of Oahu at Pupukea (TMK: 5-9-05: 6, Por. 38, 82 and TMK 5-9-06: 1, 18, 24). This development to be known as Lihi Lani will be located on a 1,144 acre site inland of Kamehameha Highway and Sunset Beach, surrounded by the COMSAT facility, State Forest Reserve, and the Pupukea Highlands and Sunset Hills subdivisions (Figure 3). This project is anticipated to be developed over a 12-year period.

The purpose of this report is to describe the water reclamation plan for the treated wastewater effluent generated by the proposed Lihi Lani Water Reclamation Facility (LLWRF). The proposed LLWRF will encompass approximately 24 acres and will serve the Lihi Lani community. See Figures 1 and 2 for Location Map and Vicinity Map, respectively.

1.2 BACKGROUND

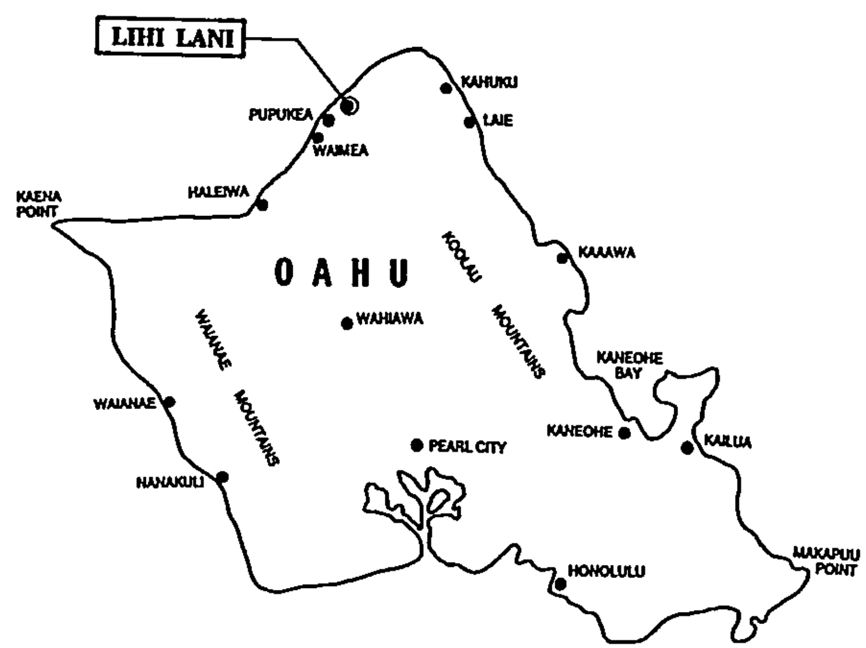
The proposed Lihi Lani project will result in the development of land uses within the 1,144-acre project site (Figure 3). The proposed project will seek to develop an integrated residential, agricultural and recreational community. The residential components of the proposed project will include one-to-three acre residential lots, single family affordable housing units, and affordable elderly housing rental units. The agricultural components include diversified agriculture, ranching, and grazing pasture uses. Potential agricultural crops include fruit trees, field stock trees, cut flowers and foliage. The recreational components include a horse ranch, horseback riding and hiking trails, campground and community park and facilities.

Approximately 18 acres of the project site are situated below the bluff along the coastal plain inland of Kamehameha Highway and northeast of Sunset Beach Elementary School. The remaining area is located on an expanse approximately 6,000 feet wide and 8,000 feet in depth, separated from the coastal plain by a 200- to 400-foot high bluff.

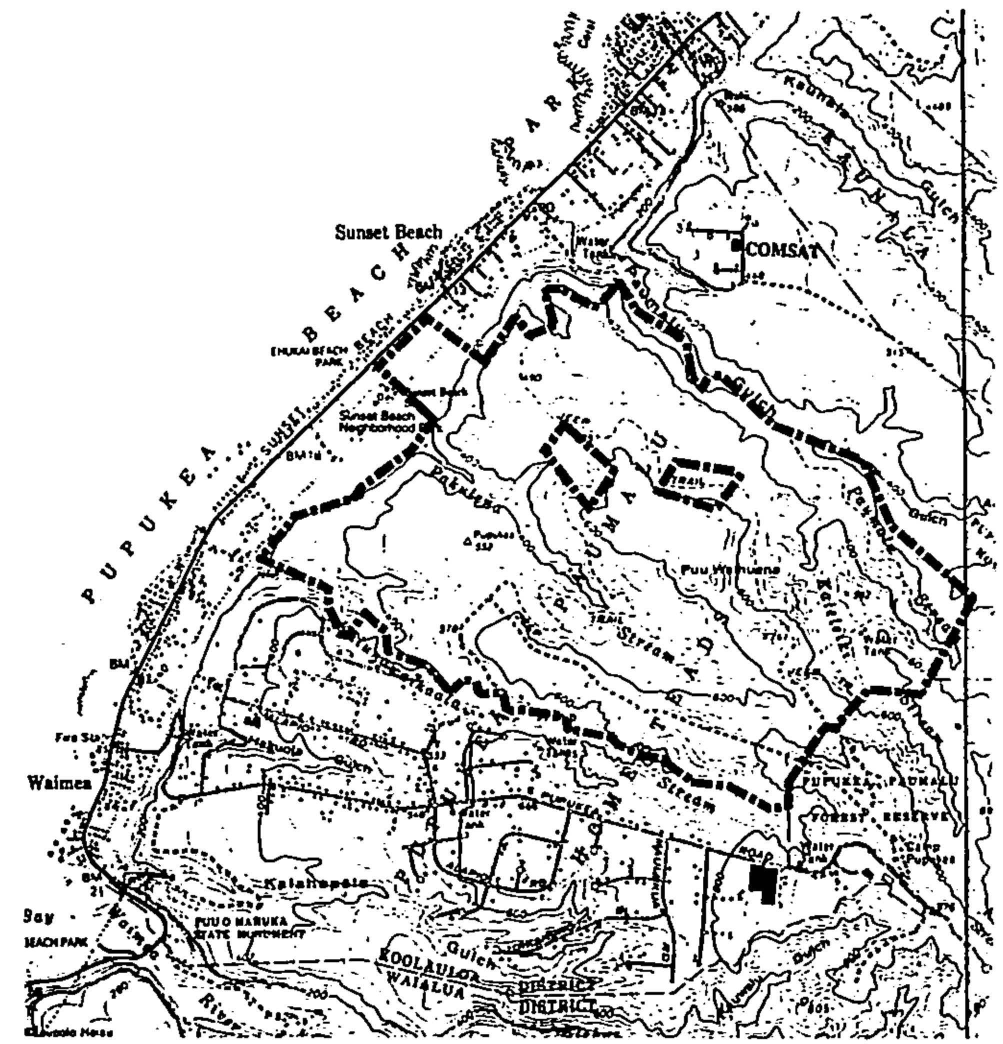
At present, the site is undeveloped and there are no significant utility or roadway systems on the property. Development of the property will require installation and construction of all infrastructure systems. The neighboring community of Sunset Beach and the Pupukea Highlands and Sunset Hills subdivisions are all serviced by individual wastewater systems (cesspools or septic tank/leachfield systems).

The site is isolated from neighboring properties on Kamehameha Highway by the bluff, and from neighbors on the northeast and southeast by the valleys of Paumalu Stream and

Kalunawaikaala Stream, respectively. Pakulena Stream bisects the site interior. The three streams experience intermittent flow, occurring only during periods of heavy rain. The elevation of the coastal parcel varies from 20 to 75 feet, while the elevation of major portions of the site varies from 200 feet at the bluff to 840 feet at the inland forest reserve region. Approximately 30 percent of the site slopes at less than 20 percent.



LOCATION MAP
LIHI LANI
FIGURE 1

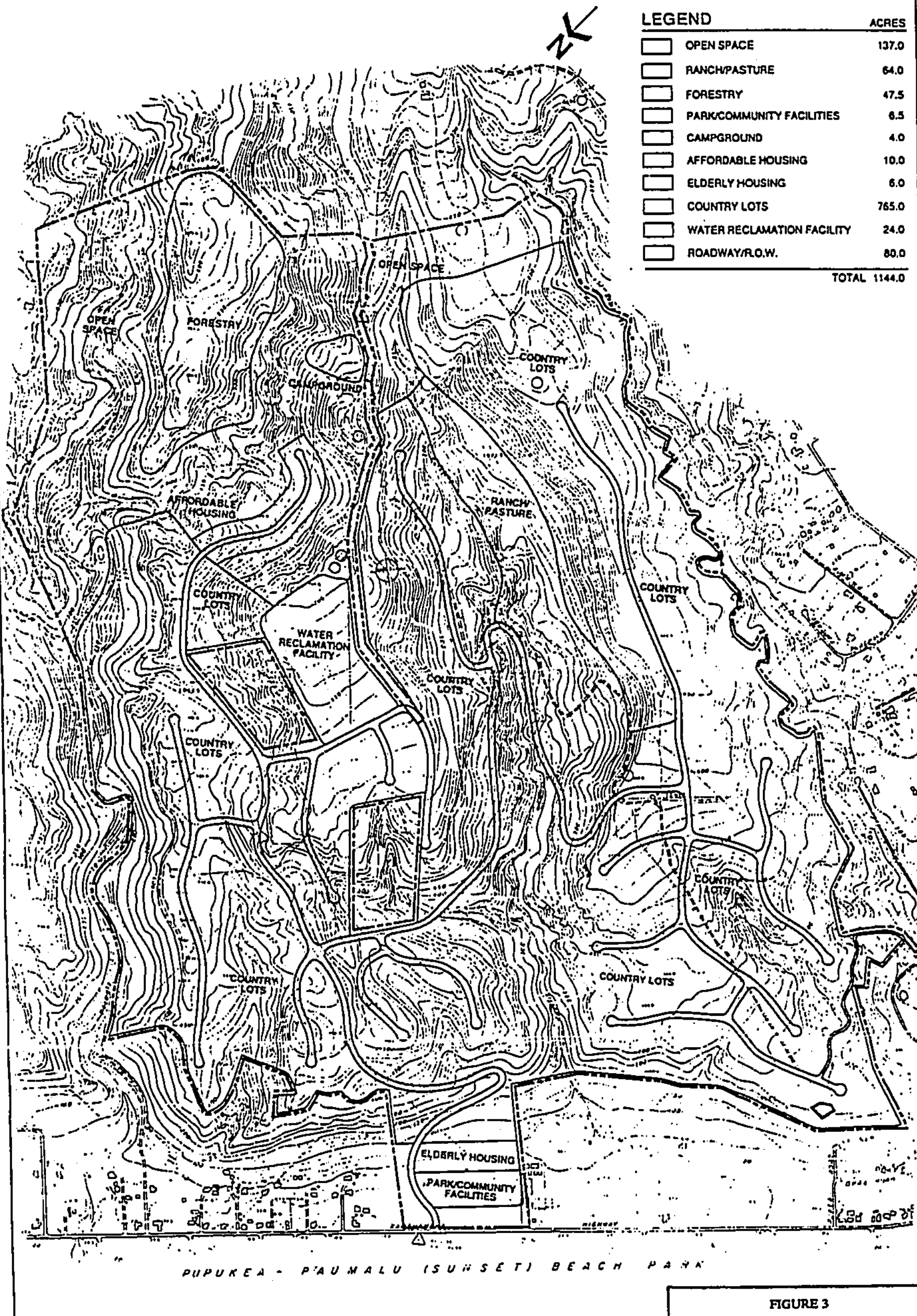


LEGEND

PROJECT BOUNDARY

0'
1000'
2000'
4000'
NORTH

VICINITY MAP
LIHI LANI
SOURCE: USGS TOPOGRAPHIC QUADRANGLE (1983)
FIGURE 2



LIHI LANI

FIGURE 3

PROPOSED DEVELOPMENT PLAN

SECTION 2

WATER RECLAMATION FACILITY

2.1 WASTEWATER TREATMENT PROCESS

As described in the August 1993, Wastewater Management Plan report prepared for Obayashi Hawaii Corporation by Engineering Concepts, Inc. and Robert Gearheart, Ph.D., the proposed method of treatment at Lihi Lani Water Reclamation Facility will consist of the following processes: 1) stabilization ponds, 2) constructed wetlands, 3) coagulant addition, if required 4) filtration, and 5) ultraviolet light disinfection. The stabilization ponds/constructed wetlands system is a land intensive, low energy, ecological system which differs significantly from the typical conventional treatment plants found in Hawaii which are energy and technology intense. It is anticipated that the stabilization ponds/wetlands treatment facility will provide high quality tertiary level treated effluent. The treated effluent will be conveyed to a central irrigation storage and control facility where it can be blended with brackish water and used for irrigation.

2.2 WASTEWATER QUANTITY

For planning purposes, the total average wastewater quantity generated by Lihi Lani is estimated to be 180,000 gallons per day at the completion of the development.

2.3 WASTEWATER CHARACTERISTICS

Wastewater generated at the project site is expected to be of typical domestic composition. As a result, the influent organic and solids loadings utilized for design is as follows:

Organics:	200-250 mg/L Biochemical Oxygen Demand (BOD)
Solids:	200-250 mg/L Suspended Solids (SS)

2.4 WASTEWATER TREATMENT FACILITY

As stated in the August 1993 Wastewater Management Plan, the wastewater treatment facility requires about 11 acres of water surface area, which includes 8 acres of stabilization ponds and 3 acres of constructed wetlands. In addition, another 13 acres will be required to accommodate the treatment facility buffer, berms, perimeter and access roads, disinfection facilities, pumps, piping, appurtenances, and laboratory/control. Thus, an approximate total of 24 acres will be required in the proposed wastewater treatment system.

2.5 HYDROGEOLOGIC ANALYSIS

The area to be irrigated is mauka of the Underground Injection Control (UIC) line. According to Tom Nance Water Resources Engineering (September 1993), the use of drip irrigation for effluent diposal is not expected to affect any potable water sources. There is little potential for potable water development from the aquifer beneath the site. Non-potable water has been developed on-site through two wells and will supplement the reclaimed irrigation water for the reclamation areas. The non-potable well water will also be used for irrigation in areas not designated to receive reclaimed water.

2.6 HYDROLOGIC SURVEY

The Water Balance Data (Table 6-1) and Pan Evaporation Data (Table 6-2, Table 6-3, and Figure 8) are provided in the Appendix.

SECTION 3

WATER RECLAMATION PLAN

3.1 RECLAMATION METHOD

The primary vehicle for wastewater reclamation in Hawaii is irrigation. Irrigation systems utilizing reclaimed water have been in place for many years in agriculture, on golf courses, landscaping, and plant nursery operations.

Reclaimed water for agricultural subsurface drip irrigation has been used as a standard for several decades at Waialua Sugar Company without noticeable effects to the groundwater quality. Waialua Sugar's main irrigation water source is the 2.5 billion gallon unlined earthen Wahiawa Reservoir. Approximately 1.7 million gallons per day of treated effluent is discharged into the stream fed Wahiawa Reservoir from the City and County of Honolulu's Wahiawa Wastewater Treatment Facility. Furthermore, approximately 3.5 million gallons per day of treated effluent from the Schofield Wastewater Treatment Facility (WWTF) discharges directly into Waialua Sugar's unlined Wahiawa Ditch.

The Wahiawa Ditch, Waialua Sugar's main irrigation ditch from the Wahiawa Reservoir, provides an average of 25 million gallons per day of irrigation water for several thousand acres of sugar cane on Kemoo Ridge, Helemano Ridge, Opaeula Ridge, Kawailoa Ridge, and ending at the Waimea Ridge fields above Waimea Valley Park. Although reclaimed water from the Wahiawa Ditch has useable nutrients for crop production, Waialua Sugar as a standard crop cultural practice requirement incorporates nitrogen and other fertilizer components in their growing of sugar cane. The majority of the fields irrigated by the Wahiawa Ditch are mauka of the Underground Injection Control (UIC) line and the land application of effluent has not shown to add nutrients to the groundwater.

Dole Packaged Foods Wahiawa Plantation has been subsurface drip irrigating 590 acres of pineapple on the Kemoo Ridge above the Wahiawa Ditch mauka of the Underground Injection Control (UIC) line for about 10 years. Dole Plantation is the first irrigation user off the Wahiawa Ditch downstream of the Schofield WWTF point of discharge. There have been no indications of nutrient addition to the groundwater.

Del Monte Corporation's Kunia Plantation subsurface drip irrigates pineapple with treated effluent generated by the Del Monte Wastewater Treatment Facility. There have been no indications of nutrient addition to the groundwater.

Reclaimed water has been used for many years to irrigate golf courses, landscaping, and plant nurseries at places such as Waikoloa Resort, Kiahuna Golf Course, Silversword Golf Course, Turtle Bay Hilton, Mauna Lani Resort, Princeville Resort, and Manele Bay Resort.

At Koloa, Kauai, the Kukuiula Development, has in place a fully automated subsurface landscape drip irrigation system capable of accommodating up to 1.0 million gallons per day of treated effluent. At Kalama Beach Park, Kihei, Maui, the County of Maui Department

of Parks and Recreation operates an automated subsurface drip irrigation system using reclaimed water. On Oahu, the 160 acre Hawaii Kai Golf Course plans to use reclaimed water to subsurface drip irrigate the Executive Course located mauka of the Underground Injection Control (UIC) line and the Championship Course, a portion of which is mauka of the UIC line.

Excessive irrigation has the potential to leach to the groundwater and coastal waters. This is especially true with sprinkler irrigation systems which have lower application and distribution efficiencies than subsurface drip irrigation systems. Drip irrigation is recommended as one measure for efficient irrigation water application. This ensures efficient use of water while minimizing runoff and soil erosion. To mitigate potential negative impacts on the human and natural environment by effluent disposal through irrigation systems, subsurface drip irrigation, based on crop water requirements, is recommended for the Lihi Lani project.

3.2 RECLAMATION AREAS AND CROP DESIGNATION

All wastewater effluent generated by the Lihi Lani development will be reclaimed through on-site subsurface drip irrigation systems in areas with limited public exposure. The reclaimed water will irrigate ranch, pasture, field stock commercial tree nursery and field stock native forestry components of the Lihi Lani project (Figure 4).

Grasses considered for the ranch and pasture reclamation areas include California grass, Dallis grass, and Giant Bermuda. Agricultural crops under consideration include native plants and trees, commercial plant and tree nurseries, and various orchard type trees. The reclaimed water will be used in accordance with the requirements of the proposed Hawaii State Department of Health Reuse Guidelines.

3.3 EFFLUENT TREATMENT REQUIREMENTS

Effluent for the subsurface drip irrigation system will be treated in accordance with the Hawaii State Department of Health "Proposed Guidelines for the Treatment and Reuse of Reclaimed Water, Draft No. 7, May 1993. The wastewater effluent will be treated to the level of "R-1 water (virtually pathogen free reclaimed water)". Draft No.7 of the proposed reuse guidelines defines "R-1 water" as reclaimed water that is at all times oxidized, then coagulated, then flocculated, then clarified, then filtered, and then exposed, after the filtration process, to a disinfection process that:

A. Has been shown to the satisfaction of DOH to reliably reduce the number of plaque-forming units of F-specific bacteriophage MS2 per unit volume of water, added to the filter effluent in a demonstration project, to one ten-thousandth (1/10,000) of the initial concentration in the filter effluent throughout the range of qualities of effluent that will occur at the reclamation facility and that might influence efficacy of disinfection, or has been shown to the satisfaction of DOH to likewise reliably reduce the number of plaque-

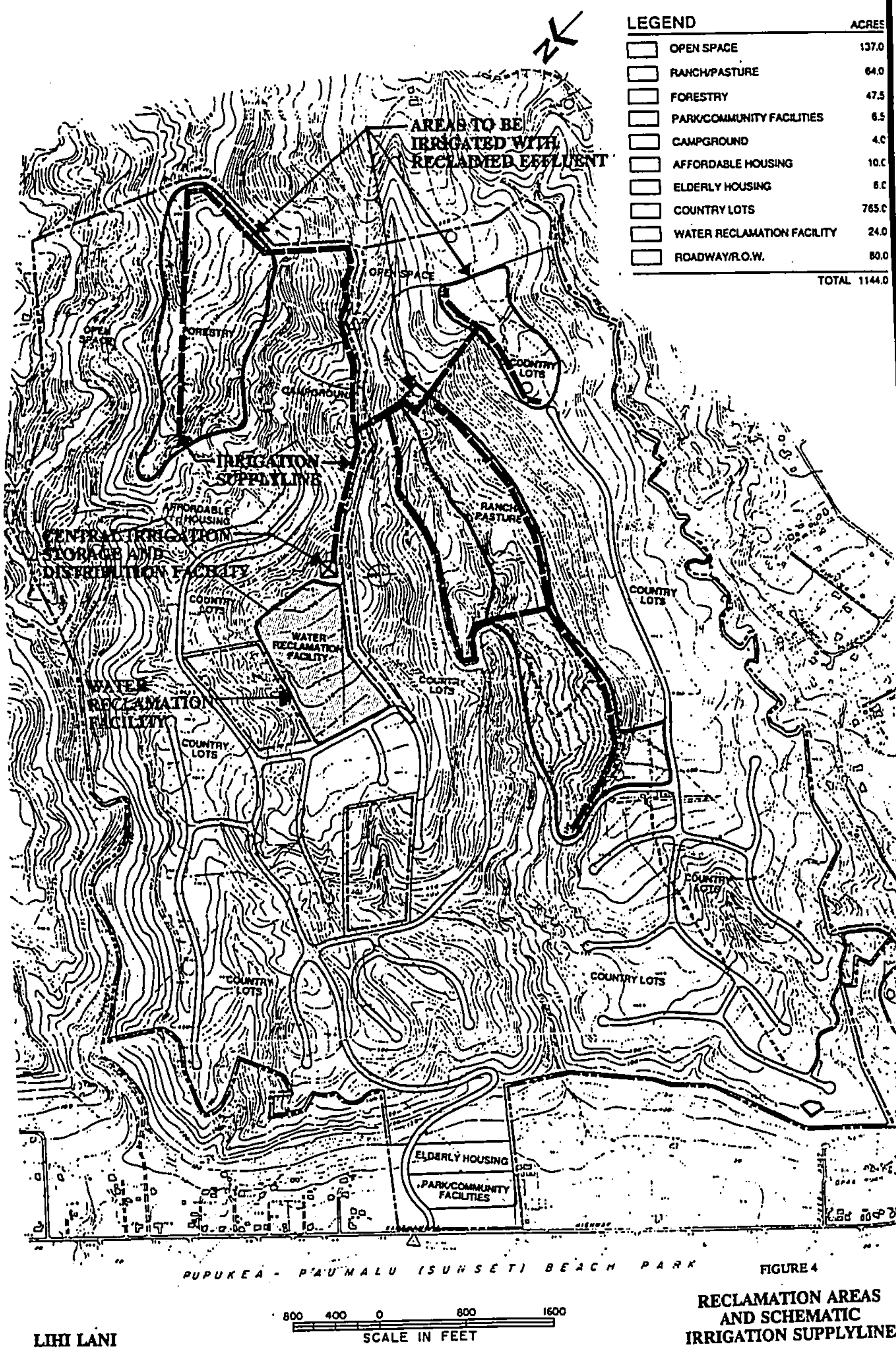


FIGURE 4

RECLAMATION AREAS AND SCHEMATIC IRRIGATION SUPPLYLINE

LIHI LANI

forming units of other virus added to the filter effluent, to one ten-thousandth (1/10,000) of the initial concentration when such other virus has been shown to the satisfaction of DOH to be at least as resistant to the form of disinfection being demonstrated as F-specific bacteriophage MS2;

B. Limit the concentration of fecal coliform bacteria to the following criteria:

(1) The producer may designate any location in the water reclamation treatment process from which all samples will be taken;

(2) The sampling procedure shall conform with the approved laboratory methods and may encompass either the membrane filter (MF) or equivalent most probable number (MPN) methods. Results using MF shall be reported as confirmed colony forming units (CFU). Results using MPN shall be reported as confirmed MPN;

(3) The median number of fecal coliform values shall not exceed 1 per 100 milliliters as determined from the bacteriological results of the last seven days for which analyses have been completed; and

(4) Any one sample shall not exceed a fecal coliform value of 4 per 100 milliliters; and

C. Treated under the process conditions that have been demonstrated to the satisfaction of DOH to consistently provide a degree of treatment equal to "best practicable technology" for the removal of pathogenic protozoan cysts and oocysts, by providing multibarrier treatment which achieves a total of 99.0 percent (2 log) removal of particles greater than 4 microns in diameter in order to be equivalent with the minimum 2 log removal requirement.

Anticipated effluent characteristics from the LLWRF for organic and solids loading is as follows:

Organics: 2 - 5 mg/L Biochemical Oxygen Demand (BOD)
Solids: 2 - 5 mg/L Suspended Solids (SS)

Additional information is provided in the August 1993 Wastewater Management Plan report prepared for Obayashi Hawaii Corporation by Engineering Concepts, Inc. and Robert Gearheart, Ph.D.

3.4 RECLAIMED WATER STORAGE AND DISTRIBUTION

Reclaimed water from the Lihi Lani Water Reclamation Facility (LLWRF) will be pumped to the Central Irrigation Storage and Distribution Facility (CISDF) (Figure 5). The CISDF will consist of a series of storage tanks, a multi-media sand filter station, a chlorination system, a booster pumping station, and computerized controls (Figure 6). If effluent flows exceed irrigation requirements, excess flow will be held in the LLWRF holding basins.

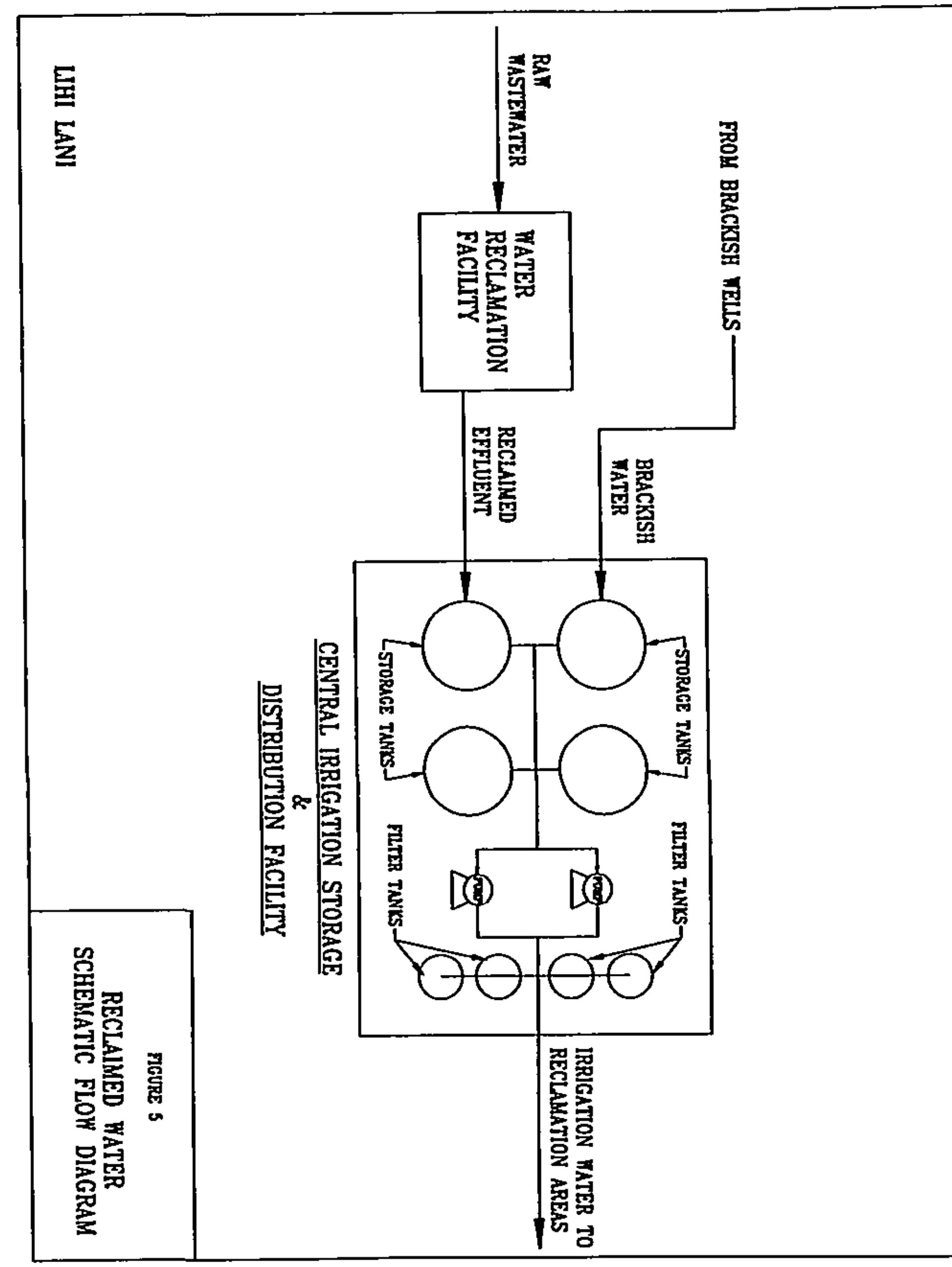
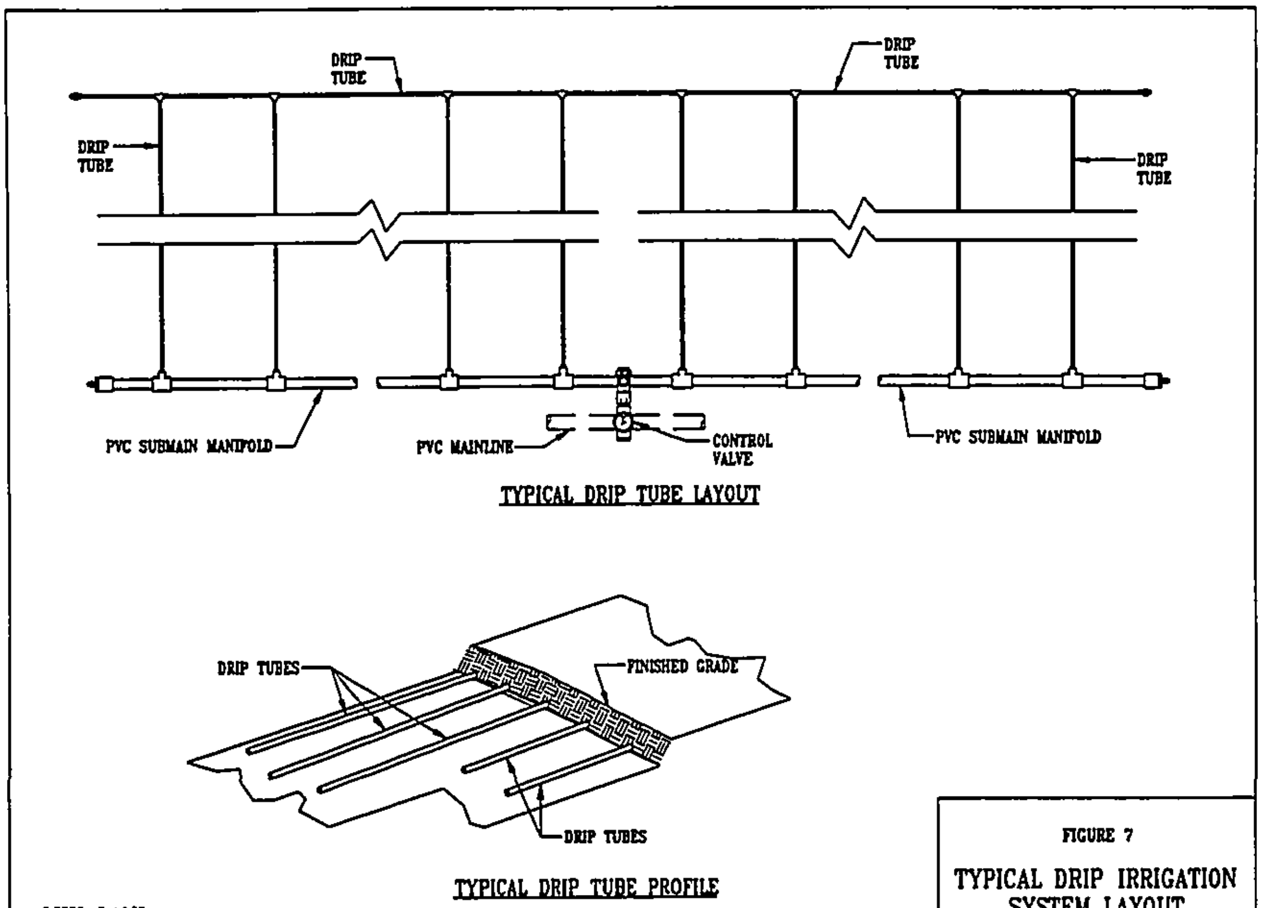


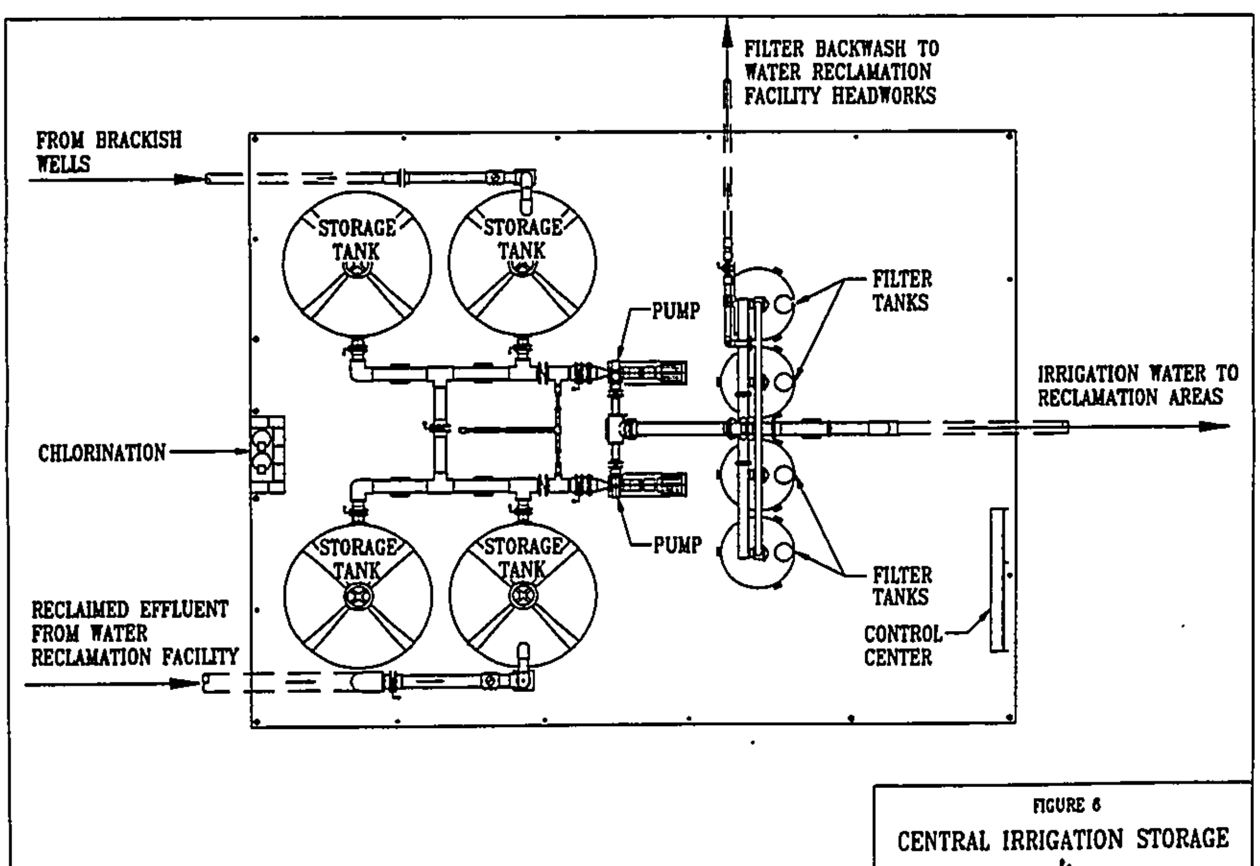
FIGURE 5
RECLAIMED WATER SCHEMATIC FLOW DIAGRAM



LIHI LANI

FIGURE 7

TYPICAL DRIP IRRIGATION SYSTEM LAYOUT



LIHI LANI

FIGURE 6

CENTRAL IRRIGATION STORAGE & DISTRIBUTION FACILITY

A fully automated subsurface drip irrigation system will provide managed use of reclaimed water for the designated reclamation areas. The designated reclamation areas will be subdivided into various irrigation control blocks sized and valved for proper distribution management of the reclaimed water.

3.5 STORAGE AND BLENDING

The CISDF will be capable of receiving reclaimed water and/or supplemental brackish water from the on-site wells depending on specific operational and use requirements. Reclaimed water from the water reclamation facility will pumped to a series of polyethylene storage tanks at the CISDF. The storage tanks will have level controls and be flow monitored.

3.6 FILTRATION

Booster pumps will transport reclaimed water from the storage tanks through a set of automated stainless steel multi-media sand filters. The sand filters will provide additional assurance for maintaining high quality irrigation water by enhancing suspended solids removal from the irrigation water. The sand media filters will be periodically self-cleaned by automatic backwashing of the sand media filter bed. A backwash line from the filter system will send backwash water back to the LLWRF influent headworks.

3.7 CHLORINATION TREATMENT

Wastewater disinfection will occur at the LLWRF in accordance with Department of Health reuse requirements. In addition, all reclaimed water received at the CISDF will be chlorinated prior to delivery to the drip irrigation system. Chlorination treatment at the CISDF will provide additional assurance for maintaining high quality irrigation water by precluding potential biological activity such as algae and bacterial slime proliferation.

3.8 IRRIGATION MANAGEMENT AND CONTROLS

A programmable central irrigation computer located at the CISDF will manage the irrigation system based on individual irrigation block requirements. The central computer will start and stop pumps, open and close individual block valves, record all flows by blocks, and respond to other various programmed conditions. The central computer will have weather station interface capability, alarm capability, and respond to indications received from mechanical failures, flow meters, level sensors in storage tanks, flow switches, pressure sensors, soil moisture sensors, and rain cut-off switches,

The central computer will be programmed to deliver measured quantities of water to individual irrigation blocks or to store water in the LLWRF basins as conditions warrant. Block flows will be programmed and monitored to match individual field requirements.

Individual blocks will have an automatic control valve, pressure regulator, back-up screen filter, buried distribution piping, and buried drip irrigation tubing (Figure 7).

A small microprocessor will be located at each irrigation block valve to communicate with the central computer via a single two-wire cable to open and close valves, provide flow meter flow data, and provide rain and other sensor indications. All data by function will be continuously recorded and stored in the central computer.

3.9 MONITORING PLAN

It is desireable with the irrigation system to set the application flow rate to less than or equal to the determined evapotranspiration (ET) rate. The estimated average ET rate in the Lihi Lani development area approximates 0.22" per day. As indicated in Appendix Table 6-1, all months show a water deficit when irrigating with reclaimed water only. As such, supplemental irrigation water from existing on-site brackish wells will be required to make up the deficit. Actual daily weather data from on-site weather stations will determine adjustments (increase or decrease) in daily application rates.

A monitoring plan will be prepared in accordance with the Department of Health "Proposed Guidelines for the Treatment and Reuse of Reclaimed Water", Draft No. 7, May 20, 1993, to preclude potential groundwater contamination. Weather data from central on-site weather stations will establish actual ET and consumptive use quantities. Irrigation system controls will continuously monitor various sensors and indicators to automatically adjust application rates to desired levels in the individual irrigation blocks to supplement actual weather station input.

3.10 BACKUP EFFLUENT DISPOSAL SYSTEM

No irrigation with reclaimed water will occur during a large rainfall or storm. There will be periods of time when reclaimed water cannot be disposed through land application because natural rainfall will meet plant water demand and soils will be saturated. The Lihi Lani Water Reclamation Facility is designed to temporarily store reclaimed water during high rainfall periods for up to an estimated 35 days. This proposed reclaimed water storage capacity meets Department of Health requirements. No other backup effluent disposal system is required.

SECTION 4

PROJECT EVALUATION

The Lihi Lani Water Reclamation Facility will be operating at far below capacity for the first few years. Irrigation requirements in the proposed reclamation areas necessitate supplemental irrigation water during this period of low reclaimed water availability. It is anticipated that two existing on-site brackish wells will more than adequately satisfy any irrigation needs during this period.

Reclaimed water application rates will be determined during initial stages of operation to establish irrigation scheduling. Soil water sensors will be installed in the reclamation areas and will be monitored. Should these devices indicate that soil water has increased to pre-determined soil water tension levels in a particular irrigation block, the central irrigation computer will switch reclaimed water flows to another irrigation block for disposal.

Records will be maintained on the cycling of reclaimed water flows through the various irrigation blocks. Based on daily calculated ET data from the weather stations, reclaimed water irrigation scheduling will be continually updated.

Reclaimed water use in land application has a proven track record throughout the State of Hawaii. Land application has been demonstrated to be a safe disposal method without creating adverse effects to groundwater or surface water resources. Lihi Lani will institute this proven technology for irrigation of up to 65 acres of pasture and field stock trees. Land application will be phased into use in progressively larger areas as the project is developed over a 12 year period. Extensive monitoring programs will ensure safe operations of the land application system. As a result of the water reclamation program, Lihi Lani will conserve up to 180,00 gallons per day of groundwater. Reclaimed water availability will also enhance viable agricultural uses of this land.

As the project enters the design stage, Obayashi Hawaii will be required to file specific reports with the Hawaii State Department of Health for reclamation activities at Lihi Lani. These reports are required to satisfy current reuse guidelines (Department of Health Draft No. 7, May 20, 1993). Reports include: Basis of Design, Engineering Design Report, and Construction Plans. The Department of Health rigorously reviews these reports prior to approving the water reclamation plan. Obayashi Hawaii will be obligated to meet strict monitoring requirements for the water reuse system.

We are challenged to safely and properly dispose our wastewater effluent and to manage and extend our limited potable water resources. Reclaimed water, as a growing potential resource, offers to successfully address both the concerns of safe effluent disposal and our ongoing irrigation water needs. Water reclamation represents the leading edge of efficient wastewater treatment and resource conservation in the United States and worldwide. Lihi Lani will bring this proven technology to their new community in Pupukea to ensure public safety, environmental preservation, and optimize resource conservation.

SECTION 5

SUMMARY AND CONCLUSIONS

The proposed Lihi Lani Water Reclamation Plan has been developed to offer the most desireable alternative to wastewater effluent disposal by reclaiming the water for a beneficial use and mitigating potential negative impacts on humans and the natural environment.

The Plan calls for reclaimed water from the Lihi Lani Water Reclamation Facility to receive further treatment at the planned Central Irrigation Storage and Distribution Facility. Upon receiving further treatment, reclaimed water will then be delivered to the advanced technology subsurface drip irrigation system for disposal and reuse.

The Lihi Lani Water Reclamation Plan offers the following features and benefits:

1. Designated reclamation areas with limited public exposure.
2. Additional filtration and chlorination of reclaimed water prior to delivering reclaimed water to drip irrigation system.
3. No spraying or aerosol drift of reclaimed irrigation water.
4. No odor, ponding, erosion, or runoff problems.
5. Extension and conservation of our potable water resources by safely using reclaimed water for irrigation.
6. Economical irrigation water
7. Low pressure, low energy demanding drip irrigation system.
8. Fully computerized and continuously monitored irrigation system .
9. A more manageable, balanced distribution of reclaimed water throughout a relatively shallow soil profile by applying reclaimed water directly in plant root zones.
10. Unrestricted irrigation scheduling.
11. Virtual elimination of vandalism and damage to subsurface drip irrigation systems compared to conventional sprinkler systems.

MAXIMUM MONTHLY APPLICATION RATE COMPARED TO QUANTITY OF RECLAIMED WATER AVAILABLE

MONTH	MEDIAN RAINFALL (IN)	EFFECTIVE RAINFALL (IN)	PAN EVAPORATION (IN)	CONSUMPTIVE USE (IN)	NET REQ'D (IN)	VOLUME (MGM/AC)	PASTURE (65 AC) (MGM)	RW FLOW (MGM)	SURPLUS/<DEFICIT> (MGM) (ACCUM.)
JUN	3.6	2.70	7.01	7.71	5.01	0.1361	8.85	5.40	< 3.45>
JUL	4.9	3.68	7.51	8.26	4.58	0.1244	8.09	5.58	< 5.96>
AUG	4.1	3.08	7.88	8.67	5.59	0.1518	9.87	5.58	<10.25>
SEP	3.6	2.70	7.17	7.89	5.19	0.1409	9.16	5.40	<14.01>
OCT	3.7	2.78	6.33	6.96	4.18	0.1135	7.38	5.58	<15.81>
NOV	3.8	2.85	5.12	5.63	2.78	0.0755	4.91	5.40	<15.32>
DEC	5.4	4.05	4.36	4.80	0.75	0.0204	1.33	5.58	<11.07>
JAN	5.8	4.35	4.37	4.81	0.46	0.0125	0.81	5.58	<6.30>
FEB	5.0	3.75	4.82	5.30	1.55	0.0421	2.74	5.04	<4.00>
MAR	4.8	3.60	5.92	6.51	2.91	0.0790	5.14	5.58	<3.56>
APR	4.4	3.30	6.02	6.62	3.32	0.0902	5.86	5.40	<4.02>
MAY	4.2	3.15	6.77	7.45	4.30	0.1168	7.59	5.58	<6.03>
TOTAL	53.3	39.99	73.28	80.61	40.62	1.1032	71.73	65.70	

September 3, 1993

NOTES:

1) EFFECTIVE RAINFALL IS BASED ON 75% OF ACTUAL RAINFALL (Soil Conservation Service literature estimates 75% of precipitation available for plant use, 25% to evaporation and runoff).
2) CONSUMPTIVE USE IS BASED ON 1.1 OF ACTUAL PAN EVAPORATION
3) NET REQUIRED = CONSUMPTIVE USE - EFFECTIVE RAINFALL
4) RW = RECLAIMED WATER
5) RAINFALL DATA TAKEN FROM STATE KEY STATION #896
6) PAN EVAPORATION DATA FROM STATE OF HAWAII REPORT 74, STATE KEY NO. 892

RAINFALL AND WATER BALANCE DATA
LIHI LANI

TABLE 6-1

SECTION 6

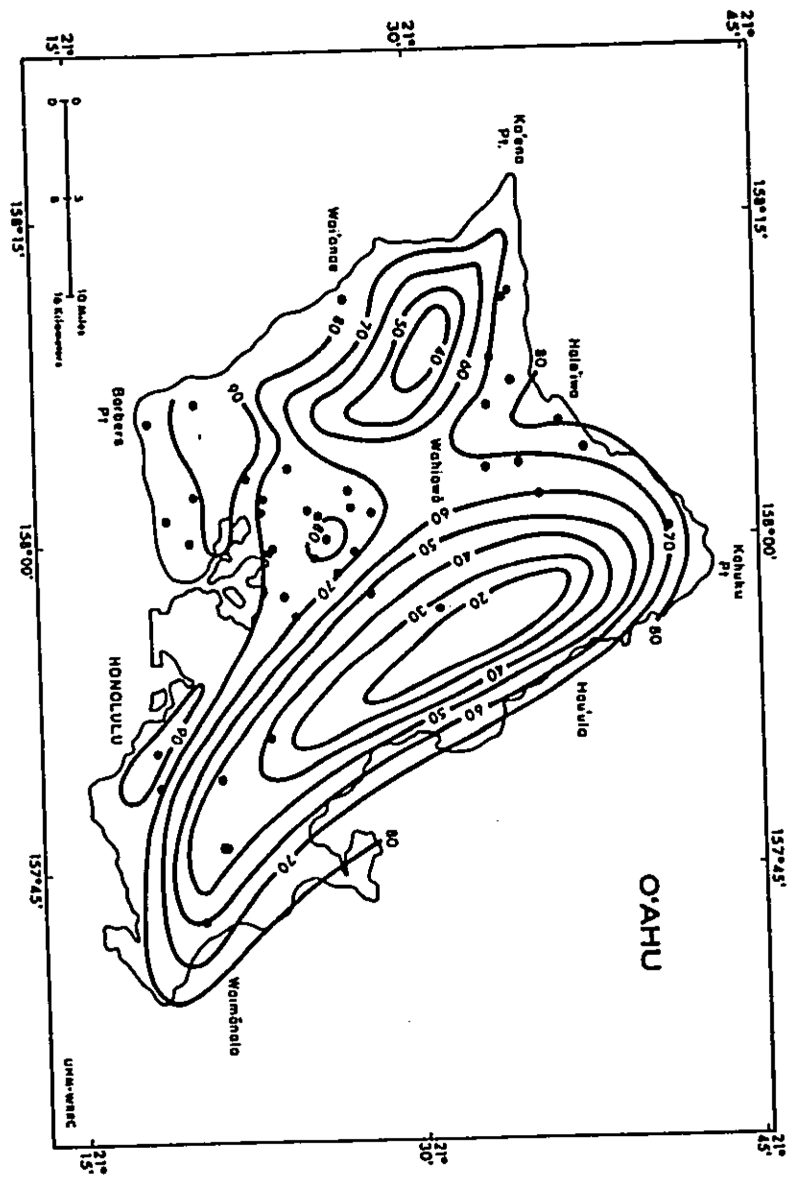
APPENDIX

PAN EVAPORATION STATION 892.00

STATE KEY NO.	NWS NO.	STATION NAME	OBSERVER	PERIOD OF YEARS	FULL YRS	EL. (FT)	CORDINATES Latitude	Longitude
892.00	9593	Waimea 3*	Waialua Ag.	1960-1983	8	420	21 deg 37'43"	158 deg 04'03"

PAN EVAPORATION DATA - STATION 892.00

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1960		4.50	5.53	7.49	7.46	7.82	6.77	8.61	7.45	6.80	5.52	3.96	
1961	4.91	5.19	6.35	6.63	8.37	7.74	9.06	8.96	7.22	5.33	4.26	4.43	78.45
1962	4.50	4.70	6.17	6.39	6.16	7.95	8.33	7.67	7.69	6.80	6.95	5.26	78.57
1963	4.31	5.68	5.70	6.12	5.95	6.79	7.23	7.37	6.18	5.45	4.80		
1964	3.97	4.32	5.43	5.52	6.56	6.73	6.90	8.40	7.96	6.36	4.65		
1965	4.28	4.96	5.63	4.62	6.45	7.09	7.54	7.20	5.62	5.21		3.53	
1966	3.94	3.58	5.71	5.82	6.05	6.44	7.86	9.41	7.90	6.82	4.81	3.73	72.07
1967	3.64	3.85	4.16	5.28	5.81	6.48	6.46	5.99	5.80	5.08	3.96	3.47	59.98
1968	4.47	5.15	5.51	5.56	6.06	7.18	8.16	10.02	8.87	7.43	6.10		
1969	5.64	5.06	6.53	6.21	7.45	7.65	7.00	7.73	5.65	5.96	4.78	4.80	76.26
1970	4.57	5.78	6.40	6.58	6.71	7.69	10.15	9.83	8.33	5.88	3.78	5.05	80.75
1971		5.19	6.52	5.76	7.65	7.05	7.56	6.88	6.21	5.91	3.96	4.26	
1972	3.62	4.15	5.25	5.22	7.08	7.22	9.14	9.12	8.42	6.69	5.27		
1973	4.69	4.67			7.13	6.69	7.03	7.15	6.57	5.33	4.39		
1974	4.06	4.41			6.05	6.42	6.77	7.80	7.81	7.88	5.57	5.20	
1975	4.37	4.36	5.95	6.45	7.37	7.39	7.70	7.73	7.05	6.01	4.86	4.27	73.51
1976			5.74	5.48	7.06	6.79	6.84	7.58	8.32	6.86	7.41	5.06	
1977			7.04	5.52		7.20	7.71	7.86	7.32				
1978		5.53	6.30	6.03	6.48	6.29	7.26	7.10	7.39	6.95	5.01		
1979		4.70	6.98	6.61	6.72	7.85	7.90	8.04	7.20	6.38	4.78		
1980		4.94	5.21	6.08	5.73	6.17	5.51	6.23	6.25	6.51	5.79		
1981		5.76	6.56	6.64	7.07	7.07	7.50	7.75	7.06				
1982		4.39	5.34	5.54	6.87	6.52	6.26	6.74	6.67	7.32	5.83	3.61	
1983	4.59	5.08	6.21	7.00	7.57	6.20							
MEAN	4.37	4.82	5.92	6.02	6.77	7.01	7.51	7.88	7.17	6.33	5.12	4.36	73.94
SD DEV	0.51	0.60	0.67	0.67	0.69	0.55	1.02	1.06	0.93	0.78	0.99	0.66	6.91
COV. %	11.71	12.40	11.29	11.10	10.20	7.90	13.53	13.51	12.99	12.39	18.67	15.25	9.35
YEARS	15	22	22	22	23	24	23	23	23	21	20	13	7



ADJUSTED ANNUAL PAN EVAPORATION FOR OAHU
LIHI LANI

FIGURE 8

SECTION 7

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APPENDIX F

Storm Drainage Plan

STORM DRAINAGE PLAN

FOR THE

PROPOSED LIHI LANI PROJECT

PUPUKEA AND PAUMALU, KOOLAULOA, OAHU, HAWAII

Prepared for:

Obayashi Hawaii Corporation

Honolulu, Hawaii

Prepared by:

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250 Ward Avenue, Suite 206
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September 1993

INTRODUCTION

The Obayashi Hawaii Corporation is proposing to construct a residential and agricultural development on the North Shore of Oahu at Pupukea (TMK: 5-9-05: por. 38, 82 and 5-9-06: 1, 18, 24). The 1,144-acre site is located inland of Kamehameha Highway and Sunset Beach, surrounded by the COMSAT facility, State Forest Reserve, and the Pupukea Highlands and Sunset Hills subdivisions (Figure 1).

The objective of this report is to present preliminary engineering information pertaining to storm drainage for the project development. Specifically, this report will address:

1. Background information on the proposed project;
2. Existing drainage conditions;
3. Proposed drainage concepts and modifications after development;
4. Erosion/sedimentation potential; and
5. Potential impacts and mitigation.

PROJECT BACKGROUND

Proposed Project

The proposed Lihi Lani project will result in the development of new land uses within the 1,144-acre project site. Included is the proposed development of 315 country lots of one acre or larger; 50 single-family affordable homes; 80 elderly housing units; a ranch with pastures, stables and riding trails; a campground; forestry land; and park/community facilities. Approximately 217 acres will remain as open space. The proposed project layout is shown in Figure 2.

Approximately 927 acres of the property are shown in the Master Plan to include new land uses. Between 400 to 480 acres will actually be affected by development activities for residential, agricultural and recreational uses. The remaining lands will be unaffected open space areas.

Consequently, although the open space area shown in the Master Plan is 217 acres, the actual area left undisturbed will be between 664 to 744 acres.

Topographic Features

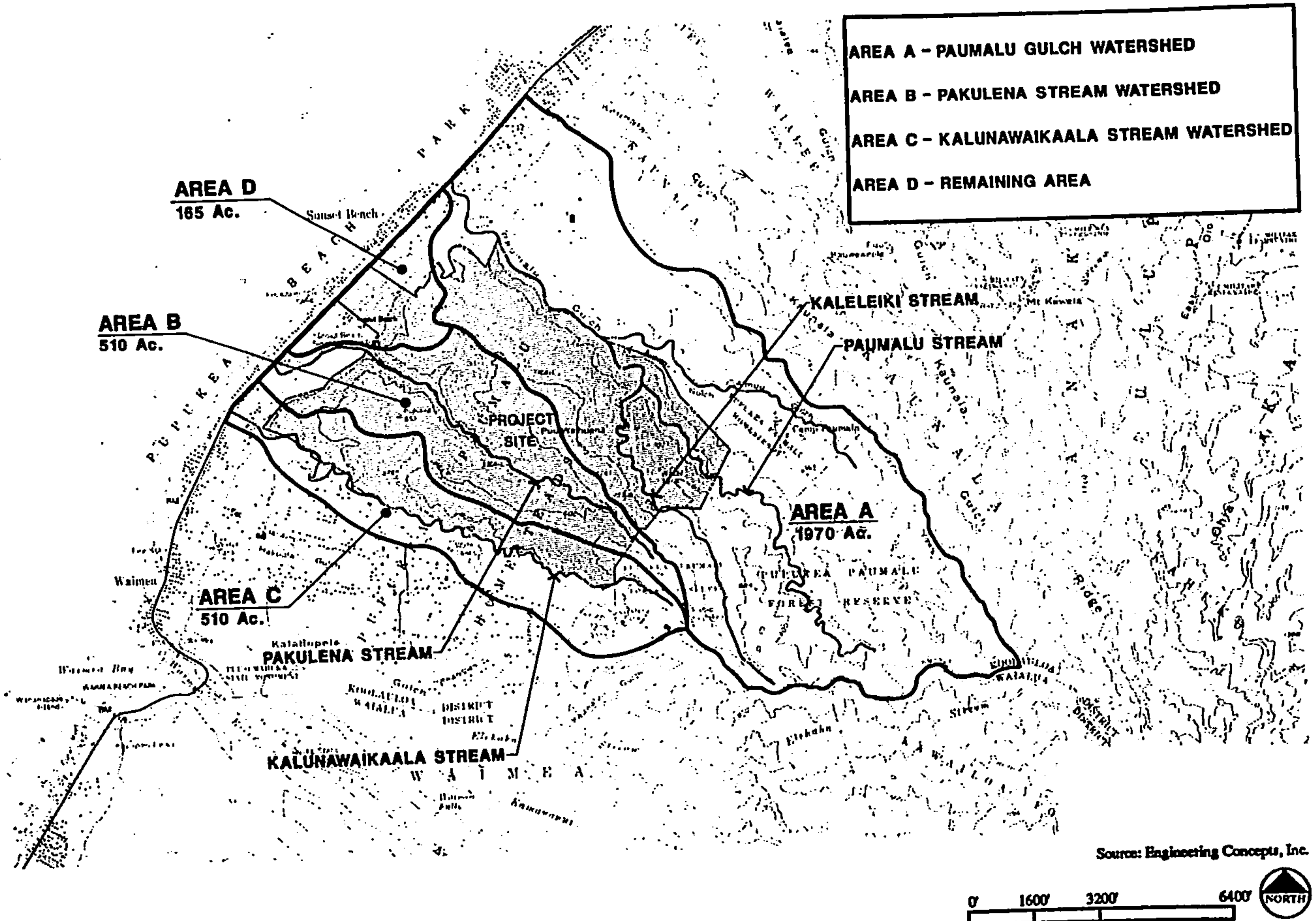
Approximately 18 acres of the project site are situated below the bluffs along the coastal lowlands inland of Kamehameha Highway and northeast of Sunset Beach Elementary School. The remaining 1,126 acres are located on an expanse approximately 6,000 feet wide and 8,000 feet in depth, separated from the coastal lowlands by a 200- to 400-foot high bluff.

The site is isolated from neighboring properties on Kamehameha Highway by the bluff, and from neighbors on the northeast and southwest by the valleys of Paumalu Stream and Kalunawaikaala Stream, respectively. Pakulena Stream bisects the site interior. The three streams flow intermittently, only during periods of heavy rain.

The elevation of the coastal parcel varies from 20 feet to 75 feet while the elevation of major portions of the site varies from 200 feet to 840 feet at the forest reserve boundary. Approximately 30 percent of the site slopes at less than 20 percent.

The property lies within three watersheds (Figure 3), the Paumalu Gulch watershed, the Pakulena Stream watershed, and the Kalunawaikaala Stream watershed. The coastal parcel portion of the property does not appear to drain to any of the watersheds, sloping directly toward Kamehameha Highway.

The Paumalu Gulch watershed is the largest of the three watersheds affected by the project. It encompasses approximately 1,970 acres and stretches almost 3.5 miles inland from Kamehameha Highway to the Pupukea-Paumalu Ridge. The Paumalu Gulch watershed contains three subwatersheds: Aimuu Gulch, Paumalu Stream, and Kaleleiki Stream, none of which are perennial.



Source: Engineering Concepts, Inc.

WATERSHED BOUNDARIES

LIHI LANI

The Pakulena Stream watershed covers approximately 510 acres, most of which fall on the project site. The Pakulena Stream watershed extends approximately 2 miles inland from Kamehameha Highway up to an elevation of 960 feet above sea level at the Boy Scouts Camp Pupukea.

The third watershed, Kalunawaikaala Stream watershed, also covers an area of approximately 510 acres. Portions of the Sunset Hills and Pupukea Highlands subdivisions fall within this watershed. The upper reach of the Kalunawaikaala Stream watershed converges with the Pakulena Stream watershed approximately 2 miles inland from Kamehameha Highway.

The three watersheds are characterized by steep gulches bordering relatively flat to rolling plateaus. The plateaus are covered with tall grass, scrub brush, and trees, with the gullies having dense tree cover and moderately thick underbrush.

Climate

The median annual rainfall recorded at the Pupukea Farm Weather Station 896.00 is 51.7 inches. Tradewinds from the sea average 8.9 mph, blowing slightly stronger during the day. The average temperatures in the summer are 83 degrees Fahrenheit (F) during the day and 69 degrees F at night, while winter temperatures average 77 degrees F during the day and 64 degrees F at night. Relative humidity averages 74.6 percent during the day.

EXISTING DRAINAGE CONDITIONS

Currently, there are no drainage improvements on the project site. Runoff flows overland to the three gulches and is conveyed to the ocean through existing culverts at Kamehameha Highway. The culvert serving the Paumalu Gulch is located approximately 3,200 feet north of the property, with the culverts serving the Pakulena and Kalunawaikaala Streams located approximately 2,200 feet and 3,800 feet south of the property, respectively. The runoff from Area D (Figure 3) flows overland to Kamehameha Highway.

Flooding of the low-lying residential areas along the coast is known to occur during heavy rains. Much of the flooding can be attributed to the many sump areas along Kamehameha Highway between the Paumalu and Pakulena Stream crossings. In addition, the three streams serving the major watersheds become less defined as they approach the ocean. A flood insurance study for the City and County of Honolulu was prepared by the U.S. Army Corps of Engineers in 1980. This report included the Sunset Beach area and mentioned that "...the principal flood problem in the area is the lack of defined streams adequate to convey storm runoff to the oceans." The report further mentioned that flooding in the lower flat lands "...is due to the lack of adequate drainage systems and local depressions." Obstruction of the stream crossings at Kamehameha Highway may also contribute to the flooding of the area. The culverts were observed to be clogged with sand, rubbish, and vegetation, with the channels to the ocean filled with sand to the point of being barely discernible.

A recent study conducted by the Department of Land and Natural Resources in 1992 reached similar conclusions. The results of their investigation are documented in a report entitled "A Study to Alleviate Chronic Flooding on Oahu's North Shore (Pupukea & Haleiwa-Waialua Areas)".

PROPOSED DRAINAGE

Overall Development

The proposed project has new land uses planned over approximately 927 of the property's 1,144 acres. However, the actual total area that could be affected by construction of the improvements will be approximately 400 to 480 acres. A large part of the 765 acres planned for country lots (one-acre minimum) will be steep, unbuildable areas that will remain as open space. Proposed areas for the various land uses in each affected watershed and the remaining area are listed in Table 1.

The proposed development will change the character of approximately 35 to 40 percent of the project site. The vegetation associated with the existing pasture and wooded lands would be

TABLE 1

PROPOSED LAND USE WITHIN WATERSHED AREA

Watershed	Total Watershed Area (acres)	Property (acres)	Proposed Land Use (acres): Residential*	Agricultural**	Ranch	Other Uses	Roadways	Undeveloped Area
Paumalu Gulch	1,970	430	55	37	0	49	13	276
Pakulena Stream	510	460	45	41	48	24	20	282
Kalunawaikaala Stream	510	184	36	34	0	0	6	108
Remainder	165	70	24	0	0	15	6	25
TOTAL		1,144	160	112	48	88	45	691

*Assumes that 20 percent of the total country lot area will be developed for residential use.

**Includes areas set aside for certain agricultural activities such as flowers, fruits, field stock trees, and nursery (includes portions of the country lots).

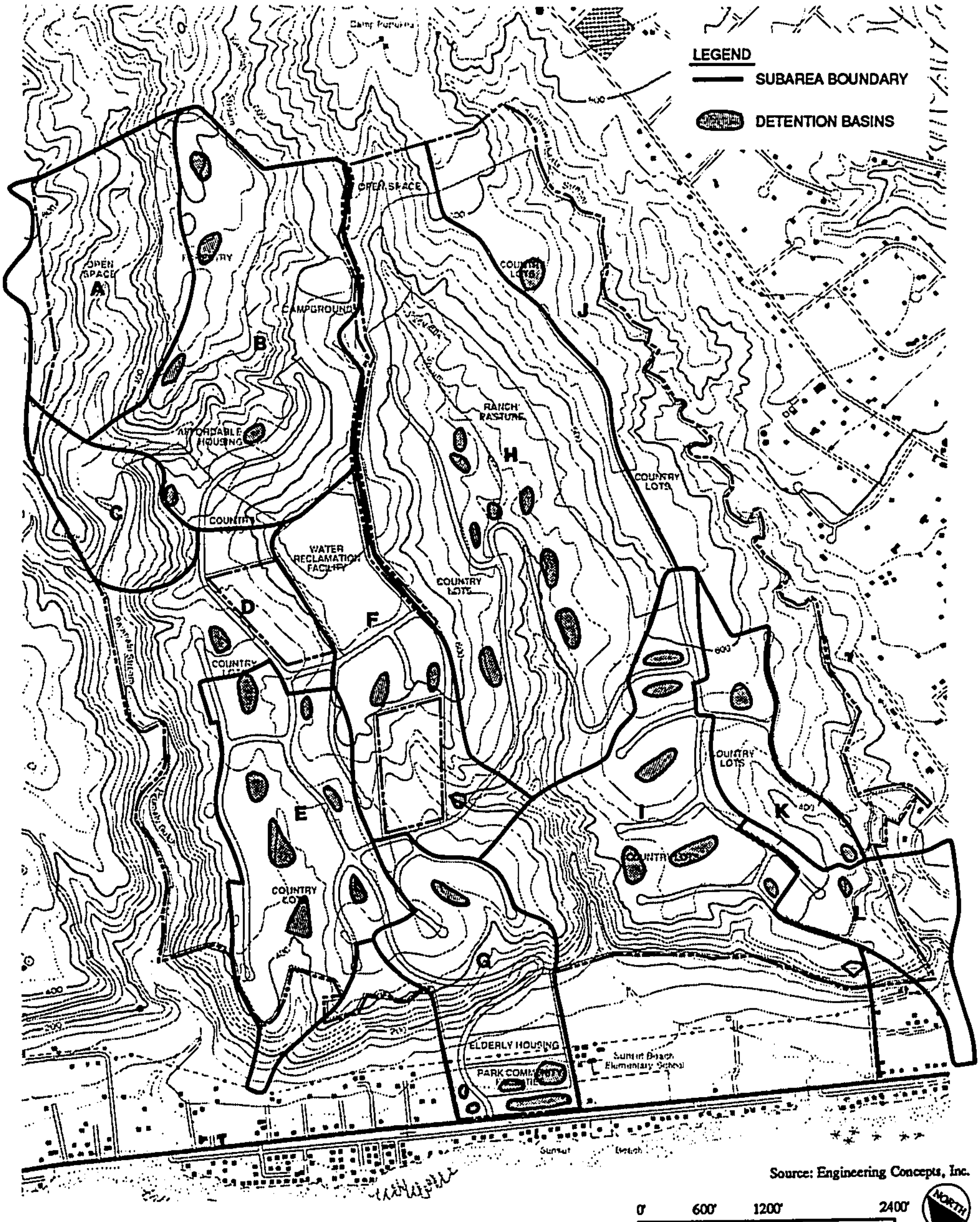
replaced with flowers, fruits, and field stock trees associated with the agricultural activities in the subdivision. Roadways and residential development will further add to the modification of the project site.

Drainage patterns are expected to remain similar to existing conditions although some diversions of runoff through the internal roads are proposed. It is anticipated that the natural slopes and vegetation of most of the areas unaffected by construction of the improvements would be maintained. Much of the unimproved areas consist of steep terrain along the slopes of the gulches.

The three major watersheds and the remaining area were divided into smaller sub-basins and analyzed (Figure 4). Runoff from developed areas will be directed to detention basins where practicable. The detention basins will be incorporated into the development plans to dampen the runoff before the project boundary such that the discharge rate after development is not greater than the discharge rate before development. Storm water leaving the detention basins will be directed to the nearest gully via a pipe outlet or overland flow.

Paumalu Gulch

The Paumalu Gulch watershed (shown as subareas A through E on Figure 4) was divided into smaller subareas based on the location of the proposed detention basins. Flow will be directed to the detention basins via cutoff swales. The amount of storage provided for Paumalu Gulch is approximately 54 acre-ft. A detailed analysis was performed modelling flood routing through the various detention basins using the Soil Conservation Service (SCS) TR-20 computer program. The detention basins were located downstream of areas to be developed and designed so that the storm runoff discharge rate and volume due to development would not increase. The peak runoff rate for a 100-year 24-hour storm before development from Paumalu Stream is about 3496 cfs. With flood routing through the detention basins in the developed site, the storm runoff rate and volume discharge to the areas below the project are expected to be slightly less.



Source: Engineering Concepts, Inc.

DRAINAGE SUB-BASIN AREAS

LIHI LANI

The runoff rate before development for the drainage basin that discharges from the plateau area towards Kamehameha Highway (subarea E on Figure 4) is 340 cfs for a 100-year 24-hour storm. With flood routing through the detention basins, the runoff rate after development reflects at least a twenty percent reduction and the runoff volume will be slightly less.

Pakulena Stream

The Pakulena Stream watershed (shown as subareas F,H, and I on Figure 4) was divided into smaller subareas based on the location of the proposed detention basins. The amount of storage provided is approximately 62 acre-ft. The runoff from the water reclamation facility is minimal due to the open ponds located onsite. The runoff rate for a 100-year 24-hour storm before development is about 1400 cfs. With flood routing through the detention basins, the storm runoff rate and volume discharged to the areas below the project are expected to be slightly less.

Kalunawaikaala Stream

The Kalunawaikaala Stream watershed (shown as subareas J,K and L on Figure 4) was divided into smaller subareas based on the location of the proposed detention basins. The amount of storage provided is approximately 17 acre-ft. The runoff rate for a 100-year 24-hour storm before development is about 1174 cfs. With flood routing through the detention basins, the storm runoff rate and volume discharged to the areas below the project are expected to be approximately the same.

Community Facilities Site

The runoff rate for a 100-year 24-hour storm before development at the community facilities site (shown as subarea G on Figure 4) based on preliminary plans is 300 cfs. The amount of storage provided is approximately 20 ac-ft. With flood routing through the proposed detention basins with drywells located near Kamehameha Highway, the discharge runoff volume is not expected to increase after development, and the peak runoff rate for the 100-year 24-hour storm is expected to decrease approximately 50 percent.

The final storm runoff numbers for the developed conditions are dependent on the final design of the development and drainage facilities.

Potential Impacts and Mitigation

The proposed development will increase the quantity of peak runoff generated onsite. However, detention basins located in agricultural areas, the ranch area and other open spaces provide a means of mitigating the impacts of the increased runoff. Runoff generated onsite will be routed through the detention basins, where practicable, to dampen the peak runoff rate such that the runoff conveyed by the streams is expected to remain at the levels experienced with existing conditions. Throughout the overall development, ponding areas to provide detention will be constructed in the development parcels, open spaces, and agricultural areas.

The impact of the country lots and affordable housing area on runoff is expected to be minimal. Many of the lots and much of the country lot housing area will drain onto open spaces or agricultural areas, allowing the runoff to be routed through detention basins. The remaining areas are located along the edge of the bluffs, with runoff sheet flowing to the three drainageways. The dense, natural vegetation along the gulch is expected to dampen the runoff, minimizing the impacts of any increase in runoff. Although the country lots are large, many lots have considerable areas that are not useable, falling on steep slopes. This condition limits development area within the lots; thus further minimizing the increase in runoff. Detention basins and drywells will be provided in the low-lying area adjacent to Kamehameha Highway to offset potential increases in onsite runoff due to improvements proposed for the elderly housing, community facilities, and the main access road.

GRADING AND SOIL EROSION POTENTIAL

Grading

There will be four phases of development over a projected ten to twelve year period. It is anticipated that grading within the project site will be limited to the ridges and plateau areas where slopes are less steep, thus favoring development. The grading concept for the country lots will be to provide a level pad area for the building and surrounding landscaped area, rather than leveling the entire lot. The steep gulch areas will generally remain in a natural or undeveloped state. However, some grading in the gulches may be required for bridges or box culvert crossings. In addition, there will be grading for roadways and other building sites (i.e. Ranch, Community Facility, etc.). An effort to balance the earthwork quantities of cut and fill is expected to minimize the cost of purchasing offsite borrow and disposing excess excavated material at an offsite location. Grading operations will be in conformance with the applicable ordinances of the City and County of Honolulu.

Soil Erosion Potential

Site Characteristics

The project site is divided into twelve subareas for the purpose of calculating soil erosion potential (Figure 5). These subareas represent sites that vary in soil erosion potential characteristics such as terrain and/or drainage network.

Subarea A, part of the Paumalu Stream drainage basin, is located on the northwestern corner of the site and occupies approximately 74 acres. Presently, subarea A is undeveloped and characterized as a medium stocked woodland with ironwood trees and needles covering the ground near the gulch areas and grassland and brush in the plateau areas. After development, approximately 16 percent will be graded for forestry and the remaining 84 percent will remain undeveloped.

The existing conditions described in subarea A is typical of the existing conditions found in all the subareas except for subareas G, I and K. Approximately 50 percent of Subareas G, I and K is characterized by pasture land. A brief characterization of each subarea is included in Table 2.

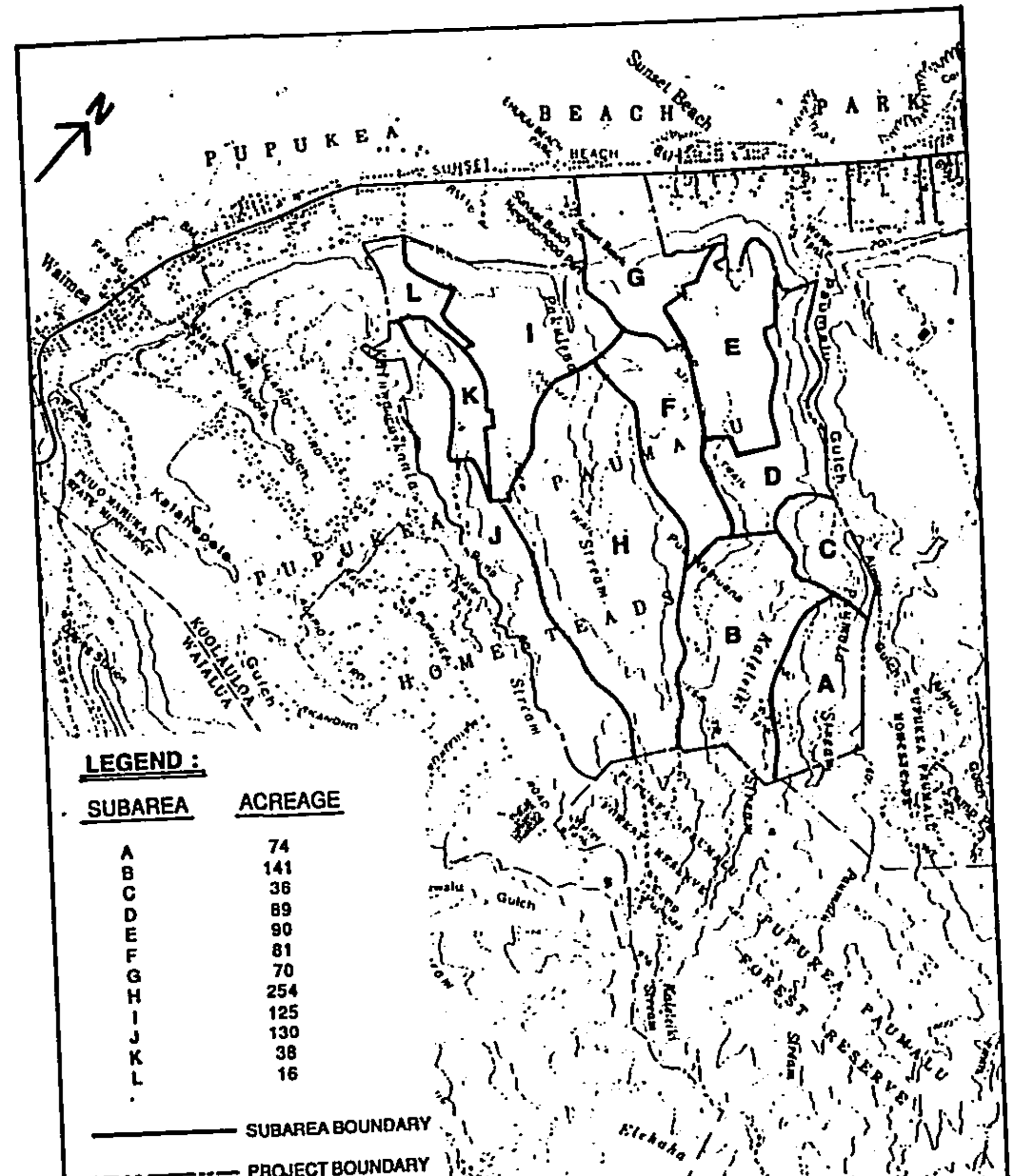


FIGURE 5
SUBAREAS FOR CALCULATION OF SOIL EROSION POTENTIAL

TABLE 2

SUBAREA CHARACTERISTICS

Subarea	Gulch/Plateau	Area (acres)	Land Use After Development % Residential	% Agricultural*	% Other
A	Paumalu Stream	74	0	0	100
B	Kaleleiki Stream	141	11	0	89
C	Paumalu Stream	36	3	0	97
D	Paumalu Stream	89	13	5	72
E	Plateau ("Amphitheatre")	90	26	36	38
F	Pakulena Stream tributary	81	12	15	73
G	Plateau	70	20	0	80
H	Pakulena Stream	254	7	0	93
I	Pakulena Stream	125	12	23	65
J	Kalunawaikaala Stream	130	9	19	72
K	Kalanawaikaala Stream tributary	38	22	23	55
L	Kalunawaikaala Stream	16	44	0	56

*Includes areas set aside for agricultural activities such as pasture, flowers, fruits, field stock trees and nursery.

