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Mr. George Kaya
Director
Department of Public Works and Waste Management
County of Maui
200 South High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Kaya:

I am pleased to accept the Final Environmental Impact Statement (EIS) for the Kalamaula Landfill Closure Project at Kalamaula, Molokai, as satisfactory fulfillment of the requirements of Chapter 343, Hawaii Revised Statutes. My acceptance of the final EIS is an affirmation of the adequacy of the document pursuant to Section 11-200-23 of the Environmental Impact Statement Rules.

Sincerely,

LINDA CROCKETT LINGLE
Mayor, County of Maui

/mlg

c: Mr. Brian Choy, Office of Environmental Quality Control

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County of Maui

Kalamaula Landfill Closure Project

Final Environmental Impact Statement

June 1993

Brown and Caldwell
Consultants

FINAL

ENVIRONMENTAL IMPACT STATEMENT
ON THE
KALAMAULA LANDFILL CLOSURE PROJECT

Prepared for
Maui County
Department of Public Works and Waste Management
Solid Waste Division
200 South High Street
Wailuku, Maui, Hawaii 96793
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By
Brown and Caldwell
June 1993

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CHAPTER 1

INTRODUCTION AND SUMMARY

This chapter provides an introduction and summary to the proposed Kalamaula Landfill (Landfill) Closure Project (Project), which is the subject of this Environmental Impact Statement (EIS). The Landfill is located on the Island of Molokai on land that is owned by the State of Hawaii, Department of Hawaiian Homelands (DHHL).

APPLICANT AND BRIEF PROJECT SUMMARY

The Applicant is the County of Maui (County) Department of Public Works and Waste Management. Since enactment of the Section 404 of the Clean Water Act in July 1975, the Landfill has encroached onto 6.5 acres of wetlands without authorization. The County is now proposing to close the Landfill, and is in the process of siting a new integrated solid waste facility about 3 miles northeast of Kaunakakai to meet the solid waste disposal needs of Molokai residents. The proposed Project, which includes in-place Landfill closure of about 19 acres, development of off-site soil borrow areas, and enhancement of the Ohiapilo Pond near the Landfill is under regulatory direction by the U.S. Environmental Protection Agency (EPA) through a consent order process. The Landfill will be closed under the State Department of Health (DOH) Interim Guidelines for Closure.

PURPOSE AND CONTENT OF THIS EIS

This EIS has been prepared to identify and assess the potential environmental impacts that could result from the proposed Project, including Landfill closure, excavation of off-site borrow areas and enhancement of the Ohiapilo Pond, and to identify appropriate mitigation measures. The Landfill site has been the subject of a number of technical studies in 1991 and 1992, which have assessed whether or not the facility was polluting surrounding areas and which have analyzed various closure options. These studies include the following:

1. Preliminary Closure and Post-Closure Maintenance Plan (January 1993)[1]
2. Wetland Delineation Study (October 1992)[2]
3. Screening Site Inspection Report (1991)
4. Expanded Site Inspection Report (August 1992)[3]
5. Hydrogeologic Assessment (January 1993)[5]

6. Survey of Wetland Ecosystems (November 1992)[6]
7. Landfill Fire Investigation (September 1992)[7]
8. Landfill Gas Migration Investigation (September 1992)[8]
9. Alternative Closure Analysis (November 1992)[9]

Appropriate information from these documents have been incorporated into this EIS. However, if desired, the documents are available for review at the County library and the County administration building in Kaunakakai, and the County Public Works Department and Waste Management offices in Wailuku. Appendix A lists these and other reference sources used in the preparation of this document.

This EIS has been prepared in compliance with the provisions of Hawaii Revised Statutes (HRS) Chapter 343 and Title 11, DOH, Chapter 200, Environmental Impact Rules, Sections 11-200-14 through 11-200-17. A description of the proposed Project; the alternatives considered; the existing environmental conditions; the probable environmental consequences that could result from the proposed Project; the mitigation measures that would be employed to minimize potential adverse impacts; and the relationship of the proposed Project to existing land use plans, policies, and controls are provided in the following chapters of this EIS. As indicated above, the information contained herein has been developed from engineering, technical, and environmental studies of the site areas; generally available information regarding the environmental characteristics of the project sites and surrounding areas; and input provided by public meetings.

NEEDS AND OBJECTIVES

The County is in the process of siting a new landfill to serve the residents of Molokai. The new landfill will be designed and constructed in accordance with EPA's criteria for municipal solid waste landfills (40 Code of Federal Regulations [CFR], Part 258). Accordingly, the solid waste disposal needs of the island's residents will be accommodated in an environmentally-sound manner. It is expected that the new landfill will be operational by October 1993. With the new facility in Naiwa, the Landfill will no longer be needed and the County proposes to close the facility according to 40 CFR, Part 258 requirements. Meeting the regulatory requirements applicable to this proposed Project means that suitable soils must be transported in from off-site sources, and that appropriate mitigation must be implemented to mitigate that wetland encroachment that has occurred. Closure in this manner, and implementation of the proposed mitigation plan, will enhance coastal resource values and will provide important new habitat for waterbirds, including the Hawaiian stilt, an endangered species.

PROJECT DESCRIPTION

The proposed project consists of closure of the Landfill, excavation of off-site borrow areas for soil cover material, and enhancement of Ohiapilo Pond as mitigation for the unauthorized wetlands encroachment that has occurred.

Project Setting

The Island of Molokai, encompassing about 261 square miles, is a long and narrow island located between the Islands of Maui and Oahu. The Landfill is situated on the south-central portion of Molokai, along the island's southern coastline. Kaunakakai, the island's largest town, is located approximately 1.5 miles east of the Landfill. The potential soil borrow areas are located from 2.5 to 9 miles from the Landfill site while the Ohiapilo Pond area is adjacent to the site. The Landfill property is identified as Tax Map Key 5-2-11:por. 1, 21, and 5-2-08:24. The DHHL is the fee owner of the underlying property.

Landfill Closure

Based on the Preliminary Closure and Post-Closure Maintenance Plan,[1] the proposed Project consists of in-place closure of about 19 acres. The in-place closure includes minor regrading of the top and sides of the Landfill, and placement of the final cover. A final cover will be provided that will meet the new federal landfill requirements (40 CFR, Part 258). The cover will consist of a low permeability layer that will reduce the amount of rainwater infiltration into the Landfill. A vegetative layer will also be provided to promote evapotranspiration and to minimize erosion of the cover. The Landfill will be graded to allow surface water to drain off of the filled areas.

Off-Site Borrow Areas

Two types of soils are needed for the final cover: (1) a low permeability soil layer for the bottom of the final cover which has a permeability no greater than 1×10^{-5} centimeters per second (cm/sec), and (2) a earthen material capable of supporting vegetative growth. A borrow site investigation revealed that suitable borrow areas are available within a reasonable distance to the Landfill site.

Enhancement of Ohiapilo Pond

A wetlands delineation revealed that the Landfill has encroached upon 6.5 acres of wetlands since enactment of Section 404 of the Clean Water Act in July 1975. A preliminary review and analysis of potential options that could meet the requirements of the EPA and the U.S. Fish and Wildlife Service (FWS) for mitigation of this encroachment was conducted. This work included field reconnaissance, meetings with representatives of DHHL and Molokai Ranch, and coordination with FWS and EPA. Based on the results of the investigation, enhancement of Ohiapilo Pond is preferred by the County, EPA, and the FWS. The development of a specific enhancement plan for Ohiapilo Pond will be separate from the Landfill closure process and will involve interagency coordination and cooperation. In general, however, enhancement will likely involve 18 to 20 acres of the pond area. A major objective will be to increase available open-water habitat for the endangered birds which are known to inhabit the area.

SUMMARY OF IMPACTS

The environmental analysis of this EIS indicates that beneficial and potentially adverse impacts are associated with the proposed Project. These impacts are summarized below.

Beneficial Impacts

Beneficial impacts include the following:

- The final cover system will be designed to meet the requirements of 40 CFR, Part 258, and thereby minimize infiltration. Thus, the proposed Landfill closure will provide substantial benefits over the existing situation, further minimize the risk of water quality degradation, and enhance long-term compatibility of the facility with surrounding natural resources.

- Enhancement of Ohiapilo Pond will provide valuable open-water habitat for endangered bird species and other wildlife, and provide an educational opportunity for residents. An expanded pond will continue to furnish other wetland values and functions such as flood water storage and erosion control.

- Landfill closure will provide a benefit for litter, odor, and vector controls and will allow for establishment of vegetation on the site, which will blend with the surrounding environs and create an aesthetically integrated open space.

- Construction-related needs for closure will serve as short-term income generators for the local economy.

Adverse Impacts and Mitigation Measures

Potentially significant adverse impacts and mitigation measures are summarized in Table 1-1. With implementation of these measures, all impacts will be reduced to less than significant levels.

SUMMARY OF ALTERNATIVES CONSIDERED

Various closure alternatives were identified and evaluated as discussed in Chapter 3, in addition to the no-action alternative. Closure alternatives evaluated, in addition to in-place closure of the total filled area, included closure of 10.8 acres (removal of fill from the encroachment area as defined by pre-1975 acreage when Section 404 of the Clean Water Act was implemented), closure of 6.9 acres (removal of fill to the current permitted Landfill boundary), and removal of all wastes to off-site disposal. The no-action alternative was rejected because it would be contrary to regulatory agency direction and would likely result in issuance of an enforcement order by the EPA. Other closure alternatives were also rejected because they would result in greater environmental impacts and are more costly. Similarly, various mitigation options were also considered, but they are considered less viable at this time because of concerns over maintenance of the sites, both in preparation and over an extended period of time, and less ability to meet the specific requirements of the EPA and FWS.

SUMMARY OF UNRESOLVED ISSUES

As indicated earlier in this chapter, a series of technical studies were conducted to evaluate whether or not the Landfill was degrading the local environment and to help define the best apparent closure method. These studies, as summarized in this Final EIS, focused on the major technical issues associated with Landfill closure. Meetings have been held with the EPA, the FWS, and the DOH regarding the results of these studies. Comments received from the Draft EIS preparation notice process, included in Appendix B, have been addressed as have the comments received from the distribution and review of the Draft EIS (Chapter 8). It should be noted that although the County is committing to mitigate the wetland encroachment that has occurred, the specific plan to enhance Ohiapilo Pond has not been prepared and will be the result of an interagency cooperative effort yet to be completed.

Table 1-1 Summary of Impacts Which Can Be Mitigated to a Less-Than-Significant Level

Potentially significant adverse impact	Mitigation measures
Geology, Soils, and Water Resources	
A. Drainage and erosion, settlement, and subsidence could damage Landfill integrity and result in water quality or biological impacts.	1. Design the final cover pursuant to 40 Code of Federal Regulations (CFR), Part 258. 2. Design and implement final grading and drainage plan. 3. Implement post-closure maintenance and monitoring plan.
B. During 100-year flood events, the eastern portion of the Landfill could be damaged.	1. Include provisions for slope protection and stabilization in closure design.
C. Long-term water quality impacts stemming from subsurface contaminant migration.	1. Implement groundwater monitoring program in compliance with State Department of Health requirements. If degradation is documented, implement corrective action program.
D. Erosion and water quality impacts at soil borrow Sites 1 and 4.	1. If development of these sites toward the ultimate use is delayed once excavation is completed, the County will work with Molokai Ranch to assure that appropriate ground cover and erosion control measures are used to control erosion.
Biological Resources	
A. Long-term biological impacts stemming from subsurface contaminant migration.	1. Implement groundwater monitoring program in compliance with State Department of Health requirements. If degradation is documented, implement corrective action program.
B. Impacts resulting from enhancement of Ohiapilo Pond.	1. Schedule the enhancement project to avoid bird nesting and mating activities (March through July) and consider conducting this work when migratory birds are away. 2. Incorporate appropriate safeguards to deter predators from gaining access to the site once enhancement activities are completed. 3. Remove access road and all building materials at the end of construction. Replant access road with *Batis* from surrounding wetland.

Table 1-1 Summary of Impacts Which Can Be Mitigated to a Less-Than-Significant Level (continued)

Potentially significant adverse impact	Mitigation measures
Air Quality	
A. Dust impacts associated with placement of soil and construction of the final cover.	1. Use a water truck to conduct frequent spraying of water to control dust generation.
Archaeology	
A. Excavation at soil borrow Site 4 could impact a potentially significant archaeological site.	1. Avoid area during excavation. 2. Conduct archaeological monitoring at the site during initial ground disturbance of any portion of the borrow site.
B. Ohiapilo Pond may be significant for its potential to yield information to the understanding of traditional culture, history, and prehistory.	1. Conduct additional subsurface coring once the zone of disturbance is identified and prior to construction to gather additional information. 2. Avoid, if possible, any identified deposits. If avoidance is not possible, work will stop and the State Historic Preservation Division will be consulted to determine the types and amount of study that is appropriate prior to damage or destruction.
Public Health and Safety	
A. Health and safety impacts stemming from use of earth-moving equipment, soil haul trucks, and risk of contacting hazardous waste material or being exposed to explosive or toxic gases.	1. Contractor will prepare and follow a health and safety plan to address these issues pursuant to Title 29, CFR, Part 1910.120.
B. Health and safety impacts associated with landfill gas (LFG) migration along northern property boundary.	1. Install and monitor three LFG probes along the northern property boundary. If LFG migration is ever detected, undertake appropriate corrective measures.

Prior to release of the Draft EIS, a series of three workshops were held on Molokai on February 10, 1993, to inform the Molokai Planning Commission, the Kalamaula Homesteaders Association, and the public about the Landfill closure project and the results of the site investigations that were conducted. A number of comments were made seeking clarification and elaboration of the materials presented. The cultural significance of the Kalamaula area, and the value of the wetland ecosystems and off-shore coastal area was emphasized by several commentors. Though determined by site investigations to not be associated with the landfill, the elevated arsenic levels found at various locations in the wetland ecosystem, which extends along an extended coastal area, are a public health concern to local residents. Several commentors stressed the importance of determining the health significance of the arsenic levels and determining the sources of arsenic contamination. The appropriateness of using MW-8 as a background well was questioned by one commentor. These issues were investigated further since the Draft EIS was published and the results have been integrated into this Final EIS. On March 31, 1993, an additional public meeting was held on Molokai to receive comments on the Draft EIS, and to share the new information that was developed. A transcript on that meeting, detailing the discussions held, is included in Chapter 8.

COMPATIBILITY WITH LAND USE PLANS AND POLICIES

The proposed Project is consistent with the Hawaii State Plan, the County General Plan, and the Molokai Community Plan. The proposed Project will also require several governmental permits as discussed below.

NECESSARY PERMITS AND APPROVALS

This EIS has been prepared to support various state and County permit applications. Table 1-2 lists the major permits and approvals required.

Table 1-2 Summary of Permits and Approvals Required

Project component	Permit/approval required	Permitting/approval agency
Landfill closure	Consent Order	Environmental Protection Agency
	Solid Waste Facilities Permit Amendment	Department of Health (DOH)
	Special Management Area (SMA) Permit	Molokai Planning Commission
	National Pollutant Discharge Elimination System (NPDES) Permit	DOH
Borrow sites	Special Use Permit (Site 1)	Molokai Planning Commission
Enhancement of Ohiapilo Pond	Nationwide Permit	U.S. Army Corps of Engineers
	SMA Permit	Molokai Planning Commission
	State Coastal Zone Consistency Review	Office of State Planning
	401 Water Quality Certification	DOH
	NPDES Permit (possible)	DOH

Source: Michael T. Munekiyo Consulting, January 1993

CHAPTER 2

DESCRIPTION OF THE PROPOSED PROJECT

This chapter provides a general description of the Kalamaula Landfill (Landfill) Closure Project (Project). Information on the proposed Landfill closure was obtained from the Preliminary Closure and Post-Closure Maintenance Plan (Closure Plan) for the Landfill.[1] Recent refinements in the plan since the Draft Environmental Impact Statement (EIS) was published are also included. Finalization of the Closure Plan and Post-Closure Maintenance and Monitoring Plan is an on-going process and further refinements will likely occur before the regulatory agency approval is obtained. The Closure Plan describes the technical approach to the Landfill closure, provides the basis for post-closure maintenance and monitoring, and gives estimated costs associated for both.

INTRODUCTION

This section provides an introduction to the proposed Project. Information is presented on site history, Project location and surrounding land use, the status and description of the Molokai replacement landfill process, and the regulatory context.

Landfill History

The Landfill was opened in the early 1970s and is the only County-operated solid waste disposal facility on the Island of Molokai. The Landfill is located on land owned by the State of Hawaii, Department of Hawaiian Homelands (DHHL). The Landfill operates under Hawaii Department of Health (DOH) Permit No. SW-209216. As designated in the lease agreement between Maui County (County) and DHHL, the Landfill was not to exceed 6.9 acres. However, the Landfill encroached upon an additional 11 acres of the Ohiapilo Wetland. Based on a wetlands delineation analysis by the U.S. Department of Fish and Wildlife Services (FWS), approximately 6.5 acres of this encroachment occurred after July 25, 1975, which is the phase-in date for enforcement of Section 404 of the Clean Water Act.

The County does not maintain formal records of waste types or quantities placed in the Landfill. According to County employees, the Landfill primarily receives residential and agricultural solid wastes. Site inspections, which were performed under the Comprehensive Response Compensation and Liability Act found that hazardous wastes disposed at the Landfill may include paints, paint thinners, lead batteries, empty pesticide containers, empty transformer shells, junked cars, and materials containing asbestos.[3]

The Landfill is unlined and has poor drainage. There are no leachate collection or landfill gas (LFG) control systems in place. The top of the Landfill is graded at a 2 percent slope, with some near vertical uncovered side slopes at some locations along the Landfill boundary.

Project Location and Surrounding Land Uses

The Island of Molokai, encompassing about 261 square miles, is a long and narrow island located between the Islands of Maui and Oahu. The Landfill is situated on the south-central portion of Molokai, along the island's southern coastline (Figure 2-1). The property is identified as Tax Map Key 5-2-11:por. 1, 21, and 5-2-08:24. Figure 2-2 is the site location map. As indicated earlier, the DHHL is the fee owner of the underlying property.

The Landfill is located south of Maunaloa Highway, and may be accessed either via Hoawa Road, which borders the site to the north, or Kahanu Place, which lies to the east of the site.

The Landfill is located in the sparsely populated Kalamaula region of the island. Regionally, the area is located south of predominantly agricultural lands which are used for grazing and diversified agricultural operations. The town of Kaunakakai is located approximately 1.5 miles to the east of the Landfill, while the Molokai Airport is located to the northwest, approximately 5 miles from the Landfill.

The Landfill is located along the south coastal plains of the island. Lands surrounding the Landfill to the immediate south, southeast, and west (Figure 2-3) are swampy marshlands consisting of mangrove and related wetland vegetation. The Ohiapilo Pond, located within the surrounding wetland area, is found directly west of the Landfill.

Lands found immediately north and east of the Landfill, across Hoawa Road and Kahanu Place, respectively, are vacant and undeveloped. Further north, across Maunaloa Highway, is the rural residential area known as the Kalanianaole Colony. This area encompasses several single-family residences.

Molokai Replacement Landfill

The County is in the process of siting a new facility to replace the Landfill. The new Molokai integrated solid waste facility (ISWF) is to be located about 3 miles northwest of Kaunakakai, approximately 1.25 miles inland and is situated between elevations of approximately 200 to 250 above mean sea level. The site is presently undeveloped and covered with rangeland vegetation.