Universal Soil Loss Equation

The U.S. Department of Agriculture, Soil Conservation Service, uses the Universal Soil Loss Equation (USLE) to estimate long term average annual soil erosion losses from sheet and rill erosion. It is used to estimate erosion on forest land, farm fields, construction/development sites, and other areas. Soil losses can be estimated for present conditions or for a future condition. The soil loss equation is:

$$A=RKLSCP$$

where:
- A=soil loss (tons/acre/year)
- R=rainfall factor
- K=soil erodibility factor
- L=slope length factor
- S=slope gradient factor
- C=cover and management factor
- P=erosion control practice factor

The rainfall factor (R) and soil erodibility factor (K) are based on the U.S. Soil Conservation Services (SCS) Erosion and Sediment Control Guide for Hawaii. The K values for each subarea is based on the weighted average of the K values for each soil type in the subarea. The cover and management factor (C) is also based on the weighted average for C values within each subarea and was recalculated accordingly to reflect conditions after development of the Lihi Lani project. Both R and K factors will remain the same for the site before and after the proposed project is constructed.

The slope length factor (L) and slope gradient factor (S) are combined into an LS factor for calculations. Each subarea has different factors to reflect the differences in topography. The LS factor decreases after development, because site grading and construction of an underground drainage system is expected to reduce the slope and length of the overland flow.

Existing Soil Erosion Potential

The existing soil erosion potential for the twelve subareas was estimated using the USLE (Table 3). The total estimated soil loss under existing conditions is 35,719 tons/year.

Soil Erosion Potential After Development

The long-term change in soil erosion potential can be estimated by the USLE for the new land uses at the site. The C factors for the subareas should decrease based on the proposed development. Accordingly, the soil erosion potential after development was estimated and is summarized in Table 4. The total estimated soil loss for developed conditions is 27,695 tons/year or approximately a 22 percent reduction as compared to existing conditions.

Soil Erosion Potential During Construction

The development of Lihi Lani will occur in four phases. Phasing the development will reduce the impact of soil erosion caused by construction activities on the project site since the entire 453 acres affected by construction will not be cleared at the same time. The first phase of development consists of the internal roadways, 70 country lots, the water reclamation facility, affordable housing, site preparation for elderly housing, park and community facility site and a portion of the ranch/pasture area. The first phase of development totals approximately 185 acres or approximately 41 percent of the total estimated area that could be affected by construction. The subsequent phases of development will be approximately 20% less than Phase I and therefore should have a lower total soil erosion potential than Phase I. The first phase of development will be further divided into sub-phases for construction with the infrastructure (including roadways and the water reclamation facility) being built in the first year, the house pads and the park/community facility being built in the second year and the agricultural operations for the country lots and the ranch/pasture area being constructed last. By phasing construction activities over several years, the related impact on the annual soil erosion potential will be further reduced. The soil erosion potential for Phase I will be estimated using the USLE.

TABLE 3

EXISTING SOIL EROSION POTENTIAL

SUBAREA	R	K	LS	C	P	A (tons/ac/yr)	Area (ac)	Tons/Yr
A	300	.37	35.6	.024	1	94.84	74	7,018
B	300	.30	25.9	.021	1	48.95	141	6,902
C	300	.39	43.1	.029	1	146.24	36	5,265
D	300	.20	56.6	.026	1	88.30	89	7,859
E	300	.27	3.8	.019	1	5.85	90	527
F	300	.30	1.1	.019	1	1.88	81	152
G	300	.17	11.8	.015	1	9.03	70	632
H	300	.28	11.8	.022	1	21.81	254	5,540
I	300	.18	3.8	.019	1	3.90	125	488
J	300	.14	11.8	.02	1	9.91	130	1,288
K	300	.09	1.5	.018	1	0.73	38	28
L	300	.18	1.1	.021	1	1.25	16	20
						TOTAL	1,144	35,719

TABLE 4

SOIL EROSION POTENTIAL AFTER DEVELOPMENT

SUBAREA	R	K	LS	C	P	A (tons/ac/yr)	Area (ac)	Tons/Yr
A	300	.37	35.6	.022	1	86.94	74	6,434
B	300	.30	4.5	.017	1	6.89	141	971
C	300	.39	43.1	.029	1	146.24	36	5,265
D	300	.20	56.6	.025	1	84.90	89	7,556
E	300	.27	3.7	.016	1	4.80	90	432
F	300	.30	0.9	.026	1	2.11	81	171
G	300	.17	4.0	.013	1	2.65	70	186
H	300	.28	11.8	.020	1	19.82	254	5,034
I	300	.18	3.1	.021	1	3.52	125	440
J	300	.14	11.8	.018	1	8.92	130	1,160
K	300	.09	1.5	.017	1	0.69	38	26
L	300	.18	1.1	.021	1	1.25	16	20
						TOTAL	1,144	27,695

Infrastructure Construction

The Phase I infrastructure construction affects approximately 53 acres (29 acres of roadway and 24 acres for the water reclamation facility) representing only 4.6% of the total 1,144 acres. Temporary erosion control measures such as interceptor ditches, berms and sediment traps will be implemented during construction. Without these erosion control measures, the increase in the soil erosion potential for this phase of construction would be 5,410 tons/year. This would be approximately 50 times the existing soil erosion potential for the 53 acres affected, but only a 15.2% increase over the existing soil erosion potential from the total project site of 1,144 acres. This relative increase would be even less for the entire drainage watershed area of 3,155 acres. With the erosion control measures implemented at the project, as stated previously, the increase in the soil erosion potential during construction is reduced to 3,136 tons/year. This quantity would be 29 times the existing soil erosion potential of the 53 acres under construction, or an 8.8% increase in the annual soil erosion potential for the total project site.

The City and County of Honolulu has established a standard maximum severity rating number for Oahu of 50,000. The City requires additional erosion control measures if the number exceeds this figure. The estimated severity rating number for this portion of construction with basic erosion control measures is approximately 42,500. This number can be further reduced by implementing additional temporary erosion control measures as necessary.

Housepad Construction

The housepad construction in Phase 1 consists of approximately 59 acres representing 5.2% of the total 1,144 acres. The grading for the housepads and community facility will be limited to not more than 15 contiguous acres at a time with seeding of half of the area. Temporary erosion control measures for the elderly housing and park/community facility area include interceptor ditches and berms. The detention/retention basins for the park area will be constructed prior to grading and will be used as sediment basins during construction. Without any erosion control measures other than the construction of the sediment basins, the soil erosion potential for this phase of construction would be 3,720 tons/year or approximately 50 times the existing soil erosion potential for the area under construction. This represents an increase of 10.4% over existing conditions for the total project site. With erosion control measures, the soil erosion potential is reduced to 1,873 tons/year or approximately 25 times the soil erosion potential of existing conditions for the area affected by this phase of construction. This results in only a 5.2% increase in the existing annual soil erosion potential for the total project site. The estimated severity rating number for this portion of construction is approximately 18,000.

<u>Agricultural Construction</u>

The agricultural construction in Phase 1 consists of planting field stock trees in agricultural easements on the country lots and ranch/pasture construction which totals to approximately 73 acres or 6.4% of the total project site. The grading for the agricultural construction will be limited to not more than 15 contiguous acres at a time with planting of the trees occurring after the grading is completed. The remaining field stock tree area will also be grassed to reduce soil erosion. For the ranch/pasture area, grading will be limited to not more than 15 contiguous acres at a time with grassing after grading is completed. The detention basins shown in the field stock trees and ranch/pasture area will be constructed prior to grading and will be used as sediment basins during construction. Temporary erosion control measures such as interceptor ditches and berms will be implemented during construction. Without any erosion control measures other than the construction of the sediment basins, the increase in the soil erosion potential for this phase of construction would be 6,343 tons/year or approximately 23 times the existing soil erosion potential for the 73 acres. This represents an increase of 17.8% over existing conditions from the total project site. With erosion control measures, the soil erosion potential is 2,620 tons/yr or 9 times the existing soil erosion potential for areas affected by this phase of construction or a 7.3% increase for the total project site. The severity rating number for this portion of construction is approximately 13,000.

During construction, the Environmental Protection Agency (EPA), under the National Pollutant Discharge Elimination System (NPDES), requires sediment basins providing 3,600 cubic feet (cf) of storage for every acre of area disturbed. For Phase I construction, 185 acres will be disturbed which will require 666,000 cf or approximately 15 acre-ft of sediment basin capacity. As part of construction, the detention basins (shown on Figure 4) located in the first phase of construction will be built prior to grading operations. The storage provided could be approximately 63 acre-ft. which is approximately four times the amount required by EPA.

Potential Impacts and Mitigation

Erosion is the process in which, by the actions of rain runoff or wind, soil particles are displaced and transported. Sediment is the eroded material suspended in flowing water or in the air (wind). What results is sedimentation which is the deposition of eroded material. Generally, concerns about erosion have to do with impacts on the Lihi Lani project site; and concerns about sedimentation are in regards to potential property damages oceanside of the project site and/or negative impacts to water quality in the intermittent streams or the ocean.

Some mitigative measures are effective in minimizing soil erosion by water and wind, while other methods are meant to reduce sediment transport. The following sections address impacts and mitigative measures as they pertain to this project.

<u>Long Term Impacts</u>

Based on the USLE, soil erosion potential at the project site should decrease after the development of the proposed Lihi Lani project. This decrease in soil erosion is attributed to the reduction of erodible surfaces (increase in buildings and pavement); reduction of length and slope of overland flow due to site grading and construction of a storm drain system; and increase in landscaped area (reduction of bare ground).

The soil erosion potential for the existing conditions and developed conditions are summarized in Tables 3 and 4. The estimated erosion potential for the project is expected to decrease by 8,024 tons/year or 22 percent.

Short Term Impacts and Mitigation

The construction of the proposed project will involve land disturbing activities that result in soil erosion. These land disturbing activities include removal of existing vegetation (clearing and grubbing) and leveling, removing, and replacing soil. Even with careful implementation of erosion/sedimentation control measures during construction, the project may cause some temporary increases in erosion and sediment transport to oceanside areas. The USLE can be used to evaluate soil erosion potential based on these short-term construction impacts.

Mitigating measures will be implemented to reduce short-term soil erosion. For example, limiting grading to not more than 15 contiguous acres at a time and seeding half of the area will reduce estimated erosion potential for the site by about 47 percent. Detailed erosion control plans prepared in accordance with the City and County of Honolulu Soil Erosion Standards and Guidelines will be submitted to the City and County of Honolulu for their approval at the time the construction plans are submitted.

Erosion control measures that could be implemented to further lessen construction impacts include:

1. Minimize time of construction.
2. Retain existing ground cover until the latest date before construction.
3. Early construction of drainage control features.
4. Use of temporary area sprinklers in nonactive construction areas when ground cover is removed.
5. Station water truck onsite during construction period to provide for immediate sprinkling, as needed, in active construction zones (weekends and holidays included).

6. Continue thorough watering of graded areas after construction activity has ceased for the day and on weekends.
7. Sod or plant all cut and fill slopes immediately after grading work has been completed.
8. Use temporary berms, cut-off ditches and other diversion channels, where needed, to interrupt runoff and divert it to the nearest sediment basin.
9. Construct temporary sediment basins to trap silt.
10. Construct temporary silt fences or straw bale barriers to trap silt.

Additional mitigation measures that are discussed in EPA's "Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters" may also be used.

CONCLUSIONS

Due to the nature of the development with its large open spaces, it is expected that the overall impact of drainage in the area will be minimal. Storm runoff will be routed through detention/retention basins in the proposed agricultural areas, ranch and other open spaces to dampen the peak runoff rate and volume due to development. Additional detention features and drywells will be provided, as necessary, in the low-lying areas adjacent to Kamehameha Highway. Actual sizes and locations of these features will be determined during the design stage of the project. Much of the natural vegetation along the gulches and undisturbed areas are expected to remain, trapping sediment in runoff from developed areas, and further minimizing the potential impact of runoff from the project.

The overall soil erosion potential of the project site is expected to decrease by approximately 22 percent after development due to the reduction of erodible surfaces. A study of the potential impacts of soil erosion on surface water quality has been prepared by Tom Nance Water Resources Engineering (September 1993).

REFERENCES

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4. U.S. Department of Agriculture, Soil Conservation Service. 1981. "Erosion and Sediment Control Guide for Hawaii." Done in cooperation with the Hawaii Association of Soil and Water Conservation Districts and the Soil Conservation Society of America, Hawaii Chapter.

5. Environmental Protection Agency. January 1993. "Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters."

APPENDIX G

Market Assessment
for Lihi Lani

KPMG Peat Marwick

Management Consultants

Focused experience for measurable results

Manufacturing and Technology Industries
Financial Institutions
Health Care
Government Services
Insurance
Real Estate and Hospitality
Airports
Retail and Wholesale
Education
Energy and Utilities
Corporate Transactions
Technology and Operations
Compensation and Benefits

Obayashi Hawaii Corporation

MARKET ASSESSMENT FOR LIHI LANI

Pupukea, Oahu, Hawaii

Report
July 1993

KPMG Peat Marwick

Management Consultants

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1001 Bishop Street
Honolulu, HI 96813-3421

Telephone 808 531 7286

Telefax 808 541 9320

July 15, 1993

Mr. Toshiharu Hino, President
Obayashi Hawaii Corporation
c/o Mr. Craig Yamagishi
Lihi Lani
66-145 Kamehameha Highway
Haleiwa, Hawaii 96712

Dear Mr. Hino:

KPMG Peat Marwick is pleased to submit the attached report entitled, "Market Assessment for Lihi Lani."

The accompanying report is divided into four chapters as follows:

1 Executive Summary
2 Project Overview and Regional Setting
3 Country Lot Market Overview
4 Country Lot Market Assessment

We have appreciated this opportunity to assist Obayashi Hawaii Corporation on this project and look forward to supporting you further in its planning and implementation.

Very truly yours,

KPMG Peat Marwick

MARKET ASSESSMENT FOR LIHI LANI

CONTENTS

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CONTENTS

1 - EXECUTIVE SUMMARY

This chapter reviews the background and scope of the market assessment for Lihi Lani and summarizes the conclusions of our study. Detailed analyses and support for our findings and conclusions are presented in the following chapters.

BACKGROUND

Obayashi Hawaii Corporation (Obayashi) plans to develop an integrated residential agricultural and recreational community on about 1,144 acres of land at Pupukea in the Ko'olauloa District on the island of Oahu, as shown in Exhibit 2-A. The combination of the various aspects of Lihi Lani will combine to maintain and further enhance the rural lifestyle and character for which the North Shore of Oahu is known.

Obayashi's plan is to preserve and protect the country lifestyle and environment of the North Shore, while helping to meet housing and community needs. Housing at Lihi Lani is proposed to include a wide range of product types which are targeted to various market segments including elderly renters, "starter" households, and "move-up" residents who seek a quality up-country way of life. The following types of developments would be within the community:

- **Country lots**

  315 country lots from about 1 to 3 acres in size are proposed to be developed on approximately 765 acres.

  The term "country lot" is used to describe a parcel of land located within a country district. A country district is identified by the City and County of Honolulu as a district intended to provide for some agricultural uses, low density residential development and some supporting services and uses. The development standards for a country district identifies that parcels must have a minimum lot area of one-acre and up to 25% of the lot may be utilized for non-agricultural structures.

- **Affordable housing**

  Obayashi will contribute towards the development of 180 affordable housing units either by developing the units, donating the land or by making a monetary contribution to a City fund designated to the development of affordable homes. While final affordable housing delivery is still being discussed with the Department of Housing and Community Development and the Department of Land Utilization, the current proposal is outlined below.

  50 single-family affordably priced homes which will be developed and sold by Obayashi at the Lihi Lani site.

  Six acres of land, including all off-site infrastructure to the parcel, will be donated by Obayashi to the City and County of Honolulu. Plans for the 6 acres of land consist of a 80 unit elderly housing project which will be developed and managed by the City.

  Obayashi will make a monetary contribution to a City fund for the development of a portion of about 50 off-site affordable housing units.

- **Horse ranch, riding and hiking trails**

  64 acres within Lihi Lani will be allocated to a horse ranch and will include stables, pasture area, tack, arena, riding trails and orchards. A network of trails encompassing several miles throughout the site would be specifically used for horseback riding and hiking. Trails will be accessible to the community, with linkage to the Kaunala Trail in the State Forest Reserve.

- **Parks, open space, natural areas, community facilities and campgrounds**

  About 200 acres will be dedicated to outdoor recreational and agricultural open space areas for crop cultivation, ranching, pasturage, horseback riding, hiking and camping activities. Four acres will be developed as a campground site that would be accessible by hiking paths, horseback, and jeep roads.

  A YMCA facility is proposed for the makai portion of the site. Various facilities which are planned include community meeting and recreation center, swimming pool, playing field for soccer and baseball, volleyball courts, and landscaped barbecue and picnic areas. Various YMCA sponsored programs which may be offered at the facility include child care, summer youth programs and after school care, exercise gym, arts and crafts classes, and senior citizen programs.

  The various proposed community facilities will serve recognized needs of the North Shore community as a site for public meetings, community programs, child care programs, and a variety of recreational activities.

- **Agriculture**

  The country lots located within Lihi Lani will be designed with an on-lot agricultural requirement. The agricultural component also includes lands which will be dedicated to diversified agriculture. Potential agricultural crops include fruit trees, field stock trees, cut flowers and foliage.

  An agricultural cooperative is being considered with central facilities for refrigeration, holding, shipping and marketing of the agricultural products.

  The agricultural use of the lots is expected to benefit Lihi Lani in several ways. It would differentiate the project, giving it a unique identity to buyers, enhance the landscape and reinforce the owners enjoyment of owning a productive farm property.

With a total of only 445 units proposed at completion, the community of Lihi Lani will have a very low density of less than one unit for every two acres of land. This is expected to preserve the secluded and rural nature of the project and enhance its appeal to buyers who seek a rustic up-country residence.

The project will be designed to complement the existing character of the North Shore. Lihi Lani will provide extensive undisturbed open spaces. The natural topography of Lihi Lani's coastal bluff will be further enhanced with the addition of landscaping. Much of the vegetation which will be utilized for landscaping along the coastal bluff and throughout the project will consist of native plant species similar to those found throughout the North Shore of Oahu. Generally, the residential, community and recreational facilities located on the mauka portion of the site will not be noticeable from the makai areas. The structures will be set back from the bluff edge and screened by landscape plantings and existing vegetation. Thus, The overall project concept and design of Lihi Lani will reflect a rustic country atmosphere.

STUDY OBJECTIVE

The objective of this study is to evaluate the potential market support for Lihi Lani and to project its anticipated market performance in terms of:

- Profile of purchasers which the project could expect to attract
- Anticipated sales absorption or expected demand
- Appropriate lot prices

COUNTRY LOT MARKET OVERVIEW

To assess the probable buyer market, market pricing and absorption for Lihi Lani, five comparable single-family lot subdivisions within the Pupukea area have been reviewed. Also, due to the limited supply of country lot projects available on the island of Oahu, acreage lot subdivisions on the island of Hawaii were also reviewed.

Pupukea Residential Market Overview

Five Pupukea projects were chosen for review and comparison to Lihi Lani because of their similarities in size, location, and project characteristics. The five subdivisions are as follows:

- Lacy Subdivision
- North Shore Heights
- Pupukea Gardens
- Pupukea Highlands
- Sunset Hills

The selected subdivisions vary in overall project size and range from 20 acres at Lacy Subdivision to over 240 acres at Pupukea Highlands.

Lot sizes at the surveyed subdivisions are diverse, ranging from 1 to 24 acres per parcel. The average lot size within each of the subdivisions varies from 1.5 acres to 2.3 acres.

As shown in the following table, since 1990, lot sales have occurred in three of the five surveyed subdivisions.

Year of transactions	Subdivision	Average lot size (acres)	Average price per lot	Average price per acre
1990	Pupukea Gardens	3.16	$665,000	$210,000
	Sunset Hills	1.92	$450,000	$234,000
1991	Pupukea Gardens	1.52	$210,000	$138,000
	Pupukea Highlands	1.05	$287,000	$275,000
1992	Pupukea Gardens	1.31	$217,000	$167,000
	Sunset Hills	2.31	$512,000	$222,000

Since 1985, there have been a total of 71 lot resales, or an average of about 9 lots per year. The range of sales vary from no sales at the Lacy Subdivision to 4 sales per year at the Pupukea Highlands subdivision.

Since 1990, all of the resales have occurred within the following three subdivisions: Pupukea Gardens; Pupukea Highlands; and Sunset Hills.

Although the rate of sales appears relatively low, when compared to the number of available vacant lots, the low rate of absorption is understandable. While originally the selected subdivisions contained from 20 to 241 vacant lots, the number of unimproved lots have since diminished to between 2 to 46 lots, creating a limited supply of vacant lots and only a portion of these available for resale in any given year. As of June 1993, only 98 lots were vacant; additionally, only a small percentage of lots are available for resale at any given time.

Island of Hawaii Acreage Lot Overview

Historically, large lot and/or agricultural lot projects have occurred on the islands of Hawaii, Maui, Kauai and Molokai. The term "agricultural lot" is synonymous with "country lots" and is the term used by the neighboring islands for lots of one-acre or more in size. The island of Hawaii has seen the most growth in this type of development in recent years.

Characteristics of the selected projects located on the island of Hawaii are as follows:

- The majority of the agricultural lot projects primarily offer distant ocean views.
- Oahu residents are a major buyer market at the Big Island acreage lot developments and represent almost 30% of the buyers of at the selected subdivisions.
- Nearly 60% of all purchasers of agricultural lots at the selected subdivisions are from the state of Hawaii.

- In 1992, the average price of selected Hawaii island agricultural lots was $300,000 per lot or $62,000 per acre, due mainly to their larger typical lot sizes of two to five acres.
- Average annual lot sales per project for the selected subdivisions range from 9 to 103 lots per year. The average total annual lot sales is about 149 lots per year.

COUNTRY LOT MARKET ASSESSMENT

This section reviews the competitive characteristics of the proposed Lihi Lani, its potential target markets, expected pricing and sales absorption of the proposed lots and briefly reviews the pricing of the proposed affordable homes.

The development plan of Lihi Lani is one that would preserve and protect the country lifestyle and environment of Pupukea and the North Shore while helping to serve housing and community needs. The overall quality of the development is expected to be reinforced by its large lot sizes, appropriate siting of lots that take full advantage of views, large open spaces, protective covenants and restrictions to guide the quality of residences and the development of recreational amenities that would fill an existing void within the North Shore community

Until the development of Lihi Lani, home buyers from Oahu seeking an up-country lifestyle could only find properties on neighbor island communities such as Kamuela, Hawi, Kohala (on the Big Island), Pukalani (Maui), Kilauea (Kauai) or Kawela (Molokai). There is a demonstrated demand from Oahu purchasers for country lots, as about 30% of all lot purchasers at Big Island country lot subdivisions were from Oahu. However, at these neighbor island projects, many of the lots have yet to be built on because Oahu and other off-island residents are forced to wait until the future or for retirement for the chance to enjoy their home.

It should be noted, however, that while many agricultural lot projects exist on the neighbor islands none of them are strictly comparable to Lihi Lani. None of the projects can provide the full benefits of being located on Oahu, the relaxed ambiance of the North Shore, active agricultural activities, extensive landscaped and open areas, strong project identity, community recreational amenities and infrastructure improvements.

The project is expected to be set apart from the other Pupukea agricultural lot developments based on its distinct image for high quality residential lots on an active agricultural development featuring horse ranch facilities and other recreational opportunities. However, the development style of Lihi Lani will be one that would preserve and protect the country lifestyle and environment of Pupukea and the North Shore while helping to serve housing and community needs.

Target Lot Purchaser Market

The majority, or 80% to 85% of all country lot purchasers at Lihi Lani are expected to be Oahu residents. Typical lot buyers are expected to be local families or older couples who are attracted to Lihi Lani as their primary place of residence due to it's spaciousness, serenity, and its location on the North Shore of Oahu.

These local families wish to up-grade their current homes to one which is more customized and built to their individual tastes and needs. Those within this market are also expected to seek out a specific type of community or lifestyle in which to raise their families. Lihi Lani, located on the North Shore of Oahu with its ingrained country values and relaxed lifestyle may be just what these residents are looking for.

As a place to retire Lihi Lani could be expected to draw, the older purchasers who have retired or are about to retire who seek a place in the country to relax and enjoy the peacefulness of the Hawaiian islands. Lihi Lani would be able to provide the solitude that many retirees look for, as well as, provide them with a place to create a home in which they will spend the rest of their lives, within relatively close proximity to family members, old time friends, professional services and community benefits.

In summary, the majority of the lot purchasers at Lihi Lani are expected to be local residents who are willing to go through the time and effort to build their "dream home," one that meets their personal tastes and needs, within an area with country values and way of life. These types of people are willing to "trade-off" urban residences in place of one located in a more rural community with an atmosphere which lends itself to an up-country rural environment. The expected buyer market mix is summarized in the following table:

**Projected Country Lot
Buyer Market Mix**

Primary place of residence	Projected market mix
Oahu	80% - 85%
Other	15% - 20%
Total	100%

The vacation/second home buyer would be a smaller market segment representing about 15% to 20% of all purchasers could be attracted by the project's location, horse ranch, orientation, excellent ocean views and privacy. These buyers are expected to be repeat visitors to the state who prefer a private residential atmosphere which is not available at resorts or other areas on the island of Oahu.

Proposed Lot Pricing

Sales prices at the surveyed comparable lot projects in Pupukea generally range from $210,000 to $665,000 per lot (1993 dollars). This is equivalent to about $140,000 to $275,000 per acre (1993 dollars) for lots averaging 1 to 3 acres in size.

Pricing for Lihi Lani's country lots was projected based on competitive prices at the surveyed projects. Adjustments were then made relative to the lots at Lihi Lani in terms of views, amenities, and size. Lots are generally proposed to range in size from 1 to 3 acres and would provide for a variety of locations and views within Lihi Lani. Based on this review, country lots at Lihi Lani are estimated to range from $250,000 to $540,000 per lot (1993 dollars) depending on size and view orientation, or about $140,000 to $240,000 per acre.

Projected Country Lot Sales Absorption

Lihi Lani is planning to offer a total of 315 country lots. The projected rate of sales was based on the rate of sales at the Pupukea subdivisions as well as a review of annual sales to Oahu buyers at Big Island projects.

Projected absorption rates indicate that 40 lots could be sold annually within the first five years of the project's completion and an average of 45 lots could be sold thereafter. Lihi Lani is expected to sell all of its lots in about eight years presuming that the lots are developed and ready for sale to meet the market demand, as shown in the following table:

Projected Lot Sales Absorption

	Annual sales	Cumulative sales
Year 1	40	40
Year 2	40	80
Year 3	40	120
Year 4	40	160
Year 5	40	200
Year 6	45	245
Year 7	45	290
Year 8	25	315

The above projected lot sales absorption assumes that:

- The project would be professionally and aggressively marketed at prices in the ranges indicated.
- Lihi Lani would be developed and offered to provide lots to purchasers on a timely basis to coincide with market demand.
- All residential related infrastructure and the lot subdivision would be completed according to the development schedule.
- A model home would be completed within the first year of marketing.
- After the first five years of sales, the project is expected to experience an absorption rate of about 45 lots per year. This "step-up" in absorption rate may be attributed to the project's overall maturity, prestige and stronger reputation. Those who may have purchased lots within the initial phase of Lihi Lani's marketing may have already built homes on their land, thereby adding to the ambiance and marketability of the entire project.

With the development of Lihi Lani, the country lot market which was once dominated by the neighbor islands can now fill the dual living and working needs of residents of Oahu.

Thus, Lihi Lani would offer residents the best of both worlds. Country lot purchasers at Lihi Lani can find an up-country community with strong family and community roots and values in a relaxed and uncrowded setting, as well as, the advantages of an Oahu location and its conveniences for employment, business, commercial and recreational pursuits.

MARKET ASSESSMENT FOR LIHI LANI

CONTENTS

2 - PROJECT OVERVIEW AND REGIONAL SETTING

This chapter describes the planned Lihi Lani development at Pupukea. It also reviews economic and demographic trends for the island of Oahu, and in the Waialua and Ko'olauloa districts on Oahu to provide the backdrop and outlook for development in this area.

PROJECT OVERVIEW

This section reviews the preliminary development plans for the master-planned community and characteristics of the project site.

Preliminary Development Concept

Obayashi Hawaii Corporation (Obayashi) plans to develop an integrated residential agricultural and recreational community on about 1,144 acres of land at Pupukea in the Ko'olauloa District on the island of Oahu, as shown in Exhibit 2-A. The combination of the various aspects of Lihi Lani will combine to maintain and further enhance the rural lifestyle and character for which the North Shore of Oahu is known.

Obayashi's plan is to preserve and protect the country lifestyle and environment of the North Shore, while helping to meet housing and community needs. The master plan for the residential community is shown in Exhibit 2-B, and is described as follows:

- **Country lots**

  315 country lots generally ranging from about 1 to 3 acres in size and are proposed to be developed on approximately 765 acres.

  The country lots will be designed for active agricultural use on a portion of each lot and will be planned in clusters with agricultural easements to establish a contiguous agricultural areas. The agricultural easements on the country lots are expected to reinforce the unique rural image of the Lihi Lani and is not expected to impact the marketability of lot sales.

- **Affordable housing**

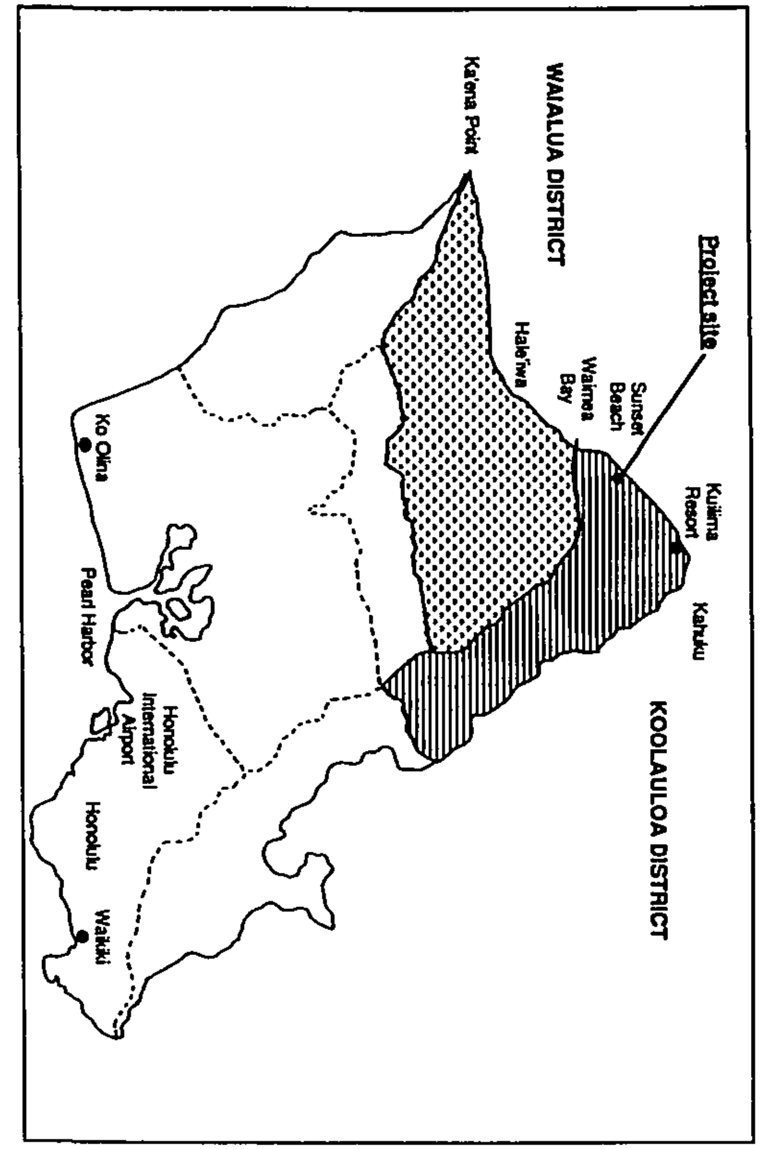
  Obayashi will contribute towards the development of 180 affordable housing units either by developing the units, donating the land or by making a monetary contribution to a City fund designated to the development of affordable homes. While final affordable housing delivery is still being discussed with the Department of Housing and Community Development and the Department of Land Utilization, the current proposal is outlined below:

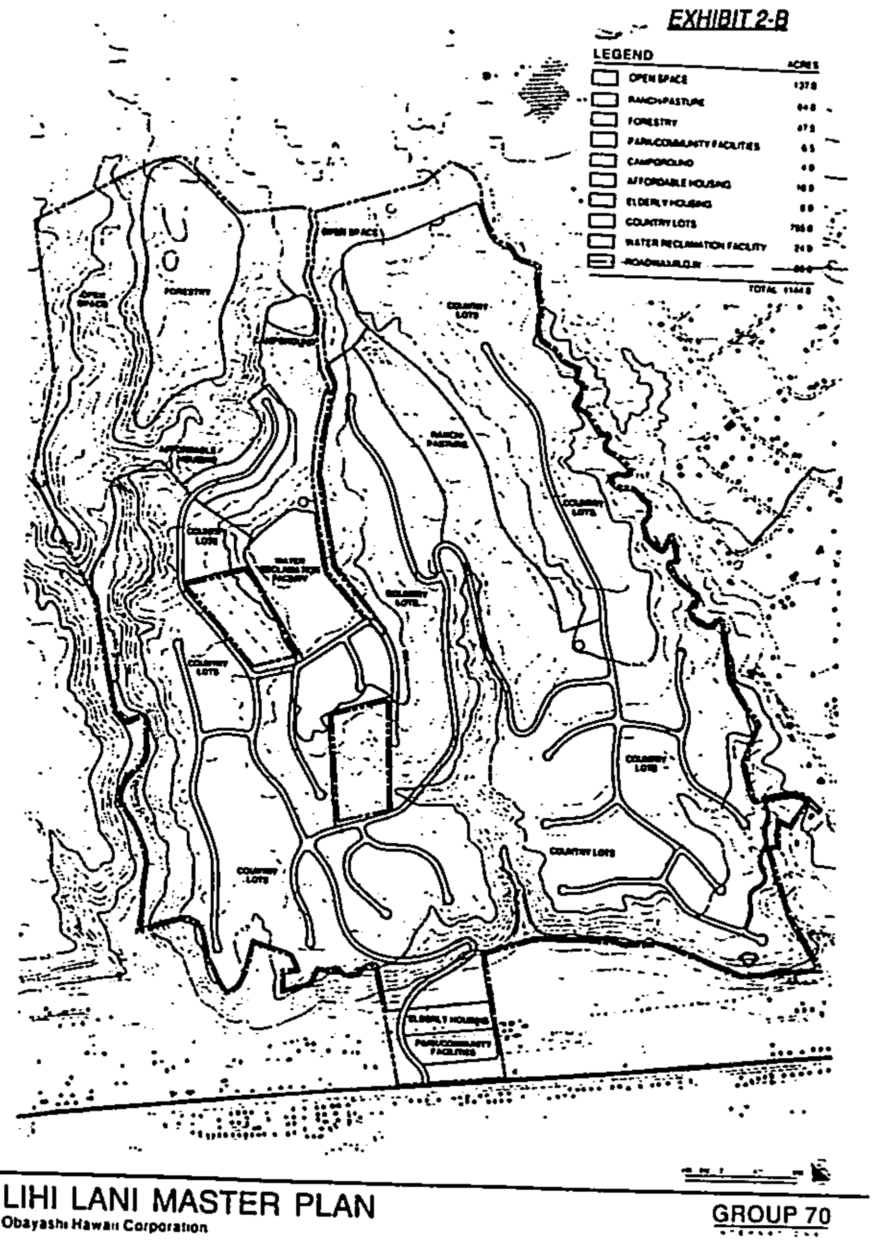
  50 single-family affordably priced homes which will be developed and sold by Obayashi at the Lihi Lani site.

  Six acres of land, including all off-site infrastructure to the parcel, will be donated by Obayashi to the City and County of Honolulu. Plans for the 6 acres of land consist of an 80 unit elderly housing project which will be developed and managed by the City.

Location of the Proposed Lihi Lani

EXHIBIT 2-A





Obayashi will make a monetary contribution to a City fund for the development of a portion of about 50 off-site affordable housing units.

- **Horse ranch, riding and hiking trails**

64 acres within Lihi Lani will be allocated to a horse ranch and will include stables, pasture area, riding trails and orchards.

Facilities within the horse ranch would include 50 stables, tack, arena, feed and maintenance facilities and pasture paddocks.

The recently completed corral is already being utilized by the Pupukea 4-H Club for exercising and training of their horses.

A network of trails encompassing several miles throughout the site would be specifically used for horseback riding and hiking.

Miles of trails throughout the property will be accessible to the community, with linkage to the Kaunala Trail in the State Forest Reserve.

- **Parks, open space, natural areas, community facilities and campgrounds**

98% of the land throughout Lihi Lani will be unaffected by development activities. Much of the land will be designated as open space for agricultural and recreational uses or kept as undeveloped land.

About 200 acres will be dedicated to outdoor recreational and agricultural open space areas for crop cultivation, ranching, pasturage, horseback riding, hiking and camping activities.

4 acres will be developed as a campground site that would be accessible by jeep road, hiking paths and horseback.

A YMCA is proposed for the makai portion of the site. Various facilities which are planned include community meeting and recreation center, swimming pool, playing field for soccer and baseball, volleyball courts, and landscaped barbecue and picnic areas. Various YMCA sponsored programs available at the facility may include child care, summer youth programs and after school care, exercise gym, arts and crafts classes, and senior citizen programs.

The various proposed components of the community facilities will serve recognized needs of the North Shore community as a site for public meetings, community programs, child care programs, and a variety of recreational activities.

- **Agriculture**

The concept of small scale agricultural activities within a country lot subdivision is currently being utilized on many of the lots within the Pupukea area.

There are two types of agricultural areas in Lihi Lani. First, country lots within Lihi Lani will be established with a mandatory agricultural requirement through the use of easements on which there will be active agricultural farming of a portion of each country lot. These easements will be located along the front, side or rear of each lot depending on the parcel's position within the community. The second type of agricultural areas are common areas in Lihi Lani which are specifically set aside for agricultural use.

Plans are for the homeowner's association to lease both the agricultural easements, as well as, common area agricultural lands to an operator who will then maintain, operate and manage the agricultural aspect of Lihi Lani.

Proceeds from the lease income will be used to defray some of the homeowner's associations common area maintenance and operational costs.

Field stock trees and/or fruit tree orchards could be raised in these areas. Other potential agricultural crops could be cut flowers, foliage or grazing pastures.

Owners of country lots will be encouraged to allot more time and space for agricultural uses within their lots, above and beyond the minimum specified agricultural easements for each lot.

Ultimately, on-site centralized facilities for refrigeration, holding, shipping and marketing of the agricultural products would be provided. The operator of the leased agricultural lands, as well as, homeowners would be able to have access to these on-site centralized facilities.

The agricultural use of the lots is expected to benefit Lihi Lani in several ways. It would differentiate the project, giving it a whole identity to buyers, enhance the landscape and reinforce the owners' enjoyment of owning a productive farm property.

With a total of only 445 units proposed at completion (315 country lots, 50 single-family affordable units, and 80 elderly affordable units), the community of Lihi Lani will have a very low density of less than one unit for every two acres of land. This is expected to reinforce the secluded and rural nature of the project and enhance its appeal to buyers who seek a rustic up-country residence.

The project will be designed to complement the existing character of the North Shore. Not only will Lihi Lani be a low density residential community but it will also include extensive undisturbed open spaces. The natural topography of Lihi Lani's coastal bluff will be further enhanced with the addition of landscaping. Much of the vegetation which will be utilized for landscaping along the coastal bluff and throughout the project will consist of native plant species similar to those found throughout the North Shore of Oahu. Generally, the residential community and recreational facilities located on the mauka portion of the site will not be noticeable from the makai areas. The structures will be set back from the bluff edge and screened by landscape plantings and existing vegetation. The overall project concept and design will reflect a rustic country land use.

Obayashi is currently propagating plants at an on-site nursery. Selected vegetation would be used within Lihi Lani's landscaping to assist in the conservation of water, erosion, pest control, and reforestation of lands decimated by erosion and overgrazing over the previous history of the existing lands.

The entire Lihi Lani project may be pictured as a serene and open countryside, where homes are surrounded by native hardwood forests, fruit tree orchards, flower nurseries, and horses grazing on acres of pasture land. Lihi Lani will not only blend with the surrounding area but complement the North Shore's rural and rustic country lifestyle.

Site Description

The project site is located on the mauka (mountain) side of Kamehameha Highway and is bordered by the telecommunications facilities of COMSAT (Kahuku-side), Boy Scout and Girl Scout camps (mauka-side), and Pupukea (Haleiwa-side) and is distinguished by two plateaus and three valleys.

The mauka portion of the site is generally located above the 400-foot coastal bluff mauka of Kamehameha Highway and rises to nearly 850 feet above sea level, offering spectacular sunset and ocean views. From the upland portions of the property, views of the Waianae Mountain Range and parts of the coast from Mokuleia to Sunset Beach are available. It is anticipated that the development would become known for its panoramic views of the ocean, sunsets and coastline landscapes.

The 30-acre makai section of the site consists of gently sloping terrain which rises from 20 to 75 feet above sea level at the foot the coastal bluffs.

The climate of Lihi Lani ranges from the low 60s to the mid-80s depending on the time of day and season. Daily temperatures may vary about 7 degrees between winter and summer seasons, and 15 to 18 degrees between day and night. Areas of higher elevations obtainable from the mauka portion of the site are expected to have cooler temperatures than those at lower elevations. The median annual rainfall of the area is 51.7 inches with an uneven distribution that varies from month-to-month.

The combined natural forestry, topography, and climate of Lihi Lani lends to a relaxed rustic up-country environment which is similar to the Kamuela-Waimea areas on the island of Hawaii.

It takes about 60 to 75 minutes to drive from Honolulu to Lihi Lani. Much of the drive is via the H-1 and H-2 freeways and the last 30 minutes are by Kamehameha Highway.

Residents of the Lihi Lani would have minimal traveling time by car to the area's white sandy beaches, the nearby Kuilima Resort area and other facilities. Thus, the project is well suited for residents who seek a tranquil and high quality living environment.

REGIONAL SETTING

Oahu is the third largest island in the state of Hawaii, covering a land area of 618 square miles and is the center of business and government for the state of Hawaii. This section briefly reviews the demographic characteristics of Oahu and its Ko'olauloa and Waialua districts, also collectively known as North Shore.

Oahu resident population

In 1990, Oahu contained about 75% of Hawaii's resident population, although it comprises only about 10% of the State's land area. During 1990, Oahu was estimated to have a resident population of 836,231, including military personnel.

EXHIBIT 2-C

In the 1980s the population in the Waialua and Ko'olauloa districts have increased more rapidly than for Oahu as a whole

O'AHU RESIDENT POPULATION GROWTH, 1980 TO 1990

	1990 Census tracts	1980	1990	Compound annual percentage change
Ko'olauloa:				
Waimea River to Walaekahana Stream	101	4,491	6,909	4.4%
Walaeikahana Stream to Kaipapau Stream	102.1	3,952	4,608	1.5%
Kaipapau Stream to Kaolo Point	102.2	5,752	6,926	1.9%
Subtotal		14,195	18,443	2.7%
Waialua:				
Kaena Point to Kalaka Bay	99.01	5,350	5,792	0.8%
Kalaka Bay to Kuakanahua Road	99.02	2,620	3,956	4.2%
Kuakanahua Road to Waimea River	100	1,879	1,801	-0.4%
Subtotal		9,849	11,549	1.6%
Rest of Oahu		738,521	806,239	0.9%
Total Oahu		762,565	836,231	0.9%
Pupukea CDP(1)		INA	4,111	-

INA = Information not available.

(1) Census Designated Place within the Ko'olauloa District.

Source: U.S. Bureau of the Census, Summary Tape File 1A; "Census of Population and Housing, Census Tracts, Honolulu, Hawaii, Standard Metropolitan Area," 1980 and 1990.

The population of Oahu grew 0.9% annually between 1980 and 1990, as shown in Exhibit 2-C. The population in the Ko'olauloa District (in which the project is located) and the neighboring Waialua District grew at a faster pace than the island as a whole, with annual growth rates of 2.7% and 1.6% in the 1980s, respectively.

Definition of Ko'olauloa and Waialua Districts

- **Ko'olauloa District** - The subject site is located near the makai (ocean) edge of the Ko'olauloa District. The Ko'olauloa District is defined as U.S. Census tracts 101, 102.1 and 102.2. The area constitutes the northern half of Oahu's windward coast, bounded by the north end of the Ko'olau Mountains and extending from Ka'a'awa Stream to Waimea Bay. Kamehameha Highway is the main roadway linking this area with the adjacent Waialua District. Residential communities bordering the highway include Ka'a'awa, Punalu'u, Hau'ula, La'ie, Kahuku, Sunset Beach and Waimea.

  Within census tract 101, one of the tracts that comprises the Ko'olauloa District, is the Pupukea census designated place (CDP). A census designated place is defined by the U.S. Bureau of the Census as a densely settled concentration of population that is identifiable by name, but is not a legally incorporated place.

- **Waialua District** - The Ko'olau and Wai'anae Mountain ranges and the areas from Waimea Bay to Ka'ena Point form the main boundaries for the traditionally rural communities of the Waialua District. The primary land uses in this region have traditionally been agricultural. Coastal residential areas are concentrated at Mokule'ia, Waialua, Hale'iwa and Kawailoa. The area is defined as U.S. Census tracts 99.01, 99.02 and 100.

WAIALUA AND KO'OLAULOA ECONOMY

The opening of the Kuilima Resort in 1972 has had the most significant economic impact on the area with an estimated 500 jobs created by the resort since its inception. The total job count for the Kuilima Resort could grow to 3,000 by the time all phases of the resort are completed. Development plans include five new hotels, commercial center, tennis complex, several multifamily developments, and an addition to the existing Turtle Bay Golf and Tennis Resort. The expansion will be phased in over the next 10 to 15 years.

Tourism to the Ko'olauloa and Waialua districts is expected to increase in terms of overnight and drive-through visitors in the years ahead as the Kuilima Resort expands and as attractions such as professional surfing events continue to attract visitors. The Polynesian Cultural Center (PCC), located in La'ie, is Hawaii's largest paid tourist attraction according to state tourism statistics. In 1992, PCC employed between about 1,000 to 1,170 employees and had a total of about 850,000 visitors.

RESIDENT POPULATION AND LIFESTYLE

The 1990 resident populations of the Ko'olauloa and Waialua districts were 18,443 and 11,549, respectively, as shown in Exhibit 2-C. Between 1980 to 1990, the Ko'olauloa and Waialua districts had an annual compound growth rate of 2.7% and 1.6%.

Also in 1990, the Pupukea CDP had a resident population of 4,111. This represented 22% of those living in the Ko'olauloa District and about 60% of those in census tract 101.

Population characteristics of the Ko'olauloa and Waialua districts

Exhibit 2-D shows general population characteristics for 1989 and 1990 of the Ko'olauloa and Waialua districts.

- **Median age** of residents in the two districts were 26.7 and 30.6 years compared to 32.2 for the island of Oahu.
- **Median household size** within the two districts were similar at 3.5 in Ko'olauloa and 3.24 in Waialua.
- **Median household income** within the two districts was lower than that of the island of Oahu. Households within the Ko'olauloa District had a median income of $35,830 while those within the Waialua District had a median income of $36,841. In comparison, the median household income for the island of Oahu, as a whole, was $40,581.
- **Generally, those who commuted to work** from the Ko'olauloa and Waialua Districts drove to work alone. When comparing the two areas, more people within the Waialua District drove alone to work than those from the Ko'olauloa District.
- **Average traveling time to work** was nearly 30 minutes for those living in the two areas, suggesting that many area residents worked outside of their residential districts.

Pupukea population characteristics

Exhibit 2-D also shows the population characteristics for the Pupukea CDP area. Those residing in the area had the following characteristics:

- **Median age** of about 32,
- **Average household size** of 3 persons,
- **Median household income** of about $38,400, and
- **Nearly 75%** of the community are in the labor force.

EXHIBIT 2-D

Residents of the Pupukea CDP area tend to have smaller households than other residents of the area

GENERAL POPULATION CHARACTERISTICS OF THE KO'OLAULOA AND WAIALUA DISTRICTS: 1989 AND 1990

	Ko'olauloa(1) Pupukea CDP	Ko'olauloa(1) Total	Waialua(2)	O'ahu
Total population	4,111	18,443	11,549	836,231
Age:				
17 and under	27%	32%	28%	24%
18 to 24	9%	15%	12%	12%
25 to 44	44%	32%	32%	34%
45 to 59	10%	11%	11%	14%
60 and over	11%	10%	16%	15%
Total	100%	100%	100%	100%
Median age	31.9	26.7	30.6	32.2
Median household size	3.03	3.50	3.24	3.02
1989 household income breakdown:				
Less than $24,999	INA	35%	30%	28%
$25,000 to $49,999	INA	32%	39%	33%
$50,000 to $74,999	INA	19%	20%	22%
$75,000 to $99,999	INA	8%	8%	9%
$100,000 or more	INA	6%	3%	8%
Total	INA	100%	100%	100%
1989 median household income	$38,382	$35,830	$36,841	$40,581
Labor force status(3):				
In the labor force	74%	70%	69%	71%
Not in the labor force	26%	30%	31%	29%

EXHIBIT 2-D, CONTINUED

Residents of the Pupukea CDP area tend to have smaller households than other residents of the area

GENERAL POPULATION CHARACTERISTICS OF THE KO'OLAULOA AND WAIALUA DISTRICTS: 1989 AND 1990

	Ko'olauloa(1)			
	Pupukea CDP	Total	Waialua(2)	O'ahu
Commute to work:				
Drive alone	INA (3)	48%	67%	58%
Carpool	20%	20%	18%	21%
Public transportation	10%	8%	7%	9%
Walk or work at home	INA	2%	6%	9%
Other	INA	20%	2%	2%
Average travel time to work (minutes)	INA	29.7	30.4	24.8

(1) Defined as census tracts 101, 102.1 and 102.2.
(2) Defined as census tracts 99.01, 99.02 and 100.
(3) 57% of all residents drive to work, however the percentage driving alone is not available.
INA = Information not available.
Source: U.S. Bureau of the Census.

The demographic characteristics of the Pupukea CDP are reflective of the general characteristics of the island of Oahu as a whole.

	Pupukea CDP	Oahu
Median age	31.9	32.2
Median household size	3.03	3.02
1989 median household income	$38,382	$40,581
Labor force status		
In the labor force	74%	71%
Not in the labor force	26%	29%

HOUSING CHARACTERISTICS

The number of housing units in the Ko'olauloa and Waialua districts has increased at a faster pace than for the Island of Oahu as a whole, as shown in Exhibit 2-E. The average percentage increase between 1980 and 1990 within the Ko'olauloa and Waialua districts were 2.3% and 1.6%, respectively; while Oahu's average annual percentage increase was 1.1%. Between 1980 and 1990, the housing supply within the two districts has grown from a total of 7,900 units to a supply of 9,700, an increase of almost 1,800 housing units within the ten-year span.

In 1990, of the total occupied units within the Ko'olauloa and Waialua districts, owner-occupied units represented 46% to 47% and renter-occupied units consisted of 54% and 53%, respectively. However, in the Pupukea CDP of the total available housing units, owner-occupied units represented 89% and renter-occupied units represented only 11%.

Pupukea CDP residents seem to have a significantly higher owner occupancy rate than residents of the North Shore. Pupukea residents are more likely to own and live in their homes while within the other parts of the district, residents are more likely to rent the homes in which they reside.

Both homeowner and rental vacancy rates within the Ko'olauloa and Waialua districts have decreased between the years 1980 and 1990. In 1990, the homeowner vacancy rates for the two districts were 1.0% and 0.8%, respectively.

OAHU VISITORS ARRIVALS

Demand for real estate in the North Shore area, and specifically for Lihi Lani, could be expected to increase as the number of visitors to the area increases.

Historically, in other visitor areas throughout the State, the facilities, attractions and entertainment opportunities become an amenity to homeowners and residents in the surrounding areas. Similarly, the attractions within the North Shore area would act as a catalysts to draw people to the area and contribute to its appeal.

The North Shore of Oahu may be regarded as a secondary resort/visitor area and has many attractions to offer Oahu visitors. The area consists of Waimea Falls Park, Kuilima Resort, Polynesian Cultural Center, and numerous world renown beaches. Tourism to the Ko'olauloa and Waialua districts could be expected to increase in terms of overnight and drive-through visitors in the years ahead.

Oahu continues to be the most visited island in the State. In 1992, visitor arrivals to Oahu reached nearly 5 million. Since 1991, visitor arrivals to Oahu have decreased, as shown in Exhibit 2-F. Visitor arrivals to Oahu reached its peak in 1990 with more than 5.3 million visitors. However, since 1990 the number of visitors to Oahu has declined. The 1991 year marked the start of the Gulf War and the number of eastbound and westbound visitors showed a drop of 6%. The continued decline in visitors since the Gulf War is attributed to the continued U.S. and Japanese recession and discount air-fares on the mainland.

EXHIBIT 2-E

The number of housing units in the Ko'olauloa and Waialua Districts has increased at a faster pace than the island of O'ahu

SELECTED HOUSING CHARACTERISTICS ON O'AHU, 1980 AND 1990

	Ko'olauloa(1)			Waialua(2)			O'ahu		
	1980	1990	Average annual percent change	1980	1990	Average annual percent change	1980	1990	Average annual percent change
Occupancy and tenure:									
Occupied housing units:									
Owner occupied	1,410	2,294	5.0%	1,127	1,642	3.8%	114,831	137,910	1.8%
Renter occupied	2,332	2,641	1.3%	1,717	1,826	0.6%	115,383	127,394	1.0%
Total occupied units	3,742	4,935	2.8%	2,844	3,468	2.0%	230,214	265,304	1.4%
Vacant housing units	633	445	-3.5%	230	169	-3.0%	20,652	11,917	-5.4%
Total year-round housing units	4,375	5,380	2.1%	3,074	3,637	1.7%	250,866	277,221	1.0%
Other(3)	333	559	5.3%	148	133	-1.1%	1,172	4,462	
Total housing units	4,708	5,939	2.3%	3,222	3,770	1.6%	252,038	281,683	1.1%
Vacancy rates:									
Homeowner	3.0%	1.0%	--	7.8%	0.8%	--	1.1%	7.0%	--
Rental	15.5%	5.1%	--	3.9%	3.1%	--	7.2%	4.3%	--
Crowded units(4)	1,076	1,367	2.4%	544	779	3.7%	35,598	43,526	2.0%

(1) Defined as census tracts 101, 102.1, and 102.2.
(2) Defined as census tracts 99.01, 99.02 and 100.
(3) Includes units intended for seasonal occupancy and vacant units held for migratory labor.
(4) Units with 1.01 persons or more per room are considered "crowded" by definition set by the U.S. Bureau of the Census.

Sources: U.S. Bureau of the Census, "1980 Census of Housing, General Housing Characteristics, Hawaii," HC80-1-A13 (July 1982), tables 1, 5, 7, 46 and 48, as reported by the Department of Business and Economic Development and Tourism in "The State of Hawaii Data Book 1990," November 1990; "Selected Population and Housing Characteristics; 1990 Honolulu County Hawaii,"; "1990 Census of Population and Housing, Summary Population and Housing Characteristics."

MARKET ASSESSMENT FOR LIHI LANI

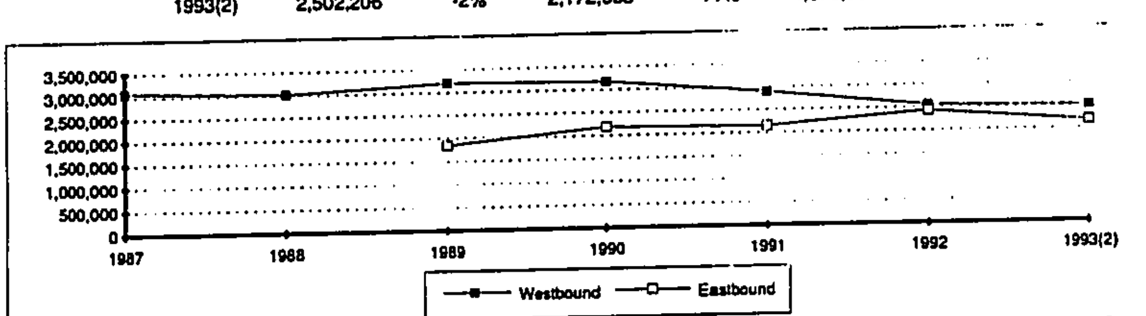
CONTENTS

EXHIBIT 2-F

Total visitors to Oahu have declined in the past three years

VISITOR ARRIVALS TO THE ISLAND OF O'AHU: 1987 TO 1993

	Westbound		Eastbound		Total	
	Visitors	Percent change	Visitors	Percent change	Visitors	Percent change
1987	3,078,500	--	--	--	3,078,500 (1)	--
1988	3,013,850	-2%	--	--	3,013,850 (1)	--
1989	3,205,800	6%	1,843,550	--	5,049,350 (1)	--
1990	3,171,630	-1%	2,179,310	18%	5,350,940	6%
1991	2,899,170	-9%	2,149,380	-1%	5,048,550	-6%
1992	2,549,850	-12%	2,430,740	13%	4,980,590	-1%
1993(2)	2,502,206	-2%	2,172,853	-11%	4,675,059	-6%



(1) Data for total westbound and eastbound visitors to the island of Oahu is not available. Therefore, the number represented excludes eastbound visitors.
(2) Annualized based on number of visitors through April and seasonally adjusted.
Source: Hawaii Visitors Bureau, Annual Research Report.

3 - COUNTRY LOT MARKET OVERVIEW

Development plans for Lihi Lani currently include large lots of one-acre or more, located within a community with amenities such as a horse ranch and recreational and community facilities. At the present time, there are few, if any comparable residential areas that encompass the range of amenities that Lihi Lani plans to offer.

To assess the probable buyer market, market pricing and absorption for Lihi Lani, five single-family lot subdivisions within the Pupukea area have been reviewed and are shown in Exhibit 3-A. Also, due to the limited supply of country lot projects on Oahu and their lack of community amenities and facilities, large agricultural lot subdivisions on the island of Hawaii were also reviewed.

It should be noted, however, even though these projects were selected for comparison, none of them are strictly comparable to Lihi Lani and provides the full benefits of an Oahu location, North Shore ambiance, agricultural activities, extensive landscaped areas, strong project identity, community recreational amenities and infrastructure improvements.

OAHU COMPARABLE PROJECT DESCRIPTIONS

Five single-family lot subdivisions within the Pupukea area were reviewed, as shown in Exhibit 3-B. These projects were chosen because of their similarities in size, location, and buyer mix. The five subdivisions are as follows:

- Lacy Subdivision
- North Shore Heights
- Pupukea Gardens
- Pupukea Highlands
- Sunset Hills

Of the five different subdivisions, the lots located throughout the Sunset Hills subdivision are most comparable to those of Lihi Lani.

Sunset Hills is the highest quality residential subdivision within the Pupukea area. The subdivision is governed by its own set of by-laws, separate from the by-laws of Pupukea. Sunset Hills also offers additional privacy to its residents by providing a gated (but unlocked) entrance with the subdivision's name on a marquee. An additional amenity of the subdivision is their underground utility system.

The views from the Pupukea area are similar to the views obtainable at Lihi Lani and span from ocean to mountain. Many Sunset Hills residents have ocean or partial ocean views with spectacular sunsets. Many of the lots throughout Lihi Lani will also experience similar panoramic views of Oahu's North Shore coastline.

Lot sizes range from 1 to 24 acres

The lot sizes at the surveyed subdivisions throughout the Pupukea area are diverse generally ranging from one to twenty-four acres per parcel. The average lot size within each of the five subdivisions vary from 1.5 acres to 2.3 acres.

The selected subdivisions also vary in overall project size and range from 20 acres at Lacy Subdivision to over 240 acres at Pupukea Highlands.

EXHIBIT 3-A

Location of Pupukea single-family lot comparables

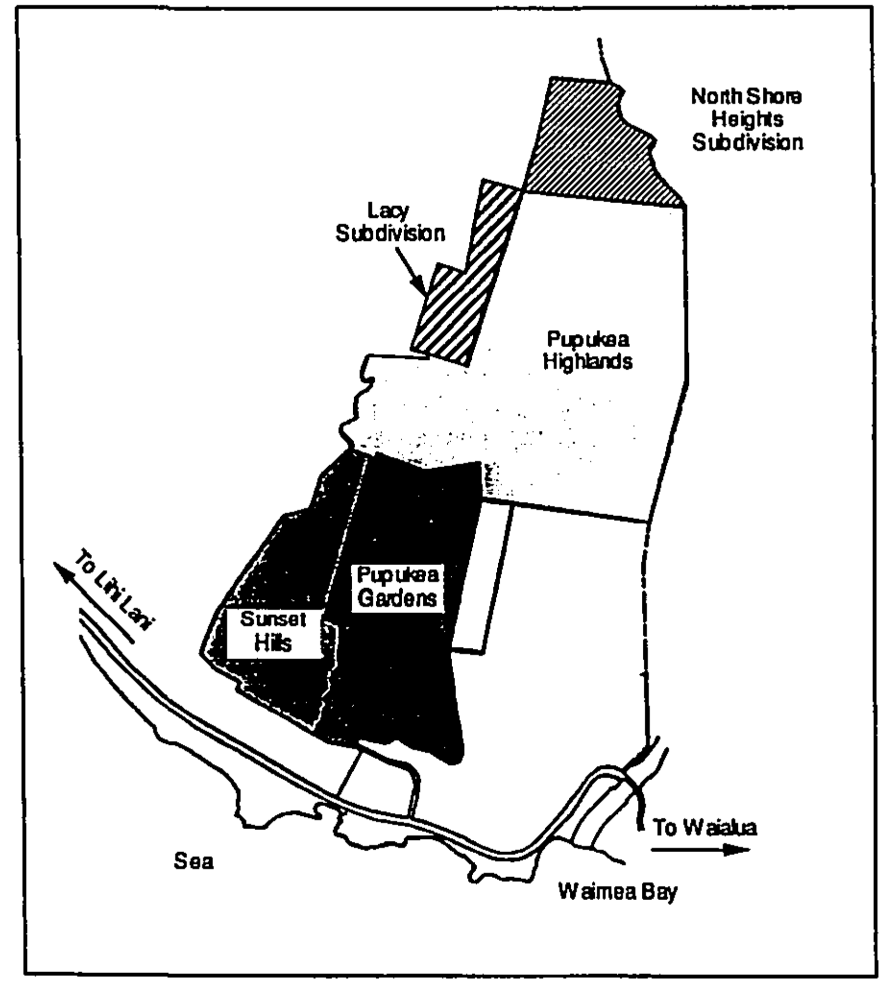


EXHIBIT 3-B

The average lot size of selected Pupukea projects range from 1.5 to 2.3 acres

CHARACTERISTICS OF SELECTED PUPUKEA ACREAGE LOT PROJECTS

Project	View orientation	Total number of lots	Lot size (acres) Range	Lot size (acres) Average
Lacy Subdivision	Distant mountain / internal	20	1.0 - 6.14	2.2
North Shore Heights	Distant mountain / internal	29	1.0 - 16.13	2.3
Pupukea Gardens	Portion has primary ocean view	110	1.0 - 5.55	1.5
Pupukea Highlands	Distant ocean / mountain	241	1.0 - 24.23	1.8
Sunset Hills	Portion has primary ocean view	74	1.0 - 7.58	1.6
Total		474		

Source: Compiled by KPMG Peat Marwick based on discussions with project representatives.

View Orientation

Each of the selected agricultural lot subdivisions are located on the slopes of Pupukea, elevated above the coastline. The majority of the lots offer views of the distant ocean and/or mountains. A portion of the lots located at Sunset Hills offer superior ocean views due to their lower elevation and close proximity to the mountain's ridge.

BUYER PROFILES AND PURCHASE MOTIVATIONS

Primary place of residence

The primary place of residence of lot owners in the Pupukea area was surveyed based on the tax bill mailing addresses reported by the Department of Taxation. The billing addresses are an indication of whether purchasers are Hawaii residents or non-resident owners.

The majority of all lot purchasers within the Pupukea area reside on Oahu making it their primary place of residence, as shown in Exhibit 3-C.

- About 85% of the purchasers of lots at the selected projects are from the island of Oahu.
- 11% of the purchasers in this area reside on the U.S. mainland.
- 6% make Japan their primary place of residence.

The buyers of lots within each of the subdivisions have very similar primary places of residence. For each of the subdivisions, the majority of the buyers are local residents of Oahu, very few reside on the U.S. mainland, and none or only a few reside outside of the country.

Buyer Motivation

Typically, agricultural lot subdivisions attract two different types of buyers: those seeking to purchase their primary residence in a private yet affordable area and those seeking to purchase a second/vacation home or retirement home.

About 75% to 85% of all lot owners have purchased Pupukea lots as their primary residences. Major purchase motivations and considerations for large lot purchases as primary homes are generally as follows:

- Low prices and good values
- Privacy
- Preference for approximately one-acre or multi-acre lots
- Less restrictive design standards

The remaining 15% to 25% of Pupukea's lot purchasers buy lots for second homes or future retirement. The second home market purchase motivations and considerations for acreage lot purchases generally concern:

- Security and privacy
- Views of the ocean
- Master-planned subdivision with uniform design standards
- Larger lot sizes
- Future retirement and/or current vacation residence

PRICE TRENDS

Average sales prices of lots sold from 1989 through 1992 are presented in Exhibit 3-D. The overall average sales prices per acre from 1989 to 1992 ranged from $126,000 to $222,000. The overall average sales price per acre reached its peak in 1990 and has since declined to $195,000 per acre in 1992.

Since 1990, lot sales have occurred in three of the five surveyed subdivisions. The following table shows the correlation of lot size and pricing by categorizing the average sales per year by average lot size.

Year of transactions	Subdivision	Average lot size (acres)	Average price per lot	Average price per acre
1990	Pupukea Gardens	3.16	$665,000	$210,000
	Sunset Hills	1.92	$450,000	$234,000
1991	Pupukea Gardens	1.52	$210,000	$138,000
	Pupukea Highlands	1.05	$287,000	$275,000
1992	Pupukea Gardens	1.31	$217,000	$167,000
	Sunset Hills	2.31	$512,000	$222,000

Typically, larger lots report per acre prices which are lower than the average pricing for smaller sized lots. Pricing levels within a project and/or subdivision will usually show a drop as the lot sizes are increased.

Current active, closed and expired listings of vacant lots in the Pupukea area are shown in Exhibit 3-E. As the exhibit indicates, only Pupukea Highlands and Sunset Hills have had any type of activity within the last year.

- **Active listings** - There are currently four active listings within the two areas, three in the Pupukea Highlands subdivision and one within the Sunset Hills project. The average list price per acre for these current listings are $153,000 (Pupukea Highlands) and $250,000 (Sunset Hills), or $612,000 and $495,000 per lot, respectively.

EXHIBIT 3-C

Almost 85% of the buyers for selected Pupukea subdivisions reside in the state of Hawaii

PRIMARY PLACE OF RESIDENCE OF BUYERS AT SELECTED PUPUKEA SUBDIVISIONS: 1985 TO 1992

		U.S. mainland		Foreign		
	Hawaii	West coast(2)	Other	Japan	Other	Total
Lacy Subdivision	0%	0%	100%	0%	0%	100%
North Shore Heights	100%	0%	0%	0%	0%	200%
Pupukea Gardens	83%	8%	0%	8%	0%	183%
Pupukea Highlands	96%	4%	0%	0%	0%	196%
Sunset Hills	44%	33%	0%	22%	0%	144%
Weighted average	83%	9%	2%	6%	0%	183%

(1) The North Shore is defined by zip codes 96791 (Waialua) and 96712 (Haleiwa) or the coastal area which is between Kaena Poi and Kawela Bay.

(2) Includes California, Oregon, Washington and Alaska.

Source: Compiled by KPMG Peat Marwick, based on information obtained from MLS Hawaii, Inc.

EXHIBIT 3-E

Current active listing range from $400,000 to $600,000 per lot or $150,000 to $300,000 per acre

RECENT LISTINGS AND SALES OF VACANT LOTS IN THE PUPUKEA AREA: 1992 TO 1993

Tax map key	Address	Land area (acre)	List price	List price per acre	Sales price	Sales price per acre
Active listings:						
Pupukea Highlands						
1-5-9-22-23	59-602 Kawoa Pl.	1.1	$320,000	$297,954	N/A	N/A
1-5-9-24-5	59-501 Akanoho Pl.	7.0	$695,000	$100,000	N/A	N/A
1-5-9-25-56	59-669 Alapio Rd.	1.4	$425,000	$304,445	N/A	N/A
Average/weighted average		3.1	$612,233	$152,867	N/A	N/A
Sunset Hills						
1-5-9-29-32	59-422 Makana Rd.	2.0	$495,000	$249,750	N/A	N/A
Closed listings:						
Pupukea Gardens						
1-5-9-17-23	59-387 Alapio Rd.	1.5	N/A	N/A	$210,000	$138,158
1-5-9-18-23	59-229 Alapio Rd.	1.1	N/A	N/A	$226,000	$207,339
Average/weighted average		1.3	N/A	N/A	$216,682	$167,050
Sunset Hills						
1-5-9-29-39	59-370 Makana Rd.	2.3	$525,000	$228,660	$525,000	$228,660
1-5-9-29-40	59-362 Makana Rd.	2.3	$525,000	$227,274	$525,000	$227,274
Average/weighted average		2.3	$525,000	$227,965	$525,000	$227,965

EXHIBIT 3-[illegible]

1992 sales prices at the selected Pupukea projects averaged about $365,000 or $195,000 per acre

LOT PRICES AT SELECTED SUBDIVISIONS, 1989 TO 1992

	1989				1990				1991				1992			
	Lots sold(1)	Average lot size (acres)	Average sales price	Average price per acre	Lots sold(1)	Average lot size (acres)	Average sales price	Average price per acre	Lots sold(1)	Average lot size (acres)	Average sales price	Average price per acre	Lots sold(1)	Average lot size (acres)	Average sales price	Average price per acre
Lacy Subdivision	1	1.20	$195,000	$162,500	0	--	-	--	0	-	-	--	0	-		
North Shore Heights	2	2.00	$308,000	$154,000	0	--	--	--	0	-	-	--	0	-		
Pupukea Gardens	1	1.48	$160,000	$108,108	1	3.16	$665,000	$210,443	1	1.52	$210,000	$138,158	2	1.31	$216,682	$167,050
Pupkea Highlands	1	2.73	$210,000	$76,923	0	--	--	--	2	1.05	$287,402	$274,641	0	--		
Sunset Hills	2	1.66	$215,000	$129,518	1	1.92	$450,000	$234,375	0	--		--	2	2.31	$512,473	$222,343
Overall average		1.81	$217,600	$126,210		2.54	$557,500	$222,409		1.29	$248,701	$208,400		1.81	$364,578	$194,637

(1) Sample size may differ from absorption shown in Exhibit 3-F due to the elimination of multiple deeds

Source: Compiled by KPMG Peat Marwick, based on information obtained from MLS Hawaii, Inc.

- **Closed listings** - Four lots have recently sold within the Pupukea Gardens and Sunset Hills subdivisions. Within the Pupukea Gardens' subdivision, the lots averaged an average sales price of $167,000 per acre, while those within the Sunset Hills' subdivision averaged about $228,000 per acre.

- **Expired listings** - There are nine lots which were on the market but have since expired within the Pupukea Highlands and Sunset Hills projects. These lots have been on the market from a half a year to a year and have since been taken off the market due to their contracts expiring. However, three of the nine lots are back on the market and are currently listed as active listings. The average list price per acre of the expired listings ranged from $173,000 and $299,000.

LOT SALES ACTIVITY

Exhibit 3-F shows annual lot resales for the selected subdivisions from 1985 to 1992. Since 1985, there have been a total of 71 lot resales, or an average of about 9 lots per year.

The exhibit also indicates the average annual sales activity for the five subdivisions. The range of sales vary from zero sales per year at the Lacy Subdivision to 4 sales per year at the Pupukea Highlands subdivision. The overall average annual sales absorption is 9 lots per year.

Higher sales activity between the late 1980s and early 1990s can be associated with the overall strength of the Hawaii real estate market during this period. Conversely, the lagging national economy has had an effect on sales activity during the past two to three years.

Since 1990, all of the resales have occurred within the following three subdivisions: Pupukea Gardens; Pupukea Highlands; and Sunset Hills.

As the comparable subdivisions are not new nor recently developed, the number of vacant lots which do not have homes constructed on them have slowly diminished. Many of the purchasers of vacant lots within the Pupukea area have since built homes on them thereby reducing the inventory of vacant lots. As of June 1993, the number of vacant lots within the Pupukea area total 98 or approximately 21% of the original inventory. The Pupukea Gardens, Pupukea Highlands, and Sunset Hills subdivisions have the largest remaining inventory of vacant lots available. The number of remaining vacant lots within the Pupukea area is shown in the following table.

EXHIBIT 3-E CONTINUED

Current active listing range from $400,000 to $600,000 per lot or $150,000 to $300,000 per acre

RECENT LISTINGS AND SALES OF VACANT LOTS IN THE PUPUKEA AREA: 1992 TO 1993

Tax map key	Address	Land area (acre)	List price	List price per acre	Sales price	Sales price per sq. ft.
Expired listings:						
Pupukea Highlands						
1-5-9-22-12	59-598 Akanoho Pl.	1.1	$325,000	$303,740	N/A	N/A
1-5-9-24-5	59-501 Akanoho Pl.	7.0	$695,000	$100,000	N/A	N/A
1-5-9-25-29	Lot #18, Alapio Rd.	1.0	$360,000	$360,000	N/A	N/A
1-5-9-25-56	59-669 Alapio Rd.	1.4	$425,000	$304,445	N/A	N/A
Average/weighted average		2.6	$588,643	$173,291	N/A	N/A
Sunset Hills						
1-5-9-29-18	59-469 Makana Rd.	1.0	$400,000	$400,000	N/A	N/A
1-5-9-29-20	59-437 Makana Rd.	1.0	$425,000	$425,000	N/A	N/A
1-5-9-29-32	59-422 Makana Rd.	2.0	$495,000	$249,747	N/A	N/A
1-5-9-29-4	Lot #39	1.0	$426,500	$421,029	N/A	N/A
1-5-9-30-18	59-574 Makana Rd.	1.9	$325,000	$167,526	N/A	N/A
Average/weighted average		1.4	$413,646	$298,702	N/A	N/A

N/A = Not applicable.
Source: Honolulu Board of Realtors.

EXHIBIT 3-E

A total of 71 Pupukea lots have been resold since 1985, or an average of 9 lots per year

RESALES OF VACANT LOTS AT SELECTED PUPUKEA SUBDIVISIONS: 1985 TO 1992

	Total developable lots	Total vacant lots as of June 1993	Annual lot resales								Number of sales	Average annual sales/ project
			1985	1986	1987	1988	1989	1990	1991	1992		
Lacy Subdivision	20	2	0	0	0	0	1	0	0	0	1	0
North Shore Heights	29	8	2	2	1	1	2	0	0	0	8	1
Pupukea Gardens	110	14	0	3	3	4	2	1	1	2	16	2
Pupukea Highlands	241	46	7	8	4	12	1	0	2	0	34	4
Sunset Hills	74	28	0	0	0	7	2	1	0	2	12	2
Total	474	98	9	13	8	24	8	2	3	4	71	9

Source: Compiled by KPMG Peat Marwick, based on information obtained from MLS Hawaii, Inc.

Subdivision	Total number of lots/parcels	Total number of vacant lots as of June 1993
Lacy Subdivision	20	2
North Shore Heights	29	8
Pupukea Gardens	110	14
Pupukea Highlands	241	46
Sunset Hills	74	28
Total	474	98

Although the rate of sales appears relatively low, as shown in Exhibit 3-F, when compared to the number of available vacant lots, the low rate of absorption is understandable. While originally the selected subdivisions contained between 20 and 241 vacant lots, the number of vacant lots have since diminished to between 2 to 46, creating a limited supply of vacant lots and only a portion of these available for resale in any given year.

BUYER CHARACTERISTICS

Discussions with Realtors and residents of the Pupukea area have indicated that the area attracts people of various working classes. Some area residents are retirees, others are entrepreneurs or professionals, and some are blue collar workers. The typical age of a purchaser ranges between the ages of 30 and 40, many of which are first time home owners.

Realtors and residents have indicated that the biggest motivating factor for people purchasing lots within the Pupukea area are its' large spacious and private lots and the quiet ranch like lifestyle of the area. Many area residents are family oriented and would prefer to raise their children in this environment rather than in a more urban setting. The majority of residents or prospective residents of the area are mainly from the urban Honolulu area and not from the Ko'olauloa or Waialua districts. Many residents originate from more urban centers of population like Honolulu, it's suburbs, or the U.S. mainland.

Many Pupukea residents work in Honolulu and commute on a daily basis. The commute to Honolulu equates to an approximate traveling time of 60 to 75 minutes during peak rush hour traffic. Area residents have likened their drive to that of those residents living on the Windward side of the island of Oahu. The driving distance is farther, however the traveling time to and from work is about the same. Therefore, for many residents, the quality of life which surrounds this area greatly outweighs the commute to the city of Honolulu on a daily basis.

NEIGHBOR ISLAND AGRICULTURAL LOT OVERVIEW

Historically, large lot and/or agricultural lot projects have occurred on the islands of Hawaii, Maui, and Kauai. The term "agricultural lot" is synonymous with "country lots" and is the term used by the neighboring islands for lots of one-acre or more in size on which various uses are permissible, one of which is agricultural production. The island of Hawaii has seen the most growth in this type of development in recent years.

Characteristics of selected projects located on the island of Hawaii are shown in Exhibits 3-G through 3-J and are summarized below:

- The majority of the agricultural lot projects primarily offer distant ocean views.
- Oahu residents are a major purchaser market at the developments and represent almost 30% of the buyers of agricultural lots at the selected subdivisions.
- Nearly 60% of all purchasers of agricultural lots at the selected subdivisions are from the state of Hawaii.
- In 1992, the average price of selected Hawaii island agricultural lots was $300,000 per lot or $62,000 per acre, due to the lower cost of real estate on the Big Island, in general, and their larger typical lot sizes of two to five acres.
- Average annual lot sales per project for the selected subdivisions range from 9 to 103 lots per year. The average total annual lot sales is about 149 lots per year.

EXHIBIT 3-G

The island of Hawaii has had the most development of agricultural lot subdivisions

CHARACTERISTICS OF AGRICULTURAL LOT PROJECTS ON THE ISLAND OF HAWAII

Project	Location	Total number of lots	Lot size (acres) Range	Lot size (acres) Average
Anekona Estates	Waimea	36	5.0 - 6.0	5.3
Maliu Ridge -	North Kohala			
Phase I		57	1.2 - 2.4	1.8
Phases 2 & 3		115	1.0 - 6.6	2.2
Kohala Ranch -	North Kohala			
The Summit & The Heathers		223	3.0 - 1.0	5.0
The Meadows		154	3.0	3.0
The Meadows II		100	5.0	5.0
Puu Lani Ranch	North Kona	110	1.0 - 5.0	2.0
Waiki'i Ranch	South Kohala	202	10.0 - 80.0	14.0
Kona Hills Estates	North Kona	72	1.0	1.0

Source: Compiled by KPMG Peat Marwick based on discussions with project representatives.

EXHIBIT 3-I

1992 sales prices at selected Hawaii island agricultural subdivisions averaged about $300,000 per lot, or $62,000 per acre

LOT PRICES AT SELECTED HAWAII ISLAND AGRICULTURAL LOT SUBDIVISIONS: 1991 AND 1992

		1991			1992(1)		
	Land tenure	Average lot size (acres)	Average sales price	Average price per acre	Average lot size (acres)	Average sales price	Average price per acre
Anekona Estates	Fee	5.3	$289,000	$55,000	5.0	$295,000	$59,000
Maliu Ridge	Fee	2.3	$190,000	$83,000	1.6	$207,000	$129,000
Kohala Ranch	Fee	4.9	$361,000	$74,000	5.1	$312,000	$61,000
Puu Lani Ranch	Fee	1.3	$233,000	$181,000	1.7	$112,000	$68,000
Waiki'i Ranch	Fee	17.8	$474,000	$27,000	10.0	$349,000	$35,000
Kona Hills Estates(2)	Fee	1.0	$320,000	$320,000	1.0	$235,000	$235,000
Total/wtd. average		33	$393,000	$58,000	24	300,000	62,000

(1) Represents sales from January 1992 through September 1992, unless otherwise indicated.
(2) Represents sales from January 1992 through August 1992.
Source: Compiled by KPMG Peat Marwick, based on information obtained from MLS Hawaii, Inc.

EXHIBIT 3-H

Almost 30% of the buyers for selected agricultural subdivisions on Hawaii are from Oahu

ORIGINS OF BUYERS AT SELECTED AGRICULTURAL SUBDIVISION ON THE ISLAND OF HAWAII: 1991 TO 1992

	Hawaii residents		U.S. mainland		Foreign		
	Oahu	Other Hawaii	West coast(1)	Other	Japan	Other	Total
Anekona Estates	30%	48%	17%	0%	0%	5%	100%
Maliu Ridge	30%	40%	20%	10%	0%	0%	100%
Kohala Ranch	21%	16%	27%	21%	11%	4%	100%
Puu Lani Ranch	20%	25%	30%	10%	10%	5%	100%
Waiki'i Ranch	60%	10%	20%	5%	5%	0%	100%
Kona Hills Estates	13%	25%	50%	0%	12%	0%	100%
Total/average	29%	27%	27%	8%	6%	2%	100%

(1) Includes California, Oregon, Washington and Alaska.
Source: Compiled by KPMG Peat Marwick, based on information obtained from MLS Hawaii, Inc.

MARKET ASSESSMENT FOR LIHI LANI

CONTENTS

EXHIBIT 3-J

Average sales absorption at selected agricultural subdivisions ranged from 9 to 103 lots per year between 1986 and 1992

NEW SALES/RESALES OF LOTS AT SELECTED AGRICULTURAL SUBDIVISIONS ON THE ISLAND OF HAWAII: 1986 TO 1992

	Total lots	Annual lot new sales/resales(1) 1986	1987	1988	1989	1990	1991	1992(2)	Average annual sales/ project(3)
Anekona Estates	36	--	--	--	--	14	28	1	16
Maliu Ridge	57	0	46	9	0	3	1	4	9
Kohala Ranch	477	20	120	110	232	140	47	23	103
Puu Lani Ranch	49	--	--	0	3	33	4	2	9
Waiki'i Ranch	130	24	24	20	0	17	4	7	14
Kona Hills Estates(4)	72	7	17	17	8	19	3	2	11
Average		13	52	31	49	38	15	7	27
Total		51	207	156	243	226	87	39	149

(1) Sales and resales of vacant lots.
(2) Represents sales from January 1992 through September 1992.
(3) Average annual sales are calculated assuming only 9 months of sales in 1992.
(4) Represents sales from January 1992 through August 1992.
Source: Compiled by KPMG Peat Marwick, based on information obtained from MLS Hawaii, Inc.

4 - COUNTRY LOT MARKET ASSESSMENT

This chapter assesses the projected market support for country lots at Lihi Lani based on the competitive advantages and distinct characteristics of Lihi Lani.

Until now, there are few, if any comparable residential projects to Lihi Lani. Lihi Lani offers its residents and visitors the total feeling of "country." The term "county" can best be visualized by such adjectives such as a good clean lifestyle, family and community values, picturesque and relaxing scenery and uncrowded and wide-open spaces

COMPETITIVE ADVANTAGES

Until the development of Lihi Lani, home buyers from Oahu seeking an up-country lifestyle could only find properties on neighbor island communities such as Kamuela, Hawi, Kohala (on the Big Island), Pukalani (Maui), Kilauea (Kauai) or Kawela (Molokai). There is a demonstrated demand from Oahu purchasers for country lots, as about 30% of all lot purchasers at Big Island country lot subdivisions were from Oahu. However, at these neighbor island projects, many of the lots have yet to be built on because Oahu and other off-island residents are forced to wait until the future or for retirement for the chance to enjoy their home.

It should be noted, however, that while many agricultural lot projects exist on the neighbor islands none of them are strictly comparable to Lihi Lani. None of the projects can provide the full benefits of being located on Oahu, the relaxed ambiance of the North Shore, active agricultural activities, extensive landscaped and open areas, strong project identity, community recreational amenities and infrastructure improvements.

The project is expected to be set apart from the other Pupukea agricultural lot developments based on its distinct image for high quality residential lots on an active agricultural development featuring horse ranch facilities and other recreational opportunities. However, the development style of Lihi Lani will be one that would preserve and protect the country lifestyle and environment of Pupukea and the North Shore while helping to serve housing and community needs.

The overall quality of the development is expected to be reinforced by its large lot sizes, appropriate siting of lots that take full advantage of views, large open spaces, protective covenants and restrictions to guide the quality of residences and the development of recreational amenities that would fill an existing void within the North Shore community.

The project is expected to attract many Hawaii resident couples or families seeking a primary or second/vacation home. The primary home market could be mostly from the island of Oahu, but could also include future retirees from out-of-state. Lihi Lani would be the ideal investment whether as a primary home or second/vacation home for many of these people from the island of Oahu who are looking for a private and quiet ranch like lifestyle that could only be found until now on the neighbor islands. Thus, the project is expected to recapture some of the Oahu second home purchasers who were forced to turn to the Big Island, Kauai, Maui or Molokai projects until now.

ANTICIPATED BUYER MIX

Exhibit 4-A presents the projected buyer market mix for Lihi Lani. The projected mix is based on the buyer mix of the surveyed country and agricultural lot subdivisions. The unique characteristics of the project were also considered when projecting the overall buyer mix.

The market for the country lots is expected to be composed principally of those seeking a primary residence or future retirement home. A much smaller proportion of the buyers is expected to be couples or families seeking a second or vacation home. The majority of the lot buyers at Lihi Lani (80% - 85%) are expected to be from Oahu and the remaining lot buyers (15% - 20%) are anticipated to originate from the U.S. or other foreign countries.

Primary resident market

The majority, or 85% of all purchasers are expected to be Oahu residents who seek the solitude, spaciousness, beauty and relaxed atmosphere of North Shore, Oahu. Typical primary resident buyers are expected to be Oahu families who wish to upgrade their current primary residence to a larger custom built home or older couples seeking a potential retirement home. Many potential residents of Lihi Lani are willing to go through the time and effort to build their "dream home," one that meets their personal tastes and family lifestyle needs. These are the people who are willing to "trade-off" urban residences in place of a rural community which would better suit their desires. This market segment may be further represented as follows:

- Household head typically 30 to 65 years old.
- Many families with one or two older children.
- Families who are willing to "trade-off" living in a more urban community and find the 60 to 75 minute commute to work along a scenic highway acceptable.
- Employment may be in the forms of self-employment, entrepreneur ship, position within a company which allows for flexible working hours, or retired.
- Places of employment could range from Honolulu to areas within the North Shore community. Those working in Honolulu and must commute to work are expected to value and appreciate living in a rural spacious and secluded environment.
- Primary attractions of the project to this market include:

  Recreation and family-oriented community
  Attractiveness of its North Shore location
  Smaller, one- to two-acre lot sizes
  Horse ranch
  Well-designed master-planned subdivision
  Excellent ocean and coastline views

Vacation/Second Home Market Segment

The vacation/second home buyer would be a smaller market segment representing about 15% to 20% of all purchasers could be attracted by the project's location, horse ranch, orientation, excellent ocean views and privacy. This market may be further described as follows:

EXHIBIT 4-A

About 80% to 85% of the lot buyers at Lihi Lani are expected to be Oahu residents

PROJECTED TARGET MARKET FOR LIHI LANI RANCH

Primary place of residence	Projected market mix	Major purchase motivation
Oahu	80% - 85%	Primary or vacation homes
U.S. mainland or foreign countries	15% - 20%	Vacation and/or future retirement homes
Total	100%	

- Household head typically 35 to 50 years old with personal and professional freedom to travel and make significant use of a second home during the year.
- Repeat visitors to the state who prefer a private residential atmosphere which is not available at resorts or other areas on the island of Oahu.
- Primary attractions to the project:

  Excellent ocean and coastline views
  Close proximity to a resort area and recreational opportunities
  Relaxed upcountry atmosphere and privacy.

PROJECTED LOT PRICING

Sales prices at the surveyed comparable lot projects in Pupukea generally range from $210,000 to $665,000 per lot (1993 dollars). This is equivalent to about $140,000 to $275,000 per acre (1993 dollars) for lots averaging 1 to 3 acres in size.

Pricing for Lihi Lani's country lots was projected based on competitive prices at the surveyed projects. Adjustments were then made relative to the lots at Lihi Lani in terms of views, amenities, and size. Lots are generally proposed to range in size from 1 to 23 acres and would provide for a variety of locations and views within Lihi Lani. Based on this review, country lots at Lihi Lani are estimated to range from $250,000 to $540,000 per lot (1993 dollars) depending on size and view orientation, or about $140,000 to $240,000 per acre.

PROJECTED LOT SALES ABSORPTION AT LIHI LANI

Lihi Lani is planning to offer 315 country lots in total. The projected rate of sales for the country lot project was based on the rate of sales at the Pupukea subdivisions as well as the number of sales to Oahu buyers at Big Island projects.

Lihi Lani is expected to sell all of its lots in about eight years, as shown in Exhibit 4-B. Projected absorption rates indicate that 40 lots could be sold annually within the first five years of the project's completion and an average of 45 lots could be sold thereafter.

Projected absorption for Lihi Lani was determined as follows:

- Absorption rates from selected subdivisions within the Pupukea area and from the island of Hawaii were analyzed. During the past eight years, about only 71 vacant lots were sold at the surveyed Pupukea subdivisions. However, this number is considered to be artificially low due to the lack of new inventory and the limited number of vacant lots available for resale. To illustrate this point, as of June 1993 only 98 lots were not improved with homes throughout the five surveyed projects.
- The average number of lots sold per year at selected Big Island subdivisions was estimated to determine the Oahu market for country lots. About 45 lots were estimated to be sold annually to Oahu purchasers at just these Big Island projects alone, exclusive of agricultural lot developments on Maui, Kauai and Molokai.

EXHIBIT 4-B

Projected lot absorption at the Lihi Lani is expected to take about 8 years

PROJECTED SALES ABSORPTION AT THE LIHI LANI RANCH

	Annual sales			Cumulative
	Oahu	Other (1)	Total	sales
Year 1	35	5	40	40
Year 2	35	5	40	80
Year 3	35	5	40	120
Year 4	35	5	40	160
Year 5	35	5	40	200
Year 6	40	5	45	245
Year 7	40	5	45	290
Year 8	20	5	25	315

(1) Includes mainland and neighbor island purchasers.

- With the opening of Lihi Lani, the project is expected to capture bout 80% of the Oahu residents who have been historically purchasing lots at the various neighbor island projects.

  Thus, during the first five years of sales at Lihi Lani, about 35 lots are expected to be sold annually to Oahu purchasers.

- Neighbor island and mainland residents are also expected to purchase lots at Lihi Lani and are estimated to constitute about 15% of the Oahu resident sales, or about 5 additional lots annually, based on the experience of other comparable country lot subdivisions.

- Total lot sales are projected to increase to 45 lots per year as the project matures per year as the project matures and gains greater visibility and recognition.

The strong market capture can be associated with demonstrated demand for country lots on the North Shore and on the Big Island. Almost 30% of the island of Hawaii's agricultural lot purchasers are from the island of Oahu.

With the development of Lihi Lani, the country lot market which was once dominated by the neighbor islands can now fill the dual living and working needs of residents of Oahu.

In summary, residents of Lihi Lani would have the best of both worlds: the advantages of a relaxed, scenic and rural lifestyle of an up-country community in a master planned and high quality development and an Oahu location which is convenient for business, employment, shopping and entertainment pursuits.

KPMG Peat Marwick

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November 17, 1993

Mr. Toshiharu Hino, President
Obayashi Hawaii Corporation
c/o Mr. Craig Yamagishi
Lihi Lani
66-145 Kamehameha Highway
Haleiwa, Hawaii 96712

Dear Mr. Hino:

KPMG Peat Marwick is pleased to submit the accompanying addendum to the report entitled, "Market Assessment for Lihi Lani," dated July 1993. The addendum addresses Question 9 in the letter to Mr. Jeffrey N. Watanabe, Esq. from the State of Hawaii, Land Use Commission dated November 5, 1993.

Specifically, the question pertains to four facilities at Lihi Lani including:

- Community facilities
- Elderly housing
- Water reclamation facility
- Affordable single-family housing

This addendum addresses demand and absorption issues associated with the facilities listed, as requested by the Land Use Commission.

RESIDENTIAL HOUSING DEMAND

Historical and projected population and household growth for the island of Oahu is shown in Exhibit A. By the year 2000, Oahu's population is estimated to be about 932,800 while the number of households throughout the island is projected to be nearly 308,200.

Oahu's median household income for 1993 is estimated at about $48,400. Over 60% Oahu's households are estimated to have incomes less than $59,499, which represents about 120% of the Oahu median household income.

Exhibit C shows the projected number of households for Oahu as a percentage of Oahu's median household income. Households with incomes between 80% to 120% of the median household income are classified as "affordable home purchasers." By 2000, an estimated 27,000 additional housing units will be needed on Oahu.

Projections of Oahu's planned residential housing supply is shown in Exhibit D. By 1999, an estimated 25,500 additional residential units are planned for the island of Oahu.

The island of Oahu's projected housing demand and supply are shown in Exhibit E. As shown in the exhibit, Oahu's projected new housing supply will not satisfy the projected demand for residential units. Even with the large number of projects planned through the year 2000, the island will experience a shortage of about 1,500 units needed to accommodate Oahu's population growth.

AFFORDABLE SINGLE-FAMILY HOUSING UNITS

Characteristics of selected affordable single-family projects are shown in Exhibits F and G.

- Densities at affordable single-family projects generally range from 6 to 7 units per acre.
- Affordable single-family projects typically consist of 2- or 3-bedroom units.
- Prices of affordable single-family projects range from about $125,000 to $220,000. Lower-priced homes have been offered at significantly reduced prices at projects developed by the Department of Housing and Community Development as well as the Housing Finance Development Corporation.
- Family incomes for "affordably priced" homes in 1993 are targeted to those making 100% ($49,900) to 120% ($59,900) of Oahu's median family income. This is equivalent to a current price level in 1993 of about $170,000 to $210,000.

Affordable single-family units generally stay on the market for less than a year, as shown in Exhibit H. The majority of the projects have long wait lists which exceed the number of available units and are able to sell the entire project in a matter of weeks. Additionally, the Hawaii Housing Policy Study surveyed various people who would like to purchase homes and found that 4.5% of those surveyed were willing to relocate to the North Shore. The 50 affordable single-family units at Lihi Lani are expected to be readily absorbed within less than one year.

ELDERLY RENTAL PROJECT

Characteristics of selected elderly rental projects are shown in Exhibits I and J.

- Densities at elderly rental projects generally range from 16 to 30 units per acre.
- Elderly rental projects typically consist of studio and 1-bedroom units with interior areas that range from about 410 to 1,000 square feet.
- Monthly rents at elderly rental projects generally range from about $480 to $690

As shown in Exhibit K, occupancy rates at the elderly rental projects are generally high. Wait lists at many of the projects and a growing elderly population on the island indicate a continued need for such projects. Lihi Lani's elderly rental project is expected to occupancy levels similar to those experienced at Waipahu Crown Elderly, Manoa Gardens, Ewa Elderly, La'iola, Whitmore Circle, Haleiwa Senior Citizen Housing Center, Waipahu Hall Elderly, Kahuku Hauoli Hale, and Kupuna Home O Waialua or about 95% to almost 100% within a short lease-up period.

COMMUNITY FACILITIES

Estimated demand for the 1,000-member community facility located at Lihi Lani is shown in Exhibit L and based on the experience of similar YMCA facilities throughout Oahu.

Membership size at the various community facilities vary due to the number of households residing within the community and income levels of the surrounding neighborhood. The ratio of YMCA members per households range from 0.11 to 0.41. and average about 0.23 members per household.

Based on the number of households on the North Shore and a relatively low participation rate of 0.15 members per household due to the lower household incomes and "spread-out" nature of the North Shore community, a YMCA facility of about 1,300 members could be supported, as shown in Exhibit L. Thus, there is expected to be ample demand for the 1,000 member community facility at Lihi Lani.

WATER RECLAMATION FACILITIES

The majority of Oahu's North Shore is not serviced by the City and County of Honolulu's sewer maintenance service. Therefore, to maintain the high quality of the residential developments and improve the sanitation and environmental compatibility, the need for a water reclamation facility at Lihi Lani is imperative.

* * * * * * *

We appreciate the opportunity to address the questions raised by the Land Use Commission and to be of assistance to Obayashi Hawaii Corporation on this important project.

Very truly yours,

KPMG Peat Marwick

EXHIBIT A

Oahu's population is projected at about 933,000 or 308,000 households by the year 2000

HISTORICAL AND PROJECTED POPULATION AND HOUSEHOLD GROWTH FOR OAHU: 1960 TO 2015

	Oahu population		Oahu households		
	Number	Average annual percent change	Average size of households(1)	Number of households	Average annual percent change
Historical:					
1960	500,394	-	4.25	117,856	-
1970	630,528	2.3%	3.83	164,763	3.4%
1980	762,534	1.9%	3.31	230,373	3.4%
1990	836,231	0.9%	3.15	265,470	1.4%
Projected (2):					
1993	880,000	1.7%	3.11	282,700	2.1%
1995	910,400	1.7%	3.09	294,900	2.1%
2000	932,800	0.5%	3.03	308,200	0.9%

(1) Historical average size of households is based on the actual population and household counts. Projected average houshold size from 1993 to 2015 adjusted to decrease at a -0.4% annual rate compared to the historical average decrease of -1.0% annually from 1960 to 1990.

(2) Department of General Planning population projections for Oahu, August 1993.

Source: Compiled by KPMG Peat Marwick, based on information obtained from the U.S. Bureau of the Census, 1960 through 1990; and the Hawaii State Department of Business and Economic Developments, "Hawaii State Data Book" and the City Department of General Planning, 1993.

EXHIBIT B

Median Oahu household income is estimated at about $48,400 for 1993

INCOME DISTRIBUTION OF OAHU HOUSEHOLDS: 1989 AND 1993

	Midpoint	As a percent of Oahu median (rounded)	1990 Oahu Households Number	Distribution
1989 income distribution (1):				
$0 - $14,999	$7,500	20%	34,511	13%
$15,000 - $34,999	$25,000	60%	76,986	29%
$35,000 - $49,999	$42,500	100%	50,439	19%
$50,000 - $74,999	$62,500	150%	55,749	21%
$75,000 - $99,999	$87,500	220%	26,547	10%
$100,000 - $149,999	$125,000	310%	15,928	6%
$150,000 +	150,000	370%	5,309	2%
Total, rounded			265,470	100%
1989 median income, rounded			$40,600	

	Midpoint	As a percent of Oahu median (rounded)	Estimated 1993 Oahu households Number	Distribution
1993 income distribution (2):				
$0 - $17,999	$9,000	20%	36,751	13%
$18,000 - $41,499	$29,700	60%	81,983	29%
$41,500 - $59,499	$50,500	100%	53,713	19%
$59,500 - $89,499	$74,500	150%	59,367	21%
$89,500 - $119,499	$104,500	220%	28,270	10%
$120,500 - $178,999	$149,700	310%	16,962	6%
$179,000 +	$179,000	370%	5,654	2%
Total, rounded			282,700	100%
Estimated 1993 median income, rounded			$48,400	

(1) 1989 distribution of households by income as reported by the US Bureau of the Census, 1991.
(2) Inflated to 1993 dollars assuming an inflation rate of 4.5% per annum.

Source: Compiled by KPMG Peat Marwick.

EXHIBIT C

Demand for 27,000 additional housing units by the year 2000 is projected based on Oahu's growth in households

INCREMENTAL GROWTH IN OAHU HOUSEHOLDS BY INCOME GROUP: 1993 TO 2000

	Projected households as a percent of Oahu median household income							
	Renters	Affordable	Gap group	Market purchasers				
Number of households	Below 80%	80% to 120%	120% to 140%	140% to 180%	180% to 260%	260% to 340%	340% and over	Total
1993 estimated (1)	118,734	53,713	41,463	20,731	28,270	16,962	5,654	282,700
As a percent of total	42%	19%	15%	7%	10%	6%	2%	101%
1995 projected	123,858	56,031	43,252	21,626	29,490	17,694	5,898	294,900
Incremental increase	5,124	2,318	1,789	895	1,220	732	244	12,322
2000 projected	129,444	58,558	45,203	22,601	30,820	18,492	6,164	308,200
Incremental increase	5,586	2,527	1,951	975	1,330	798	266	13,433
Total increase, rounded	10,710	4,845	3,740	1,870	2,550	1,530	510	25,755
Total increase with 5% vacancy factor, rounded	11,200	5,100	3,900	2,000	2,700	1,600	500	27,000

(1) Based upon information presented in Exhibits F and G.

EXHIBIT D

About 25,500 units are estimated to be completed on Oahu, the majority in the 1995 to 1999 time period

PLANNED RESIDENTIAL HOUSING SUPPLY FOR THE ISLAND OF OAHU

	1993-1995	1996 - 2000	Total
Development plan areas:			
Central Oahu	4,207	6,184	10,391
Ewa	6,073	12,742	18,815
Primary urban center (PUC)	274	1,621	1,895
East Honolulu	159	-	159
Koolaupoko	121	25	146
Koolauloa	0	360	360
North Shore(1)	0	200	200
Waianae	207	346	553
Total, rounded	11,040	21,480	32,520
Projected completion of units(2)	10,500	15,000	25,500
Annual average	**5,250**	**3,000**	
Percentage distribution	**41%**	**59%**	**100%**

(1) The development plan area of the North Shore includes the Lihi Lani.

(2) Completion factor considers uncertainty of many projects which may not be developed as listed in the Dept. of General Planning's Development Plan. A 95% completion rate for planned units has been utilized for the 1993-1995 time period. A 70% completion factor has been projected for units from 1996 to 2000 listed in the Development Plan.

Sources: Compiled by KPMG Peat Marwick based information from the City and County of Honolulu, Planning Department, "Development Plan Annual Report, Fiscal Year 1993," September 1993 and as revised by various published articles and interviews with representatives from DHCD and HFDC. This inventory of proposed developments are estimates and may not be composed of the entire number of proposed developments for the island of Oahu.

EXHIBIT E

Based on the number of planned residential housing, the island of Oahu is still in need of additional housing

PROJECTED HOUSING SUPPLY AND DEMAND FOR THE ISLAND OF OAHU

	Projected housing demand: New household formation(1)	Projected housing demand: Desired vacancy factor	Projected housing demand: Total new housing demand	Estimated housing units(2)	Estimated (shortage)/ surplus (end of period)	Cumulative (shortage)/ surplus
1993 - 1995	12,300	5%	12,920	10,500	(2,420)	(2,420)
1996 - 2000	13,400	5%	14,070	15,000	930	(1,490)
Total (rounded)	25,700		27,000	25,500	(1,500)	

(1) As shown in Exhibit C.
(2) As shown in Exhibit D.

Source: Compiled by KPMG Peat Marwick.

Exhibit E

Affordable single-family project densities generally range from 6 and 7 units per acre

CHARACTERISTICS OF SELECTED AFFORDABLE SINGLE-FAMILY PROJECTS

Development/ Project name	Developer	Year first marketed	Number of units	Range of lot sizes (s.f.)	Density	
					Acres	Units/ acre
Waikele/ Sunset Pointe	Castle & Cooke Res. Inc.	1992	123	INA	34.0	7.4
Mililani Mauka/The Cottages	Castle & Cooke Res. Inc.	1993	164	3,900	INA	INA
Villages of Kapolei:						
Village I - Kumu Iki	Oceanic Properties	1990	312	3,200 - 6,710	71.3	7.3
Village II - A'eloa	Watt Hawaii, Inc.	INA	125	INA	56.1	5.6
Village III - Malanai	Watt Hawaii, Inc.	1991	184	3,890 - 5,970	52.1	5.9
West Loch Estates:						
Phase I - The Garden Line	Westloch Inc./ C&C of Hon.	1990	356	3,000 - 4,000	INA	INA
Phase II - Greenway Homes	Westloch Inc./ C&C of Hon.	1993	315	3,000 - 4,000	INA	INA
Proposed units at Lihi Lani	Obayashi Hawaii Corporation	1996	50	5,000	10.0	5.0

INA = Information not available/ applicable.
Sources: Sales material, site visits, interview with developers, and State and County officials.

Exhibit G

Typical affordably priced homes generally range from about $125,000 to $220,000

PRICE RANGES BY UNIT TYPE AT SELECTED SINGLE-FAMILY PROJECTS IN EWA AND CENTRAL OAHU (1992-1993)

Development/ Project name	Number of units	2-Bedroom Low	2-Bedroom High	3-Bedroom Low	3-Bedroom High	4-Bedroom Low	4-Bedroom High	Target buyer markets
Waikele/ Sunset Pointe	123	$195,000	$195,000	$215,000	$225,000	--	--	First-time
Mililani Mauka/The Cottages		--	--	259,500	310,900	--	--	First-time
Villages of Kapolei:								
Village I - Kumu Iki	312	89,000	120,000	105,000	120,000	--	--	First-time
Village III - Malanai	184	INA	INA	280,000	315,000	--	--	First-time, GAP income buyers
West Loch Estates:								
The Garden Line	356	100,000	100,000	120,000	120,000	$126,000	$126,000	First-time
The Greenway Line	315	INA	INA	INA	INA	INA	INA	First-time
Average		$128,000	$138,300	$195,900	$218,200	$126,000	$126,000	

INA = Information not available/ applicable.
Sources: Sales material; site visits; interviews with developers, managers and State and County officials.

Exhibit H

Affordably priced single-family projects generally are completely sold out in one to six months

ABSORPTION AT SELECTED AFFORDABLE SINGLE-FAMILY PROJECTS (1992-1993)

Development/ Project name	Planned units	Price range ($000's)	Units released(1) Reserved or sold	Available	Total	Sale dates Begin	End	Months in sales	Indicated monthly sales absorption	U Reserved Comments
Waikele/ Sunset Pointe	123	$195 - 225	123	0	123	Oct-91	Oct-91	0.3	492.0	3,000 applicants
Mililani Mauka/The Cottages	164	$260 - 311	156	8	164	May-93	Present	5.0	31.2	
Villages of Kapolei:										
Village I - Kumu Iki	312	$89 - 120	312	0	312	Aug-90	Sep-90	0.3	1,248.0	
Village III - Malanai	184	$280 - 315	184	0	184	Oct-90	Oct-90	0.3	736.0	3,800 applicants
West Loch Estates:										
Phase I - The Garden Line	356	$94 - 121	356	0	356	Jan-88	Jan-88	0.3	1,424.0	8,000 applicants
Phase II - Greenway models	315	$100 - 126	315	0	315	Dec-90	Dec-90	0.3	1,260.0	8,800 applicants
Total/ average	1,454		1,446	8	1,454			6.3	231.4	

INA = Information not available/ applicable.

Sources: Sales material; site visits; interviews with developers, managers and State and County officials.

Exhibit I

Elderly rental project densities range from 16 to 30 units per acre

CHARACTERISTICS OF SELECTED ELDERLY RENTAL PROJECTS

Development/ Project name	Developer(1)	Location	Date of completion	Number of units	Density: Acres	Density: Units/ acre
Waipahu Crown Elderly(2)	HFDC	Waipahu	1993	340	13.3	25.6
West Loch Village	DHCD	Ewa	1993	150	5.7	26.5
Manoa Gardens	DHCD	Manoa	1992	80	3.3	24.2
Ewa Elderly	DHCD	Ewa	1991	84	5.0	16.8
La'iola (Wahiawa Elderly)	HFDC	Wahiawa	1991	108	3.5	30.9
Whitmore Circle	HFDC	Wahiawa	1988	44	1.5	29.3
Haleiwa Senior Citizen Housing Center	Hawaii Civic Service	Haleiwa	1982	60	N/A	N/A
Waipahu Hall Elderly	NCHP	Waipahu	1982	72	2.8	25.7
Kahuku Hauoli Hale	N/A	Kahuku	1979	64	6.0	10.7
Kupuna Home O Waialua	N/A	Waialua	1977	40	N/A	N/A
Proposed elderly housing at Lihi Lani	**DHCD**	**Pupukea**	**N/A**	**80**	**6.0**	**13.3**

(1) Acronyms used for the various developers are as follows:
HFDC = Housing Finance and Development Corportion
DHCD = Department of Housing and Community Development
NCHP = National Coalition of Housing Partners
(2) To be completed in four phases with phase one consisting of approximately 111 units.
N/A = Not available as to the project will be developed and operated by the City and County of Honolulu.
Source: Discussions with property managers and representatives of the respective projects.

Exhibit J

Rents at elderly rental projects generally range from about $480 to $690

UNIT RENTS OF SELECTED AFFORDABLE RENTAL PROJECTS ON OAHU: 1993

Development/ Project name	Number of units	Studio		1-Bedroom		2-Bedroom	
		Low	High	Low	High	Low	High
West Loch Village(1)	150	$150	$645	$150	$780	--	--
Manoa Gardens:							
Low-moderate (below 80% of MFI)	39	565	565	680	680	--	--
Gap (80% to 120% of MFI)	9	635	635	720	720	--	--
Market	31	675	675	760	760	--	--
Ewa Elderly(1)	84	--	--	70	700	--	--
La'iola (Wahiawa Elderly)(1)	108	150	475	175	500	--	--
Whitmore Circle	44	--	--	400	400	$500	$500
Haleiwa Senior Citizen Housing Center	60	--	--	635	635	--	--
Waipahu Hall Elderly	72	--	--	890	890	--	--
Kahuku Hauoli Hale	64	--	--	735	737	--	--
Kupuna Home O Waialua	40	675	675	775	775		
Average, rounded		$480	$610	$540	$690	$500	$500

(1) Low end of range represents the actual rents paid by the lowest restricted rent category, while high end is the highest market rent.
Sources: Sales material; site visits; interviews with developers, managers and State and County officials.

EXHIBIT K

Occupancy rates at elderly rental projects generally range from about 95% to 100%

OCCUPANCY RATES AND RENTER CHARACTERISTICS AT SELECTED RENTAL PROJECTS

Development/ Project name	Number of units	Occupancy rate	Comments on demand and renter profile
Waipahu Crown Elderly	340	100% (1)	Built based on 1988 HHA statistics citing demand for 1,980 elderly rental units. The project consists of four phases. Phase 1, consisting of 111 units, is scheduled for occupancy as of December 1, 1993. The number of applicants for residency at Phase I were greater than the number of available units. Phase II is expected to begin construction as of December 1, 1993 while development information of Phases III and IV are not available.
West Loch Village	150	70%	Low occupancy rate after completion is attributed to the Ewa location, large project size and high rental rates which are similar to town rates.
Manoa Gardens	80	100%	Market units were last to be rented.
Ewa Elderly	84	100%	One year waiting list; 2 to 4 inquiries per month.
La'iola (Wahiawa Elderly)	108	97%	Sees continued demand for elderly units. Waipahu is more desirable compared to Wahiawa.
Whitmore Circle	44	100%	20- to 25-unit waiting list.
Haleiwa Senior Citizen Housing Center	60	100%	Waiting time for an available unit is estimated to be between 1 1/2 to 2 years.
Waipahu Hall Elderly	72	100%	Independent-care facility.
Kahuku Hauoli Hale	64	100%	Waiting time for an available unit is estimated to be between 1 to 1 1/2 years.
Kupuna Home O Waialua	40	95%	Over 120 families on the waiting list. 100% occupancy is expected once renters are notified.

(1) Based on the number of applicants being greater than the number of available units.
Source: discussions with property managers and representatives of the respective projects.

EXHIBIT L

Oahu's North Shore community could more than support the proposed 1,000-member community facility

ESTIMATED DEMAND FOR YMCA MEMBERSHIP

	Existing areas with YMCA facilities			
	Mililani(1)	Kailua(2)	Kaimuki(3)	Total
Existing YMCA demand:				
Total YMCA members(4)	3,000	1,500	1,300	5,800
Total households (1989)	8,820	13,275	3,208	25,303
Members per household	0.34	0.11	0.41	0.23
Average household income (1989)	$54,573	$55,105	$63,816	--
Projected Lihi Lani community facility demand(5):				
Total households on the North Shore (1989)				8,834
Estimated members per household				0.15
Estimated membership demand				1,325

(1) Defined as census tracts 89.06, 89.07, 89.08, 89.09, 89.10.
(2) Defined as census tracts 109.01, 109.03, 109.04, 109.05, 110, 111.03, 111.04, 111.05, 111.06, 112.01, 112.02.
(3) Defined as census tracts 4.97, 5.0, 9.01.
(4) As provided by representatives of the YMCA.
(5) Defined as census tracts 99.01, 99.02, 100, 101, 102.1, 102.2. The average household income is about $36,500.

APPENDIX H

Stormwater Impacts Report

D R A F T

Predicted Water Quality Effects of the Lihi Lani Project at Pupukea-Paumalu, Oahu, Hawaii

Prepared for

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September 1993

Table of Contents

List of Figures

List of Tables

Introduction

A revised development plan, dated July 7, 1993, has been prepared by Group 70 for the Lihi Lani project at Pupukea-Paumalu. Development of the 1144-acre site would ultimately consist of the land uses tabulated below. Approximately 480 acres or 42 percent of the project site would be altered by development; the remaining 664 acres, primarily the steeply sloping land, would be left unchanged.

Land Use		Total Area (Acres)	Graded Area* (Acres)
Ranch / Pasture		64	48
Forestry		47.5	47.5
Park / Community Facilities		6.5	6.5
Campground		4	2
Affordable Housing (50 Units)		10	10
Elderly Housing (80 Units)		6	6
Water Reclamation Facility		24	24
Roadway ROW		80	80
Country Lots	- House Pads	72	72
	- Landscaping	72	72
	- Agriculture	112	112
	- Open Space	509	0
Other Open Space		137	0
Totals		1,144	480

* *The graded areas were estimated by Engineering Concepts.*

Development of the project can be expected to affect surface runoff and groundwater to at least some extent. This report evaluates both of these effects. The surface water analysis is based on the Storm Drainage Plan prepared by Engineering Concepts (1993). The groundwater analysis draws from previous assessments (discussed in the next section) as well as additional field investigation and analyses.

Previous Surface and Groundwater Assessements

Several surface and groundwater assessments were completed previously when the Lihi Lani development plan included an 18-hole golf course. Although the golf course has been eliminated and the development plan has been revised in other ways, methods and information in these reports have been used for this current assessment. For the surface water analysis, Dugan (1990) and Environmental and Turf Services, Inc. (1993) were used. The Environmental and Turf Services study utilized computer modeling to focus primarily on the effects of the golf course. Dugan's methodology was based on Soil

Conservation Service curve numbers and runoff equations. Although numerically less sophisticated, it is more appropriate for the current land use plan. The methodology used for this present assessment is quite similar to Dugan's.

Groundwater assessments in Mink (1990) and Nance (1993) were made for the earlier development plan which included a golf course. Mink (1990) used a box model to determine mass balances and water quality effects. Nance (1993) utilized a two-dimensional, plan view computer model to assess groundwater impacts. Because the golf course has been removed from the development plan, less rigorous analytical techniques similar to those in Mink (1990) are used for this assessment.

Surface Water Analysis

Watershed Areas. The project site lies within the four watersheds listed below. Three of these are well defined, normally dry gulches which convey surface runoff during moderate to heavy rainfall events to culverts in Kamehameha Highway. The Paumalu and Kalunawaikaala Gulches are the north and south boundaries of the site; Pakulena Gulch bisects it. The fourth "watershed" area is comprised of the bluffs and lowlands beneath the project site. This area has no defined drainageway; rather, runoff occurs as overland flow which generally moves toward Kamehameha Highway. Figure 1 identifies the project site within these four watersheds and Table 1 provides a more detailed breakdown of the land uses summarized below.

Distribution of the Project Area in the Four Watersheds

Watershed	Total Area (Acres)	Portion of Project (Acres)	Area to be Disturbed (Acres)
Paumalu Gulch	1,970	450	168.8
Pakulena Gulch	510	445	209.5
Kalunawaikaala Gulch	510	185	71.8
Bluffs and Lowlands	160	64	29.9
Totals	3,150	1,144	480.0

Drainage Plan. The drainage plan presented in Engineering Concepts (1993) proposes excavation of 40 drainage sumps to reduce runoff volumes and peaks from the development area. Locations of these sumps are shown on Figure 4 of Engineering Concepts (1993). Proposed sump storage in each of the four watersheds would be as listed below:

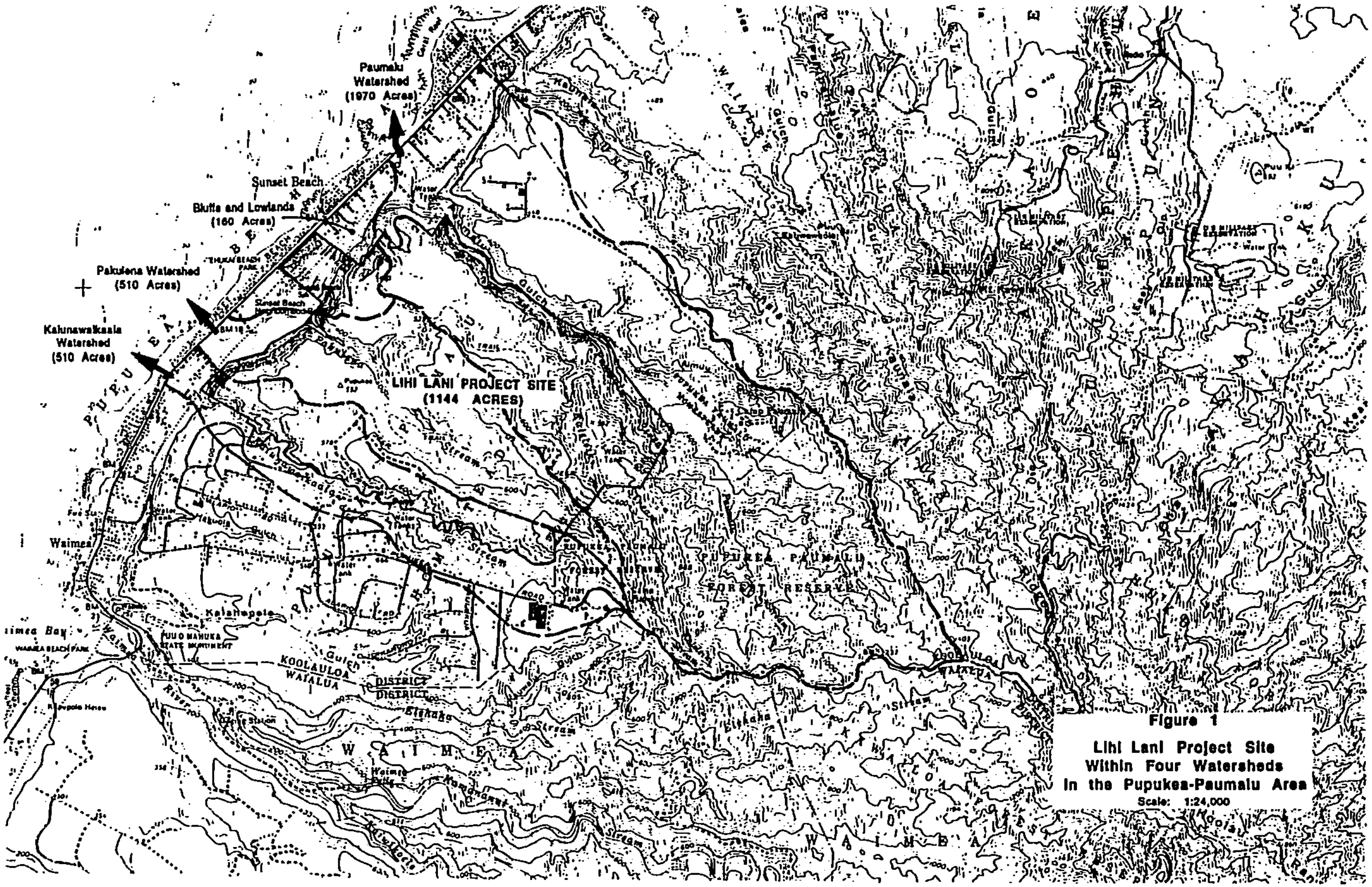

Figure 1

Lihi Lani Project Site Within Four Watersheds In the Pupukea-Paumalu Area

Scale: 1:24,000

Table 1. Distribution of Developed Land Uses in the Four Drainage Basins

Land Use	Developed Areas (Acres)			
	Paumalu Basin	Pakulena Basin	Kalunawaikaala Basin	Bluffs and Lowlands
Country Lots: House Pads	22.4	30.3	15.8	3.5
: Other Landscaping	22.4	30.3	15.8	3.5
: Agriculture	35.6	48.3	28.1	--
Ranch/Pasture	--	48.0	--	--
Forestry	47.5	--	--	--
Park/Community Facilities			--	6.5
Campground	2.0	--	--	--
Affordable Housing	10.0	--	--	--
Elderly Housing	--	--	--	6.0
Water Reclamation Facility	5.7	18.3	--	--
Road R.O.W.	23.2	34.3	12.1	10.4
Totals	166.8	209.5	71.8	29.9

Notes: 1. Delineation of the 480 acres to be graded was done by Engineering Concepts.

2. Calculation of the graded areas to respective watersheds was done by Tom Nance Water Resource Engineering.

Watershed	Proposed Sump Storage (Acre-Feet)
Paumalu	58.2
Pakulena	62.0
Kalunawaikaala	17.4
Bluffs and Lowlands	24.3
Total	161.9

Storm Events Chosen for Analysis. Three storm events were chosen to illustrate changes in runoff volume and water quality due to development: 2-year, 24-hour storm; 10-year, 24-hour storm; and 100-year, 24-hour storm. These were chosen based on available rainfall-frequency information (taken from Giambelluca, 1984) and the relative magnitudes of runoff in comparison to proposed sump storage. The proposed sump volumes are relatively large in comparison to the stormwater runoff potential. Little or no runoff from developed areas would occur for storms of significantly shorter duration than 24 hours, particularly if the storms have a frequency of occurrence of two years or less. Rainfall amounts of the chosen storms are summarized below.

Storm Event	Rainfall at Mauka End of the Property (Inches)	Rainfall at Makai End of the Property (Inches)
2-Year, 24-Hour	5.6	4.5
10-Year, 24-Hour	9.0	7.9
100-Year, 24-Hour	13.7	12.4

Note: Rainfall amounts taken from Giambelluca, 1984.

Computed Runoff Volumes for Existing Conditions. Runoff volumes for existing ground conditions and the three chosen storm events were calculated using the Soil Conservation Service method. Soil types were determined from Foote, D. E. et al., 1972. Respective hydrologic soil classes were identified using U.S. Soil Conservation Service, 1972. Curve numbers (CN values) to calculate runoff were determined by Engineering Concepts and adopted for this study. The final step was to compute runoff for each storm event using the following Soil Conservation Service formula:

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

where:

Q = runoff in inches

P = storm rainfall in inches

$S = \frac{1000}{CN} - 10$

CN = weighted Curve Number

Tables 2 through 5 present the computations for the four watersheds and the three chosen storm events. Paumalu basin was subdivided into eight sub-areas and the other basins were subdivided as appropriate. The results provide a benchmark for comparison with developed conditions.

Runoff Volumes After Development. Runoff volumes after development is completed were calculated using the same SCS analytical technique. Significant differences included the obvious land use changes (reflected primarily in increased CN values) and the necessity to further subdivide each watershed to account for the beneficial effect of the 40 excavated sumps proposed in the Engineering Concepts drainage plan. A comparison of required watershed subdivisions for existing and developed conditions is as follows:

Watershed	Number of Sub-Areas for Existing Conditions	Number of Sub-Areas for Developed Conditions
Paumalu Gulch	8	20
Pakulena Gulch	4	17
Kalunawaikaala Gulch	4	7
Bluffs and Lowlands	1	3

Calculated runoff volumes for developed conditions are compiled in Tables 6 through 9. Without the 40 detention sumps proposed by Engineering Concepts, runoff volumes would have been increased due to development by between 5 and 15 percent. However, with the sumps to provide extended runoff detention, the runoff volumes for all three chosen storm events would be less. Table 10 summarizes these results. Overall, runoff volumes after development would be 15.6, 8.8, and 4.3 percent less than for existing conditions for the 2-year, 10-year, and 100-year storms, respectively. It is worth noting that for lesser storms than these, the beneficial effect of the sumps would be even greater.

Table 2. Calculated Runoff Volumes from the Paumalu Watershed for Existing Conditions

Sub. Area	Area (Sq. Miles)	Weighted CN	2-Year, 24-Hour Storm		10-Year, 24-Hour Storm		100-Year, 24-Hour Storm	
			Rainfall (Inches)	Runoff (Acre-Feet)	Rainfall (Inches)	Runoff (Acre-Feet)	Rainfall (Inches)	Runoff (Acre-Feet)
1 A	0.2540	40	5.7	5.58	8.9	22.56	14.0	63.00
1 B	0.2185	60	5.2	16.54	8.8	45.97	13.3	89.56
2 A	1.0000	40	6.0	26.67	10.0	118.79	15.0	284.44
2 B	0.1333	61	5.4	11.48	8.9	29.46	13.4	56.42
3	0.0596	66	5.0	5.49	8.6	14.32	13.1	26.89
4	0.5940	55	5.4	37.57	8.8	105.94	13.4	219.80
5	0.6740	66	4.6	52.52	8.3	152.94	12.6	287.76
6	0.1463	84	4.6	10.35	8.3	31.38	12.5	60.08
Total	3.0797	--	--	166.20	--	521.36	--	1087.95

Table 3. Calculated Runoff Volumes from the Pakulena Watershed for Existing Conditions

Sub. Area	Area (Sq. Miles)	Weighted CN	2-Year, 24-Hour Storm		10-Year, 24-Hour Storm		100-Year, 24-Hour Storm	
			Rainfall (Inches)	Runoff (Acre-Feet)	Rainfall (Inches)	Runoff (Acre-Feet)	Rainfall (Inches)	Runoff (Acre-Feet)
8 A	0.0429	55	5.5	2.84	9.1	8.15	13.8	16.84
8 B	0.3875	60	5.1	28.83	8.8	80.34	13.1	159.23
8 C	0.1185	59	4.8	7.09	8.4	22.25	12.7	44.28
8 D	0.2379	68	4.7	21.18	8.1	54.80	12.4	103.08
Total	0.7968	--	--	59.94	--	165.54	--	323.21

Notes to Tables 2 and 3: 1. Delineation of sub-areas and respective CN values was done by Engineering Concepts.
2. Determination of rainfall amounts and calculations of runoff volumes was done by Tom Nance Water Resource Engineering.

Table 4. Calculated Runoff Volumes from the Kalunawaikaala Watershed for Existing Conditions

Sub. Area	Area (Sq. Miles)	Weighted CN	2-Year, 24-Hour Storm		10-Year, 24-Hour Storm		100-Year, 24-Hour Storm	
			Rainfall (Inches)	Runoff (Acre-Feet)	Rainfall (Inches)	Runoff (Acre-Feet)	Rainfall (Inches)	Runoff (Acre-Feet)
9 A	0.6203	84	5.1	54.45	8.6	141.11	13.1	269.55
9 B	0.0838	86	4.8	7.12	8.3	19.02	12.6	35.78
9 C	0.0654	84	4.6	4.63	8.0	13.19	12.3	25.93
9 D	0.0274	87	4.5	2.14	7.9	5.90	12.1	11.26
Total	0.7969	--	--	68.34	--	179.22	--	342.52

Table 5. Calculated Runoff Volumes from the Bluffs and Lowlands for Existing Conditions

Sub. Area	Area (Sq. Miles)	Weighted CN	2-Year, 24-Hour Storm		10-Year, 24-Hour Storm		100-Year, 24-Hour Storm	
			Rainfall (Inches)	Runoff (Acre-Feet)	Rainfall (Inches)	Runoff (Acre-Feet)	Rainfall (Inches)	Runoff (Acre-Feet)
D	0.1082	70	4.5	9.66	7.9	25.27	12.4	48.57

Notes to Tables 4 and 5:
1. Delineation of sub-areas and respective CN values was done by *Engineering Concepts*.
2. Determination of rainfall amounts and calculations of runoff volumes was done by Tom Nance Water Resource Engineering.

Table 6. Calculated Runoff Volumes for the Paumalu Watershed for Developed Conditions

Sub. Area	Area (Sq. Miles)	Weighted CN	Detention Storage (Acre-Feet)	2-Year, 24-Hour Storm			10-Year, 24-Hour Storm			100-Year, 24-Hour Storm		
				Rainfall (Inches)	Total Runoff (Acre-Feet)	Runoff Excess (Acre-Feet)	Rainfall (Inches)	Total Runoff (Acre-Feet)	Runoff Excess (Acre-Feet)	Rainfall (Inches)	Total Runoff (Acre-Feet)	Runoff Excess (Acre-Feet)
1 A	0.2540	40	--	5.7	5.58	5.58	9.5	26.62	26.62	14.1	63.95	63.95
A 1	0.0092	60	3.9	5.4	0.78	--	8.8	1.84	--	13.5	3.86	--
A 2	0.0164	60	4.2	5.4	1.35	--	8.8	3.45	--	13.5	6.87	2.87
A 3	0.0056	60	4.1	5.4	0.46	--	8.8	1.18	--	13.5	2.35	--
A 4	0.0256	60	--	5.4	2.10	2.10	8.8	5.39	5.39	13.5	10.73	10.73
A 5	0.0063	66	--	5.4	0.85	0.85	8.8	1.53	1.53	13.5	2.91	2.91
A 6	0.0327	65	3.7	5.1	3.00	--	8.6	7.65	3.95	13.1	14.48	10.78
A 7	0.0252	75	3.5	5.1	3.40	--	8.6	7.51	4.01	13.1	13.18	9.68
1 B	0.1000	63	4.1	5.5	9.78	5.68	9.0	23.84	19.74	13.5	44.52	40.42
2 A	1.0000	40	--	6.0	26.67	26.67	10.0	118.79	118.79	15.0	284.44	284.44
2 B	0.1308	61	--	5.4	11.27	11.27	8.8	28.36	28.38	13.5	55.97	55.97
3	0.0596	66	--	5.1	5.71	5.71	8.6	14.32	14.32	13.1	28.89	28.88
4	0.5940	55	--	5.4	37.57	37.57	8.8	105.94	105.94	13.4	218.80	219.80
B 1	0.0535	69	4.1	4.7	4.97	0.87	8.3	13.14	9.04	12.5	23.88	19.76
5	0.6161	67	--	4.7	52.48	52.48	8.3	143.64	143.64	12.5	285.01	285.01
C 1	0.0188	77	7.0	4.8	2.44	--	8.4	5.80	--	12.7	9.63	2.63
C 2	0.2010	76	4.8	4.8	2.54	--	8.4	5.92	1.12	12.7	10.25	5.46
C 3	0.0410	71	10.8	4.8	4.30	--	8.4	10.78	--	12.7	19.34	8.64
C 4	0.0391	77	8.0	4.8	4.77	--	8.4	11.27	3.27	12.7	19.65	11.66
C 5	0.0367	77	--	4.8	4.81	4.81	8.4	11.04	11.04	12.7	19.00	19.00
Totals	3.0845	--	58.2	--	184.81	153.39	--	547.91	496.76	--	1116.89	1060.28

Notes:
1. Delineation of sub-areas, CN values, and detention storage volume was done by Engineering Concepts.
2. Determination of rainfall amounts and calculations of runoff volumes was done by Tom Nance Water Resource Engineering.
3. In each of the sub-areas with detention storage, areas will be graded to direct runoff (in the "Total Runoff" columns) and sump storage. This net amount is in the columns labeled "Runoff Excess."

Table 7. Calculated Runoff Volumes for the Pakulena Watershed for Developed Conditions

Sub. Area	Area (Sq. Miles)	Weighted CN	Detention Storage (Acre-Feet)	2-Year, 24-Hour Storm Rainfall (Inches)	2-Year, 24-Hour Storm Total Runoff (Acre-Feet)	2-Year, 24-Hour Storm Runoff Excess (Acre-Feet)	10-Year, 24-Hour Storm Rainfall (Inches)	10-Year, 24-Hour Storm Total Runoff (Acre-Feet)	10-Year, 24-Hour Storm Runoff Excess (Acre-Feet)	100-Year, 24-Hour Storm Rainfall (Inches)	100-Year, 24-Hour Storm Total Runoff (Acre-Feet)	100-Year, 24-Hour Storm Runoff Excess (Acre-Feet)
8 A	0.0136	55	--	5.8	0.94	8.4	9.3	2.69	2.89	13.8	5.27	5.27
E1	0.1523	62	2.0	5.4	16.44	11.39	8.8	40.70	38.70	13.5	79.59	77.59
E2	0.0253	62	4.4	5.1	2.02	--	8.6	5.43	1.03	13.1	10.57	6.17
E3	0.0382	60	2.8	5.1	2.77	--	8.6	7.72	5.12	13.1	19.30	12.70
E4	0.0181	57	4.2	4.7	0.92	--	8.3	3.10	--	12.5	8.29	2.09
E5	0.1114	66	13.5	5.1	10.87	--	8.8	28.75	13.26	13.1	50.28	38.78
F1	0.0172	69	--	5.1	1.86	1.86	8.8	4.46	4.46	13.1	8.18	8.15
F2	0.0112	77	2.0	4.7	1.42	--	8.3	3.32	1.32	12.5	5.66	3.68
F3	0.0130	76	4.8	4.7	1.59	--	8.3	3.77	--	12.5	8.50	1.70
F4	0.0492	63	2.2	4.7	3.47	1.27	8.3	10.25	8.05	12.5	19.57	17.37
F5	0.0161	61	--	4.7	1.02	1.02	8.3	3.16	3.16	12.5	8.14	8.14
8 B	0.0670	63	--	4.7	4.73	4.73	8.3	13.96	13.96	12.5	28.65	28.65
G1	0.0208	75	7.8	4.7	2.41	--	8.3	5.81	--	12.5	10.09	2.49
G2	0.0187	72	4.2	4.7	1.96	--	8.3	4.96	0.75	12.5	8.78	4.59
G3	0.0468	74	11.9	4.7	5.28	--	8.3	12.88	0.88	12.5	22.54	10.84
G4	0.1655	72	--	4.8	16.72	16.72	8.0	41.44	41.44	12.3	78.04	78.04
G5	0.0160	72	2.8	4.7	1.68	--	8.3	4.01	1.41	12.5	7.81	4.91
Totals	0.8298	--	62.0	--	78.90	37.93	--	194.41	136.33	--	384.96	302.96

Notes:
1. Delineation of sub-areas, CN values, and detention storage volume was done by Engineering Concepts.
2. Determination of rainfall amounts and calculations of runoff volumes was done by Tom Nance Water Resource Engineering.
3. In each of the sub-areas with detention storage, areas will be graded to direct runoff (in the "Total Runoff" columns) and sump storage. This net amount is in the columns labeled "Runoff Excess."

Table 8. Calculated Runoff Volumes for the Kalunawaikaala Watershed for Developed Conditions

Sub. Area	Area (Sq. Miles)	Weighted CN	Detention Storage (Acre-Feet)	2-Year, 24-Hour Storm Rainfall (Inches)	2-Year, 24-Hour Storm Total Runoff (Acre-Feet)	2-Year, 24-Hour Storm Runoff Excess (Acre-Feet)	10-Year, ,24-Hour Storm Rainfall (Inches)	10-Year, ,24-Hour Storm Total Runoff (Acre-Feet)	10-Year, ,24-Hour Storm Runoff Excess (Acre-Feet)	100-Year, 24-Hour Storm Rainfall (Inches)	100-Year, 24-Hour Storm Total Runoff (Acre-Feet)	100-Year, 24-Hour Storm Runoff Excess (Acre-Feet)
H1	0.0343	65	8.1	5.5	3.68	--	9.0	8.63	2.53	13.5	15.86	9.75
9 A	0.8005	86	--	5.1	57.52	57.52	8.8	144.28	144.26	13.1	270.92	270.92
I1	0.0150	72	5.4	4.7	1.58	--	8.3	3.87	--	12.5	7.04	1.84
I2	0.0449	70	2.2	4.7	4.35	2.15	8.3	11.31	9.11	12.5	20.38	18.18
J1	0.0105	73	3.7	4.7	1.15	--	8.3	2.84	--	12.5	5.01	1.31
9C	0.0495	64	--	4.8	3.50	3.50	8.0	9.98	9.98	12.3	19.82	19.82
9D	0.0274	67	--	4.5	2.14	2.14	7.9	5.90	5.90	12.1	11.28	11.26
Totals	0.7821	--	17.4	--	73.89	65.31	--	189.89	171.78	--	350.08	332.68

Table 9. Calculated Runoff Volumes for the Bluffs and Lowlands for Developed Conditions

Sub. Area	Area (Sq. Miles)	Weighted CN	Detention Storage (Acre-Feet)	2-Year, 24-Hour Storm Rainfall (Inches)	2-Year, 24-Hour Storm Total Runoff (Acre-Feet)	2-Year, 24-Hour Storm Runoff Excess (Acre-Feet)	10-Year, 24-Hour Storm Rainfall (Inches)	10-Year, 24-Hour Storm Total Runoff (Acre-Feet)	10-Year, 24-Hour Storm Runoff Excess (Acre-Feet)	100-Year, 24-Hour Storm Rainfall (Inches)	100-Year, 24-Hour Storm Total Runoff (Acre-Feet)	100-Year, 24-Hour Storm Runoff Excess (Acre-Feet)
D1	0.0171	74	3.1	4.5	1.80	0.0	8.0	4.49	1.39	12.2	8.03	4.93
D2	0.0759	77	14.8	4.5	8.95	0.0	8.0	21.35	6.75	12.2	37.35	22.75
D3	0.0169	71	6.6	4.5	1.57	0.0	8.0	4.13	--	12.2	7.55	0.95
Totals	0.1099	--	24.3	--	12.32	0.0	--	29.97	8.14	--	52.93	28.63

Notes on Tables 8 and 9:
1. Delineation of sub-areas, CN values, and detention storage volume was done by Engineering Concepts.
2. Determination of rainfall amounts and calculations of runoff volumes was done by Tom Nance Water Resource Engineering.
3. In each of the sub-areas with detention storage, areas will be graded to direct runoff (in the "Total Runoff" columns) and sump storage. This net amount is in the columns labeled "Runoff Excess."

Table 10. Comparison of Runoff Volumes for Existing and Developed Conditions

Basin	Detention Storage (Acre-Feet)	Runoff Volumes: 2-Year, 24-Hour Storm: Existing (Acre-Feet)	Developed (Acre-Feet)	10-Year, 24-Hour Storm: Existing (Acre-Feet)	Developed (Acre-Feet)	100-Year, 24-Hour Storm: Existing (Acre-Feet)	Developed (Acre-Feet)
Paumalu	58.2	166.20	153.39	521.36	498.76	1087.95	1060.28
Pakulena	62.0	59.94	37.93	165.54	136.33	323.21	302.96
Kakunawaikaala	17.4	68.34	65.31	179.22	171.78	342.52	332.68
Bluffs & Lowlands	24.3	9.66	0.00	25.27	6.14	48.57	28.63
Totals	161.90	304.14	256.63	891.39	813.01	1802.25	1724.55

Notes:

1. Runoff volumes for existing conditions taken from Tables 2 through 5.
2. Runoff volumes for developed conditions taken from Tables 6 through 9.

Runoff Water Quality. Constituents of stormwater runoff were chosen for the water quality analysis based on the following two criteria: most likely to be effected by development; and most likely to have an impact on receiving water quality. On this basis, total nitrogen, total phosphorus, and suspended solids were selected. Concentrations of these constituents for pre- and post-development conditions were chosen from the results of field sampling done in June and July 1993, from the previous analysis in Dugan (1990), and from a sediment transport study by the U.S. Geological Survey (Jones et al., 1971). None of the field samples were collected during runoff events as large as the three storms chosen for analysis. However, the results are instructive. Sampling was done on Paumalu Stream and on several locations along Pupukea Road. Results are summarized on Table 11. The Paumalu Stream samples are generally representative of existing conditions. It is felt that the Pupukea Road samples reasonably reflect the quality of runoff than can be expected from Lihi Lani's roadways and adjacent development areas which will drain onto the roadways.

Constituent concentrations chosen to compare existing and developed stormwater runoff quality are tabulated below. Several of the concentrations used previously in Dugan (1990) were in close accord with the field sampling results summarized in Table 11; these values, which included nitrogen and phosphorus for existing conditions at 0.90 and 0.09 milligrams per liter (mgl), respectively, were used for this study without adjustment. Dugan (1990) used suspended sediment concentrations for existing conditions of 600 mgl based on data in Jones et al. (1971) and on the assumption that 30 percent of the 40 to 60 inches of annual rainfall becomes runoff. Based on stream gaging data in similar hydrologic circumstances elsewhere on Oahu and on hydrologic budget calculations such as in Giambelluca (1986), it is likely that the annual runoff fraction is somewhat less. This has been translated to a higher suspended sediment concentration of 900 mgl for this study.

Constituent Concentrations Used for Analysis

Development Status	Total Nitrogen (mgl)	Total Phosphorus (mgl)	Suspended Sediment (mgl)
Existing Conditions	0.90	0.09	900
Developed Areas			
Roadways and Areas Draining to Roads	0.60	0.17	1,250
Other Developed Areas	0.60	0.17	250

Table 11. Surface Runoff Quality in the Pupukea-Paumalu Area

Constituent		Paumalu Stream Samples	Pupukea Road Samples
Total Nitrogen	: No. of Samples	3	6
	: Mean Value (mg/l)	2.27	0.91
	: Modal Value (mg/l)	0.92	0.51
Total Phosphorus	: No. of Samples	3	6
	: Mean Value (mg/l)	0.099	0.15
	: Modal Value (mg/l)	0.037	0.17
Suspended Solids	: No. of Samples	3	4
	: Mean Value (mg/l)	33.9	1268
	: Modal Value (mg/l)	34.0	1221

Notes: 1. All samples of stormwater runoff were collected in June and July 1993 by Group 70 and/or Marine Research Consultants.

2. Water quality analyses were done by Marine Analytical Specialists.

Chosen phosphorus values for developed conditions are based largely on the field sampling results. Dugan (1990) used a value about three times higher, based on data in Fujiwara (1973). The field sampling results, due to their high suspended sediment content and potential to transport phosphorus, are considered to be a worst case and therefore a reasonable choice. The choice for suspended sediment concentration from roadways and areas tributary to roadways is substantially higher than used in Dugan (1990). It was selected based on the field sampling. This is a conservative choice, meaning that it is probably an overestimation.

Water quality calculations for existing and developed conditions are compiled on Table 12. Due to the decrease in runoff volume which would be brought about by the 40 excavated sumps, nitrogen and sediment loading would actually decrease due to development. However, some increase in phosphorus is identified by these calculations for the 10- and 100-year storms. For all four basins combined, these amount to 3.9 and 9.3 percent increases, respectively.

Potential Runoff Water Quality During Construction. No data are available to accurately assess the potential impact on surface runoff water quality if a storm occurs during construction. However, since there is a concern for what the affect may be, a rough approximation is offered here. In the storm drainage plan by Engineering Concept (1993), the section on soil erosion potential during construction provides a basis for this illustration. The pace of construction over the first three years is depicted as follows:

1st Year:	29 acres of roads and the 24-acre wastewater treatment plant site
2nd Year:	59 acres of housepad construction
3rd Year:	73 acres of agricultural area construction

Engineering Concepts determined, based on Universal Soil Loss equation (USLE) results, that the most critical period for sediment loss would be in the first year. It determined that, even with appropriate erosion control measures, the annual erosion potential would be 29 times greater than for existing conditions. Although the USLE calculation is not event-specific and its result is expressed as an annual soil loss, it will be used in this way for purposes of illustration. During the first year, with construction opening 15 acres of land for road construction (the limit under the grading ordinance), it is assumed that a 10-year, 24-hour storm occurs and that the suspended sediment concentration from the open areas is 29 times greater than for existing conditions, i.e. the concentration is 26,100 mg/l rather than 900 mg/l.

Table 13. Computed Nitrogen, Phosphorus, and Suspended Solid Volumes in Surface Runoff for Existing and Developed Conditions

Paumalu Basin

Storm Event	Runoff Volume (Acre-Feet)		Constituents in Stormwater Runoff: Total Nitrogen (Pounds)			Total Phosporus (Pounds)			Suspended Solids (Tons)		
	Existing	Developed	Existing	Developed	Increase (+) or Decrease (-)	Existing	Developed	Increase (+) or Decrease (-)	Existing	Developed	Increase (+) or Decrease (-)
2-Year, 24-Hour	196.2	153.4	406.6	364.4	-42.2	40.7	40.4	-0.3	203.3	180.8	-22.5
10-Year, 24-Hour	621.4	496.6	1275.5	1180.2	-95.3	127.6	131.0	+4.4	637.8	585.4	-52.4
100-Year, 24-Hour	1087.9	1060.3	2661.4	2518.9	-142.5	265.1	278.6	+13.5	1330.7	1249.4	-81.3

Pakulena Basin

Storm Event	Runoff Volume (Acre-Feet)		Constituents in Stormwater Runoff: Total Nitrogen (Pounds)			Total Phosporus (Pounds)			Suspended Solids (Tons)		
	Existing	Developed	Existing	Developed	Increase (+) or Decrease (-)	Existing	Developed	Increase (+) or Decrease (-)	Existing	Developed	Increase (+) or Decrease (-)
2-Year, 24-Hour	69.9	37.9	149.5	80.0	-69.5	14.6	12.7	-1.9	73.3	39.1	-34.2
10-Year, 24-Hour	165.6	136.3	404.9	287.9	-117.0	40.5	45.6	+5.1	202.4	140.8	-61.6
100-Year, 24-Hour	323.2	303.0	790.7	630.9	-159.8	79.1	101.3	+22.2	395.3	313.0	-82.3

Kalunawaikaala Basin

Storm Event	Runoff Volume (Acre-Feet)		Constituents in Stormwater Runoff: Total Nitrogen (Pounds)			Total Phosporus (Pounds)			Suspended Solids (Tons)		
	Existing	Developed	Existing	Developed	Increase (+) or Decrease (-)	Existing	Developed	Increase (+) or Decrease (-)	Existing	Developed	Increase (+) or Decrease (-)
2-Year, 24-Hour	69.3	65.3	167.1	152.3	-14.8	16.7	17.9	+1.2	83.5	76.6	-6.9
10-Year, 24-Hour	179.2	171.8	438.4	400.7	-37.7	43.8	47.2	+3.4	219.2	201.5	-17.7
100-Year, 24-Hour	342.9	332.7	837.9	778.6		83.8	91.3	+7.5	418.9	390.2	-28.7

Bluffs and Lowlands

Storm Event	Runoff Volume (Acre-Feet)		Constituents in Stormwater Runoff: Total Nitrogen (Pounds)			Total Phosporus (Pounds)			Suspended Solids (Tons)		
	Existing	Developed	Existing	Developed	Increase (+) or Decrease (-)	Existing	Developed	Increase (+) or Decrease (-)	Existing	Developed	Increase (+) or Decrease (-)
2-Year, 24-Hour	9.7	0.0	23.7	0.0	-23.7	2.4	0.0	-2.4	11.9	0.0	-11.9
10-Year, 24-Hour	25.3	8.1	61.9	17.0	-44.9	6.2	2.8	-3.4	30.9	9.0	-21.9
100-Year, 24-Hour	48.8	28.9	118.8	59.9	-58.9	11.9	9.7	-2.2	59.4	31.9	-27.5

For this initial 15 acres of road construction, seven of the 17 sub-areas used to calculate runoff for existing conditions would be affected. On four of these, permanent drainage sumps would be constructed for additional control of sediment. For the other three sub-areas, construction of detention sumps is not practical. Results of the series of calculations of runoff volume and suspended sediment load for the 10-year storm are compiled on Table 13. On the four sub-areas with detention sumps, all runoff volume and its corresponding suspended sediment load would be caught. However, the suspended sediment load on the other three sub-areas would be substantially increased. The net result would be to increase suspended sediment load for this storm on the seven sub-areas by 73.65 tons or 16 percent. For the entire watershed, the increase would amount to 8 percent.

Groundwater Analysis

Occurrence of Groundwater. The occurrence of groundwater is established by data from the wells identified on Figure 2 and compiled on Table 14. Groundwater levels are between 2.5 and 3.8 feet above mean sea level and well water salinity is sensitive to pumping rates. These are typical attributes of a relatively thin basal lens for which salinity intrusion is not significantly impeded by the alluvial and beach sand deposits along the shoreline. The Board of Water Supply's Sunset Beach wells (Nos. 4002-04 and -05 just north of the project site) used to provide a limited amount of potable water but have not been used since 1983. All of the other wells produced brackish water when they were tested or used. None of these wells are in use today. More detailed descriptions of the groundwater occurrence can be found in Nance (1993) and Mink (1988, 1989, and 1990).

Natural Recharge for Existing Conditions. For existing conditions, deep percolation of a portion of rainfall does occur. The generalized water balance in Giambelluca (1986) suggests that the rate may vary from 20 percent of the rainfall amount at the lower end of the project where annual rainfall is 45 inches to a little over 30 percent at the mauka end where rainfall is approximately 80 inches per year. The groundwater recharge computations in Shade (1991) are of approximately the same magnitude. Over the entire site, this natural recharge might average about 13 inches annually. This is equivalent to a year-round average of 1.1 MGD over the 1,144 acres.

Effects on Groundwater. There are two possible effects on groundwater to consider. First, the two existing onsite brackish wells will be utilized for irrigation. Withdrawals by these wells will cause the basal lens to adjust to the pumping stress. Second, the fraction of the amount of water applied for irrigation which returns to the lens through deep percolation may pick up dissolved constituents which could affect the quality of the receiving groundwater.

Table 13. Potential Increase in Suspended Sediment for a 10-Year, 24-Hour Storm Occurrence During Construction

Watershed	Sub Area	Total Area (Sq. Mi.)	Disturbed Area (Acres)	Siltation Basin Storage (Acre-Feet)	10-Year, 24-Hour Storm Runoff Volume: Total (Acre-Feet)	10-Year, 24-Hour Storm Runoff Volume: Increase (+) or Decrease (-) (Acre-Feet)	10-Year, 24-Hour Suspended Sediment Load: Mass (Tons)	10-Year, 24-Hour Suspended Sediment Load: Increase (+) or Decrease (-) (Tons)
Paumalu	1B	.2185	2.3	0.0	46.39	+0.44	98.52	+42.29
	3	.0598	0.9	0.0	14.44	+0.12	34.08	+16.55
	5	.6740	1.1	0.0	153.09	+0.15	206.25	+19.18
	6	.1463	3.0	2.6	30.39	-0.99	37.18	-1.21
Pakulena	8B	.3975	2.4	6.6	79.57	-0.77	97.33	-0.94
	8C	.1185	1.7	2.2	21.74	-0.51	28.59	-0.62
Bluffs/Lowlands	D	.1062	3.6	17.1	23.96	-1.31	29.31	-1.60
Totals		1.7226	15.0	28.7	369.58	-2.87	529.24	+73.65

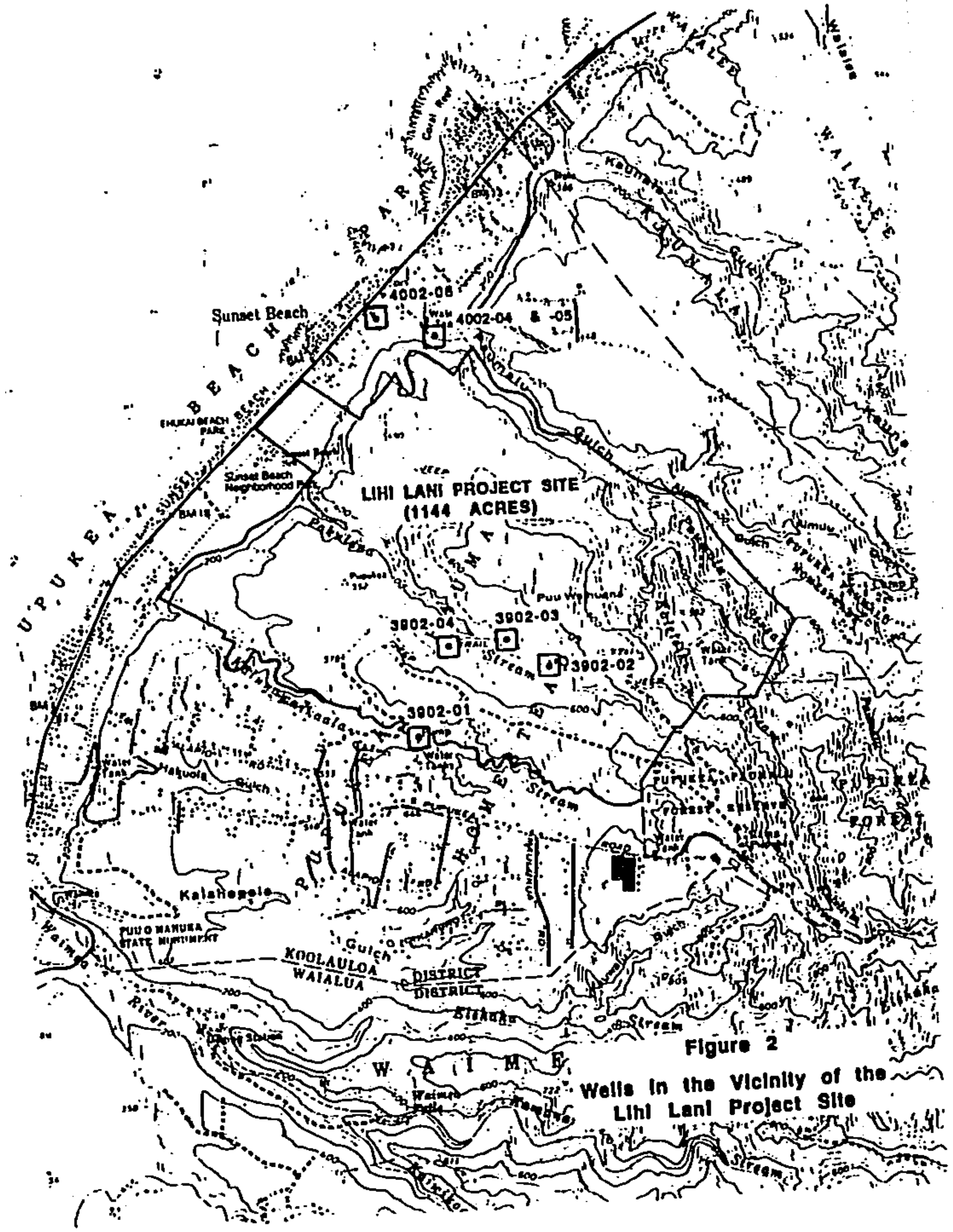

Figure 2
Wells in the Vicinity of the Lihi Lani Project Site

Table 14. Existing Wells in the Vicinity of the Lihi Land Project Site

Parameter	State Well No. 3902-01	3902-02	4002-04	4002-05	3902-03	3902-04	4002-08
Owner	Finance Factors	Obeyashi	BWS	BWS	Obeyashi	Obeyashi	Henry
Date of Construction	1946	1958	1948	1948	1989	1989	1955
Ground Elevation (Feet MSL)	499	611	66	70	418	468	32
Casing Diameter (Inches)	12	1	7	10	12	12	8
Total Depth (Feet)	554	560	125	140	455	500	108
Elevation at Bottom (Feet MSL)	(-)55	(-)49	(-)59	(-)70	(-)37	(-)34	(-)77
Water Level (Feet Above MSL)	2.8	N/A	2.7	2.5	3.8	3.7	N/A
Pumping Rate (GPM)	600	N/A	140	55	600	500	- 50
Chloride Concentration During Pumping (mg/l)	140 to 390	N/A	120	120	250	330	880
Distance From Coastline (Feet)	6500	7300	1750	1750	6500	5600	750

<u>Expected Irrigation Use</u>. Three different sources of supply will be used for irrigation: (1) the onsite brackish wells; (2) reclaimed wastewater from the project's wastewater treatment facility; and (3) BWS' potable system. A monthly irrigation water balance in ITC Water Management (1993) anticipates a year-round average irrigation requirement of 2,980 gallons per day per irrigated acre (Table 15). On Table 16, this requirement is applied to the project's land uses and acreages to arrive at total irrigation use rates. By these calculations, the two brackish wells would draw an average of 0.57 million gallons per day (MGD); all of the project's wastewater, amounting to 0.180 MGD, would be disposed of by irrigation reuse; and 0.094 MGD from the BWS system would be used for landscape irrigation. The total of all three sources is 0.844 MGD.