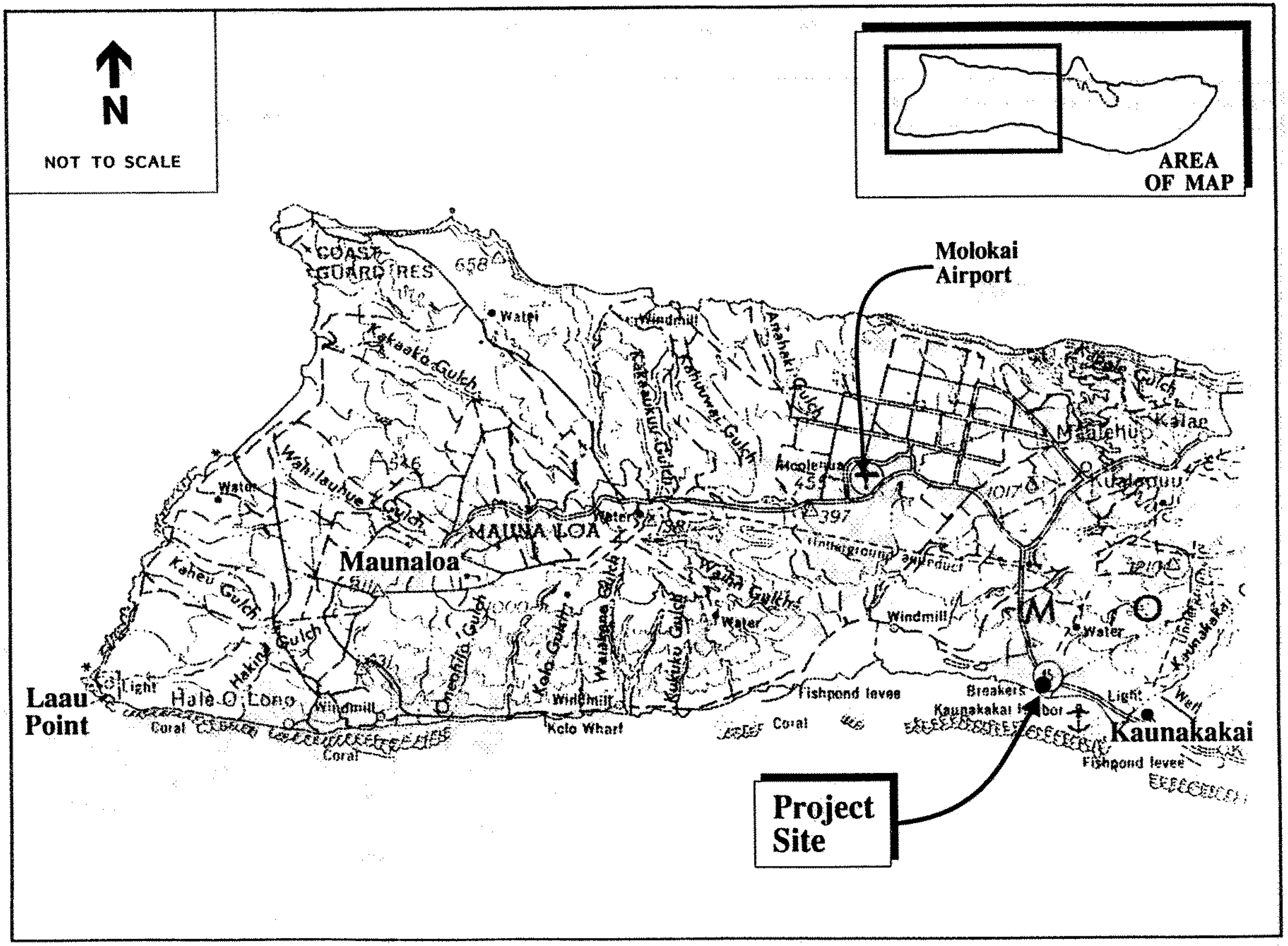
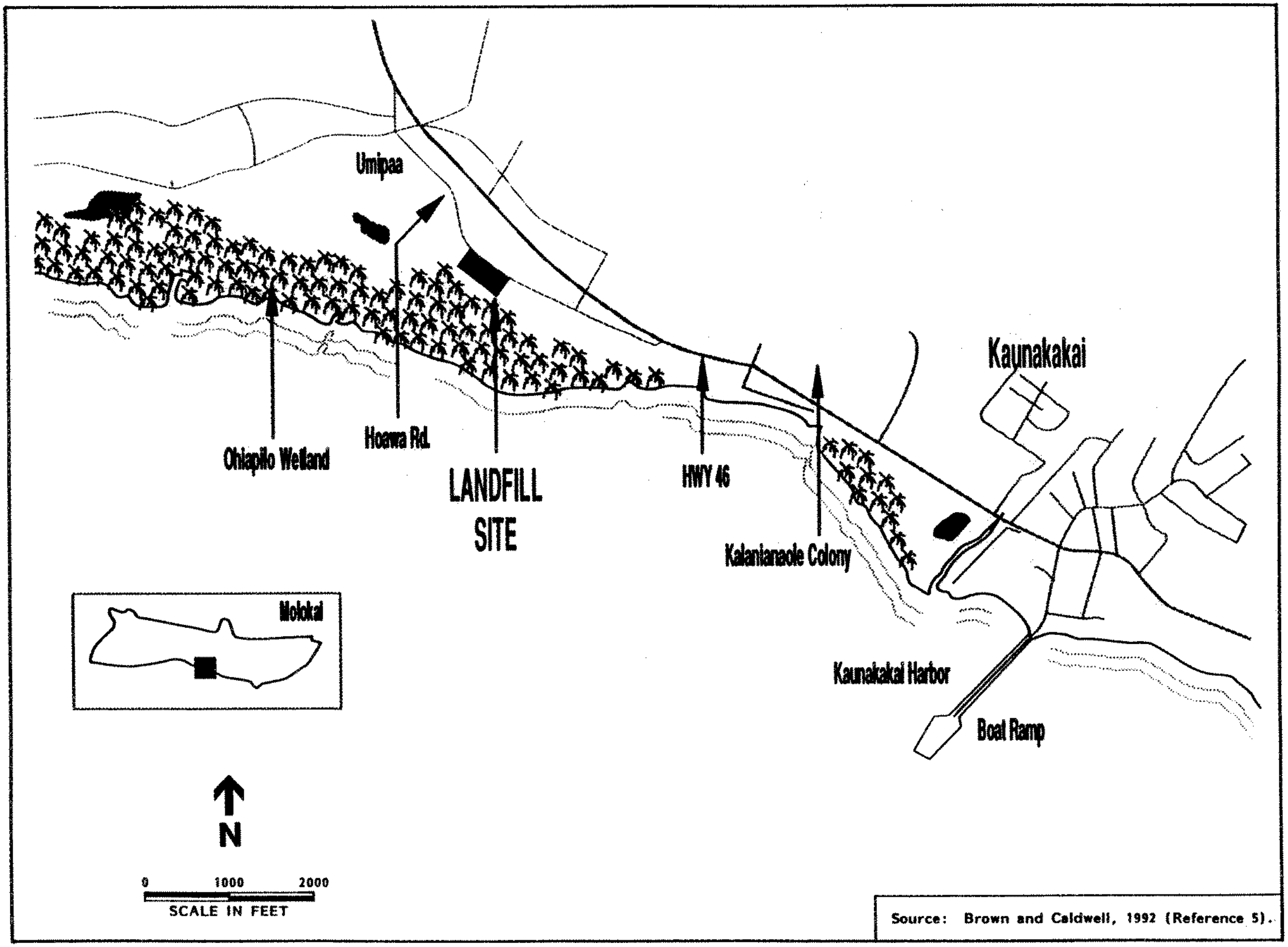
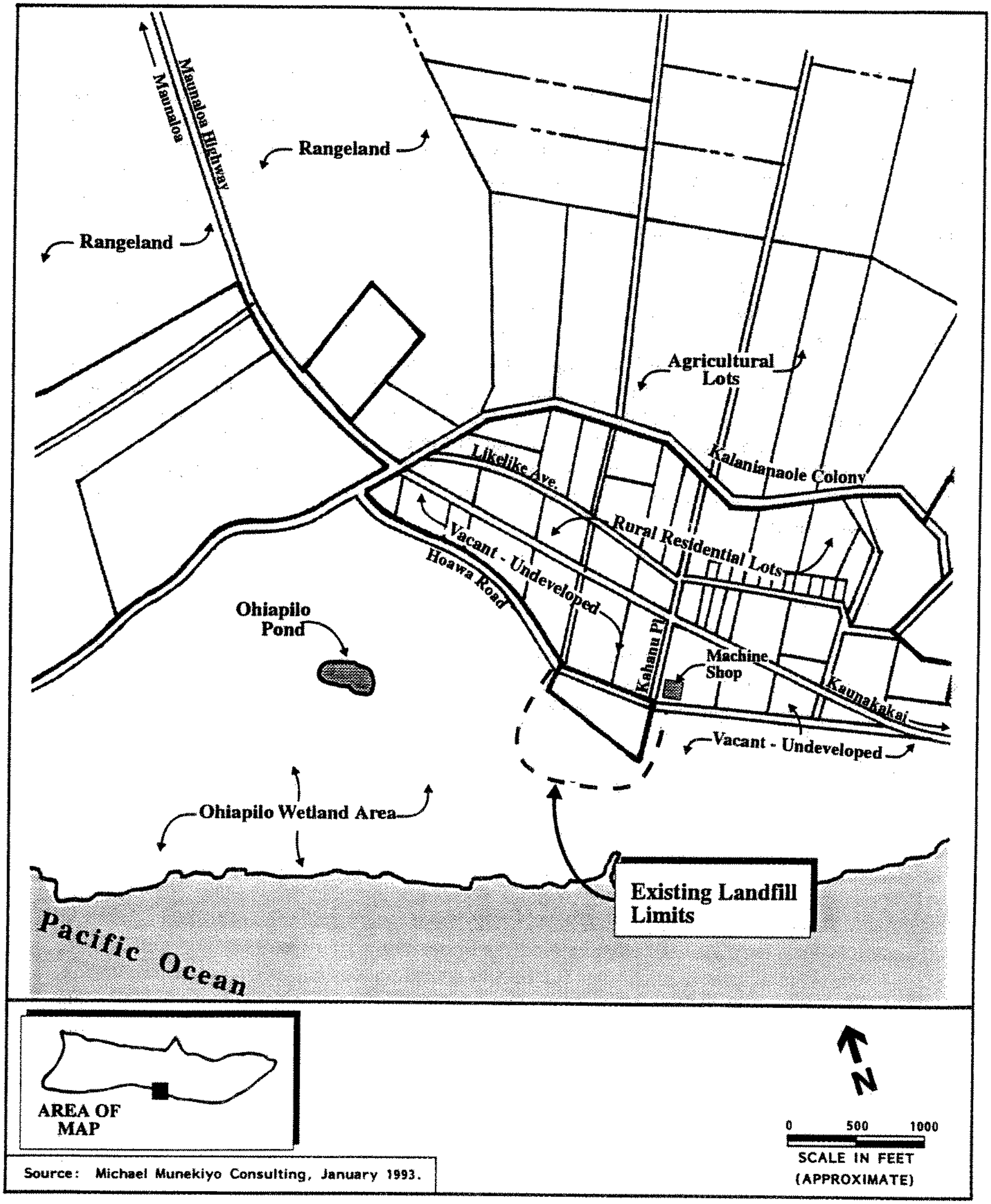


Figure 2-1 Project Vicinity Map



Source: Brown and Caldwell, 1992 (Reference 5).

Figure 2-2 Site Location Map



Source: Michael Munekiyo Consulting, January 1993.

Figure 2-3 Surrounding Land Uses

The total design life of the new landfill is 30 years with a total capacity of 584,000 cubic yards.[59] The landfill is planned to cover an approximate area of 12 acres and a maximum depth of 70 feet. Application of solid waste to the landfill will be in 18,250 cubic yard cells. This corresponds to 1 year's volume of refuse and daily and intermediate cover. The landfill will be developed in six phases with each phase consisting of 5 years. Approximately five cells constitute a phase. Upon completion of each phase, intermediate cover will be placed over the entire phase to provide LFG, run-off, and vector control.

The ISWF is being designed to provide Molokai with recycling and composting capabilities to reduce the incoming solid waste stream to the new landfill to less than 20 tons per day. The ISWF will include a recycling drop-off facility that will be designed to receive glass, paper, cardboard, and metal and a compost facility which will operate using composting windrows. If the ISWF is ultimately operated as designed, which includes considerations discussed above as well as annual precipitation, surface transportation, and groundwater quality concerns, it will be permitted as a small landfill under the Resource Conservation and Recovery Act (RCRA), Subtitle D. A preliminary design report (PDR) is currently being prepared for the ISWF. The ISWF is planned to go on line in October 1993 which corresponds to the time of closure of the Landfill.

Regulatory Context

Closure of the Landfill, development of the soil borrow area, and enhancement of the Ohiapilo Pond are subject to various federal, state, and local requirements. Chapter 1 lists the permits and approvals required, and Chapter 5 reviews the proposed Project relative to applicable governmental plans, policies, and controls. The encroachment onto the Ohiapilo Wetland is a key aspect of the Landfill closure. As will be discussed below, because of the encroachment, federal requirements under Section 404 of the Federal Water Pollution Control Act Amendments (Clean Water Act) play a significant role in closure of the Landfill.

Landfill Regulations. The U.S. Environmental Protection Agency (EPA) has promulgated new federal regulations for solid waste disposal facilities under the Resource Conservation and Recovery Act, Subtitle D. Under these new regulations (40 Code of Federal Regulation [CFR], Part 258), all existing landfills in operation after October 1993 will have to comply with set minimum requirements for landfill operation, design, groundwater monitoring, and corrective action, as well as financial assurance. Landfills that stop accepting waste before October 9, 1993, such as proposed by the County for the Landfill, however, will only be required to comply with the regulation's final cover requirements. The regulations also require that final cover must be installed within 6 months of last receipt of wastes.

Wetlands. Under Section 404 of the Clean Water Act, EPA has permitting authority over fill activities in waters of the United States and adjacent wetlands. Encroachment onto the wetlands has already occurred at the Landfill. EPA has three regulatory agency options for addressing this encroachment: (1) issue a retroactive Section 404 permit, (2) issue an enforcement order, or (3) issue a consent order. EPA is intending to issue a consent order for the proposed Project since the County is working cooperatively with the agency in closing the Landfill and providing wetlands mitigation. In development of the consent order, the FWS will provide recommendations to the EPA for mitigation of the wetlands encroachment that has occurred and will work with the EPA to assure that issues related to the wetlands encroachment and concerns over long-term impacts to the Ohiapilo Wetlands and any threatened, rare, or endangered species are addressed.

EPA requested the FWS to conduct a wetlands delineation study to delineate the encroachment that occurred which would serve as a basis for determining appropriate mitigation. The FWS determined that the phase-in date for the application of Section 404 of the Clean Water Act is July 25, 1975. Based on an examination of a series of aerial photographs of the Landfill site, the FWS determined the acreage of the Landfill on wetlands as of July 25, 1975, to be approximately 10.8 acres. The amount of fill placed in the Landfill between July 25, 1975, and December 7, 1989, and without authorization under Section 404 of the Clean Water Act, covered 6.5 acres.[2] The County has not encroached further onto wetlands since 1989. Thus, a total of 6.5 acres will have to be mitigated in order to offset the encroachment that has occurred. The proposed mitigation plan is discussed later in this chapter. The total area proposed for in-place closure is about 19 acres. Included in the in-place closure of 19 acres is about 1.5 acres of previously-disturbed land along the eastern edge of the Landfill.

PROJECT DESCRIPTION

The description of the proposed Project is presented below. The Project consists of closure of the Landfill, the excavation of off-site borrow areas for soil cover material, and enhancement of nearby wetland habitat as mitigation for the encroachment that has occurred.

Needs and Objectives

As indicated earlier in this chapter, the County is in the process of siting a new landfill to serve the residents of Molokai. The new landfill will be designed and constructed in accordance with EPA's criteria for municipal solid waste landfills (40 CFR, Part 258). Accordingly, the solid waste disposal needs of the island's residents will be accommodated in an environmentally sound manner. It is expected that the new landfill will be operational by October 1993. With the new facility in Naiwa, the Landfill will no longer be needed and the County proposes to close the facility according to 40 CFR, Part 258 requirements. Meeting the regulatory requirements applicable to this Project means that suitable soils must be transported in from off-site sources,and that appropriate mitigation must be implemented to mitigate that wetland encroachment which has occurred. Closure in this manner, and implementation of the proposed mitigation plan, will enhance coastal resource values and will provide important new habitat for waterbirds, including the Hawaiian stilt, an endangered species.

Landfill Closure

A series of site investigations were conducted for the County to provide supporting information for the Closure Plan. Technical Memoranda were prepared that described the investigations. The technical investigations included a wetlands delineation and analysis[2], a hydrogeologic assessment,[5] an ecological assessment,[6] a subsurface fire investigation,[7] a landfill gas migration investigation,[8] and an alternative closure analysis.[9] Results of the site investigation were reviewed with the FWS, EPA, and the state DOH, resulting in endorsement by these agencies of closure in place.

Closure Concept. The alternative closure analysis evaluated three closure alternatives based on engineering, economic, and environmental criteria.[9] These closure alternatives are: (1) in-place closure of 18.9 acres; (2) removal of encroachment areas which could involve: (a) closure within pre-1975 acreage of 10.8 acres, or (b) closure within permitted acreage of 6.9 acres; and (3) removal of all waste to off-site disposal. Based on the alternatives analysis, the in-place closure of about 19 acres was determined to be the most favorable alternative based on engineering, economic, and environmental criteria. Chapter 3 of this Environmental Impact Statement (EIS) provides a thorough discussion of the closure alternatives. Work conducted after the draft alternative closure analysis technical memorandum has resulted in a slight reduction in the total area.

The in-place closure of about 19 acres includes minor regrading of the top and sides of the Landfill, and placement of the final cover. A final cover will be provided that will meet the new Subtitle D requirements. The cover will consist of a low permeability layer that will reduce the amount of infiltration into the Landfill. A vegetative layer will also be provided to promote evapotranspiration and to minimize erosion of the cover. The Landfill will be graded to allow surface water to drain off of the filled areas. Because the results of the hydrogeologic assessment demonstrated that the Landfill is not contributing significant contaminants to the groundwater, soils and surrounding surface waters, a containment wall will not be provided. In addition, the depth to a low permeability material that would be suitable to key the containment wall into is uncertain. A clay layer was encountered at approximately 40 feet below the ground surface; however, the thickness and permeability of this material is not known.

Figure 2-4 shows the assumed closure limits and final contours. Figure 2-5 shows a cross section (profile) of the closure. Discussion is included in the following sections on the final grading and drainage plan, the final cover system, the post-closure maintenance and monitoring plan, and the preliminary closure costs and schedule.

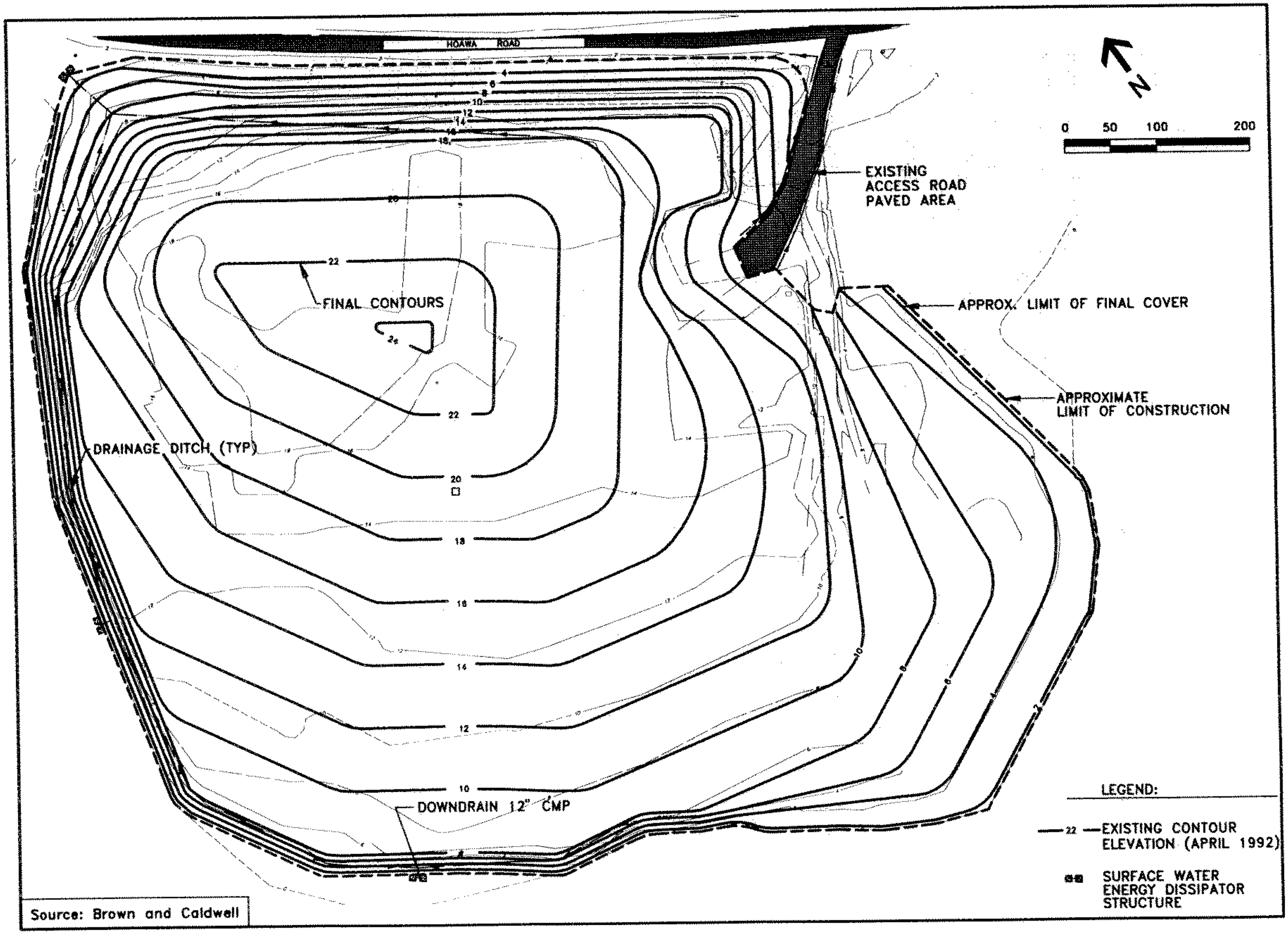
Final Grading and Drainage Plan. The final grading and drainage plan will be designed to promote runoff and minimize erosion. Because the Landfill will be closed in-place, only minor grading will be performed prior to placement of final cover. Based on a topographic survey conducted in April 1992, the Landfill covered 18.9 acres and contained 304,000 cubic yards (cu yd) of solid waste and cover material. It is estimated that by October 8, 1993, an additional 22,500 cu yd of landfill volume will be filled, resulting in a total in-place volume of 326,500 cu yd. This section discusses the design criteria used to develop the proposed grading and drainage plan and the construction requirements.

Design Criteria. Design criteria for the Landfill closure include landfill grading, drainage, and final cover criteria. The selected closure concept involves minor regrading of the top and sides of the Landfill to achieve the necessary slopes for closure. Specifically, side slopes will be graded to obtain a maximum of 3:1 horizontal to vertical. The top of the Landfill will be gently sloped at 2 to 4 percent. Drainage facilities will be installed. The grading plan and drainage facilities will effectively promote runoff, while minimizing the amount of erosion that takes place.

Construction Requirements. Before placement of final cover can begin, the Landfill surface must be prepared to receive the cover soils. Construction requirements for Landfill closure include clearing, grading, construction debris processing, and subgrade preparation. These requirements are discussed briefly in the following paragraphs.

1. **Clearing and Grading.** Clearing the site will consist of removing any vegetation, surface debris, or materials stored on the Landfill surface. The County is in the process of removing an existing scrap metal and old car pile. Any materials remaining on the Landfill will be removed prior to commencing any earthwork operations. Next, the site will be graded to meet the criteria established above. Bulky wastes, such as construction debris, located along the southern edge of the Landfill may require special handling and processing; this will be discussed in the next section.

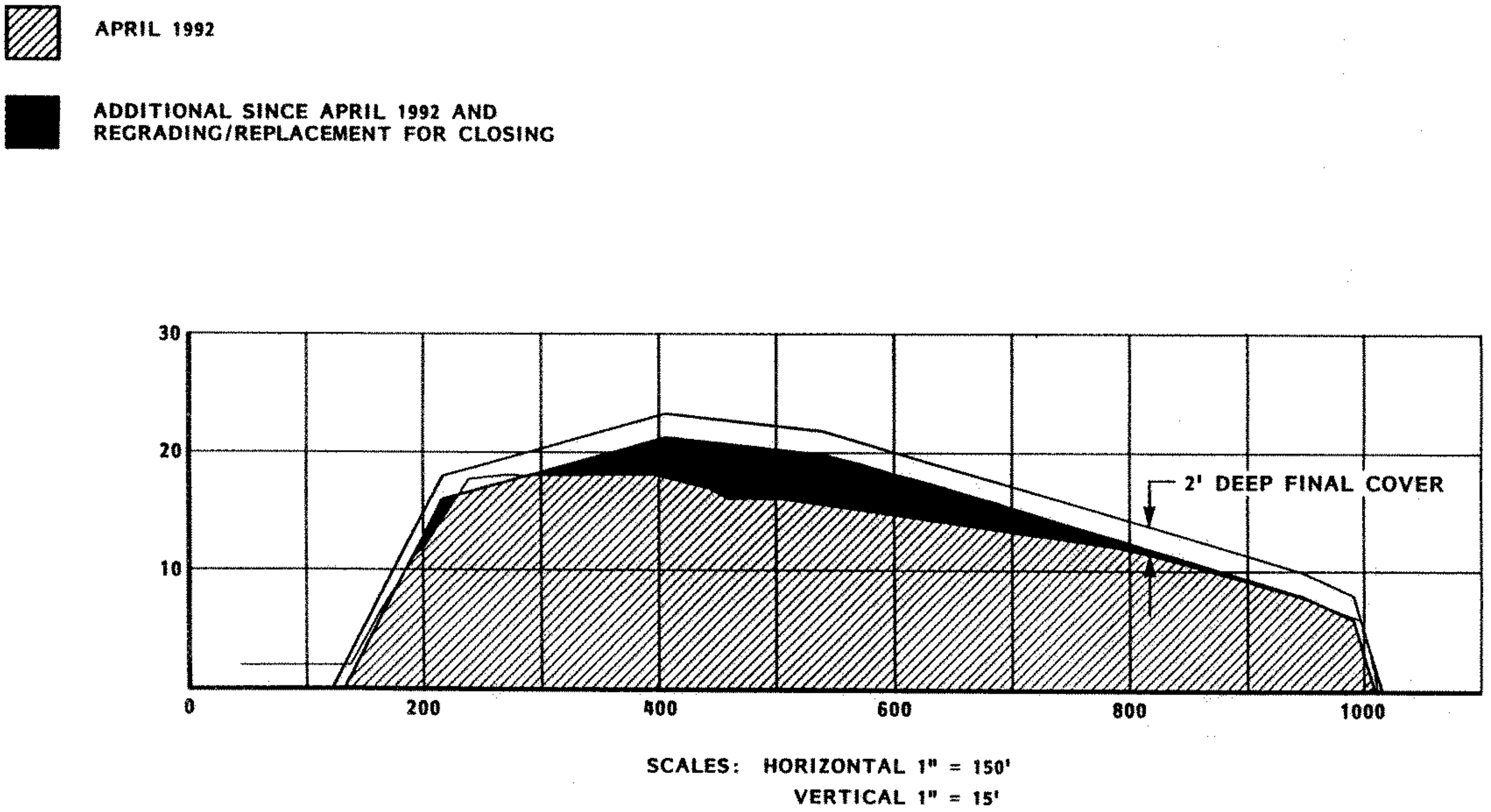
2. **Construction Debris Processing.** Large pieces of concrete and wood wastes must be broken up into smaller pieces before these materials can be graded back into the Landfill. This material can be crushed using specialized equipment such as a tub grinder for wood wastes or a rock crusher for concrete rubble. If these specialized equipment are not available, a similar effect can be achieved by running heavy equipment over the bulky wastes.



Source: Brown and Caldwell

Figure 2-4 Final Grading and Drainage Plan

APRIL 1992 VOLUME = 304,000 Cubic Yards
ADDITIONAL VOLUME THROUGH OCT 8, 1993 = 22,500 Cubic Yards
TOTAL IN-PLACE VOLUME AT CLOSURE = 326,500 Cubic Yards



Source:
Brown and Caldwell, January 1993.

NOTE: SEE FIGURE 2-4 FOR LOCATION OF CROSS SECTION

Figure 2-5 In-Place Closure Profile

3. **Subgrade Preparation.** Before the final cover can be placed, the subgrade must be properly graded and compacted to provide a suitable foundation for the cover soils. The subgrade preparation will take place after the regrading is accomplished. Subgrade preparation will consist of compacting the surface with a sheepsfoot or vibratory roller and may also include the placement of a supplemental or preparatory soil layer in certain areas.

4. **Drainage Control System.** The drainage plan will closely follow the slopes and grades established by the final grading plan. It is anticipated that the majority of the runoff will take place via overland or sheet flow. Small drainage ditches will be used to collect runoff and direct the flow towards downchutes. These downchutes will consist of corrugated metal pipes or a similar material that is flexible and can withstand some settlement. Erosion control such as rip rap will be provided at the base of the downchutes. Additional erosion control may be provided in other areas, as needed.