<u>Irrigation Return Flow and Net Draft From the Aquifer</u>. Irrigation rates in ITC Water Management (1993) assume that no percolation would occur since irrigation application is assumed to exactly match plant uptake. In actuality, irrigation water is applied imperfectly and deep percolation does occur. Water balance computations in Giambelluca (1986) suggest that for low density development such as proposed for Lihi Lani, recharge would be increased by development over natural conditions due to irrigation return. The change would be from an overall average of 13 inches to about 18 to 20 inches per year. Over the 480-acre area to be developed, this would amount to a net increase in recharge of 0.21 MGD. Since a total of 0.844 MGD is estimated as the average irrigation rate, the computed percolation rate amounts to 25 percent of applied irrigation water. This result is a reasonable approximation.

The net draft from the aquifer would be 0.36 MGD, calculated as the difference between 0.57 MGD to be pumped from the two onsite wells and the expected increase in percolation of 0.21 MGD. The natural groundwater flow beneath the site is estimated to be 5 MGD in Mink (1988) and 6.35 MGD in Nance (1993). The computed net draft rate would amount to 5 to 7 percent of this natural flow.

<u>Change in Groundwater Quality</u>. Water quality effects to consider are potential salinity intrusion caused by pumping the two onsite wells and contamination of the lens by percolating irrigation return water. Based on the computer modeling reported in Nance (1993), pumping the two onsite wells at a combined total of 0.57 MGD is unlikely to cause salinity intrusion. A drop of water level on the order of 0.2 feet in the immediate vicinity of the wells is likely. However, at moderate distances away from the wells, the water level decline would be insignificant.

Table 15. Irrigation Water Balance by Month

Month	Effective Rainfall (Inches)	Pan Evaporation (Inches)	Consumptive Use (Inches)	Required Irrigation	
				Depth (Inches)	Average Rate (GPD/Acre)
January	4.20	4.37	4.81	0.61	534
February	3.75	4.82	5.30	1.55	1503
March	3.60	5.92	6.51	2.91	2549
April	3.30	6.02	6.62	3.32	3005
May	3.15	6.77	7.45	4.30	3766
June	2.70	7.01	7.71	5.01	4534
July	3.68	7.51	8.26	4.58	4012
August	3.08	7.88	8.67	5.59	4898
September	2.70	7.17	7.89	5.19	4697
October	2.78	6.33	6.96	4.18	3661
November	2.85	5.12	5.63	2.78	2516
December	5.05	4.36	4.80	None	None
Annual	40.84	73.28	80.61	40.02	2977

Notes:
1. The water balance has been adapted from ITC Water Management (1993).
2. Effective rainfall is assumed to be 75% of actual rainfall.
3. Consumptive use is 1.1 times pan evaporation.
4. Required irrigation is consumptive use less effective rainfall.

Table 16. Estimated Irrigation Rates by Land Use Types

Land Use	Areas		Estimated Average Irrigation		
	Total (Acres)	Graded (Acres)	Brackish System (MGD)	Reclaimed Water (MGD)	BWS System (MGD)
Country Lots: House Pads	72	72			0.065
: Other Landscaping	72	72	0.215		
: Agriculture	112	112	0.334		
: Open Space	509	--			
Ranch/Pasture	64	48		0.180	
Forestry	47.5	47.5		(Note 3)	
Community Facilities	3.5	3.5			0.003
Park	3	3			0.009
Campground	4	2			
Affordable Housing	10	10			0.009
Elderly Housing	6	6			0.005
Water Reclamation Facility	24	24	0.001		
Road R.O.W.	80	80	0.020		0.003
Other Open Space	137	--		(Note 3)	
Totals	1144	480	0.570	0.180	0.094

Notes:
1. Irrigation for the 315 Country Lots is based on the following: (i) lots will average 10,000 square feet each for house pads and one-third of this area will be irrigated at 2960 GPD/acre from the BWS system; (ii) another 72 acres among the 315 lots will be landscaped and irrigated by the brackish system at 2960 GPD/acre; (iii) 112 acres will be part of an agricultural venture and will be irrigated at 2960 GPD/acre from the brackish system; and (iv) the remaining open space will not be irrigated.
2. Landscape irrigation for the Elderly and Affordable Housing is based on one-third the respective areas being landscaped and irrigated at 2960 GPD/Acre.
3. The quantity of reclaimed wastewater to be disposed of by irrigation is determined in Gearheart and Engineering Concepts (1993). The Ranch/Pasture land use will be the primary disposal area. During wetter periods when irrigation rates are limited, excess reclaimed water will be disposed of in the Forestry and Open Space areas or will be stored for later disposal. If needed, the Forestry and Open Space areas will be used for disposal of reclaimed water during wetter periods.

Constituents present in sufficient concentrations in the irrigation return flow to effect the basal lens are chlorides and nitrate nitrogen. Potential impacts can be illustrated with mass balance calculations. Although lysimeter studies (Ekern et al., 1974; Handley and Ekern, 1981; and Lau et al., 1989) have generally shown modest to no increase in chlorides in leachate and effective uptake of nitrogen, significant increases in both of these constituents are assumed here for purposes of illustration. Calculations are made two ways: mixing the percolate throughout the lens and mixing it only into the upper half. The required series of assumptions and calculations are listed below. The natural flowrate is assumed to be 6.0 MGD, a value which is between those in Mink (1988) and Nance (1993). Chloride levels are based on pump test results in Mink (1989) and on grab samples and salinity profiling in Nance (1993). Nitrate levels are reported in Mink (1989). Concentrations in the irrigation return are conservative assumptions; chlorides and nitrate nitrogen are not expected to actually be this high. With these values and assumptions, only moderate changes to chlorides and nitrates in the receiving groundwater are computed. It is reasonable to conclude that the impact to groundwater quality would be negligible.

	Return Flow Average Through the Entire Basal Lens	Return Flow Only to Upper Half of the Basal Lens
Natural Flowrate (MGD)	6.0	3.0
Extraction by Onsite Wells (MGD)	0.57	0.57
Existing Concentrations - Chlorides (mgl)	300	200
- Nitrate-N (mgl)	0.7	0.7
Irrigation Return Flowrate (MGD)	0.21	0.21
Assumed Return Flow Concentrations		
- Chlorides (mgl)	400	400
- Nitrate-N (mgl)	2.1	2.1
Residual Flowrate in the Lens (MGD)	5.64	2.64
Calculated Mixed Concentrations		
- Chlorides (mgl)	303.7	215.9
- Nitrate-N (mgl)	0.75	0.81
Percent Increases in Concentrations		
- Chlorides (%)	1.2	8.0
- Nitrate-N (%)	7.1	15.7

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APPENDIX I

Assessment of
Potential Impacts to the
Marine Environment

Lihi Lani Marine Water
Chemistry Monitoring
Program

ASSESSMENT OF POTENTIAL FOR IMPACTS TO THE MARINE ENVIRONMENT FROM THE PROPOSED LIHI LANI PROJECT, PUPUKEA, OAHU, HAWAII

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I. INTRODUCTION

The Lihi Lani Project site, located at Pupukea in the Koolauloa District on the north shore of Oahu, consists of a total area of 1,144 acres, with not more than 480 acres (42%) planned for development of an integrated residential, agricultural, and recreational community phased over a period of 10-12 years. The remaining 664 acres of the project site will remain unaltered. The residential component of the development plan includes 315 one to three acre residential lots, 50 single family affordable housing units, and 80 affordable elderly housing rental units. The agricultural component include diversified agriculture, ranching and grazing pastures. Recreational activities include horseback riding, hiking, camping, and community park facilities. In support of the project, access and circulation roadways, a wastewater treatment and disposal system, a potable water supply, and a non-potable irrigation system will be included in the development.

There are, however, no plans within the project framework for any shoreline modification. Thus, potential changes to the marine environment that might result from the project could only occur through alteration of input from surface drainage and nonpoint source discharges. Nonpoint source discharge could occur through material input to groundwater and surface flow that enters the ocean at, or near, the shoreline. Construction of the proposed development will also alter runoff characteristics of storm waters that enter the ocean.

Because of the importance of the marine environment to the north shore community with respect to recreational activities and overall "quality" of life, a very important aspect of the planning process has involved determining the potential for impacts to the marine environment. In addition, statements have been made by detractors of the project regarding potential impacts of the project to the marine environment. While there is virtually no substantive data or case histories to support these allegations, it is nevertheless important to address these issues using valid, defensible scientific methodologies.

In particular, claims have been made that the proposed Lihi Lani project will cause increases of runoff that have the potential to destroy the living coral reefs that occupy the nearshore area. Following such destruction of the living reef, it has been suggested that erosional forces will change the character of the seafloor, resulting in alteration of the characteristics of waves at surf breaks fronting the project site (e.g. Pipeline, Rocky Point).

In order to illustrate why such projections are invalid, and to provide an information base that can provide some insight into the natural physical, chemical and biological processes that shape the marine environment, several studies have been performed. The first study that is described in this report was performed to illustrate that characteristics of breaking waves are not in jeopardy from alterations to growing reefs. Samples of the reef were collected and dated using the most up-to-date scientific techniques. The second study is a consideration of engineering projections of changes to the drainage patterns during construction and after completion of the project. It is possible to evaluate the potential changes from the present situation that should occur with respect to input of sediment and nutrients to the nearshore zone. In the third study, samples of sediment from existing intermittent stream, beaches and offshore marine areas were collected and analyzed to determine the fraction of material that is delivered to the ocean from runoff. Simple calculations reveal how much of the sediment on the ocean floor is from marine origin versus origin from land, and how these conditions may change with the development. Based on the all three of these discussions, sufficient data will be evident to indicate that the allegations of serious and permanent changes to the marine environment from the Lihi Lani Project are without merit. Rather, it appears that with the proposed engineering designs that are presently planned, the project should result in potentially less input of land-derived material to the marine environment than is occuring under the present undeveloped conditions.

Background Studies

In order to evaluate the potential magnitude of alteration, a baseline assessment of the nearshore marine environment was conducted in the vicinity of the proposed Lihi Lani Project in 1990 (Marine Research Consultants 1990). The primary objective of the baseline assessment was to construct a comprehensive qualitative and quantitative description of existing water chemistry parameters that can be used to evaluate the magnitude of possible changes that may result from construction and operation of the project. In addition, qualitative assessments of the nearshore biological communities inhabiting the area were conducted in order to evaluate the potential for changes to biota from alteration of water chemistry.

An additional objective of the baseline assessment was to evaluate the degree of natural stresses (e.g. wave scour, freshwater input, etc.) that influence nearshore marine communities in the vicinity of the proposed development. Typically, the composition of reef communities is intimately associated with the magnitude and frequency of these stresses, and any impacts caused by the proposed development will be superimposed on natural environmental factors. Therefore, evaluating the range of natural stress is a prerequisite for assessing the potential for additional change to the marine environment owing to the planned development.

Subsequent to the baseline assessment conducted in 1990, three addition water quality monitoring surveys have been conducted in 1991, 1992 and 1993. Results of these surveys provides an ongoing time-course evaluation of water quality offshore of the project site prior to any construction activity at Lihi Lani. Such a data set provides a long-term indication of the existing variability in water quality parameters. Only with such a pre-construction data set is it possible to determine changes brought about by the proposed project.

Physical Setting

The physical (and to a large part chemical and biological) oceanographic setting of the area offshore of the proposed development is dominated by the effects of wave action. During the winter months, large waves that originate from storms in the north Pacific impact the north shores of the Hawaiian Islands. Within the nearshore area fronting the proposed development is the "Pipeline", a surfing area that is renown worldwide for the quality and force of waves breaking on the nearshore reefs. Because all of the property frontage consists of open coastline, there is no regions sheltered from wave energy.

The entire shoreline fronting the development is composed of a wide beach composed of coarse calcareous sand. Portions of the shoreline are composed of solid limestone (beachrock) that generally occurs in areas where there is consistent flow of low salinity groundwater into the ocean.

The nearshore region is essentially divided into two zones - a nearshore boulder/sand area and a deeper reef platform zone. Moving seaward from the beach, the most shoreward zone consists primarily of boulders and limestone extrusions interspersed on a sandy bottom. Surfaces of the rocks are essentially barren owing to frequent mechanical stress from breaking waves and scouring action of sand. The only macro-organisms occurring on the boulders are marine algae of several species. The extent of the boulder zone in terms of distance offshore varies depending on the specific location, but in general is on the order of 50 m.

At a water depth of about 5 m the seafloor grades from sand and boulders to a solid calcium carbonate reef platform. Interspersed in the solid pavement are pockets of sand, as well as shallow ledges and small undercut caves. Owing to the greater water depth and distance from shore, destructive force of waves is less in this area, allowing reef biota to

occur. The major forms of benthic (bottom dwelling) organisms in this area are corals and algae; however the occurrence of corals is limited to small flat encrustations. The flat carbonate pavement continues out to the limits of investigation for this study, approximately 500 m offshore, and to water depths of about 15 m.

II. DATING OF REEF MATERIAL

Methods

In order to determine if the calcium carbonate reef platform is presently undergoing active deposition of material from biogenic accretion processes, a set of samples was collected for radiocarbon dating on June 19, 1993. All sample collection and analyses were conducted by Dr. Anthony Jones. At six sites (see Figure 1), surface sections of the reef were removed with a hammer and chisel. A brief summary of the location, depth and description of each sample is presented below.

Sample 1. Banzai Pipeline. Representative samples of the shallow submarine carbonate platform were collected in the nearshore zone at a depth of 10 feet about 500 feet west of Ehukai Beach Park lifeguard tower, and approximately 150 feet offshore. A swimming survey of the area revealed only several small encrusting patches of living coral. Submarine erosional features in this area included circular potholes with rounded boulders and elongate sand-sculptured channels trending onshore-offshore. A film of algae and foraminifera encrusted the surface of the submarine carbonates with some algal tufts present.

Samples 2 and 3. Rocky Point. These samples were collected from the submarine carbonates about 1,200 feet east of the Ehukai Beach Park lifeguard tower in about 8-10 feet of water. The bottom morphology was similar to that off the Pipeline area with substantial erosional features characterizing the surface of the platform. Sample 2 consisted of amorphous limestone, while sample 3 consisted of a recognizable coral of the genus *Porites*. When the coral in Sample 3 was cross-sectioned in the laboratory, bore holes from sipunculid worms were evident, as were iron stains on the annual coral growth bands.

Sample 4 was collected in the same area as samples 2 and 3, but closer to shore and in shallower water (2-3 feet water depth). This sample was collected on a modern algal ledge. The carbonate material comprising sample 4 contained coral fragments (*Porites spp.*) with some iron-stained growth bands. No signs of boring was detected in the coral from Sample 4.

Sample 5. Sample 5 was collected off Sunset Beach near the west end of the beach near the drainage of Paumalu Stream. This area is somewhat unique in that volcanic rocks are visibly exposed in the nearshore area. No live coral was seen in the swimming survey at this site. Benthic algae were noticeable more abundant at this site than at any of the other locales that were examined. The uppermost section of the limestone platform that formed a sculpted channel was sampled for dating. Water depth at the sampling site was approximately 12 feet, and was approximately 100 feet from shore.

Sample 6. Sample 6 was collected in 8 feet of water depth offshore of the area where Pakulena Stream crosses the beach. The reef sample was collected on the erosional platform erosional with little living coral in the area.

Following field collection, the outermost surfaces of each sample were removed with a rock saw to detach encrusted calcareous and filamentous algae. Two samples (sample 2 and 4) were examined by x-ray diffraction for signs of diagenetic alteration. The mineralogy of the carbonates indicated little diagenetic alteration or recrystallization.

Approximately 5 grams of carbonate material from each sample was etched in weak acid to remove outer layers. Radiocarbon dating was conducted by Beta Analytic (Miami, Florida) using benzene synthesis. Age determinations by ^{14}C are based on a ^{14}C half-life of 5,568 years and are reported in conventional ^{14}C years before 1950 in Table 1. The errors given in Table 1 represent one standard deviation.

Measurement of $\delta^{13}C$ and the isotopically-corrected ages (^{13}C adjusted ages) are also shown in Table 1. Isotopically adjusted dates were calibrated for the marine reservoir effect using CALIB Rev 2.1 for samples younger than 8,580 yr B.P. (Stuiver and Reimer, 1987). All dates reported in the text are calibrated years before present (B.P.).

Results and Conclusions

Based on the analyses of the surface platform, the estimated age of the offshore carbonate platform between Sunset Beach and Pipeline is approximately 3,700 yr B.P. This result is based on the two samples from Rocky Point (samples 2 and 3) that yielded similar ages, and were the best suited for radiocarbon dating. The two samples with older dates (Samples 1 and 6) must have been contaminated with an older carbon source, as sea level prior to 10,000 yr B.P. in the Hawaiian Islands was 10 m below present sea level (Easton and Olson, 1976, Jones, 1992, 1993). Therefore, prior to 10,000 yr B.P. the present coastal area was emergent land, and could not have been the site of active reef

accretion. The sample from Sunset Beach (Sample 5) with an age of less than 1,000 years is likely to have been contaminated with younger carbon. It is likely that the modern encrusting algae was not completely removed during sample preparation. The carbonate platform underlying the algal ledge at Rocky Point is dated at 1,130 yr B.P.

Although, the ability to estimate the exact age of the underlying carbonate platform is limited to the samples obtained in one field visit, extensive and expensive drilling could decisively determine the age of the platform. However, results of dating the carbonate platform are consistent with the observation that the area is definitely not an actively accreting coral reef system.

The overall conclusion drawn from this study is that the carbonate platform underlying the north shore surf sites was accreted approximately 3,000-4,000 years ago (late-Holocene). The age of the carbonate platform at 3,700 yr B.P. is in agreement with the age of Hanalei fossil reef (3,340 - 4,200 yr B.P.) found on Kauai (Jones, 1992) and the age of the Kapapa stand on Oahu (~3,800 yr B.P.) (Fletcher and Jones 1992, 1993). None of the data indicates that the reef is presently accreting as a result of active growth by corals and other calcium carbonate producing organisms. In fact, it appears that naturally occurring processes of bioerosion and scouring by wave action is presently resulting in erosion of the reef platform. As such, it is clearly not a viable possibility that any alteration in sediment delivery from land (regardless of the source) will result in any alteration of reef growth that in turn will alter the manner in which waves break in a particular way on each individual reef.

III. POTENTIAL CHANGES IN GROUNDWATER AND SURFACE RUNOFF CHARACTERISTICS

Groundwater

Previous versions of the Lihi Lani project included an 18-hole golf course. All sewage produced by the project was proposed to be used as irrigant for the golf course. Projected peak capacity of the project sewage treatment plant is 190,000 gpd (7×10^5 l per day). Sewage effluent nitrogen concentration at Lihi Lani are expected to be about 5-7 mg/L (Robert Gearheart, personal communication). If all sewage nitrogen generated by the STP was used as golf course irrigant, a total of 260 moles of N would be applied each day. Existing literature states that golf course grasses remove about 95% of the N and 100% of the P applied as irrigants (Chang and Young 1977, Lau 1975). Thus, if 5% of applied N can percolate through the soil zone and reach groundwater, 13 moles may reach the nearshore environment, barring any further biological and chemical uptake processes during the transit to the ocean (a very unlikely occurrence). Thus, the maximum golf course contribution to groundwater nutrient subsidy was only about 4% of the 320 moles that were measured to be injected directly into the water table at the shoreline through residential cesspools. At present, the golf course has been eliminated from the project plan. However, if capacity of the sewage treatment plant remains the same from the residential component, and sewage is recycled for landscaping and agricultural usage, the arguments concerning leaching to groundwater which eventually reaches the ocean should be similar for the original and modified development scenario.

Based on the current development scenario, groundwater flow beneath the development site is expected to increase 5-7% as a result of irrigation return (Nance 1993). Changes in groundwater composition, through changes brought about by irrigation of agricultural lands appear to be small with respect to natural input, and should have no impact on marine water quality.

Surface Runoff

In addition to subsidy from percolation to groundwater, storm runoff also results in delivery of fresh water, sediment and nutrients to the nearshore ocean. Estimates of changes to storm water components (hydraulic loading, N, P and suspended solids) between existing conditions and the fully developed residential-agricultural build-out have been calculated by Nance (1993) using the Soil Conservation Service method. The surface water analysis was based on the Strom Drainage Plan prepared by Engineering Concepts (1993). None of the data tables from these reports are reproduced in this document. All cited data is available in Nance (1993).

Several important factors were critical in the evaluation of storm water runoff. The project site lies within four watersheds; three are well-defined, normally dry gulches which convey surface runoff during moderate to heavy rainfall events (Paumaulu, Pakulena and Kalunawaikaala gulches). The fourth watershed is comprised of the bluffs and lowlands beneath the project site. The drainage plan presented by Engineering Concepts (1993) features 40 excavated drainage sumps to reduce runoff peaks and volumes from the developed areas. Total sump storage is 161.9 acre-feet, none of which presently exists on the site. Sump storage is quite large in comparison to the stormwater runoff potential.

Model storms in Nance's estimates have durations of either 24 hours, and recurrence intervals of 2, 10 and 100 years. These events were selected because little or no runoff from developed areas would occur for storms with durationsf significantly shorter than 24 hours, particularly for storms with a frequency of occurrence of less than 2 years.

With the sumps providing extended runoff detention compared to the existing conditions, the runoff volumes for all three chosen storm events are less than at present (Nance 1993). Overall, runoff volumes after development would by reduced by 15.6% for the 2-year storm, 8.8% for the 10-year storm, and 4.3% for the 100-year storm. For lesser storm events, the beneficial effect of the sumps would be even larger.

Nance based his calculations of changes in runoff water quality on concentrations of samples collected in the field following an unusually heavy rainfall caused by two tropical depressions that passed north of the Island in June and July 1993, and from existing data in the scientific literature. Due to the decrease in runoff volume brought about by the 40 drainage sumps, it is projected that nitrogen and sediment loading will be reduced during all storm events following construction of the development compared to existing conditions. Decreases in suspended solids can be considered an environmental benefit of the proposed development. Similarly, for the 2-year storm in all of the drainage areas, and for the 10- and 100-year storms for the bluffs and lowland drainage basin, phosphorus loading will decrease following development. However, in the Paumalu, Pakulena and Kalunawaikaala drainage basins, total phosphorus loading is projected to increase by a total of 12.9 lbs for the 10-year storm and 43.2 lbs for the 100-year storm. The greatest increase in phosphorus loading is in the Pakulena Basin with 12% increases for the 10-year event, and a 22% increase for the 100-year storm. In comparison, in the Paumalu Basin the increases are 3% and 5% for the 10- and 100-year storms, respectively. For the Kalunawaikaala Basin, there is a projected 8% increase in phosphorus delivery during both design storms. When averaged over the four drainages that comprise the entire project acreage, the net increase in phosphorus input is about 4% over existing input for the 10-year event, and a 8% increase for the 100-year event.

With respect to the storm events which appear to result in increases in phosphorus delivery, several important points should be considered. Storm input occurs episodically, and is not a potentially chronic or long-term stress. If the highest projected phosphorus input from the 10- and 100-year storm events (12.9 and 43.2 lbs, respectively) is normalized for the interval between storms, incremental additions for the entire development would be about 1.3 and 0.4 lbs per year, or 0.004 and 0.001 lbs per day respectively. In molar units the daily input is equivalent to 0.06 moles day^{-1} for the 10-year storm and 0.01 moles day^{-1} for the 100-year storm. By comparison, based on composition of naturally occurring groundwater water from wells on the development site, and estimated rates of groundwater efflux, it appears that about 8 moles of phosphorus enter the ocean each day via natural groundwater input. Thus, the contribution from increased runoff following the most severe scenario is equivalent to approximately 0.7% of the input that is presently occurring on a daily basis from completely natural sources.

Such increases in terms of a chronic input of phosphorus are clearly insignificant. In terms of a instantaneous input, it is theoretically possible that the projected increases in phosphorus input from storm runoff could result in increased uptake by plant biota. However, several scenarios will likely prevent such a community response. First, a basic biological principal is that only if a community is nutrient limited can addition of that nutrient cause changes to the biotic composition of the community. There is no indication from monitoring data that the nearshore area off the development site is phosphorus limited. Hence, slight increases in phosphorus will have no effect other than to change the concentration in the nearshore zone. It is likely that during severe weather events, natural stresses to the environment in the form of wave action will probably prove substantially more damaging than increased nutrients in stream runoff. Mixing processes are likely to be maximal during storm events and will probably dilute the small amount of additional runoff rapidly to background levels after entry in the ocean. Thus, it is unlikely that community responses in the form of eutrophication will probably not occur owing to the rapidity of mixing of the nutrient subsidy.

Erosion during construction probably presents the greatest potential for alteration of water quality. Nance has calculated the potential increases in sediment runoff should a 24-hour, 10-year storm event occur during the initial 3 years of construction. These calculations are considered "worst case" as only 4 of the 40 drainage sumps are assumed to be functional during the initial period of construction. An additional assumption for the worst case scenario is that a maximum of 15 acres can be excavated at any point in time.

The calculations of the initial construction scenario indicate there should be no effect on the Kalunawaikaala drainage, a 12% increase in the Paumalu drainage, and decreases of 0.8% and 5.2% in the Pakulena and bluffs/lowlands drainages, respectively. Averaged over the entire development area, sediment loading is projected to increase during a 10-year event during construction by about 6.8%, which equals an increase of about 74 tons over the present sediment input of about 1090 tons per event. To put this increase in perspective, the 74 tons of sediment represent only 3% of the loading that occurs under present undeveloped conditions during the 100-year storm. Thus, the total 24-hour projected sediment load during a 10-year storm during construction is about 1164 tons, only about one-half of the sediment loading that would occur under present conditions during a 100-year storm. While any increase in sediment loading is not desirable, the projected increases during construction appear to be well within the range of severe, but natural events. While these intense storm events result in sediment plumes in

the nearshore zone, such occurrences must be considered natural stresses to the existing marine communities. As many of these events occur during the winter when wave action is most intense, mixing and dispersal of sediment plumes is also maximal.

While there appears to be potential for increases in sediment runoff during construction in some of the drainages, the projected changes indicate a net decrease in sediment runoff following construction in all of the drainages. Thus, the long term net effect of the project should be an overall reduction in sediment loading in the nearshore ocean.

III. SEDIMENT DISPERSION IN THE NEARSHORE ZONE

Perhaps a more relevant concern regarding construction-related sediment than alteration of the reef platform is retention of terrigenous materials in the nearshore zone. Speculative concern is that sediment emanating from runoff that enters the nearshore area will remain in the nearshore sediment reservoir, potentially causing impacts to water quality and biotic community structure. In order to address such potential, sets of sediment samples from the stream drainages through the connecting beaches to the nearshore area were collected during two periods. The initial set of samples was collected in March 1993 following a period of low rainfall; the second set of samples was collected in August 1993 following a period of unusually heavy rains that resulted from two tropical depressions that passed north of the Island chain. While no water was draining from the streams to the ocean at the time of the August sediment sampling, stream flow had occurred in the previous weeks.

Methods

Sediments were collected at 4 locations at each of the Paumalu, Pakulena, and Kalunawaikaala drainages between the stream beds and the nearshore ocean in March 1993. Sediments were collected at 5 locations in the Paumalu and Pakulena drainages in August 1993. Sediments were collected in the stream beds landward of Kamehameha Highway, at the point where the stream intersects with the beaches, on the beaches where drainage pathways are evident by detrital remnants, at the sediment water interface, and on the shallow reef platform. Figure 1 shows the locations of samples during each of the surveys.

In the laboratory, sediments were rinsed with distilled water to remove salts, dried for 48 hours at 50° C, and weighed. Following multiple dissolutions with dilute HCl, samples were dried and weighed again. The difference in weight is assumed to represent calcium carbonate ($CaCO_3$), while the remaining fraction is considered the non-$CaCO_3$ fraction. The non-$CaCO_3$ fraction was weighed again after ashing at 550° for 2 hours. The fraction lost on ashing is assumed to be the organic component of the sediment. The remaining fraction is considered the inorganic non-carbonate fraction. Results, in terms of percentage $CaCO_3$, non-$CaCO_3$, and organic content of each sample are shown in Table 2.

Results and Discussion

Owing to the basaltic composition of the Island mass, it is assumed that all of the $CaCO_3$ in the sediment samples is of marine origin, and all of the non-$CaCO_3$ is of terrestrial origin. Non-carbonate basaltic detrital grains are considered a small, but normal component of Hawaiian Beach sands (Moberly et al. 1965). It can be seen in Table 2 that the percent of non-$CaCO_3$ in the stream beds is relatively high (97% at Paumalu, 3-20% at Pakulena) compared to sediment collected on the beaches and in the nearshore zone. In the nearshore zone, percentage of non-$CaCO_3$ material that could be attributable to input from land ranged from 0.4% to 1.2% of the total sediment. Similarly, the organic fraction was substantially higher in the stream beds (12-13% at Paumalu, 1-5% at Pakulena) than on the beaches or in the nearshore zone. It can also be seen in Table 2 that there is no substantial difference between the samples collected in the nearshore zone in March (PA-4, PK-4, and KA-4) compared to August (PA-5, PK-5). As the August sampling took place soon after a relatively heavy rainfall event, it might be expected to see higher percentages of non-$CaCO_3$ components in the August samples compared to March. The lack of any substantial difference indicates that mixing processes rapidly disperse most of the organic and non-$CaCO_3$ materials that are delivered to the marine environment during storm drainage. In addition, the similarity of non-$CaCO_3$ composition between samples collected in March (following the winter season of high surf) and August (following the summer season of relative calm condition) indicates that sediment composition in the nearshore zone is relatively constant at levels of about 1%.

Modeling dispersion of sediments in the nearshore zone is problematic owing to the huge variation in physical conditions within the seasonal cycle. Nearshore conditions vary regularly from near calm to breaking waves 10-20 feet in height. Hence, it is more relevant to determine if the terrigenous input that remains within the sediment comprises a substantial portion of the yearly total sediment production. As the residual terrigenous sediment is the material that remains within the nearshore system, this is the component that could provide the potential for changes in nearshore water quality.

A typical sedimentation rate in coral reef systems can be considered equal to the production rate of material on the reef. As the predominant component of beach and

nearshore sands is $CaCO_3$ of biogenic origin, a typical sediment production rate of 1 mm of sediment per year is appropriate (Buddemeier and Smith 1988). In terms of weight, this production rate is the equivalent of the accumulation of 1 kilogram per square meter per year (kg m^{-2} yr^{-1}). If the length of beach area that runoff from the project could effect is estimated at 4 km (4,000 m) and the distance offshore that sediment plumes could reach is estimated at 200 m, then the total area of sediment deposition is 8×10^5 m^2. This is equivalent to 8×10^5 kg of production of natural reef material that comprises beach sands on the north shore.

Nance (1993) has estimated that under existing conditions, for a 24-hour, 2-year storm event there is delivery of about 370 tons (3×10^5 kg) of sediment to the ocean from each storm event. For the 24-hour, 10 year storm, sediment delivery under present conditions is estimated at 1,090 tons (1×10^6 kg). If the carbonate production is scaled to the yearly intervals of the design storms, $CaCO_3$ production is about 1.6×10^6 for the 2-year interval, and 8×10^6 for the 10-year interval. Based on these estimates, natural terrigenous material delivered to the ocean from stream runoff is about 18% of natural reef sediment production for the 2-year event, and 12% of natural reef production for the 10-year event. Thus, the delivery rates of terrigenous sediment is an order of magnitude (10 times) higher than the terrigenous composition of the nearshore sediments (~1% in Table 2).

The order of magnitude difference in delivery and retention of land-derived material in the nearshore zone indicates that most of the terrigenous material does not remain in the nearshore area, but is rapidly dispersed. The similarity in sediment composition between the spring (high mixing, low rainfall) and late summer (high rainfall, low mixing) suggests that the dispersion is rapid under all conditions of mixing. Estimates of increases in sediment delivery during the "worst case scenario" indicate that sediment may increase by approximately 7% for each storm event when construction is underway. Such an increase would not change the order of magnitude differences between terrigenous delivery and natural reef production. Similarly, the reduced stream runoff that is projected to occur following completion of the project would not substantially change the relationships between sediment delivery and natural sand production. In conclusion, it does not appear likely that under any conditions will the proposed change in land use cause a change in the sediment composition of the nearshore zone.

CONCLUSIONS

1. Concern has been expressed that the proposed Lihi Lani development will cause changes in patterns of runoff that would have the potential to alter the nearshore marine ecosystem, and associated recreational activities. In particular, it has been stated that altered runoff could result in changes in sediment composition of the nearshore zone, which in turn could alter coral reef growth and reef accretion. It has been speculated that such changes could result in alteration of the shape and quality of surfing waves at breaks such as the Pipeline. While there is virtually no data or a theoretical basis for such speculation, several studies were nevertheless carried out to provide evidence of the potential (or lack of potential) for such scenarios to occur.

2. The marine environment off the proposed Lihi Lani development is characterized by seasonal intense wave activity which limits the development of reef biota to those assemblages which can withstand the impact of breaking waves. As a result, growth of corals is extremely limited. Radiometric dating of the reef platform in the region where waves crest and break during the winter months indicates that the reef platform is on the order of 3,000-4,000 years old. This result can be interpreted to indicate that the reef is not presently growing (accreting), but rather is eroding as a result of natural processes. This description of the processes occuring on the reef platforms off the Lihi Lani area are not unique, and appears to be the typical scenario for most wave-exposed areas throughout the Hawaiian Archipelago. The notion that sediment entering the marine system could affect living corals, which in turn could affect reef growth and the shape of breaking waves is clearly not a viable concern.

3. Due to the decrease in runoff volume brought about by the 40 drainage sumps, it is projected that runoff, total nitrogen and sediment loading will be reduced during all storm events following construction of the development compared to existing conditions. Decreases in suspended solids can be considered an environmental benefit of the proposed development. Because of the projected difference in phosphorus content in runoff between present conditions and following construction, some of the projections indicate and increase in phosphorus loading during storm events. Such increases are small in comparison with the natural input under existing conditions which have no negative impacts to the marine environment. As phosphorus does not appear to be a limiting nutrient, increases in loading should not cause any response in the biotic community. In addition, mixing processes by wave action is generally most intense during the times when storm runoff occurs.

4. While there appears to be potential for increases in sediment runoff during construction in some of the drainages, these increases are small in comparison to naturally occuring runoff during peak storm activity. Because of numerous retention basins that are part of the drainage plan projected drainage estimates indicate an overall net decrease in sediment runoff following construction in all of the drainages. Thus, the long term net effect of the project should be an overall reduction in sediment loading in the nearshore ocean.

5. Analyses of stream, beach and nearshore sediments indicates that the non-carbonate fraction in the nearshore zone is consistently on the order of 1%, regardless of season or recent rainfall. On a yearly basis, production of reef sediment (sand) is about 10 times greater than delivery of terrigenous material to the ocean from runoff. Because only about 1% of the marine sediment is of terrigenous origin, it appears that most of the land-derived material does not remain in the nearshore area, but is rapidly dispersed by wave action. The similarity in sediment composition between the spring (high mixing, low rainfall) and late summer (high rainfall, low mixing) suggests that the dispersion is rapid under all conditions of mixing. Estimates of increases in sediment delivery during the "worst case scenario" indicate that sediment may increase by approximately 7% for each storm event when construction is underway. Such an increase would not change the order of magnitude differences between terrigenous delivery and natural reef production. Similarly, the reduced stream runoff that is projected to occur following completion of the project would not substantially change the relationships between sediment delivery and natural sand production. In conclusion, it does not appear likely that under any conditions will the proposed change in land use cause a change in the sediment composition of the nearshore zone.

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FIGURE 1. Map showing location of the proposed Lihi Lani project on the north shore of Oahu. Also shown are locations of offshore marine monitoring sites LL-1 (Ehukai Beach Park), LL-2 (Rocky Point), LL-3 (Pakulena Stream) and LL-4 (Paumalu Stream).

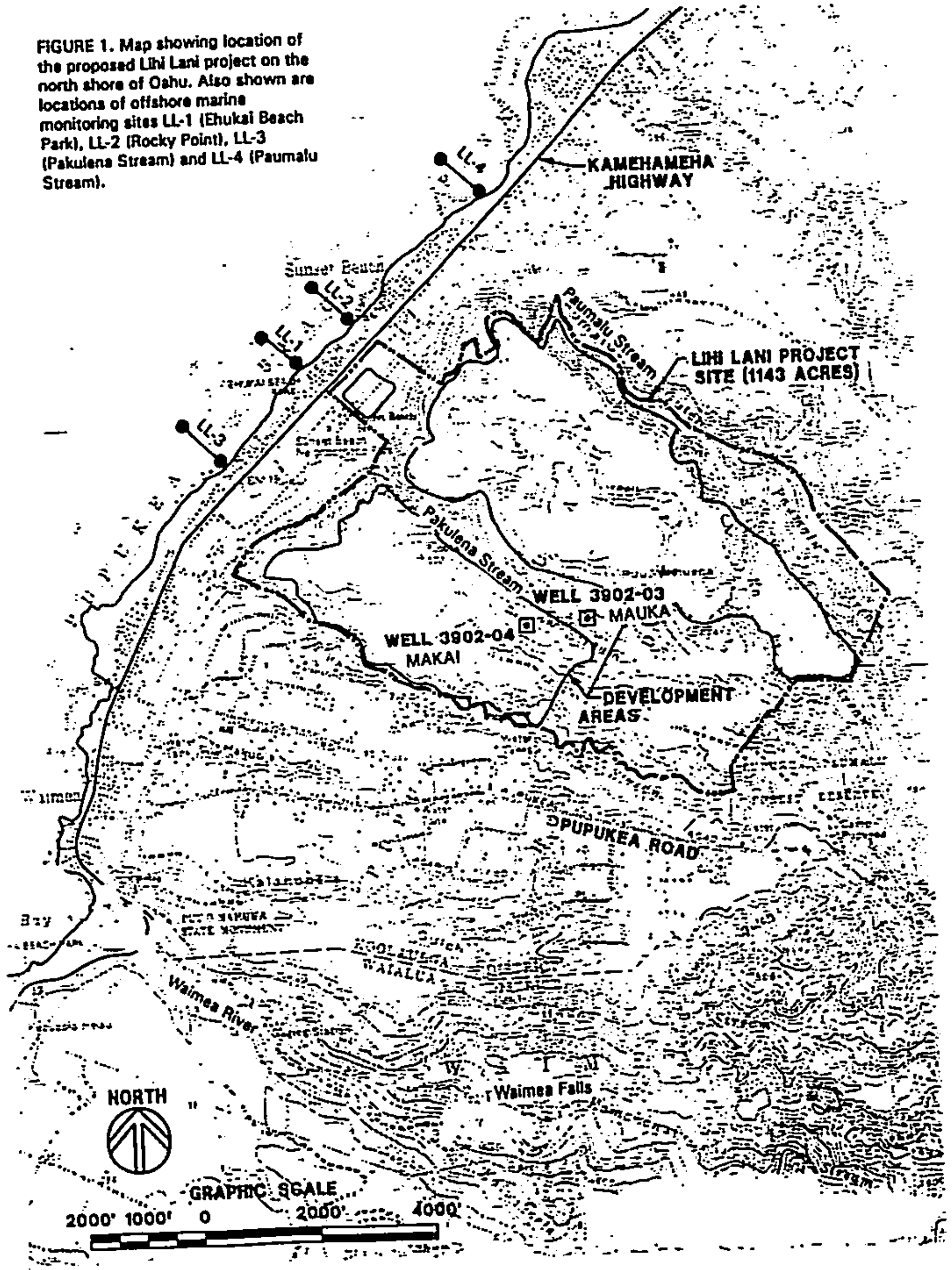

TABLE 1. Radiocarbon ages of carbonates collected on the North Shore of Oahu, offshore of the Lihi Lani site. For sampling locations, see Figure 1.

SAMPLE	CONVENTIONAL ^{14}C AGE	$\delta^{13}C$	^{13}C ADJUSTED AGE	CALIBRATED* ^{14}C AGE
1	16,700 ± 100	-4.0	17,040 ± 100	19,780
2	3,860 ± 70	+1.9	4,300 ± 70	4,271 (4,141-4,396)
3	3,600 ± 70	+1.9	4,040 ± 70	3,894 (3,803-4,015)
4	1,130 ± 60	+0.7	1,560 ± 60	967 (911-1,057)
5	980 ± 70	+1.2	1,420 ± 70	850 (737-927)
6	10,470 ± 100	-3.7	10,820 ± 110	12,560

* For ^{14}C ages up to 8,580 yr B.P., ages are calibrated with CALIB of Stuiver and Reimer (1987) using a reservoir ΔR of 115 ± 50. For ^{14}C ages older than 8,580 yr B.P., ages calibrated using data from Bard et al. (1990).

TABLE 2. Composition of sediments (% $CaCO_3$, % non-$CaCO_3$, % organic) collected in streams, beaches, and offshore marine sites off of the proposed Lihi Lani development. Samples labelled "PA" were collected off Paumalu Stream; "PK" represents samples collected off of Pakulena Stream; "KA" represents samples collected off of Kalunawaikaala Stream. At all sites, sample 1 was collected in the stream beds mauka of the Highway, samples 2 and 3 were collected on the beach, and samples 4 and 5 were collected in the ocean. For location of sampling sites, see Figure 1.

SAMPLING DATE	SAMPLE NO.	% CaCO3	% NON-CaCO3	% ORGANIC
MARCH 1992	PA-1	2.91	97.09	13.27
	PA-2	98.56	1.45	0.23
	PA-3	98.33	1.68	0.61
	PA-4	98.91	1.09	0.44
	PK-1	96.77	3.23	0.67
	PK-2	98.60	1.40	0.34
	PK-3	96.53	3.47	0.39
	PK-4	99.61	0.39	0.14
	KA-1	98.85	1.15	0.35
	KA-2	98.89	1.11	0.33
	KA-3	99.15	0.85	0.27
	KA-4	98.81	1.19	0.32
AUGUST 1993	PA-1	3.29	96.71	11.76
	PA-2	90.48	9.52	1.25
	PA-3	98.76	1.24	0.25
	PA-4	99.11	0.89	0.15
	PA-5	98.98	1.02	0.29
	PK-1	79.89	20.11	4.57
	PK-2	95.84	4.16	0.47
	PK-3	99.45	0.55	0.19
	PK-4	98.71	1.29	0.53
	PK-5	99.11	0.89	.0.30

LIHI LANI MARINE WATER CHEMISTRY

MONITORING PROGRAM

REPORT I-93

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INTRODUCTION

The proposed Lihi Lani Project, located at Pupukea in the Koolauloa District on the north shore of Oahu, consists of a total area of 1,144 acres, with not more than 480 acres (42%) planned for development of an integrated residential, agricultural, and recreational community phased over the next 10-12 years. The remaining 664 acres of the project site will remain unaltered. The residential component of the development plan includes 315 one to three acre residential lots, 50 single family affordable housing units, and 80 affordable elderly housing rental units. The agricultural component include diversified agriculture, ranching and grazing pastures. Recreational activities include horseback riding, hiking, camping, and community park facilities. In support of the project, access and circulation roadways, a wastewater treatment and disposal system, a potable water supply, and a non-potable irrigation system will be included in the development.

There are, however, no plans within the project framework for any shoreline modification. Thus, potential changes to the marine environment that might result from the project could only occur through alteration of input from surface drainage and nonpoint source discharges. Nonpoint source discharge could occur through material input to groundwater and surface flow that enters the ocean at, or near, the shoreline. Construction of the proposed development will also alter runoff characteristics of storm waters that enter the ocean.

Because each development scenario represents a unique situation, it is important to include information in the planning process that can be useful for assuring maintenance of environmental integrity for all prospective land use changes. The basic premise for recognizing the potential for effects to the marine environment is that materials applied to land for irrigation and fertilization may percolate into groundwater, move laterally downslope, and enter coastal waters at the shoreline. Additionally, periodic intense rainfall events can carry particulate and dissolved material to the ocean via surface drainage. Once in the nearshore ocean, these materials may cause alteration of water chemistry, which may have the potential to affect biological components of the marine environment.

The marine environment in the vicinity of the Lihi Lani Project was assessed in a preliminary baseline survey (Marine Research Consultants 1990) in order to evaluate the potential magnitude of alteration. Because of the concern for maintaining, or improving, the level of environmental quality in the area, and as a means of ensuring that proper

procedures are set forth, it has been deemed appropriate to voluntarily institute a marine monitoring program. The ultimate purpose of the monitoring program is to conduct a time-course evaluation of water quality in order to identify and mitigate any potential environmental problems caused by the development activities on shore. A prerequisite to identifying such changes that might occur as a result of the proposed development is a characterization of the existing state of the environment, in what can be considered the pre-construction state. This report constitutes the fourth increment in the monitoring program, and contains data from water chemistry sampling conducted in August 1993. The previous three surveys were conducted in December 1990, July 1991, and July 1992. Thus, pre-construction surveys have been conducted at yearly intervals for the last 4 years. It should be noted that while voluntary at present, the monitoring program has been designed to meet any future requirements for marine monitoring that might be imposed by County, State or Federal agencies.

METHODS

In the initial two monitoring surveys, two sites directly offshore of the proposed Lihi Lani development were selected as sampling areas. During the July 1992 and August 1993 surveys, two additional sites were added to the sampling regime in order to more thoroughly assess the impacts potential of the major stream drainages in the area. All of the survey sites are located downslope of the Lihi Lani property: Site 1 lies directly offshore of the northern edge of Ehukai Beach Park, Site 2 lies offshore from the northern boundary of the subject property shoreline extension (Rocky Point), Site 3 lies offshore of the area where Pakulena Stream discharges, and Site 4 lies offshore of the area where Paumalu Stream discharges (see Figure 1). Pakulena and Paumalu Streams both flow intermittently, and drain the watershed that contains most of the Lihi Lani development. Neither stream was flowing, or contained any standing water at the time of the August 1993 survey. However, during June and July 1993, relatively heavy rainfall had occurred on Oahu as a result of the passing of two tropical disturbances to the north of the Island chain. Despite heavy rainfall, monitoring Pakulena and Paumalu Streams revealed virtually no discharge to the ocean.

Water quality was evaluated at each site along transects oriented perpendicular to the shoreline. Sampling transects extended from the highest wash of waves at the shoreline to a distance of 500 meters (m) offshore, and also included samples collected at distances of 1, 3, 10 and 100 m from the shoreline. Such a scheme concentrates sampling near the shoreline as this is the region where inputs from land are most likely to be detectable. Sampling to a distance of 500 m offshore ensures that the range of sampling will extend to waters that are beyond the influence of input from land. At all stations, except in the nearshore breaker zone (0 and 1 m from shore), samples were collected at two depths; a surface sample was collected within approximately 10 centimeters (cm) of the surface, and a deep sample was collected within 1 m of the sea floor. Samples were also collected from an irrigation well (#3902-04) located within the Lihi Lani property (see Figure 1).

All fieldwork was conducted on August 7, 1993, with samples collected by swimming from shore. Water quality parameters evaluated included the 10 specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (Open Coastal waters) of the Water Quality Standards, Department of Health (DOH), State of Hawaii. These criteria include: total dissolved nitrogen (TDN), nitrate + nitrite nitrogen ($NO_3^- + NO_2^-$), ammonia nitrogen (NH_4^+), total dissolved phosphorus (TDP), Chlorophyll a (Chl a), turbidity, dissolved oxygen, temperature, pH and salinity. In addition, orthophosphate phosphorus (PO_4^{-3}) and dissolved silica (Si) were also reported because these parameters are sensitive indicators of biological activity and degree of groundwater mixing, respectively.

Water samples for nutrient analysis were collected in 1-liter (l) polyethylene bottles opened by divers at the desired location. Sub-samples for nutrient analyses were filtered through glass-fiber filters (GF/F) into 125-milliliter (ml) acid-washed, triple rinsed, polyethylene bottles in the field and immediately placed on ice. Analysis for NH_4^+, $NO_3^- + NO_2^-$ (hereafter termed NO_3^-), and PO_4^{3-} were performed using standard techniques on a Technicon autoanalyzer (Strickland and Parsons 1968, Technicon Systems 1973, Grasshoff 1983). TDN and TDP were analyzed in a similar fashion following UV digestion. Dissolved organic nitrogen (DON) and dissolved organic phosphorus (DOP) were calculated as the difference between TDN and dissolved inorganic N, and TDP and dissolved inorganic P, respectively. The level of detection for analysis of dissolved nutrients is 0.2 μM for TDN and Si, 0.02 μM for TDP, NO_3^- and NH_4^+, and 0.01 μM for PO_4^{3-}.

Water for other analyses was subsampled from 1-liter polyethylene bottles and kept chilled until analysis. Turbidity was determined on 60-ml subsamples fixed with $HgCl_2$ to terminate biological activity. Fixed samples were kept refrigerated until turbidity was measured on a Monitek Model 21 nephelometer and reported in nephelometric turbidity units (ntu)(level of detection = 0.01 ntu). Chl a was measured by filtering 300 ml of water through glass fiber filters; pigments on filters were extracted in 90% acetone in the

dark at -5° C for 12-24 hours, and the fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer (level of detection 0.01 mg/L). Salinity was determined using an AGE Model 2100 laboratory salinometer with a level of detection of 0.0001 ‰.

In-situ field measurements included water temperature (measured with a hand-held mercury thermometer readable to 0.1 °C), and pH (measured with a portable meter with a readability of 0.01 pH units).

Nutrient, turbidity, and salinity analyses were conducted by Marine Analytical Specialists (Honolulu, HI); Chl a analysis was performed by OI Consultants, Inc. (Waimanalo, HI). Both laboratories have complied with DOH certification testing.

Physical Description of the Study Sites

The physical (and to a large part chemical and biological) oceanographic setting of the area offshore of the proposed development is dominated by the effects of wave action. During the winter months, large waves that originate from storms in the north Pacific impact the north shores of the Hawaiian Islands. Within the nearshore area fronting the proposed development is the "Pipeline", a surfing area that is renown worldwide for the quality and force of waves breaking on the nearshore reefs. Because all of the property frontage consists of open coastline, there are no regions sheltered from wave energy.

The entire shoreline fronting the development is composed of a wide beach composed of coarse calcareous sand. Portions of the shoreline are composed of solid limestone (beachrock) that generally occurs in areas where there is consistent flow of low salinity groundwater into the ocean. In other areas, particularly where intermittent streams enter the ocean, there are scattered basaltic boulders that extend across the shoreline and into the nearshore zone.

The nearshore region is essentially divided into two zones - a nearshore boulder/sand area and a deeper reef platform zone. Moving seaward from the beach, the most shoreward zone consists primarily of boulders and limestone extrusions interspersed on a sandy bottom. Surfaces of the rocks are essentially barren owing to frequent mechanical stress from breaking waves and scouring action of sand. The only macro-organisms occurring on the boulders are marine algae of numerous species. The extent of the boulder zone in terms of distance offshore varies depending on the specific location, but in general is on the order of 50 m.

At a water depth of about 5 m, the seafloor grades from sand and boulders to a solid fossil calcium carbonate reef platform. Interspersed in the solid pavement are pockets of sand, as well as shallow ledges and small undercut caves. Owing to the greater water depth and distance from shore, the destructive force of waves is less in this area, allowing reef biota to occur. The major forms of benthic (bottom dwelling) organisms in this area are corals and algae; however the occurrence of corals is limited to small flat encrustations. The flat carbonate pavement continues out to the limits of investigation for this study, approximately 500 m offshore, and to water depths of about 15 m.

RESULTS OF WATER CHEMISTRY ANALYSES

Horizontal and Vertical Stratification

Tables 1 and 2 show the results of all water chemistry analyses from samples collected offshore of the Lihi Lani property in August 1993. Also shown are results of analyses of groundwater collected from the well drilled on the Lihi Lani site. Table 1 shows dissolved nutrient concentrations in units of micromoles per liter (μM); Table 2 shows dissolved nutrient concentrations in units of micrograms per liter (μg/L). The concentrations of eight dissolved nutrient constituents in surface and deep samples are plotted as functions of distance from the shoreline in Figure 2. Salinity, turbidity, Chl a and temperature are plotted as functions of distance from the shoreline in Figure 3.

It can be seen from the analyses of well water that concentrations of PO_4^{3-}, NO_3^- and Si in groundwater are one to two orders of magnitude higher than ocean waters (Table 1). It can also be seen that PO_4^{3-} comprises 98% of TDP in groundwater, while NO_3^- comprises 97% of TDN. Concentrations of NH_4^+, DON and DOP are relatively low in naturally occurring groundwater. Concentrations of Si in groundwater are one to two orders of magnitude higher than oceanic samples as a result of dissolution of aluminosilicate minerals within the basaltic aquifer.

Several patterns of distribution are evident in Figures 2 and 3. At Sites 1-3, the concentrations of dissolved Si and NO_3^- were higher in samples collected within 10 m of the shoreline than in samples 100-500 m from shore (Figure 2). At Sites 1 and 3, there were five and eight-fold increases, respectively, in concentrations of Si in surface samples

collected at the shoreline compared to 500 m offshore (Table 1). Concentrations of NO_3^- were four and ten times greater at the shoreline than in offshore samples at Sites 1 and 3, respectively (Table 1). At Site 2, the same pattern of elevated Si and NO_3^- at the shoreline was evident, but not to the extent as at Sites 1 and 3. Salinity exhibited the opposite trend with decreased values within 10 m of the beach compared to samples collected 100-500 m from shore (Figure 3, Table 1). As was the case with Si and NO_3^-, the greatest difference in salinity occurred at Site 3 where the shoreline salinity was 0.5‰ lower than 500 m from the shoreline. Concentrations of PO_4^{3-} were only slightly elevated (0.03 μM) in the shoreline samples at Sites 1 and 3 compared to the most seaward samples. Concentrations of PO_4^{3-} showed no variation with respect to distance from shore at Site 2 (Figure 2). At Site 4, Si, NO_3^-, PO_4^{3-} and salinity remained relatively constant with respect to distance offshore (Tables 1, Figures 2 and 3).

These patterns appear to be a result of input of groundwater to the nearshore ocean. Low salinity groundwater, which contains high concentrations of Si, NO_3^- and PO_4^{3-} (see potable well values in Tables 1 and 2), percolates to the ocean at the shoreline, resulting in a nearshore region of mixing. In many areas of the Hawaiian Islands, such groundwater input results in horizontal gradients of increasing salinity and decreasing nutrients moving seaward. From the horizontal gradients that are evident in August 1993 data set, it is apparent that groundwater efflux at the shoreline was greatest at Site 3 (Pakulena), detectable at Sites 1 (Ehukai) and 2 (Rocky Point), and essentially absent, or undetectable, at Site 4 (Paumalu).

Other dissolved nutrients that do not occur in elevated concentrations in groundwater relative to ocean water do not display the same gradients with distance from shore. While NH_4^+, DON, and DOP vary in concentration somewhat among the different sampling sites, they do not display any distinct horizontal gradients with distance from shore (Table 1, Figures 2 and 3).

Figures 2 and 3 also show concentrations of water chemistry constituents measured from surface and deep water at stations located 3 m from the shoreline and beyond. In Hawaiian waters, vertical stratification sometimes occurs in the nearshore zone when low salinity groundwater or surface runoff "floats" on denser, more saline ocean water. The data set collected off the Lihi Lani site does not display such distinct vertical stratification, probably as a result of the relatively low input of freshwater, and the high degree of turbulent mixing processes caused by breaking waves. However, while there was no apparent surface layer of lower saline water, there was a consistent pattern of lower salinity, and higher concentrations of NO_3^- and Si, at the deep sampling stations 10 m from the shoreline at all four sites. Such a consistent pattern suggests that there was efflux of low salinity, high nutrient groundwater from the ocean floor in the area about 10 m from the beach. Owing to the relatively shallow water depth at this distance from shore (5-7 m) it was possible to collect water samples very close to the sediment-water interface. At a distance of 3 m from shore, surface samples has consistently lower salinities than deep samples, as was the case in most of the samples collected 100-500 m from shore. Comparison of surface water and deep water samples showed no discernible differences in concentrations for DON and DOP at any of the sites (Figures 2 and 3).

While groundwater efflux does not necessarily result in alteration of water clarity, turbidity was elevated in the samples collected within 3 m of the shoreline (Table 1, Figure 3). The largest gradient in turbidity occurred at Site 1, with values of 0.64 ntu at the station located 3 m from the shoreline and 0.12 ntu 500 m from shore (Figure 3). Such a pattern of increased turbidity at the shoreline is often indicative of sediment stirring by nearshore turbulence (waves), rather than from runoff from land or groundwater input. Concentrations of Chl a also showed slight elevations in the nearshore zone with the steepest gradient evident at Site 2 (Table 1, Figure 3). The highest measurement of Chl a during the August 1993 survey occurred 100 m from shore at Site 4 (0.24 µg/L). No vertical stratification was evident for turbidity or Chl a (Figure 3).

Temperature at Sites 1, 2 and 4 showed no distinct pattern with respect to distance from the shoreline, and varied by no more than 0.1 °C along any one transect, ranging between 26.2-27.10 °C (Figure 3). Surface temperatures at Site 3 showed more variability; measurements 3 m and 10 m from the shoreline were 0.2-0.3°C higher than those recorded at the shoreline or offshore. Site 3 was also the only site to show any differences between surface and deep water temperature measurements. In general, temperature in the surface water was 0.2-0.4° C warmer than that of the deep water at Site 3 (Tables 1 and 2).

Temporal Comparison of Monitoring Results

Figures 4-11 compare the concentrations of water chemistry constituents from surface samples at all four sites over the 4-year course of the Lihi Lani monitoring program. Comparisons are made for the first four increments of the monitoring program at Sites 1 and 2 and for the last two survey dates at Sites 3 and 4 (Sites 3 and 4 were established in July 1992).

At Site 1, Si, NO_3^- and salinity showed steeper gradients during the December 1990 survey compared to the other three surveys (Figures 4 and 5). At Site 2, the concentrations of Si, NO_3^- and PO_4^{3-} were higher, and salinity lower in July 1991 as compared to the other three dates (Figures 6 and 7). At both sites, the concentrations of NH_4^+ and DOP were higher in August 1993 while the concentration of DON generally showed no distinct differences among survey dates (Figures 4 and 6). At Sites 1 and 2, turbidity was elevated in the nearshore zone compared to offshore waters during all four surveys (Figures 5 and 7). Turbidity was generally higher in the 1990 and 1991 surveys compared to the most recent two surveys. A seasonal trend in temperature is not obvious from the data; however, July 1992 had the lowest temperatures at both Sites 1 and 2 (Figure 5 and 7). Chl a was elevated in the shoreline samples during all surveys at Site 1 with slightly higher concentrations measured during the December 1990 and July 1991 surveys (Figure 5). Concentrations of Chl a were lower during August 1993 compared to the other survey dates at Site 2 (Figure 7).

These patterns suggest that variations in groundwater efflux are more a reflection of site differences than of seasonal influences. At Site 2, the influence of groundwater entering the ocean during July 1991 appears to be more apparent than during December 1990, July 1992 or August 1993. This result may have been due to more rapid mixing with seawater to reach background levels during December 1990, July 1991 and August 1993. Such a pattern is not unexpected as the July 1991 sampling occurred during a period of very calm sea conditions when turbulent mixing from wave activity was minimal. On the contrary, water chemistry constituents that are not associated with groundwater input (except temperature) are very similar in magnitude and pattern of distribution during all four surveys. Temperature was consistently lower in the July 1992 samples.

With only two monitoring surveys completed to date at Sites 3 and 4, and with both surveys having been conducted in the summer months, it is difficult to assess any seasonal or temporal patterns. At Site 3 (Pakulena), the pattern of distributions of Si, NO_3^-, DOP, DON, and salinity are remarkably similar between the 1992 and 1993 surveys (Figures 8 and 9). Concentrations of PO_4^{3-} and NH_4^+ are about 0.1 µM and 0.3 µM higher, respectively, at all sampling stations in 1993 compared to 1992. Conversely, Chl a was consistently about 0.1 µg/L higher in 1992 compared to 1993. While only a month apart, temperature was about 2°C cooler in July 1992 compared to August 1993 (Figure 9).

At Site 4 (Paumalu), patterns of distribution were also similar between years for most constituents. Concentrations of NH_4^+ were consistently higher by up to 0.4 μM in the 1993 survey (Figure 10). Salinity was consistently lower by 0.2‰ in the most recent survey. As at Site 3, temperature was elevated by about 2°C in August 1993 relative to July 1992 (Figure 11).

Conservative Mixing Analysis

A useful treatment of water chemistry data for interpreting the extent of material input from land is application of a hydrographic mixing model. In the simplest form, such a model consists of plotting the concentration of a dissolved chemical species as a function of salinity (Officer 1979, Dollar and Atkinson 1992, Smith and Atkinson 1993). Figure 12 shows plots of the concentrations of Si, NH_4^+, NO_3^-, and PO_4^{3-} as functions of salinity for the samples collected in August 1993. Similar plots which include data for all four monitoring surveys are presented in Figure 13. Each graph also shows conservative mixing lines constructed by connecting the endpoint concentrations of open ocean water and groundwater concentration from the irrigation well located on the Lihi Lani property. Figure 13 shows four such mixing lines, each constructed using well data from each respective monitoring survey date.

Comparison of the curves produced by such plots with conservative mixing lines provides an indication of the origin and fate of the material in question. If the parameter in question displays purely conservative behavior (i.e., no input from other than natural sources, and no uptake or removal from any process other than physical mixing), data points should prescribe a straight line which falls on the conservative mixing line. If however, external material is added to the system through processes such as leaching of fertilizer nutrients to groundwater, data points will fall above the mixing line. If material is being removed from the system by processes such as biological uptake, data points will fall below the mixing line. Curvature of the mixing lines prescribed by the data points indicates sources (downward concave curvature) or sinks (upward concave curvature) of the nutrient material under consideration.

Dissolved Si represents a check on the model as this material is present in high concentration in groundwater, but is not a major component of fertilizer. In addition, Si is not utilized rapidly within the nearshore environment by biological processes. Concentrations of Si plotted as functions of salinity from the August 1993 survey prescribe a linear pattern near the conservative mixing line for Sites 1, 2 and 3 (Figure 12). Samples

collected from Site 4 fall in a somewhat distinct cluster below the conservative mixing line. These results indicate that groundwater entering the ocean near Site 4 has a different Si composition than that of groundwater entering the ocean near Sites 1, 2 and 3. The fact that most of the data points from Site 1, 2 and 3 fall on a straight line and close to the conservative mixing line supports the conclusion that Si is behaving as a conservative tracer, and validates the assumptions of the mixing model. In addition, the linear distribution indicates that at the Lihi Lani site, groundwater entering the ocean at the shoreline appears to be similar in composition to the well water.

The plots of NO_3^- versus salinity show a different pattern of distribution than Si (Figure 12). In general, it appears that each survey site displays a different pattern, suggesting different processes may be occurring at each site. The only survey area where concentrations of NO_3^- plotted versus salinity fall in a linear pattern near the mixing line is at Site 1. Data points from Site 3 are roughly linear in distribution, and fall predominantly above the conservative mixing line. Data points from Sites 2 and 4 do not represent a linear relationship with salinity. At Site 3, off of Pakulena Stream, the apparent subsidy of NO_3^- over that which is present in groundwater may be a result of input from land. In past surveys, similar subsidies were attributed to cesspools or fertilizer nutrients. It is apparent that similar inputs do not appear to be occurring at the other sites.

The other form of dissolved inorganic nitrogen, NH_4^+ shows a different pattern of distribution than NO_3^-. The endmember concentrations of NH_4^+ are nearly identical; concentrations in open ocean water and groundwater are nearly identical, producing a "flat" conservative mixing line. Plots of NH_4^+ versus salinity reveal that concentrations of NH_4^+ are similar within a site, but that there is a distinct difference between sites (Figure 12). The lack of any difference in concentration with salinity indicates that the NH_4^+ in the nearshore ocean does not appear to be a result of input from land, but rather from biological processes occurring in the ocean. Because of the slightly different physical and biotic setting of each site, it appears that the concentrations of NH_4^+ are slightly different at each site.

PO_4^{3-} is usually not found to leach to groundwater to the extent of NO_3^-, owing to a high absorptive affinity of phosphorus in soils. Most of the PO_4^{3-} data points for August 1993 fall above the conservative mixing line but do not fall in a linear arrangement (Figure 12). In addition, there is no indication of different distributions of data from different sites. Because PO_4^{3-} concentrations are an order of magnitude higher in groundwater than in open coastal water 500 m from the shoreline (see Table 1), a linear relationship with concentrations decreasing with increasing salinity would be expected if PO_4^{3-} concentrations in the nearshore areas were a result of input from land. Rather, the scattered distribution with concentrations generally above the conservative mixing line suggest that PO_4^{3-} is a result of biological activity in the water column.

Figure 13 shows mixing diagrams with data from all four surveys. With respect to Si, it can be seen that data from each sampling period prescribes a slightly different, but somewhat linear distribution that falls close to the respective mixing line for the particular survey. This is in marked contrast to the distributions of NO_3^- versus salinity in Figure 13. For the surveys in December 1990, July 1991 and August 1993, NO_3^- data points, especially those at lower salinities fall predominantly above the line. During December 1990 and July 1991 a substantial input of NO_3^- was occurring off Sites 1 (Ehukai) and 2 (Rocky Point). It was suggested that the input was likely a result of activities on land, especially leaching from cesspools utilized by residences along the shoreline. During the most recent survey, the subsidy of NO_3^- is evident primarily at Site 3 (Pakulena), rather than at Sites 1 and 2 (Figure 12). During July 1992, the subsidy was not apparent as most data points fall below the mixing line (Figure 13). The magnitude of the apparent subsidy in 1993 is similar to that observed in 1990 and 1991 (Figure 13).

The situation for PO_4^{3-} is similar to NO_3^-, with most concentrations falling above the mixing line in all the surveys except July 1992. It appears that these subsidies vary between years. Distributions of NH_4^+ show consistently higher concentrations during August 1993 compared to the other three surveys. However, the lack of a inverse linear relationship between concentrations of NH_4^+ and salinity indicates that the levels of NH_4^+ in nearshore waters are not a result of input from land, but rather a result of natural marine biological activity.

Compliance with DOH Criteria

Samples that exceed the State Dept. of Health water quality standards for open coastal waters under "dry" conditions are shown in Tables 1 and 2. The criteria for dry conditions are applied to the Lihi Lani area as this area receives a groundwater input of about 1.5 million gallons per day (mgd) per mile of shoreline (Mink 1990).

DOH standards include specific criteria for three situations; criteria that are not to be exceeded during either 10% or 2% of the time, and criteria that are not to be exceeded by the geometric mean of samples. With only four samples collected to date from each

sampling station at Sites 1 and 2, comparison of the 10% or 2% of the time criteria for any sample is not statistically meaningful. However, comparing sample concentrations to these criteria provide an indication of whether water quality is near the stated specific criteria.

Comparison of the water chemistry measurements from off the Lihi Lani project site to DOH standards reveals that 7 measurements for NO_3^- exceeded the 10% criteria. These samples were collected within 10 m of the shoreline at Sites 2 and 3. Twenty-one measurements of NH_4^+ and 2 measurements of turbidity also exceeded the 10% criteria. No measurements of TDP, TDN, or Chl *a* exceeded DOH specific limits during the August 1993 monitoring survey.

Tables 3 and 4 show geometric means calculated from samples collected at the same locations during four increments of the monitoring program at Sites 1 and 2 and during the past two surveys at Sites 3 and 4. Also shown in Tables 3 and 4 are the samples that exceed the DOH geometric mean limits. Twenty-six measurements of NO_3^-, 13 measurements of NH_4^+, 20 measurements of turbidity, and 16 measurements of Chl *a* exceeded the DOH geometric mean criteria. In no cases did TDN and TDP exceed the geometric mean limits.

As there has been no construction activity to date on the Lihi Lani project, the observed cases where DOH standards have been exceeded are a result of either natural processes within the marine environment, or existing activities on land.

SUMMARY

1. The fourth evaluation of the nearshore water chemistry off the proposed Lihi Lani project site was carried out in August 1993. Forty ocean water samples were collected from four sites fronting the project site; Site 1 was off Ehukai Beach, Site 2 was off Rocky Point, Site 3 was off Pakulena Stream, and Site 4 was off Paumalu Stream. Water samples were collected on transects perpendicular to shore, extending from the shoreline to a distance of 500 m offshore. An additional sample was collected from an irrigation well located on the development site. Analysis of water chemistry constituents included all parameters specified in DOH water quality standards.

2. Water chemistry analyses indicated that nutrients present in high concentrations in groundwater relative to ocean water (NO_3^-+NO_2^-, Si) were present in relatively high

concentrations within 10 m of the shoreline compared to farther offshore. Such horizontal gradients in nutrients are likely a result of groundwater entering the ocean near the shoreline. Input of groundwater appeared to be greatest offshore of Pakulena Stream (Site 3), and lowest off of Paumalu Stream (Site 4). Water chemistry constituents not present in high concentrations in groundwater were distributed uniformly through the nearshore zone. While there did not appear to be distinct vertical stratification of the water column, there was an indication of groundwater seeps at a distance of 10 m from the shoreline at all four sampling sites.

3. Application of a conservative mixing model indicated that in August 1993, there were subsidies of NO_3^- from sources other than groundwater only at Site 3 (Pakulena Stream). In previous surveys in 1990 and 1991 (but not 1992) similar subsidies of NO_3^- were observed at other areas fronting the proposed development. As no construction activity for the project has taken place, the most likely source of the NO_3^- subsidy is leaching from existing cesspools serving residences shoreward of the sampling sites. Future monitoring surveys will indicate if the nutrient subsidies from cesspool input remains.

4. Comparative results from the four monitoring surveys for Sites 1 and 2 indicate site-specific differences in dissolved nutrients rather than a temporal variation. Trends were apparent in temperature at all four sites but was not seasonal.

5. Several water samples exceeded State DOH 10% standards for NO_3^- and NH_4^+ at Sites 2, 3 and 4. samples. These samples appear to contain dissolved NO_3^- and NH_4^+ in excess of standards as a result of both existing land-based inputs, and natural marine biological processes. Results of the August 1993 survey marked the first time for exceedance of DOH standards for NH_4^+.

6. Geometric mean data for NO_3^-, NH_4^+, turbidity and Chl a exceeded State DOH standards many of the nearshore samples from all four sites.

7. The next phase of monitoring is planned for early 1994.

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TABLE 1. Water chemistry measurements off the Lihi Lani Recreational Community sites collected August 7, 1993. Abbreviations as follows: S = surface; D = deep; DFS = distance from shore. Shaded values exceed DOH criteria for open coastal waters under "dry" conditions. For site locations, see Figure 1.

SITE	NO.	DFS (m)	PO4 (µM)	NO3 (µM)	NH4 (µM)	Si (µM)	DOP (µM)	DON (µM)	TDP (µM)	TDN (µM)	TURB (NTU)	SALINITY (o/oo)	CHL a (µg/L)	TEMP (deg.C)	pH
LL-1	1S	0	0.11	0.44	0.27	9.78	0.25	5.17	0.36	5.88	0.41	34.383	0.10	26.3	8.21
	2S	1	0.08	0.47	0.17	10.35	0.26	5.41	0.34	6.05	0.41	34.375	0.12	26.3	8.20
	3S	3	0.11	0.57	0.16	8.74	0.28	5.54	0.39	6.27	0.64	34.406	0.13	26.3	8.20
	3D	3	0.09	0.51	0.13	8.08	0.29	5.71	0.38	6.35	0.57	34.433	0.11	26.3	8.20
	4S	10	0.07	0.43	0.23	7.37	0.30	4.65	0.37	5.31	0.23	34.449	0.15	26.3	8.20
	4D	10	0.09	0.45	0.18	7.78	0.24	4.69	0.33	5.32	0.25	34.155	0.16	26.3	8.20
	5S	100	0.08	0.43	0.14	6.44	0.24	4.78	0.32	5.35	0.15	34.490	0.09	26.3	8.19
	5D	100	0.08	0.19	0.25	3.74	0.24	6.03	0.32	6.47	0.16	34.600	0.11	26.3	8.20
	6S	500	0.07	0.11	0.15	1.77	0.27	6.22	0.34	6.48	0.12	34.612	0.08	26.3	8.22
	6D	500	0.08	0.15	0.18	2.02	0.31	6.27	0.39	6.60	0.13	34.669	0.08	26.3	8.21
LL-2	1S	0	0.09	0.83	0.47	5.21	0.30	5.12	0.39	6.62	0.21	34.547	0.14	26.5	8.21
	2S	1	0.11	0.87	0.25	5.08	0.30	5.61	0.41	6.63	0.26	34.539	0.12	26.5	8.22
	3S	3	0.05	0.24	0.26	4.90	0.23	5.67	0.28	6.17	0.18	34.575	0.16	26.5	8.24
	3D	3	0.05	0.23	0.41	5.25	0.23	5.47	0.28	6.11	0.19	34.585	0.15	26.4	8.25
	4S	10	0.07	0.20	0.30	4.60	0.25	5.09	0.32	5.59	0.17	34.586	0.11	26.4	8.23
	4D	10	0.11	0.25	1.26	7.89	0.26	4.21	0.37	5.72	0.19	34.311	0.06	26.4	8.23
	5S	100	0.04	0.20	0.60	6.48	0.26	5.06	0.30	5.76	0.16	34.467	0.10	26.4	8.19
	5D	100	0.06	0.07	0.25	2.89	0.24	5.38	0.30	5.70	0.18	34.647	0.09	26.3	8.21
	6S	500	0.11	0.10	0.33	2.23	0.23	5.39	0.34	5.82	0.15	34.618	0.07	26.3	8.22
	6D	500	0.14	0.22	0.41	2.76	0.27	5.40	0.41	6.03	0.16	34.677	0.08	26.3	8.21
LL-3	1S	0	0.16	1.42	0.38	17.09	0.28	3.92	0.44	5.72	0.29	34.142	0.10	26.8	8.21
	2S	1	0.14	1.43	0.32	16.96	0.29	4.07	0.43	5.82	0.38	34.154	0.10	26.7	8.20
	3S	3	0.14	1.01	0.41	14.19	0.30	4.07	0.44	5.49	0.28	34.220	0.14	27.1	8.21
	3D	3	0.17	1.02	0.41	14.00	0.29	4.92	0.46	6.35	0.23	34.219	0.07	26.9	8.21
	4S	10	0.13	0.64	0.40	9.79	0.26	5.14	0.39	6.18	0.19	34.383	0.12	27.0	8.22
	4D	10	0.20	0.72	0.42	9.76	0.27	5.34	0.47	6.48	0.19	34.358	0.06	26.6	8.23
	5S	100	0.11	0.32	0.31	6.49	0.28	5.66	0.39	6.29	0.23	34.492	0.09	26.8	8.21
	5D	100	0.12	0.24	0.60	4.33	0.29	5.49	0.41	6.33	0.17	34.593	0.10	26.6	8.21
	6S	500	0.10	0.15	0.42	2.04	0.30	4.82	0.40	5.39	0.14	34.638	0.08	26.7	8.22
	6D	500	0.11	0.17	0.51	2.52	0.30	4.71	0.41	5.39	0.16	34.637	0.10	27.0	8.21
LL-4	1S	0	0.07	0.50	0.41	2.74	0.26	5.48	0.32	6.39	0.29	34.312	0.11	26.2	8.20
	2S	1	0.10	0.51	0.31	2.90	0.25	5.61	0.35	6.43	0.29	34.327	0.10	26.3	8.19
	3S	3	0.07	0.39	0.37	3.02	0.25	5.58	0.32	6.34	0.27	34.633	0.11	26.2	8.19
	3D	3	0.15	0.38	0.47	2.88	0.25	5.50	0.40	6.35	0.26	34.425	0.16	26.3	8.20
	4S	10	0.05	0.23	0.40	2.77	0.31	4.82	0.36	5.45	0.19	34.646	0.12	26.2	8.20
	4D	10	0.04	0.32	0.42	2.80	0.31	4.94	0.35	5.68	0.23	34.651	0.10	26.3	8.19
	5S	100	0.09	0.41	0.44	2.19	0.31	5.07	0.40	5.92	0.17	34.667	0.24	26.3	8.20
	5D	100	0.07	0.41	0.32	5.11	0.31	5.71	0.38	6.44	0.22	34.367	0.10	26.3	8.19
	6S	500	0.10	0.40	0.35	2.20	0.30	5.44	0.40	6.19	0.15	34.676	0.09	26.3	8.19
	6D	500	0.05	0.35	0.41	2.19	0.28	5.12	0.33	5.88	0.17	34.689	0.08	26.3	8.18
	WELL		1.59	41.94	0.22	695.5	0.03	0.88	1.62	43.04	0.97	0.726			
DOH WATER QUALITY STANDARDS															
NOT TO EXCEED 10%				0.71	0.33				0.97	12.86	0.50		0.50		
NOT TO EXCEED 2%				1.43	0.64				1.45	17.86	1.00		1.00		

TABLE 2. Water chemistry measurements (in µg/L) off the Lihi Lani Recreational Community sites collected August 7, 1993. Abbreviations as follows: S = surface; D = deep; DFS = distance from shore. Shaded values exceed DOH criteria for open coastal waters under "dry" conditions. For site locations, see Figure 1.