Final Cover System. The final cover system will be placed directly over the prepared subgrade. The proposed cover system is a total of 2-foot thick and consists of two layers. Suitable soils for final cover are needed to close the Landfill; it is anticipated that materials for the cover will be obtained from local sources. A total of 71,000 in-place cubic yards (cu yd) of soil will be needed, including 45,700 cu yd of low permeability soil and 25,300 cu yd of soil capable of sustaining vegetative growth. The County is currently excavating the Landfill daily cover soil material from a site owned by the DHHL adjacent to and west of the Molokai Airport near Hoolehua. This section discusses the final cover design criteria, the possible soil borrow sources and the necessary construction procedures and testing requirements.

sign Criteria. The final cover system will be designed to meet the requirements set th in 40 CFR, Part 258, Subpart F. According to the criteria in the regulations, the l cover must be designed to minimize infiltration and erosion. This is accomplished by utilizing a multilayered cover. The upper, or vegetative layer, will consist of 6 inches of earthen material capable of sustaining vegetative growth. A species that is drought resistant with a shallow root zone will be selected. The bottom, or low permeability soil layer, must be a minimum of 18 inches of earthen material and have a permeability no greater than 1 x 10^{-5} centimeters per second (cm/sec).

Soil Borrow Sources. A soil borrow site investigation was conducted as part of the hydrogeologic assessment to identify suitable cover soils for landfill closure. As will be discussed later in this chapter, four soil borrow sources were identified and investigated. The results of this investigation indicated that one site, located on Molokai Ranch, south of Mahana Nursery, met final cover requirements for low permeability soils. Plans and specifications for excavating, hauling, placing, and compacting this clay layer will be provided in the final closure plan documents.

Construction and Testing Requirements. The low permeability layer will be placed directly on top of the Landfill surface which will be carefully prepared to receive the final cover. The specifications will be written to provide construction and testing requirements that will achieve the desired permeability. Specifically, the 18-inch low permeability soil layer will be placed in a minimum of three 6-inch lifts or layers. Each layer will be placed and compacted to 95 percent relative compaction (as measured by the modified Proctor Test) at a moisture content of between 0 to 4 percent above optimum.

Post-Closure Maintenance and Monitoring. The Preliminary Closure Plan[1] contains a preliminary post-closure maintenance and monitoring plan describing the procedures required for long-term care of the Landfill. Components of the Landfill closure that will require maintenance and monitoring include final cover, drainage control system, LFG monitoring system, and groundwater monitoring system.

Final Cover Maintenance. Post-closure care requirements, outlined in the Hawaiian DOH Interim Guidelines for Closure, require that the County maintain the integrity and effectiveness of the Landfill cover, including making repairs to the cover as necessary to correct the effects of settling, subsidence, erosion, or other events, and prevent run-on and runoff from eroding or otherwise damaging the final cover. The upper 6 inches of the 2-foot final cover will be planted with vegetation appropriate to the ecosystem. The grasses will be selected for the dry climate and should not require supplemental irrigation. The vegetative cover will require periodic mowing to inhibit the growth of volunteer species.

Settlement and subsidence in the Landfill can occur as solid wastes continue to decompose and consolidate. This may cause the cover soil to crack and water to pond. If this occurs, the area will be filled with additional cover soil and graded for proper drainage. The final cover will be reseeded as necessary to maintain the vegetative layer.

Visual inspections for settlement, subsidence, erosion and vegetation stress will be performed on a quarterly basis and maintenance and repairs will be performed as needed. Quarterly monitoring and maintenance will help to maintain the long-term integrity and effectiveness of the cover.

Drainage Control System. The drainage control system will consist of ditches and downchutes to convey surface water from the final cover. The drainage control system will be inspected quarterly and following significant rainfall events for erosion, excessive settlement or ponding, overtopping, sediment buildup, debris, weeds and other possible problems. Portions of the system that are in need of repair or maintenance will be noted and the work will be performed in a timely manner.

If erosion occurs in the ditches, repairs will be made as needed by regrading or reshaping the ditch. Soil will also be added, if necessary, and the area reseeded. Problem areas may need additional erosion control, such as matting or rip rap.

Excessive landfill settlement may cause ponding or ditch overtopping. Also, the deposition of solids or debris may prevent the ditch from effectively conveying surface water. Long-term ponding and ditch overtopping will require regrading of the affected area; sediments and debris will be removed as needed. Culverts and downchutes will be cleaned as necessary. The access road should require little maintenance; potholes and ruts on the sides of the road where it meets the fill will need to be repaired as required.

FG Monitoring System. Federal regulations establish allowable limits for ncentrations of LFG at the Landfill boundary and within structures on the Landfill. ese are 5 and 1.25 percent methane (the lower explosive limit (LEL) and 20 percent EL), respectively. The results of the LFG migration investigation performed under Subtask 2.5 of the Final Work Plan for Landfill closure, indicated that these limits were not exceeded. Furthermore, the report concluded that the LFG migration potential is very low. LFG monitoring will be performed following Landfill closure.

The LFG monitoring system will consist of three LFG probes located along the northern property boundary, adjacent to the Hoawa Road. Initially, the LFG probes will be monitored quarterly during the first year following closure. This will be reduced in subsequent years if the monitoring results indicate no LFG migration.

Groundwater Monitoring Program. Post-closure monitoring at the Landfill will include a groundwater monitoring program designed to detect the off-site migration of contaminants. The proposed groundwater monitoring program, including the network of monitoring wells and the constituents to be analyzed, is discussed below.

Nine groundwater monitoring wells were installed at the Landfill as part of the hydrogeologic investigation.[5] These wells will be made available for future use as piezometers to measure groundwater levels. For the proposed groundwater monitoring program, one new background and three new down gradient wells will be installed once appropriate approvals have been obtained.

ause the Landfill will stop accepting waste before October 9, 1993, it is exempt from CFR, Part 258, groundwater monitoring requirements. Based on the Hydrogeological essment by Brown and Caldwell, the impact of the Landfill on groundwater resources is not significant. The groundwater monitoring program will consist of monitoring of constituents quarterly for the first two years, and semi-annually for the third, fourth, and fifth years. If any contaminants are detected, the monitoring program will be re-evaluated as will be directed by the DOH.

Preliminary Closure Costs and Schedule. The estimated capital costs, estimated long-term maintenance costs and a schedule for the closure of the Landfill is presented below Primary responsibility for payment of closure costs rests with the County.

Preliminary Construction Cost Estimates. Preliminary closure improvements required for closure of the Landfill, not for normal lan as the placement of daily cover material. Estimated closure costs in waste regrading, health and safety monitoring, hazardous waste dis excavation and placement, drainage control system, and groundwater a systems. These costs are listed in Table 2-1. They are in 1993 contractors overhead, profit, area allowance costs, construction mana tax, and contingencies. These estimates are preliminary and will be r design and preparation of plans and specifications.

Preliminary Long-Term Maintenance Cost Estimates. The preliminary long-term maintenance costs are for a 5-year post-closure period. This is a gradually decreasing program that reflects the minor contamination that has occurred to date. These costs include maintenance on the final cover, revegetation, drainage system, and long-term LFG and groundwater monitoring. These costs are listed in Table 2-2. As indicated earlier, the costs could change if the monitoring program detects movement of contaminants.

If the Landfill is unable to close within the allowable grace period, there would be a considerable cost the County would have to assume for closure/post-closure maintenance in order to comply with provisions of 40 CFR 258. In addition to the costs listed above, financial assurance, and additional laboratory analysis for the Landfill closure would be required. Financial assurance cost for post-closure care is estimated at a one-time initial cost of $459,000 for the 30-year post-closure duration. Financial assurance would not be required if closure occurs within 6 months of last receipt of waste (if on or before October 8, 1993) or if a variance for a longer period is received. Laboratory analysis outside the grace period must include the analysis for the components listed in 40 CFR 258, and an analysis period of 30 years. The per year cost of analysis if the grace period is missed is estimated to be $70,000, an increase of $36,000 per year over the estimated groundwater monitoring costs for within grace period closure.

Schedule for Closure. In order to close the Landfill as proposed, the County must stop receiving wastes at the facility on October 8, 1993. The County will then have 6 months to construct and install the final cover. Prior to the start of construction and installation of the final cover, the EIS process must be completed, the necessary permits and approvals must be obtained, final design completed, and the contractor selected.

Table 2-1 Kalamaula Landfill Closure Cost Estimates

Item	Cost, dollars
Mobilization	80,000
Temporary and environmental controls	30,000
Health and safety plan	10,000
Solid waste regrading	42,000
Subbase	55,000
Final cover	
Infiltration layer	393,020
Erosion layer	152,000
Hydroseed/mulching	28,350
Drainage system	47,750
Borrow site permitting/remediation	100,000
Environmental monitoring system construction	
Install LFG probes	900
Abandon groundwater monitoring wells	6,000
Subtotal	945,020
Contractor's field management, 5 percent	47,251
Contractor's overhead and profit, 18 percent	170,104
Area allowance, 25 percent	236,255
Subtotal	1,398,630
Construction management, 8 percent	111,890
Sales tax, 4.16 percent	58,183
Contingencies, 15 percent	209,794
Total	1,778,497

Source: Brown and Caldwell, Reference 1.

Table 2-2 Estimated Post-Closure Maintenance and Monitoring Costs

Year	Item	Cost/year, dollars
1 and 2	Final cover and drainage system	15,000
	LFG and groundwater systems	15,000
	Yearly Total	30,000
3, 4, and 5	Final cover and drainage system	15,000
	LFG and groundwater systems	7,000
	Yearly Total	22,000

Source: Brown and Caldwell, Reference 1

Soil Borrow Sites

As indicated earlier, a borrow site investigation was conducted as part of the hydrogeologic assessment to identify suitable cover soils for landfill closure. Two types of soil are needed for the final landfill cover: (1) a low permeability soil layer for the bottom of the final cover which has a permeability no greater than 1 x 10^{-5} cm/sec, and (2) an earthen material capable of supporting vegetative growth. Appendix C includes the soil borrow area investigation. Figure 2-6 shows the location of the four potential borrow sites analyzed.

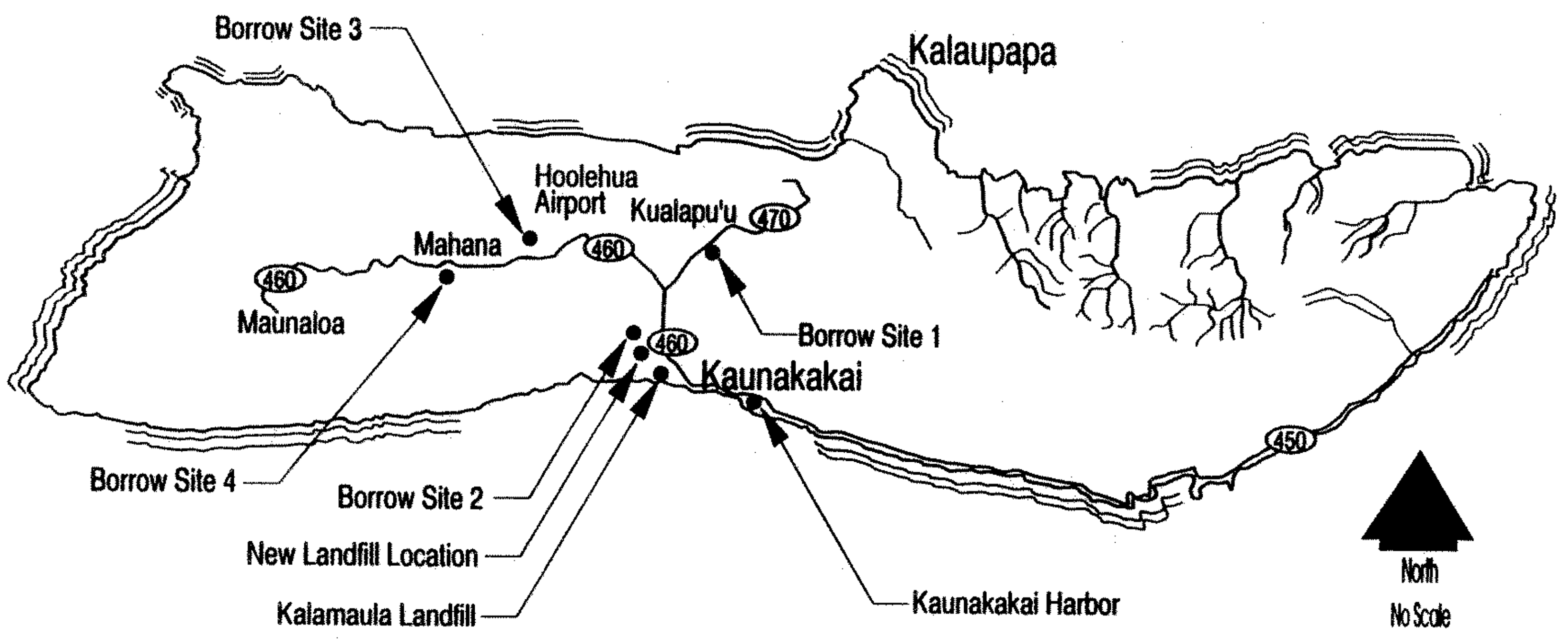
Low Permeability Soils. Site 4, owned by Molokai Ranch and located about midway between Hoolehua Airport and Maunaloa and immediately adjacent to Route 460 near Mahana Nursery, was determined to have adequately low permeabilities for the final cover soil. Site 4 is located about 9 miles from the Landfill. Approximately 45,700 cu yd of low permeability soils are needed. Preliminary calculations indicate about 4 to 6 acres of this site would need to be excavated to a depth of 6 to 8 feet to supply the needed quantities of low permeability soil. The use of the site would be consistent with the Molokai Ranch plans for the area which could include construction of a water storage reservoir at this location.

Soils for Supporting Vegetative Growth. Sites 1, 2, and 3 do not have soils with sufficiently low permeability to be used for the low permeability layer of the final cover, but these sites could provide soils for the subbase preparation and the upper 6-inch vegetative layer of the final cover. About 25,300 cu yd of solid would be needed from these sources. Either of the sites, or a combination of the sites could be used by the Contractor to meet the Landfill soil needs.

Site 1. Site 1, located about 3 1/2 miles from the Landfill, is near the Molokai Ranch wastewater treatment ponds just south of Kualapuu. The area is being considered by Molokai Ranch for expansion of their existing wastewater ponds. Approximately 12,000 cu yd of soil could be available from this site. Access to Site 1 can be made via a well-traveled dirt road that is a right turn off of Routes 470 and 460.

Site 2. Site 2 is located closest to the Landfill (2 1/2 miles), and is on Molokai Ranch land that is leased to Patterson Construction and Trucking, which operates a quarry at the site. Access to Site 2 can be made via the Patterson Quarry gate, which is located on the left site of Route 460. The actual borrow site is located about 1/2 mile from Route 460.

Site 3. Site 3 is on DHHL property adjacent to the Molokai Airport. Site 3 is located about 6 miles from the Landfill.



Location	Approximate One-Way Driving Distance to Kalamaula Landfill, Miles
Kaunakakai Harbor	2
New Sanitary Landfill	2.5
Borrow Site 1	3.5
Borrow Site 2	2.5
Borrow Site 3	6
Borrow Site 4	9

Source: Brown and Caldwell, see Appendix C.

Figure 2-6 Borrow Site and Landfill Locations

For purposes of this EIS, Sites 1 and 4 are analyzed in the appropriate sections of Chapter 4, thus providing the necessary environmental clearance for use in the Landfill closure. Sites 2 and 3 are existing facilities and are available sources of soil material for Landfill closure without further evaluations of those sites.

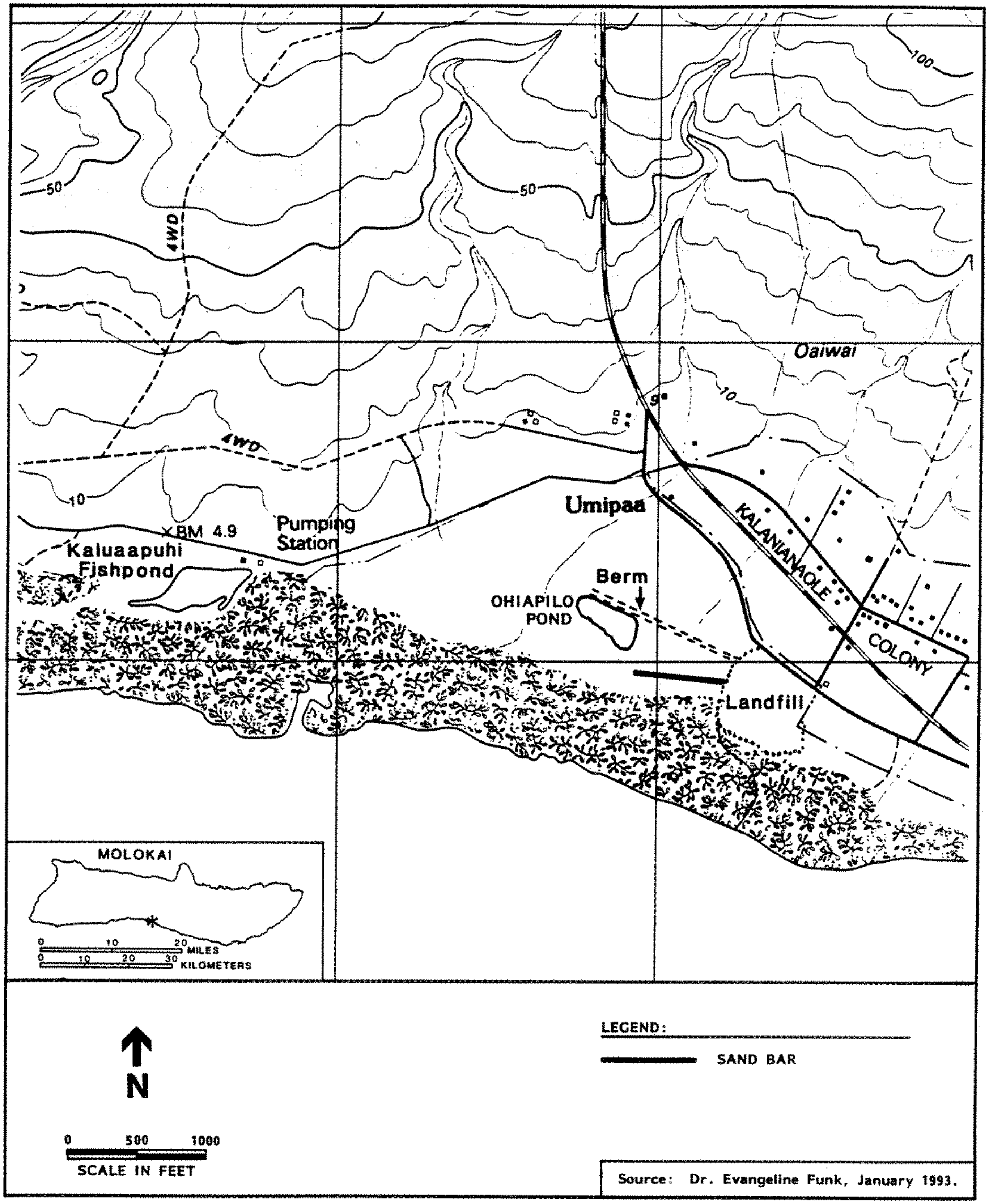
Enhancement of Ohiapilo Pond

As discussed earlier in this chapter, the Landfill has encroached upon 6.5 acres of wetlands without authorization under Section 404 of the Clean Water Act. This figure is based on a delineation study conducted by the FWS.[2] A work component of the survey of wetland ecosystems[6] was to conduct a preliminary review and analysis of potential options which could serve to mitigate the wetlands encroachment which has occurred. This work included field reconnaissance, meetings with representatives of DHHL and Molokai Ranch, and coordination with the FWS. Based on results of the investigation, enhancement of Ohiapilo Pond is preferred by the County, EPA, and FWS. The mitigation options which were considered are discussed in Chapter 3 of this EIS.

A general concept for enhancement of the pond is discussed below, but it should be noted that the specific enhancement plan will be a process subject to separate study by the agencies. The implementation of the plan may parallel Landfill closure, but the process will be separate because of different objectives and constraints. Because enhancement of Ohiapilo Pond could result in site-specific impacts, site surveys have been conducted and appropriate discussions of selected areas is included in Chapter 4 of this EIS. If enhancement of Ohiapilo Pond proves infeasible, further consideration of the options discussed in Chapter 3 may be required or a study of additional options may be necessary. In either case, further environmental review will be necessary and appropriate permits will need to be obtained.

Overview of Concept. The activities necessary to enhance Ohiapilo Pond could range substantially depending on the planning process to be conducted by the FWS and the County. It is anticipated, however, that the enhancement project will directly affect about 18 to 20 acres of the Kalaneanaole-Pakanaka Fishpond wetland ecosystem. A road would be constructed on a sandbar which parallels the berm shown on Figure 2-7. The sandbar is about 800-feet long, 150-feet wide, and about 2 feet above the surrounding wetland and would be incorporated into the wetland when the mitigation is complete.

One enhancement concept that will be given serious consideration will be to increase available open-water habitat for the endangered birds which are known to inhabit the Ohiapilo Pond area. This activity would require removal of the vegetation (*Batis maritima*) on the flat land to the west, south, and east of Ohiapilo Pond. Accumulated silt would need to be removed from the cleaned area to a depth sufficient to ensure an open-water habitat.



Source: Dr. Evangeline Funk, January 1993.

Figure 2-7 Ohiapilo Pond Location Map

Value of Enhancement. The expansion of Ohiapilo Pond by excavation of adjacent *Batis* flats will ensure that the necessary open-water element required by the Hawaiian stilt will persist, and it will provide space for expansion of the small flock of birds that now occupy the site. The enlarged pond will attract other water birds which are known to be opportunistic in the use of appropriate habitat. The Kalamaula Wetland should have considerable potential for Hawaiian stilt considering the similar habitat of this area to the prime Hawaiian stilt nesting areas of Nuupia Fishponds on Oahu and Kealia Pond on Maui. Unlike other endangered water birds in Hawaii which prefer fresh water habitats, the Hawaiian stilt is often found around saline coastal ponds. In addition to providing wildlife habitat, an expanded Ohiapilo Pond will continue to furnish other wetland values and functions such as flood water storage and erosion control and recharge of the groundwater.

CHAPTER 3

ALTERNATIVES CONSIDERED

In compliance with the provisions of Title 11, Hawaii Department of Health (DOH), Chapter 200, Environmental Impact Statement (EIS) Rules, Section 11-200-17(f), the alternatives are discussed in this chapter. Those closure alternatives which could feasibly attain the objectives of the proposed Project are described and evaluated. Also included is a discussion of the alternative mitigation options that were identified and evaluated. Input for this chapter was obtained from the hydrogeologic assessment,[5] the survey of wetland ecosystems,[6] and the alternative closure analysis for the Kalamaula Landfill (Landfill).[9]

PROPOSED ACTION

In-place closure of the Landfill, which includes development of off-site soil borrow areas and a wetlands mitigation site, is the proposed action. The in-place closure of about 19 acres includes minor regrading of the top and sides of the Landfill, placement of the final cover, and provides a cost-effective, environmentally acceptable alternative for Landfill closure. As will be discussed in Chapter 4 of this EIS, results of the hydrogeologic assessment indicated no significant contamination of groundwater or soils under the Landfill. The wetland ecosystem survey indicated that the Landfill is not a source of contaminants in the area, particularly arsenic which exists at high levels in the coastal area.

NO-ACTION ALTERNATIVE

As discussed in Chapter 2, the Landfill has encroached onto 6.5 acres of wetlands without authorization since enactment of the Clean Water Act in 1975. A regulatory action process has been initiated by the U.S. Environmental Protection Agency (EPA) in the form of a consent order. This order, which will be issued in early 1993, will contain the requirements for Landfill closure and wetlands mitigation along with a schedule for their completion. The County is also in the process of siting a new disposal facility at Naiwa to replace the Landfill as discussed in Chapter 2. Because no-action would be contrary to regulatory agency direction and would likely result in issuance of an enforcement order by the EPA, the no-action alternative was rejected.

3-2

CLOSURE ALTERNATIVES

The alternative closure analysis included an analysis of a full range of closure alternatives ranging from closure in-place (proposed Project) to removal of all wastes to off-site disposal.[9] This section provides a description of the alternatives, a comparison of the proposed Project to the alternatives, and an economic evaluation of the alternatives.

Description of Alternatives

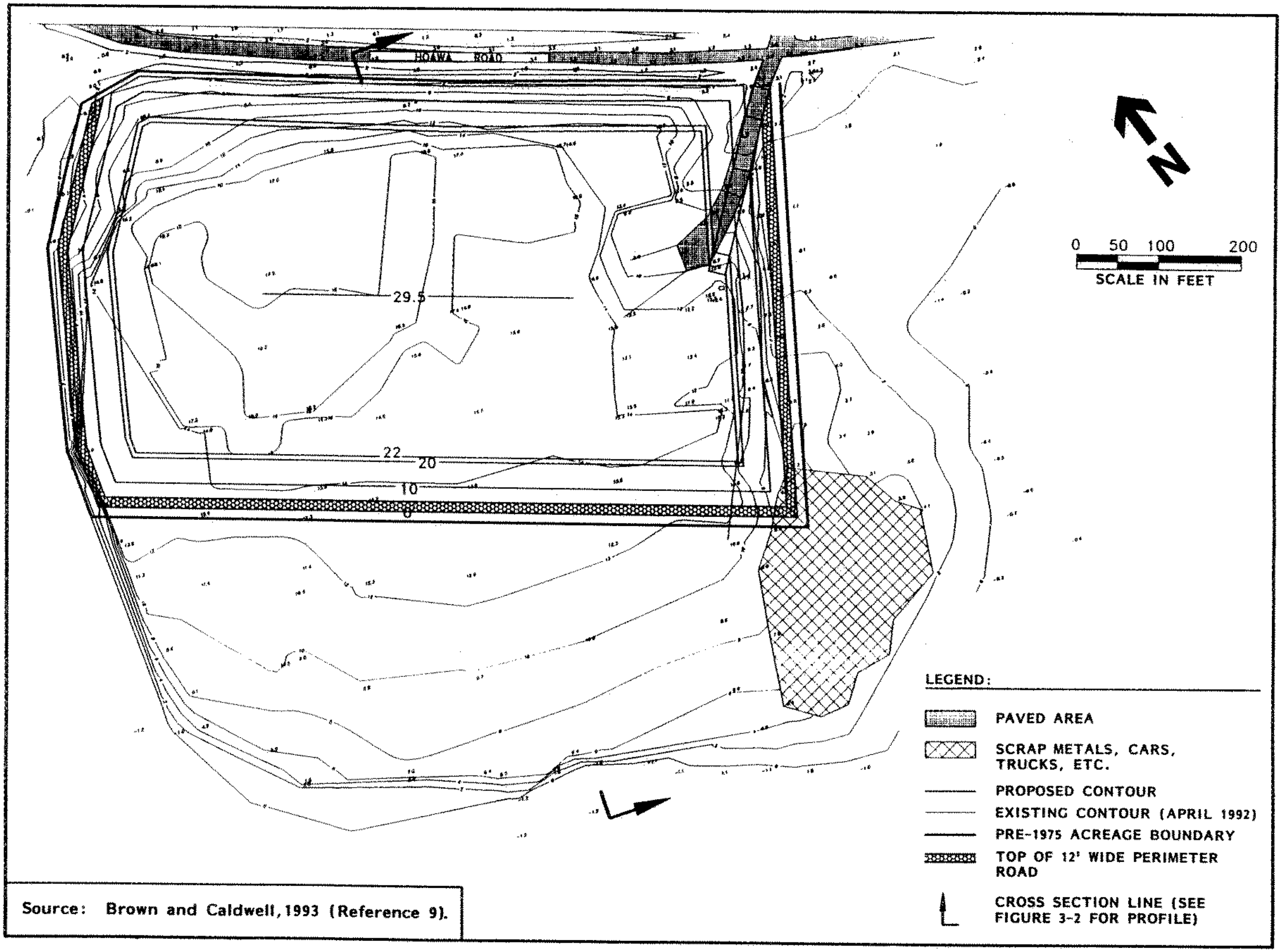
The alternatives with various subalternatives include the following:

1. In-place closure (19.2 acres) (This acreage has been reduced slightly.)
2. Removal from encroachment acreage
   - 2A Closure within pre-1975 acreage (10.8 acres)
     - 2A-1 On-site placement and closure
     - 2A-2 Off-site transport and disposal
   - 2B Closure within permitted acreage (6.9 acres)
     - 2B-1 On-site placement and closure
     - 2B-2 Off-site transport and disposal
3. Remove all waste to off-site disposal

Alternatives to the proposed project are described below.

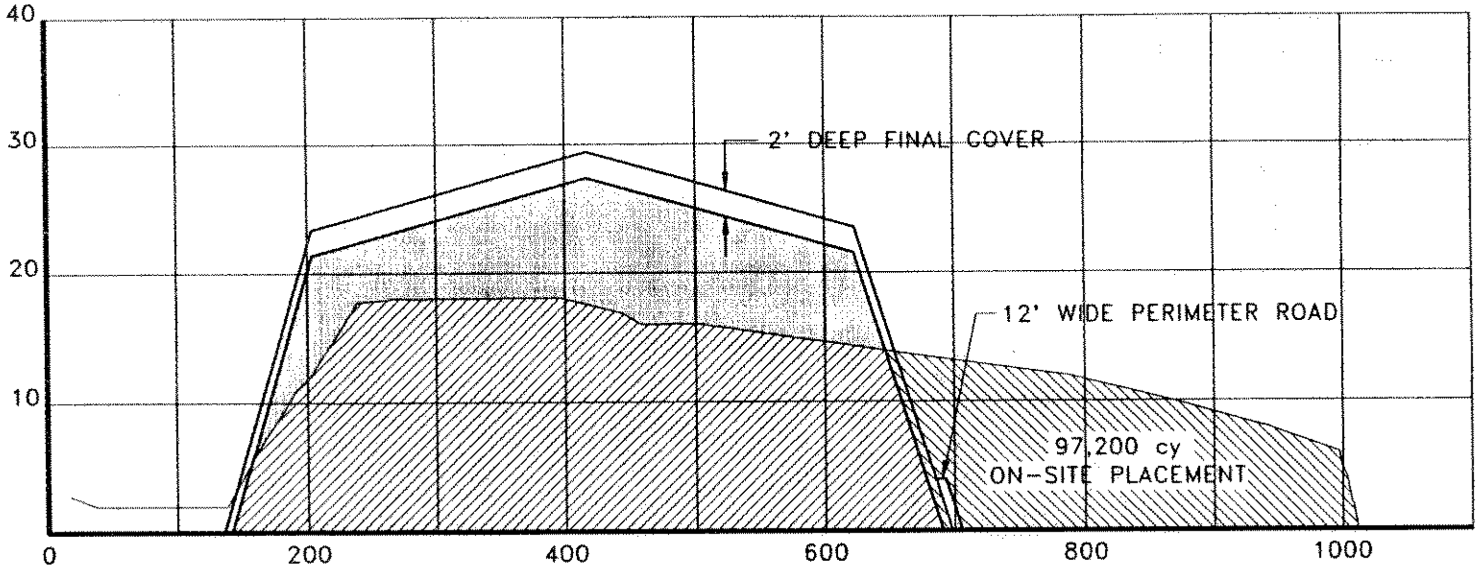
Alternative 2A--Closure Within Pre-1975 Acreage. This alternative includes removal of all solid waste outside the limits of 10.8 acres. The removed solid waste will either be placed over the fill within the 10.8 acres (2A-1) or hauled off site for disposal (2A-2). Figure 3-1 shows the assumed closure limits and final contours of Alternative 2A-1. Figure 3-2 shows a cross section of the closure. A perimeter road is included around the east, south, and west edges of the fill. Alternative 2A-2 does not have the additional height shown on Figures 3-1 and 3-2.

Alternative 2B--Closure Within Permitted Boundaries. This alternative includes removal of all solid waste outside the limits of the area included in the landfill permit (6.9 acres). The removed solid waste will either be placed over the fill within the 6.9 acres with some hauled off site (2B-1) or hauled off site for disposal (2B-2). Figure 3-3 shows the assumed closure limits and final contours for Alternative 2B-2. Figure 3-4 shows a cross section of the closure. A perimeter road is included around the east, south, and west edges of the fill. Alternative 2B-2 does not have the additional height shown on Figures 3-3 and 3-4.



Source: Brown and Caldwell, 1993 (Reference 9).

Figure 3-1 Alternative 2A: Closure with Pre-1975 Acreage - Plan



Scale: HORIZ 1"=150'
Vert 1"=15'

LEGEND

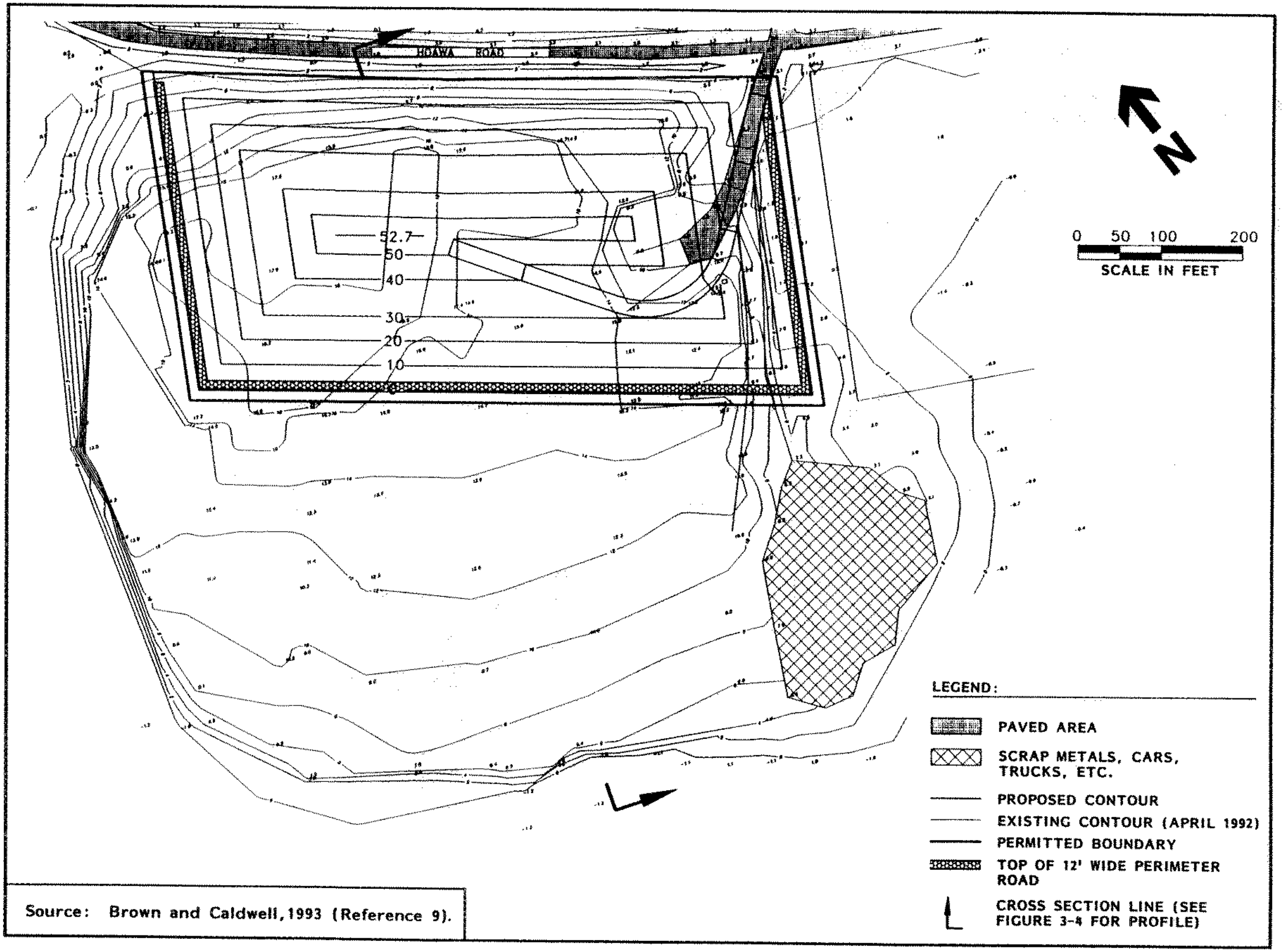
▨ APRIL 1992

▒ ADDITIONAL SINCE APRIL 1992 AND REGRADING/REPLACEMENT FOR CLOSURE

NOTE:
APRIL 1992 VOLUME = 304,000 Cubic Yards
ADDITIONAL VOLUME THROUGH OCT 8, 1993 = 22,500 Cubic Yards
TOTAL IN-PLACE VOLUME AT CLOSURE = 326,500 Cubic Yards

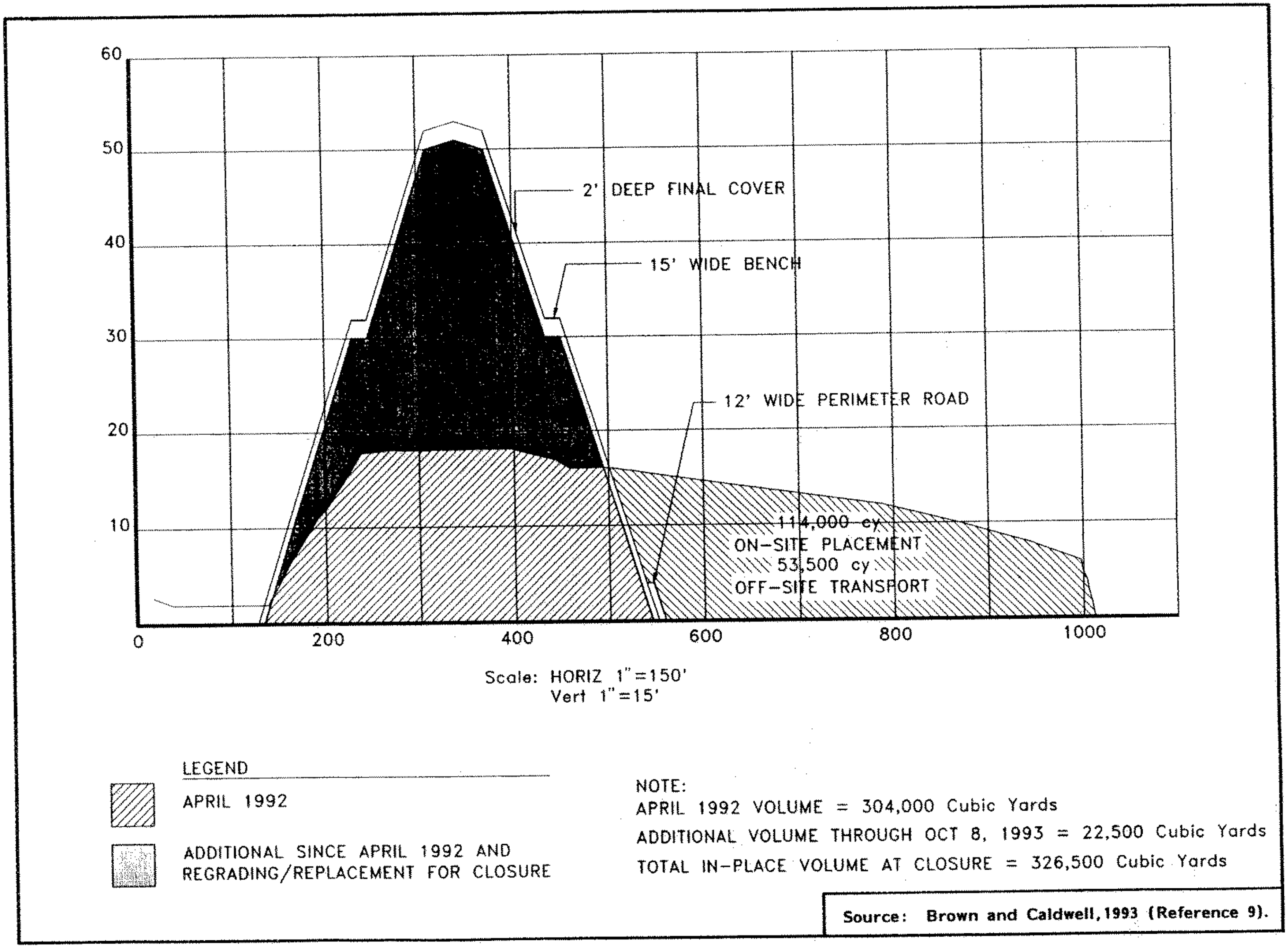
Source: Brown and Caldwell, 1993 (Reference 9).

Figure 3-2 Alternative 2A: Closure with Pre-1975 Acreage - Profile



Source: Brown and Caldwell, 1993 (Reference 9).

Figure 3-3 Alternative 2B: Closure with Permitted Boundaries - Plan



NOTE:
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TOTAL IN-PLACE VOLUME AT CLOSURE = 326,500 Cubic Yards

Source: Brown and Caldwell, 1993 (Reference 9).

Figure 3-4 Alternative 2B: Closure with Permitted Boundaries - Profile

Alternative 3--Remove All Waste to Off-Site Disposal. This alternative includes removal of all solid waste within the limits of the filled ares (about 19 acres).

Additional Subalternatives. In addition to these alternatives, the evaluation includes consideration of (1) a containment wall around the perimeter of the closure area for Alternatives 1, 2A-1, and 2B-1 and (2) barge hauling the waste removed for off-site disposal for Alternatives 2A-2, 2B-2, and 3.

Design Criteria

Some of the alternatives require similar design for the cover soil, its permeability, and slope; top slope and the slope sides around the perimeter; the perimeter road; the containment wall; encroachment area restoration; and health and safety monitoring. Each option will also include monitoring wells to be used for long-term monitoring. The following describes these common design systems.

Final Cover. According to 40 Code of Regulations (CFR), Part 258, Subpart F - Closure Criteria, a final cover system must be installed that is designed to minimize infiltration and erosion. The final cover system must be comprised of an erosion layer underlain by an infiltration layer. The infiltration layer must be a minimum of 18 inches of earthen material which has a permeability less than or equal to the natural soils present or a permeability no greater than 1×10^{-5} cm/sec, whichever is less. Since the natural soils at the Landfill have a permeability greater than 1×10^{-4} cm/sec, a cover with a permeability no greater than 1×10^{-5} cm/sec will be used. The erosion layer will be 6 inches of earthen material that can sustain native plant growth and natural soils will be used which are known to sustain plant growth. A total of 2 feet of cover soil will be used, but the total quantities of cover soil will vary for each alternative. The top of the Landfill will be graded to about a 3 percent slope for each closure alternative except Alternative 3. The sides slopes of the Landfill, after being graded, will have no less than a 3:1 horizontal to vertical ratio. Subalternatives for providing the required permeability include (1) mixing an additive to the native soil (i.e., bentonite), (2) placing a synthetic liner within the soil cover, and (3) importing clay. Bentonite would need to be shipped from Wyoming. Synthetic liners would require an additional 1 foot of cover soil and a 1-foot foundation layer between the solid waste and synthetic and on top of the synthetic. The costs of these subalternatives are compared in the economic evaluation.

Off-Site Transport and Disposal. Alternatives 2A-2, 2B-1, 2B-2, and 3 include off-site transport and disposal of some or all of the waste in the removal area for the particular alternative. Transportation would be by truck with disposal at the new County landfill at Naiwa. A subalternative includes barge-haul to the Island of Maui with disposal at the Central Landfill.

Perimeter Road. Each subalternative of Alternative 2 includes a perimeter road along the east, south, and west edges of the fill in order to provide access for maintenance and monitoring. The perimeter road would be 4 feet high with a 12-foot top. Figures 3-1 and 3-3 show the location of the perimeter road and Figures 3-2 and 3-4 show the profile of the perimeter road.

Containment Wall. A containment wall around the perimeter of the Landfill boundary is a subalternative for Alternatives 1 and 2. The function of the containment wall would be to limit possible leakage of contaminants beyond the closure boundary. The containment wall would be a low permeability material keyed into a natural impermeable layer under the Landfill. The slurry would be placed in a 2-foot-wide trench. Based on data from the hydrogeologic assessment report (Well W-7)[5], the depth would be approximately 45 feet. The length would vary.

Encroachment Area Restoration. The alternatives involving removal of solid waste fill from the wetlands area (Alternatives 2A-2, 2B-1, 2B-2, and 3) include restoration of the areas from which solid waste is removed. The fill would be removed and the areas refilled with soil to bring the area to an approximate elevation of 0 feet mean lowest low tide. It is assumed that an average of 1 foot of soil would be required. The areas would be allowed to revegetate naturally.

Health and Safety Monitoring. Health and safety monitoring would be conducted during Landfill closure activities. Contact with hazardous wastes is a possibility. A site and safety plan which addresses potential exposure to hazardous wastes and details contingencies for emergencies would need to be developed. A temporary hazardous waste storage area may have to be designed if warranted. If extensive excavation took place, a removal and relocation plan including construction details and schedule would need to be prepared and implemented for the temporary relocation of the hazardous waste storage area.

Post-Closure Monitoring Wells and Probes. A total of nine wells have been installed at the Landfill as part of hydrogeologic assessment study.[5] Some of these existing monitoring wells will be used for permanent groundwater monitoring wells following closure. Those wells not used for permanent wells would be sealed with grout and abandoned. New downgradient monitoring wells would be required for Alternative 2. All wells would be abandoned with Alternative 3. Three Landfill gas probes would be installed along the northern edge of the Landfill for Alternatives 1 and 2.

Comparison of Alternatives

This section provides a comparison of the physical, economic, and environmental characteristics of the closure alternatives.

Physical Characteristics. Table 3-1 provides estimates for each alternative of the closure area (acres), the amount of waste material to be removed from the removal area outside the closure area, the amount of waste material to be exported off site, the amount of soil required for final cover and perimeter road construction, the maximum height of the final fill area, and the lengths of the perimeter road and the containment wall.

The acres for closure range from a maximum of about 19 acres for Alternative 1 to zero acres for Alternative 3. Solid waste removed outside the closure area ranges from a maximum of 326,500 cubic yards for Alternative 3 to zero for Alternative 1. Solid waste transported off site ranges from a maximum of 326,500 cubic yards for Alternative 3 to zero for Alternative 1. Solid waste is both placed over the fill within the permitted acreage and hauled off site for Alternative 2B-1. The amount of cover soil applied for closure ranges from a maximum of 62,000 cubic yards for Alternative 1 (a more refined estimate of 71,000 cu yd is included in the Closure Plan[1]) to a minimum of zero cubic yards for Alternative 3. The Landfill maximum elevation ranges from 53 feet to zero feet. A containment wall is considered only for Alternatives 1 and 2, in which case the length is 3,470 feet for Alternative 1 and 2,340 feet for Alternative 2B. A perimeter road is considered only for Alternative 2, in which case Alternative 2A requires a longer perimeter road than Alternative 2B.

Economic Evaluation. This section includes cost estimates and economic comparisons of the alternatives. Subalternative cover systems are compared first. This is followed by a comparison of closure costs for the closure alternatives, estimated costs for containment walls and barge transfer of waste, and estimated post-closure costs.

Closure Cost Comparison. The estimated costs for each closure alternative are included in Table 3-2. The table includes unit costs for key identifiable cost components for solid waste grading, excavating, transporting, disposing, restoration, and groundwater and landfill gas (LFG) monitoring. The cover subalternative included in the table is bentonite admixture at a 2 percent by volume rate. This is for comparative purposes only. Since completion of the alternatives closure analysis, it has been determined that suitable soils exist on the Island for use in the final cover and use of bentonite should not be necessary.

Table 3-1 Comparison of Closure Alternatives

Alternative number	Alternative description	Closure, acres	Solid waste removed, cubic yards	Solid waste transported off-site, cubic yards	Cover soil, cubic yards	Landfill maximum elevation, feet	Subalternative containment wall length, linear feet	Perimeter road length, linear feet	Perimeter road soil volume, cubic yards	Restoration area soil volume, cubic yards	Time required to remove and/or regrade waste, days
1	In-place closure (proposed project)	19.2	0	0	62,000[a]	24	3,470	0	0	0	5
2A	Closure within pre-1975 acreage										
	A-1 on-site placement and closure	10.8	97,200	0	34,800	31	2,630	1,770	4,850	13,500	40
	A-2 off-site transport and disposal	10.8	97,200	97,200	34,800	21	2,630	1,770	4,850	13,500	50
2B	Closure within permitted boundaries										
	B-1 on-site placement and closure	6.9	167,500	53,500	22,300	53	2,340	1,490	4,100	19,800	70
	B-2 off-site transport and disposal	6.9	167,500	167,500	22,300	21	2,340	1,490	4,100	19,800	80
3	Remove all waste to off-site disposal	0	326,500	326,500	0	0	0	0	0	31,000	160

[a] Preliminary estimate used for comparison of alternatives. The current soil cover estimate is based on preliminary design is 71,000 cubic yards and the current area is 18.9 acres.

Table 3-2 Comparison of Closure Costs

	Cost for closure alternative, dollars					
Closure item	1[a]	2A-1[b]	2A-2[c]	2B-1[d]	2B-2[e]	3[f]
Closure	1,986,660	2,648,751	4,053,453	4,054,190	5,277,706	9,519,882
Containment wall[g]	1,145,100	867,900	867,900	772,200	772,200	0
Barge transport[h]	0	0	12,150,000	6,687,500	20,937,500	40,812,500

[a] In-place closure using bentonite additive for low permeability.
[b] On-site placement and closure (pre-1975 acreage).
[c] Off-site transport and disposal (pre-1975 acreage).
[d] On-site placement and closure (within permitted boundaries).
[e] Off-site transport and disposal (within permitted boundaries).
[f] Remove all waste to off-site disposal.
[g] Assumes installation of a 2-foot wide and 45-foot deep slurry wall.
[h] Assumes $150 per ton for loading and truck transfer to barge terminal, transfer to barge, barge transport to Maui, transfer to truck, and truck transfer to Central Maui Landfill.