SITE	NO.	DFS (m)	PO4 (µg/L)	NO3 (µg/L)	NH4 (µg/L)	Si (µg/L)	DOP (µg/L)	DON (µg/L)	TDP (µg/L)	TDN (µg/L)	TURB (NTU)	SALINITY (o/oo)	CHL a (µg/L)	TEMP (deg.C)	pH
LL-1	1S	0	3.41	6.16	3.78	276	7.75	72.4	11.16	82.3	0.41	34.383	0.10	26.3	8.21
	2S	1	2.48	6.58	2.38	291	8.06	76.7	10.54	84.7	0.41	34.376	0.12	26.3	8.20
	3S	3	3.41	7.98	2.24	246	8.68	77.6	12.09	87.8	0.64	34.406	0.13	26.3	8.20
	3D	3	2.79	7.14	1.82	227	8.99	79.9	11.78	88.9	0.57	34.433	0.11	26.3	8.20
	4S	10	2.17	6.02	3.22	207	9.30	65.1	11.47	74.3	0.23	34.449	0.15	26.3	8.20
	4D	10	2.79	6.30	2.52	219	7.44	65.7	10.23	74.5	0.25	34.155	0.16	26.3	8.20
	5S	100	2.48	6.02	1.96	181	7.44	66.9	9.92	74.9	0.15	34.490	0.09	26.3	8.19
	5D	100	2.48	2.66	3.50	105	7.44	84.4	9.92	90.6	0.16	34.600	0.11	26.3	8.20
	6S	500	2.17	1.54	2.10	50	8.37	87.1	10.54	90.7	0.12	34.612	0.08	26.3	8.22
	6D	500	2.48	2.10	2.52	57	9.61	87.8	12.09	92.4	0.13	34.669	0.08	26.3	8.21
LL-2	1S	0	2.79	13.02	6.58	146	9.30	71.7	12.09	91.3	0.21	34.547	0.14	26.5	8.21
	2S	1	3.41	12.18	3.50	143	9.30	77.1	12.71	92.8	0.25	34.539	0.12	26.5	8.22
	3S	3	1.55	3.36	3.64	138	7.13	79.4	8.68	86.4	0.18	34.575	0.16	26.5	8.24
	3D	3	1.55	3.22	5.74	148	7.13	76.6	8.68	85.5	0.19	34.585	0.15	26.4	8.25
	4S	10	2.17	2.80	4.20	129	7.75	71.3	9.92	78.3	0.17	34.586	0.11	26.4	8.23
	4D	10	3.41	3.50	17.64	222	8.06	58.9	11.47	80.1	0.19	34.311	0.06	26.4	8.23
	5S	100	1.24	2.80	7.00	182	8.06	70.8	9.30	80.6	0.16	34.467	0.10	26.4	8.19
	5D	100	1.86	0.98	3.50	81	7.44	75.3	9.30	79.8	0.18	34.647	0.09	26.3	8.21
	6S	500	3.41	1.40	4.62	63	7.13	75.5	10.54	81.5	0.15	34.618	0.07	26.3	8.22
	6D	500	4.34	3.08	5.74	78	8.37	75.6	12.71	84.4	0.16	34.677	0.08	26.3	8.21
LL-3	1S	0	4.96	19.88	5.32	480	8.68	54.9	13.64	80.1	0.29	34.142	0.10	26.8	8.21
	2S	1	4.34	20.02	4.48	477	8.99	57.0	13.33	81.5	0.38	34.154	0.10	26.7	8.20
	3S	3	4.34	14.14	5.74	399	9.30	57.0	13.64	76.9	0.26	34.220	0.14	27.1	8.21
	3D	3	5.27	14.28	6.74	393	8.99	68.9	14.26	88.9	0.23	34.219	0.07	26.9	8.21
	4S	10	4.03	8.96	5.60	275	8.06	72.0	12.09	86.5	0.19	34.383	0.12	27.0	8.22
	4D	10	6.20	10.08	5.88	274	8.37	74.8	14.57	90.7	0.19	34.358	0.06	26.6	8.23
	5S	100	3.41	4.48	4.34	182	8.68	79.2	12.09	88.1	0.23	34.492	0.09	26.8	8.21
	5D	100	3.72	3.36	8.40	122	8.99	76.9	12.71	88.6	0.17	34.593	0.10	26.6	8.21
	6S	500	3.10	2.10	5.88	57	9.30	67.5	12.40	75.5	0.14	34.638	0.08	26.7	8.22
	6D	500	3.41	2.38	7.14	71	9.30	65.9	12.71	75.5	0.16	34.637	0.10	27.0	8.21
LL-4	1S	0	2.17	7.00	5.74	77	7.75	76.7	9.92	89.5	0.29	34.312	0.11	26.2	8.20
	2S	1	3.10	7.14	4.34	81	7.75	78.5	10.85	90.0	0.29	34.327	0.10	26.3	8.19
	3S	3	2.17	5.46	5.18	85	7.75	78.1	9.92	88.8	0.27	34.633	0.11	26.2	8.19
	3D	3	4.65	5.32	6.58	81	7.75	77.0	12.40	88.9	0.26	34.425	0.16	26.3	8.20
	4S	10	1.55	3.22	5.60	78	9.61	67.5	11.16	76.3	0.19	34.646	0.12	26.2	8.20
	4D	10	1.24	4.48	5.88	79	9.61	69.2	10.85	79.5	0.23	34.651	0.10	26.3	8.19
	5S	100	2.79	5.74	6.16	62	9.61	71.0	12.40	82.9	0.17	34.667	0.24	26.3	8.20
	5D	100	2.17	5.74	4.48	144	9.61	79.9	11.78	90.2	0.22	34.367	0.10	26.3	8.19
	6S	500	3.10	5.60	4.90	62	9.30	76.2	12.40	86.7	0.16	34.676	0.09	26.3	8.19
	6D	500	1.55	4.90	5.74	62	8.68	71.7	10.23	82.3	0.17	34.689	0.08	26.3	8.18
	WELL		49.29	587	3.08	19543	0.93	12.3	50.2	603	-	0.578	-	-	-
DOH WATER QUALITY STANDARDS															
NOT TO EXCEED 10%				10.00	5.00				30.00	180.0	0.50		0.50		
NOT TO EXCEED 2%				20.00	9.00				45.00	250.0	1.00		1.00		

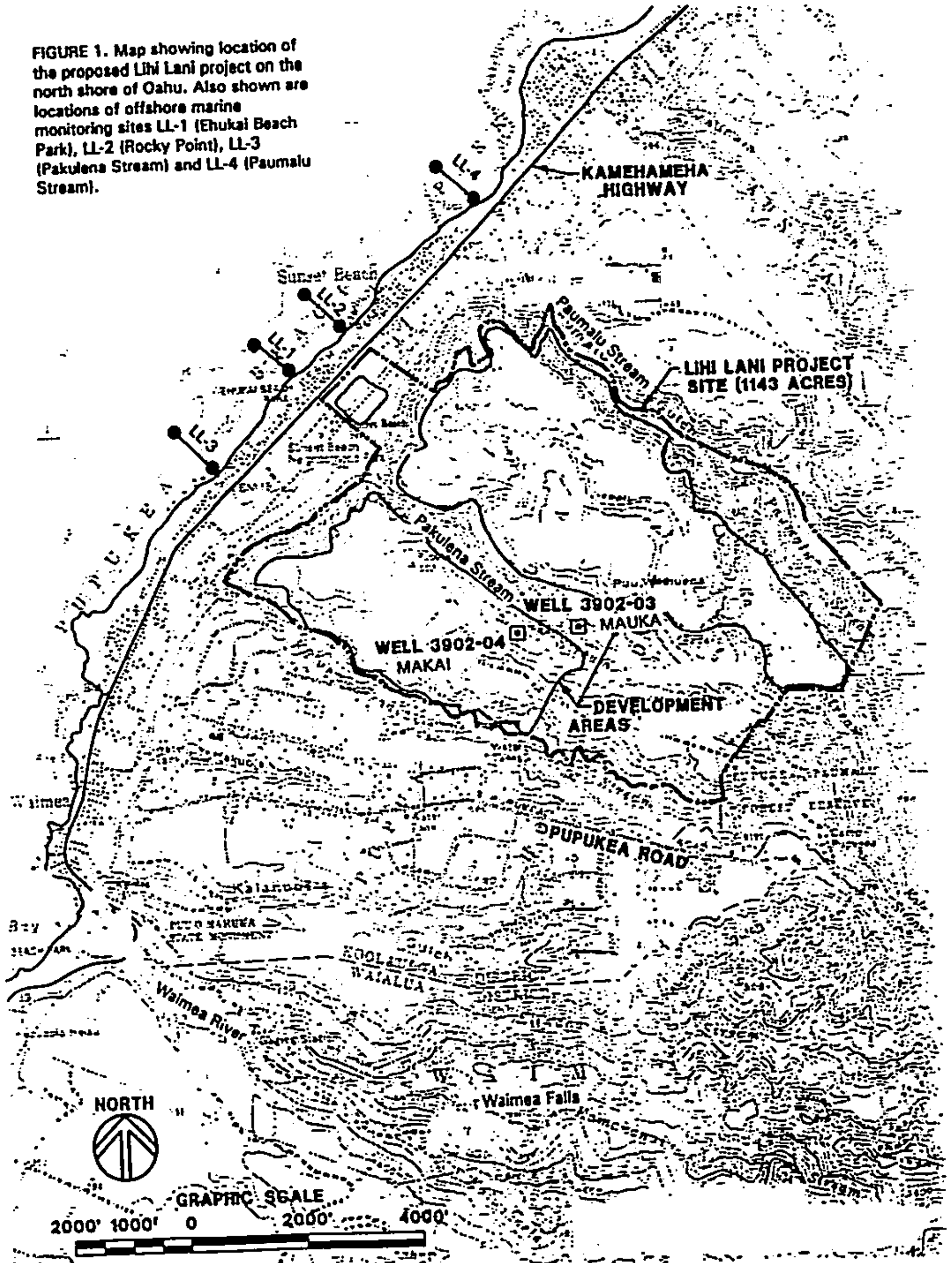
TABLE 3. Geometric mean data from water chemistry measurements off the Lihi Lani Recreational Community sites collected in December 1990, July 1991, July 1992 and August 1993. Abbreviations as follows: S=surface; D=deep; DFS=distance from shore. Measurements below detection limit were not included in mean calculations. Shaded values exceed DOH geometric mean criteria for open coastal waters under "dry" conditions. For sampling site locations, see Figure 1.

SITE	NO.	DFS (m)	PO4 (μM)	NO3 (μM)	NH4 (μM)	Si (μM)	DOP (μM)	DON (μM)	TDP (μM)	TDN (μM)	TURB (NTU)	SALINITY (o/oo)	CHL a (μg/L)	TEMP (deg.C)	pH
LL-1	1S	0	0.10	0.89	0.12	13.39	0.20	4.73	0.29	6.07	0.40	34.305	0.19	25.5	8.10
	2S	1	0.09	0.88	0.09	13.61	0.18	4.81	0.27	5.87	0.41	34.301	0.23	25.6	8.10
	3S	3	0.09	0.82	0.08	12.22	0.19	5.26	0.28	6.14	0.40	34.337	0.19	25.7	8.08
	3D	3	0.09	0.72	0.10	11.82	0.19	4.89	0.27	5.84	0.34	34.346	0.20	25.7	8.10
	4S	10	0.07	0.36	0.13	6.85	0.21	5.17	0.27	5.66	0.24	34.394	0.20	25.4	8.09
	4D	10	0.09	0.36	0.10	6.50	0.18	4.74	0.26	5.34	0.29	34.294	0.20	25.4	8.10
	5S	100	0.07	0.22	0.10	4.17	0.21	4.85	0.27	5.38	0.18	34.534	0.12	25.4	8.10
	5D	100	0.07	0.18	0.12	3.88	0.20	5.07	0.27	5.40	0.19	34.572	0.14	25.4	8.10
	6S	500	0.07	0.11	0.12	2.37	0.20	4.81	0.28	5.04	0.10	34.705	0.10	25.5	8.14
	6D	500	0.07	0.10	0.09	2.22	0.22	5.12	0.29	5.28	0.11	34.730	0.11	25.5	8.13
LL-2	1S	0	0.07	0.60	0.12	7.74	0.22	4.79	0.27	5.73	0.24	34.506	0.20	26.1	8.11
	2S	1	0.09	0.54	0.15	7.20	0.21	4.41	0.27	5.20	0.24	34.498	0.19	26.0	8.13
	3S	3	0.07	0.33	0.12	8.70	0.19	4.81	0.24	5.45	0.20	34.514	0.20	25.8	8.14
	3D	3	0.08	0.36	0.17	7.00	0.18	4.59	0.24	5.33	0.19	34.492	0.19	25.9	8.15
	4S	10	0.07	0.36	0.16	6.96	0.22	4.46	0.26	5.22	0.17	34.444	0.15	25.6	8.13
	4D	10	0.07	0.39	0.20	8.89	0.21	3.90	0.26	5.06	0.18	34.353	0.15	25.8	8.13
	5S	100	0.07	0.33	0.12	8.16	0.19	4.22	0.24	5.23	0.17	34.359	0.18	25.7	8.12
	5D	100	0.07	0.22	0.11	5.65	0.20	5.22	0.24	5.98	0.16	34.498	0.17	25.6	8.14
	6S	500	0.08	0.06	0.19	2.38	0.20	4.98	0.29	5.20	0.11	34.723	0.10	25.6	8.16
	6D	500	0.08	0.08	0.13	2.59	0.21	4.58	0.30	4.86	0.12	34.740	0.10	25.8	8.16
LL-3	1S	0	0.08	0.78	0.19	14.76	0.25	4.63	0.34	5.86	0.32	34.243	0.13	26.4	8.15
	2S	1	0.07	0.78	0.17	14.84	0.25	4.74	0.33	5.92	0.36	34.249	0.12	26.1	8.14
	3S	3	0.08	0.63	0.21	13.72	0.28	4.46	0.37	5.44	0.27	34.283	0.15	26.3	8.15
	3D	3	0.09	0.62	0.20	13.58	0.25	4.98	0.35	5.92	0.26	34.278	0.12	26.3	8.14
	4S	10	0.07	0.47	0.17	11.12	0.25	5.29	0.33	6.01	0.24	34.362	0.13	26.0	8.15
	4D	10	0.08	0.52	0.14	11.05	0.27	5.77	0.38	6.56	0.24	34.351	0.09	25.8	8.16
	5S	100	0.05	0.23	0.12	8.25	0.28	5.66	0.35	6.09	0.21	34.465	0.13	26.0	8.15
	5D	100	0.06	0.13	0.15	4.95	0.28	5.63	0.35	6.11	0.15	34.631	0.12	25.9	8.16
	6S	500	0.05	0.08	0.13	2.25	0.28	5.42	0.35	5.77	0.11	34.735	0.11	25.9	8.17
	6D	500	0.06	0.10	0.23	2.43	0.31	5.68	0.38	6.15	0.12	34.732	0.13	26.0	8.16
LL-4	1S	0	0.06	0.40	0.06	2.33	0.23	5.61	0.29	6.23	0.26	34.577	0.15	26.0	8.13
	2S	1	0.08	0.35	0.06	2.25	0.23	5.53	0.31	6.05	0.22	34.587	0.13	26.2	8.13
	3S	3	0.06	0.31	0.09	2.21	0.27	7.16	0.33	7.74	0.23	34.742	0.17	26.0	8.13
	3D	3	0.09	0.27	0.47	2.26	0.26	5.78	0.37	6.30	0.23	34.635	0.19	26.1	8.13
	4S	10	0.05	0.19	0.13	2.21	0.24	5.13	0.30	5.55	0.18	34.745	0.19	25.6	8.14
	4D	10	0.05	0.21	0.13	2.20	0.24	5.04	0.30	5.50	0.21	34.747	0.15	25.4	8.13
	5S	100	0.07	0.29	0.11	2.19	0.25	5.15	0.32	5.70	0.15	34.751	0.24	25.6	8.13
	5D	100	0.06	0.27	0.06	3.21	0.27	5.89	0.34	6.35	0.19	34.600	0.16	25.6	8.12
	6S	500	0.08	0.38	0.13	2.38	0.29	6.00	0.38	6.60	0.15	34.761	0.12	25.6	8.12
	6D	500	0.05	0.22	0.11	2.24	0.19	5.37	0.25	6.84	0.13	34.760	0.13	25.6	8.12
DOH WATER QUAL. STDS.				0.25	0.14				0.52	7.86	0.20		0.15		

TABLE 4. Geometric mean data (in μg/L) from water chemistry measurements off the Lihi Lani Recreational Community sites collected in December 1990, July 1991, July 1992 and August 1993. Abbreviations as follows: S=surface; D=deep; DFS=distance from shore. Measurements below detection limit were not included in mean calculations. Shaded values exceed DOH geometric mean criteria for open coastal waters under "dry" conditions. For sampling site locations, see Figure 1.

SITE	NO.	DFS (m)	PO4 (μg/L)	NO3 (μg/L)	NH4 (μg/L)	Si (μg/L)	DOP (μg/L)	DON (μg/L)	TDP (μg/L)	TDN (μg/L)	TURB (NTU)	SALINITY (o/oo)	CHL a (μg/L)	TEMP (deg.C)	pH
LL-1	1S	0	3.04	12.43	1.64	187.52	6.06	66.19	9.11	84.92	0.40	34.305	0.19	25.5	8.10
	2S	1	2.77	12.34	1.23	190.51	5.72	67.33	8.38	82.16	0.41	34.301	0.23	25.6	8.10
	3S	3	2.90	11.52	1.18	171.02	5.78	73.63	8.70	85.96	0.40	34.337	0.19	25.7	8.08
	3D	3	2.66	10.02	1.36	165.52	5.87	68.49	8.34	81.69	0.34	34.348	0.20	25.7	8.10
	4S	10	2.28	5.03	1.82	95.90	6.45	72.32	8.52	79.23	0.24	34.394	0.20	25.4	8.09
	4D	10	2.64	4.88	1.33	91.04	5.71	66.37	8.16	74.73	0.29	34.294	0.20	25.4	8.10
	5S	100	2.23	3.02	1.37	58.44	6.36	67.87	8.40	75.32	0.18	34.534	0.12	25.4	8.10
	5D	100	2.23	2.49	1.66	54.34	6.08	71.04	8.43	75.61	0.19	34.572	0.14	25.4	8.10
	6S	500	2.24	1.51	1.63	33.24	6.27	67.35	8.57	70.51	0.10	34.705	0.10	25.5	8.14
	6D	500	2.16	1.43	1.20	31.11	6.91	71.70	9.10	73.91	0.11	34.730	0.11	25.5	8.13
LL-2	1S	0	2.18	8.47	1.69	216.60	6.72	67.09	8.47	80.26	0.24	34.506	0.20	26.1	8.11
	2S	1	2.72	7.61	2.07	201.61	6.36	61.70	8.39	72.85	0.24	34.498	0.19	26.0	8.13
	3S	3	2.02	4.64	1.71	187.55	5.93	67.31	7.52	76.33	0.20	34.514	0.20	25.8	8.14
	3D	3	2.49	5.11	2.36	196.11	5.59	64.26	7.53	74.64	0.19	34.492	0.19	25.9	8.16
	4S	10	2.28	5.03	2.20	194.76	6.68	62.49	8.03	73.07	0.17	34.444	0.15	25.6	8.13
	4D	10	2.17	5.48	2.79	249.01	6.41	54.54	8.13	70.86	0.18	34.353	0.15	25.8	8.13
	5S	100	2.23	4.66	1.71	228.57	5.95	59.09	7.30	73.19	0.17	34.359	0.18	25.7	8.12
	5D	100	2.23	3.09	1.58	158.25	6.24	73.14	7.44	83.76	0.16	34.498	0.17	25.6	8.14
	6S	500	2.43	0.82	2.67	66.50	6.28	69.76	8.87	72.77	0.11	34.723	0.10	25.6	8.16
	6D	500	2.56	1.08	1.84	72.54	6.49	64.16	9.25	68.01	0.12	34.740	0.10	25.8	8.16
LL-3	1S	0	2.48	10.94	2.73	413.16	7.87	64.83	10.68	82.02	0.32	34.243	0.13	26.4	8.15
	2S	1	2.32	10.98	2.38	415.44	7.83	66.30	10.37	82.94	0.36	34.249	0.12	26.1	8.14
	3S	3	2.69	8.79	2.97	384.22	8.66	62.46	11.45	76.16	0.27	34.283	0.15	26.3	8.16
	3D	3	2.86	8.72	2.83	380.20	7.65	69.71	10.72	82.89	0.26	34.278	0.12	26.3	8.14
	4S	10	2.24	6.53	2.34	311.47	7.74	74.03	10.24	84.18	0.24	34.362	0.13	26.0	8.16
	4D	10	2.40	7.23	2.03	309.39	8.52	80.75	11.83	91.90	0.24	34.351	0.09	25.8	8.16
	5S	100	1.45	3.27	1.74	231.14	8.83	79.31	10.78	85.21	0.21	34.465	0.13	26.0	8.15
	5D	100	1.86	1.81	2.17	138.61	8.67	78.86	10.87	85.48	0.15	34.631	0.12	25.9	8.16
	6S	500	1.70	1.08	1.81	62.98	8.82	75.91	10.74	80.80	0.11	34.735	0.11	25.9	8.17
	6D	500	1.78	1.41	3.16	67.99	9.60	79.52	11.74	86.06	0.12	34.732	0.13	26.0	8.16
LL-4	1S	0	2.01	5.60	0.90	65.22	7.10	78.52	9.11	87.19	0.26	34.577	0.15	26.0	8.13
	2S	1	2.40	4.90	0.78	63.08	7.27	77.41	9.70	84.76	0.22	34.587	0.13	26.2	8.13
	3S	3	2.01	4.28	1.20	61.74	8.35	100.25	10.37	108.36	0.23	34.742	0.17	26.0	8.13
	3D	3	2.94	3.76	6.58	63.40	8.20	80.89	11.43	88.27	0.23	34.636	0.19	26.1	8.13
	4S	10	1.70	2.69	1.77	62.00	7.52	71.75	9.30	77.69	0.18	34.745	0.19	25.6	8.14
	4D	10	1.52	2.96	1.81	61.63	7.52	70.61	9.17	77.03	0.21	34.747	0.15	25.4	8.13
	5S	100	2.28	4.11	1.61	61.32	7.72	72.16	10.00	79.74	0.15	34.751	0.24	25.6	8.13
	5D	100	2.01	3.80	0.79	89.96	8.46	82.49	10.47	88.98	0.19	34.600	0.16	25.6	8.12
	6S	500	2.69	5.31	1.85	66.58	9.14	84.01	11.76	92.36	0.15	34.761	0.12	25.6	8.12
	6D	500	1.70	3.10	1.55	62.70	5.91	75.17	7.76	81.78	0.13	34.760	0.13	25.6	8.12
DOH WATER QUAL. STDS.				3.50	2.00				16.00	110.00	0.20		0.15		

FIGURE 1. Map showing location of the proposed Lihi Lani project on the north shore of Oahu. Also shown are locations of offshore marine monitoring sites LL-1 (Ehukai Beach Park), LL-2 (Rocky Point), LL-3 (Pakulena Stream) and LL-4 (Paumalu Stream).



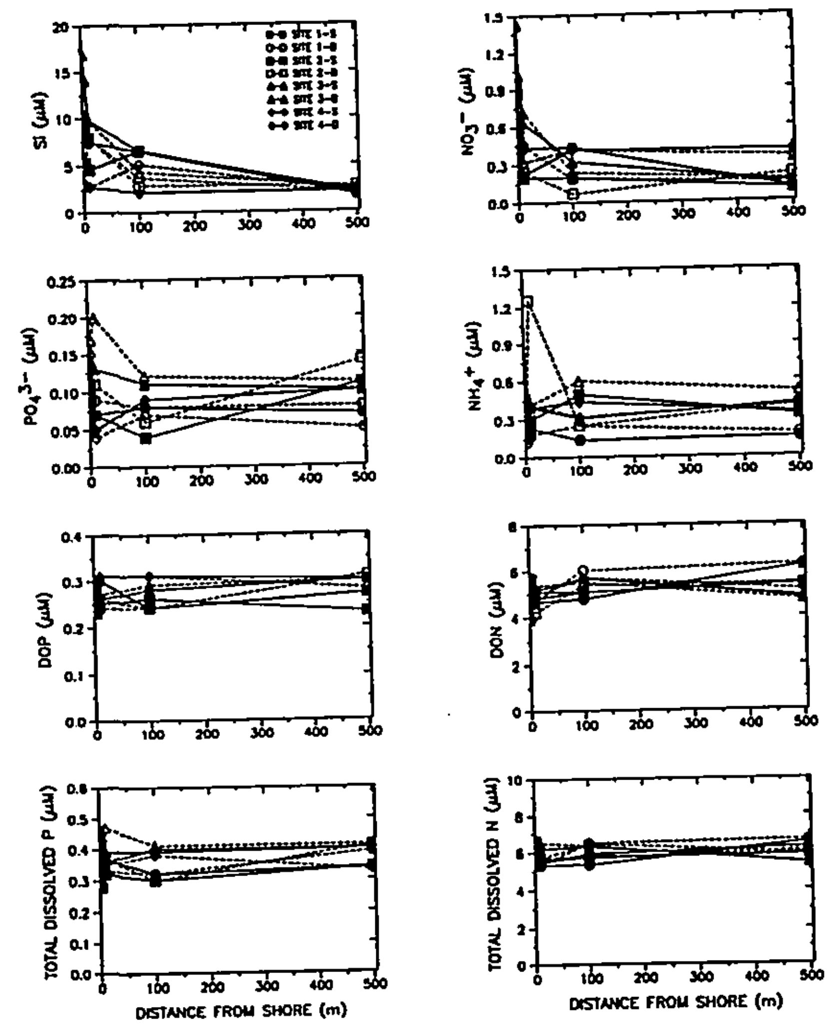


FIGURE 2. Plots of dissolved nutrient constituents collected from surface (S) and deep (D) samples off the Lihi Lani Recreational Community site in August 1993 as functions of distance from shore on sampling transects shown in Figure 1.

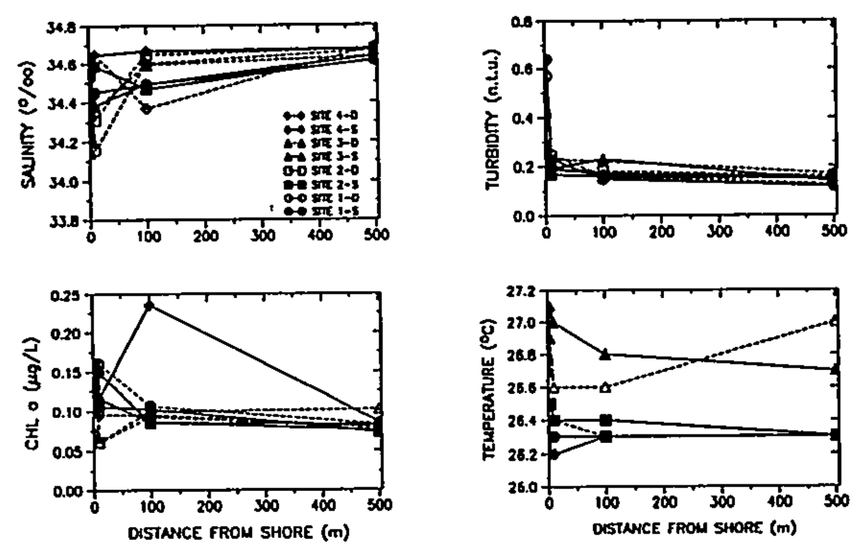


FIGURE 3. Plots of water chemistry constituents collected from surface (S) and deep (D) samples off the Lihi Lani Recreational Community site in August 1993 as functions of distance from shore on sampling transects shown in Figure 1.

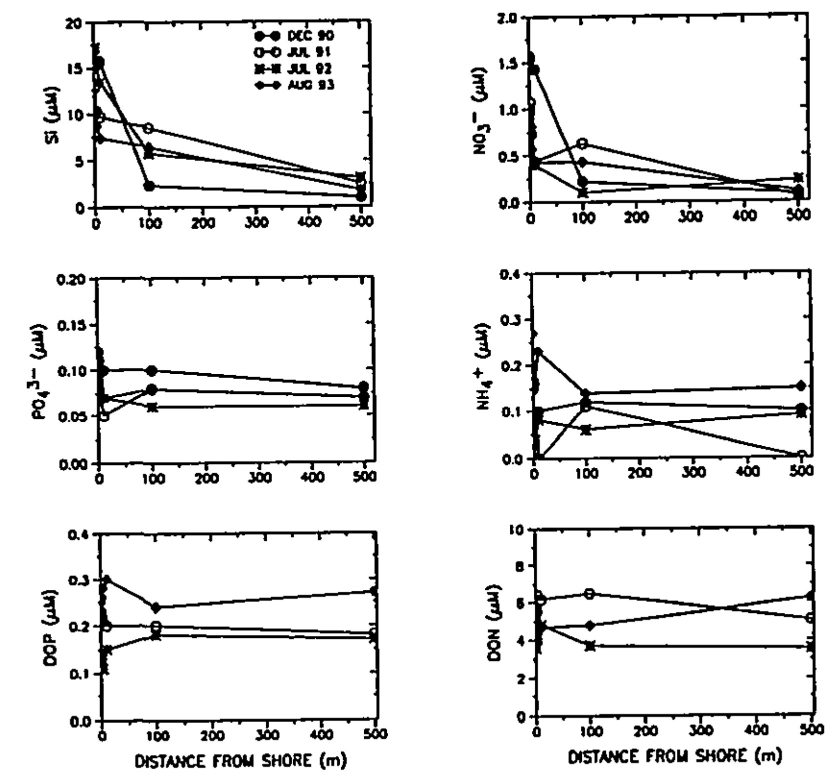


FIGURE 4. Plots of dissolved nutrient constituents in surface samples collected in December 1990, July 1991 and 1992 and August 1993 at Site 1 off the Lihi Lani Recreational Community development as functions of distance from shore. For location of Site 1, see Figure 1.

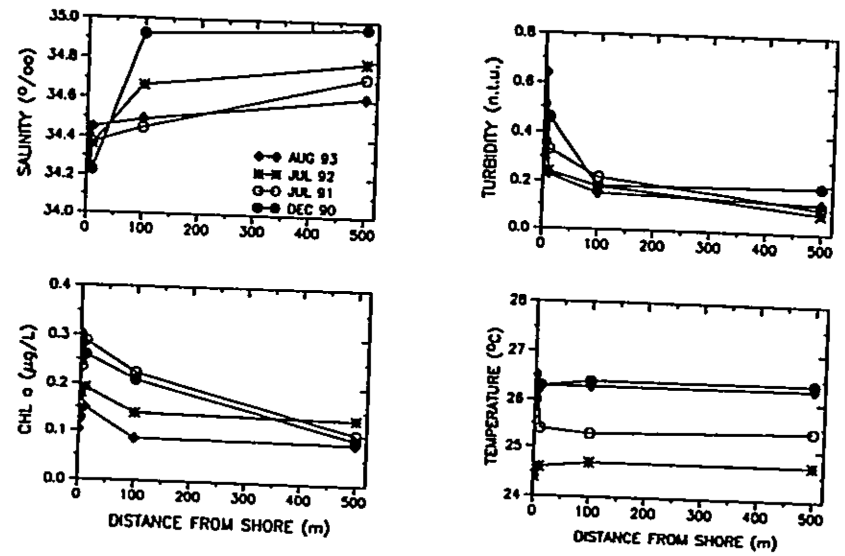


FIGURE 5. Plots of water chemistry constituents in surface samples collected in December 1990, July 1991 and 1992 and August 1993 at Site 1 off the Lihi Lani Recreational Community development as functions of distance from shore. For location of Site 1, see Figure 1.

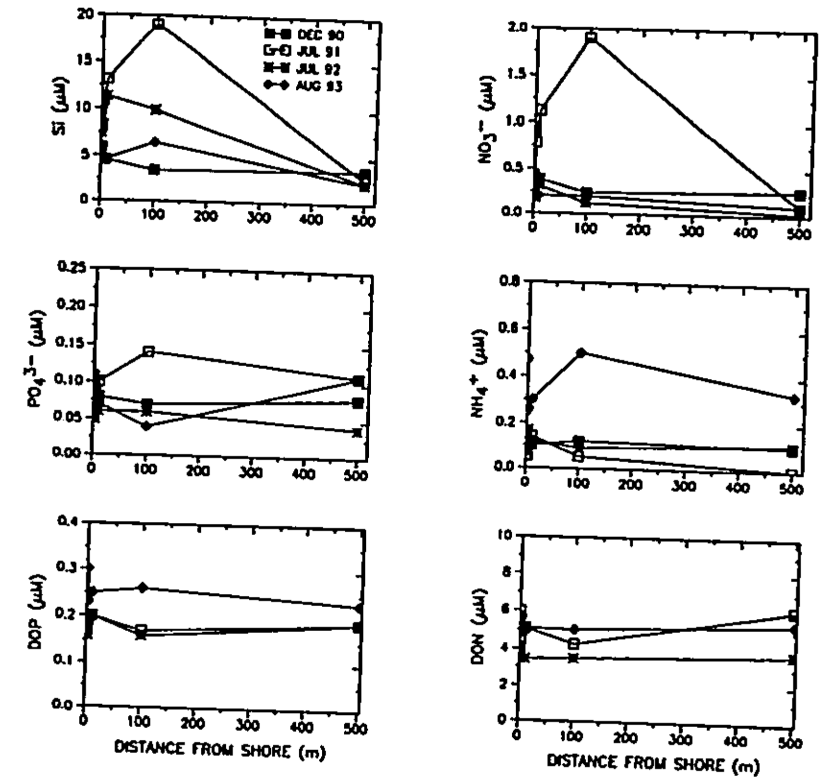


FIGURE 6. Plots of dissolved nutrient constituents in surface samples collected in December 1990, July 1991 and 1992 and August 1993 at Site 2 off the Lihi Lani Recreational Community development as functions of distance from shore. For location of Site 2, see Figure 1.

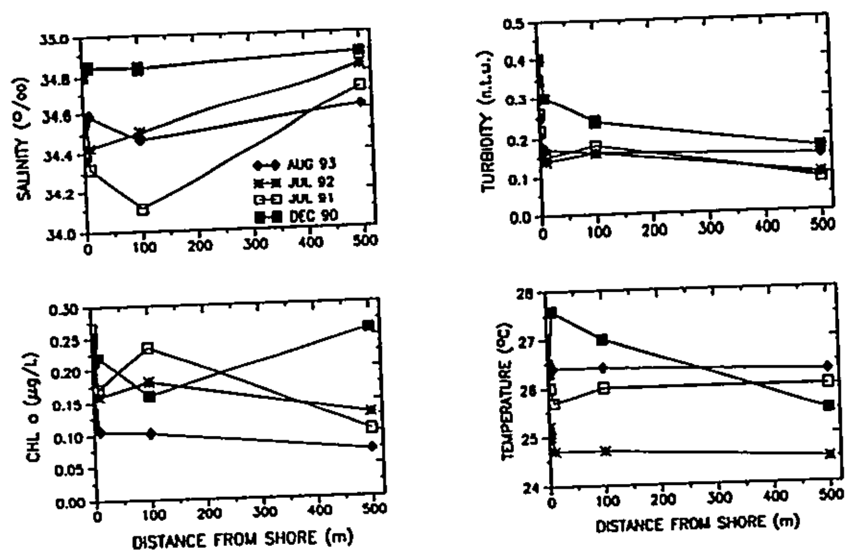


FIGURE 7. Plots of water chemistry constituents in surface samples collected in December 1990, July 1991 and 1992 and August 1993 at Site 2 off the Lihi Lani Recreational Community development as functions of distance from shore. For location of Site 2, see Figure 1.

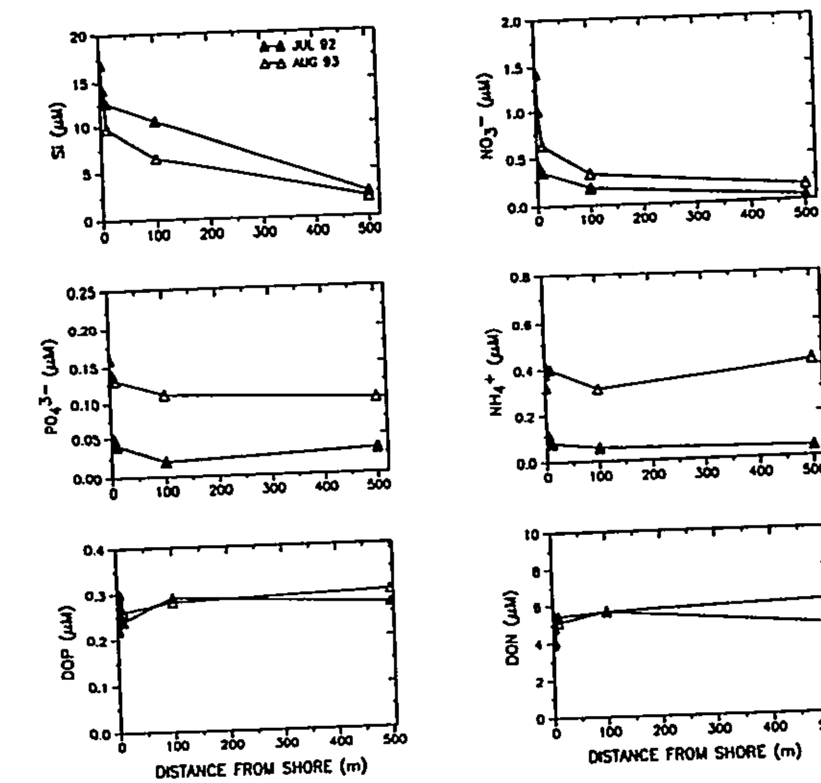


FIGURE 8. Plots of dissolved nutrient constituents in surface samples collected in December 1990, July 1991 and 1992 and August 1993 at Site 3 off the Lihi Lani Recreational Community development as functions of distance from shore. For location of Site 3, see Figure 1.

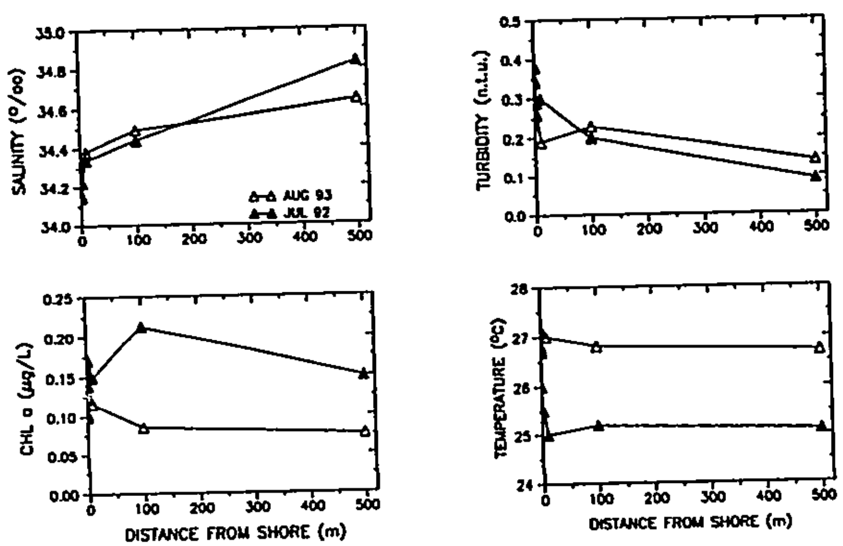


FIGURE 9. Plots of water chemistry constituents in surface samples collected in December 1990, July 1991 and 1992 and August 1993 at Site 3 off the Lihi Lani Recreational Community development as functions of distance from shore. For location of Site 3, see Figure 1.

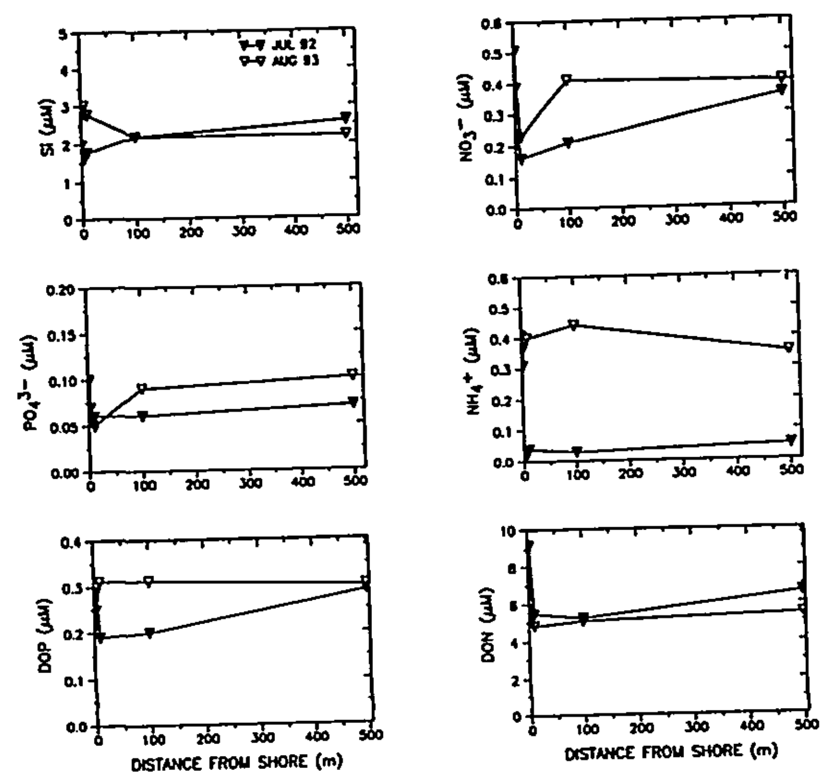


FIGURE 10. Plots of dissolved nutrient constituents in surface samples collected in December 1990, July 1991 and 1992 and August 1993 at Site 4 off the Lihi Lani Recreational Community development as functions of distance from shore. For location of Site 4, see Figure 1.

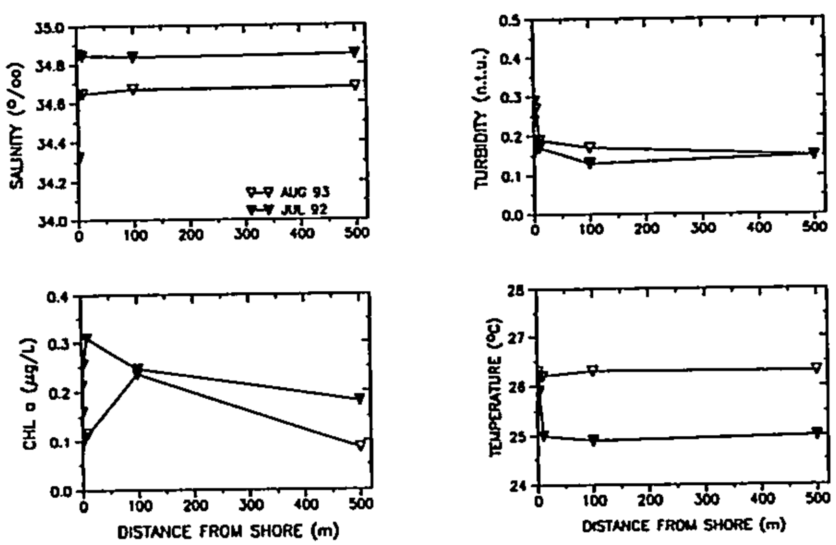


FIGURE 11. Plots of water chemistry constituents in surface samples collected in December 1990, July 1991 and 1992 and August 1993 at Site 4 off the Lihi Lani Recreational Community development as functions of distance from shore. For location of Site 4, see Figure 1.

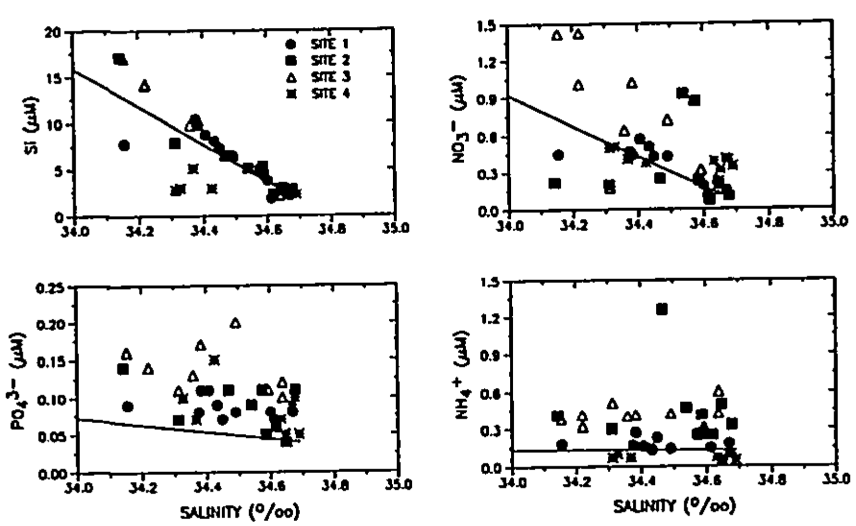


Figure 12. Plots of dissolved nutrients from water samples collected at four sites off the Lihi Lani Recreational Community development in August 1993 as functions of salinity. Solid line is the conservative mixing line constructed by connecting endpoint concentrations of open ocean water and well water. For site locations, see Figure 1.

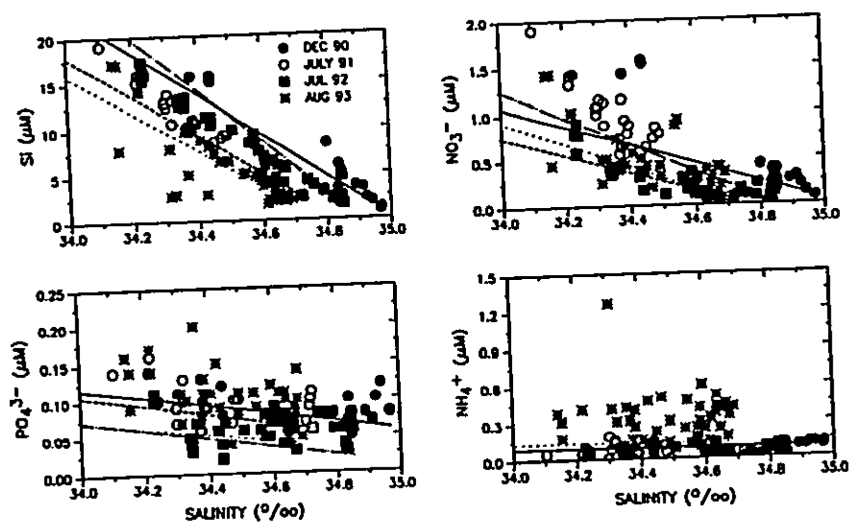


Figure 13. Plots of dissolved nutrients from water samples collected at all sites off the Lihi Lani Recreational Community development during December 1990, July 1991 and 1992 and August 1993 as functions of salinity. Conservative mixing lines are constructed by connecting endpoint concentrations of open ocean water and well water for December 1990 (solid line), July 1991 (dashed line), July 1992 (dash/dotted line) and August 1993 (dotted line).

APPENDIX J

Traffic Impact
Assessment Report

TRAFFIC IMPACT ASSESSMENT REPORT

FOR

LIHI LANI

Pupukea, Oahu, Hawaii
TMK 5-9-05: 38 and 5-9-06: 18 & 24

September 1993

Prepared for:

Obayashi Hawaii Corporation

Prepared by:

Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
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TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

FOREWORD

The traffic forecasts shown within this report's figures and tables are the direct result of Pacific Planning & Engineering, Inc.'s proprietary analytical tools. For report editing and review purposes, the forecast values have been rounded to the nearest five vehicles from our mathematical results, although we do not imply this level of accuracy can exist in any forecast method. The rounded values, however, reasonably quantify the forecasted traffic volumes for the purposes of this study.

EXECUTIVE SUMMARY

Pacific Planning & Engineering, Inc. (PPE) was engaged to undertake a study to identify and assess the expected traffic impacts which would be caused by the proposed Lihi Lani project. This report identifies and evaluates the probable impact of traffic generated by the proposed development for study years 2002 and 2008.

Project Description

The Obayashi Hawaii Corporation is proposing to develop the Lihi Lani project in Pupukea on the island of Oahu. The development will be located on approximately 1,144 acres of land.

The project will be a low-density residential community consisting of single-family units, elderly multi-family units, a horse ranch with pasture, campground, agricultural uses, and community facilities. The project will be developed in four residential build-out phases. Phases I and II are assumed to be completed by the year 2002 and will consist of single and multi-family residential units, horse ranch, agricultural, and community facilities. Phases III and IV are assumed to be completed by the year 2008 and will provide additional residential units and agricultural uses.

Methodology

Analysis was conducted at the following locations to determine the relative impact of the proposed project on the local roadway system:

- Intersection of Kamehameha Highway & project access road,
- Intersection of Kamehameha Highway & Sunset Beach Elementary School driveway,

- Intersection of Kamehameha Highway and Pupukea Road,
- Segment of Kamehameha Highway near Haleiwa Beach Park,
- Segment of Kamehameha Highway near the Kahuku Sugar Mill.

Future traffic was forecasted at the study intersections for the years 2002 and 2008 by adding the following:

- Existing traffic volumes,
- The increase in through-traffic along Kamehameha Highway,
- Traffic generated by other planned developments in the nearby area that would impact the study intersections, and
- Traffic generated by the proposed Lihi Lani project.

The report assesses the impact on each intersection and roadway segment by determining the level-of-service (LOS) for existing, future without project, and future with project traffic conditions for the years 2002 (Phases I/II) and 2008 (Phase III/IV).

Conclusions & Recommendations

The proposed Lihi Lani project would have a small impact on traffic conditions along Kamehameha Highway and the study intersections, when the project is scheduled to be completed in year 2002 for Phases I & II and year 2008 for Phases III & IV. A summary of the analysis findings for present and future (Years 2002 and 2008) conditions are described below.

Existing 1993 Traffic Conditions

Presently, the results of the analysis indicate that Kamehameha Highway generally operates at an average travel speed of 35-40 miles per hour (LOS D and E) at the study locations during the weekday peak hours.

According to the two-lane rural highway analysis in the Highway Capacity Manual, the maximum attainable level-of-service along Kamehameha Highway at the study locations is LOS D due to the speed limit and geometric configurations. During the weekend peak hour, however, Kamehameha Highway traffic at Haleiwa Beach Park is congested (LOS F) and traffic backs up from the Anahulu Bridge in Haleiwa. Traffic is congested at certain locations along Kamehameha Highway due to various contributing factors, such as:

- Recreational traffic due to Oahu residents and visitors sightseeing and going to beaches along the North Shore,
- Traffic bottlenecks, such as drivers parking along Kamehameha Highway at surfing locations and driving through Haleiwa town,
- Drivers slow down along Kamehameha Highway to watch the surf,
- Slow moving construction traffic, delivery and military vehicles, and
- Local travel by residents living near project area going to and from Haleiwa and other areas for various activities.

Year 2002 Traffic Conditions

By the year 2002 without the proposed Lihi Lani project, traffic conditions along Kamehameha Highway in Haleiwa are expected to improve, due to the completion of the Haleiwa Bypass Road. The LOS for motorists at the study locations are expected to operate with very long delays and slower speeds (LOS E and LOS F). Improvements such as traffic signalization and separate turn lanes may reduce delays for minor street traffic at the study intersections.

With the project in the year 2002, the LOS at the study locations and intersections would not change significantly from the year 2002 without

project conditions. The project would access Kamehameha Highway via the proposed project access road. The following improvements are recommended at the new intersection of Kamehameha Highway and the project access road:

- Provide a left-turn storage lane along Kamehameha Highway for Haleiwa-bound left-turns into the project. The left-turn storage lane would alleviate possible delays or back-ups along Kamehameha Highway caused by vehicles turning into the project. This should also minimize rear-end collisions between through-traffic and vehicles slowing down or stopping to turn left into the project.

- Provide separate right and left-turn lanes for the makai-bound project access road. This will permit left turning vehicles to exit the project without creating unnecessary delays for drivers turning right onto Kamehameha Highway.

Year 2008 Traffic Conditions

In the year 2008 without the proposed Lihi Lani project, traffic conditions along Kamehameha Highway and at the study intersections are expected to worsen due to the projected increase in traffic volumes. Motorists exiting minor streets at the study intersections are expected to experience very long delays (LOS F). If the projected traffic volumes are realized by the year 2008, then additional laneage may be needed along with the year 2002 improvements at the study intersections.

With the project in year 2008, the LOS at the study locations and intersections along Kamehameha Highway is not expected to change significantly from the year 2008 without project condition. The intersections are expected to continue operating with long delays (LOS F) to minor street traffic. No additional improvements would be needed to accommodate the project traffic in the year 2008.

Construction-Related Traffic

Our preliminary review of proposed construction activities near the proposed project indicate that construction truck traffic will have minimal impact on traffic along Kamehameha Highway. A maximum of 10 vehicles is estimated to impact the study intersections and roadway segments during the weekday peak hours due to construction activities.

Traffic Contribution from Developments

The percentage of total traffic which is contributed from the Lihi Lani project and other future developments is shown in the following table for the weekday and weekend peak hours. The percentages were calculated using the years 2002 and 2008 forecasted traffic volumes at a section of Kamehameha Highway approaching the Pupukea Road intersection. The calculated percentage for Kamehameha Highway includes 1993 existing traffic plus the increase in through-traffic along Kamehameha Highway.

The major contributors to traffic congestion on Kamehameha Highway in the years 2002 and 2008 would be island-wide traffic growth, other developments, and local resident highway traffic. The Lihi Lani project contributes about 5 to 8% of the total traffic to Kamehameha Highway in the years 2002 and 2008. The market-priced residential units within Lihilani would be attributable for approximately 3 to 5% of the total Kamehameha Highway traffic volumes.

Summary of Traffic Contribution along Kamehameha Highway
for Years 2002 & 2008

Phases I & II - Year 2002:

Development	Morning Peak Hour Percentage	Afternoon Peak Hour Percentage	Sunday Peak Hour Percentage
Lihi Lani Project			
Market Housing	2.2%	2.9%	2.0%
Affordable Housing	0.9%	1.3%	1.7%
YMCA	0.9%	2.2%	1.0%
Ranch Facilities	0.8%	0.8%	0.5%
Lihi Lani Subtotal	4.8%	7.2%	5.2%
Kamehameha Hwy.	45.6%	51.0%	57.5%
Other Regional Developments*	49.6%	41.8%	37.3%
Total Percentage	100.0%	100.0%	100.0%

Phases III & IV - Year 2008:

Development	Morning Peak Hour Percentage	Afternoon Peak Hour Percentage	Sunday Peak Hour Percentage
Lihi Lani Project			
Market Housing	3.4%	4.7%	3.3%
Affordable Housing	0.8%	1.1%	1.4%
YMCA	0.7%	1.8%	0.8%
Ranch Facilities	0.6%	0.6%	0.5%
Lihi Lani Subtotal	5.5%	8.2%	6.0%
Kamehameha Hwy.	36.7%	42.6%	49.3%
Other Regional Developments*	57.8%	49.2%	44.7%
Total Percentage	100.0%	100.0%	100.0%

Note: * - Includes Kahuku Villages, Laie Developments, Kuilima Resort Expansion, and Pupukea Shopping Village

The traffic volumes forecasted for years 2002 and 2008 are estimated projections based on future developments planned for the North Shore area and future growth along Kamehameha Highway. The forecasts were based on estimated time schedules from developers for different projects in the area. The actual time schedules for the projects are subject to changes in the economy and market and these factors are difficult to anticipate at this time. If the planned projects are not developed according to their anticipated schedules, then the traffic volumes along the highway and proposed roadway improvements could differ from the findings described in this study.

Overall, the increase of through traffic volumes along Kamehameha Highway will likely create the need for improvements to the existing roadway facilities by the years 2002 and 2008. These improvements, with the exception of the project access road, would be needed with or without the proposed Lihi Lani project.

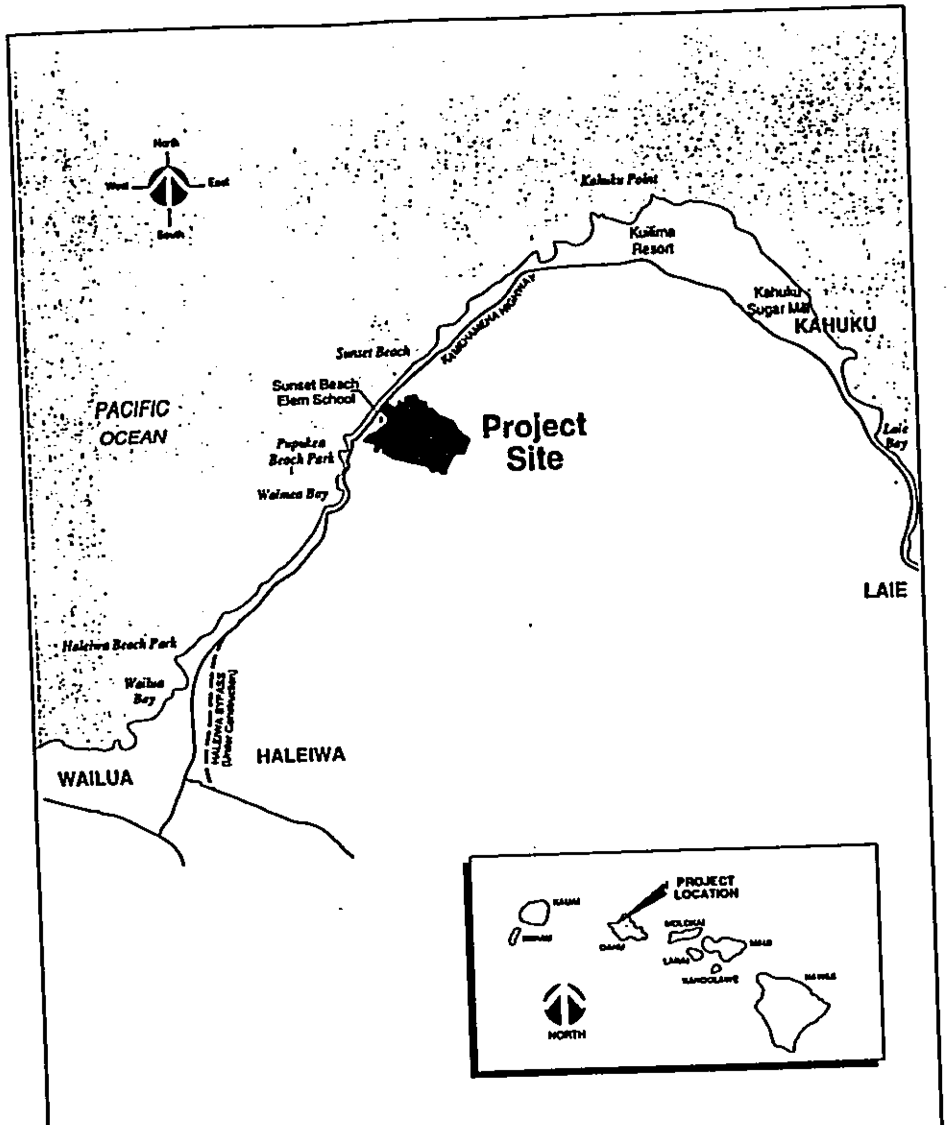
PROJECT DESCRIPTION

The Obayashi Hawaii Corporation is proposing to develop the Lihi Lani project in Pupukea on the island of Oahu. Figure 1 shows the location of the project site and the surrounding roadway network. The development will be located on approximately 1,144 acres of land presently zoned for residential and agricultural use.

The project will be a residential community consisting of single-family residential units, multi-family elderly housing, horse ranch with pasture, campground, agricultural land, and community facilities. Table 1 provides a breakdown of the various land uses for the project. The site plan for the proposed project is shown on Figure 2. The project will be developed in four residential build-out phases. Phases I and II are expected to be completed and occupied by year 2002 and Phases III and IV by year 2008.

Table 1. Project Land Uses

Description of Land Use	Amount	Units
Phases I and II (Year 2002)		
Market Lots	160	residential lots
Affordable Homes	50	dwelling units
Elderly Housing	80	dwelling units
Farm/Orchards	388	acres
Campground	4	acres
Horse Stables/Ranch	6	acres
Community Facilities	6.3	acres
Phases III and IV (Year 2008)		
Market Lots	155	residential lots



PACIFIC PLANNING
Project Location Map
Figure 1

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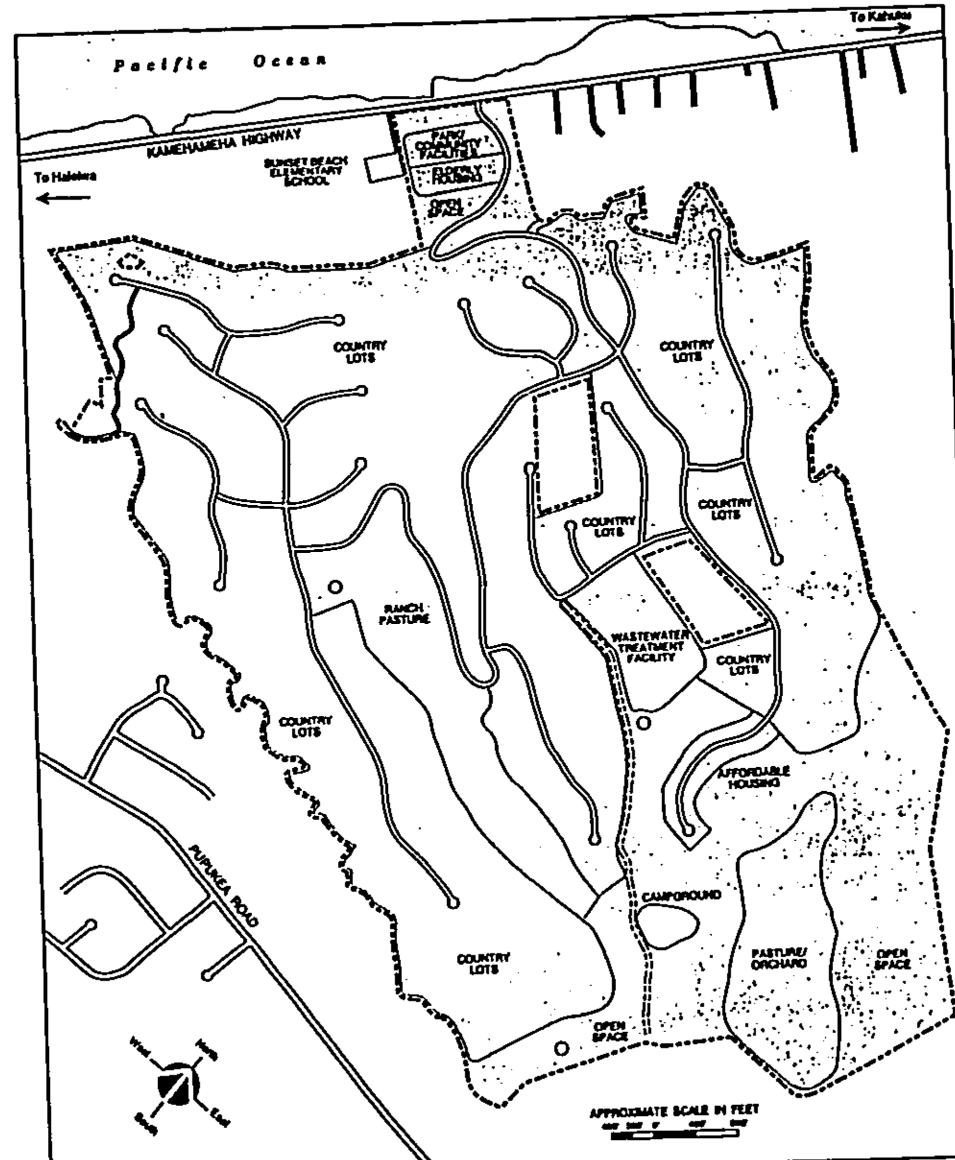


PACIFIC PLANNING ENGINEERING, INC
Site Plan
Figure 2

-10-

The project will include single-family residential units in the affordable price range and houselots in market price range. The affordable residential dwelling units are expected to be constructed by the year 2002 and occupied by full-time residents only. The market houselots will be sold individually with completion of sales projected by year 2008; the time frame for construction and occupancy of the market dwelling units would be expected to vary according to the desires of the individual buyers. The market units are expected to be occupied by full-time residents, as well as part-time residents using them as second homes.

The project will also include elderly affordable rental units, which will be jointly developed with the City Department of Housing and Community Development (DHCD). The multi-family units will be constructed and managed by DHCD and are expected to be completed and fully occupied by year 2002.

Recreational uses within the project include the horse ranch and the community facility. The ranch will provide stalls for approximately 100 horses and the campground will serve 30 to 40 persons on weekends. The community facility will be jointly developed with the YMCA organization; various amenities, such as a soccer field, swimming pool, meeting and exercise rooms may be included. Completion of the ranch and community facilities is expected to occur by the year 2002.

Vehicular access to and from the proposed development will be from Kamehameha Highway. A privately owned project access road will connect to Kamehameha Highway in a new T-intersection, located approximately 900 feet west of the Sunset Elementary School driveway. This project road will provide vehicular access into the project site and also provide circulation within the recreational community.

EXISTING CONDITIONS

An inventory of existing conditions was conducted to ascertain the current traffic conditions in the area and to provide a basis for estimating the potential traffic impact of the proposed project. The review included the land uses in the area, roadway facilities, and existing traffic conditions.

Land Uses

The existing land uses surrounding the project site are generally residential, recreational and agricultural. Kamehameha Highway, Sunset Beach Elementary School and Neighborhood Park border the makai side of the project site, with residential housing and beach parks, including Ehukai Beach Park, located across (makai of) the highway. Residential housing and the Comsat facility are located in the Kahuku direction. In the Haleiwa direction, there are residential developments located adjacent to the project site.

The North Shore of Oahu has many recreational areas. The area is known for its spectacular surf during the winter months and calm scenic beaches during the summer months. Haleiwa town is a tourist attraction popular for its "plantation" appeal. North of the project are attractions such as the Polynesian Cultural Center in Laie and the Kuilima Resort.

Roadway Facilities

Kamehameha Highway is the only major roadway facility located in this area connecting population centers along the North Shore. Kamehameha Highway is the main arterial which travels along the coastline and carries through traffic to the rest of Oahu.

Streets

Kamehameha Highway is a State-maintained highway with a 50-foot wide right-of-way and a 22-foot wide pavement. There is a 11-foot wide lane provided for vehicles traveling in each direction. The shoulders are grassed, and vehicles park along both sides of the road especially near beach parks. The posted speed limit along Kamehameha Highway is 45 miles per hour (mph) near the project site. In the vicinity of Sunset Beach Elementary School, the posted speed limit is lowered to 25 mph when indicated by flashing yellow lights.

Study Intersections

The intersection of Kamehameha Highway with Sunset Beach Elementary School driveway is the nearest existing intersection to the project site. The school driveway is not marked, but is wide enough to permit separate lanes for left and right turn movements onto Kamehameha Highway.

The intersection of Kamehameha Highway with Pupukea Road operates as a cross-intersection with a beach park driveway providing the makai leg of the intersection. Pupukea Road has an exclusive left-turn lane and a shared through/right-turn lane on its approach to the Kamehameha Highway intersection.

Traffic Conditions

A review of 1992 State Department of Transportation (DOT) traffic count data indicated that the weekday commuter peak hours along Kamehameha Highway in the vicinity of the project generally occur between 6:00 to 8:30 in

the morning and 3:00 to 5:30 in the afternoon. The weekend peak period was determined based upon discussions with community representatives and generally occurs between 1:00 and 4:00 p.m. on Sunday.

Manual traffic counts were taken during the weekday morning, afternoon, and weekend peak hours at the following locations and intersections:

- Intersection of Kamehameha Highway with Sunset Beach Elementary School driveway.
- Intersection of Kamehameha Highway with Pupukea Road.
- Kamehameha Highway near Haleiwa Beach Park.
- Kamehameha Highway near the Kahuku Sugar Mill.

The traffic counts were taken in March 1993 at the study intersections during the weekday morning and afternoon, and Sunday peak hours. Traffic counts at the intersection of Kamehameha Highway and Sunset Beach Elementary School were also taken during school peak hours, which differ slightly from normal weekday peak hours. These counts were used as the baseline condition upon which future estimated traffic volumes were added.

During the counts the weather was sunny and clear. The Sunday count was taken on the day of a surf meet at Ehukai Beach, which attracts surfers and sightseers. Sunset Beach Elementary School was closed on the weekend, but the school parking lot was used as additional parking for Ehukai Beach Park, located directly across Kamehameha Highway.

Figures 3, 4, and 5 show the existing volumes of traffic at the study intersections during the observed weekday and weekend peak hours. The manual traffic count data are summarized in Appendix B.

Observed Traffic Conditions

The following observations were made during the field surveys:

Along Kamehameha Highway between Haleiwa and Kahuku:

On the weekdays:

- There were a large number of trucks on Kamehameha Highway due to ongoing construction of the Haleiwa Bypass Road.

On the weekend:

- Large numbers of cars parked along both shoulders of the highway at various surf spots such as Waimea Bay, Sunset Beach and Ehukai Beach Park.
- Bottlenecks occurred at surf spots due to parking maneuvers and drivers slowing down to observe beach activities.
- A traffic bottleneck occurred at Haleiwa due to the narrow Anahulu Bridge, commercial activities along the highway, and visitor-related traffic.

At the Pupukea Road and Kamehameha Highway Intersection:

During the weekdays:

- Delivery trucks at Foodland would block traffic temporarily when they made turning maneuvers into the driveway.
- Vehicles entering and exiting Foodland would sometimes slow the flow of traffic on Kamehameha Highway.

On the weekdays and weekend:

- Drivers would drive along the shoulder to pass vehicles waiting to execute left turns from Kamehameha Highway into Pupukea Road.

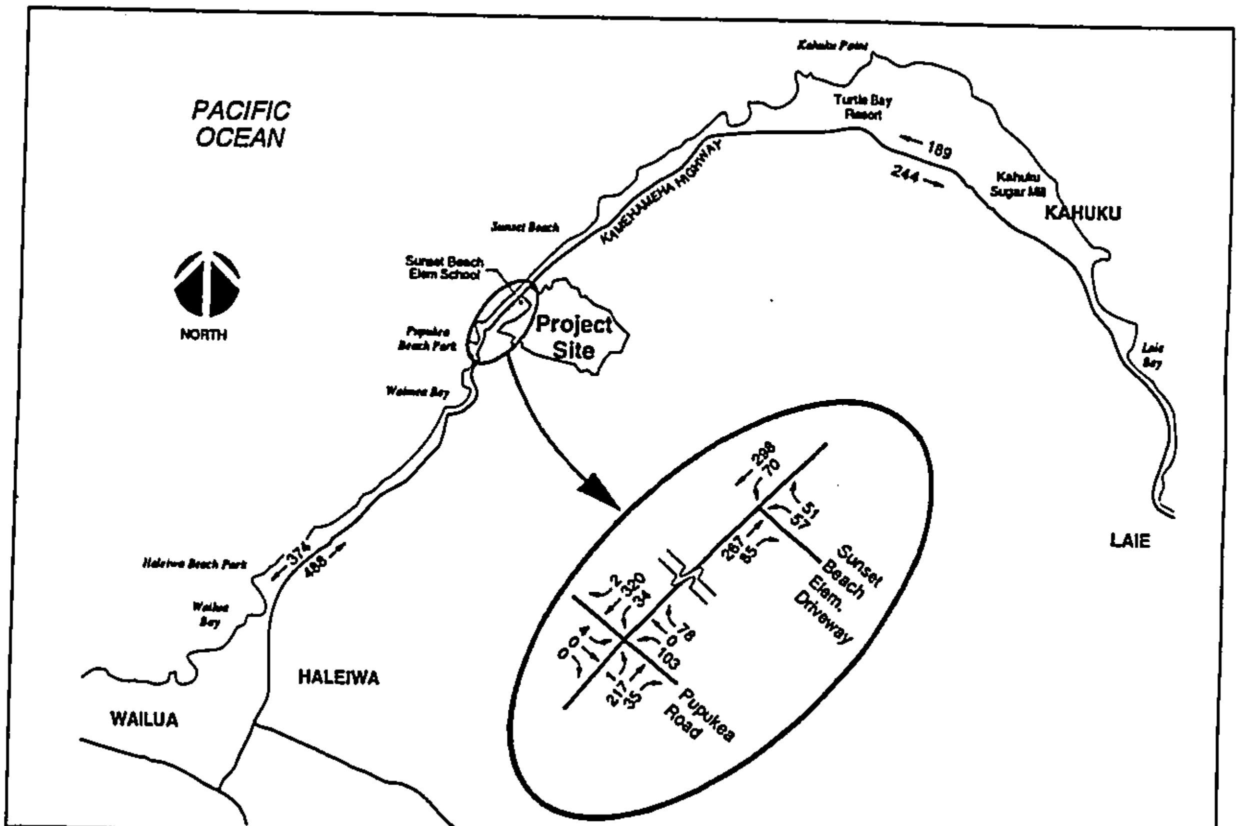
At the Sunset Beach Elementary Driveway and Kamehameha Highway Intersection:

During the weekday morning and afternoon peak hours:

- Several drivers drop-off and pick-up their children along Kamehameha Highway before and after school.
- Many cars park along the shoulders of the highway in the afternoon due to recreational activities at the beach park and at the school (soccer practice).

During the weekend:

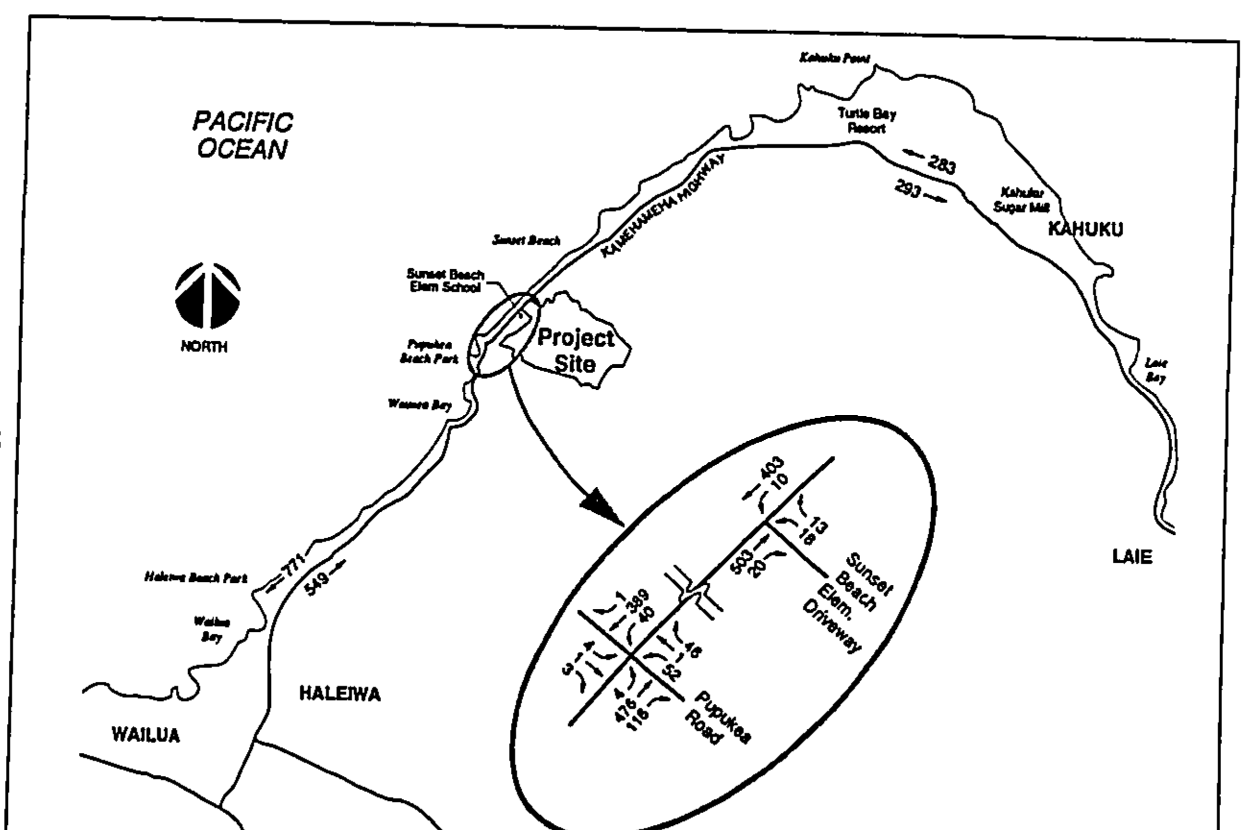
- Large number of cars park along the shoulder of the highway near the vicinity of the intersection.



PACIFIC PLANNING

Existing Weekday Morning Peak Hour Traffic

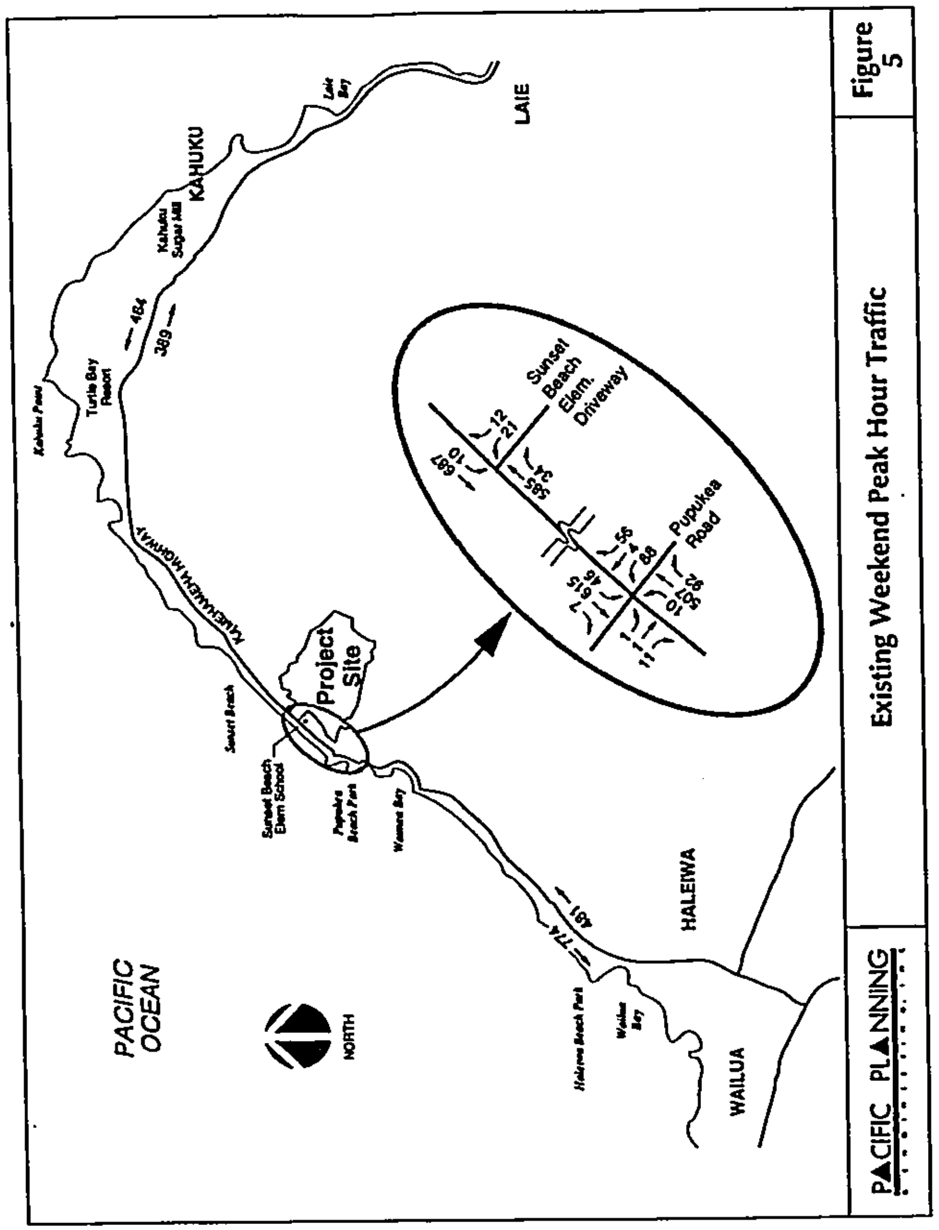
Figure 3



PACIFIC PLANNING

Existing Weekday Afternoon Peak Hour Traffic

Figure 4



Existing Weekend Peak Hour Traffic

FUTURE CONDITIONS

Research of approved planned developments and improvements to transportation facilities was conducted to estimate future traffic conditions at the study intersections.