Source: Reference 9.

The estimated closure costs range from a low of $1,986,660 for Alternative 1 (using local soils this is now estimated to be about $1,056,000) to a high of $9,519,822 for Alternative 3. Costs increase as more material is transported off-site and disposed. Also, as the area to be excavated increases, costs associated with restoration increase. As time required for closure increases so does the cost for health and safety monitoring.

Additional Subalternatives. Subalternatives include construction of a containment wall (Alternatives 1 and 2) and barge transfer of wastes (Alternatives 2A-2, 2B, and 3). Comparative costs for these subalternatives are also summarized in Table 3-2. At $330 per linear foot, the estimated containment wall costs range from about $772,000 (Alternative 2B) to $1,145,000 (Alternative 1). The estimated additional cost for barge transporting and disposing of the removed waste ranges from about $6.7 million to over $40 million (Alternative 3).

Post-Closure Costs. Post-closure maintenance will require the following: maintaining the integrity of the final cover; groundwater monitoring; and maintaining and operating a LFG monitoring system. Maintenance of the final cover includes ensuring proper drainage and controlling vegetative growth (i.e., removal of any trees). The estimated annual costs for post closure are as follows:

Post-closure maintenance	Year 1, dollars	Years 2 and 3, dollars	Years 4 and 5, dollars
Final cover and drainage system	15,000	15,000	15,000
LFG and groundwater systems	15,000	7,000	3,000
Total	30,000	22,000	18,000

If the final cover of the Landfill is not completed within the 6-month period following October 8, 1993, there would be a considerable cost to the County in order to comply with 40 CFR, Part 258. For example, the time period for post-closure care would extend to 30 years unless DOH later reduced this time period. In addition, the County would need to establish an acceptable financial assurance mechanism for post-closure costs.

Environmental Evaluation. Technical memoranda (TM) have been prepared for the Landfill to evaluate the impact the facility has caused on the surrounding environment.[5,6,7,8] The results of these TMs are incorporated into the appropriate sections of Chapter 4 of this EIS. While each of the closure alternatives would have specific impacts, the impacts generally differ by relative magnitude such as those associated with hauling in cover soil or the amount of solid waste excavation and off-site disposal required.

Off-Site Trips and Equipment Days. Table 3-3 provides a summary of estimated off-site trips and equipment days associated with the closure alternatives. Data is provided relative to hauling in and placing soil material, excavation and transporting solid waste off site, and on-site grading or regrading the solid waste. The following observations can be made regarding Table 3-3.

1. The amount of soil material needed for closure is dependent on the size of the facility to be closed. Closure of the 19 acres in place (Alternative 1--the project closure plan) requires the most soil, while total excavation and off-site disposal (Alternative 3) requires the least. Some soil is still needed for Alternative 3 to replace material that would be removed with the solid waste.

2. Similarly, the amount of solid waste requiring excavation and off-site disposal is dependent on the alternatives. Alternatives 2A-2, 2B-1, 2B-2, and 3 all require that varying quantities of solid waste be hauled off site. The estimated number of equipment days required ranges from 336 to 2,040.

Table 3-3 Comparison of Estimated Off-Site Trips and Equipment Days for Closure Alternatives

Item description	Alternative 1[a]	Alternative 2A-1[b]	Alternative 2A-2[c]	Alternative 2B-1[d]	Alternative 2B-2[e]	Alternative 3[f]
Soil material						
Quantity hauled in (cubic yards)	62,000[m]	53,150	53,150	46,200	46,200	31,000
Number of off-site trips[g]	3,100	2,658	2,658	2,310	2,310	1,550
Number of equipment days[h]	74	56	56	48	48	32
Place (cubic yards)[i]	62,000	53,150	53,150	46,200	46,200	31,000
Number of equipment days[j]	124	108	108	92	92	64
Solid waste						
Quantity hauled off site	0	0	97,200	53,500	167,500	326,500
Number of off-site trips[g]	0	0	4,860	2,675	8,375	16,325
Number of equipment days[k]	0	0	608	336	1,048	2,040
Solid waste						
Remove and grade or regrade	10,000	97,200	0	114,000	0	0
Number of equipment days[l]	20	156	0	184	0	0
Total						
Number of off-site trips	3,100	2,658	7,518	4,985	10,685	17,875
Number of equipment days	534	594	1,046	900	1,428	2,296

[a] In-place closure.
[b] On-site placement and closure (pre-1975 acreage).
[c] Off-site transport and disposal (pre-1975 acreage).
[d] On-site placement and closure (within permitted boundaries).
[e] Off-site transport and disposal (within permitted boundaries).
[f] Remove all waste to off-site disposal.
[g] Assumes 20-yard truck for each trip.
[h] Assumes six trucks @ eight trips per truck per day. Information from local haulers.
[i] Includes placing and compacting erosion layer, impermeable layer, and perimeter road and placement in the encroachment area.
[j] Assumes 2,000 cubic yards per day can be placed and compacted using four pieces of equipment.
[k] Assumes eight trucks @ eight trips per day. Information from local haulers.
[l] Assumes 2,500 cubic yards per day can be removed and/or regraded using four pieces of equipment.
[m] This preliminary estimate for the proposed closure plan has been revised during preliminary design to be 70,900 cubic yards. For purposes of comparison, however, this and other numbers in this column can be used. Chapter 4 considers the most current data for analysis of impacts.

Source: Brown and Caldwell, Reference 9.

3. The amount of solid waste requiring regrading or excavation from the closure area and regrading varies. The estimated number of equipment days ranges from 20 to 184.

4. Table 3-3 indicates that the estimated number of off-site trips ranges from 2,658 (Alternative 2A-1) and 3,100 (Alternative 1--proposed closure plan) to 17,875 (Alternative 3). The estimated number of equipment days ranges from a low of 534 (Alternative 1) to 2,296 (Alternative 3). The days required to remove and/or regrade the waste ranges from a low of 5 (Alternative 1) to 160 (Alternative 3), as shown in Table 3-1.

Use of on-site equipment and trucks for hauling in cover soil and solid waste off site will create noise, odor, dust, air pollutant emissions, and consume fuel. Off-site hauling of solid waste can create conflicts with sensitive land uses such as residential areas, and contribute to roadway pavement deterioration. Alternative 1 (in-place closure) and 2A-1 (on-site placement and closure within the pre-1975 area of 10.8 acres) pose the least potential to create the above-mentioned impacts while the remaining alternatives would cause substantially more impacts.

Solid Waste Excavation. As indicated above, solid waste excavation will create noise, odor, air pollutant emissions, and will consume fuel. However, there are other issues associated with solid waste excavation.

While excavating wastes, there is a possibility of coming in contact with unknown hazardous waste material. Also, accumulation of explosive or toxic gases in the excavation area can pose a further danger to personnel. These potentially significant safety impacts would need to be addressed in a health and safety plan prepared for the Project. This safety issue differs in degree with the various closure alternatives. In-place closure (Alternative 1) would have minimal impact in this regard, while the other closure alternatives all would have varying degrees of excavation and, thus, more potential for safety hazard impacts.

Excavation of solid waste also poses another risk. Excavation and removal of any or all of the wastes has the risk of remobilizing heavy metals that might otherwise remain bound and isolated from the surrounding environment.[6] If remobilization were to occur, unknown and potentially significant environmental and public health and safety impacts could occur.

Basis for Rejection. While the results of the hydrogeological assessment, which are discussed in Chapter 4, revealed release of contaminants to shallow groundwter underlying the Landfill, the survey of the wetland ecosystem indicated that the Landfill has not created significant impacts to local biota. Given these data, and the cost-effectiveness of in-place closure, Alternative 1 was selected for implementation with the endorsement of the EPA and the United States Fish and Wildlife Services (FWS). All the other alternatives were rejected because of greater concern for environmental impacts and cost.

ALTERNATIVE MITIGATION OPTIONS

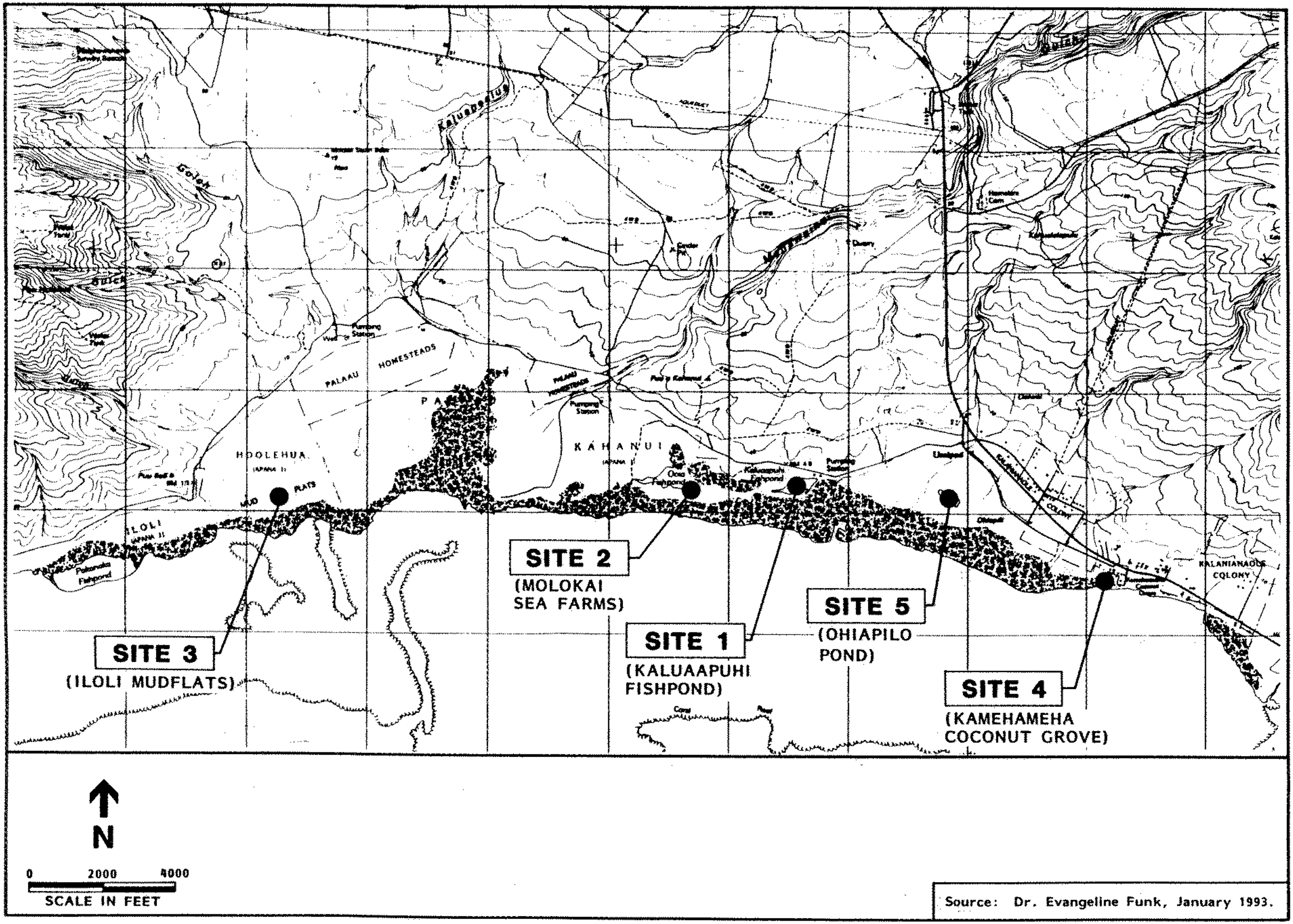
Based on the wetland delineation study conducted by the FWS[2], it was determined that the Landfill encroached upon 6.5 acres of wetlands since enactment of Section 404 of the Clean Water Act. Accordingly, the survey of wetland ecosystems included a task to identify and evaluate alternative mitigation options that could potentially meet the mitigation requirements for the wetlands encroachment that has occurred. Representatives from EPA and the FWS were included in this evaluation, including several field reconnaissances to review each alternative site. This investigation concluded that enhancement of the Ohiapilo Pond was the preferred option as discussed in Chapter 2. The locations of Ohiapilo Pond and of the other options considered are shown on Figure 3-5. The options include the Kaluaapuhi Fishpond, the Molokai Sea Farms, Iloli Mudflats, and a site near Kamehameha Coconut Grove.

Site 1--Kaluaapuhi Fishpond

The Kaluaapuhi Fishpond is located approximately 2 miles west of the Landfill, on Molokai Ranch property. This is an ancient Hawaiian fishpond with some of the old infrastructure, such as concrete sluiceways that allow the passage of tidal-induced flow between different cells or ponds, still in place. The pond is being inundated by mangrove. The birds identified at this site during the site visit included coots, night heron, and numerous Hawaiian ducks. However, all of these native species were found in low numbers. This site was not recommended because the initial cost of restoration would be prohibitive and the mangrove would be a hindrance to long-term maintenance and management of the site as endangered species habitat.

Site 2--Molokai Sea Farms (Shrimp Farm)

Molokai Sea Farms is a commercial shrimp growing operation which attracts large numbers of endangered and native shore birds. This site, leased from Molokai Ranch, is located less than 1 mile west of Site 1. The use of this site was not recommended as a mitigation site, but was of great interest to FWS personnel.



Source: Dr. Evangeline Funk, January 1993.

Figure 3-5 Location of Alternative Mitigation Sites

Site 3--Iloli Mudflats

Iloli Mudflats are found approximately 3 miles west of the Landfill near Puu Iloli. This is a broad, flat area which extends from Palaau Homesteads (upland) to a long line of mangrove trees along the shore, a distance of approximately one-quarter to one-half mile. These mudflats support a scant covering of *Batis martima* plants and during the wet season a broad, shallow, temporary pond develops. This open, isolated site was regarded as already part of the overall wetland. Initially, it was believed that the State of Hawaii owned land in this area and that a land trade could be effected so an endangered bird habitat could be created. Since this proved not to be the case, the FWS inspectors felt that the open, pristine nature of this site should not be disturbed.

Site 4--Near Kamehameha Coconut Grove

This site is located on State of Hawaii, Department of Hawaiian Homelands land less than 1 mile from the Landfill and just west of the Kamehameha Coconut Grove. The small pond is brackish and overgrown with mangrove. As with Site 1, the aggressive invasion of the pond by the mangrove, and the limited acreage available results in the site, by itself, not meeting the mitigation needs set forth by the agencies.

CHAPTER 4

ENVIRONMENTAL SETTING, IMPACTS, AND MITIGATION MEASURES

This chapter provides an assessment of the potential environmental impacts associated with the proposed Kalamaula Landfill (Landfill) Closure Project (Project). The analysis addresses a variety of environmental issues, but emphasizes issues dealing with water quality and biological resources which are key considerations associated with Landfill closure. While the data base for the project area is not extensive, site studies were conducted to supplement the data base in key areas.

GEOLOGY, SOILS, AND WATER RESOURCES

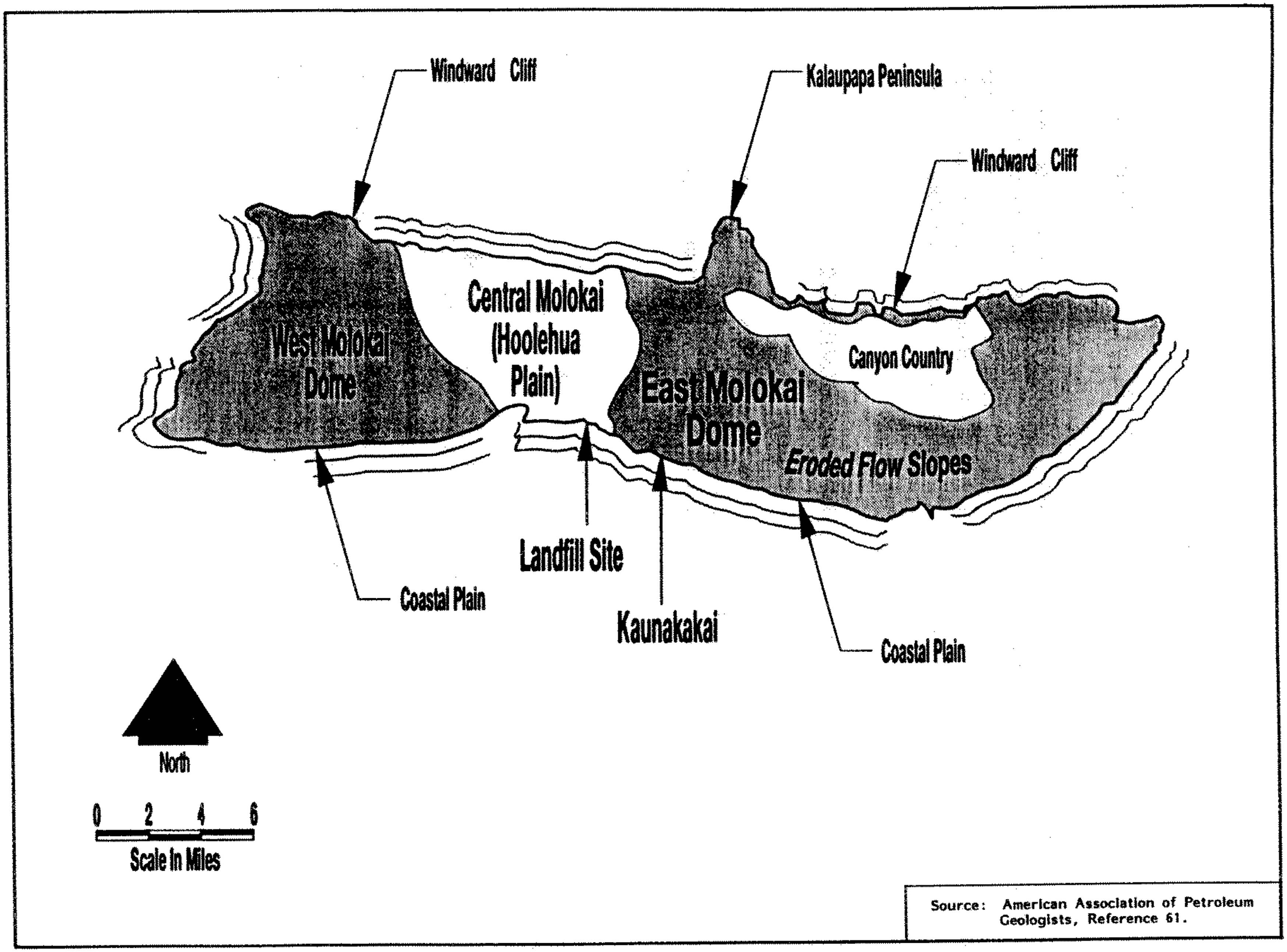
Geology, soils, and water resources are major considerations associated with closure of the Landfill. A hydrogeologic assessment was conducted for the Landfill.[5] The purpose of the assessment was to evaluate the extent of affected soil and groundwater at the Landfill site.

SETTING

Regional Setting

The Landfill is located on the southern coast of the Island of Molokai. Molokai is approximately 38 miles long and 8 miles wide encompassing a total land area of about 260 square miles.

Physiography and Generalized Regional Geology. The Island of Molokai is divided into three geomorphic provinces: the East Molokai Dome, the West Molokai Dome (each a major volcanic mountain), and Central Molokai.[61] Figure 4-1 illustrates the geomorphology of Molokai. Molokai's two volcanoes were built up from the ocean floor by successive basaltic lava flows, probably from Tertiary time (about 70 million years ago) to less than 2 million years ago for the rocks exposed at the land surface.



Source: American Association of Petroleum Geologists, Reference 61.

Figure 4-1 Geomorphology of Molokai, Hawaii

Mountain building activity during Tertiary time was followed by a long period of erosion during which large valleys were cut into the leeward or southern slopes (eroded flow slopes on Figure 4-1) of the East Molokai Dome. Much less erosion occurred on West Molokai because of a drier climate.[3] Prominent sea cliffs have been formed by marine erosion along the northern (windward) coast of East and West Molokai.

During the late Tertiary or early Pleistocene, the island was partially submerged to a level at least 560 vertical feet above the present shore line, then reemerged.[12] Later shifts of sea level, probably resulting from Pleistocene glaciation and deglaciation on the continents, ranged from 300 feet below to 100 feet or more above present sea level. Marine deposits on the southern slopes extend to an elevation of at least 200 feet above present sea level. Volcanic activity was renewed on East Molokai during late Pleistocene time with the eruption of basalt at the foot of the windward sea cliffs. Deposition of marine and stream derived terrestrial sediments has built a series of narrow terraces close to sea level along the southern coast.

The Landfill is located within Central Molokai, also called the Hoolehua Plain or Isthmus of Molokai, a subprovince of the East Molokai Dome. The Hoolehua Plain is composed of lava flows from East Molokai Volcano banked against the older West Molokai Volcano. The lava beds dip 6 to 10 degrees on the crest of East Molokai and 1 to 3 degrees on the Hoolehua Plain.[12]

Central Molokai contains about 30,000 acres of rich soil, most of it deep beds (10 to 30 feet) of decomposed volcanics and sediment relatively free from stones. The surface is gently rolling with slopes cut by a few shallow gulches. Due to cultivation of the land and overgrazing, large flats of red soil eroded from the plain are forming along the south shore of Molokai. Ancient Hawaiian fishponds are also being filled with mud and mangrove swamps are developing.[11]

Hydrogeology. The groundwater resources of Molokai are of three types: basal, perched, and dike confined. Springs originate from all three types, with some contributing to streamflow and others developed directly for local water supply.[11] Basal groundwater is developed with dug or blasted wells, Maui-type wells (shafts sunk to or below the basal water table, with one or more tunnels extending outward to skim fresh water from the top of the basal zone), and drilled wells. Perched water is typically developed with tunnels, while dike-confined water is developed with tunnels or wells.

Basal groundwater underlies most of the island. It is a lens of fresh water which has percolated downward through the rocks and generally flows from the mountains toward the coast to sea level and is floating on salt water of greater density. The water table indicating the top of fresh water rises gradually inland, at a rate of approximately 1 foot above sea level for every 40 feet that the base of the lens extends below sea level. Water levels in the basal lens along the coast are influenced by the ocean tides.

Because of the relatively dry climate, the rate of fresh water recharge is low in West and Central Molokai and along the southern shore of East Molokai, resulting in brackish water in the basal lens. Shallow wells dug along the southern coast of the island for irrigation purposes tap this brackish water. Saltwater intrusion is the major problem affecting the quality of Molokai's groundwater supplies.[12]

Water Resources. The inhabitants of Molokai obtain water for potable use from both surface and groundwater supplies. The vast majority of the water consumed, however, is derived from surface resources. All surface water resources as well as all fresh groundwater on Molokai are derived from rainfall.[12] Because of the relationship of the local prevailing wind directions and the orographic effect of mountain barriers, the vast majority of rainfall on Molokai occurs on the windward (northeastern) side of the East Molokai Mountains. Consequently, nearly all of the perennial streams on Molokai originate in the East Molokai Mountains and flow north and east to the Pacific Ocean. The major drainage basins of this region with the perennial streams are the Waikolu, Pelekunu, Wailau, Kawaihui, and Halawa Valleys (Figure 4-2). Most of the streams on the southern slopes of the East Molokai Mountains originate from high altitude swamps. Generally, these streams, such as the Kaunakakai, are perennial in their upper reaches as they flow over relatively impermeable lava. However, water is lost by direct evaporation and by seepage into the more permeable lavas and soils in their lower reaches. Only during heavy rainfall do these streams flow to the ocean.[12] No measurable streamflow occurs in arid and semi-arid Central and West Molokai.

With one exception, the inhabitants of the island depend primarily upon the rainfalling on the windward valleys of East Molokai for their water supply.[12] This water is distributed to the residents of Central and West Molokai by the Molokai Tunnel. This aqueduct is capable of transporting up to 40 million gallons per day from the windward valleys to the eastern portal in the Waikolu Valley of Central Molokai. The exception to this is the populated areas along the south coast of East Molokai which utilize primarily groundwater supplies for domestic consumption.

The Landfill is located within the Ohiapilo wetland. The wetland and the Pacific Ocean are not sources of drinking water.[3] Drinking water for the inhabitants of the area near the Landfill is derived from East Molokai.

Water Quality. Chemically, the surface water of Molokai is safe for domestic consumption, as judged by U.S. Public Health Service and Clean Water Act standards. Physically, the surface water is of acceptable quality. Molokai's surface water resources are of excellent quality for irrigation.[12]

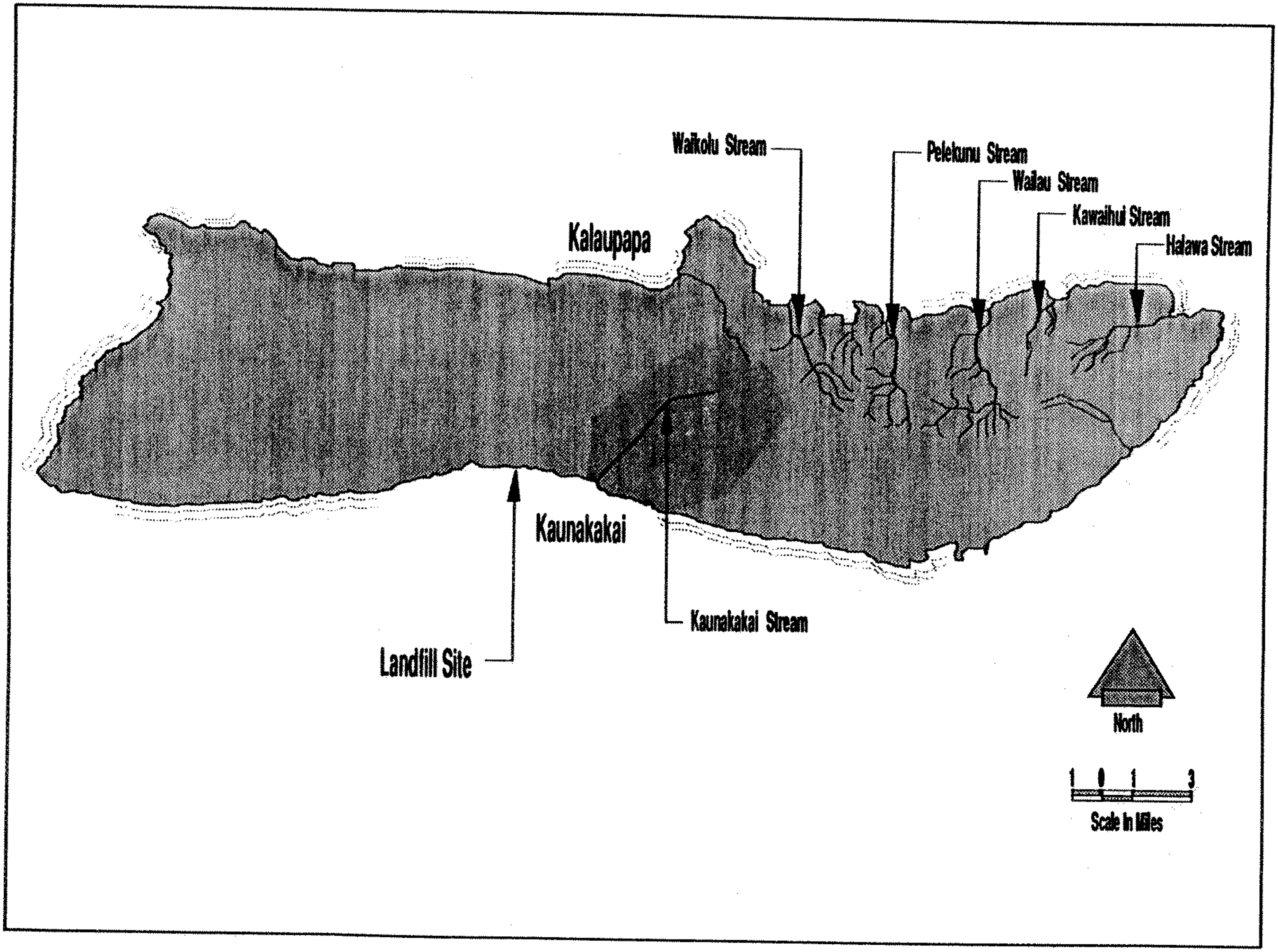


Figure 4-2 Occurrence of Major Drainage Basins

There are four documented and three undocumented wells located within 1 mile of the Landfill (Figure 4-3) which range in depth from 15 to 343 feet. Three of the documented wells are used for irrigation purposes and produce very brackish water. The fourth documented well was reported to be abandoned in 1977. There is no specific information about the undocumented wells. The available water quality information for these wells is limited to chloride concentrations. These data are shown in Table 4-1.

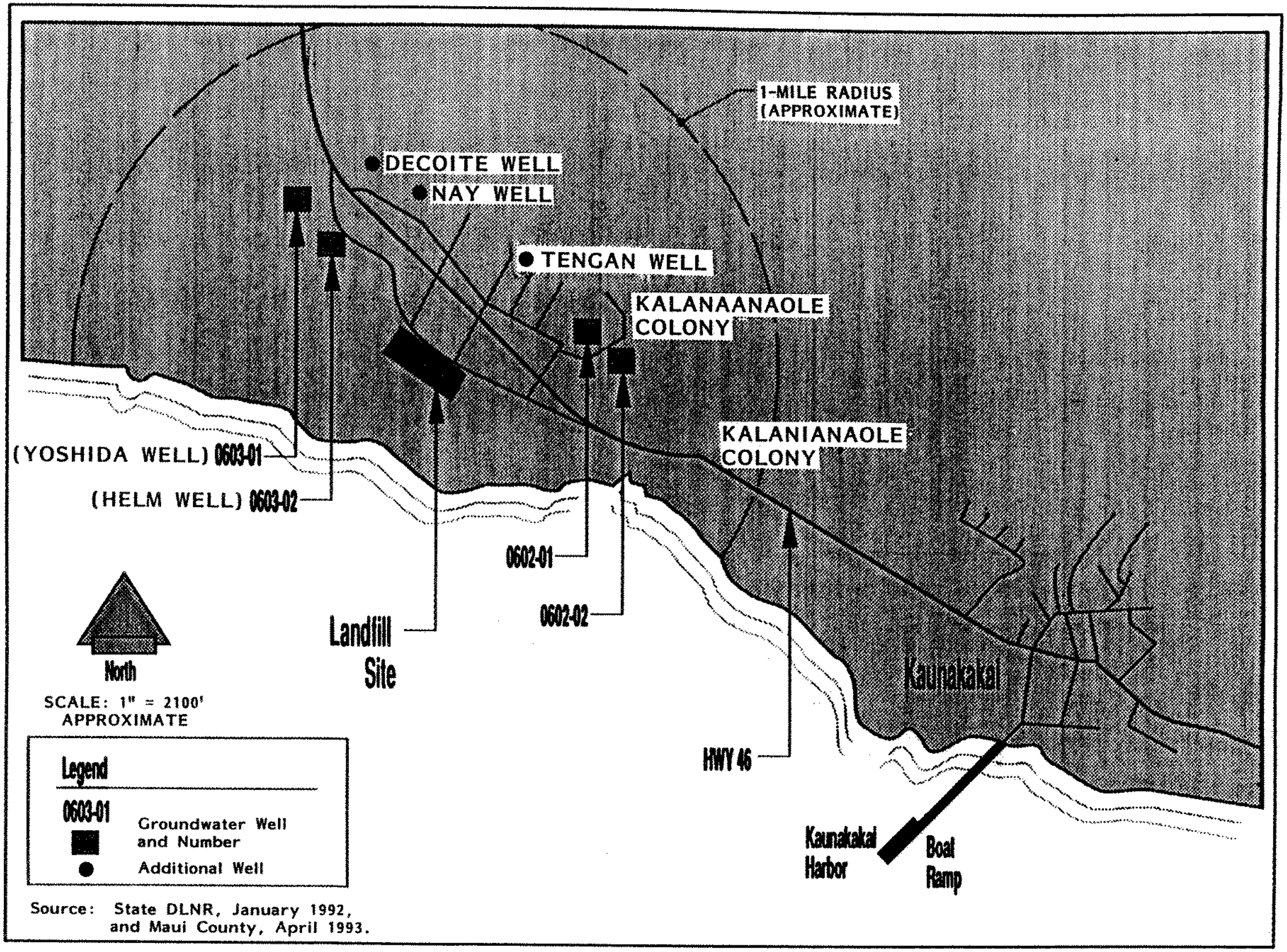
Table 4-1 Water Quality Data for Wells Located Near the Kalamaula Landfill

Well number[a]	Total depth, feet	Static head, feet	Maximum chloride, milligrams per liter
0602-01	60	2.4	1,060
0602-02	343	-	2,133
0603-01 (abandoned)	16	2.4	639
0603-02	15	2.6	780
Decoite well	Unknown	Unknown	Unknown
Nay well	Unknown	Unknown	Unknown
Tengan well	Unknown	Unknown	Unknown

[a] See Figure 4-3 for location of wells.

Sources: Department of Land and Natural Resources, March 1993 for documented wells
Maui County for undocumented wells

As shown in Table 4-1, groundwater in existing wells a short distance east and northwest of the Landfill is brackish and is reported to fluctuate with the tide, indicating direct hydraulic connection with the salt water of the Pacific Ocean on both sides of the Landfill. Figure 4-4 shows the location of the Landfill relative to Molokai's groundwater areas. Because of its brackish quality, groundwater beneath the Landfill is not considered a usable source of drinking water.[3] Information on tidal fluctuations is available in the U.S. Department of Commerce, National Oceanic, and Atmospheric Administration's Tide Tables for West Coast of North and South America, Including the Hawaiian Islands. Tidal fluctions in the groundwater beneath the Landfill is discussed later in this chapter.



Source: State DLNR, January 1992, and Maui County, April 1993.

Figure 4-3 Location of Groundwater Wells within 1-mile of the Kalamaula Landfill

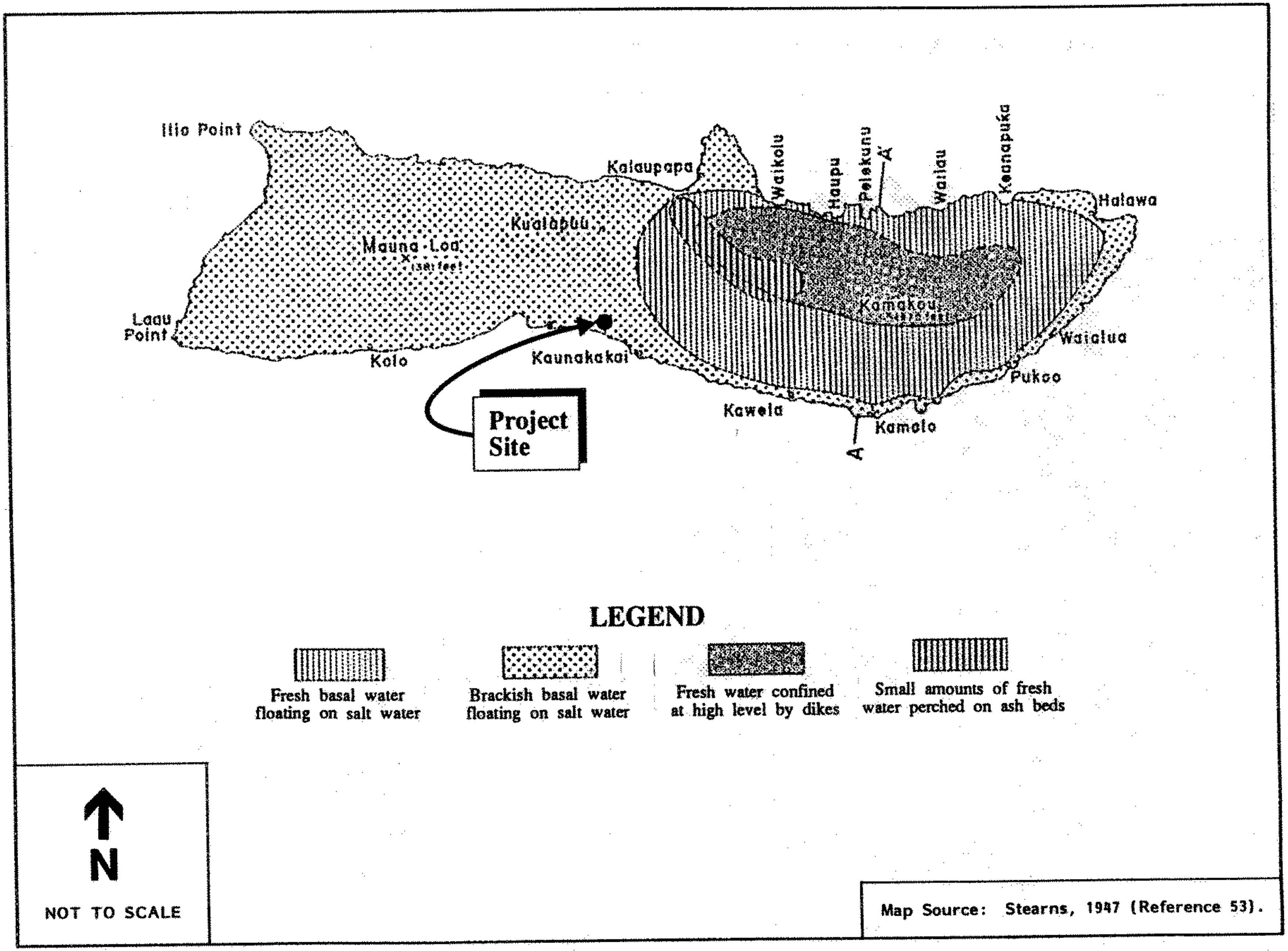


Figure 4-4 Molokai Groundwater Areas

Project Site Setting

To provide an adequate data base to evaluate potential impacts, site investigations for the hydrogeological study were conducted. Published sources of information were also used to augment the data base.

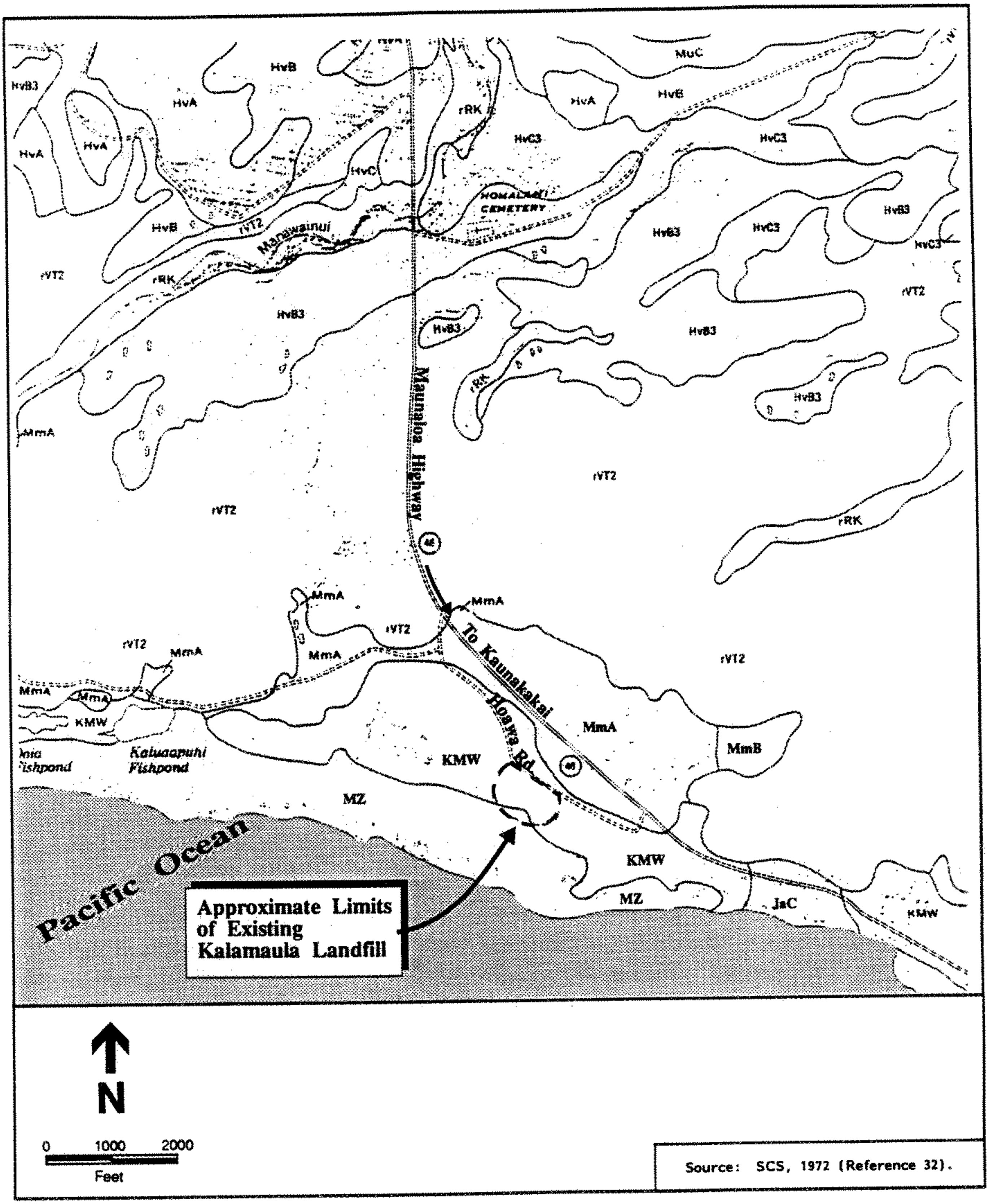
Topography and Soils. The Landfill site is situated on flat coastal lowlands near sea level. The Landfill rises to a maximum 16-foot elevation with the surface of the Landfill exhibiting a uniform and level terrain. "Top of bank" elevations along the perimeter of the Landfill ranges from 2 to 3 feet along the Landfill's makai (southern or seaward) extent, to 8 to 14 feet along the mauka (northern or inland) edge. An unnamed drainage gulch lies approximately 0.25 mile to the east of the Landfill site.

Underlying the proposed site and surrounding lands are soils of Jaucas-Mala-Pulehu soil association. Soil types specific to the project site include the Kealia Series (Kealia Silt Loam, KMW) and marsh (MZ) (Figure 4-5) which are included in the Jaucas-Mala-Pulehu soil association.[32] According to the Soil Conservation Service, Kealia Silt Loam is poorly drained and has a high content of salt. Ponding occurs in low areas after a heavy rain. The soil has a brackish water table that fluctuates with the tides. The permeability is moderately rapid. Runoff is slow to very slow.

Land designated marsh (MZ) consists of wet, periodically-flooded areas which occur in low-lying areas along the coastal plain. Water standing in marsh lands may be fresh or brackish, depending on proximity to the ocean and the availability of fresh water.

The University of Hawaii's Land Study Bureau's Detailed Land Classification designates the subject parcel as "E28" and "E80." The letter designation "E" refers to the overall suitability of the land for agricultural use, with "A" representing the class of highest productivity and "E" the lowest. The numeric designations "28" and "80" refer to land type characteristics (e.g., soil properties, topography, and climate). Land type "28" is characterized as moderately fine to fine, poorly-drained lands. Land type "80" is characterized as flooded mangrove and swamp.

Site Geology. An unknown thickness of Quaternary sediments overlay volcanic bedrock at the Landfill. These sediments include alluvium, beach or dune sands (partly calcified), and volcanic and coral gravels.[32] The Landfill is located within the nearly level Kealia silt loam of the Kealia soil series. Ponding of water after heavy rains is typical of this soil series.



Source: SCS, 1972 (Reference 32).

Figure 4-5 Soil Classification Map

As identified during drilling of boreholes at the site (logs in Appendix D), the first 4 to 4.5 feet below original ground surface (bgs) consists of dusky brown sandy silt, sandy clayey silt, and fine to coarse volcanic sands with basalt cobbles up to 1.25 inches. (It is noted that bgs indicates that depths are referenced from the original ground surface and do not include wastes within the landfill.) A 6-inch-thick black organic layer was recorded in a few of the boreholes, immediately underlying the silts. Some charcoal, roots, and decaying leaves along with other organics were noted as part of this layer. This organic layer occurs near or at the water table and is consistent with the descriptions of the Kealia soil series. In the landfill itself, waste material was generally 8 to 10 feet thick.

Underlying the organic layer from approximately 5 feet to 40 feet bgs are interbedded gray silty sands, silty coral gravels, sandy coral gravels, and silty clays. Sands are predominately calcareous with abundant shell fragments though some volcanic sands were encountered. Gravels are primarily composed of coral and reef fragments with occasional basalt of gravel size. Colors of calcareous units ranged from light gray to grayish orange pink to pale orange. At approximately 35 feet bgs, a 6-inch-thick dusky brown sandy silt was encountered.

At 47 to 50 feet bgs, a dense, stiff brown clay was encountered. This horizon and the silt layer encountered at 35 feet bgs may have been deposited during fluctuations of sea level during the Pleistocene glacial epoch or may be a residual soil developed when this level was at the ground surface. This clay layer likely has a very low permeability. The total thickness of this clay is not known due to the termination of the borehole at 50 feet bgs.

Site Hydrogeology. Groundwater is relatively shallow in the vicinity of the Landfill. Groundwater occurs at approximately 1 to 4 feet bgs, and at approximately 10 to 12 feet below the Landfill surface. Groundwater is brackish, nonpotable, and has a noticeable sulfur odor. Origin of the sulfur odor in the groundwater is unknown, but may be a product of subsurface sulphur springs. Some locals mention hot springs along the coast west of Kaunakakai.

To initially identify the influence of tides on groundwater beneath the Landfill, depth to groundwater was measured in monitoring wells which were installed at the Landfill during the hydrogeological study. Depths were measured on August 12 and September 9, 1992, during the morning low tides and afternoon high tides. As shown in Table 4-2, groundwater elevations ranged from -1.23 feet during low tide to -0.07 feet during high tide. Groundwater elevations increased from low to high tide in all eight groundwater wells. Increases ranged from 0.03 to 0.70 feet on August 12, and 0.02 to 0.12 feet on September 9. Tidal information was obtained from tidal charts published for Kaunakakai Harbor by the National Oceanic and Atmospheric Administration.

To further evaluate the influence of tides on the groundwater, a 10-day tidal monitoring program was carried out between March 19 and March 29, 1993. Electronic data loggers and pressure transducers were installed in monitoring wells MW-1, MW-4, MW-6, and MW-8.

Table 4-2 Kalamaula Landfill Groundwater Elevations

Well number/date measured[a]	Top of casing elevation[b], ft	Depth to water[c], ft	Groundwater elevation[a], ft	Change from low to high tide, ft
MW-1	4.81			
8/12/92 L[d]		5.70	-.89	--
8/12/92 H[e]		5.64	-.83	0.06
9/9/92 L		5.58	-.77	--
9/9/92 H		5.56	-.75	0.02
MW-2	12.62			
8/12/92 L		13.32	-.70	--
8/12/92 H		13.14	-.52	0.18
9/9/92 L		13.16	-.54	--
9/9/92 H		13.12	-.50	0.04
MW-3	6.21			
8/12/92 L		7.45	-1.24	--
8/12/92 H		6.92	-.71	0.53
9/9/92 L		6.92	-.71	--
9/9/92 H		6.82	-.61	0.10
MW-4	8.26			
8/12/92 L		9.02	-.76	--
8/12/92 H		8.90	-.64	0.12
9/9/92 L		8.88	-.62	--
9/9/92 H		8.78	-.52	0.10
MW-5	12.15			
8/12/92 L		12.98	-.83	--
8/12/92 H		12.95	-.80	0.03
9/9/92 L		12.88	-.73	--
9/9/92 H		12.94	-.69	0.04
MW-6	11.21			
8/12/92 L		11.84	-.63	--
8/12/92 H		11.14	+.07	0.70
9/9/92 L		11.70	-.49	--
9/9/92 H		11.64	-.43	0.06
MW-7	11.75			
8/12/92 L		--	--	--
8/12/92 H		12.12	-.37	--
9/9/92 L		12.14	-.39	--
9/9/92 H		12.02	-.27	0.12
MW-8	3.55			
8/12/92 L		4.14	-.59	--
8/12/92 H		4.00	-.48	0.14
9/9/92 L		3.98	-.43	--
9/9/92 H		3.88	-.33	0.10

[a] See Figure 4-7 for well location.
[b] Elevations are based on professional survey on August 19, 1992. Datum referenced is 5.23 above mean lower low water (MLLW).
[c] Measured from top of casing.
[d] L = Water level taken at approximately low tide.
[e] H = Water level taken at approximately high tide.

Source: Brown and Caldwell, Reference 5.

These wells were selected to provide information to identify the magnitude and timing of tidal influence around the Landfill.