Future Land Uses

Traffic generated by the following proposed developments in the immediate area, as shown in Table 2, are expected to impact the study intersections by study years 2002 and 2008:

Table 2. Future Developments

Development	Land Use
Kuilima Resort Expansion	
Kuilima Hotels	2,599 rooms
Kuilima Resort Condominiums	625 units
Kuilima Shopping Village	100,000 square feet, GLA
Kuilima Tennis Center	36 tennis courts
Parks	190 parking stalls
Kahuku Villages	177 SF dwelling units
Laie Development Plan Amendments	
Residential Units	450 SF & MF dwelling units
Polynesian Cultural Center Expansion	21 acres
Pupukea Shopping Village	70,000 square feet, GLA

Notes: GLA - Gross leasable area
SF - Single-family
MF - Multi-family

Future Roadway Facilities

There is one roadway improvement currently being constructed in the study area. The Haleiwa Bypass will provide an alternative route for drivers who want to bypass Haleiwa town to reach destinations along the North Shore. The Haleiwa Bypass is expected to be completed by the year 1994 and the location of the bypass is shown in Figure 1.

PROJECTED TRAFFIC CONDITIONS

Future traffic was forecast to determine traffic conditions without and with the Lihi Lani project. Traffic forecasts were estimated for the weekday morning and afternoon peak hours, and weekend peak hour for years 2002 (Phases I/II) and 2008 (Phases III/IV), when the project is expected to be completed and fully occupied.

Future Traffic Without Project

Future traffic without the project was forecasted by adding the following: (1) existing peak hour traffic volumes, (2) the increase in through-traffic along Kamehameha Highway due to growth in tourist and local traffic, and (3) traffic generated by other developments in the North Shore area that will be completed by the study years.

Through-Traffic Growth along Kamehameha Highway

Through-traffic describes vehicular traffic without an origin or destination point near the project site. The North Shore is a recreational attraction to both visitors and local residents due to its spectacular surf and beautiful beaches. As a result, the increase in through-traffic along Kamehameha Highway reflects increases in local, as well as, visitor populations. The growth in through-traffic was estimated based upon the growth trend of local resident and visitor de facto population forecasts by the Hawaii State Department of Business and Economic Development (DBED)[1].

[1] Series M-K Projections for De facto Population, by Hawaii State Department of Business and Economic Development, Population and Economic Projections for the State of Hawaii to 2010, November 1988.

From the DBED projections, it was estimated that daily traffic along Kamehameha Highway would increase by approximately 0.8% annually. Therefore, existing through-traffic peak hour volumes along Kamehameha Highway were increased by approximately 7% for Phase I and 12% for Phase II.

Construction-Related Traffic

Our preliminary review of proposed construction activities near the proposed project indicate that construction truck traffic will have minimal impact on traffic along Kamehameha Highway. Trucks hauling construction materials such as cement, pipes, lumber, crushed rock, and asphalt concrete will average one or two trips per day initially. Traffic by construction workers will occur during the early morning hours when they enter the jobsite and in the early evening hours when the workers leave the site. An estimated 10 to 30 workers daily at the work site are expected to generate not more than 10 vehicles during the morning and afternoon peak hours. Most of the workers will be transported to the job site on company trucks from baseyards in Honolulu.

Preliminary plans call for all earth moving operations to be confined to the project site, therefore, no trucks are expected to haul fill material onto the project or remove excess excavated material off the project site. This will further minimize truck traffic in and out of the project and along Kamehameha Highway.

Traffic from Other Developments

A three-step procedure of trip generation, trip distribution and traffic assignment was used to forecast future peak hour traffic volumes

generated from other proposed developments by the study years of 2002 and 2008 in the North Shore area.

Trip generation estimates the number of vehicle trips that would be generated by future developments based on the development's land use and data from the Institute of Transportation Engineers (ITE) Trip Generation Report[2]. Table 3 shows the resulting trip generation for the future developments listed in Table 2.

Trips generated by Kuilima Resort's expansion[3] and the Laie project[4] during the weekday afternoon and weekend (Sunday) peak hours were based upon individual traffic studies prepared for these projects.

For the Kahuku Village development, a comparison of the manual traffic counts and trips estimated by ITE trip rates indicate that trip rates for single family dwelling units located in rural areas tend to be lower than similar uses in urban areas. As a result, the ITE single family dwelling units rates in the Trip Generation Report were reduced by 30% for the weekday morning and afternoon, and weekend peak hours. These reduced single-family dwelling unit trip rates were applied to the Kahuku Village project.

The lower rural trips rates reflect that persons living in rural areas may experience different travel commute behavior than persons living in urban areas. Due to longer travel times to employment in Honolulu, persons living on the North Shore may choose to work at home or select employment

2 Trip Generation Report, by the Institute of Transportation Engineers, Fifth Edition, 1991.
3 Traffic Impact Report for the Proposed Turtle Bay Resort, by Austin, Tsutsumi & Associates, Inc., June 1985.
4 Traffic Impact Analysis Report for the Proposed Laie Development Plan Amendments, by The Traffic Management Consultant, April 7, 1992.

Table 3. Trip Generation for Future Developments
Phases I/II (Year 2002) and Phase III/IV (Year 2008)

Land Use Description	Amount	Units	Weekday Morning Enter	Weekday Morning Exit	Weekday Afternoon Enter	Weekday Afternoon Exit	Sunday Enter	Sunday Exit
Phases I and II - Year 2002								
Kuilima Resort Expansion								
Kuilima Hotels	1,563	rooms	436	224	353	292	329	188
Resort Condos	625	units	67	33	71	68	40	32
Tennis Center	10	courts	8	8	14	14	25	25
Parks	190	park. stalls	89	44	48	57	95	115
Kahuku Villages	177	units	24	65	88	52	55	51
Laie Developments								
Single-family Residential	350	units	31	89	109	59	88	75
Apartments	90	units	4	20	20	10	13	13
Pupukea Shopping Village	70,000	sf, GLA	86	50	269	269	365	365
		Subtotal	745	533	972	821	1010	864
Phases III and IV - Year 2008								
Kuilima Resort Expansion								
Kuilima Hotels	1,036	rooms	289	149	236	194	219	126
Resort Condos	375	units	40	20	42	41	24	19
Tennis Courts	26	courts	22	22	37	37	65	65
Laie Developments								
Polynesian Cultural Center	21	acres	36	28	48	58	107	56
		Subtotal	387	219	363	330	415	266
Phases I, II, III & IV		*Total*	*1132*	*752*	*1335*	*1151*	*1425*	*1130*

Notes: sf - Square feet
GLA - Gross Leasable Area

locations and work hours where travel can occur at less congested periods of the day. The comparison of ITE rates and the trips counted at an existing North Shore subdivision are shown in Appendix C.

For the Pupukea Shopping Village, pass-by trips were deducted from the total trips generated by the development. Pass-by trips are vehicle trips which are a secondary part of a trip to a primary destination. Examples of pass-by trips include residents stopping by a shopping center on their way home from work or tourists stopping by a restaurant on their way to other attractions. A percentage of the trips generated for the Pupukea Shopping Village were assumed to be pass-by trips. These pass-by trips would not increase trips on Kamehameha Highway because they reflect vehicle trips already on the roadways.

The number of pass-by trips for the Pupukea Shopping Village was determined from the ITE Trip Generation Report for the weekday and weekend peak hours. The adjustments made for pass-by trips were 40% for the weekday morning and weekend peak hour, and 50% for the weekday afternoon peak hour.

The trip distribution step assigns trips to their predicted origins and destinations. In determining the distribution of trips, consideration was given to factors such as the employment, population, resort activities, shopping areas, and existing travel patterns from collected traffic counts. The distribution for trips generated by the Kuilima Resort expansion were generally based upon the existing distribution pattern obtained from manual counts and percentages used in the Kuilima Resort traffic study. Table 4 displays the trip distribution for each of the other developments in the North Shore area.

Table 4. Trip Distribution for Future Developments

Land Use Description	Entering From Haleiwa	Entering From Laie	Exiting To Haleiwa	Exiting To Laie
Weekday Morning Peak Hour				
Kuilima Resort Expansion	65%	35%	65%	35%
Kahuku Villages	70%	30%	70%	30%
Laie Developments	37%	63%	44%	56%
Pupukea Shopping Village	50%	50%	50%	50%
Weekday Afternoon Peak Hour				
Kuilima Resort Expansion	55%	45%	55%	45%
Kahuku Villages	70%	30%	70%	30%
Laie Developments	40%	60%	40%	60%
Pupukea Shopping Village	50%	50%	50%	50%
Weekend (Sunday) Peak Hour				
Kuilima Resort Expansion	55%	45%	55%	45%
Kahuku Villages	60%	40%	60%	40%
Laie Developments	40%	60%	40%	60%
Pupukea Shopping Village	50%	50%	50%	50%

The traffic assignment step assigns trips to a specific route on the roadway network that will take the driver from origins to destinations. Traffic was assigned based on the estimated shortest path or travel time between origins to destinations. Since Kamehameha Highway is the only major roadway in the area, 100% of the traffic was assigned to the highway in the vicinity of the project. The traffic assigned to and from Haleiwa was assigned to both Kamehameha Highway and the Haleiwa Bypass for future conditions. According to the environmental impact statement completed for the Haleiwa Bypass[5], the new bypass would relieve approximately 60%

5 Haleiwa Bypass Final Environmental Impact Statement, by U.S. Department of Transportation Federal Highway Administration and Hawaii State Department of Transportation Highways Division, 1981.

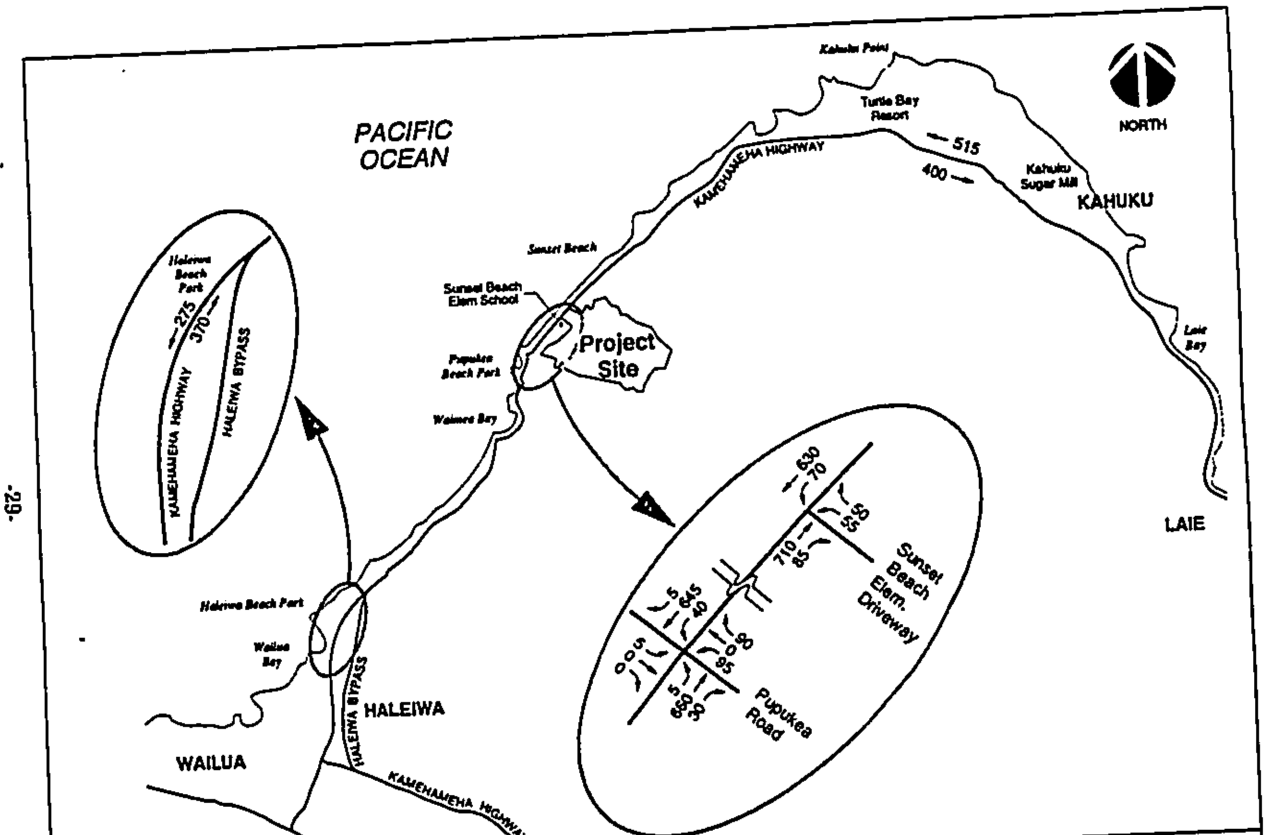
of the through traffic along Kamehameha Highway. Therefore, 60% of the traffic forecasted to pass through Haleiwa town was assigned to the bypass and the remaining 40% was assigned to Kamehameha Highway.

The resulting forecast traffic volumes without the project during the weekday morning, afternoon, and weekend peak hours for year 2002 are shown on Figures 6, 7, and 8, respectively. Similarly, the without project traffic volumes for year 2008 are shown in Figures 9, 10, and 11. The forecasted traffic volumes for all future conditions were rounded to the nearest five vehicles.

Future Traffic With Project

Future traffic with the project was forecasted by adding the traffic generated by the Lihi Lani project to the forecast traffic volumes without the project.

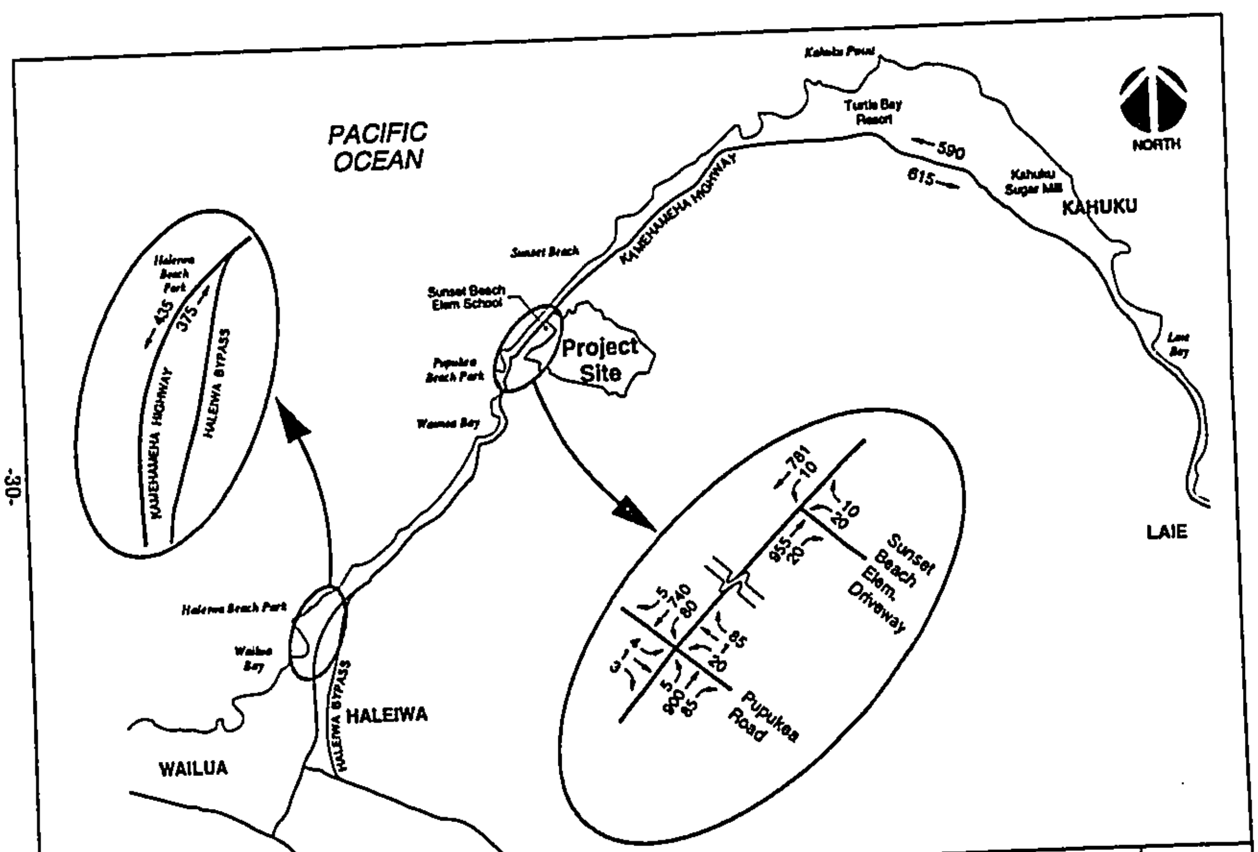
The three-step procedure of trip generation, trip distribution, and traffic assignment was used to forecast future traffic generated from the proposed project. The number of trips generated by the project were determined based upon the project's land uses and data from the ITE Trip Generation Report. Table 5 shows the trips generated by the project for Phases I, II, III, and IV, and includes the reduction of internal trips which would remain within the project boundaries.



PACIFIC PLANNING

2002 Without Project Morning Peak Hour Traffic

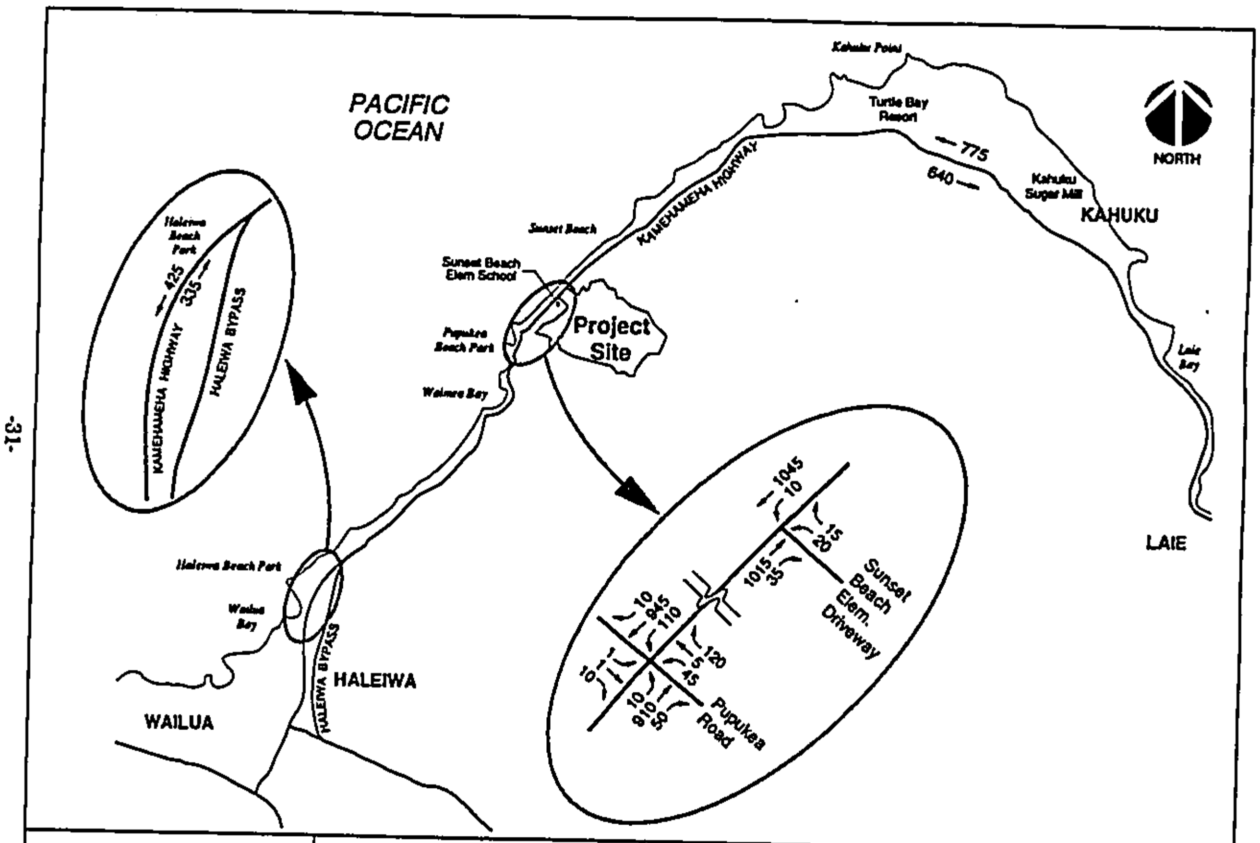
Figure 6



PACIFIC PLANNING

2002 Without Project Afternoon Peak Hour Traffic

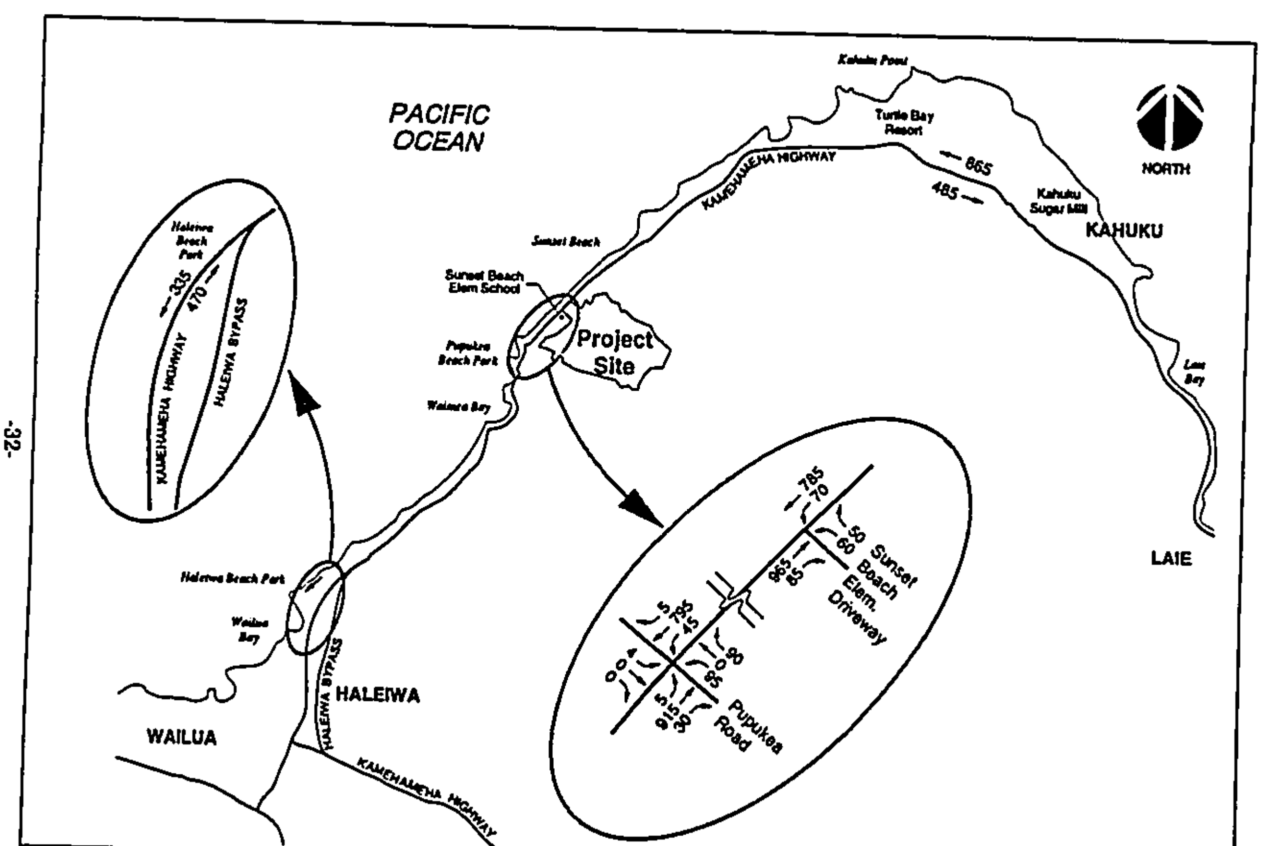
Figure 7



PACIFIC PLANNING

2002 Without Project Weekend Peak Hour Traffic

Figure 8



PACIFIC PLANNING

2008 Without Project Morning Peak Hour Traffic

Figure 9

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

Table 4. Trip Distribution for Future Developments

Land Use Description	Entering From Haleiwa	Entering From Laie	Exiting To Haleiwa	Exiting To Laie
Weekday Morning Peak Hour				
Kuilima Resort Expansion	65%	35%	65%	35%
Kahuku Villages	70%	30%	70%	30%
Laie Developments	37%	63%	44%	56%
Pupukea Shopping Village	50%	50%	50%	50%
Weekday Afternoon Peak Hour				
Kuilima Resort Expansion	55%	45%	55%	45%
Kahuku Villages	70%	30%	70%	30%
Laie Developments	40%	60%	40%	60%
Pupukea Shopping Village	50%	50%	50%	50%
Weekend (Sunday) Peak Hour				
Kuilima Resort Expansion	55%	45%	55%	45%
Kahuku Villages	60%	40%	60%	40%
Laie Developments	40%	60%	40%	60%
Pupukea Shopping Village	50%	50%	50%	50%

The traffic assignment step assigns trips to a specific route on the roadway network that will take the driver from origins to destinations. Traffic was assigned based on the estimated shortest path or travel time between origins to destinations. Since Kamehameha Highway is the only major roadway in the area, 100% of the traffic was assigned to the highway in the vicinity of the project. The traffic assigned to and from Haleiwa was assigned to both Kamehameha Highway and the Haleiwa Bypass for future conditions. According to the environmental impact statement completed for the Haleiwa Bypass[5], the new bypass would relieve approximately 60% of the through traffic along Kamehameha Highway. Therefore, 60% of the traffic forecasted to pass through Haleiwa town was assigned to the bypass and the remaining 40% was assigned to Kamehameha Highway.

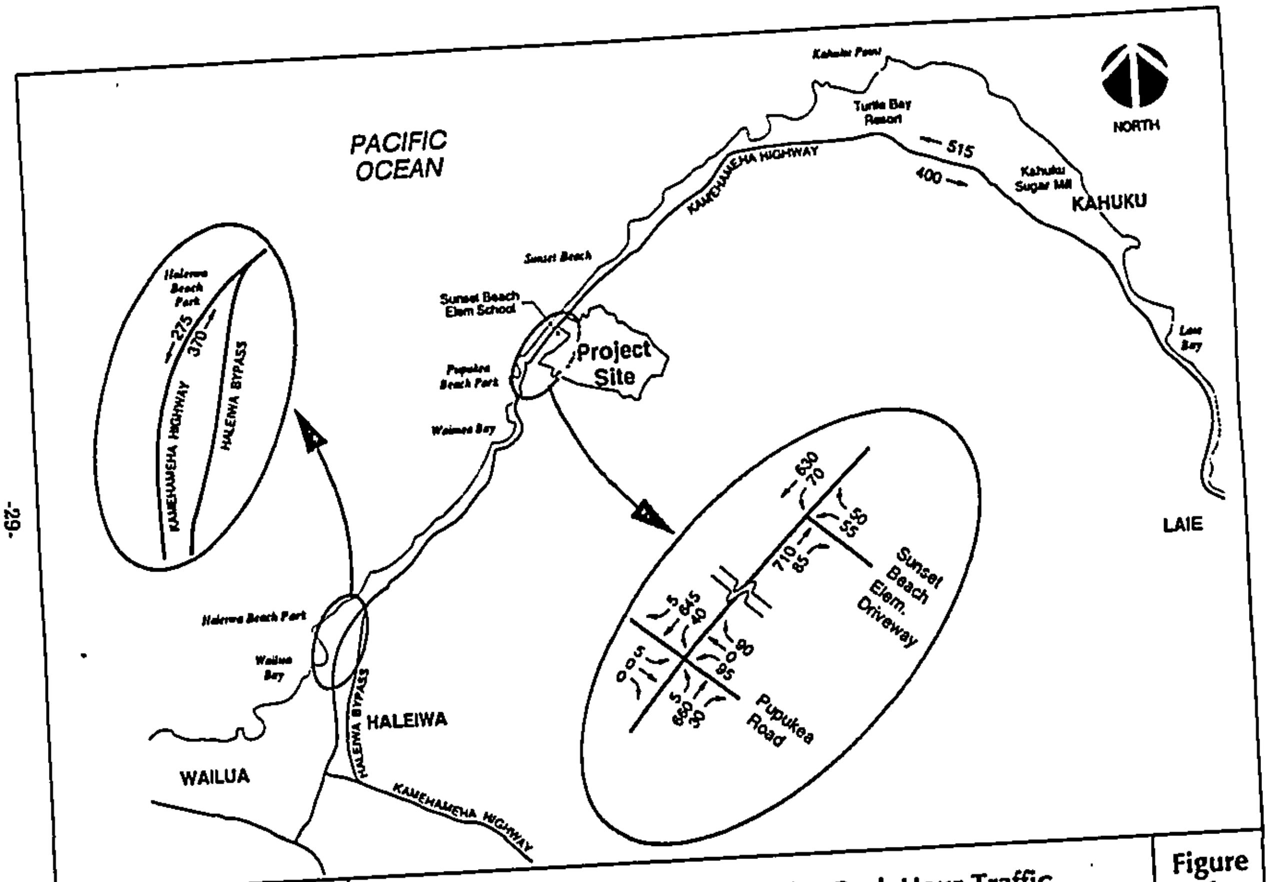
5 Haleiwa Bypass Final Environmental Impact Statement, by U.S. Department of Transportation Federal Highway Administration and Hawaii State Department of Transportation Highways Division, 1981.

The resulting forecast traffic volumes without the project during the weekday morning, afternoon, and weekend peak hours for year 2002 are shown on Figures 6, 7, and 8, respectively. Similarly, the without project traffic volumes for year 2008 are shown in Figures 9, 10, and 11. The forecasted traffic volumes for all future conditions were rounded to the nearest five vehicles.

Future Traffic With Project

Future traffic with the project was forecasted by adding the traffic generated by the Lihi Lani project to the forecast traffic volumes without the project.

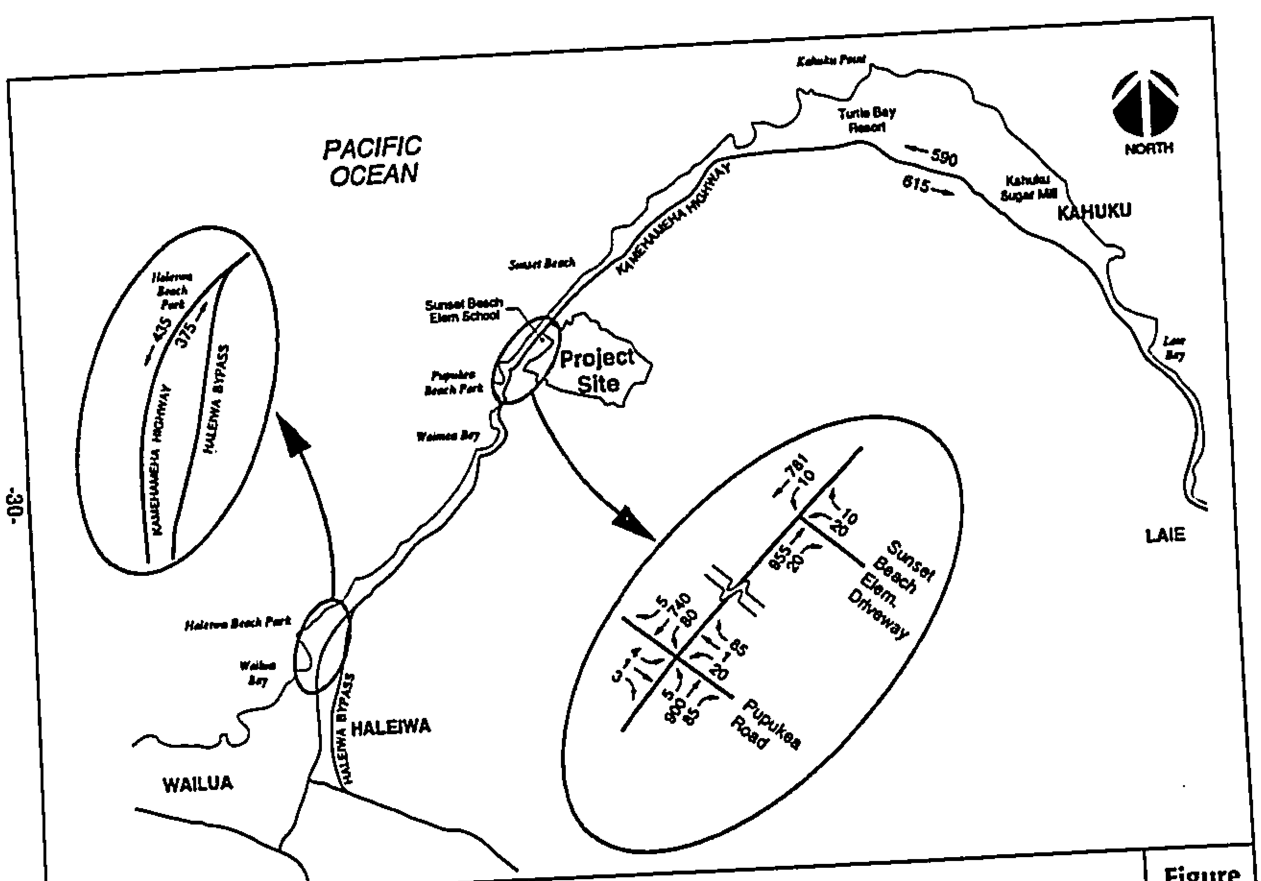
The three-step procedure of trip generation, trip distribution, and traffic assignment was used to forecast future traffic generated from the proposed project. The number of trips generated by the project were determined based upon the project's land uses and data from the ITE Trip Generation Report. Table 5 shows the trips generated by the project for Phases I, II, III, and IV, and includes the reduction of internal trips which would remain within the project boundaries.



PACIFIC PLANNING

2002 Without Project Morning Peak Hour Traffic

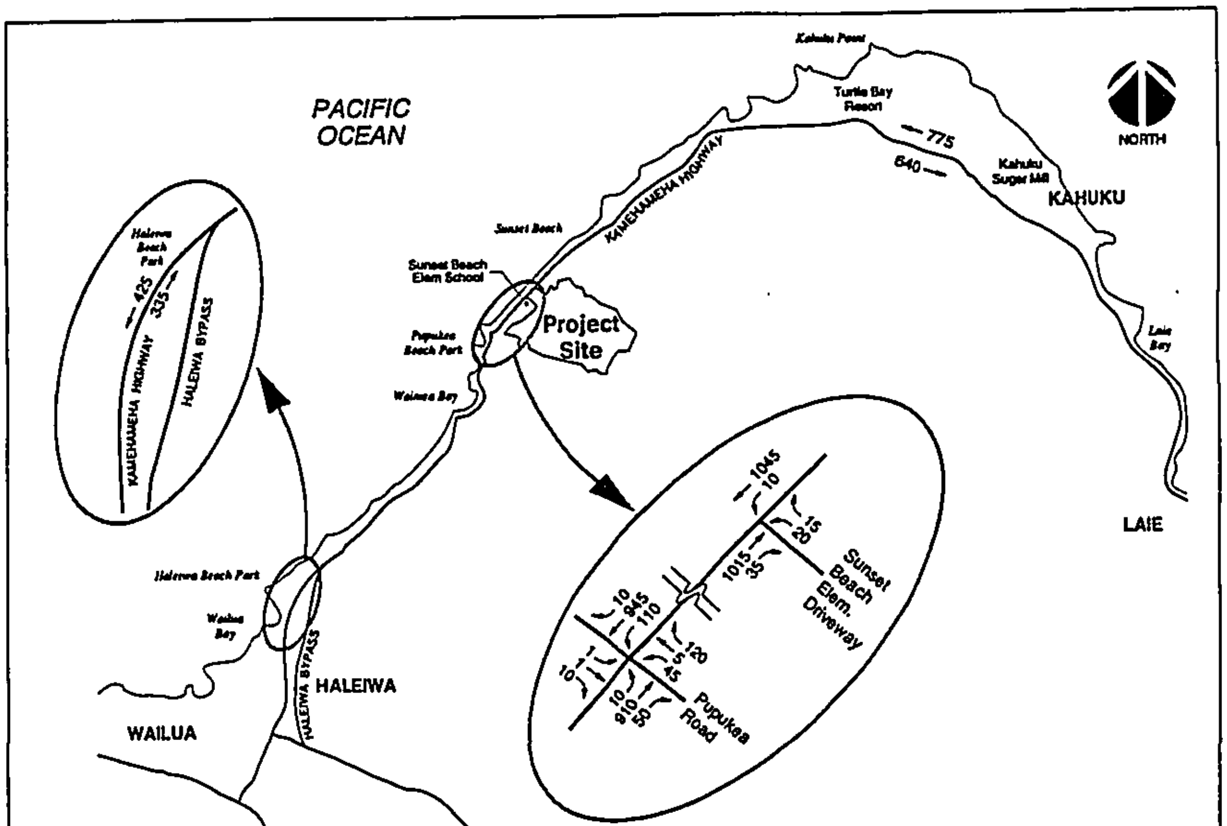
Figure 6



PACIFIC PLANNING

2002 Without Project Afternoon Peak Hour Traffic

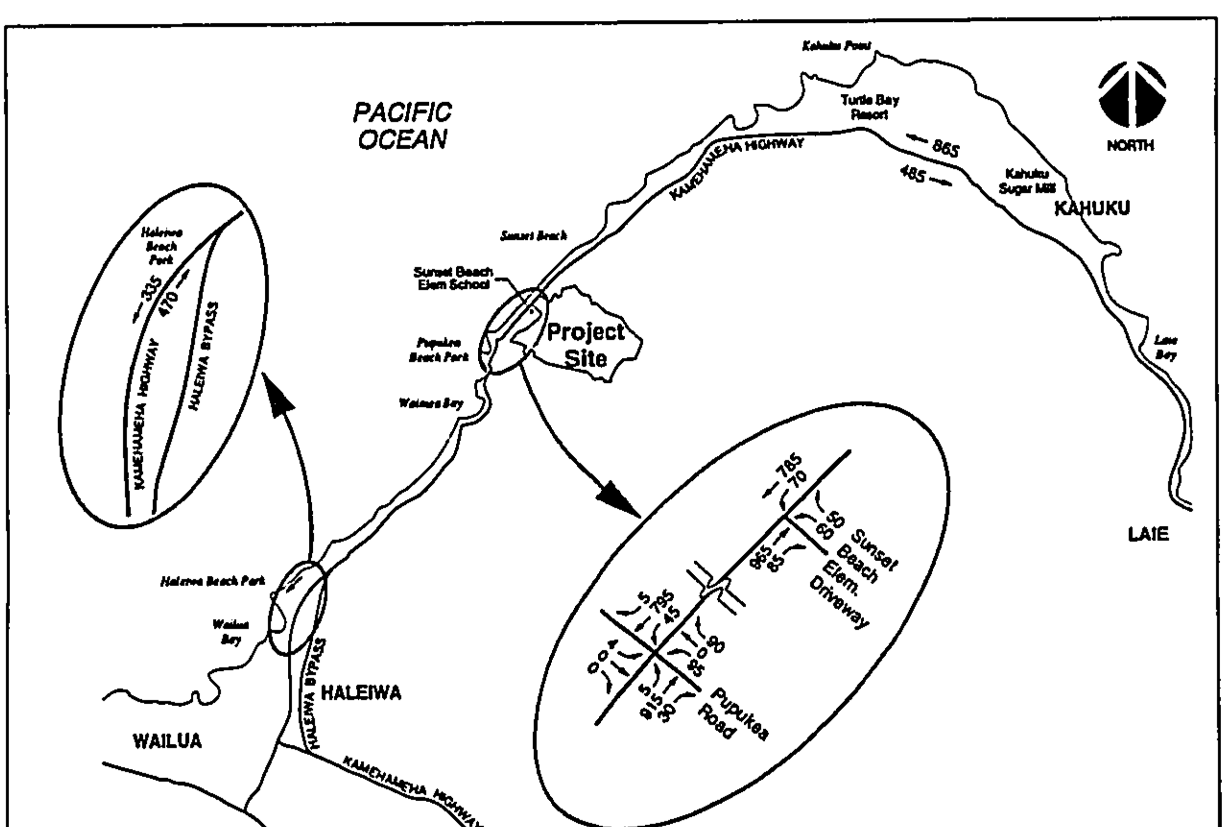
Figure 7



PACIFIC PLANNING

2002 Without Project Weekend Peak Hour Traffic

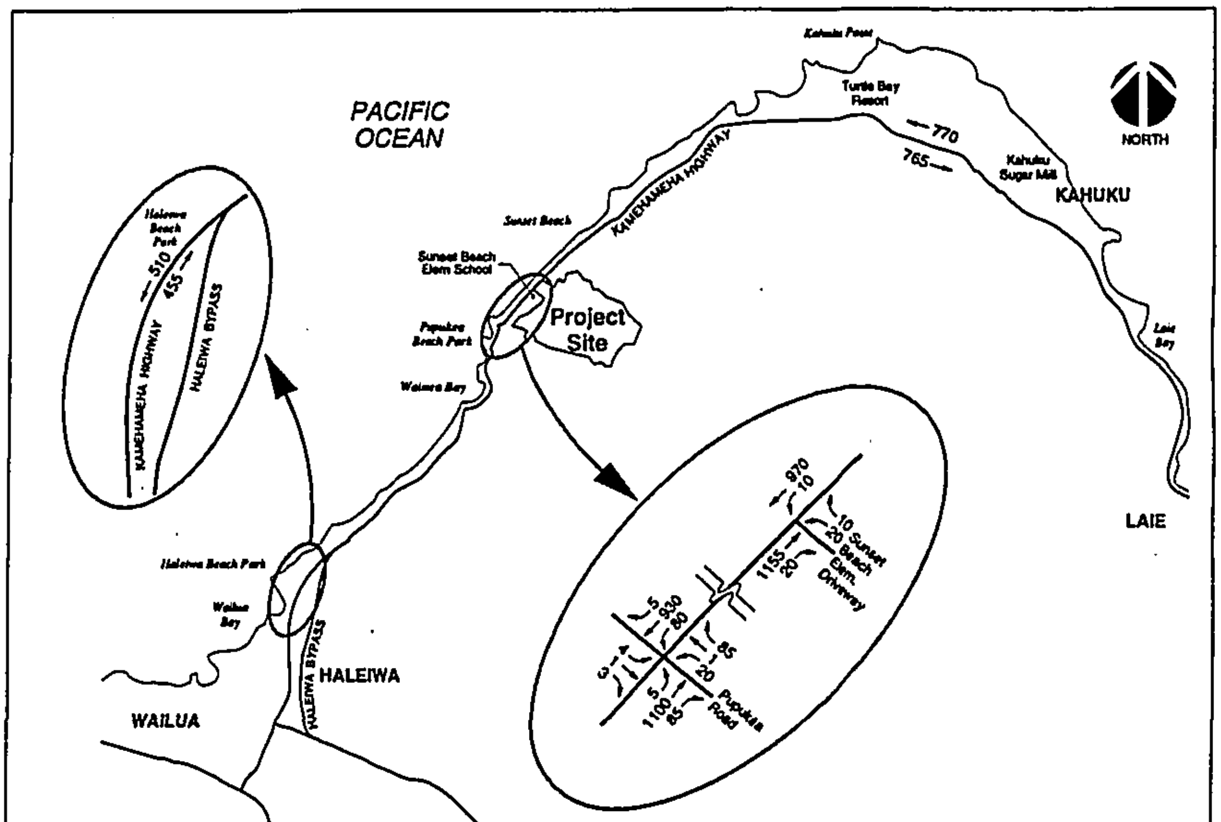
Figure 8



PACIFIC PLANNING

2008 Without Project Morning Peak Hour Traffic

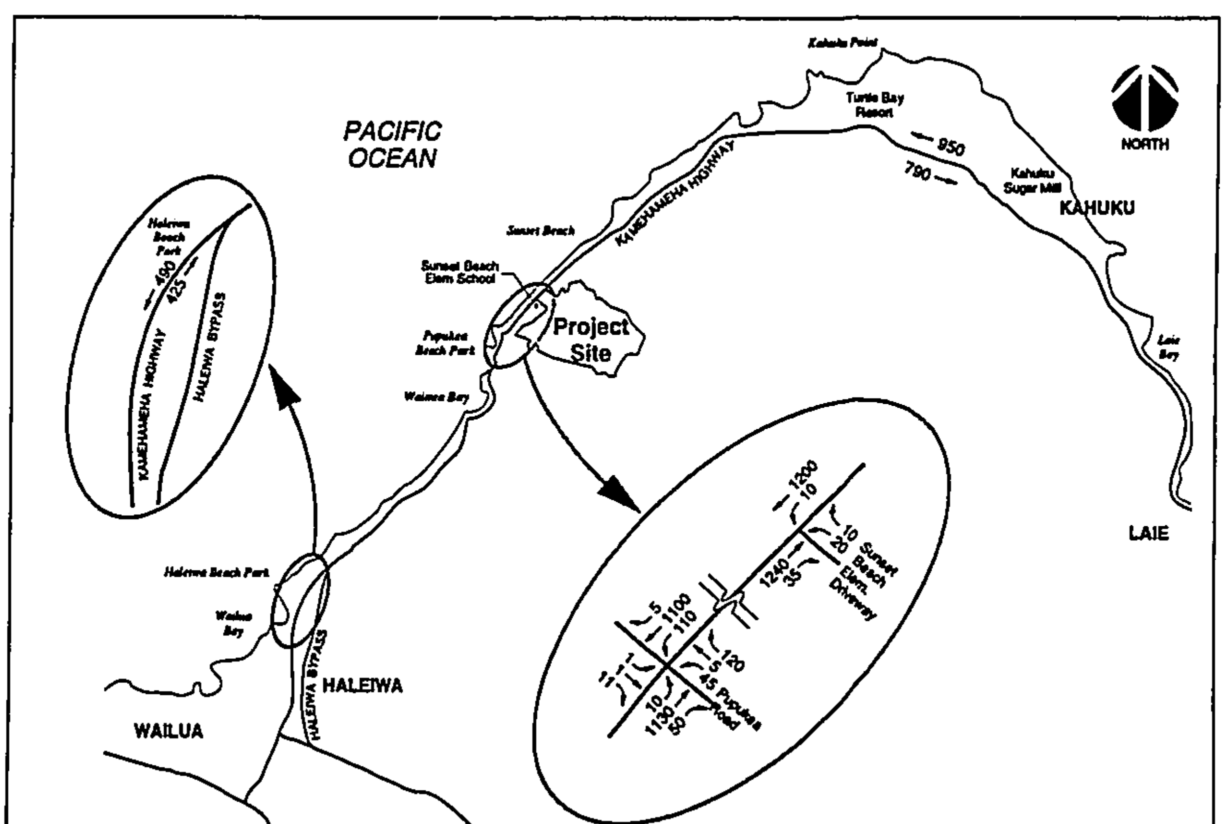
Figure 9



PACIFIC PLANNING

2008 Without Project Afternoon Peak Hour Traffic

Figure 10



PACIFIC PLANNING

2008 Without Project Weekend Peak Hour Traffic

Figure 11

Table 5. Trip Generation for Lihi Lani Project

Phases I & II- Year 2002

Land Use	Units	Parameter	AM Peak Enter	AM Peak Exit	PM Peak Enter	PM Peak Exit	Sunday Peak Enter	Sunday Peak Exit
Full-time Market	120	SF units	16	46	55	31	37	37
Part-time Market	40	SF units	4	2	4	6	6	8
Full-time Affordable	50	SF units	7	19	23	12	16	16
Elderly Rental Units	80	MF units	2	2	4	2	22	22
North Shore YMCA	1	TM	17	10	42	30	25	18
Ranch Facilities	100	stalls	18	7	12	13	12	12
		Subtotal	64	86	140	94	118	113
Internal Trips (Reduction)			7	7	11	11	23	23
		Net Total	49	71	117	71	95	90

Phase III & IV - Year 2008

Land Use	Units	Parameter	AM Peak Enter	AM Peak Exit	PM Peak Enter	PM Peak Exit	Sunday Peak Enter	Sunday Peak Exit
Full-time Market	120	SF units	16	45	54	28	37	37
Part-time Market	35	SF units	4	2	4	5	6	7
		Subtotal	20	47	58	33	43	44
Internal Trips (Reduction)			3	3	4	4	8	8
		Net Total	17	44	54	29	35	36
Phases I, II, III & IV		*Total Net Trips*	*74*	*123*	*183*	*112*	*130*	*126*

Note: SF - Single family
MF - Multi family
TM - Thousand Members

This study assumes that 75% of the market homes would be occupied by full-time residents, and the remaining 25% of the market homes would be used as recreational homes by part-time residents. The affordable homes are assumed to be occupied by full-time residents only.

Trips generated by the single-family affordable and market homes (occupied by full-time residents) were adjusted due to the lower number of trips generated by homes located in rural areas. Trips generated by the full-time single-family residential land uses were reduced by 30% from the ITE trip generation values for the weekday morning, afternoon, and weekend peak hours. The trip rate reduction value (30%) was derived from current traffic counts taken at a nearby North Shore residential development, which is summarized in Appendix C.

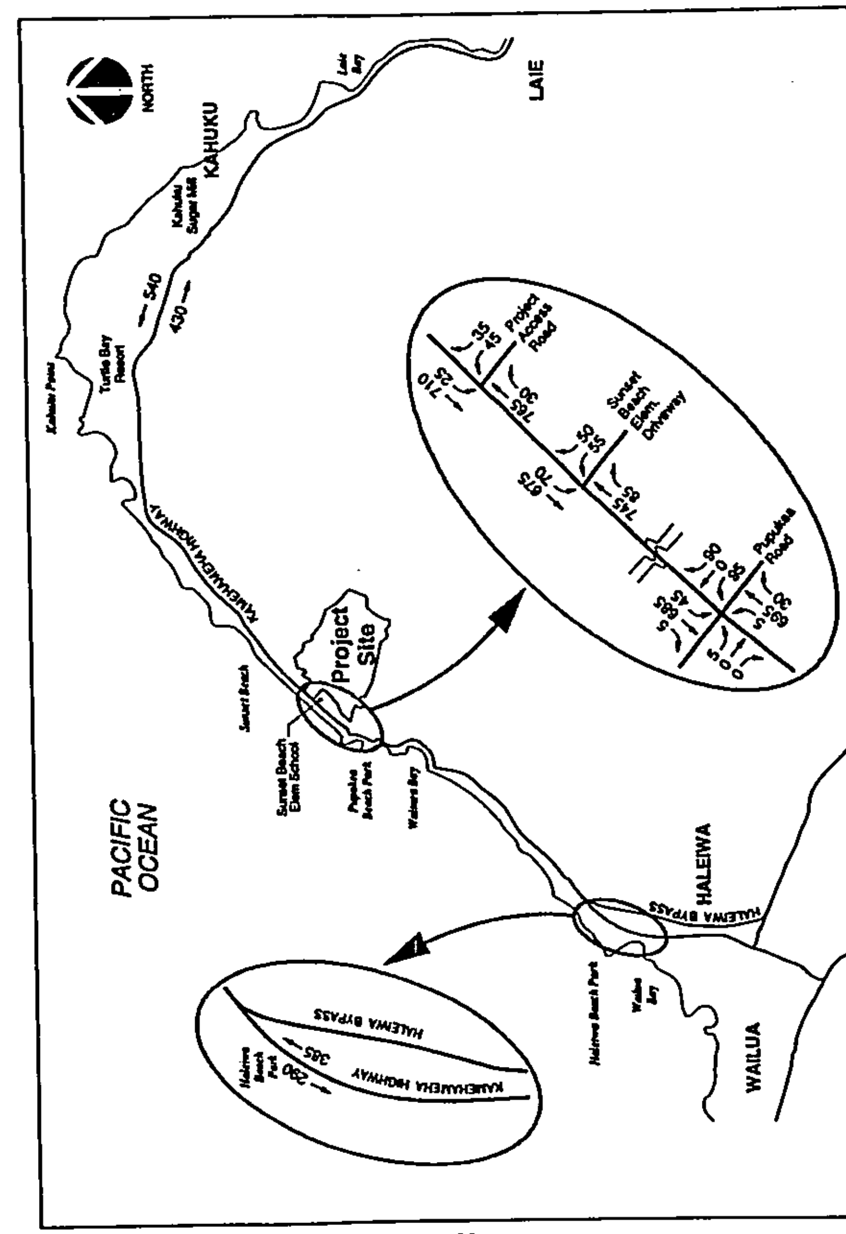
Trip distribution for the project traffic was based upon existing traffic patterns and the distribution of population and employment on Oahu, taking into account Kuilima Resort expansion and future employment within the district. Table 6 shows the trip distribution for the Lihi Lani project. Due to the project being a residential planned community, with mixed uses such as recreational activities located within the project site, a portion of the trips generated by the project would remain within the development.

Table 6. Trip Distribution for Lihi Lani Project

To/From:	Morning	Afternoon	Sunday
Haleiwa	50%	60%	50%
Laie	40%	30%	30%
Internal Trips	10%	10%	20%
Total	100%	100%	100%

The traffic assignment used for the other future projects was also used for the Lihi Lani project. Traffic was assigned to Kamehameha Highway in the project vicinity, and to Kamehameha Highway and the Haleiwa Bypass in the Haleiwa area. The same distribution between roadways was used for the project; 60% to the Haleiwa Bypass and 40% to Kamehameha Highway.

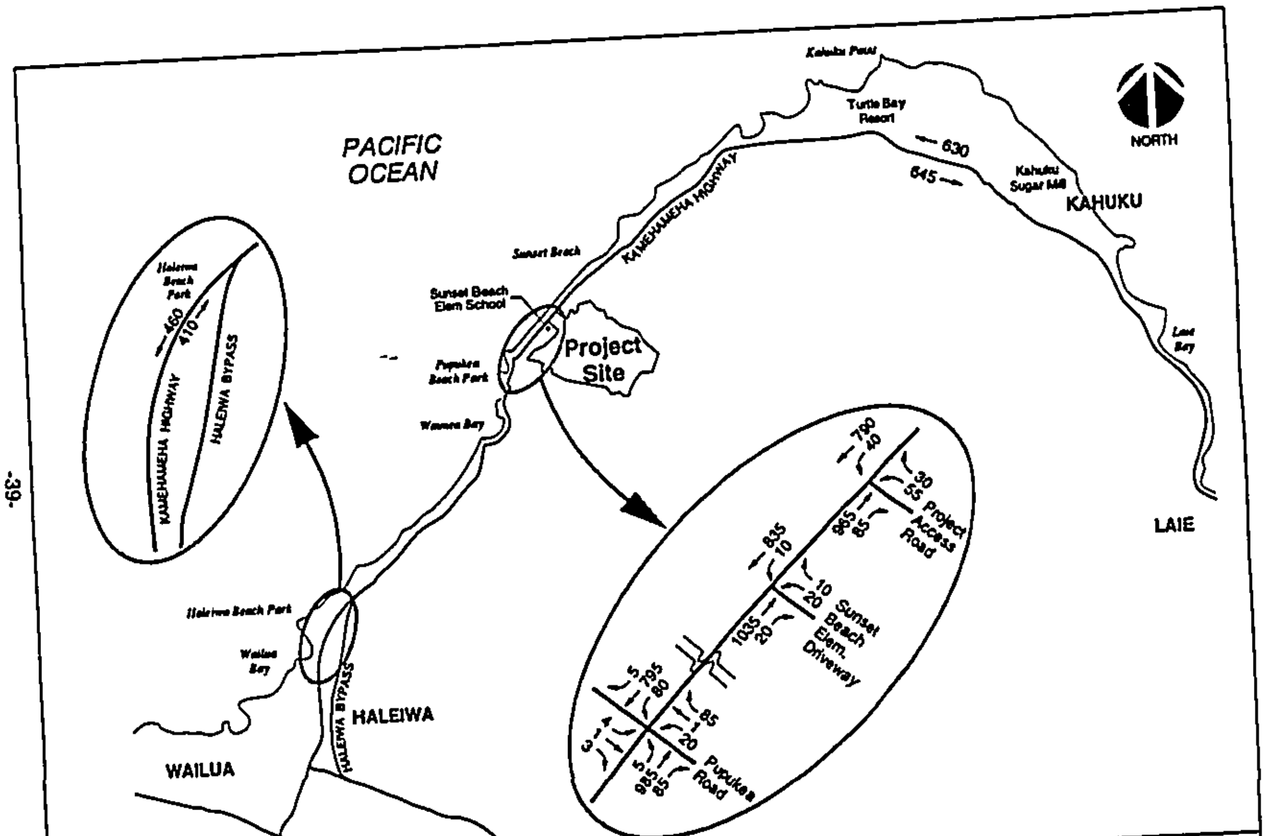
The resulting year 2002 traffic volumes with the project are shown in Figures 12, 13, and 14 for weekday and weekend peak hours. Similarly, the forecasted year 2008 traffic volumes are shown in Figures 15, 16, and 17.



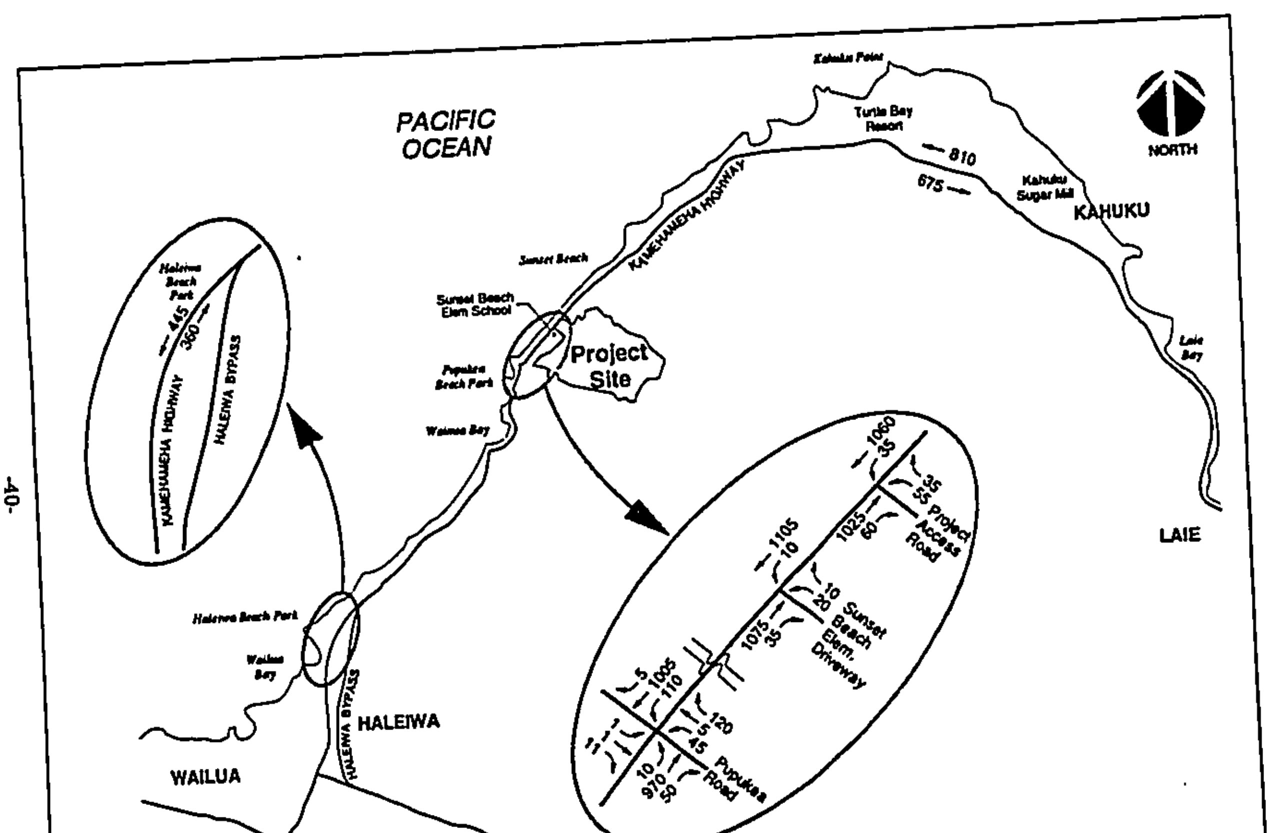
PACIFIC PLANNING

2002 With Project Morning Peak Hour Traffic

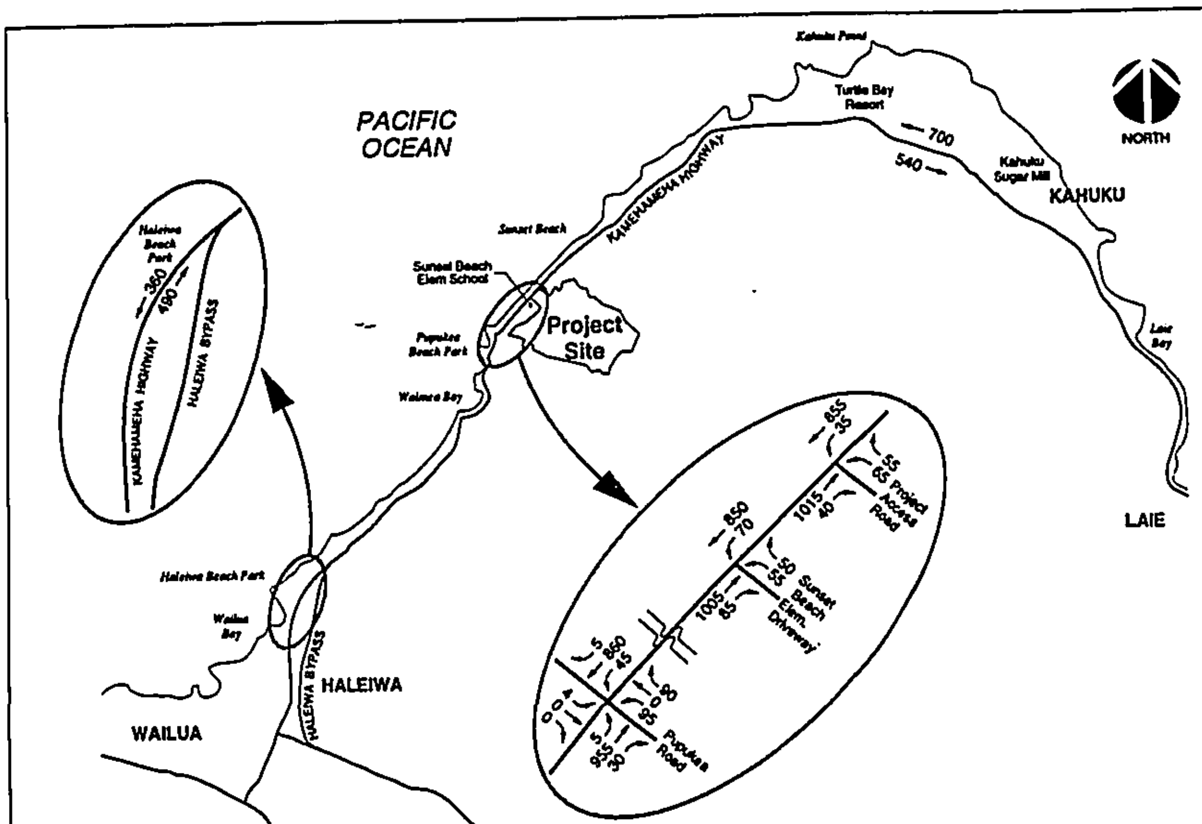
Figure 12



PACIFIC PLANNING | 2002 With Project Afternoon Peak Hour Traffic | Figure 13



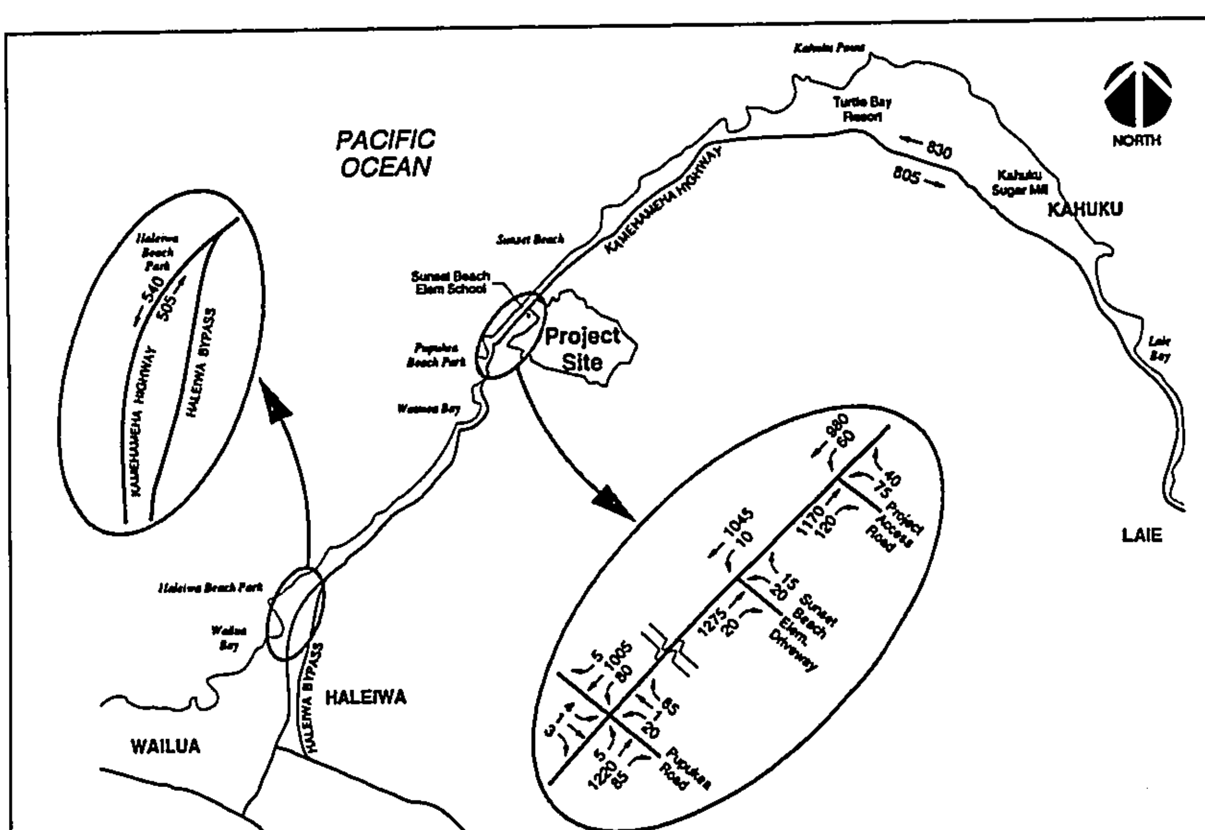
PACIFIC PLANNING | 2002 With Project Weekend Peak Hour Traffic | Figure 14



PACIFIC PLANNING

2008 With Project Morning Peak Hour Traffic

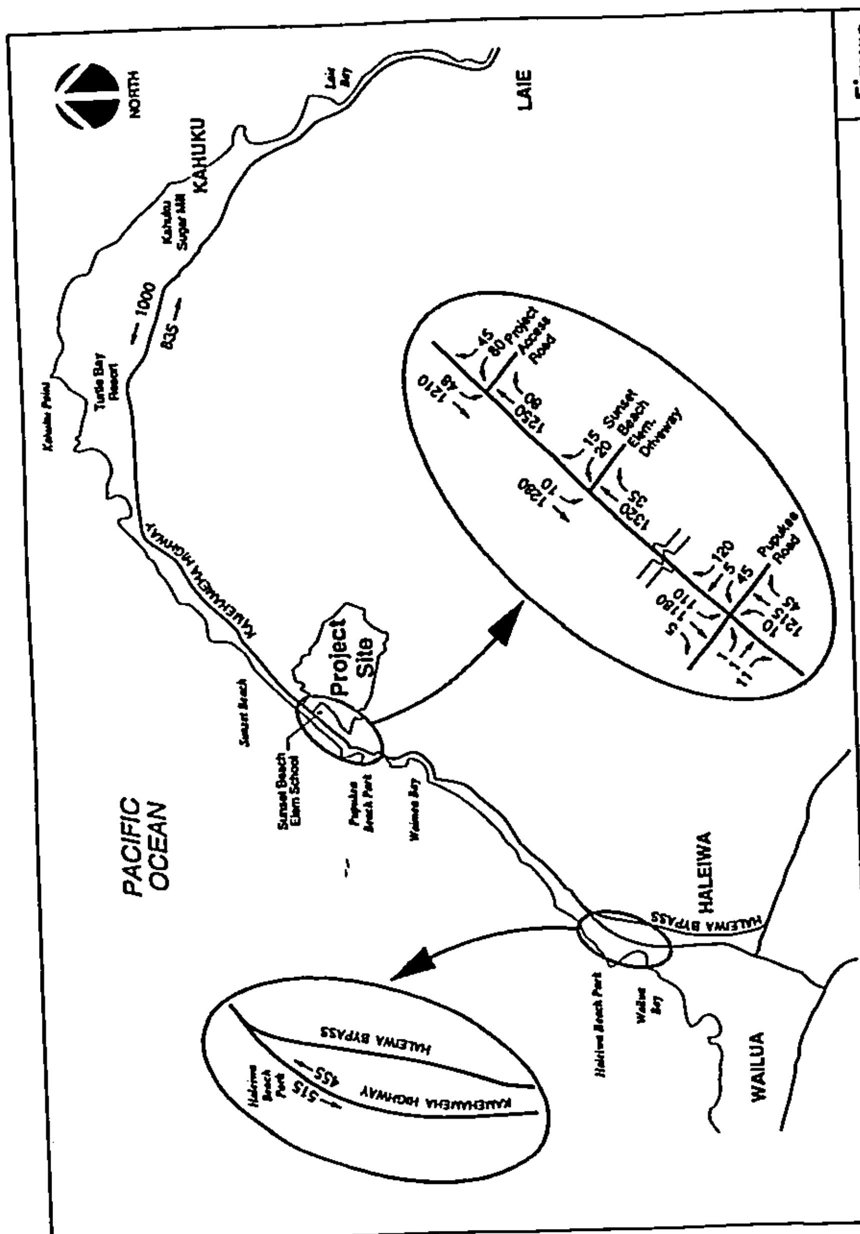
Figure 15



PACIFIC PLANNING

2008 With Project Afternoon Peak Hour Traffic

Figure 16



PACIFIC PLANNING

2008 With Project Weekend Peak Hour Traffic

Figure 17

TRAFFIC ANALYSIS

Analyses were conducted for the study intersections and segments of Kamehameha Highway to determine the relative impact of the Lihi Lani project on the local roadway system and improvements to mitigate the impact of the project, if necessary.

Project Impact Analysis

Analyses were conducted on the study intersections to determine the relative impact of the proposed project on the local roadway system. The analysis of the study intersections and roadway segments were conducted for existing and future conditions, Phases I/II (Year 2002) and Phases III/IV (Year 2008), for without and with project conditions. The analysis of forecasted traffic was based on the existing roadway network and committed improvements to the study facilities.

Analysis Methods

The study intersections were analyzed using the unsignalized intersection analysis contained in the Highway Capacity Manual[6] (HCM). Segments of Kamehameha Highway were analyzed using rural two-lane highway analysis.

Unsignalized intersection analysis measures *level-of-service* (LOS) based on the reserve capacity for a turning movement. The reserve capacity is the additional number of vehicles which could cross or exit a minor street

[6] Highway Capacity Manual, Special Report 209, by the Transportation Research Board, National Research Council, 1985.

and turn onto a major street or cross it. As the reserve capacity decreases, the LOS also decreases.

Unsignalized intersection analysis describes traffic flow conditions in terms of LOS ranging from A to F, where LOS A represents the best conditions and LOS F represents the worst conditions.

Rural highway analysis uses average travel speeds and ability to pass other vehicles as a measure of traffic operational conditions on a section of highway. Slower speeds are an indication of poor levels-of-service.

Level-of-service for rural highways and unsignalized intersections are not directly comparable because they are measured using different criteria. Appendix A gives the LOS definitions for each analysis method.

Analysis Findings

The results of the analysis for two-lane rural highway analysis are described below and are summarized in Table 7. The results of the unsignalized intersection analysis are shown in Tables 8, 9, and 10 for weekday morning, afternoon, and weekend peak hours, respectively. Descriptions of the analysis results are shown below and following the analysis tables.

Rural Highway Analysis for Segments of Kamehameha Highway

- *Presently*, segments of Kamehameha Highway operate at LOS D or better during the weekday and weekend peak hours in Kahuku. At Haleiwa Beach Park, it operates at LOS F on the weekend by observation, although the analysis results indicate LOS E[7]. During the weekday peak hours, the highway operates at LOS E or better at this location.

[7] The discrepancy in LOS occurs because the HCM two-lane rural highway analysis method does not accurately measure LOS when traffic conditions are extremely congested.

Table 7. Level-of-Service for Two-Lane Rural Highway along Kamehameha Highway

Highway Segment	1993 Existing	2002 Without Project	2002 With Project	2008 Without Project	2008 With Project
Weekday Morning Peak Hour					
Near Haleiwa Beach Park*	D	D	D	D	D
Near Kahuku Sugar Mill*	C	D	D	E	E
Weekday Afternoon Peak Hour					
Near Haleiwa Beach Park*	E	D	D	D	D
Near Kahuku Sugar Mill*	C	D	D	E	E
Weekend (Sunday) Peak Hour					
Near Haleiwa Beach Park*	E**	D	D	D	D
Near Kahuku Sugar Mill*	D	E	E	E	E

Note: * - The highest attainable level-of-service on Kamehameha Highway is LOS D, due to existing geometrics and speed limit of 45 mph along this highway.
** - By observation, this section operated at LOS F.

- *By 2002 without the project*, the LOS along Kamehameha Highway in Kahuku will drop to LOS E during the weekend peak hour. The LOS at Haleiwa Beach Park would improve to LOS D for all peak hours due to the Haleiwa Bypass.
- *By 2002 with the project*, the LOS of segments along Kamehameha Highway would remain the same as without project conditions for weekday and weekend peak hours.
- *By 2008 without the project*, the LOS along Kamehameha Highway in Kahuku would operate at LOS E for the weekday and weekend peak hours. The LOS at Haleiwa Beach Park would remain the same as Year 2002 conditions.
- *By 2008 with the project*, the LOS at both segments along Kamehameha Highway would remain the same as without project conditions.

Table 8. Level-of-Service for Unsignalized Intersections
Morning Peak Hour

Intersection	Movement	1993 Existing	2002 Without Project	2002 With Project	2008 Without Project	2008 With Project
Kamehameha Highway with Pupukea Road						
Kamehameha Highway						
Laie Bound	LT	A	A	A	A	A
Haleiwa Bound	LT	A	A	A	B	B
Pupukea Beach Park Dr.						
Mauka Bound	LT/TH/RT	B	E	E	E	E
Pupukea Road						
Makai Bound	LT	B	E	E	F	F
	TH/RT	A	B	B	C	C
Kamehameha Highway with Sunset Beach Elementary Driveway						
Kamehameha Highway						
Haleiwa Bound	LT	A	A	A	C	C
Sunset Beach Elem. Driveway						
Makai Bound	LT/RT	B	E	E	F	F
Kamehameha Highway with Project Access Road						
Kamehameha Highway						
Haleiwa Bound	LT	n/a	n/a	A	n/a	B
Project Access Road						
Makai Bound	LT	n/a	n/a	E	n/a	F
	RT	n/a	n/a	A	n/a	C

Notes: LT - Left turn
RT - Right turn
TH - Through

Table 9. Level-of-Service for Unsignalized Intersections
Afternoon Peak Hour

Intersection	Movement	1993 Existing	2002 Without Project	2002 With Project	2008 Without Project	2008 With Project
Kamehameha Highway with Pupukea Road						
Kamehameha Highway						
Laie Bound	LT	A	A	A	A	B
Haleiwa Bound	LT	A	B	C	C	D
Pupukea Beach Park Dr.						
Mauka Bound	LT/TH/RT	C	E	E	E	E
Pupukea Road						
Makai Bound	LT	D	E	E	E	E
	TH/RT	A	C	C	D	D
Kamehameha Highway with Sunset Beach Elementary Driveway						
Kamehameha Highway						
Haleiwa Bound	LT	A	B	B	B	C
Sunset Beach Elem. Driveway						
Makai Bound	LT/RT	B	E	E	E	E
Kamehameha Highway with Project Access Road						
Kamehameha Highway						
Haleiwa Bound	LT	n/a	n/a	C	n/a	D
Project Access Road						
Makai Bound	LT	n/a	n/a	F	n/a	F
	RT	n/a	n/a	B	n/a	C

Notes: LT - Left turn
RT - Right turn
TH - Through

Table 10. Level-of-Service for Unsignalized Intersections
Weekend Peak Hour

Intersection	Movement	1993 Existing	2002 Without Project	2002 With Project	2008 Without Project	2008 With Project
Kamehameha Highway with Pupukea Road						
Kamehameha Highway						
Laie Bound	LT	A	A	B	B	B
Haleiwa Bound	LT	A	C	C	D	D
Pupukea Beach Park Dr.						
Mauka Bound	LT/TH/RT	B	D	E	E	E
Pupukea Road						
Makai Bound	LT	E	F	F	F	F
	TH/RT	A	D	D	E	E
Kamehameha Highway with Sunset Beach Elementary Driveway						
Kamehameha Highway						
Haleiwa Bound	LT	A	B	B	C	C
Sunset Beach Elem. Driveway						
Makai Bound	LT/RT	D	E	E	E	E
Kamehameha Highway with Project Access Road						
Kamehameha Highway						
Haleiwa Bound	LT	n/a	n/a	C	n/a	D
Project Access Road						
Makai Bound	LT	n/a	n/a	F	n/a	F
	RT	n/a	n/a	B	n/a	C

Notes: LT - Left turn
RT - Right turn
TH - Through

Unsignalized Intersection Analysis for Study Intersections

Intersection of Kamehameha Highway with Pupukea Road

- *Presently,* motorists attempting turning movements from Pupukea Road onto Kamehameha Highway experience moderate delays (LOS C or better), with the exception of the left turn exiting Pupukea Road. This movement would operate at LOS E with long delays during the weekend peak hour, and LOS D during the afternoon peak hour.
- *By 2002 without the project,* motorists exiting Pupukea Road and the beach park driveway onto Kamehameha Highway would experience very long delays, LOS E and LOS F during the peak hours.
- *By 2002 with the project,* the LOS for turning movements from Kamehameha Highway and Pupukea Road would drop slightly for the afternoon and weekend peak hours. During the morning peak hour, the LOS would remain the same as without project conditions. Motorists making left turns out of Pupukea Road would still experience very long delays (LOS E and F) at this intersection.
- *By 2008 without the project,* motorists attempting turning movements from Kamehameha Highway and Pupukea Road would experience very long delays (LOS E and F) at this intersection.
- *By 2008 with the project,* the LOS would drop slightly (LOS C to D) for the afternoon peak hour. The remaining LOS would be the same as without project conditions.