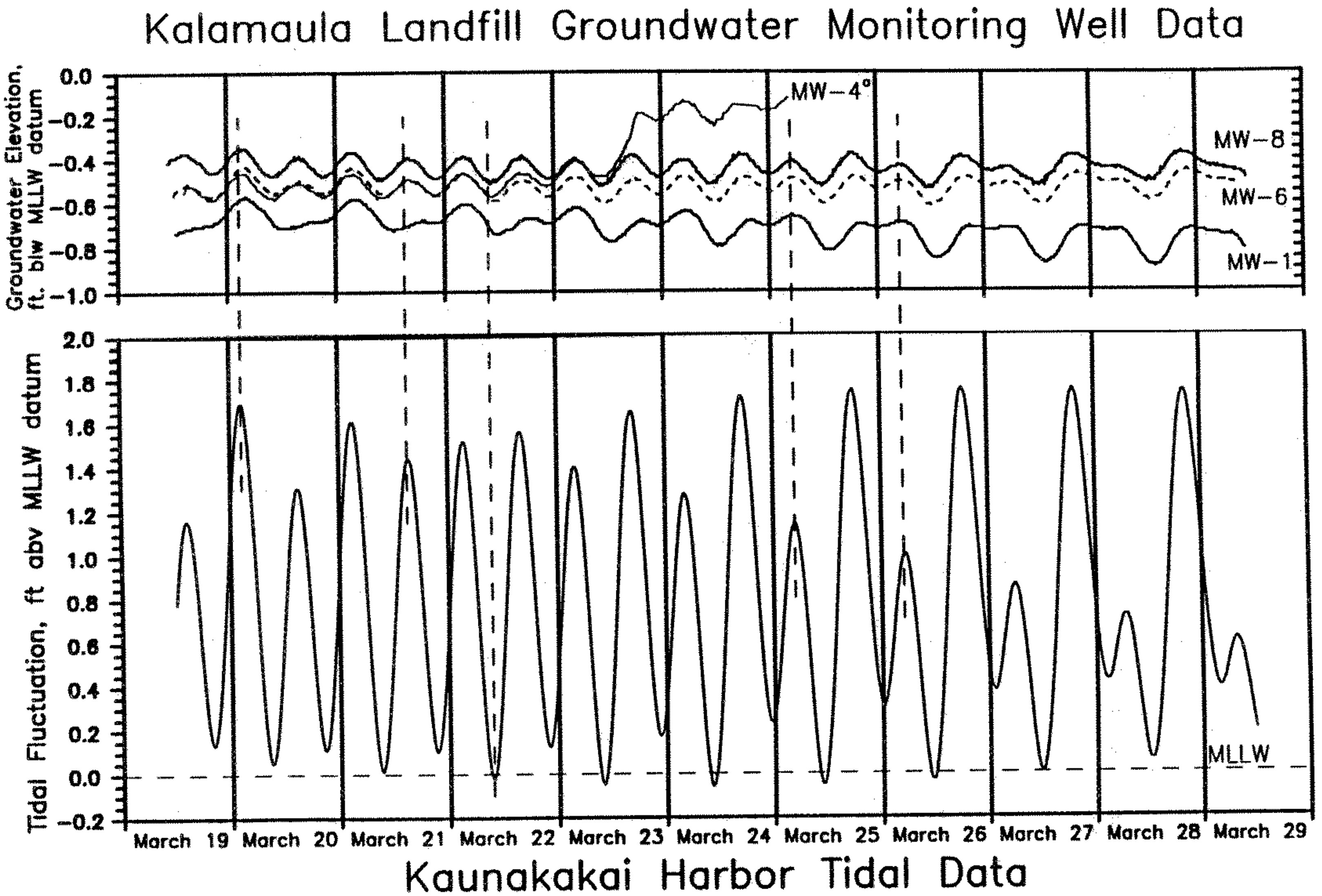
Figure 4-6 shows the tidal fluctuations from the monitoring program. Depth to water readings were recorded at 15-minute intervals throughout the time period. These readings were converted to elevations based on surveyed top of casing elevations. Also shown on Figure 4-6 is the ocean tidal data from Kaunakakai Harbor during the same time period. Data for monitoring well MW-4 were only valid until approximately noon on March 23 because of equipment malfunction.

The tidal data indicate the following:

- Maximum tidal fluctuation at Kaunakakai was 1.80 feet on March 25, 1993.
- Maximum tidal induced groundwater response was 0.15 feet in well MW-8 on March 25, 1993.
- The groundwater wells monitored over the 10-day period show a lag in response of about 1 to 3 hours after the corresponding high or low tide. (Vertical dashed lines on Figure 4-6 from selected highs and lows intercept the well data before the corresponding groundwater high or low.)
- Response is in time and magnitude in MW-1, MW-6, and MW-8 away from the ocean as it is in well MW-4, near the ocean.

These data show that the magnitude of tidal fluctuation is small (about 8 percent of the corresponding ocean tidal fluctuation) and that the fluctuation occurs relatively uniformly throughout the site. This indicates that the tides are not causing significant flow into the landfill or causing significant mixing of the groundwater because the water levels rise and fall relatively uniformly beneath the site.

Because of the tidal influence, groundwater levels are always changing. This situation makes it difficult to determine the actual direction of groundwater flow beneath the Landfill. To evaluate this situation, all water level measurements were averaged for each of the first 3 days with 24-hour records (the time period for which MW-4 data are usable) for the four wells monitored. This resulted in a 24-hour average water level for each well. These water levels were then contoured to produce average groundwater contours for each of the three. Figure 4-7 shows these plots. The plots indicate that the water level in MW-8 is always the highest and MW-1 is the lowest. Average groundwater flow would be from wells MW-8, MW-6, and MW-4 towards the east of the Landfill and then towards the ocean.

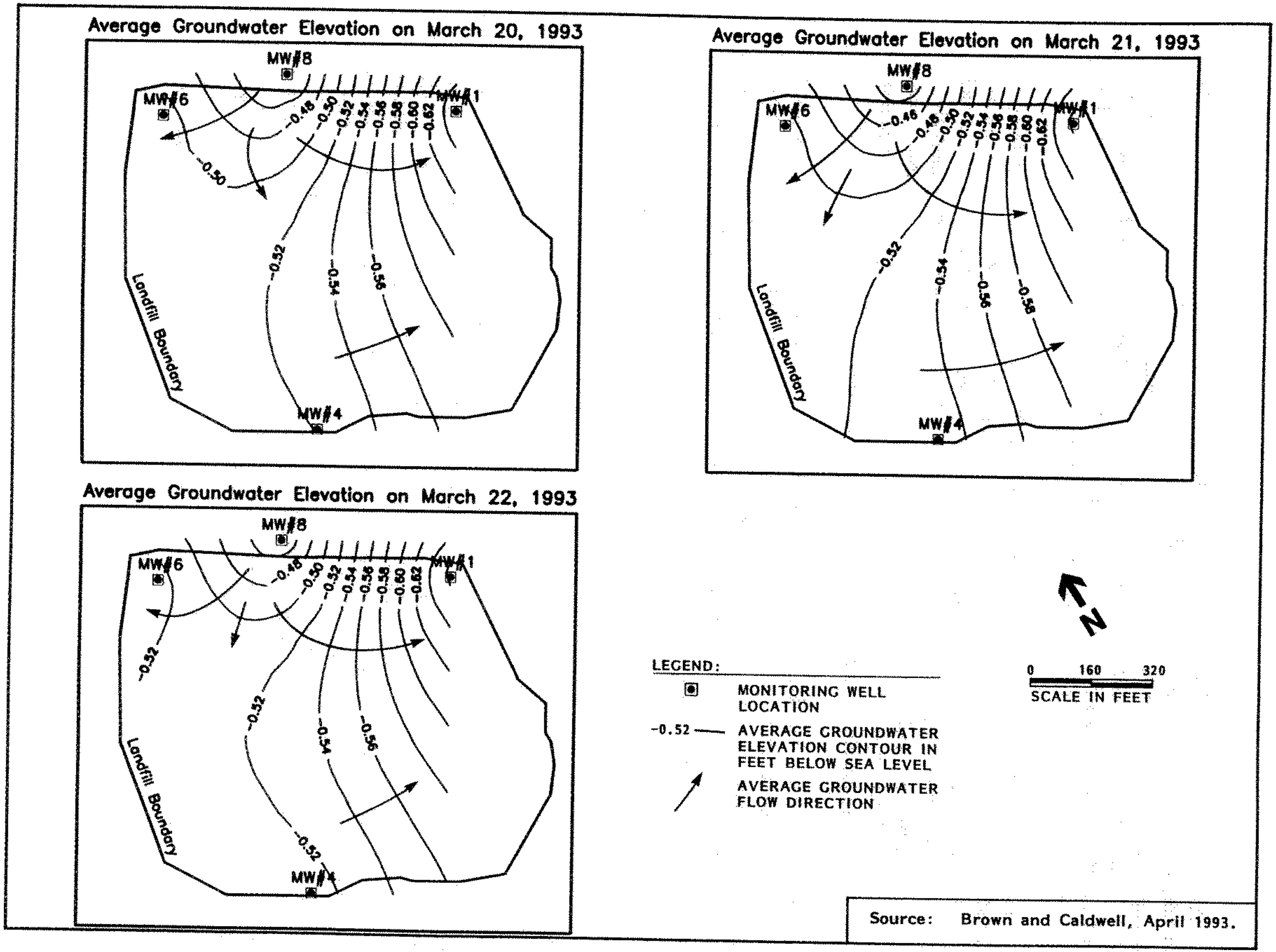

Kalamaula Landfill Groundwater Monitoring Well Data

Kaunakakai Harbor Tidal Data

ªDue to an apparent equipment malfunction, data from Well MW−4 after about 1200 hours on March 23, 1993, is invalid.

Source: Brown and Caldwell, March 1993.

Figure 4-6 Tidal Fluctuations in Monitoring Wells



Source: Brown and Caldwell, April 1993.

Figure 4-7 Average Daily Groundwater Elevation Contours

Average hydraulic gradients are very similar during low and high tides, measured values fluctuating between 0.006 feet/foot and 0.0007 feet/foot. These gradients suggest a nearly horizontal water table. Figures 4-8 through 4-11 are groundwater level contours for the four rounds of water level measurements shown in Table 4-2. With the exception of the high tide on August 12, 1992, the contours show groundwater flow from the landfill towards the ocean. The August 12 data indicate flow toward the center of the landfill.

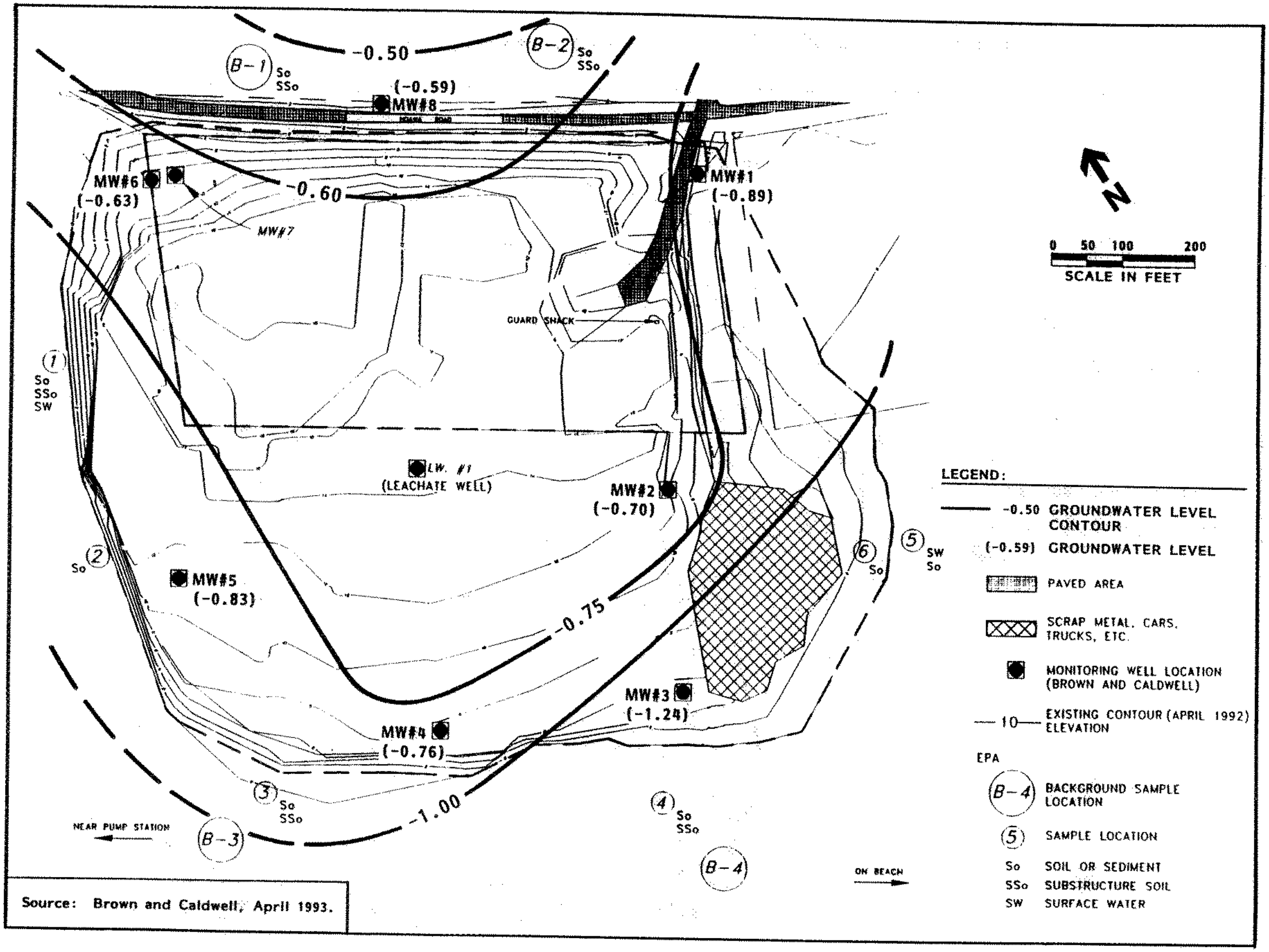
Estimated permeability of the soils beneath the Landfill range from very low to very high. The sands encountered in most of the boreholes are assumed to have very high permeability. Silty gravels and silty sands are estimated to be moderately permeable while clayey silts and clays have estimated to have low to very low permeability. Soils adjacent to slotted intervals in most of the monitoring wells appear to have moderate to high permeabilities. Pumping rates during well development ranged from 5 to 10 gallons per minute. Visible recovery occurred in all wells almost immediately after development pumping ceased.

Flood Hazard. The Landfill site is located on the flat coastal lowlands of Molokai's south shore. The eastern portions of the Landfill site encroach into lands designated Zone B and Zone A2 on the Flood Insurance Rate Map (FIRM), as shown on Figure 4-12. Lands designated Zone B are defined as areas between the limits of the 100-year and 500-year flood. Areas designated A2 are subject to the 100-year flood.

Those areas of the Landfill site not falling within Zones B and A2 are designated Zone C, areas of minimal flooding.

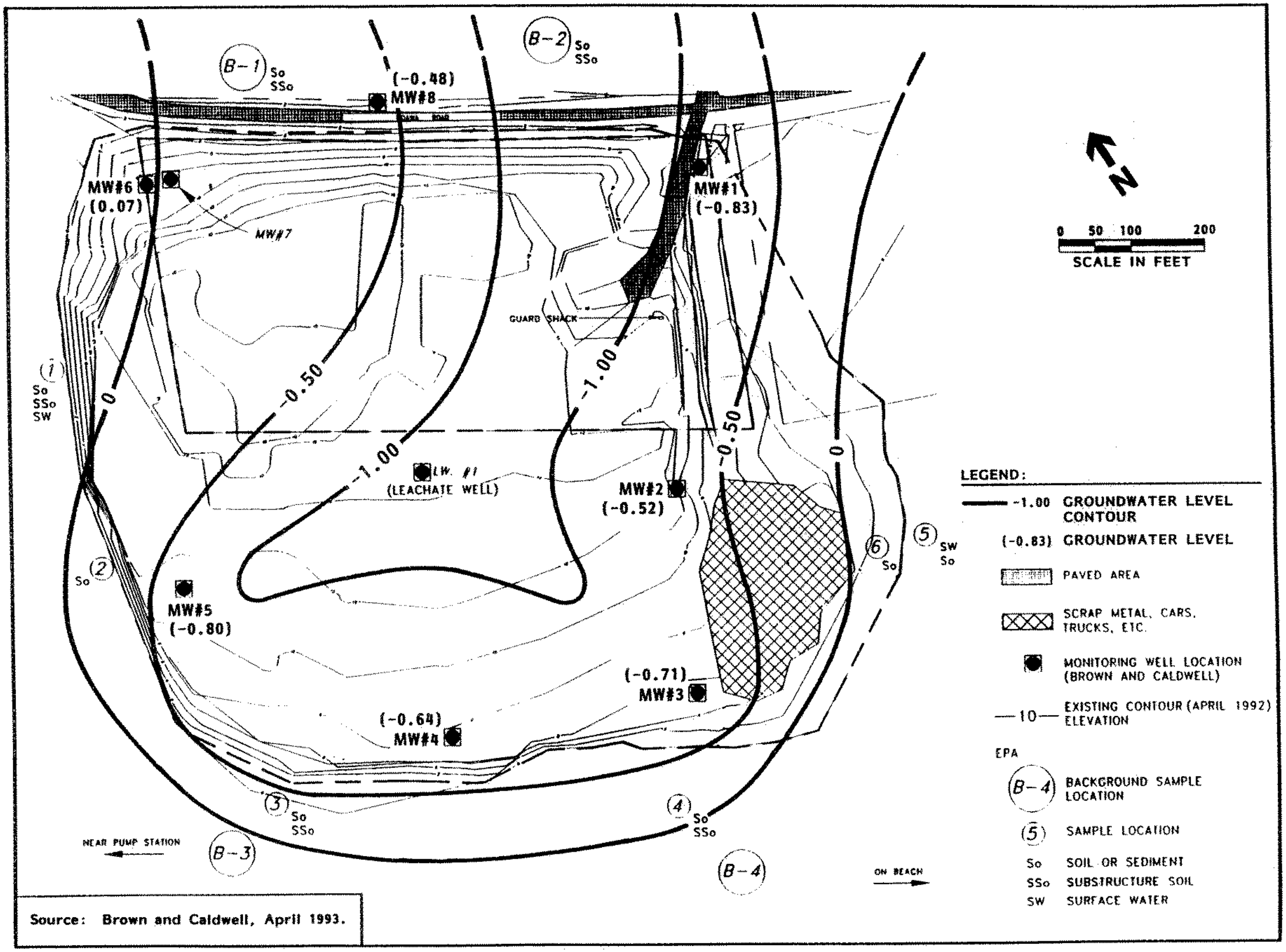
Soil and Groundwater Contaminants

The field investigation for the hydrogeologic assessment included the collection and laboratory analysis of both soil and groundwater samples. Eight groundwater monitoring wells (MW-1 through MW-8) and one leachate monitoring well (L-1) were installed during the field investigation. Well MW-8 is located north of the Landfill along the north shoulder of Hoawa Road. This location was selected to be the upgradient monitoring location, however, as discussed later, it appears that groundwater at this location has been affected. The predominant groundwater flow gradient, although relatively flat, is to the south-southwest toward the ocean. The remaining wells are located on the Landfill due to the inaccessibility of the surrounding wetlands. The pattern of well locations gives a basis for comparison of laboratory data for landfill leachate from L-1 to the groundwater under the landfill from MW-1 through MW-8. The monitoring well locations are shown on Figure 4-13 along with the locations of cross sections A-A' and B-B'. Figure 4-14 presents the cross sections. The cross sections are vertically exaggerated to show subsurface detail.



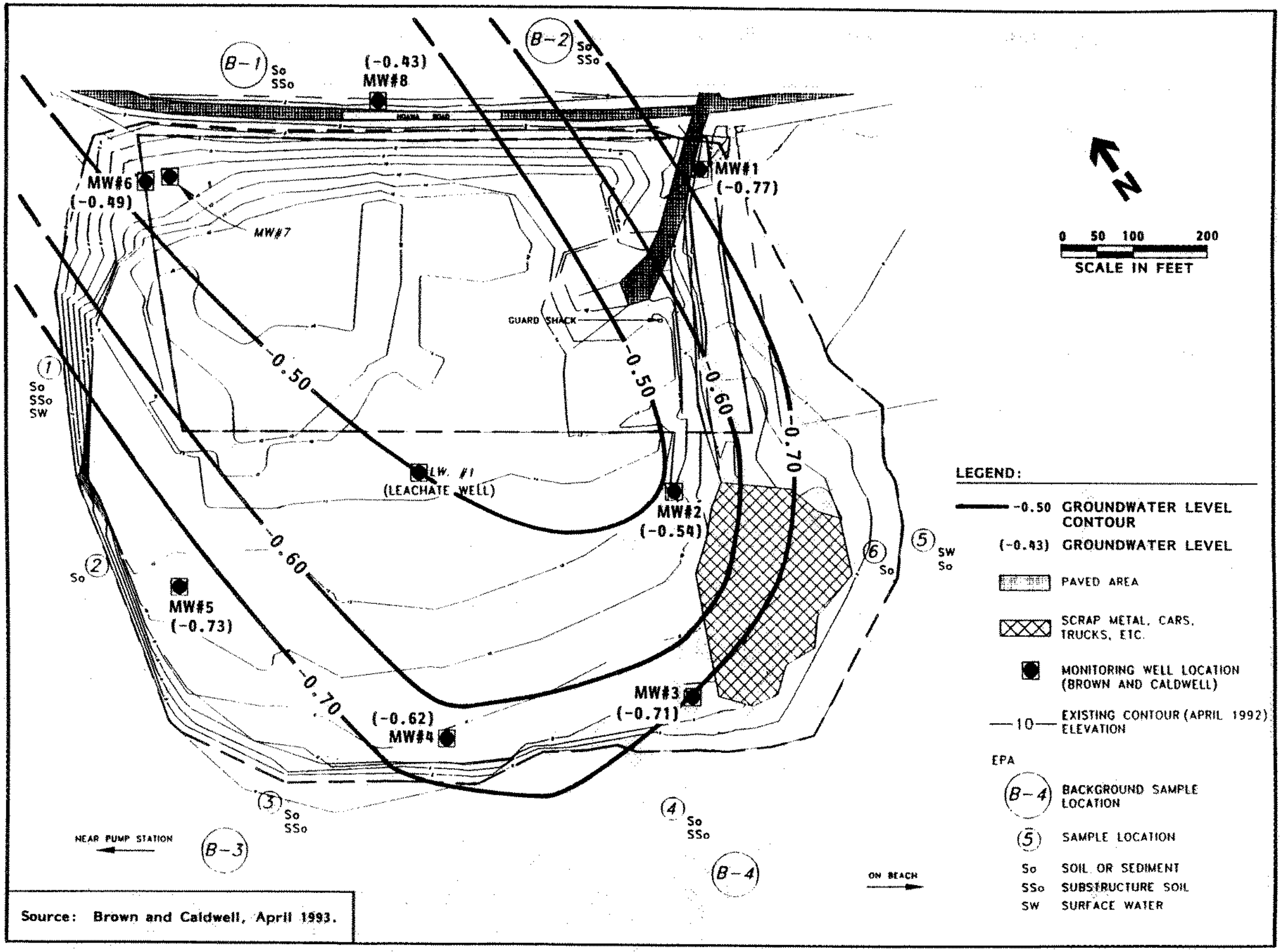
Source: Brown and Caldwell, April 1993.