Intersection of Kamehameha Highway with Sunset Beach Elementary

- *Presently,* motorists exiting Sunset Beach Elementary School onto Kamehameha Highway experience long delays (LOS D or better) during the weekend peak hour. Motorists attempting left-turns from Kamehameha Highway into the school driveway experience LOS A during both weekday and weekend peak hours.
- *By 2002 without the project,* the motorists turning into the school driveway would experience long delays (LOS E) for weekday and weekend peak hours.
- *By 2002 with the project,* the LOS for turning movements at this intersection would remain the same as without project conditions.

- *By 2008 without the project*, the delays to motorists turning into the school driveway would lengthen slightly to LOS C for the morning and weekend peak hours. The delays to motorists exiting the school driveway would also be very long (LOS F) during the morning peak hour.

Intersection of Kamehameha Highway with Project Access Road

- *By 2002 with the project*, motorists turning left out the project onto Kamehameha Highway may experience long delays (LOS D) during the weekday morning peak hour and very long delays (LOS F) during the weekday afternoon and weekend peak hours. Motorists attempting left-turns from Kamehameha Highway into the school driveway would experience average delays, LOS C or better, during weekday and weekend peak hours.
- *By 2008 with the project*, motorists turning left out the project onto Kamehameha Highway may experience very long delays (LOS F) during the peak hours. Motorists attempting left-turns from Kamehameha Highway into the school driveway may experience long delays, LOS D or better, during weekday and weekend peak hours.

Improvement Analysis

The findings of the analysis in the previous section indicate that three of the study intersections may operate at poor levels of service (LOS F) for the study years. The analysis of future (2002 and 2008) conditions indicate very long delays with and without the traffic from the proposed Lihi Lani project. Descriptions and possible measures to improve operations are identified in this section for the intersections of Kamehameha Highway with Pupukea Road, Kamehameha Highway with the Sunset Beach Elementary School driveway, and Kamehameha Highway with the proposed project access road.

A review of traffic signal warrants was conducted according to procedures in the Manual of Uniform Traffic Control Devices (MUTCD)[8].

[8] Manual on Uniform Traffic Control Devices, by the Federal Highway Administration, Warrant 11 Check, 1988.

The warrant analysis provides an indication of the need for traffic signal control, however, further studies should be completed by the responsible agency before making the final determination of signalizing an intersection.

Warrant 11, which is based on peak hour traffic volumes, was applied to the forecasted traffic volumes at the study intersections which are expected to operate with very long delays, if they remain unsignalized. The results of the Warrant 11 check are shown below in Table 11.

Table 11. Warrant 11 Summary for Unsignalized Intersections

		2002		2008	
Intersection	1993 Existing	Without Project	With Project	Without Project	With Project
Kamehameha Hwy. with Pupukea Rd.					
AM Peak	NO	NO	YES	YES	YES
PM Peak	NO	NO	NO	NO	NO
Sunday Peak	NO	YES	YES	YES	YES
Kamehameha Hwy. with Sunset Beach Elementary School Driveway					
AM Peak	NO	NO	NO	NO	NO
PM Peak	NO	NO	NO	NO	NO
Sunday Peak	NO	NO	NO	NO	NO
Kamehameha Hwy. with Project Access Road					
AM Peak	n/a	n/a	NO	n/a	NO
PM Peak	n/a	n/a	NO	n/a	NO
Sunday Peak	n/a	n/a	NO	n/a	NO

Notes: YES - Meets Warrant 11
NO - Does Not Meet Warrant 11
n/a - Not applicable

The results of the analysis at the intersection of Kamehameha Highway with Pupukea Road indicate that the Sunday peak hour traffic volumes for years 2002 and 2008, meet traffic signalization Warrant 11. The warrant is also met for the morning peak hour during the year 2002 with project and 2008 conditions.

The forecasted volumes at the intersections of Kamehameha Highway with Sunset Beach Elementary School and Kamehameha Highway with the proposed project access road do not meet Warrant 11 for the peak hours in the years 2002 and 2008. There are, however, separate warrants which take into account other considerations for signalization, such as delay and school traffic, and would require further study.

Although the intersections of Kamehameha Highway with Sunset Beach Elementary School and Kamehameha Highway with the proposed project access road do not meet Warrant 11 for the peak hours, the unsignalized analysis at these intersections indicate that vehicles turning left from the minor streets onto Kamehameha Highway may experience very long delays (LOS F). Therefore, the following is recommended to reduce the delays at these intersections:

- The traffic volumes along Kamehameha Highway should be monitored to determine if year 2002 and 2008 traffic volumes warrant signalization. If the projected volumes at the intersections of Kamehameha Highway with Sunset Beach Elementary School or Kamehameha Highway with the proposed project access road warrant signalization, then at least one of the intersections may need to be signalized. These two intersections may be close enough that the gaps in the highway traffic flow created by the traffic signals at one of these intersections may be sufficient to reduce the need to

signalize the other intersection. A warrant study should be conducted to determine whether signalization is needed at one or both intersections and which intersection should be the first to be signalized.

<u>Signalized Intersection Analysis</u>

The intersection of Kamehameha Highway with Pupukea Road was analyzed to determine its capacity level, if signalized. The Planning Analysis method for signalized intersections from the Highway Capacity Manual was used. Planning analysis provides a general indicator of how a traffic signal would operate and the laneage needed at the intersection.

The planning analysis for signalized intersections considers the movements that conflict at an intersection, such as a left turn and the opposing through movement. A critical volume of less than 1,200 vehicles indicates that the intersection will operate under capacity, between 1,200 and 1,400 vehicles indicates near capacity, and greater than 1,400 vehicles indicates over capacity.

The intersection of Kamehameha Highway and Pupukea Road was analyzed with the improvements to the existing configuration which are required for the intersection to operate under capacity. With the following improvements, the intersection would operate under capacity by the study years:

For year 2002,

- Left-turn storage lane on Kamehameha Highway in the Haleiwa-bound direction, for vehicles turning into Pupukea Road, and

- Right turn storage lane on Kamehameha Highway in the Kahuku-bound direction, for vehicles turning into Pupukea Road.

For year 2008,

- A section of Kamehameha Highway near the Pupukea Road intersection widened to four lanes, with two through and shared turn lanes in each direction.

According to recommendations in the Oahu Regional Transportation Plan (ORTP)[9], Kamehameha Highway may need to be widened to four lanes in the Central Oahu-North Shore corridor beyond the year 2005. The ORTP suggests that Kamehameha Highway be widened between Haleiwa and the Waimea or Kuilima areas if traffic volumes warrant this improvement. The results of the analysis with the above improvements are shown below in Table 12. The critical volumes shown in Table 12 for year 2008 are lower than 2002 volumes because the improvements mentioned above are included in the analysis and the Kamehameha Highway and Pupukea Road intersection would have greater capacity in the year 2008 with a widened Kamehameha Highway.

10 Oahu Regional Transportation Plan, by Oahu Metropolitan Planning Organization (OMPO), June 1991.

Table 12. Improvement Planning Analysis Summary for Kamehameha Highway and Pupukea Road

	2002 Without Project*		2002 With Project*		2008 Without Project**		2008 With Project**	
Time Period	Critical Volume	Capacity Level	Critical Volume	Capacity Level	Critical Volume	Capacity Level	Critical Volume	Capacity Level
AM Peak Hour	832	Under	834	Under	613	Under	635	Under
PM Peak Hour	1151	Under	1235	Near	768	Under	829	Under
Weekend Peak Hour	1195	Under	1254	Near	969	Under	1008	Under

Notes: * - Analyzed with separate left turn lanes on Kamehameha Highway
** - Analyzed with two additional through lanes on Kamehameha Highway

Capacity Levels: 0 to 1,200 - Under Capacity
1,201 to 1,400 - Near Capacity
Greater than 1,400 - Over Capacity

Other Considerations

Alternate means of travel, such as express buses, shuttle vans and bicycles, should be supported in order to reduce the number of vehicular trips to and from the Lihilani project. The YMCA is considering the acquisition of vans to shuttle children between the YMCA facilities/activities and their homes. A possibility exists that these vans could be utilized during the peak hours to shuttle Lihilani and other North Shore commuters to park-n-ride sites in Central Oahu. If sufficent demand exists, it may also be possible to develop shuttles to transport the the elderly or to provide service to recreation destinations, such as the beaches. In addition, the provision of bicycle facilities, such as bike routes and racks, could encourage the use of bicycles for local trips.

CONCLUSIONS AND RECOMMENDATIONS

The proposed Lihi Lani project would have a small impact on traffic conditions along Kamehameha Highway and the study intersections, when the project is scheduled to be completed in year 2002 for Phases I & II and year 2008 for Phases III & IV. A summary of the analysis findings for present and future (Years 2002 and 2008) conditions are described below.

Existing 1993 Traffic Conditions

Presently, the results of the analysis indicate that Kamehameha Highway generally operates at an average travel speed of 35-40 miles per hour (LOS D and E) at the study locations during the weekday peak hours. According to the two-lane rural highway analysis in the Highway Capacity Manual, the maximum attainable level-of-service along Kamehameha Highway at the study locations is LOS D due to the speed limit and geometric configurations. During the weekend peak hour, however, Kamehameha Highway traffic at Haleiwa Beach Park is congested (LOS F) and traffic backs up from the Anahulu Bridge in Haleiwa. Traffic is congested at certain locations along Kamehameha Highway due to various contributing factors, such as:

- Recreational traffic due to Oahu residents and visitors sightseeing and going to beaches along the North Shore,
- Traffic bottlenecks, such as drivers parking along Kamehameha Highway at surfing locations and driving through Haleiwa town,
- Drivers slow down along Kamehameha Highway to watch the surf,
- Slow moving construction traffic, delivery and military vehicles, and
- Local travel by residents living near project area going to and from Haleiwa and other areas for various activities.

Year 2002 Traffic Conditions

By the year 2002 without the proposed Lihi Lani project, traffic conditions along Kamehameha Highway in Haleiwa are expected to improve, due to the completion of the Haleiwa Bypass Road. The LOS for motorists at the study locations are expected to operate with very long delays and slower speeds (LOS E and LOS F). Improvements such as traffic signalization and separate turn lanes may reduce delays for minor street traffic at the study intersections.

With the project in the year 2002, the LOS at the study locations and intersections would not change significantly from the year 2002 without project conditions. The project would access Kamehameha Highway via the proposed project access road. The following improvements are recommended at the new intersection of Kamehameha Highway and the project access road:

- Provide a left-turn storage lane along Kamehameha Highway for Haleiwa-bound left-turns into the project. The left-turn storage lane would alleviate possible delays or back-ups along Kamehameha Highway caused by vehicles turning into the project. This should also minimize rear-end collisions between through-traffic and vehicles slowing down or stopping to turn left into the project.

- Provide separate right and left-turn lanes for the makai-bound project access road. This will permit left turning vehicles to exit the project without creating unnecessary delays for drivers turning right onto Kamehameha Highway.

Year 2008 Traffic Conditions

In the year 2008 without the proposed Lihi Lani project, traffic conditions along Kamehameha Highway and at the study intersections are expected to worsen due to the projected increase in traffic volumes. Motorists exiting minor streets at the study intersections are expected to experience very long delays (LOS F). If the projected traffic volumes are realized by the year 2008, then additional laneage may be needed along with the year 2002 improvements at the study intersections.

With the project in year 2008, the LOS at the study locations and intersections along Kamehameha Highway is not expected to change significantly from the year 2008 without project condition. The intersections are expected to continue operating with long delays (LOS F) to minor street traffic. No additional improvements would be needed to accommodate the project traffic in the year 2008.

Traffic Contribution from Developments

The percentage of total traffic which is contributed from the Lihi Lani project and other future developments is shown in Table 13 for the weekday and weekend peak hours. The percentages were calculated using the years 2002 and 2008 forecasted traffic volumes at a section of Kamehameha Highway approaching the Pupukea Road intersection. The calculated percentage for Kamehameha Highway includes 1993 existing traffic plus the increase in through-traffic along Kamehameha Highway.

Table 13. Summary of Traffic Contribution along Kamehameha Highway for Years 2002 & 2008

Phases I & II - Year 2002:

Development	Morning Peak Hour Percentage	Afternoon Peak Hour Percentage	Sunday Peak Hour Percentage
Lihi Lani Project			
Market Housing	2.2%	2.9%	2.0%
Affordable Housing	0.9%	1.3%	1.7%
YMCA	0.9%	2.2%	1.0%
Ranch Facilities	0.8%	0.8%	0.5%
Lihi Lani Subtotal	4.8%	7.2%	5.2%
Kamehameha Hwy.	45.6%	51.0%	57.5%
Other Regional Developments*	49.6%	41.8%	37.3%
Total Percentage	100.0%	100.0%	100.0%

Phases III & IV - Year 2008:

Development	Morning Peak Hour Percentage	Afternoon Peak Hour Percentage	Sunday Peak Hour Percentage
Lihi Lani Project			
Market Housing	3.4%	4.7%	3.3%
Affordable Housing	0.8%	1.1%	1.4%
YMCA	0.7%	1.8%	0.8%
Ranch Facilities	0.6%	0.6%	0.5%
Lihi Lani Subtotal	5.5%	8.2%	6.0%
Kamehameha Hwy.	36.7%	42.6%	49.3%
Other Regional Developments*	57.8%	49.2%	44.7%
Total Percentage	100.0%	100.0%	100.0%

Note: * - Includes Kahuku Villages, Laie Developments, Kuilima Resort Expansion, and Pupukea Shopping Village

The major contributors to traffic congestion on Kamehameha Highway in the years 2002 and 2008 would be island-wide traffic growth, other developments, and local resident highway traffic. The Lihi Lani project contributes about 5 to 8% of the total traffic to Kamehameha Highway in the years 2002 and 2008. The market-priced residential units within Lihilani would be attributable for approximately 3 to 5% of the total Kamehameha Highway traffic volumes.

The traffic volumes forecasted for years 2002 and 2008 are estimated projections based on future developments planned for the North Shore area and future growth along Kamehameha Highway. The forecasts were based on estimated time schedules from developers for different projects in the area. The actual time schedules for the projects are subject to changes in the economy and market and these factors are difficult to anticipate at this time. If the planned projects are not developed according to their anticipated schedules, then the traffic volumes along the highway and proposed roadway improvements could differ from the findings described in this study.

Overall, the increase of through traffic volumes along Kamehameha Highway will likely create the need for improvements to the existing roadway facilities by the years 2002 and 2008. These improvements, with the exception of the project access road, would be needed with or without the proposed Lihi Lani project.

APPENDIX A

DEFINITION OF LEVEL-OF-SERVICE

FOR

TWO-LANE RURAL HIGHWAYS AND UNSIGNALIZED INTERSECTIONS

DEFINITION OF LEVEL-OF-SERVICE FOR TWO-LANE RURAL HIGHWAYS

Level of service for two-lane highways is defined in terms of *percent time delay.*

Level-of service A describes completely free-flow conditions. Motorists are able to drive at their desired speed. Driver would be delayed no more than 30 percent of the time by slow-moving vehicles. A maximum flow rate of 420 passenger cars per hour (pcph), total in both directions, may be achieved under ideal conditions.

Level-of-service B characterizes the region of traffic flow wherein speeds of 55 mph or slightly higher are expected on level terrain. Drivers are delayed up to 45 percent of the time on the average. Service flow rates of 750 pcph, total in both directions, can be achieved under ideal conditions.

Level-of-service C characterizes the region of traffic flow wherein speeds of 52 mph or slightly higher are expected on level terrain even though unrestricted passing demand exceeds passing capacity. Traffic flow is still stable. Drivers are delayed up to 60 percent of the time on the average. Service flow rates of 1200 pcph, total in both directions, can be achieved under ideal conditions.

Level-of-service D borders on unstable flow. Speeds of 50 mph or slightly higher can still be achieved on level terrain under ideal conditions. Passing demand is very high while passing capacity approaches zero. Traffic flow is still stable. Drivers are delayed up to 75 percent of the time on the average. Service flow rates of 1800 pcph, total in both directions, can be achieved under ideal conditions.

Level-of-service E is defined as traffic flow conditions on two-lane highways having a percent time delay of greater than 75 percent. Under ideal conditions, speeds will drop below 50 mph. Average travel speeds on highways with less than ideal conditions will be slower, as low as 25 mph on sustained upgrades. Under ideal conditions, capacity is 2800 pcph, total in both directions.

Level-of-service F represents heavily congested flow with traffic demand exceeding capacity. volumes are lower than capacity, and speeds are below capacity speed.

REFERENCE: Highway Capacity Manual (Special Report 209, 1985)

DEFINITION OF LEVEL-OF-SERVICE FOR UNSIGNALIZED INTERSECTIONS

The concept of levels-of-service is defined as a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers. A level-of-service definition generally describes these conditions in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety.

Six levels-of-service are defined for each type of facility for which analysis procedures are available. They are given letter designations, from A to F, with Level-of-Service A representing the best operating conditions and Level-of-Service F the worst.

Level-of-Service definitions--In general, the various levels of service are defined as follows for uninterrupted flow facilities:

Level-of-Service A represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high. The general level of comfort and convenience provided to the motorist, passenger, or pedestrian is excellent.

Level-of-Service B is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is slight decline in the freedom to maneuver within the traffic stream from LOS A. The level of comfort and convenience provided is somewhat less than at LOS A, because the presence of others in the traffic stream begins to affect individual behavior.

Level-of-Service C is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. The selection of speed is now affected by the presence of others, and maneuvering within the traffic stream requires substantial vigilance on the part of the user. The general level of comfort and convenience declines noticeably at this level.

Level-of-Service D represents high-density, but stable, flow. Speed and freedom to maneuver are severely restricted, and the driver or pedestrian experiences a generally poor level of comfort and convenience. Small increases in traffic flow will generally cause operational problems at this level.

Level-of-Service E represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform value. Freedom to maneuver within the traffic stream is extremely difficult, and it is generally accomplished by forcing a vehicle or pedestrian to "give way" to accommodate such a maneuver. Comfort and convenience levels are extremely poor, and driver or pedestrian frustration is generally high. Operations at this level are usually unstable, because small increases in flow or minor perturbations within the traffic stream will cause breakdowns.

Level-of-Service F is used to define forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. Queues form behind such locations. Operations within the queue are characterized by stop-and-go wave, and they are extremely unstable. Vehicles may progress at reasonable speeds for several hundred feet or more, then be required to stop in a cyclic fashion. Level-of-Service F is used to describe the operating conditions within the queue, as well as the point of the breakdown. It should be noted, however, that in many cases operating conditions of the vehicles or pedestrians discharged from the queue may be quite good. Nevertheless, it is the point at which arrival flow exceeds discharge flow which causes the queue to form, and Level-of-Service F is an appropriate designation for such points.

These definitions are general and conceptual in nature, and they apply primarily to uninterrupted flow. Levels-of-service for interrupted flow facilities vary widely in terms of both the user's perception of service quality and the operational variables used to describe them.

REFERENCE: Highway Capacity Manual (Special Report 209, 1985)

APPENDIX B

MANUAL TRAFFIC COUNT DATA

Intersection: Kamehameha Highway with Pupukea Road

Date: Wednesday, March 17, 1993

	Pupukea Road						Kamehameha Highway					
	Northbound			Southbound			Eastbound			Westbound		
Time (a.m.)	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
6:30 - 6:45	20	0	9	0	0	0	0	32	3	7	60	0
6:45 - 7:00	33	1	11	0	0	0	0	31	1	3	57	0
7:00 - 7:15	24	0	14	0	0	0	0	44	6	2	63	0
7:15 - 7:30	32	0	19	0	0	2	1	50	7	7	73	2
7:30 - 7:45	30	0	28	1	0	0	0	65	10	6	82	0
7:45 - 8:00	23	0	14	0	0	0	0	48	9	17	78	0
8:00 - 8:15	21	0	15	1	0	0	0	53	10	8	77	1
8:15 - 8:30	29	0	21	2	0	0	1	51	6	3	83	1
8:30 - 8:45	19	1	7	0	0	2	1	54	5	13	56	1
8:45 - 9:00	16	0	9	2	0	0	1	52	3	13	80	0
Peak Hour Totals 7:30 - 8:30	103	0	78	4	0	0	1	217	35	34	320	2

Date: Tuesday, March 16, 1993

	Pupukea Road						Kamehameha Highway					
	Northbound			Southbound			Eastbound			Westbound		
Time (p.m.)	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
3:15 - 3:30	10	0	10	2	1	1	1	108	27	13	74	1
3:30 - 3:45	19	1	10	1	0	0	2	112	23	17	107	1
3:45 - 4:00	9	0	7	0	1	2	0	128	29	7	104	0
4:00 - 4:15	8	0	16	3	0	0	1	116	28	9	90	0
4:15 - 4:30	16	0	13	0	0	1	1	120	36	7	68	0
4:30 - 4:45	20	0	19	0	0	0	1	114	32	9	76	0
4:45 - 5:00	9	0	8	0	0	0	5	113	31	17	74	0
5:00 - 5:15	13	0	7	4	0	0	1	100	33	5	67	1
Peak Hour Totals 3:30 - 4:30	52	1	46	4	1	3	1	476	116	40	389	1

Date: Sunday, March 21, 1993

	Pupukea Road						Kamehameha Highway					
	Northbound			Southbound			Eastbound			Westbound		
Time (p.m.)	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
2:00 - 2:15	19	1	18	0	1	1						
2:15 - 2:30	0	0	0	0	0	0	3	133	25	9	202	1
2:30 - 2:45	29	1	10	0	0	4	0	0	0	0	0	0
2:45 - 3:00	25	1	11	0	0	2	2	129	19	14	168	3
3:00 - 3:15	15	1	17	1	0	4	3	109	22	10	115	1
3:15 - 3:30	15	0	9	1	0	1	2	136	28	13	130	2
3:30 - 3:45	19	1	19	2	0	5	6	107	25	12	138	0
3:45 - 4:00	16	0	8	2	0	1	4	138	28	9	163	0
4:00 - 4:15	22	1	17	1	1	3	1	128	13	15	155	2
4:15 - 4:30	19	0	15	0	0	1	1	135	17	18	135	0
4:30 - 4:45	22	0	15	1	0	0	1	98	21	11	134	0
4:45 - 5:00	18	1	18	1	0	0	0	87	13	18	108	0
Peak Hour Totals 3:15 - 4:15	84	3	47	2	0	11	13	481	92	49	551	6

Intersection: **Kamehameha Highway with Sunset Beach Elementary School Driveway**

Date: Wednesday, March 17, 1993

	Kamehameha Highway				Sunset Beach Elementary Driveway	
	Laie Bound		Haleiwa Bound		Makai Bound	
Time (a.m.)	TH	RT	LT	TH	LT	RT
6:30 - 6:45	34	3	1	61	1	1
6:45 - 7:00	40	7	4	50	2	0
7:00 - 7:15	35	7	7	64	2	3
7:15 - 7:30	77	22	13	77	6	7
7:30 - 7:45	65	32	30	76	21	16
7:45 - 8:00	82	24	23	70	24	19
8:00 - 8:15	43	7	4	75	6	9
8:15 - 8:30	59	1	1	61	11	2
Peak Hour Totals						
7:15 - 8:15	267	85	70	298	57	51

Date: Tuesday, March 16, 1993

	Kamehameha Highway				Sunset Beach Elementary Driveway	
	Laie Bound		Haleiwa Bound		Makai Bound	
Time (p.m.)	TH	RT	LT	TH	LT	RT
3:15 - 3:30	101	1	8	86	5	2
3:30 - 3:45	144	7	2	9	5	6
3:45 - 4:00	117	6	4	117	6	2
4:00 - 4:15	108	5	1	104	5	5
4:15 - 4:30	134	2	3	83	2	0
4:30 - 4:45	125	4	5	98	4	4
4:45 - 5:00	114	3	3	85	6	4
5:00 - 5:15	110	6	2	87	2	2
Peak Hour Totals						
3:30 - 4:30	803	20	10	403	18	13

Date: Sunday, March 21, 1993

	Kamehameha Highway				Sunset Beach Elementary Driveway	
	Laie Bound		Haleiwa Bound		Makai Bound	
Time (p.m.)	TH	RT	LT	TH	LT	RT
2:00 - 2:15	162	7	2	166	6	2
2:15 - 2:30	131	8	3	191	3	2
2:30 - 2:45	144	12	4	199	9	3
2:45 - 3:00	148	7	1	131	3	5
3:00 - 3:15	146	7	1	148	2	5
3:15 - 3:30	132	5	1	158	5	3
3:30 - 3:45	158	3	1	178	1	2
3:45 - 4:00	133	5	3	178	5	4
4:00 - 4:15	171	1	2	150	0	3
4:15 - 4:30	148	2	1	169	6	3
4:30 - 4:45	149	2	2	138	5	2
4:45 - 5:00	143	1	0	137	2	0
5:00 - 5:15	113	5	2	133	3	2
5:15 - 5:30	142	5	1	108	15	3
5:30 - 5:45	103	1	2	119	1	3
5:45 - 6:00	94	2	2	86	0	4
Peak Hour Totals						
2:00 - 3:00	585	34	10	687	21	12

Intersection: Kamehameha Highway at Haleiwa Beach Park

Date: Wednesday, March 17, 1993

	Kamehameha Hwy	
	Kahuku-Bound	Honolulu-Bound
Time (a.m.)	TH	TH
6:30 - 6:45	117	63
6:45 - 7:00	120	50
7:00 - 7:15	117	65
7:15 - 7:30	120	78
7:30 - 7:45	109	123
7:45 - 8:00	128	93
8:00 - 8:15	121	87
8:15 - 8:30	130	71
Peak Hour		
Totals		
7:30 - 8:30	488	374

Date: Tuesday, March 16, 1993

	Kamehameha Hwy	
	Kahuku-Bound	Honolulu-Bound
Time (p.m.)	TH	TH
3:15 - 3:30	143	155
3:30 - 3:45	150	136
3:45 - 4:00	139	213
4:00 - 4:15	149	201
4:15 - 4:30	125	196
4:30 - 4:45	136	161
4:45 - 5:00	136	178
5:00 - 5:15	118	152
Peak Hour		
Totals		
3:45 - 4:45	549	771

Date: Sunday, March 21, 1993

	Kamehameha Hwy	
	Kahuku-Bound	Haleiwa-Bound
Time (p.m.)	TH	TH
2:00 - 2:15	172	135
2:15 - 2:30	198	192
2:30 - 2:45	197	238
2:45 - 3:00	181	202
3:00 - 3:15	221	199
3:15 - 3:30	168	210
3:30 - 3:45	164	230
3:45 - 4:00	169	205
4:00 - 4:15	150	238
4:15 - 4:30	139	233
4:30 - 4:45	130	150
4:45 - 5:00	100	164
5:00 - 5:15	112	227
5:15 - 5:30	105	241
5:30 - 5:45	117	230
5:45 - 6:00	114	241
Peak Hour		
Totals		
4:15 - 5:15	481	774

Intersection: Kamehameha Highway at Kahuku Sugar Mill

Date: Wednesday, March 17, 1993

	Kamehameha Hwy	
	Kahuku-Bound	Honolulu-Bound
Time (a.m.)	TH	TH
6:30 - 6:45	24	25
6:45 - 7:00	37	37
7:00 - 7:15	32	34
7:15 - 7:30	56	47
7:30 - 7:45	61	48
7:45 - 8:00	85	55
8:00 - 8:15	42	39
8:15 - 8:30	42	38
8:30 - 8:45	38	55
Peak Hour Totals		
7:15 - 8:15	244	189

Date: Tuesday, March 16, 1993

	Kamehameha Hwy	
	Kahuku-Bound	Honolulu-Bound
Time (p.m.)	TH	TH
3:15 - 3:30	63	79
3:30 - 3:45	70	67
3:45 - 4:00	76	66
4:00 - 4:15	84	71
4:15 - 4:30	75	55
4:30 - 4:45	77	49
4:45 - 5:00	77	55
5:00 - 5:15	64	53
Peak Hour Totals		
3:15 - 4:15	293	283

Date: Sunday, March 21, 1993

	Kamehameha Hwy	
	Kahuku-Bound	Haleiwa-Bound
Time (p.m.)	TH	TH
2:00 - 2:15	98	128
2:15 - 2:30	96	117
2:30 - 2:45	101	98
2:45 - 3:00	98	123
3:00 - 3:15	91	96
3:15 - 3:30	103	103
3:30 - 3:45	110	113
3:45 - 4:00	104	87
4:00 - 4:15	84	89
4:15 - 4:30	103	73
4:30 - 4:45	116	75
4:45 - 5:00	100	58
5:00 - 5:15	96	68
5:15 - 5:30	85	61
Peak Hour Totals		
3:00 - 4:00	408	399

APPENDIX C

TRIP GENERATION RATES FOR SINGLE-FAMILY RESIDENTIAL LAND USE

The trip generation for the future residential land uses in the North Shore area were derived from data in the Institute of Transportation Engineers (ITE) Trip Generation Report[1] and existing traffic counts taken at a nearby residential development. The trip generation rates in the Trip Generation Report were adjusted due to the lower number of trips generated by homes located in rural areas.

A comparison of the ITE rates for single-family residential units with the rates derived from traffic counts at the nearby Pupukea residential development is shown in Table C1. For this study, the ITE trip rates were reduced by 30% for the weekday morning, afternoon, and weekend peak hours to more closely represent the number of trips generated in rural areas.

Table C1. Comparison of Trip Generation Rates for Single-Family Residential Land Use

	Enter	Exit
ITE Trip Generation Rates:		
Weekday AM Peak	0.19	0.55
Weekend PM Peak	0.66	0.35
Weekend Peak	0.44	0.44
Trip Generation Rates Derived from Pupukea Road Traffic Counts:		
Weekday AM Peak	0.12	0.31
Weekend PM Peak	0.27	0.17
Weekend Peak	0.24	0.23
***Reduced (-30%) ITE Trip Generation Rates:**		
Weekday AM Peak	0.13	0.39
Weekend PM Peak	0.46	0.25
Weekend Peak	0.31	0.31

Trip Generation Equation:

T = Trip Rate x N

Where T = Total number of trips; N = Number of residential units

Note: * - Selected for use in this study

[1] Trip Generation Report, by the Institute of Transportation Engineers, Fifth Edition, 1991.

APPENDIX A

DEFINITION OF LEVEL-OF-SERVICE

FOR

TWO-LANE RURAL HIGHWAYS AND UNSIGNALIZED INTERSECTIONS

DEFINITION OF LEVEL-OF-SERVICE FOR TWO-LANE RURAL HIGHWAYS

Level of service for two-lane highways is defined in terms of *percent time delay*.

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Level-of-service B characterizes the region of traffic flow wherein speeds of 55 mph or slightly higher are expected on level terrain. Drivers are delayed up to 45 percent of the time on the average. Service flow rates of 750 pcph, total in both directions, can be achieved under ideal conditions.

Level-of-service C characterizes the region of traffic flow wherein speeds of 52 mph or slightly higher are expected on level terrain even though unrestricted passing demand exceeds passing capacity. Traffic flow is still stable. Drivers are delayed up to 60 percent of the time on the average. Service flow rates of 1200 pcph, total in both directions, can be achieved under ideal conditions.

Level-of-service D borders on unstable flow. Speeds of 50 mph or slightly higher can still be achieved on level terrain under ideal conditions. Passing demand is very high while passing capacity approaches zero. Traffic flow is still stable. Drivers are delayed up to 75 percent of the time on the average. Service flow rates of 1800 pcph, total in both directions, can be achieved under ideal conditions.

Level-of-service E is defined as traffic flow conditions on two-lane highways having a percent time delay of greater than 75 percent. Under ideal conditions, speeds will drop below 50 mph. Average travel speeds on highways with less than ideal conditions will be slower, as low as 25 mph on sustained upgrades. Under ideal conditions, capacity is 2800 pcph, total in both directions.

Level-of-service F represents heavily congested flow with traffic demand exceeding capacity. volumes are lower than capacity, and speeds are below capacity speed.

REFERENCE: Highway Capacity Manual (Special Report 209, 1985)

DEFINITION OF LEVEL-OF-SERVICE FOR UNSIGNALIZED INTERSECTIONS

The concept of levels-of-service is defined as a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers. A level-of-service definition generally describes these conditions in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety.

Six levels-of-service are defined for each type of facility for which analysis procedures are available. They are given letter designations, from A to F, with Level-of-Service A representing the best operating conditions and Level-of-Service F the worst.

Level-of-Service definitions--In general, the various levels of service are defined as follows for uninterrupted flow facilities:

Level-of-Service A represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high. The general level of comfort and convenience provided to the motorist, passenger, or pedestrian is excellent.

Level-of-Service B is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is slight decline in the freedom to maneuver within the traffic stream from LOS A. The level of comfort and convenience provided is somewhat less than at LOS A, because the presence of others in the traffic stream begins to affect individual behavior.

Level-of-Service C is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. The selection of speed is now affected by the presence of others, and maneuvering within the traffic stream requires substantial vigilance on the part of the user. The general level of comfort and convenience declines noticeably at this level.

Level-of-Service D represents high-density, but stable, flow. Speed and freedom to maneuver are severely restricted, and the driver or pedestrian experiences a generally poor level of comfort and convenience. Small increases in traffic flow will generally cause operational problems at this level.

Level-of-Service E represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform value. Freedom to maneuver within the traffic stream is extremely difficult, and it is generally accomplished by forcing a vehicle or pedestrian to "give way" to accommodate such a maneuver. Comfort and convenience levels are extremely poor, and driver or pedestrian frustration is generally high. Operations at this level are usually unstable, because small increases in flow or minor perturbations within the traffic stream will cause breakdowns.

Level-of-Service F is used to define forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. Queues form behind such locations. Operations within the queue are characterized by stop-and-go wave, and they are extremely unstable. Vehicles may progress at reasonable speeds for several hundred feet or more, then be required to stop in a cyclic fashion. Level-of-Service F is used to describe the operating conditions within the queue, as well as the point of the breakdown. It should be noted, however, that in many cases operating conditions of the vehicles or pedestrians discharged from the queue may be quite good. Nevertheless, it is the point at which arrival flow exceeds discharge flow which causes the queue to form, and Level-of-Service F is an appropriate designation for such points.

These definitions are general and conceptual in nature, and they apply primarily to uninterrupted flow. Levels-of-service for interrupted flow facilities vary widely in terms of both the user's perception of service quality and the operational variables used to describe them.

REFERENCE: Highway Capacity Manual (Special Report 209, 1985)

APPENDIX B

MANUAL TRAFFIC COUNT DATA

Intersection: Kamehameha Highway with Pupukea Road

Date: Wednesday, March 17, 1993

	Pupukea Road						Kamehameha Highway					
	Northbound			Southbound			Eastbound			Westbound		
Time (a.m.)	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
6:30 - 6:45	20	0	9	0	0	0	0	32	3	7	60	0
6:45 - 7:00	33	1	11	0	0	0	0	31	1	3	57	0
7:00 - 7:15	24	0	14	0	0	0	0	44	6	2	68	0
7:15 - 7:30	32	0	19	0	0	2	1	60	7	7	73	2
7:30 - 7:45	30	0	28	1	0	0	0	65	10	6	82	0
7:45 - 8:00	23	0	14	0	0	0	0	48	9	17	78	0
8:00 - 8:15	21	0	15	1	0	0	0	53	10	8	77	1
8:15 - 8:30	29	0	21	2	0	0	1	51	6	3	83	1
8:30 - 8:45	19	1	7	0	0	2	1	54	5	13	58	1
8:45 - 9:00	16	0	9	2	0	0	1	62	3	13	80	0
Peak Hour Totals												
7:30 - 8:30	103	0	78	4	0	0	1	217	35	34	320	2

Date: Tuesday, March 16, 1993

	Pupukea Road						Kamehameha Highway					
	Northbound			Southbound			Eastbound			Westbound		
Time (p.m.)	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
3:15 - 3:30	10	0	10	2	1	1	1	106	27	13	74	1
3:30 - 3:45	19	1	10	1	0	0	2	112	23	17	107	1
3:45 - 4:00	9	0	7	0	1	2	0	128	29	7	104	0
4:00 - 4:15	8	0	16	3	0	0	1	116	28	9	90	0
4:15 - 4:30	16	0	13	0	0	1	1	120	36	7	88	0
4:30 - 4:45	20	0	19	0	0	0	1	114	32	9	76	0
4:45 - 5:00	9	0	8	0	0	0	5	113	31	17	74	0
5:00 - 5:15	13	0	7	4	0	0	1	100	33	5	67	1
Peak Hour Totals												
3:30 - 4:30	52	1	46	4	1	3	1	476	116	40	389	1

Date: Sunday, March 21, 1993

	Pupukea Road						Kamehameha Highway					
	Northbound			Southbound			Eastbound			Westbound		
Time (p.m.)	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
2:00 - 2:15	19	1	18	0	1	1						
2:15 - 2:30	0	0	0	0	0	0	3	133	25	9	202	1
2:30 - 2:45	29	1	10	0	0	4	0	0	0	0	0	0
2:45 - 3:00	25	1	11	0	0	2	2	129	19	14	168	3
3:00 - 3:15	15	1	17	1	0	4	3	109	22	10	115	1
3:15 - 3:30	15	0	9	1	0	1	2	136	28	13	130	2
3:30 - 3:45	19	1	19	2	0	5	6	107	25	12	138	0
3:45 - 4:00	16	0	8	2	0	1	4	138	28	9	163	0
4:00 - 4:15	22	1	17	1	1	3	1	128	13	15	155	2
4:15 - 4:30	19	0	15	0	0	1	1	135	17	18	135	0
4:30 - 4:45	22	0	15	1	0	0	1	98	21	11	134	0
4:45 - 5:00	18	1	18	1	0	0	0	87	13	18	108	0
Peak Hour Totals												
3:15 - 4:15	84	3	47	2	0	11	13	481	92	49	551	6

Intersection: Kamehameha Highway with Sunset Beach Elementary School Driveway

Date: Wednesday, March 17, 1993

	Kamehameha Highway				Sunset Beach Elementary Driveway	
	Laie Bound		Haleiwa Bound		Makai Bound	
Time (a.m.)	TH	RT	LT	TH	LT	RT
6:30 - 6:45	34	3	1	61	1	1
6:45 - 7:00	40	7	4	50	2	0
7:00 - 7:15	35	7	7	64	2	3
7:15 - 7:30	77	22	13	77	6	7
7:30 - 7:45	65	32	30	76	21	16
7:45 - 8:00	82	24	23	70	24	19
8:00 - 8:15	43	7	4	75	6	9
8:15 - 8:30	59	1	1	61	11	2
Peak Hour Totals						
7:15 - 8:15	267	85	70	298	57	51

Date: Tuesday, March 16, 1993

	Kamehameha Highway				Sunset Beach Elementary Driveway	
	Laie Bound		Haleiwa Bound		Makai Bound	
Time (p.m.)	TH	RT	LT	TH	LT	RT
3:15 - 3:30	101	1	8	66	5	2
3:30 - 3:45	144	7	2	9	5	6
3:45 - 4:00	117	6	4	117	6	2
4:00 - 4:15	108	5	1	104	5	5
4:15 - 4:30	134	2	3	83	2	0
4:30 - 4:45	125	4	5	86	4	4
4:45 - 5:00	114	3	3	85	6	4
5:00 - 5:15	110	6	2	87	2	2
Peak Hour Totals						
3:30 - 4:30	503	20	10	403	18	13

Date: Sunday, March 21, 1993

	Kamehameha Highway				Sunset Beach Elementary Driveway	
	Laie Bound		Haleiwa Bound		Makai Bound	
Time (p.m.)	TH	RT	LT	TH	LT	RT
2:00 - 2:15	162	7	2	166	6	2
2:15 - 2:30	131	8	3	191	3	2
2:30 - 2:45	144	12	4	199	9	3
2:45 - 3:00	148	7	1	131	3	5
3:00 - 3:15	146	7	1	148	2	5
3:15 - 3:30	132	5	1	156	5	3
3:30 - 3:45	158	3	1	178	1	2
3:45 - 4:00	133	5	3	178	5	4
4:00 - 4:15	171	1	2	150	0	3
4:15 - 4:30	148	2	1	169	6	3
4:30 - 4:45	149	2	2	138	5	2
4:45 - 5:00	143	1	0	137	2	0
5:00 - 5:15	113	5	2	133	3	2
5:15 - 5:30	142	5	1	108	15	3
5:30 - 5:45	103	1	2	119	1	3
5:45 - 6:00	94	2	2	86	0	4
Peak Hour Totals						
2:00 - 3:00	585	34	10	687	21	12

Intersection: Kamehameha Highway at Haleiwa Beach Park

Date: Wednesday, March 17, 1993

	Kamehameha Hwy	
	Kahuku-Bound	Honolulu-Bound
Time (a.m.)	TH	TH
6:30 - 6:45	117	63
6:45 - 7:00	120	50
7:00 - 7:15	117	65
7:15 - 7:30	120	78
7:30 - 7:45	109	123
7:45 - 8:00	128	93
8:00 - 8:15	121	87
8:15 - 8:30	130	71
Peak Hour Totals		
7:30 - 8:30	488	374

Date: Tuesday, March 16, 1993

	Kamehameha Hwy	
	Kahuku-Bound	Honolulu-Bound
Time (p.m.)	TH	TH
3:15 - 3:30	143	155
3:30 - 3:45	150	136
3:45 - 4:00	139	213
4:00 - 4:15	149	201
4:15 - 4:30	125	196
4:30 - 4:45	136	161
4:45 - 5:00	136	178
5:00 - 5:15	118	152
Peak Hour Totals		
3:45 - 4:45	549	771

Date: Sunday, March 21, 1993

	Kamehameha Hwy	
	Kahuku-Bound	Haleiwa-Bound
Time (p.m.)	TH	TH
2:00 - 2:15	172	135
2:15 - 2:30	198	192
2:30 - 2:45	197	238
2:45 - 3:00	181	202
3:00 - 3:15	221	199
3:15 - 3:30	168	210
3:30 - 3:45	164	230
3:45 - 4:00	169	205
4:00 - 4:15	150	238
4:15 - 4:30	139	233
4:30 - 4:45	130	150
4:45 - 5:00	100	164
5:00 - 5:15	112	227
5:15 - 5:30	105	241
5:30 - 5:45	117	230
5:45 - 6:00	114	241
Peak Hour Totals		
4:15 - 5:15	481	774

Intersection: Kamehameha Highway at Kahuku Sugar Mill

Date:Wednesday, March 17, 1993

	Kamehameha Hwy	
	Kahuku-Bound	Honolulu-Bound
Time (a.m.)	TH	TH
6:30 - 6:45	24	25
6:45 - 7:00	37	37
7:00 - 7:15	32	34
7:15 - 7:30	56	47
7:30 - 7:45	61	48
7:45 - 8:00	85	55
8:00 - 8:15	42	39
8:15 - 8:30	42	38
8:30 - 8:45	36	55
Peak Hour Totals		
7:15 - 8:15	244	189

Date:Tuesday, March 16, 1993

	Kamehameha Hwy	
	Kahuku-Bound	Honolulu-Bound
Time (p.m.)	TH	TH
3:15 - 3:30	63	79
3:30 - 3:45	70	67
3:45 - 4:00	76	66
4:00 - 4:15	84	71
4:15 - 4:30	75	65
4:30 - 4:45	77	49
4:45 - 5:00	77	65
5:00 - 5:15	64	63
Peak Hour Totals		
3:15 - 4:15	293	283

Date: Sunday, March 21, 1993

	Kamehameha Hwy	
	Kahuku-Bound	Haleiwa-Bound
Time (p.m.)	TH	TH
2:00 - 2:15	96	128
2:15 - 2:30	96	117
2:30 - 2:45	101	96
2:45 - 3:00	96	123
3:00 - 3:15	91	96
3:15 - 3:30	103	103
3:30 - 3:45	110	113
3:45 - 4:00	104	87
4:00 - 4:15	84	89
4:15 - 4:30	103	73
4:30 - 4:45	116	75
4:45 - 5:00	100	58
5:00 - 5:15	96	68
5:15 - 5:30	86	61
Peak Hour Totals		
3:00 - 4:00	408	399

APPENDIX C

TRIP GENERATION RATES FOR SINGLE-FAMILY RESIDENTIAL LAND USE

The trip generation for the future residential land uses in the North Shore area were derived from data in the Institute of Transportation Engineers (ITE) Trip Generation Report[1] and existing traffic counts taken at a nearby residential development. The trip generation rates in the Trip Generation Report were adjusted due to the lower number of trips generated by homes located in rural areas.

A comparison of the ITE rates for single-family residential units with the rates derived from traffic counts at the nearby Pupukea residential development is shown in Table C1. For this study, the ITE trip rates were reduced by 30% for the weekday morning, afternoon, and weekend peak hours to more closely represent the number of trips generated in rural areas.

[1] Trip Generation Report, by the Institute of Transportation Engineers, Fifth Edition, 1991.

Table C1. Comparison of Trip Generation Rates
for Single-Family Residential Land Use

ITE Trip Generation Rates:

	Enter	Exit
Weekday AM Peak	0.19	0.55
Weekend PM Peak	0.66	0.35
Weekend Peak	0.44	0.44

Trip Generation Rates Derived from Pupukea Road Traffic Counts:

	Enter	Exit
Weekday AM Peak	0.12	0.31
Weekend PM Peak	0.27	0.17
Weekend Peak	0.24	0.23

***Reduced (-30%) ITE Trip Generation Rates:**

	Enter	Exit
Weekday AM Peak	0.13	0.39
Weekend PM Peak	0.46	0.25
Weekend Peak	0.31	0.31

Trip Generation Equation:

T = Trip Rate x N

Where T = Total number of trips; N = Number of residential units

Note: * - Selected for use in this study

APPENDIX K

Update of Lihi Lani Socio-Economic Impact Assessment

UPDATE OF LIHI LANI SOCIO-ECONOMIC IMPACT ASSESSMENT

September 1993

Prepared for:
Obayashi Hawaii Corporation
Group 70 International

Prepared by:
Community Resources, Inc.

INTRODUCTION

This brief report updates our **Socio-Economic Impact Assessment of the proposed Lihi Lani Recreational Community** (January 1991, termed "the 1991 SIA" herein) by providing:

- Tables showing information from the 1990 Census on the demographic, household, and income characteristics of the inhabitants of areas surrounding the project site;
- A discussion of the relationship between the revised project's population/housing impacts and City and County policies concerning regional growth; and
- An overview of the major social impacts of the revised project, insofar as these are different from the impacts anticipated in our earlier report.

For the 1991 assessment, Community Resources, Inc. (CRI) conducted an extensive review of existing and anticipated conditions in the area, and estimated impacts in relation to those conditions. For this report, CRI has updated its account of regional trends and facilities by noting (a) the Census data shown in Exhibits A to E, enclosed, and (b) changes in Development Plan status of land and public facilities in the Koolauloa/North Shore region.

The revised project is a low density residential development with recreational amenities available to the whole community. In contrast, the 1991 project included golf and tennis features that some in the community saw as exclusive and as attracting a new, distinctive group of residents to the North Shore. Major impacts of the <u>revised</u> project (compared to 1991 SIA) noted in this report include:

- Slower buildout (and hence slower development of impacts on public services, traffic, and infrastructure);
- In the long run, a larger residential population -- but the revised project population would exceed the earlier project's population only by the year 2010 or later;
- <u>Less</u> additional enrollment in schools in the next ten years or more, due to the slow buildout, coupled with <u>increased</u> total contributions to a scholarship fund;
- Appreciably smaller operations employment and daily visitor population (due to the removal of the golf course from the project);

- Provision of a site for elderly housing; and
- Fewer affordable housing units than were planned in the 1991 version of Lihi Lani.

Some potential social <u>issues</u> -- such as the "compatibility" of elderly housing in an area currently dedicated to youth activities -- are likely to depend on the perceptions of those involved. This report focuses more on specific impacts, such as school enrollments, for which it is possible to provide clear estimates.

PROJECT DESCRIPTION

The Lihi Lani Recreational Community Proposal has changed in several respects. It now includes:

- A total of 315 large lots, one to three acres in size, with agricultural easements (compared to 120 one-acre lots proposed in 1991);
- Fifty affordable single-family homes, to be built on site (compared to 180 single- and multi-family units in 1991);
- A six-acre parcel to be deeded to the City and County of Honolulu for development of 80 units of affordable rental housing for the elderly;
- A commitment to fund construction of additional affordable housing units off-site; and
- Recreation facilities -- including a horse ranch, trails, a campground, and an area set aside for community facilities. Major differences between the new proposal and the 1991 are (a) the project now includes no golf course or tennis center, and (b) community facilities would consist of a North Shore YMCA, with a swimming pool, and nearby playing fields.

SOCIO-ECONOMIC CONDITIONS

Exhibits A through E at the end of this report update the account of demographic, household, income, and labor force characteristics of residents of the surrounding area, based on the 1990 Census. They deal with:

- The **Pupukea Census Designated Place** (CDP), an area between Waimea Bay and Kawela Bay, including residential areas in Waimea, Sunset Beach, and Pupukea. This is equivalent to the **Primary Study Area** in the 1991 SIA.

- **The North Shore and Koolauloa** Census Divisions. Together these make up the **Total Study Area** considered in the 1991 SIA.

  The Census Divisions are not identical with the Development Plan areas of the same name. The Pupukea CDP is in the Koolauloa Census division (and the Koolauloa State judicial district) but in the North Shore Development Plan (DP) area. Finally, the combined Koolauloa/North Shore region is the same, whether divisions, districts, or DP areas are under study. (See Community Resources, Inc., 1991, Figure 2-2, for the boundaries of the various areas.)

- **The City and County of Honolulu.**

CENSUS DATA. The 1990 Census showed several findings and trends of interest:

- **Demography:** The 1980's saw growth in the study area at rates higher than anticipated:
  - The Primary Study Area population was 4,111 in 1990, as shown in Exhibit A. This represents an increase of nearly 900 persons (or 28%) over the 1980 figure of 3,212 persons.
  - The Total Study Area population grew to nearly 30,000, nearly 3.6% of the countywide resident population (compared to the 1989 estimate of 3.1% reported in the 1991 SIA).
  - The average annual rate of population increase for the Total Study Area has been consistently 2% or above, from 1950 to 1990. In the 1980's, population growth in the Primary Study Area averaged 2.5% annually, nearly as much as in Koolauloa. (In this decade, the City and County rate of population increase slowed to 0.9% annually.)
  - In all areas studied, the population is aging. The median age has increased to about 32 years for both the County and the Primary Study Area (compared to 28 and 27 years respectively in 1980).
  - In 1990, about 40% of the Pupukea CDP population was born in Hawaii, and 50% was born elsewhere in the United States, while over half the population of the Total Study Area was Hawaii-born (as shown in Exhibit B).

EXHIBIT A: DEMOGRAPHIC CHARACTERISTICS, 1990

	HONOLULU COUNTY	Koolauloa/ North Shore	Koolauloa Division	North Shore Division	Pupukea CDP (1)
POPULATION	836,231	29,992	18,443	11,549	4,111
ETHNICITY					
Caucasian	32%	36%	39%	32%	64%
Japanese	23%	9%	6%	14%	6%
Filipino	14%	18%	8%	33%	12%
Hawaiian	11%	20%	25%	12%	10%
Other	20%	18%	23%	9%	7%
AGE					
Less than 5 years	7%	9%	10%	7%	8%
5 to 17 years	17%	22%	22%	20%	18%
18 to 34 years	31%	31%	32%	29%	31%
35 to 64 years	34%	29%	28%	31%	35%
65 or more years	11%	9%	7%	12%	7%
Median age (years)	32.2	N/A	26.7	30.6	31.9
EDUCATION OF PERSONS AGED 25 & OVER (2)					
High School Diploma	28%	29%	25%	34%	22%
College Degree (3)	33%	27%	31%	22%	37%
PERSONS AGED 5 & OVER WHO SPEAK A LANGUAGE OTHER THAN ENGLISH AT HOME (2)	26%	25%	25%	25%	17%
PERSONS WITH MOBILITY OR SELF-CARE LIMITATIONS (2)					
% of persons aged 16 to 64	4%	5%	3%	9%	1%
% of persons aged 65 or more	18%	21%	18%	24%	21%

NOTES: N/A Data not available.
(1) In 1990, Pupukea CDP (Census Designated Place) was coterminous with Block Groups 2 & 3 of Census Tract 101. In 1980, this area was coterminous with Block Group 2 of Census Tract 101. Besides Pupukea, this area includes Sunset Beach from Kawela Bay to Waimea Bay. While Pupukea CDP lies within the Koolauloa Census Division -- a region coterminous with the State's Koolauloa Judicial District -- it is NOT part of the City's Koolauloa Development Plan Area. Rather, Pupukea CDP is considered part of the City's North Shore Development Plan Area.
(2) Based on 15% sample; hence, figures represent estimates only.
(3) Includes Associate, Bachelor's, and graduate degrees.

SOURCES: U.S. Bureau of the Census, 1992, 1991.

EXHIBIT B: GEOGRAPHIC MOBILITY, 1990 (1)

	HONOLULU COUNTY	Koolauloa/ North Shore	Koolauloa Division	North Shore Division	Pupukea CDP
PERSONS (2)					
PLACE OF BIRTH					
Born in Hawaii	54%	53%	50%	59%	39%
Other U.S.-born (3)	30%	32%	35%	27%	49%
Foreign-born	16%	15%	16%	14%	11%
RESIDENCE 5 YEARS PREVIOUS FOR PERSONS AGED 5 & OVER					
Same house	50%	52%	46%	62%	45%
Same county, different house	26%	25%	28%	18%	28%
Same state, different county	1%	1%	1%	1%	1%
Different state	17%	17%	17%	16%	22%
Lived abroad	5%	5%	7%	2%	5%
HOUSEHOLDERS (2)					
WHEN HOUSEHOLDER MOVED INTO UNIT					
In the last 5 years	53%	53%	57%	46%	59%
6 to 20 years ago	29%	33%	32%	33%	32%
21 to 30 years ago	10%	7%	5%	9%	6%
31 years ago or more	8%	8%	5%	12%	3%

NOTES: (1) Based on 15% sample; hence, figures represent estimates only.
(2) Base figures used in calculating these data may be different than in 100% count.
(3) Includes persons born in U.S. territories, and persons born abroad or at sea to American parents.

SOURCE: U.S. Bureau of the Census, 1992.

- The elderly formed a smaller share of the Total Study Area population than of the island population. A separate tabulation of the population age 60 and over (City and County of Honolulu, Department of Human Resources, Elderly Affairs Division, 1992) shows the North Shore DP Area to have nearly as many older residents as the islandwide average:

Share of Population Age 60 and over, 1990

City and County of Honolulu	15.4%
North Shore DP Area*	14.5%
Koolauloa DP Area*	9.2%

* Reported for Neighborhood Board areas, which are, in these cases, equivalent to DP areas.

- **Employment:** In 1990, 73% of Primary Study Area adults had civilian jobs -- a figure higher than found in the surrounding district and islandwide (as shown in Exhibit C).

- **Income:** Study area incomes were lower than islandwide figures, but costs were relatively high, especially in the Pupukea CDP:
  - The median household income in the Primary Study Area was nearly $38,400 in 1989 (as reported in the 1990 Census). This median was about 95% of the median reported for the entire county but well above the medians for the Koolauloa and North Shore Districts. (See Exhibit D.)
  - Median housing costs in the Primary Study Area were well above the islandwide medians for both homeowners and renters.
  - The share of the population living in poverty was 11% in the Total Study Area. In the Primary Study Area, this figure dropped to 9%, which is still above the islandwide median (7%).

- **Housing:** Data reported in the Census (in Exhibit E) pointed to problems of supply:
  - In both the Koolauloa and North Shore districts, average household size is higher than the islandwide average. In the Primary Study Area, however, the number of persons per household is nearly the same as islandwide.

EXHIBIT C: LABOR FORCE CHARACTERISTICS, 1990 (1)

	HONOLULU COUNTY	Koolauloa/ North Shore	Koolauloa Division	North Shore Division	Pupukea CDP
POPULATION AGED 16 & OVER	651,920	21,992	13,259	8,733	3,085
In Armed Forces	8%	4%	1%	8%	2%
POTENTIAL CIVILIAN LABOR FORCE	598,371	21,182	13,110	8,072	3,028
In Civilian Labor Force	69%	68%	69%	66%	73%
CIVILIAN LABOR FORCE	410,023	14,404	9,070	5,334	2,214
MALE					
Labor force participation (2)	75%	74%	76%	71%	83%
Unemployed	4%	4%	4%	2%	4%
FEMALE					
Labor force participation (2)	63%	62%	62%	61%	62%
Unemployed	3%	6%	5%	7%	6%
EMPLOYED CIVILIAN LABOR FORCE	395,811	13,746	8,645	5,101	2,114
BY SELECTED INDUSTRY					
Agriculture, forestry, fishing, mining	2%	5%	5%	5%	8%
Construction	7%	11%	11%	10%	15%
Manufacturing	6%	7%	4%	12%	9%
Transportation	7%	6%	6%	6%	5%
Retail trade	19%	15%	13%	18%	16%
Finance, insurance, real estate	8%	6%	5%	7%	4%
Personal, entertainment, recreation	8%	14%	18%	8%	11%
Health, education, professional	22%	24%	27%	18%	20%
Public administration	9%	7%	6%	9%	5%
BY OCCUPATION					
Managerial, professional	28%	25%	29%	19%	29%
Technical, sales, support	35%	26%	24%	29%	20%
Service	17%	19%	20%	18%	16%
Farming, forestry, fishing	2%	5%	5%	6%	7%
Precision, craft, repair	10%	13%	13%	14%	16%
Operators, cleaners, laborers	9%	11%	9%	14%	12%
COMMUTE TO WORK					
More than 45 minutes	16%	33%	34%	31%	37%
Mean travel time (minutes)	25	N/A	30	30	31

NOTES: (1) Based on 15% sample; hence, figures represent estimates only.
(2) Calculated by dividing "Civilian Labor Force" by "Potential Civilian Labor Force."

SOURCE: U.S. Bureau of the Census, 1992.

EXHIBIT D: INCOME CHARACTERISTICS AND COSTS, 1990 (1)

	HONOLULU COUNTY	Koolauloa/ North Shore	Koolauloa Division	North Shore Division	Pupukea CDP
HOUSEHOLDS (2)					
INCOME LEVEL					
Lowest (3)	13%	18%	20%	15%	16%
Highest (4)	39%	32%	33%	31%	37%
Median Income	$40,581	N/A	$35,830	$36,841	$38,382
WITH SELECTED INCOME SOURCES					
Social Security Income	24%	25%	20%	32%	15%
Retirement Income	20%	18%	15%	22%	10%
Public Assistance Income	6%	8%	8%	10%	6%
OWNER HOUSING COSTS (5)					
35% or more of Household Income	15%	17%	22%	12%	30%
Median Monthly Costs	$1,121	N/A	$963	$806	$1,411
RENTER HOUSING COSTS (6)					
35% or more of Household Income	34%	34%	38%	28%	37%
Median Gross Rent	$663	N/A	$625	$595	$816
Median Contract Rent (7)	$615	N/A	$563	$541	$710
POPULATION (2)					
PERSONS BELOW POVERTY LEVEL	7%	11%	13%	9%	9%
% of persons aged 18 to 64	6%	10%	12%	8%	9%
% of persons aged 65 or more	8%	9%	9%	8%	8%
% of related children aged less than 18	10%	14%	15%	12%	9%
% of unrelated individuals	19%	22%	23%	20%	15%

NOTES: (1) Based on 15% sample (except "Median Contract Rent"); hence, figures represent estimates only.
(2) Base figures used in calculating this data may be different than in 100% count.
(3) Incomes of less than $15,000.
(4) Incomes of $50,000 or more.
(5) Owner costs include (but are not limited to) mortgage, real property tax, property insurance, utilities, and fuels.
(6) Renter costs include (but are not limited to) rent, utilities, and fuels.
(7) Monthly cash rent only. Does not include other costs.

SOURCES: U.S. Bureau of the Census, 1992, 1991.

EXHIBIT E: HOUSING CHARACTERISTICS, 1990 (1)

	HONOLULU COUNTY	Koolauloa/ North Shore	Koolauloa Division	North Shore Division	Pupukea CDP
HOUSING UNITS	281,683	9,709	5,939	3,770	1,488
TOTAL VACANT UNITS	6%	13%	17%	8%	11%
Seasonal/recreational	2%	7%	9%	4%	5%
AGE OF STRUCTURE (1)					
1 year	2%	3%	4%	0%	4%
2 to 10 to years	14%	20%	20%	21%	22%
11 to 20 years	30%	32%	38%	23%	38%
21 years or more	54%	45%	37%	56%	36%
UNITS IN STRUCTURE					
1 unit	55%	77%	76%	79%	89%
2 to 4 units	7%	7%	7%	7%	7%
5 or more units	36%	15%	16%	12%	3%
Trailer, other	1%	1%	1%	2%	1%
NOT COMPLETE PLUMBING (1)	1%	2%	2%	2%	1%
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
HOUSEHOLDS	265,304	8,403	4,935	3,468	1,331
HOUSEHOLD TYPE					
1 or more non-relatives	12%	15%	15%	14%	25%
No non-relatives	88%	85%	85%	86%	75%
TENURE					
Owner-occupied	52%	47%	46%	47%	47%
Renter-occupied	48%	53%	54%	53%	53%
PERSONS PER HOUSEHOLD	3.02	3.39	3.50	3.24	3.03
CROWDED HOUSEHOLDS					
Mildly crowded (2)	8%	13%	14%	11%	10%
Very crowded (3)	8%	13%	14%	11%	8%
MEDIAN VALUE (4)	$283,600	N/A	$197,000	$180,900	$318,100

NOTES: (1) Based on 15% sample; hence, figures represent estimates only.
(2) Indicated by households with 1.00 to 1.50 persons per room.
(3) Indicated by households with 1.51 or more persons per room.
(4) For owner-occupied, non-condominium housing units.

SOURCES: U.S. Bureau of the Census, 1992, 1991.

- Vacant units comprised 13% of the housing stock in the Total Study Area. Most of the vacant units were held for seasonal or recreational use. If second homes are excluded, vacancy rates were similar to the islandwide average -- well below the 5% level usually taken as needed for buyers and renters to find appropriate housing when needed.

- Crowded conditions were reported in both districts of the Total Study Area, but conditions in the Primary Study Area were much like those of the island as a whole.

- The reported presence of non-relatives in a quarter of the housing units in the Primary Study Area points to the use of much housing by surfers and others, including transients, attracted by a surfing-oriented lifestyle.

HOUSING SUPPLY AND DEMAND. Demand for affordable housing is far greater than supply throughout Hawaii. The study area is no exception.

A 1990 regional needs assessment survey conducted for the Kuilima Resort Company provides further indication of housing problems (Community Resources, Inc. 1990). Notably, more than 20% of the "single-family" units surveyed actually included more than one unit (because additional units had been built, a home had been divided into more than one unit.

Doubling-up, crowding, and hidden units all testify to residents' need for affordable housing in the region. In addition, residents from other areas may seek homes in the Total Study Area. A 1992 market survey (Locations, Inc. and SMS Research and Marketing Services, 1993) showed that 3.3% of those interested in buying homes in Hawaii, and 10.1% of those seeking to rent, would like to live in the "North Shore" (i.e., the Total Study Area). This survey suggests that demand already exists for over 10,000 vacant or additional Study Area units.

Housing for the elderly is in short supply throughout Hawaii. A 1992 report estimated that wait lists for elderly housing included some 4,300 names (City and County of Honolulu, Department of Human Resources, Elderly Affairs Division, 1992). Applicants must wait three to six years for public housing, and a minimum of one and a half years for private projects. Remote rural elderly projects have shorter waiting times than most.

The City and County of Honolulu provided 115 housing units for low-income families at Kahuku Village. Kahuku Village Phase IV, with 132 affordable units for sale, is to begin construction in 1993. Elderly housing projects are located at Kahuku (24 units) and Waialua (40 units).

QUANTIFIED SOCIO-ECONOMIC IMPACTS

EMPLOYMENT. The updated economic and fiscal study by KPMG Peat Marwick (1993) shows that employment at the project will be smaller than expected in 1991, and construction will continue over a longer period than was originally forecast.

POPULATION. The resident population at Lihi Lani would be small in the next few years, and grow to about 750 in 2010. This is about 8% larger than the buildout population estimated in 1991.

The relatively slow buildout of housing anticipated by KPMG Peat Marwick is consistent with data from other large-lot subdivisions. Also, the reconfigured project lacks the membership features -- golf course and tennis center -- which could have spurred investors to build nearby homes sooner rather than later.

The residential population on site at Lihi Lani is now projected as about 370 persons by 2000, mostly in the affordable single-family units and the elderly rental units. Over time, the total project residential population would climb to about 750 in 2010 and about 975 at eventual buildout. Few daily visitors are projected, now that the project lacks a golf course.

Thus, the total (de facto) population impacts for the revised project would be appreciably less than for the original proposal until the project is nearly built out.

KPMG Peat Marwick estimates that 20% of Lihi Lani's country lot residents and 15% of employees could come from outside Hawaii. The total in-migrant population impact would amount to some 30 persons in the year 2000 and about 110 persons in 2010.

HOUSING. At buildout, the Lihi Lani site would include a total of 50 affordable units built by the developer, 315 houses built by owners, and 80 elderly units built by the City and County. The developer will also contribute towards construction of off-site affordable housing units.

The developer will fulfill the affordable housing requirement prescribed by the City and County. This calls for 30% of the total residential unit count to be affordable housing (as defined by City and County guidelines). Current plans call for 315 country lots, 50 affordable single-family homes and contribution of land and infrastructure to the City and County for construction of 80 elderly affordable rentals -- a total of 445 units. The affordable requirement -- 30% of 445 -- comes to 134 units. Obayashi will satisfy this requirement through (a) the 50 single-family affordable homes; (b) contributions for the elderly housing; and (c) any remaining contributions needed to reach the requirement made in the form of an in-lieu fee for off-site affordable housing projects developed by the City and County.

(In the 1991 version of Lihi Lani, 60% of the residential units were to be affordable, following the requirements then upheld by the State. The State is no longer demanding a 60/40 division of affordable and market housing. Instead, the City and County affordable housing requirement is being followed. The result is a decrease in the total number of affordable units contributed by the developer, although current plans should result in more housing for the elderly than in the 1991 version.)

The project will have fewer employees and will generate less demand for housing from in-migrant employees. Hence, the net result of the revised project is a small increase in the new housing stock available for study area residents, if the off-site affordable housing is built in the Total Study Area.

POPULATION AND HOUSING IN RELATION TO REGIONAL TRENDS AND POLICIES. The project is in keeping with the low-density character prized by many in the North Shore area. It will contribute to the ongoing trend of regional population growth.

The project's residential population in 2010 amounts to about 2.5% of the 1990 population of the Total Study Area, and 2.0% of the "population capacity" estimated by the City and County Department of Planning (1993) for the Total Study Area. (The population capacity of an area is a projection of population based on existing housing and residential approvals.)

The redesigned project will probably appeal to much the same market as the adjoining Pupukea Highlands. However, the density of population and housing in the revised Lihi Lani project is low in comparison with both Pupukea Highlands and the Sunset Beach coastal strip, as shown in Exhibit F.

The Honolulu General Plan sets out "guidelines" for population in the various Development Plan areas, expressed as target population shares for the year 2010. These were last amended in 1988. The 1990 Census showed that the current percentage share of the island's population living in the Kooloauloa and North Shore DP areas is already higher than that projected for 2010, as shown in Exhibit G. The 1990 population of Koolauloa DP area was already higher than the target population anticipated for 2010. Similarly, the estimated population capacity of the two DP areas combined is already about 18% above the upper limit of the 2010 population target (Planning Department, 1993).

The recent historical trend is for population growth in these and other outlying areas of Oahu. Such growth has been fairly constant, while the overall island growth rate has declined.

EXHIBIT F: LIHI LANI POPULATION & HOUSING DENSITIES IN COMPARISON TO 1990 STUDY AREA COMMUNITIES (1)

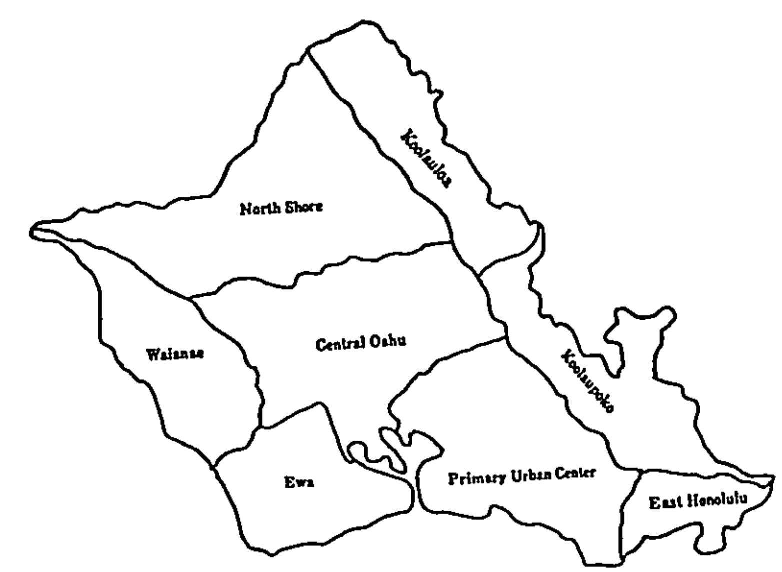
	Population in Households (2)	Housing Units	Acres	Persons per Acre	Housing Units per Acre
Pupukea Highlands (3)	1,594	571			
Total Acreage (4)			1,329	1.20	0.43
Residential Acreage (5)			745	2.14	0.77
Sunset Beach (6)	2,440	917	582	4.19	1.58
Proposed Lihi Lani Community, 2010 (7)	753	348			
Total Acreage			1,143	0.66	0.30
Residential Acreage			781	0.96	0.45

NOTES:
(1) Communities and acreages based on 1980 Census Block Group maps and statistics.
(2) Excludes 77 persons in group quarters.
(3) Comprised of Blocks 206, 207, 219, 220, 222, 223, and 224 in Census Tract 101.
(4) Acreage estimated by Community Resources Inc. from 1980 Census Block maps (U.S. Census, 1983).
(5) Acreage estimated by Group 70 International, covering all the subdivided area in Pupukea Highlands (rather than the total area included in Census blocks).
(6) The coastal portion of Pupukea CDP, from Kawela Bay to Waimea Bay. Population and housing units calculated here by subtracting Pupukea Highlands from total Pupukea CDP.
(7) Population estimate adapted from KPMG Peat Marwick, 1993. Acreages are from the 1993 Environmental Assessment.

SOURCES: U.S. Bureau of the Census, 1991, 1992.

EXHIBIT G: TARGET POPULATIONS FOR DEVELOPMENT PLAN AREAS

	1990		2010 Targets	
	Resident Population	% of Total	Projected Range of Population (1)	Target % of Total
OAHU TOTAL	836,231	100.0%	949,500 - 1,049,500	95.0% - 105.0%
Primary Urban Center	432,023	51.6%	450,800 - 497,800	45.1% - 49.8%
Ewa	42,983	5.1%	119,900 - 132,900	12.0% - 13.3%
Central Oahu	130,474	15.6%	148,900 - 164,900	14.9% - 16.5%
East Honolulu	45,654	5.5%	53,000 - 58,000	5.3% - 5.8%
Koolaupoko	117,694	14.1%	109,900 - 121,900	11.0% - 12.2%
KOOLAULOA	14,263	1.7%	13,000 - 14,000	1.3% - 1.4%
NORTH SHORE (2)	15,729	1.9%	16,000 - 18,000	1.6% - 1.8%
Waianae	37,411	4.5%	38,000 - 42,000	3.8% - 4.2%



NOTES:
(1) Population ranges based on target percentages specified in the General Plan and the Hawaii State DBED Series M-K population projection of 999,500 for the year 2010.
(2) Includes the project site.

SOURCES: U.S. Bureau of the Census, 1991; Honolulu City & County, 1989.

If population growth continues at the rates experienced in the 1980's, the North Shore DP area population would exceed the anticipated 2010 guideline maximum of 18,000 by 1997. By 2010, continued growth at historical rates would yield a North Shore DP area population of 23,308 and a Total Study Area population of 46,666.

For the City and County as a whole, the General Plan guidelines allow for population growth at rates <u>higher</u> than those of the 1980s. For the Study Area, however, the guidelines could only be met by a substantial reduction in the amount of growth, as shown in Exhibit H.

The impact of the project on population guidelines and planning is as follows:

- The guideline percentages have already been exceeded. Any attempt to make population and housing in the Total Study Area conform to the guidelines by 2010 would likely demand down-zoning and stringent controls on growth of any kind, lowering "population capacity" to levels within the guidelines.

- Project densities are low. This is in keeping with the General Plan's aim of preserving the region's low density rural character -- the aim which the guidelines were designed to implement.

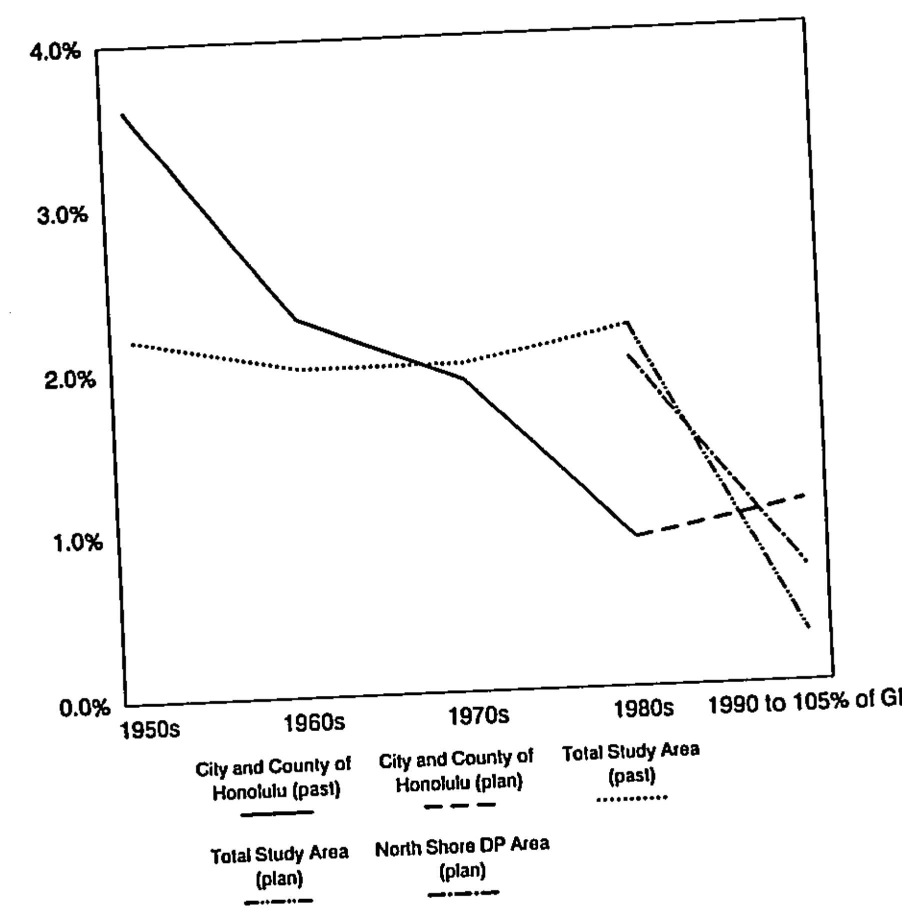
- The revised proposal calls for <u>fewer</u> affordable units on Urban-designated land on-site than the earlier proposal. Since "population capacity" is calculated on the basis of such designation, the revision will have the effect of <u>lowering</u> the regional capacity slightly.

- Also, the revised project, with fewer jobs than the 1991 project, would have little off-site impact on housing.

- However, the revised project includes more large lots than the 1991 version. By 2010, about 220 of these would be built out, compared to 120 lots in the 1991 version.

If the revised project is granted its DP amendment, the impact on Planning Department calculations would be a <u>reduction</u> in the disparity between population capacity and population guidelines. However, the project has a 2010 population only slightly larger than the earlier proposal. (At eventual buildout, the revised project population would be about 140% of the resident population estimated for the 1991 proposal.)

EXHIBIT H: AVERAGE ANNUAL RATES OF POPULATION GROWTH FOR HONOLULU AND REGION



SOURCES: U.S. Census data and Honolulu General Plan (cited in Lihi Lani FEIS and Exhibit G of this update memorandum).

OTHER SOCIO-ECONOMIC IMPACTS

RECREATION. The revised project offers community recreation facilities. The proposed North Shore YMCA would complement the region's existing recreational resources, which largely consist of beach parks. The proposed swimming pool would be the site for swimming and water safety classes, encouraging the North Shore's children to participate safely in water activities.

The golf and tennis facilities in the 1991 project would have responded to both regional and islandwide demand. However, the golf course was also seen by many as an inappropriate addition to the North Shore. While the revised project will enhance local recreational resources, it will not provide the variety of resources proposed earlier.

PUBLIC FACILITIES. The revised project will differ from the earlier version in its impact on schools and health facilities:

- **Schools:** At buildout, the revised project would have about the same impact on schools as the earlier version. However, buildout is now expected to occur long after 2010, so the impacts of the revised project on schools over the next 20 years would be much less than was anticipated in 1991.

  The Department of Education (DOE) estimates that the revised project at buildout would increase public school enrollments by 154 students (Charles T. Toguchi, Superintendent, to Robin Foster, letter dated August 21, 1993). Buildout will only occur after 2020. The DOE estimate can be converted into a near-term estimate as follows:

ADAPTED DOE ESTIMATE OF SCHOOL IMPACTS

		Enrollments*			
Year	SF Homes Built	K-6	7-8	9-12	TOTAL
1996	55	13	3	6	22
2000	102	24	6	10	40
2010	268	64	16	27	107

* Estimated by Community Resources, Inc. (after discussion with DOE personnel) using the following ratios for single-family housing:

Elementary (K-6)	24 students per 100 houses
Intermediate (7-8)	6 students per 100 houses
High (9-12)	10 students per 100 houses

This calculation suggests that the project would add about one classroom's enrollment at Sunset Beach Elementary at first. By 2010, the project's total impact on the schools would be about 70% of the enrollment projected by the DOE at buildout.

The above analysis follows the DOE in estimating future project school impacts from current enrollment levels in the Pupukea CDP area. This procedure may yield an overestimate, because of (a) the trend, in Hawaii and nationwide, towards smaller family sizes; and (b) the possibility that households in a new large-lot subdivison might be smaller than in Pupukea Highlands, where many residents have built homes with space for large two- and three-generational families.

Children from the 50 single family affordable units would account for most of the Lihi Lani students through the year 2000. By 2010, the affordable units would only amount to about 20% of the project's single family units.

The project developer has offered to contribute $5,000 per lot sold to a trust fund for scholarships and schools in the Total Study Area. With the increase in the number of market lots in the project, the fund will be larger than was proposed earlier. (With the revised project, the number of market lots sold by 2000 would be greater than the total number of market lots in the earlier version of Lihi Lani. Total contributions to the fund would be more than 250% of the contributions projected earlier.)

- **Health Care:** With 80 units of elderly housing to be built by the City and County, the revised project involves health care needs distinct from those of the earlier version of Lihi Lani. However, the regional hospital, Kahuku Hospital, already provides care for the older residents of the region (including residents of a convalescent home). The hospital is underutilized. Its facilities are adequate to handle any anticipated additional demand from the project, including additional demand for medical services for the elderly (personal communication, Peter Basler, Administrator, Kahuku Hospital, September 9, 1993).

COMMUNITY CHARACTER AND CHANGE. The revised project's impacts on community character cannot be predicted with certainty, since these depend on community perceptions and future interactions between project occupants and others. Five major factors deserve note as likely to shape the revised project's future impact on community character:

- **Recreation Facilities as a Community Focus:** The community facilities are planned to meet perceived regional needs. The North Shore YMCA will likely be used by residents of the area from Kahuku to Haleiwa.

- **Need for Affordable Housing:** The project responds to local and islandwide needs.

- **Need for Elderly Housing:** A market study has not been completed for the elderly housing component of the project. However, need for additional units is indicated by the waiting list for spaces at the Kahuku Elderly Housing project. Applicants must now wait about two years to be placed there.

  Many residents of the elderly housing units could come from the study area or could have relatives in the study area. However, the Kahuku project normally houses some persons from other areas of Oahu, even though preference is given to residents of Koolauloa (personal communication, Keawe Rellamas, Resident Manager, September 10, 1993). It is likely that the Lihi Lani elderly housing would mostly attract residents from the Total Study Area, but would also house people from the rest of the island.

  Many older residents of the region have expressed support for elderly housing at the site in conversations with the developer's representatives. Some were interested in living at the project (personal communication, Y. Ohashi, Planner, Group 70 International, September 14, 1993).

- **Compatibility of Elderly Housing with Nearby Land Uses:** One issue deserving future consideration is the potential for conflict between residents of the elderly housing area and users of nearby land. Adjoining uses are largely recreational, attracting children and young families. Also, surfers now use all available parking near Ehukai Beach Park at times. Once on-road parking and school parking are filled, some surfers will likely try to park at the proposed community facilities.

  CRI notes that (a) landscaping shown in project plans could buffer the elderly housing area from some of the noise generated nearby; (b) the operators of the adjacent YMCA facility could help to control traffic and parking, lessening the chance that these will affect the elderly housing area itself; and (c) the YMCA will likely provide activities and classes for senior citizens.

- **Removal of Project Elements Deemed "Incompatible" with North Shore Lifestyles:** Since the project was originally proposed, several components -- notably, a helipad, two golf courses, and the whole concept of a subdivision based on expensive memberships -- have been removed. The result is a

project similar in many respects to adjacent areas of the Pupukea Highlands. This greatly increases the chance that residents will be, and will be perceived as, similar in outlook and interests to their neighbors.

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APPENDIX L

Economic and Fiscal Impacts of Lihi Lani

KPMG Peat Marwick

Management Consultants

Focused experience for measurable results

Manufacturing and Technology Industries

Financial Institutions

Health Care

Government Services

Insurance

Real Estate and Hospitality

Airports

Retail and Wholesale

Education

Energy and Utilities

Corporate Transactions

Technology and Operations

Compensation and Benefits

Obayashi Hawaii Corporation

ECONOMIC AND FISCAL IMPACTS OF LIHI LANI

Pupukea, Oahu, Hawaii

Final Report
November 1993

KPMG Peat Marwick

Management Consultants

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Honolulu, HI 96813-3421

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Telefax 808 541 9320

November 17, 1993

Mr. Toshiharu Hino, President
Obayashi Hawaii Corporation
c/o Mr. Craig Yamagishi
Lihi Lani
66-145 Kamehameha Highway
Haleiwa, Hawaii 96712

Dear Mr. Hino:

KPMG Peat Marwick is pleased to submit the attached report assessing the economic and fiscal impacts of Lihi Lani.

BACKGROUND

Obayashi Hawaii Corporation (Obayashi) plans to develop Lihi Lani on about 1,144 acres of land at Pupukea on the island of Oahu. The project is planned to create and preserve the unique lifestyle and environment of the North Shore. Plans now include 315 country lots, 180 affordable homes for families and the elderly, acres of land designated for agricultural use, a nursery, ranch facilities, a community park and recreation center, and trails for jogging and biking as well as hiking and horseback riding.

In July 1993, KPMG Peat Marwick assessed the market for the project in a report entitled, "Market Assessment for Lihi Lani." The proposed development is expected to have employment, population, economic, and fiscal impacts on the North Shore of Oahu. The objective of this report is to evaluate the anticipated economic and fiscal impacts of Lihi Lani to the County of Honolulu and State of Hawaii. This study assumes that the project is developed and received in the marketplace as described in the July 1993 market study.

The economic impacts generated by Lihi Lani have been projected based on the project's estimated development timetable for completion of the country lots, affordable housing units and community facilities and infrastructure. Additionally, individual lot owners are expected to complete construction of homes on their country lots over a longer, more gradual development period, similar to the experience of other comparable projects.

Although the full development of homes at Lihi Lani is expected to occur over a long period of time, it should be noted that development of the 56 acres of land being petitioned for change from agriculture to urban classification are estimated to be fully developed within five years of Land Use Commission approval. This area includes elderly and affordable housing units and wastewater treatment facilities.

Home completions at vacant lot projects are typically very gradual

Home completions at seven vacant lot subdivisions on Oahu and the island of Hawaii were reviewed and are presented in Exhibit 1-A. The average number of homes completed at the various surveyed projects range from 1 to 26 homes per year and varied significantly depending on the size, location and resident/visitor orientation of the project.

Typically, projects which maintain a greater amount of second home or vacation home purchasers have fewer home completions than projects which are typically purchased and occupied by owner-occupant residents. For example, projects that consist of predominantly owner-occupants experienced a home build-out rate of 19 and 26 homes a year. However, projects that consist of predominantly second home or vacation home purchasers have home completions of between 1 and 6 homes annually.

Home build-out rates for the surveyed projects were estimated on the number of vacant lots remaining annually and the actual number of homes that have been built since the projects were completed. Annual build-out rates for the surveyed projects are very low ranging from only 1% to 8% of the remaining vacant lots per year, as also shown in Exhibit 1-A.

The gradual nature of home completions and low build-out rates on large lot projects can best be illustrated by examining the experience of subdivisions in the Pupukea area which is the oldest and largest of the surveyed projects. The area consists of several different subdivisions of various ages of development. An average age of 20 years has been used to estimate the development period for the entire Pupukea area. There are a total of 474 lots in the Pupukea area. During the past twenty years, the area has only been 79% built-out with only 376 homes completed and an average home completion rate of 8% annually.

Lihi Lani is expected to take 18 years to reach 80% housing build-out

The basis for the impacts associated with the development of Lihi Lani are the projected home completions and development timing of the proposed country lots, affordable housing units, and recreational and community facilities located throughout Lihi Lani.

Home completion rates at vacant lot subdivisions are typically very gradual, as experienced at other comparable projects throughout the state. Home completion trends indicate an initial slow increase in home development, a plateau of home completions, and thereafter development becomes very moderate. Of the selected vacant lots shown in Exhibit 1-A, the average build-out rate is about 4% of the available vacant lots annually and range between 1% and 8% per year.

Home completions at Lihi Lani are expected to be built at a significantly faster rate than experienced at the surveyed lot projects due to the following reasons:

- Location on Oahu, rather than the neighbor islands.
- The majority of the purchasers of lots at Lihi Lani are expected to be Oahu residents.

- The majority of lots are also expected to be used for primary residential purposes rather than secondary or retirement homes.

Projected country lot sales at Lihi Lani are based on market support as reported in the market assessment report. This sales absorption rate has been slowed somewhat to coincide with the development phasing of Lihi Lani's country lots. Based on the market assessment, Lihi Lani's 315 country lots are projected to be sold within a period of 8 years. However, due to the more gradual development phasing of the country lots, absorption of Lihi Lani's 315 country lots is expected to take approximately 11 years and is projected to be sold out by 2006, as shown in Exhibit 1-B.

Based on a 12% build-out rate, about 80% of the homes, or 257 residences are expected to be completed by the year 2014, as shown in Exhibit 1-C. Thereafter, vacant lot projects throughout the state indicate that home completions taper off as some investment lots, or vacation or retirement homes still remain unbuilt. The remaining vacant lots at Lihi Lani are similarly expected to be built-out at a more gradual pace. Therefore, 100% housing build-out can be anticipated from as early as the year 2020 to several decades later.

EMPLOYMENT IMPACTS

Lihi Lani will generate short-term employment during the construction of its new facilities and long-term employment in the operation and support of those facilities. Projected employment at Lihi Lani is estimated in the following sections and is also classified as being direct, indirect or induced.

Direct construction employment could generate an average of 80 employees per year during the initial 12 years of development

Direct employment is that which could be supported directly by the construction of Lihi Lani. Such employment includes on-site laborers, operatives and craftsmen, as well as the professional, managerial, sales and clerical workers whose usual place of employment may be elsewhere on the island or State.

As shown in Exhibit 2-A direct construction employment for the country lots and affordable units are based on a total of 2.7 and 0.9 person-years per home, respectively, over a one year construction period. Direct construction employment or the number of full-time person years required for construction of the campground, ranch, and community facility are calculated by estimating the percentage of development costs devoted to labor (estimated at 40%) and dividing this amount by the estimated wages and benefits of an average construction worker (estimated at about $73,900 for Oahu workers). This results in estimated total employment which is measured in full-time equivalent (FTE) "person-years."

Direct construction employment is projected to be highest in the first three years of construction when a substantial amount of the affordable housing and infrastructure development is anticipated to occur. An estimated 140 full-time equivalent persons could be utilized during each of the first three years of construction at Lihi Lani, as shown in Exhibit 2-A. Direct annual construction employment is projected to drop to about 30 full-time equivalent persons at 80%

housing build-out and 10 full-time equivalent persons at 100% housing build-out. Overall average direct employment during the first 12 years of construction from 1996 to 2008 could amount to 80 employees per year.

Indirect and induced construction employment could amount to 110 full-time equivalent positions during Lihi Lani's first three years of development

The direct employment of construction workers at Lihi Lani will stimulate additional employment on the island and elsewhere in the State. Based on ratios derived from DBED, an estimated 0.79 full-time equivalent positions are created in the State for every full-time equivalent job in the building construction industry. This multiplier is used to project the indirect and induced employment to be supported statewide by direct construction employment, as shown in Exhibit 2-B.

About 80% of indirect and induced employment is anticipated to occur on Oahu, with the remainder occurring elsewhere in the State. As with direct construction, the greatest employment from indirect and induced laborers could occur in 1996 and could amount to about 110 new full-time equivalent positions. Indirect and induced employment due to construction at Lihi Lani would then drop to about 50 positions from 2007 to 2008.

Total employment due to construction at Lihi Lani could amount to an average of 150 full-time equivalent positions per year during the initial 12 years of development

As also shown in Exhibit 2-B, direct, indirect and induced employment due to construction at Lihi Lani could amount to a total of 250 full-time equivalent positions in 1996, and taper off to about 110 FTE positions by the period 2007 to 2008. Thus, an average of about 150 full-time equivalent positions are expected to be derived as a direct result of construction at Lihi Lani during its initial 12 years of development.

Direct operational employment is projected to stabilize at 30 full-time equivalent employees

Direct operational employment at Lihi Lani will be created as a result of operations of the ranch, property management and sales, and the community facility, as shown in Exhibit 2-C.

Full-time equivalent employment for the ranch, property management and sales, and community facility is assumed to be 5, 10, and 20 FTEs, respectively. Property management and sales is projected to require about ten full-time positions during project's initial marketing and sales and is assumed to stabilize at a total of 5 full-time equivalent positions by 2000. Positions within the property management and sales category include property management and sales staff, campground employees, and employees of Lihi Lani's agricultural operations.

Lihi Lani is thus expected to generate about 40 full-time equivalent direct operational positions in 1996 and about 30 full-time equivalent positions at employment stabilization at about the year 2000.

Indirect and induced employment due to Lihi Lani's operations could amount to another 50 full-time equivalent positions at stabilization

Facility operations at Lihi Lani would also indirectly generate employment elsewhere in the State. Recent studies on the total economic impacts of direct, indirect and induced employment multipliers in the food and beverage, retail, real estate and other service industries by DBED suggest that the activities at Lihi Lani could be expected to support between 1.31 and 2.16 indirect and induced full-time equivalent positions elsewhere in the State for each direct position created.

Thus indirect and induced operational employment is estimated to amount to an additional 60 full-time equivalent positions in 1996 and stabilize at 50 full-time equivalent positions by 2000, as also shown in Exhibit 2-C.

Total operational employment is projected to reach 80 full-time equivalent positions by 2000

Total direct, indirect and induced operational employment is estimated to represent about 100 full-time equivalent positions per year by 1996, and stabilize by 2000 with an estimated 80 full-time equivalent positions, as also shown in Exhibit 2-C.

POPULATION IMPACTS

The development of Lihi Lani could lead to a population increase in the North Shore area, and to a lesser extent, in the County of Honolulu and the State of Hawaii. Those who purchase lots at Lihi Lani may reside within the residential community during most or part of each year, while day visitors and Lihi Lani employees such as temporary construction employees and permanent operation employees will contribute to the average daily population.

On-site population is projected based on the assumptions shown in Exhibit 3-A. Full-time residents residing on country lots are assumed to constitute 75% of the residential population; while part-time residents are assumed to consist of 25%. Residents of the affordable homes are assumed to all be full-time residents.

Households residing on country lot at Lihi Lani are assumed to have an average household size of 2.3 persons while those residing in the affordable homes are expected to have an average household size of 2.4.

On-site resident population is expected to reach nearly 1,000 at 100% housing build-out

Projections for Lihi Lani's resident population are based on key assumptions regarding usage patterns of completed homes at the site, as shown in Exhibit 3-B. These assumptions are based on the number of homes completed, occupancy rates, and average household size. The number of residents at Lihi Lani are projected to reach over 600 by 2006, when all 445 country lots and affordable residential units are assumed to be sold, and is expected to increase to nearly 1,000 at 100% housing build-out.

Lihi Lani's on-site daily visitor population is projected to stabilize by the year 2000

Day visitors to Lihi Lani would primarily consist of non-Lihi Lani residents including campground and ranch facility guests, as also shown in Exhibit 3-B. Campground visitors are estimated based on an average daily population of 25 persons during the summer months and an average daily population of 11 persons during the remainder of the year. Ranch facility guests are based on the assumption that 70% of the stable renters are Lihi Lani and North Shore residents, therefore, the visitor population to the area would constitute approximately 30% of the stable renters who would then visit the facilities at least twice a week. Based on these assumptions, the average daily visitor population at Lihi Lani is projected to be about 17 people by 2000 and stabilize thereafter.

The projected daily usage of the community facility is based on discussions with YMCA representatives and assumes a 1,000 member facility located at Lihi Lani. The daily population at the community facility is expected to be about 140.

Resident in-migration as a result of Lihi Lani is expected to be minimal

The in-migrant population to the State could include Lihi Lani residents, operational employees and their dependents who move to the State from outside of Hawaii, as a result of the project's development. Construction employees required for the development are assumed to be satisfied by the State's labor pool.

Residents of Lihi Lani are expected to contribute to the in-migrant population to the State based on the assumption that 20% of the country lot residents will originate from outside of the State. Therefore, in-migrant residents to Lihi Lani could contribute almost 130 new residents to the State by 80% housing build-out, as shown in Exhibit 3-C.

Operational employees migrating to the State could represent about 15% of all direct operational employees, with an estimated one additional dependent for every employee. This could result in about 12 persons per year in 1996 and stabilizing at about 10 persons per year by 2000.

Therefore, total projected in-migrant residents is expected to be minimal and contribute only about 100 new residents to the State by 2008 and slightly over 150 at 100% housing build-out.

Additional housing demands due to the development of Lihi Lani is also expected to be minimal

The majority of Lihi Lani's operational employees are expected to already reside on Oahu, specifically in the North Shore region. However, an estimated 10% of the direct operational employees may be expected to require housing units while working at Lihi Lani. This would amount to an average of 3 new housing units per year, as shown in Exhibit 3-D.

Housing units may also be required by new in-migrant households who represent about 15% of the operational labor force at Lihi Lani. This would result in a demand for 5 new units in 1996 and stabilizing at four units by the year 2000. This is estimated based on the assumption that 80% of the direct in-migrant operational employees would need new housing units.

Thus, a total of eight new housing units are expected to be required between 1996 and 1998 and six new housing units between the year 2000 and 100% housing build-out. The amount of housing needed is more than met by the 130 affordable single-family units and elderly multifamily units being provided at Lihi Lani. Additional housing units are also assumed to be readily available in the nearby community to fill this relatively small incremental housing need.

ECONOMIC IMPACTS

Lihi Lani would have an impact on income for residents of the County of Honolulu and State of Hawaii through employee wages, salaries and fringe benefits, as well as through revenue to its proprietors. Personal income, is defined as the wages and salaries paid to the direct construction and operational employees of the development. Personal income is projected on the basis of average industry wages and salaries for the various anticipated categories of employment and on the projected future employment demands.

Direct personal income from Lihi Lani's operations could reach $600,000 per year at build-out

Personal income paid to Hawaii residents employed in the construction of Lihi Lani could be expected to average about $6.6 million in 1996 and subsequently decline to $2.8 in 2008 as construction within the project is substantially completed, as shown in Exhibit 4-A.

Operational employment is expected to increase personal income to Hawaii residents by $740,000 in 1996 and 1998 and is expected to stabilize thereafter at $600,000 per year.

Lihi Lani's impact on total annual personal income for both construction and operational employment could total about $7.4 million in 1996, $3.5 million in 2008, and about $1.1 million by 100% housing build-out.

FISCAL IMPACTS

Lihi Lani is expected to generate significant positive fiscal benefits to the County of Honolulu and the State of Hawaii. These fiscal impacts have been evaluated by comparing the operating tax revenues with the new operating expenditures which are projected to be incurred by the State and County governments.

Government revenues

Development of Lihi Lani would bring additional tax revenues to the County and State governments. County government revenues would be principally from real property taxes on the facilities, however, additional County revenue sources would also include fuel, utility, motor vehicle and other non-grant taxes.

Revenues to the State government would be composed primarily of general and specific excise taxes, personal income taxes paid by new state residents, and the general excise taxes and sales revenues attributable to day visitors of Lihi Lani.

- **Net new property taxes to the County are projected to reach $650,000 per year**

  Real property in the County of Honolulu is taxed separately based on building value and land value. The tax rate on buildings range from $3.52 to $9.64 per $1,000 net taxable building value, depending on the land use class and user status. Land is taxed at rates which vary from $3.23 to $9.00 per $1,000 of net taxable value and is also dependent on the land use class and user status.

  The following is a breakdown of the user classifications and real property tax rates for Lihi Lani:

  > Improvements on the country lots and the affordable units are assumed to be taxed at a rate of $3.92 per $1,000 of assessed value,
  >
  > Improved country lots and the land under the affordable units are assumed to be taxed at a rate of $3.12 per $1,000 of assessed value,
  >
  > Unimproved county lots are assumed to be taxed at a rate of $3.92 per $1,000 of assessed value,
  >
  > Commercial and industrial zoned land are taxed at a rate of $8.51 per $1,000 of assessed value, and
  >
  > Land zoned conservation is taxed at a rate of $9.00 per $1,000 of assessed value.
  >
  > No county real property taxes are assumed to be paid by the community facilities due to their non-profit status and for the elderly housing project which is expected to be operated by the Department of Housing and Community Development.

  Tax exemptions for owner-occupied homes range from $40,000 to $120,000. Lihi Lani's country lot owner-occupant tax exemptions are assumed to average $50,000 for owner-occupied units. This estimate considers the standard County exemption of $120,000 for owner-occupants 70 years of age and older, $100,000 for those between 60 to 64, $60,000 for those 55 to 59, and $40,000 for those 55 years of age and younger.

New tax revenues to the County are based on the above tax rates less the current property taxes, as shown in Exhibit 5-A. Net new property tax revenues for the County of Honolulu are estimated to be about $19,000 in 1996 and increase to $720,000 in 2008, and is expected to increase to about $810,000 by 100% housing build-out.

- **Total new taxes to the County are projected to reach $680,000 at build-out**

Miscellaneous revenues to the County include taxes from fuel, utility, motor vehicle, and other non-grant sources and are estimated to be $260 per person per year, for both residents and visitors.

Adding these additional county revenue sources to the projected net new property taxes previously noted, total new taxes to the County as a result of Lihi Lani are thus estimated to reach $30,000 in 1996, $590,000 in 2008, and about $680,000 at 100% housing build-out, as also shown in Exhibit 5-A.

- **State revenues from construction spending could generate almost $2.0 million during the first year of construction**

New revenues to the State could also be generated by general excise taxes related to construction spending. A 0.5% tax is charged to contractors on all wholesale construction materials, while a 4% general excise tax is also charged to the developer on total construction costs. Annual revenues from direct construction spending could reach almost $1.3 million in 1996 and decline to $230,000 in 2008, as shown in Exhibit 5-B.

Indirect and induced expenditures could also be generated as a result of the construction expenditures associated with Lihi Lani. Additional general excise taxes on indirect and induced spending was subsequently estimated based on a ratio of $1.59 for every $1 of direct construction expenditure.

Annual revenues from construction spending, including direct, indirect and induced expenditures could total about $2.0 million in 1996 and eventually $360,000 by 2008, as also shown in Exhibit 5-B.

- **In-migrant residents could contribute about $690,000 in annual State revenues by 2008**

In addition to the revenues received from construction spending, revenues to the State government could also be generated by new residents drawn to the State because of the project. These in-migrant residents would bring in additional excise sales taxes, individual income taxes and other specific State taxes such as liquor, tobacco, fuel, inheritance, estate and conveyance taxes.

In-migrant residents that will reside at Lihi Lani are estimated to contribute about $7,518 per person in State revenues, while off-site in-migrant residents are estimated to contribute $3,688 per person in 1993 dollars, based on a 1991 report issued by the Tax Foundation of Hawaii. Thus, new tax revenues to the State government attributable to in-migrant residents are expected to be about $60,000 in 1996 and increase to $690,000 in 2008, as shown in Exhibit 5-C.

- **Total State revenues are projected to be nearly $2.1 million in 1996**

  Considering all the sources previously identified, total new revenues to the State attributed to Lihi Lani is expected to be about $2.1 million in 1996, $3.1 million in 1998, $1.1 million in 2000 and 2002, $1.5 million in 2004, $1.5 million in 2006, and $1.1 million by 2008, as also shown in Exhibit 5-C.

Government Operating Expenditures

New residents attracted to the County and State by Lihi Lani would also necessitate additional expenditures of State and County public resources. In-migrant residents would require additional public expenditures for public safety, maintenance of highways, recreational facilities and natural resources, health and sanitation measures, special cash capital improvements, education, retirement and pension funds public welfare and other government functions.

- **New County expenditures are projected to reach $800 per resident**

  The various County government operating expenditures for fiscal year 1991 were analyzed with respect to the relevant population served by each of the government functions. This analysis indicates that the City and County of Honolulu government expenditures in 1991 totaled about $730 per resident and $510 per visitor, as shown in Exhibit 6-A. A 4.8% annual increase, equal to the rise in the Honolulu Consumer Price Index (CPI) between 1991 and 1993 was applied to estimate per capita expenditures in 1993 dollars of about $800 for residents and $560 for visitors.

- **Total new annual County expenditures are estimated to be $120,000 at 100% build-out**

  Based on the estimated per capita County government outlays, annual County expenditures on behalf of the added population at Lihi Lani, could be expected to total about $10,000 in 1996 and increase to $80,000 in 2008 as the project is built-out, and about $120,000 at 100% housing build-out, as shown in Exhibit 6-B.

- **State expenditures are projected to reach $4,160 per resident**

  The various State government operating expenditures for fiscal year 1991 were analyzed with respect to the relevant population served by each of the government functions. This analysis indicates that the State of Hawaii's expenditures in 1991 totaled about $3,800 per resident and $1,100 per visitor, as shown in Exhibit 6-C. A 4.8% annual increase, equal to the rise in the Honolulu Consumer Price Index (CPI) between 1991 and 1993 is applied to estimate per capita expenditures in 1993 dollars of about $4,160 for residents and $1,200 for visitors.

- **Total new annual State expenditures are projected to be about $650,000 at build-out**

  Based on the above State government outlays, annual public expenditures by the State on behalf of the added population at Lihi Lani could be expected to total about $60,000 in 1996 and increase to $410,000 in 2008, and $650,000 at 100% housing build-out, as shown in Exhibit 6-D. These expenditures were based on the projected immigrant community residents and employees to the State attributable to Lihi Lani's development.

Revenue and Expenditure Analysis

The new fiscal impacts of Lihi Lani to the County and State operating budgets are estimated by comparing the projected operating revenues and expenditures of both the County and State.

- **Net additional revenues to the County could reach $560,000 at build-out**

  Comparison of projected public revenues and expenditures attributable to the project's development indicates that the County government could expect to net about $20,000 in 1996, $70,000 in 1998, $420,000 in 2000, $230,000 in 2002, $370,000 in 2004, $490,000 in 2006, $510,000 in 2008, and $560,000 at 100% housing build-out, as shown in Exhibit 6-E. The analysis also indicates that additional County government revenues generated by Lihi Lani and its facilities could be about 2.3 times the additional operating expenses incurred by the County government in the initial year of development and about 5.5 as well at the end of the projection period, as also shown in the exhibit.

- **Net additional revenues to the State could reach $4.7 million during its first year of development**

  Based on a similar analysis, the State is also expected to realize net additional revenues as a result of Lihi Lani's development. State revenues are projected to exceed expenditures by $2.0 million in 1996, $3.0 million in 1998, $900,000 in 2000, $820,000 in 2002, $1.2 million in 2004, $1.2 million in 2006, $650,000 in 2008, and $480,000 at full build-out, as shown in Exhibit 6-F. Thus, State government benefit/cost ratios generated by the development of Lihi Lani could be almost 34.5 times the expenditures incurred by the State government in 1996, about 2.6 times by 2008 and 1.7 times at full housing completion, as also shown in the exhibit.

* * * * * * *

KPMG Peat Marwick

Mr. Toshiharu Hino, President
November 17, 1993
Page 12

We appreciate the opportunity to be of assistance to Obayashi Hawaii Corporation on this important project and look forward to providing further support to its development.

Very truly yours,

KPMG Peat Marwick

EXHIBIT 1-A

Home completions at vacant lot subdivisions is gradual with only 1% to 8% of the available lots improved annually

BUILD-OUT RATES AT VARIOUS ACREAGE LOT PROJECTS

Project	Island	Average age of development	Number of lots: Total	Number of lots: Improved	Number of lots: Vacant	Percent improved	Average number of homes completed per year	Average build-out rate (1)
Pupukea (2)	Oahu	20 (est.)	474	376	98	79%	19	8%
Hawaii Loa Ridge (2)	Oahu	12	556	310	246	56%	26	7%
Mauna'olu - Makaha (2)(3)	Oahu	7	143	19	124	13%	3	2%
Kohala Ranch (4)	Hawaii	7	477	44	433	9%	6	2%
Puu Lani Ranch (4)	Hawaii	5	49	8	41	16%	2	4%
Maliu Ridge (4)	Hawaii	7	57	19	38	33%	3	6%
Waikii Ranch (4)	Hawaii	7	130	9	121	7%	1	1%

(1) Based on the cumulative number of vacant lots and the average number of homes built per year.
(2) The area consists of several different subdivisions with various ages of development. Data shown is as of August 1993.
(3) Based on TMK 1-8-4-29 and information obtained from MLS Hawaii, Inc.
(4) Data shown is as of November 1992.
N/A = Information not available.
Source: Interviews with representatives from various projects and MLS Hawaii, Inc.

EXHIBIT 1-B

Similar to other vacant lot projects, residential home completion at Lihi Lani is expected to reach a peak before tapering off in later years

PROJECTED RESIDENTIAL HOME COMPLETIONS AT LIHI LANI

Year	Cumulative lots sold (1)	Vacant lots sold	Homes built (2)	Vacant lots remaining
1996	40	40	5	35
1997	70	65	8	57
1998	70	57	7	50
1999	160	140	17	124
2000	165	129	15	113
2001	165	113	14	100
2002	165	100	12	88
2003	245	168	20	148
2004	245	148	18	130
2005	245	130	16	114
2006	315	184	22	162
2007	315	162	19	143
2008	315	143	17	126
2009	315	126	15	110
2010	315	110	13	97
2011	315	97	12	86
2012	315	86	10	75
2013	315	75	9	66
2014	315	66	8	58
Total (80% housing build-out)			257	

(1) Based on projected lot sales as shown in the market asssessment and adjusted for the actual development timetable for the project.

(2) Annual home completions have been estimated at 12% of the vacant lots sold.

Exhibit 1-C

Residential home completion is expected to be gradual and plateau when 80% of the houses are built

LIHI LANI DEVELOPMENT AND OPERATIONAL ASSUMPTIONS

	Project period								
	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
Country lot sales and home development (cumulative):									
Homes completed(1)	5	20	52	77	115	153	189	257	315
Unbuilt, sold lots	35	50	113	88	130	162	126	58	0
Total lots sold (2)	40	70	165	165	245	315	315	315	315
On-site affordable home development and sales (cumulative):									
Single-family homes completed	50	50	50	50	50	50	50	50	50
Elderly/multifamily units (3)	0	0	80	80	80	80	80	80	80
Total affordable homes	50	50	130	130	130	130	130	130	130
Ranch center:									
Number of stalls	0	50	50	50	50	50	50	50	50
Projected occupancy rate	0%	20%	40%	55%	75%	80%	80%	80%	80%
Occupied stalls	0	10	20	28	38	40	40	40	40

(1) As shown in Exhibit 1-B, based on home build-out rates at comparable lot projects. Build-out rates at other planned communities indicate a build-out rate of 1% to 8% per year. A build-out rate of 12% was assumed at Lihi Lani in anticipation of a larger percentage of primary residences.
(2) Based on market absorption as adjusted for development phasing.
(3) Obayashi Hawaii Corporation will be donating the site for the elderly/multifamily housing with infrastructure to the City of Honolulu. The City of Honolulu will develop and manage the facility. Therefore, it is assumed that earliest full utilization of the facility will begin in 1999.

Source: Discussions with representatives from Obayashi Hawaii Corporation and Group 70; and market assessment report.

Exhibit 2-A

Lihi Lani could generate direct construction employment for the equivalent of 80 full-time equivalent construction employees per year during the initial 12 years of development

PROJECTED DIRECT CONSTRUCTION EMPLOYMENT

Facility Type	1996	1997 & 1998	1999 & 2000	2001 & 2002	2003 & 2004	2005 & 2006	2007 & 2008	At 80% housing build-out	At 100% housing build-out	Total at 100% housing build-out
	Total annual person years									
Country lots - home construction (1)	13	20	44	34	51	51	49	30	8	849
Affordable single-family units(2)	45	–	–	–	–	–	–	–	–	45
Affordable elderly multifamily units(2)	0	36	–	–	–	–	–	–	–	72
Campground (3)	1	1	–	–	–	–	–	–	–	2
Ranch (4)	1	1	1	1	–	–	–	–	–	7
Community facility (5)	4	4	–	–	–	–	–	–	–	12
Infrastructure(6)	78	78	13	13	19	14	10	–	–	373
Total, direct employment (rounded)	140	140	60	50	70	70	60	30	10	1,360
Overall average annual direct employment (rounded) (1996 to 2008)							80			

(1) Estimated at 2.7 total person-years over a one year construction period per home.
(2) Estimated at .9 total person-years over a one year construction period per home.
(3) Assumes development costs of $300,000, with 40% dedicated to labor costs, and labor wages and benefits averaging $73,913.
(4) Assumes development costs of $1,300,000, with 40% dedicated to labor costs, and labor wages and benefits averaging $73,913.
(5) Assumes development costs of $2,300,000, with 40% dedicated to labor costs, and labor wages and benefits averaging $73,913.
(6) Assumes development costs of $93,362,000, with four full-time equivalent jobs per million dollars.

Note: Refer to Exhibit 5-A for improvement cost estimates; ratio of labor to construction cost varies by development type, but is generally 50%/50%, after a 20% profit margin. The labor portion of the development cost is then divided by an average construction worker's annual wages (estimated at about $47,000) and benefits (estimated at about 56% of wages) to determine full-time equivalent positions.

Exhibit 2-B

Development of Lihi Lani could generate total employment of about 150 employees per year during the initial 12 years of development

PROJECTED TOTAL CONSTRUCTION EMPLOYMENT

		Total annual person years									
		1996	1997 & 1998	1999 & 2000	2001 & 2002	2003 & 2004	2005 & 2006	2007 & 2008	At 80% housing build-out	At 100% housing build-out	Cumulative total at 100% housing build-out
Direct employment (1)		140	140	60	50	70	70	60	30	10	1,360
Indirect and induced employment:											
On-island(2)	80% of other employment	90	90	40	30	50	50	40	20	10	856
Elsewhere in State		20	20	10	10	10	10	10	0	0	214
Subtotal, indirect and induced employment		110	110	50	40	60	60	50	20	10	1,070
Total(3)	179% of direct employment	250	250	110	90	130	130	110	50	20	2,430
Average annual construction employment (rounded) (1996 to 2008)								150			

(1) As shown in Exhibit 2-A.
(2) Estimated at 80% of total indirect and induced employment.
(3) Total direct, indirect and induced effect estimated at 1.79 full-time equivalent positions per direct positions, based on 1991 ratios from the DBED Input-Output Model and Hawaii Econometric Model, as presented in the Department of Business and Economic Development, "The Hawaii State Data Book," 1992.

Lihi Lani could generate about 30 direct full-time equivalent operational employees at housing build-out

PROJECTED TOTAL OPERATIONAL EMPLOYMENT IMPACTS OF THE LIHI LANI DEVELOPMENT
(Full-time equivalent positions)

		Project period								
Employment type	Full-time equivalent assumptions	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
Direct employment:										
Ranch(1)		5	5	5	5	5	5	5	5	5
Property management and sales (2)		10	10	5	5	5	5	5	5	5
Community facility (3)		20	20	20	20	20	20	20	20	20
Subtotal, direct (rounded)		40	40	30	30	30	30	30	30	30
Indirect and induced employment(4):										
Ranch	131% of direct	7	7	7	7	7	7	7	7	7
Property management and sales	216% of direct	22	22	11	11	11	11	11	11	11
Community facility	141% of direct	28	28	28	28	28	28	28	28	28
Subtotal, indirect and induced (rounded)		60	60	50	50	50	50	50	50	50
Total		100	100	80	80	80	80	80	80	80

(1) Ranch operational employment based on employment patterns of comparable local equestrian and stable operations.
(2) Property management and sales operational employment based on discussions with Realtors and developers, includes campground and agricultural operations.
(3) Community facilities employment based on discussions with YMCA representatives, includes instructors, childcare workers, maintenance and administrative and management positions.
(4) Weighted estimate based on the projected mix of employment type and 1.26, 1.66, 1.66 and 3.16 full-time equivalent indirect and induced positions per direct position from DBED (1991) for eating and drinking, other retail, real estate and other services, respectively.

Reference: 1991 DBED Input-Output Model and Hawaii Econometric Model as published in the "Hawaii State Data Book," 1992.

Exhibit 3-A

Residents of the country lots and Lihi Lani's affordable homes are expected to be inhabited by an average of 2.3 and 2.4 residents, respectively

UNIT USAGE ASSUMPTIONS FOR ON-SITE POPULATION PROJECTIONS

Type of unit	Percent distribution(1)	Projected occupancy rate	Persons per unit(2)
Completed country homes:			
Full-time residences	75%	95%	3.0
Part-time residences	25%	25%	2.5
Total/ average per unit	100%	78%	2.3
Completed affordable units:			
Single-family units	100%	95%	3.0
Elderly/multifamily units	100%	95%	1.4
Total/ average per unit	100%	95%	2.4

(1) Occupied units only. Based on a projected market mix of Oahu residents (80% - 85%) and mainland or foreign residents (15% - 20%) and adjusted for user profile.
(2) Based on 1990 average household size for Pupukea CDP of 3.03 adjusted for user profile.

Source: U.S. Bureau of the Census, Summary Tape File 1A; "Census of Population and Housing, Census Tracts, Honolulu, Hawaii, Standard Metropolitan Area," 1990.

Exhibit 3-B

Average on-site daily resident population is estimated to reach nearly 1,000 people at build-out

PROJECTED AVERAGE DAILY RESIDENT AND USER POPULATION AT LIHI LANI

	Project period								
	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
Projected housing units at Lihi Lani (1):									
Country lot households:									
Full-time	4	15	39	58	86	115	142	193	236
Part-time	1	5	13	19	29	38	47	64	79
Total lot households	5	20	52	77	115	153	189	257	315
Resident affordable households:									
Single-family units	50	50	50	50	50	50	50	50	50
Elderly/multifamily units	0	0	80	80	80	80	80	80	80
Total affordable households	50	50	130	130	130	130	130	130	130
Projected on-site population (2):									
Lihi Lani resident population:									
Country lot residents:									
Full-time	11	43	112	166	248	330	408	555	680
Part-time	1	3	8	12	18	24	29	40	49
Affordable unit residents:									
Single-family units	143	143	143	143	143	143	143	143	143
Elderly/multifamily units	0	0	106	106	106	106	106	106	106
Subtotal, daily residents	154	189	369	427	515	603	686	843	977
Lihi Lani visitor population/day:									
Campground (3)	0	0	13	13	13	13	13	13	13
Ranch facilities (4)	0	4	4	4	4	4	4	4	4
Subtotal, daily visitors	0	4	17	17	17	17	17	17	17
Total daily population	154	193	386	444	532	620	703	861	995

Average on-site daily resident population is estimated to reach nearly 1,000 people at build-out

PROJECTED AVERAGE DAILY RESIDENT AND USER POPULATION AT LIHI LANI

	Project period								
	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
Projected off-site population:									
Daily North Shore resident population utilizing the community facility (5)	140	140	140	140	140	140	140	140	140

(1) Based on Exhibits 1-C and 3-A.
(2) Based on Exhibit 3-A.
(3) Estimated at 25 persons per day during the summer months and an average of 11 persons daily for the remainder of the year.
(4) Assumes 70% of stable renters are Lihi Lani, North Shore and Koolauloa residents, therefore the additional off-site population is expected to be 30%. Assuming that renters will visit twice a week.
(5) Based on discussions with YMCA representatives and assuming a 1,000 member facility.

Source: Discussions with representatives from Obayashi Hawaii Corporation and Group 70; and market assessment report.

Exhibit 3-C

Resident in-migration as a result of Lihi Lani is expected to be minimal

TOTAL PROJECTED ADDITIONAL IN-MIGRANT RESIDENT POPULATION TO THE STATE OF HAWAII

In-migrant type	Assumptions	Project period								
		1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
On-site community residents(1)	20% of total	2	9	24	36	53	71	87	119	146
Off-site community residents(2):										
Operational employees(3)	15% of direct	6	6	5	5	5	5	5	5	5
Dependents(4)	100% of above	6	6	5	5	5	5	5	5	5
Subtotal		12	12	10	10	10	10	10	10	10
Total in-migrant population impact, state		14	21	34	46	63	81	97	129	156

(1) Based on the assumption that 20% of Lihi Lani's country lot residents originate from outside the state, as shown in Exhibit 3-B.
(2) Construction labor requirements assumed to be satisfied by Oahu labor force.
(3) Based on 15% of total direct operational employment as shown in Exhibit 2-C.
(4) Assumes 1.0 additional in-migrant for each in-migrant full-time equivalent employee.

Exhibit 3-D

Additional employee housing demand as a result of development at Lihi Lani is also expected to be minimal

DIRECT OPERATIONAL EMPLOYEES AT LIHI LANI PROJECTED TO REQUIRE ADDITIONAL HOUSING

		Project period								
Housing demand source	Assumptions	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
Direct operational employees(1)		40	40	30	30	30	30	30	30	30
Available local labor force(2)	85% of direct	34	34	26	26	26	26	26	26	26
New island households(3)	10% of above	3	3	3	3	3	3	3	3	3
In-migrants(4)	15% of direct	6	6	5	5	5	5	5	5	5
New in-migrant households (5)	80% of above	5	5	4	4	4	4	4	4	4
Total new housing demand		8	8	6	6	6	6	6	6	6

(1) As shown in Exhibit 2-C.
(2) Island labor force estimated at total direct operational employees (Exhibit 2-C) less in-migrant employees (Exhibit 3-C) or 85% of direct operational employees.
(3) New island household formation projected based on 10% of direct available local labor force.
(4) As shown in Exhibit 3-C.
(5) New in-migrant household formation projected based on 80% of direct in-migrant operational employment.

Exhibit 4-A

Direct personal income from Lihi Lani's operations could reach $600,000 per year at build-out

PROJECTED DIRECT PERSONAL INCOME FROM DIRECT EMPLOYMENT ASSOCIATED WITH LIHI LANI

(Millions of 1993 dollars)

		Project period								
Type of direct employment	Full-time equivalent wages(1)	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
Construction(2)	$47,380	$6.63	$6.63	$2.84	$2.37	$3.32	$3.32	$2.84	$1.42	$0.47
Operational(3)-										
Ranch facilities	$16,560	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Property management & sales	$28,060	0.28	0.28	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Community facilities	$19,000	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Subtotal, operational income		$0.74	$0.74	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60
Total annual personal income		$7.38	$7.38	$3.45	$2.97	$3.92	$3.92	$3.45	$2.02	$1.08

(1) 1992 salaries adjusted to reflect full-time equivalent employees based on a 40-hour work week.
(2) Average Honolulu County wage for category multiplied by average number of construction workers for period as shown in Exhibit 2-A.
(3) Weighted pay estimated by applying the expected distribution of employment type and the number of employees (Exhibit 2-C) to their respective wages in the following categories: Amusement and recreation ($16,763), retail trade ($24,411), food and beverage establishments ($15,759), real estate ($26,736) and personal services ($19,912).

Source: Department of Labor and Industrial Relations (DLIR), "Labor Area News," monthly and DLIR Research and Statistics Office.

Exhibit 5-A

Total new taxes to the County could amount to $680,000 per year

PROJECTED ADDITIONAL TAX REVENUES TO THE COUNTY GOVERNMENT ATTRIBUTABLE TO LIHI LANI

(Millions, 1993 dollars)

	Project period								
Source of tax revenue	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
Property taxes:									
Sold country lots (1):									
Improved lots (2)	$0.01	$0.05	$0.31	$0.17	$0.25	$0.33	$0.41	$0.56	$0.69
Unimproved lots (3)	0.05	0.08	0.17	0.13	0.20	0.24	0.19	0.09	0.00
Sold affordable homes:									
Completed units (4)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Ranch, campground, and community facility (5)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Other developed land (6)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Other undeveloped land (7)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Total new property tax revenues	$0.19	$0.25	$0.60	$0.42	$0.57	$0.70	$0.72	$0.77	$0.81
Plus: miscellaneous tax revenues (8)	$0.00	$0.01	$0.01	$0.01	$0.02	$0.02	$0.03	$0.03	$0.04
Less: current property taxes (9)	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16
Total new County revenues	$0.03	$0.09	$0.44	$0.27	$0.42	$0.56	$0.59	$0.64	$0.68

(1) Based on development of sold lots from Exhibit 1-A.
(2) Based on assessments of $384,000 for improvements and $384,000 for land; an average $50,000 owner-occupant tax exemption; and a tax rate of $3.92 per thousand dollars of value.
(3) Based on assessments of $384,000 land and a tax rate of $3.12 per thousand dollars of value.
(4) Based on assessments of $200,000 for completed homes and an average $40,000 owner-occupant tax exemption; and a tax rate of $3.92 per thousand dollars of value.
(5) Based on an improvement assessments of $1.3 million for the ranch, $0.3 million for the campgrounds, $2.3 million for the community facility, and a tax rate of $8.51 per thousand dollars of value.
(6) Includes about 92 acres of zoned land under ranch and campground assessed at at a weighted average of $50,000 per acre. Tax rate is $8.51 per thousand dollars of value.
(7) Based on weighted average of current assessed value of $18,200 per acre for approximately 265 acres and a tax rate of $9.00 per thousand dollars of value.
(8) Other county tax collections from miscellaneous taxes such as liquid fuel, utility franchises, motor vehicle weight and other (non-grant) sources could be expected to be generated by Lihi Lani and total about $260 per in-migrant resident However, due to the low in-migrant residential population, such taxes are expected to be negligible.
(9) Current property tax is estimated at about $165,000, according to information obtained from MLS, Hawaii.

Exhibit 5-B

Construction at Lihi Lani could generate between $2.0 and $3.0 million in annual state revenues during the first three years of construction

PROJECTED ANNUAL EXCISE TAX REVENUES TO THE STATE GOVERNMENT

(Millions, 1993 dollars)

	Project period								
Revenue source	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
General excise tax on direct construction spending (1):									
Country lots, improved	0.06	0.09	0.20	0.16	0.23	0.29	0.22	0.08	0.00
Single-family affordable housing	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Campground, ranch, and community facility	0.04	0.07	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Infrastructure	0.86	1.71	0.29	0.29	0.41	0.31	0.00	0.00	0.00
Subtotal	$1.25	$1.87	$0.52	$0.45	$0.64	$0.60	$0.23	$0.08	$0.00
General excise tax on indirect and induced spending	0.74	1.10	0.31	0.26	0.38	0.36	0.13	0.05	0.00
Total annual general excise tax on construction spending (2)	$1.99	$2.97	$0.83	$0.71	$1.02	$0.96	$0.36	$0.13	$0.00

(1) Based on wholesale construction material tax of 0.5% charged to contractors for materials (assumed to be 40% of construction cost) and an additional 4.167% general excise tax charged to the developer (including total construction costs).
(2) Projected at $1.59 per one dollar of general excise tax on direct construction spending.

EXHIBIT 5-C

Total State revenues generated from the development of Lihi Lani is expected to reach between $2.1 and $3.1 million during the first three years of construction

PROJECTED ANNUAL REVENUES TO THE STATE GOVERNMENT ATTRIBUTABLE TO LIHI LANI

(Millions, 1993 dollars)

		Project period								
Revenue source	Basis per unit	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
General excise tax from construction (1)		$1.99	$2.97	$0.83	$0.71	$1.02	$0.96	$0.36	$0.13	$0.00
Income taxes from in-migrant residents:										
On-site-										
Number of persons(2)		2	9	24	36	53	71	87	119	146
State tax revenues(3)	$7,518 per person	$0.02	$0.07	$0.18	$0.27	$0.40	$0.53	$0.66	$0.89	$1.10
Off-site-										
Number of persons(2)		12	12	10	10	10	10	10	10	10
State tax revenues(4)	$3,688 per person	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Subtotal resident revenues		$0.06	$0.11	$0.22	$0.30	$0.44	$0.57	$0.69	$0.93	$1.13
Total state revenues		$2.06	$3.08	$1.05	$1.01	$1.45	$1.53	$1.06	$1.06	$1.13

(1) As shown in Exhibit 5-B.
(2) As shown in Exhibit 3-C.
(3) Includes state income, general excise, auto weight, gas and specific excise taxes; based on typical tax burdens for households with incomes of $100,000, based on marginal state income tax rates, and ratio of income to other state taxes paid as shown for "The Tax Burden of The Arnie Aloha Family," by the Tax Foundation of Hawaii.
(4) Includes state income, general excise, auto weight, gas and specific excise taxes; based on typical tax burdens for households earning the median 1993 income of $49,900 (HUD), based on marginal state income tax rates, and ratio of income to other state taxes paid as shown for "The Tax Burden of The Arnie Aloha Family," by the Tax Foundation of Hawaii.

Exhibit 6-A

The City and County of Honolulu County spends about $800 for each Oahu resident

COUNTY OF HONOLULU PER CAPITA GOVERNMENT EXPENDITURES

Function	Total expenditures FY91 (000's)(1)	Service population(2)	Annual expenditure Per resident	Per visitor
General government	$76,894	852,000	$90	–
Public safety	167,393	919,200	182	$182
Highways	28,495	919,200	31	31
Health and sanitation	90,225	919,200	98	98
Recreation	53,452	919,200	58	58
Interest	63,951	919,200	70	70
Bond redemption	27,702	852,000	33	–
Retirement and pension	34,246	852,000	40	–
Mass transit	50,617	919,200	55	55
Cash capital improvements	15,130	919,200	16	16
Miscellaneous	44,745	852,000	53	–
Total 1991 dollars	$652,850		$726	$511
Total 1993 dollars (rounded) (3)			$800	$560

(1) County government operating expenditures for fiscal year ended June 30, 1991, as reported in Tax Foundation of Hawaii, "Government in Hawaii," 1992.
(2) Resident and de facto population estimates for the County as of July 1, 1991, as reported by Federal-State Cooperative Program for Population Estimates.
(3) Adjusted to 1993 dollars based an estimated increase of 4.8% per annum 1991 and 1993, as reported by Bank of Hawaii Information Center, 1992.

Exhibit 6-B

New annual county expenditures from in-migrant Hawaii residents are projected to be about $120,000 at build-out

PROJECTED ANNUAL COUNTY GOVERNMENT EXPENDITURES ASSOCIATED WITH LIHI LANI

(Millions, 1993 dollars)

		Project period								
	Basis per unit	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
In-migrant Hawaii residents (1):										
Community residents		2	9	24	36	53	71	87	119	146
In-migrant employees & dependents		12	12	10	10	10	10	10	10	10
Total		14	21	34	46	63	81	97	129	156
Total expenditures from in-migrant Hawaii residents (2)	$800 per resident	$0.01	$0.02	$0.03	$0.04	$0.05	$0.06	$0.08	$0.10	$0.12

(1) As shown in Exhibit 3-C.
(2) Based on per capita expenditures of $800 per resident, as shown in Exhibit 6-A.

Exhibit 6-C

The State of Hawaii spends an average of $4,160 per resident annually

STATE OF HAWAII PER CAPITA GOVERNMENT EXPENDITURES

Function	Total expenditures FY91 (000's)(1)	Service population(2)	Annual expenditure Per resident	Per visitor
General government	$379,208	1,136,600	$334	–
Public safety	156,845	1,277,600	123	123
Highways	100,074	1,277,600	78	78
Natural resources	36,240	1,277,600	28	28
Health and sanitation	152,265	1,277,600	119	119
Hospitals and institutions	216,147	1,136,600	190	–
Public welfare	523,488	1,136,600	461	–
Education	1,250,981	1,136,600	1,101	–
Recreation	37,070	1,277,600	29	29
Utilities and other enterprises	229,571	1,277,600	180	180
Debt service	285,732	1,277,600	224	224
Retirement and pension	165,176	1,136,600	145	–
Employees' health insurance	927	1,136,600	1	–
Unemployment compensation	68,097	1,136,600	60	–
Grants-in-aid to counties	2,839	1,277,600	2	2
Urban redevelopment and housing	361,601	1,136,600	318	–
Cash capital improvements	391,184	1,277,600	306	306
Miscellaneous	102,362	1,136,600	90	–
Total 1991 dollars	$4,459,807		$3,789	$1,089
Total 1993 dollars (rounded) (3)			$4,160	$1,200

(1) State government operating expenditures for fiscal year ended June 30, 1991 as reported in Tax Foundation of Hawaii, "Government in Hawaii," 1992.
(2) Resident and de facto population estimates for the County as of July 1, 1991 as reported by Federal-State Cooperative Program for Population Estimates.
(3) Adjusted to 1993 dollars based an estimated increase of 4.8% per annum 1991 and 1993, as reported by Bank of Hawaii Information Center, 1992.

Exhibit 6-D

New annual State expenditures as a result of Lihi Lani are estimated to be about $650,000 at build-out

PROJECTED ANNUAL STATE GOVERNMENT EXPENDITURES ASSOCIATED WITH LIHI LANI

(Millions, 1993 dollars)

Population and expenditure type	Basis per unit	Project period 1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
In-migrant Hawaii residents (1):										
Community residents		2	9	24	36	53	71	87	119	146
In-migrant employees & dependents		12	12	10	10	10	10	10	10	10
Total		14	21	34	46	63	81	97	129	156
Total expenditures from in-migrant Hawaii residents (2)	$4,160 per resident	$0.06	$0.09	$0.14	$0.19	$0.26	$0.34	$0.41	$0.54	$0.65

(1) As shown in Exhibit 3-G.
(2) Based on per capita expenditures of $4,160 per resident, as shown in Exhibit 6-C.

Exhibit 6-E

Net new County revenues from Lihi Lani are projected to far exceed additional County costs and peak at $560,000 annually

SUMMARY OF COUNTY GOVERNMENT REVENUE AND EXPENDITURES ASSOCIATED WITH LIHI LANI

(Millions, 1993 dollars)

	Project period								
	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
New County revenues(1)	$0.03	$0.09	$0.44	$0.27	$0.42	$0.56	$0.59	$0.64	$0.68
New County expenditures(2)	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.10	0.12
Net additional revenues	$0.02	$0.07	$0.42	$0.23	$0.37	$0.49	$0.51	$0.54	$0.56
Revenue/expenditure ratio(3)	2.3	5.2	16.2	7.4	8.3	8.6	7.5	6.2	5.5

(1) As shown in Exhibit 6-A.
(2) As shown in Exhibit 6-B.
(3) New revenues divided by new expenditures.

Exhibit 6-F

Net new State revenues associated with Lihi Lani are projected to reach about $2.0 to $3.0 million during the first three years of development

SUMMARY OF STATE GOVERNMENT REVENUE AND EXPENDITURES ASSOCIATED WITH LIHI LANI

(Millions, 1993 dollars)

	Project period								
	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
New State revenues(1)	$2.06	$3.08	$1.05	$1.01	$1.45	$1.53	$1.06	$1.06	$1.13
New State expenditures(2)	0.06	0.09	0.14	0.19	0.26	0.34	0.41	0.54	0.65
Net additional revenues	$2.00	$3.00	$0.90	$0.82	$1.19	$1.19	$0.65	$0.52	$0.48
Revenue/expenditure ratio(3)	34.5	34.9	7.4	5.3	5.5	4.5	2.6	2.0	1.7

(1) As shown in Exhibit 6-C.
(2) As shown in Exhibit 6-D.
(3) New revenues divided by new expenditures.

KPMG Peat Marwick

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November 17, 1993

Mr. Toshiharu Hino, President
Obayashi Hawaii Corporation
c/o Mr. Craig Yamagishi
Lihi Lani
66-145 Kamehameha Highway
Haleiwa, Hawaii 96712

Dear Mr. Hino:

KPMG Peat Marwick is pleased to submit the accompanying addendum to the report entitled, "Economic and Fiscal Impacts of Lihi Lani," dated September 1993. The addendum addresses Question 8 in the letter to Mr. Jeffrey N. Watanabe, Esq. from the State of Hawaii, Land Use Commission dated November 5, 1993.

Specifically, the question pertains to four facilities at Lihi Lani including:

- Community facilities
- Water reclamation facility
- Affordable single-family housing
- Elderly housing

The economic and fiscal impacts of the first three of these facilities were already included as a part of our September 1993 study, thus these responses can be considered an expansion or subset of our previous study. The elderly housing impacts are being addressed in this addendum, as requested, however plans are for the project to be developed and operated by the City and County of Honolulu Department of Housing and Community Development rather than by Obayashi Hawaii Corporation.

PROJECTED TAX REVENUES TO THE COUNTY AND STATE DUE TO THE CONSTRUCTION OF THE COMMUNITY FACILITIES

The proposed community facilities include a 10,000 square foot multipurpose facility which would be developed on 6.5-acres of land and include a 25-meter swimming pool and playing fields for soccer and baseball.

New County revenues attributed to the community facilities at Lihi Lani are expected to be minimal. The proposed facility is expected to be owned and operated by the Young Men's Christian Association (YMCA) of Honolulu and the non-profit organization would be exempt from real property taxes except for a minimum charge of about $100 annually.

State revenues due to the community facilities, however, would include general excise tax collections on direct, indirect and induced construction expenditures and are shown in Exhibit A. Construction of the community facilities, including its associated infrastructure, is projected to generate about $90,250 in additional State revenues during the first three years. During the same time period, indirect and induced spending is expected to generate an additional $53,250 in general excise taxes. Total new State revenues attributable the community facilities located at Lihi Lani is estimated to be about $143,500 during each of the first three years of development.

INDIRECT AND INDUCED CONSTRUCTION EMPLOYMENT FOR THE AFFORDABLE SINGLE-FAMILY HOMES, ELDERLY RENTAL UNITS, COMMUNITY FACILITIES, AND WATER RECLAMATION FACILITY

As shown in Exhibit B, construction of the affordable single-family units, elderly rental project, community facilities and water reclamation facility is projected to occur within the first three years of Lihi Lani's development. Employment for the construction of these facilities include man-power for direct construction as well as for infrastructure work and could created an estimated 340 direct full-time equivalent construction positions.

Indirect and induced employment for the selected facilities are shown in Exhibit C and total about 265 full-time equivalent positions.

As also shown in the exhibit, total direct, indirect and induced employment due to construction is estimated to be about 600 full-time positions.

INCOME TAXES DUE TO IN-MIGRANT RESIDENTS OF THE AFFORDABLE SINGLE-FAMILY UNITS AND ELDERLY RENTAL PROJECT

In response to the question raised by the Land Use Commission, the development of affordable single-family homes and elderly rental units is not expected to generate new in-migrant population to the County or State. In order to qualify for the purchase or rental of units at these specific developments homeowners must be existing residents of the State. Therefore, the projects are not expected to have any impact on in-migrant residents to the County or State.

Although the four identified facilities are not expected to generate new in-migrant residents who live on-site at Lihi Lani, the demands for operational employees may create a small number of new in-migrant residents who live elsewhere on the island.

Assuming that about 15% of the operational employees of the four projects would come from out of state, and that they would be accompanied by an average of on other person, there are expected to be about 9 or 10 additional in-migrant residents at 100% build-out, as shown in Exhibit D.

KPMG Peat Marwick

Mr. Toshiharu Hino, President
November 17, 1993
Page 3

COUNTY AND STATE EXPENDITURES DUE TO THE AFFORDABLE SINGLE-FAMILY HOMES, ELDERLY RENTAL UNITS, COMMUNITY FACILITIES, AND WATER RECLAMATION FACILITY AT LIHI LANI

New County and State expenditures are based on new government outlays to serve the in-migrant population who move to Hawaii as a result of development of the selected facilities. Generally, in-migrant residents attributable these facilities are expected to be minimal.

- Construction of the selected facilities is not expected to generate any in-migrant population due to the relatively small project size and the availability of Oahu's labor force which is expected to be able to accommodate the additional work generated.
- Two of the four selected facilities are residential projects, and are not expected to contribute towards the in-migrant resident population of Lihi Lani due to residency requirements.
- Operational employment may generate some in-migrant residents. However, it is expected to be minimal, consisting of 15% of the selected facilities' direct operational employment, or about 4 to 5 employees.

Additional County expenditures due to the development of the selected facilities are projected to be nominal or about $7,120 a year through 1998 and is expected to decrease to about $5,520 thereafter due to the decline in operational employees after the affordable and elderly projects are completed and marketed, as shown in Exhibit E.

Similarly, new State expenditures attributable to the selected facilities at Lihi Lani are shown in Exhibit E and are also expected to be minimal consisting of about $37,000 in 1996 and stabilizing at about $28,700 per year, as shown in Exhibit F.

* * * * * * *

We appreciate the opportunity to clarify these issues for Lihi Lani. Please feel free to call us if we can assist you further in anyway.

Very truly yours,

KPMG Peat Marwick

EXHIBIT A

The community facilities located at Lihi Lani are expected to generate about $143,500 a year in additional State revenues during the first three years of development

PROJECTED ANNUAL EXCISE TAX REVENUES TO THE STATE GOVERNMENT ATTRIBUTED TO THE COMMUNITY FACILITIES AT LIHI LANI

	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
General excise tax on direct construction spending (1)	$90,251	$90,251	$90,251	$0	$0	$0	$0	$0	$0
General excise tax on indirect and induced spending	53,249	53,249	53,249	0	0	0	0	0	0
Total annual general excise tax on construction spending (rounded)(2)	$143,500	$143,500	$143,500	$0	$0	$0	$0	$0	$0

(1) Based on wholesale construction material tax of 0.5% charged to contractors for materials (assumed to be 40% of construction costs) and an additional 4.167% general excise tax charged to the developer (including total construction costs of $6.2 million).
(2) Projected at $1.59 per one dollar of general excise tax on direct construction spending.

EXHIBIT B

Direct construction employment for the affordable singe-family homes, elderly rental units, community facilities, and water reclamation facility could generate the equivalent of about 340 full-time employees during the first three years of development

PROJECTED DIRECT CONSTRUCTION EMPLOYMENT FOR SELECTED FACILITY TYPES AT LIHI LANI

	Assumptions	1996	1997 & 1998	1999 & 2000	2001 & 2002	2003 & 2004	2005 & 2006	2007 & 2008	At 80% housing build-out	At 100% housing build-out
Affordable single-family units:										
Number of completed homes		50	0	0	0	0	0	0	0	0
Housing construction employees(1)	0.9 persons per home	45	0	0	0	0	0	0	0	0
Infra. construction employees(2)	$1,380,000	7	0	0	0	0	0	0	0	0
Total construction employees		52	0	0	0	0	0	0	0	0
Elderly rental units:										
Number of completed homes(3)		0	80	0	0	0	0	0	0	0
Housing construction employees(1)	0.9 persons per home	0	72	0	0	0	0	0	0	0
Infra. construction employees(4)	$2,056,000	11	0	0	0	0	0	0	0	0
Total construction employees		11	72	0	0	0	0	0	0	0
Community facilities:										
Building construction employees(5)	$2,300,000	12	0	0	0	0	0	0	0	0
Infra. construction employees(6)	$1,690,000	9	0	0	0	0	0	0	0	0
Total construction employees		22	0	0	0	0	0	0	0	0
Water reclamation facility:										
Construction employees(7)	3.1 persons per month	37	9	0	0	0	0	0	0	0
Infra. construction employees(8)	$24,612,000	133	0	0	0	0	0	0	0	0
Total construction employees		170	9	0	0	0	0	0	0	0
Total, direct employment (rounded)		260	80	0	0	0	0	0	0	0

(1) Estimated at 0.9 total person-years over a one year construction period per home.
(2) Assumes on-site infrastructure development costs of $1,380,000, as provided by Engineering Concepts, with 40% dedicated to labor costs, and labor wages and benefits averaging $73,913 per worker.
(3) Assumes that the Department of Housing and Community Development (DHCD) will complete the project as of 1997; however, DHCD will make the final determination of the completion date.
(4) Assumes on-site infrastructure development costs of $2,056,000, as provided by Engineering Concepts, with 40% dedicated to labor costs, and labor wages and benefits averaging $73,913 per worker.
(5) Assumes development costs of $2.3 million, with 40% dedicated to labor costs, and labor wages and benefits averaging $73,913 per worker.
(6) Assumes on-site infrastructure development costs of $1,690,000, as provided by Engineering Concepts, with 40% dedicated to labor costs, and labor wages and benefits averaging $73,913 per worker.
(7) Based on the weighted average of a total of 20 full-time employees for 9-months and a total of 40 full-time employees for 6-months, based on discussions with representatives of Group 70.
(8) Assumes infrastructure development costs of $24,612,000, as provided by Group 70, with 40% dedicated to labor costs, and labor wages and benefits averaging $73,913 per worker.

EXHIBIT C

Development of affordable single-family homes, elderly rental units, community facilities, and water reclamation facility at Lihi Lani could generate employment of about 600 employees during the first three years of development

PROJECTED TOTAL CONSTRUCTION EMPLOYMENT FOR SELECTED FACILITY TYPES AT LIHI LANI

	Assumptions	1996	1997 & 1998	1999 & 2000	2001 & 2002	2003 & 2004	2005 & 2006	2007 & 2008	At 80% housing build-out	At 100% housing build-out
Affordable single-family units:										
Direct construction(1)		0	52	0	0	0	0	0	0	0
Indirect and induced employment -										
On-island(2)	80% of other	0	33	0	0	0	0	0	0	0
Elsewhere in the State	employment	0	8	0	0	0	0	0	0	0
Subtotal, indirect and induced employment		0	41	0	0	0	0	0	0	0
Total, direct, indirect and induced employment(3)	179% of direct employment	0	93	0	0	0	0	0	0	0
Elderly rental units:										
Direct construction(1)		11	72	0	0	0	0	0	0	0
Indirect and induced employment -										
On-island(2)	80% of other	7	46	0	0	0	0	0	0	0
Elsewhere in the State	employment	2	11	0	0	0	0	0	0	0
Subtotal, indirect and induced employment		9	57	0	0	0	0	0	0	0
Total, direct, indirect and induced employment(3)	179% of direct employment	20	129	0	0	0	0	0	0	0
Community facilities										
Direct construction(1)		22	0	0	0	0	0	0	0	0
Indirect and induced employment -										
On-island(2)	80% of other	14	0	0	0	0	0	0	0	0
Elsewhere in the State	employment	3	0	0	0	0	0	0	0	0
Subtotal, indirect and induced employment		17	0	0	0	0	0	0	0	0
Total, direct, indirect and induced employment(3)	179% of direct employment	39	0	0	0	0	0	0	0	0

Development of affordable single-family homes, elderly rental units, community facilities, and water reclamation facility at Lihi Lani could generate employment of about 600 employees during the first three years of development

PROJECTED TOTAL CONSTRUCTION EMPLOYMENT FOR SELECTED FACILITY TYPES AT LIHI LANI, CONTINUED

	Assumptions	1996	1997 & 1998	1999 & 2000	2001 & 2002	2003 & 2004	2005 & 2006	2007 & 2008	At 80% housing build-out	At 100% housing build-out
Water reclamation facility:										
Direct construction(1)		170	9	0	0	0	0	0	0	0
Indirect and induced employment -										
On-island(2)	80% of other employment	107	6	0	0	0	0	0	0	0
Elsewhere in the State		27	1	0	0	0	0	0	0	0
Subtotal, indirect and induced employment		134	7	0	0	0	0	0	0	0
Total, direct, indirect and induced employment(3)	179% of direct employment	304	16	0	0	0	0	0	0	0
Facilities summary:										
Direct construction(1)		203	133	0	0	0	0	0	0	0
Indirect and induced employment -										
On-island(2)		128	84	0	0	0	0	0	0	0
Elsewhere in the State		32	21	0	0	0	0	0	0	0
Subtotal, indirect and induced employment		160	105	0	0	0	0	0	0	0
Total, direct, indirect and induced employment(3)		363	238	0	0	0	0	0	0	0

(1) As shown in Exhibit B.
(2) Estimated at 80% of total indirect and induced employment.
(3) Total direct, indirect and induced employment estimated at 1.79 full-time equivalent positions per direct position, based on 1991 ratios from the DBED Input-Output Model and Hawaii Econometric Model, as presented in the Department of Business and Economic Development, "The Hawaii State Data Book," 1992.

EXHIBIT D

New annual State revenues from in-migrant Hawaii residents attributable to the affordable single-family homes, elderly rental units, community facilities, and water reclamation facility at Lihi Lani are projected to be about $25,450 by the year 2000

PROJECTED ANNUAL STATE REVENUES ASSOCIATED WITH SELECTED FACILITY TYPES AT LIHI LANI

	Assumptions	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
Affordable single-family units:										
On-site:										
Number or people(1)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
State tax revenues(2)	$7,518 per person	$0	$0	$0	$0	$0	$0	$0	$0	$0
Off-site:										
Number or people(1)		1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
State tax revenues(3)	$3,688 per person	$3,688	$3,688	$0	$0	$0	$0	$0	$0	$0
Subtotal resident revenues		$3,688	$3,688	$0	$0	$0	$0	$0	$0	$0
Elderly rental units:										
On-site:										
Number or people(1)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
State tax revenues(2)	$7,518 per person	$0	$0	$0	$0	$0	$0	$0	$0	$0
Off-site:										
Number or people(1)		1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
State tax revenues(3)	$3,688 per person	$3,688	$3,688	$0	$0	$0	$0	$0	$0	$0
Subtotal resident revenues		$3,688	$3,688	$0	$0	$0	$0	$0	$0	$0
Community facilities:										
On-site:										
Number or people(1)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
State tax revenues(2)	$7,518 per person	$0	$0	$0	$0	$0	$0	$0	$0	$0
Off-site:										
Number or people(1)		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
State tax revenues(3)	$3,688 per person	$22,128	$22,128	$22,128	$22,128	$22,128	$22,128	$22,128	$22,128	$22,128
Subtotal resident revenues		$22,128	$22,128	$22,128	$22,128	$22,128	$22,128	$22,128	$22,128	$22,128

New annual State revenues from in-migrant Hawaii residents attributable to the affordable single-family homes, elderly rental units, community facilities, and water reclamation facility at Lihi Lani are projected to be about $25,450 by the year 2000

PROJECTED ANNUAL STATE REVENUES ASSOCIATED WITH SELECTED FACILITY TYPES AT LIHI LANI, CONTINUED

	Assumptions	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
Water reclamation facility:										
On-site:										
Number or people(1)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
State tax revenues(2)	$7,518 per	$0	$0	$0	$0	$0	$0	$0	$0	$0
Off-site:										
Number or people(1)		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
State tax revenues(3)	$3,688 per person	$3,319	$3,319	$3,319	$3,319	$3,319	$3,319	$3,319	$3,319	$3,319
Subtotal resident revenues		$3,319	$3,319	$3,319	$3,319	$3,319	$3,319	$3,319	$3,319	$3,319
Facilities summary:										
Affordable single-family units		$3,688	$3,688	$0	$0	$0	$0	$0	$0	$0
Elderly rental units		3,688	3,688	0	0	0	0	0	0	0
Community facilities		22,128	22,128	22,128	22,128	22,128	22,128	22,128	22,128	22,128
Water reclamation facility		3,319	3,319	3,319	3,319	3,319	3,319	3,319	3,319	3,319
Total State revenues associated with selected facility types (rounded)		$32,820	$32,820	$25,450	$25,450	$25,450	$25,450	$25,450	$25,450	$25,450

(1) As shown in Exhibit F.
(2) Includes state income, general excise, auto weight, gas and specific excise taxes; based on typical tax burdens for households with incomes of $100,000, based on marginal state income tax rates, and ratio of income to other state taxes paid as shown for "The Tax Burden of The Amie Aloha Family," by the Tax Foundation of Hawaii.
(3) Includes state income, general excise, auto weight, gas and specific excise taxes; based on typical tax burdens for households earning the median 1993 income of $49,900 (HUD), based on margina state income tax rates, and ratio of income to other state taxes paid as shown for "The Tax Burden of The Amie Aloha Family," by the Tax Foundation of Hawaii.

New annual County expenditures from in-migrant Hawaii residents attributable to the affordable single-family homes, elderly rental units, community facilities, and water reclamation facility at Lihi Lani are projected to be about $5,500 by the year 2000

PROJECTED ANNUAL COUNTY EXPENDITURES ASSOCIATED WITH SELECTED FACILITY TYPES AT LIHI LANI

	Assumptions	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
Affordable single-family units:										
In-migrant resident population(1)	15% of dir. oper. emp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
In-migrant construction employees and dependents(2)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
In-migrant operational employees(3)	15% of dir. oper. emp.	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
In-migrant operational dependents	100% of above	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total expenditures from in-migrant Hawaii residents(4)	$800 per resident	$800	$800	$0	$0	$0	$0	$0	$0	$0
Elderly rental units:										
In-migrant resident population(1)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
In-migrant construction employees and dependents(2)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
In-migrant operational employees(3)	15% of dir. oper. emp.	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
In-migrant operational dependents	100% of above	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total expenditures from in-migrant Hawaii residents(4)	$800 per resident	$800	$800	$0	$0	$0	$0	$0	$0	$0
Community facilities:										
In-migrant construction employees and dependents(2)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
In-migrant operational employees(3)	15% of dir. oper. emp.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
In-migrant operational dependents	100% of above	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Total expenditures from in-migrant Hawaii residents(4)	$800 per resident	$4,800	$4,800	$4,800	$4,800	$4,800	$4,800	$4,800	$4,800	$4,800

EXHIBIT E, CONTINUED

New annual County expenditures from in-migrant Hawaii residents attributable to the affordable single-family homes, elderly rental units, community facilities, and water reclamation facility at Lihi Lani are projected to be about $5,500 by the year 2000

PROJECTED ANNUAL COUNTY EXPENDITURES ASSOCIATED WITH SELECTED FACILITY TYPES AT LIHI LANI, CONTINUED

	Assumptions	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
Water reclamation facility:										
In-migrant construction employees and dependents(2)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
In-migrant operational employees(3)	15% of dir. oper. emp.	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
In-migrant operational dependents	100% of above	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Total expenditures from in-migrant Hawaii residents(4)	$800 per resident	$720	$720	$720	$720	$720	$720	$720	$720	$720
Facilities summary:										
Affordable single-family units		$800	$800	$0	$0	$0	$0	$0	$0	$0
Elderly rental units		800	800	0	0	0	0	0	0	0
Community facilities		4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800
Water reclamation facility		720	720	720	720	720	720	720	720	720
Total County expenditures associated with selected facility types		$7,120	$7,120	$5,520	$5,520	$5,520	$5,520	$5,520	$5,520	$5,520

(1) Assumed to be zero, due to affordable and elderly housing restrictions to residents of the State.
(2) Construction employment is assumed to be captured by the Oahu labor force.
(3) Assumed to be 15% of direct operational employees as shown in Exhibit 2-C in the study entitled, "Economic and Fiscal Impacts of Lihi Lani," dated July 1993.
(4) Based on per capita expenditures of $800 per resident, as shown in Exhibit 6-A in the study entitled, "Economic and Fiscal Impacts of Lihi Lani," dated July 1993.
(5) Operational employment estimated at 3 full-time employees (2 full-time and 2 part-time), based on estimates by Group 70.

EXHIBIT E

New annual State expenditures from in-migrant Hawaii residents attributable to the affordable single-family homes, elderly rental units, community facilities, and water reclamation facility at Lihi Lani are projected to be about $28,700 by the year 2000

PROJECTED ANNUAL STATE EXPENDITURES ASSOCIATED WITH SELECTED FACILITY TYPES AT LIHI LANI

	Assumptions	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
Affordable single-family units:										
In-migrant resident population(1)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
In-migrant construction employees and dependents(2)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
In-migrant operational employees(3)	15% of dir. oper. emp.	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
In-migrant operational dependents	100% of above	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total expenditures from in-migrant Hawaii residents(4)	$4,160 per resident	$4,160	$4,160	$0	$0	$0	$0	$0	$0	$0
Elderly rental units:										
In-migrant resident population(1)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
In-migrant construction employees and dependents(2)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
In-migrant operational employees(3)	15% of dir. oper. emp.	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
In-migrant operational dependents	100% of above	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total expenditures from in-migrant Hawaii residents(4)	$4,160 per resident	$4,160	$4,160	$0	$0	$0	$0	$0	$0	$0
Community facilities:										
In-migrant construction employees and dependents(2)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
In-migrant operational employees(3)	15% of dir. oper. emp.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
In-migrant operational dependents	100% of above	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Total expenditures from in-migrant Hawaii residents(4)	$4,160 per resident	$24,960	$24,960	$24,960	$24,960	$24,960	$24,960	$24,960	$24,960	$24,960

New annual State expenditures from in-migrant Hawaii residents attributable to the affordable single-family homes, elderly rental units, community facilities, and water reclamation facility at Lihi Lani are projected to be about $28,700 by the year 2000

PROJECTED ANNUAL STATE EXPENDITURES ASSOCIATED WITH SELECTED FACILITY TYPES AT LIHI LANI, CONTINUED

	Assumptions	1996	1998	2000	2002	2004	2006	2008	At 80% housing build-out	At 100% housing build-out
Water reclamation facility:										
In-migrant construction employees and dependents(2)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
In-migrant operational employees(3)	15% of dir. oper. emp.	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
In-migrant operational dependents	100% of above	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Total expenditures from in-migrant Hawaii residents(4)	$4,160 per resident	$3,744	$3,744	$3,744	$3,744	$3,744	$3,744	$3,744	$3,744	$3,744
Facilities summary:										
Affordable single-family units		$4,160	$4,160	$0	$0	$0	$0	$0	$0	$0
Elderly rental units		4,160	4,160	0	0	0	0	0	0	0
Community facilities		24,960	24,960	24,960	24,960	24,960	24,960	24,960	24,960	24,960
Water reclamation facility		3,744	3,744	3,744	3,744	3,744	3,744	3,744	3,744	3,744
Total State expenditures associated with selected facility types		$37,024	$37,024	$28,704	$28,704	$28,704	$28,704	$28,704	$28,704	$28,704

(1) Assumed to be zero, due to affordable and elderly housing restrictions to residents of the State.
(2) Construction employment is assumed to be captured by the Oahu labor force.
(3) Assumed to be 15% of direct operational employees as shown in Exhibit 2-C in the study entitled, "Economic and Fiscal Impacts of Lihi Lani," dated July 1993.
(4) Based on per capita expenditures of $4,160 per resident, as shown in Exhibit 6-C in the study entitled, "Economic and Fiscal Impacts of Lihi Lani," dated July 1993.
(5) Operational employment estimated at 3 full-time employees (2 full-time and 2 part-time), based on estimates by Group 70.