Figure 4-8 Groundwater Level Contours During August 12, 1992, Low Tide



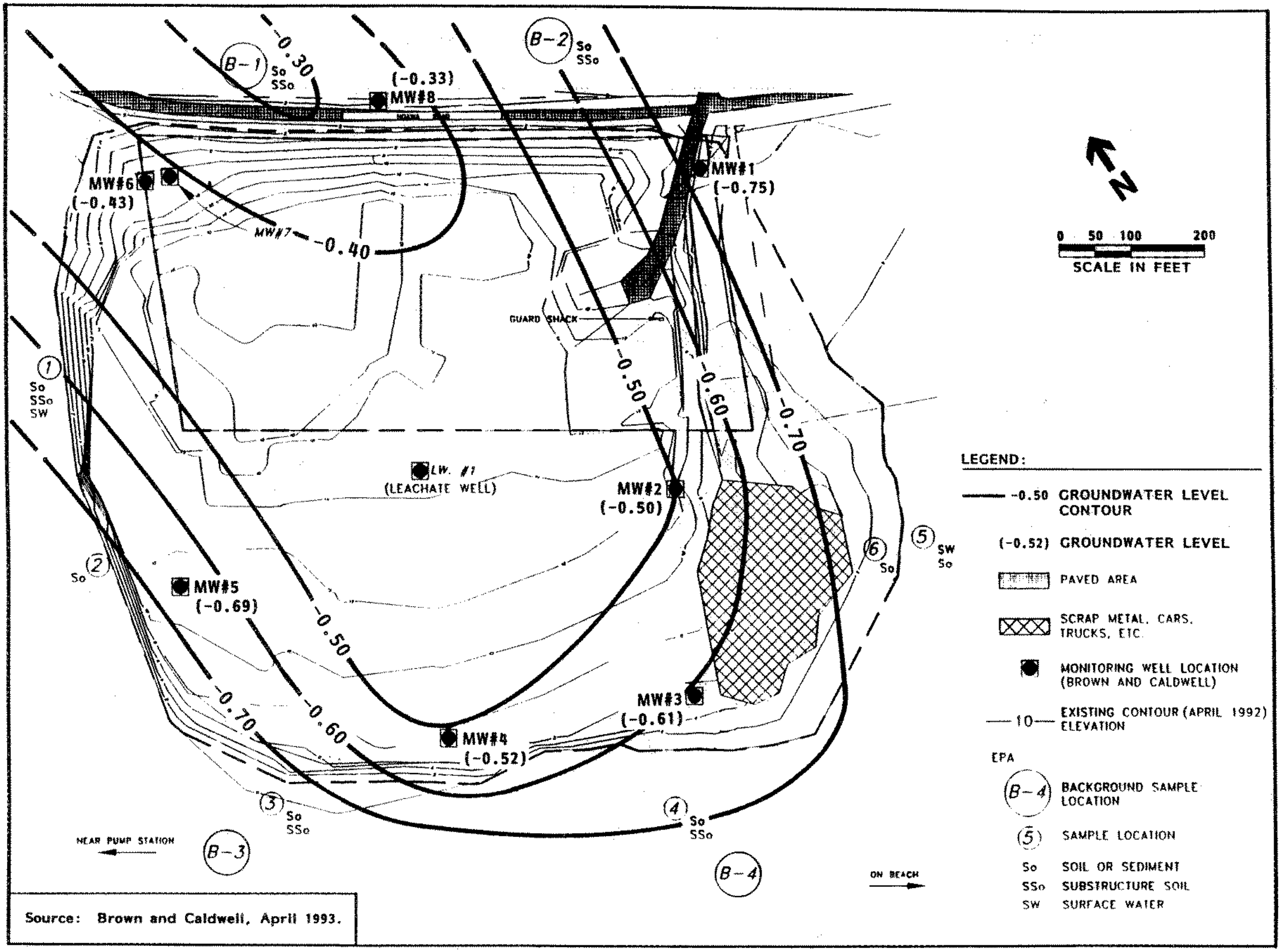
Source: Brown and Caldwell, April 1993.

Figure 4-9 Groundwater Level Contours During August 12, 1992, High Tide



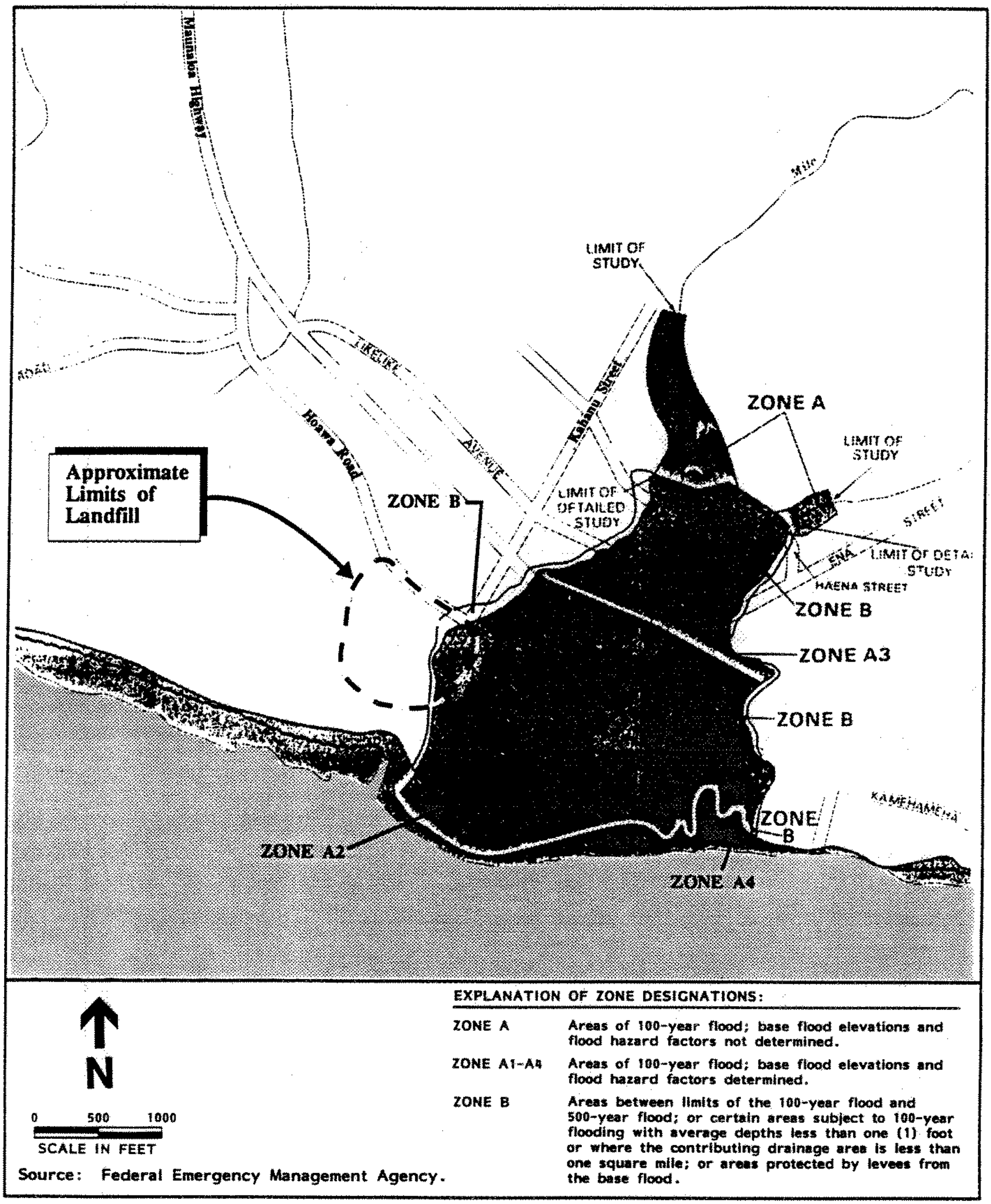
Source: Brown and Caldwell, April 1993.

Figure 4-10 Groundwater Level Contours During September 9, 1992, Low Tide



Source: Brown and Caldwell, April 1993.

Figure 4-11 Groundwater Level Contours During September 9, 1992, High Tide

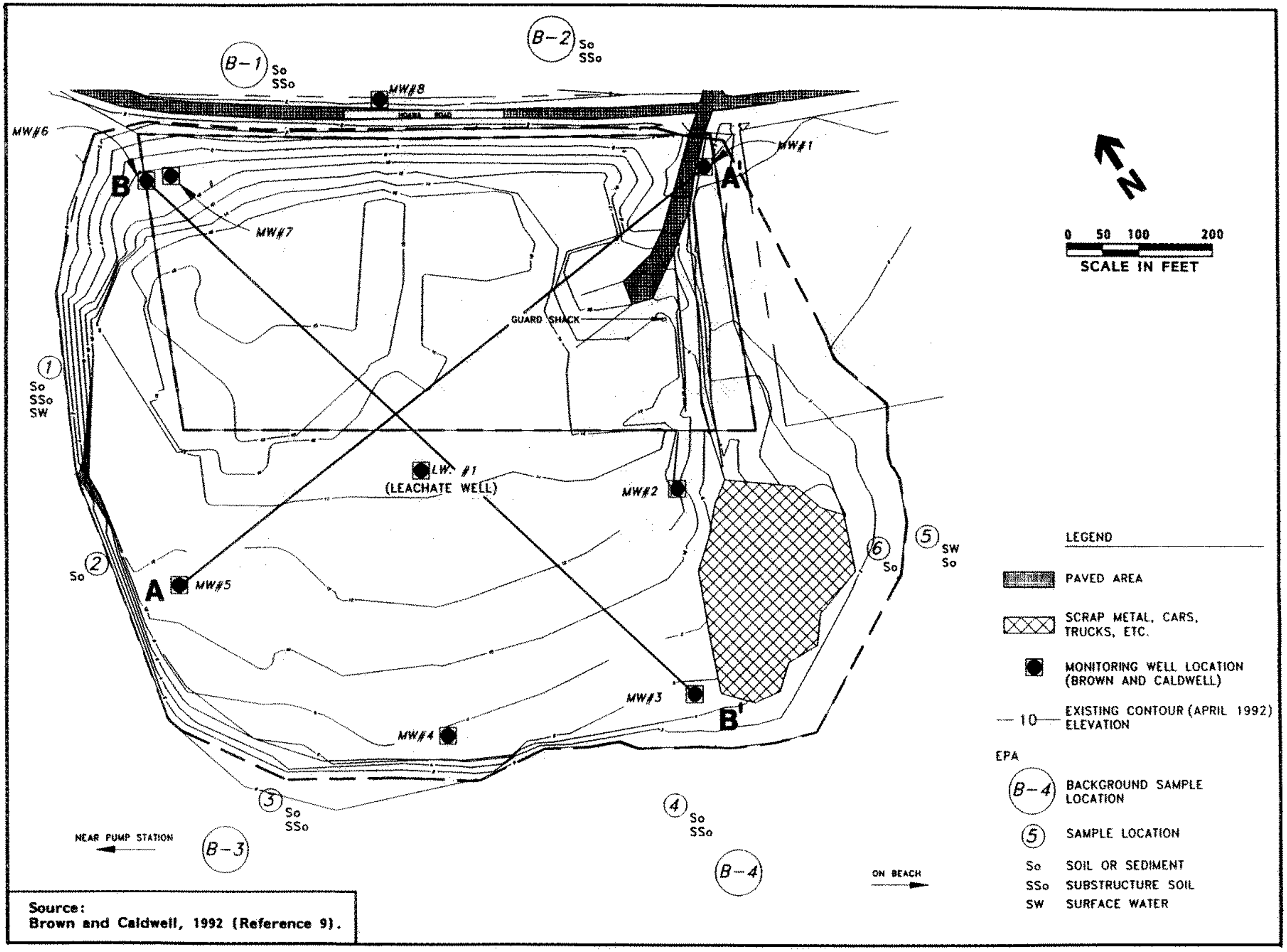


Source: Federal Emergency Management Agency.

EXPLANATION OF ZONE DESIGNATIONS:

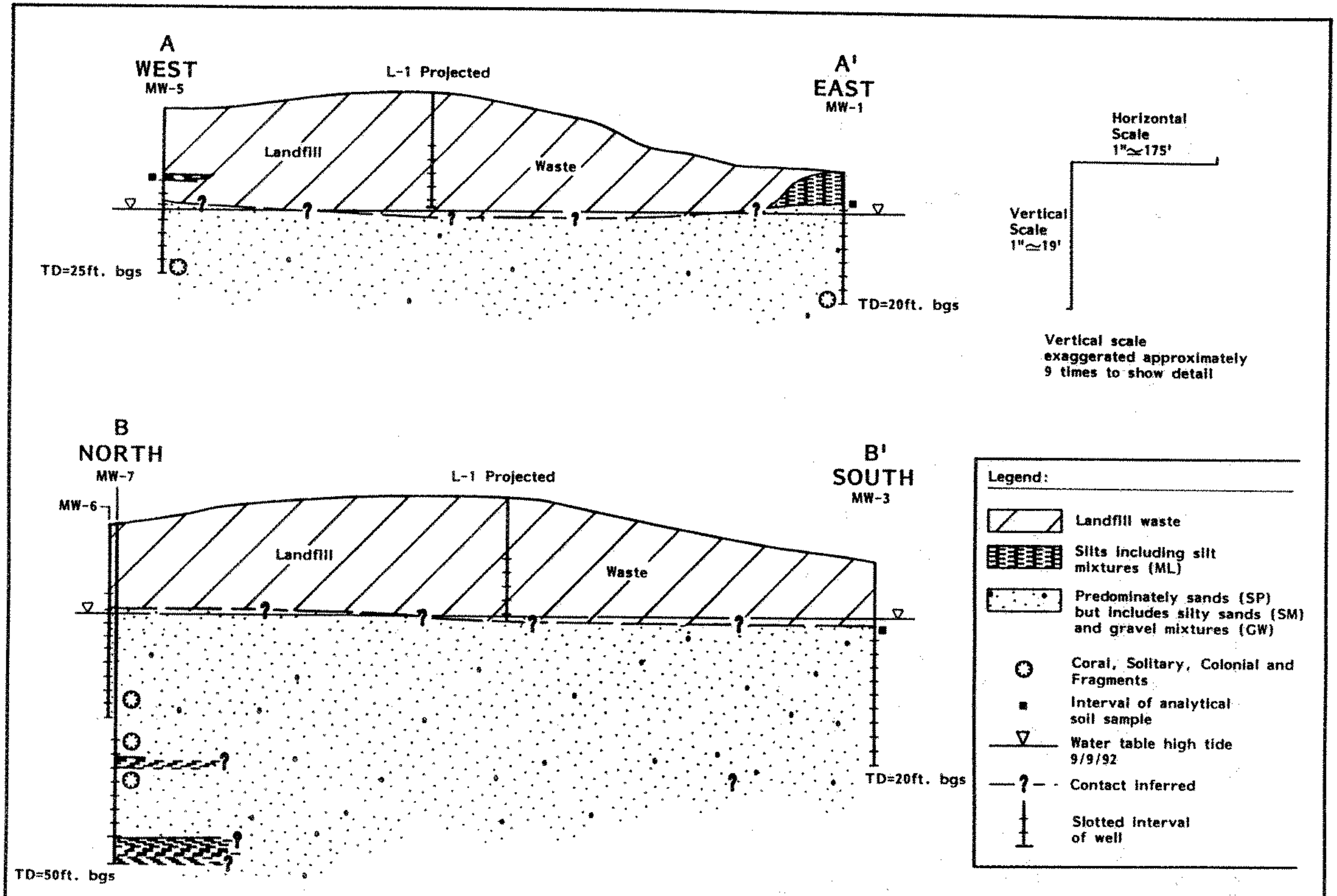
ZONE A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
ZONE A1-A4	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
ZONE B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood.

Figure 4-12 Flood Insurance Rate Map



Source:
Brown and Caldwell, 1992 (Reference 9).

Figure 4-13 Sample Locations for Soil, Sediment and Water Investigations



NOTE:
SEE FIGURE 4-13 FOR CROSS SECTION LINE LOCATIONS.

Source: Brown and Caldwell, 1992 (Reference 5).

Figure 4-14 Vertical Cross Sections A-A' and B-B'

During installation of the monitoring wells, soil samples were collected and subsequently analyzed for volatile organic compounds (VOCs), pesticides/polychlorinated biphenyls (PCBs), extractable organics, and total metals as indicators of potential affect of the Landfill on the groundwater. Water samples were collected and analyzed following installation and development of the monitoring wells. Water samples were analyzed for volatile organics, pesticides/PCBs, total metals, extractable organics, and general minerals. Analytical results are discussed in the following sections.

Soil Sample Analytical Results. The Landfill site was investigated for the Environmental Protection Agency (EPA) in 1991 by Ecology and Environment, Inc.[10] The EPA Expanded Site Inspection conducted by Bechtel Environmental, Inc., in January 1992 included collection and analysis of background soil samples from two locations north of the Landfill and Hoawa Road.[3] Figure 4-13 shows the subsurface soil sample locations from the EPA investigation, along with the monitoring well borehole locations.

To provide a comparison of the Landfill subsurface soil analytical results, the EPA Hazard Ranking System (HRS) guidance was utilized. The EPA HRS guidance states that an observed release is established if the contaminant in question is three times the background sample concentration. This criteria was also used in the Expanded Site Inspection.[3] For this analysis, background concentrations were established by averaging the two EPA background locations (B-1 and B-2). The constituents that were identified at concentrations greater than three times background values are discussed below.

Extractable Organics. Extractable (semi-volatile) organics were identified in soil at two Landfill locations (MW-5 and MW-6), but were not identified in background locations. Table 4-3 presents the extractable organics concentrations identified in subsurface soil samples.

Table 4-3 Soil Analytical Results for Extractable Organics

	Concentration, mg/kg[b]		
Sample location[a]	Bis(2-ethylhexyl) phthalate	Butylbenzyl phthalate	Di-n-octylphthalate
MW-5	1.1	0.57	2.5
MW-6	1.6	ND[c]	ND

[a] See Figure 4-7 for sample locations.
[b] mg/kg = milligrams per kilogram.
[c] Not detected.
Source: Brown and Caldwell, Reference 5.

VOCs. VOCs were identified in soil at three locations (MW-2, MW-5, and L-1), as shown in Table 4-4, but were not identified in background samples.

Table 4-4 Soil Analytical Results for Volatile Organic Compounds

	Concentration, µg/kg[b]				
Sample location[a]	Acetone	1,2-dichlorobenzene	Methyl ethyl ketone	Two C10 oxygenated compounds	C10 cyclic compound
MW-2	84	ND[c]	ND	ND	ND
MW-5	ND	12	ND	ND	ND
L-1	380	ND	79	200	10

[a]See Figure 4-7 for sample location.
[b]µg/kg = micrograms per kilogram.
[c]Not detected.
Source: Brown and Caldwell, Reference 5.

Pesticides/PCBs. Subsurface soil samples from MW-2 and MW-4 contained concentrations of DDE greater than three times the background concentration. Three times the average background concentration for DDE is 124.5 µg/kg. The concentrations for MW-2 and MW-4 are 150 and 270 µg/kg, respectfully.

Metals. Calcium, arsenic, magnesium, and lead were found in concentrations greater than three times the background concentrations. However, the calcium and magnesium concentration are likely to be associated with the brackish water beneath the site. In addition, an arsenic concentration of 16.7 milligrams per kilograms (mg/kg) was identified in a sediment sample at EPA background location B-4, and confirmed in a separate sample taken by AECOS during their studies of the biological effects of the Landfill.[6] This concentration of arsenic exceeded all other surface soil, sediment, and subsurface soils collected from in or around the Landfill. Therefore, the data do not clearly demonstrate that the Landfill is the source of arsenic. The metal concentrations identified above three times the background concentration are presented Table 4-5. The lead background concentration has been compared to published information on ranges in basaltic rocks, (3-6 mg/kg) and argillaceous (10-30 mg/kg) and volcanic (1.5-18 mg/kg) soils.[61,62,63] The background concentration at this site is well within the range for soils and slightly above the range for basaltic rocks.

Groundwater Sample Results. EPA's Marine Water Quality Criteria (MWQC) are used to evaluate potentially affected groundwater because the groundwater is brackish and influenced by ocean tides. Groundwater quality is compared to both acute and chronic MWQC in this analysis. If there is no MWQC for an identified compound, the HRS criteria are used for evaluation purposes.

Table 4-5 Soil Analytical Results for Metals

Sample location[a]	Concentration, mg/kg			
	Arsenic	Lead	Calcium	Magnesium
Background[b]	2.4	7.7	5,765	3,823
Three times background	7.2	23.1	17,295	11,469
MW-1	6.7	-	280,000	9,000
MW-2	1.6	5	25,000	6,500
MW-3	13	-	580,000	12,000
MW-4	2.7	42	28,000	5,700
MW-5(1)[c]	2.1	46	31,000	5,200
MW-6	0.4	-	7,600	3,100
L-1	6.8	28	31,000	3,400

[a] See Figure 4-7 for sample locations.
[b] Obtained by averaging B-1 and B-2.
[c] This sample was collected from the first borehole that was attempted. This borehole was abandoned due to obstructions.

Source: Brown and Caldwell, Reference 5.

VOCs. VOCs were identified in groundwater samples from monitoring wells MW-6, MW-7, and L-1. Table 4-6 presents the concentrations identified in the monitoring wells along with the EPA MWQC.

The concentrations are low and do not exceed either of EPA's MWQC, where available. It should be noted that toluene and xylene were also identified in groundwater from MW-8 at concentrations of 1.1 and 1.7 µg/L, respectively.

Table 4-6 Groundwater Analytical Results for Volatile Organic Compounds

Sample identification[a]	Concentrations, micrograms per liter				
	Ethylbenzene	Toluene	Xylene	1,2 Dichloro-benzene	Cis-1,2 Dichloro-benzene
EPA acute marine criteria[b]	430	6,300	N/A[c]	1,970	113,000
EPA chronic marine criteria[b]	N/A	5,000	N/A	129	N/A
MW-6	ND[d]	ND	ND	3	ND
MW-7	ND	6.3	ND	ND	ND
L-1	4.8	5.2	4.3	ND	2.2

[a] See Figure 4-7 for location of MW-6, MW-7, and L-1.
[b] Source: California Regional Water Quality Control Board, Central Valley Region, A Compilation of Water Quality Goals, September 1991.
[c] Criteria not available.
[d] Not detected.

Source: Brown and Caldwell, Reference 5.

Pesticides/PCBs. Neither PCBs or pesticides were identified in any of the groundwater samples.

Extractable Organics. C-12 to C-25 total hydrocarbons were identified in MW-3, C10 to C16 total hydrocarbons were identified in L-1, and phenanthrene was identified in MW-4 as shown in Table 4-7. These compounds were not identified in well MW-8. EPA has not established marine water quality guidance for these constituents.

Table 4-7 Groundwater Analytical Results for Extractable Organics

Sample location[a]	Extractable organics,[b] milligrams per liter		
	C12-C25	C10-C16	Phenanthrene
MW-3	100	ND[c]	ND
MW-4	ND	ND	5
L-1	ND	8	ND

[a] See Figure 4-7 for well locations.
[b] Marine water quality criteria do not exist for these constituents.
[c] Not detected.
Source: Brown and Caldwell, Reference 5.

Metals. Table 4-8 shows the groundwater analytical results for metals along with the EPA MWQC and the background concentrations. Arsenic was identified in MW-1 and MW-4 in concentrations higher than EPA's chronic MWQC. However, these concentrations were lower than EPA's acute MWQC. Silver was identified in L-1 in concentrations exceeding EPA's acute MWQC. Concentrations of chromium (as total chromium) in samples collected from MW-4, MW-5, and L-1 exceed EPA chronic marine criteria for hexavalent chromium.

General Chemistry. Groundwater samples from each well were analyzed for general minerals. Groundwater beneath the Landfill contains high total dissolved solids (TDS) and other constituents generally associated with sea water. Calcium is also found at concentrations that may be associated with the deposits of corals (calcium carbonate) beneath the surface in addition to sea water. Several constituent concentrations may fluctuate from well to well due to their proximity to the marsh, ocean, underlying coral layers, tidal influence, or capillary action of the Landfill waste.

Data Evaluations and Conclusions. Hydraulic gradients at the Landfill site are flat, however, groundwater contours generally show flow towards the ocean. As discussed previously, tidal influence appears to be relatively uniform beneath the Landfill as indicated by response in MW-8 fartherest from the ocean being similar to MW-4 closest to the ocean. This information, along with the average hydraulic gradient derived from the tidal study, indicate that the general flow direction is seaward.

Because the Landfill is not lined and groundwater is shallow (approximately 1 to 4 feet below ground surface), it is probable that leachate from the Landfill has entered and mixed with the groundwater below the Landfill. However, the slow movement of the groundwater causes

Table 4-8 Groundwater Analytical Results for Metals

Sample identification[a]	Metals, micrograms per liter					
	Arsenic	Selenium	Iron	Barium	Chromium	Silver
EPA acute marine criteria	69[b,c]	410	NA	50,000[a]	1,100[c,d]	2.3
EPA chronic marine criteria	36[b,d]	54	NA	50,000[a]	50[c,a]	NA
MW-8	6.6	4.2	5,600	ND	ND	ND
MW-1	41	ND	100,000	330	ND	ND
MW-2	18	ND	63,000	280	ND	ND
MW-3	6	ND	6,700	ND	ND	ND
MW-4	46	ND	130,000	540	140	ND
MW-5	24	ND	57,000	310	70	ND
MW-6	16	ND	63,000	270	ND	ND
MW-7	ND	ND	9,200	130	ND	ND
L-1	21	ND	130,000	1,100	78	180

[a] See Figure 4-13 for well locations.
[b] As tri-arsenic form.
[c] 1-hour average concentration.
[d] 4-day average.
[e] Hexavalent form.

Source: Brown and Caldwell, October 1992 leachate constituents to move slowly after reaching the groundwater. This slow movement also tends to minimize lateral migration distances. Therefore, although leachate may migrate from the Landfill to groundwater relatively quickly, movement beneath the Landfill will take place slowly.

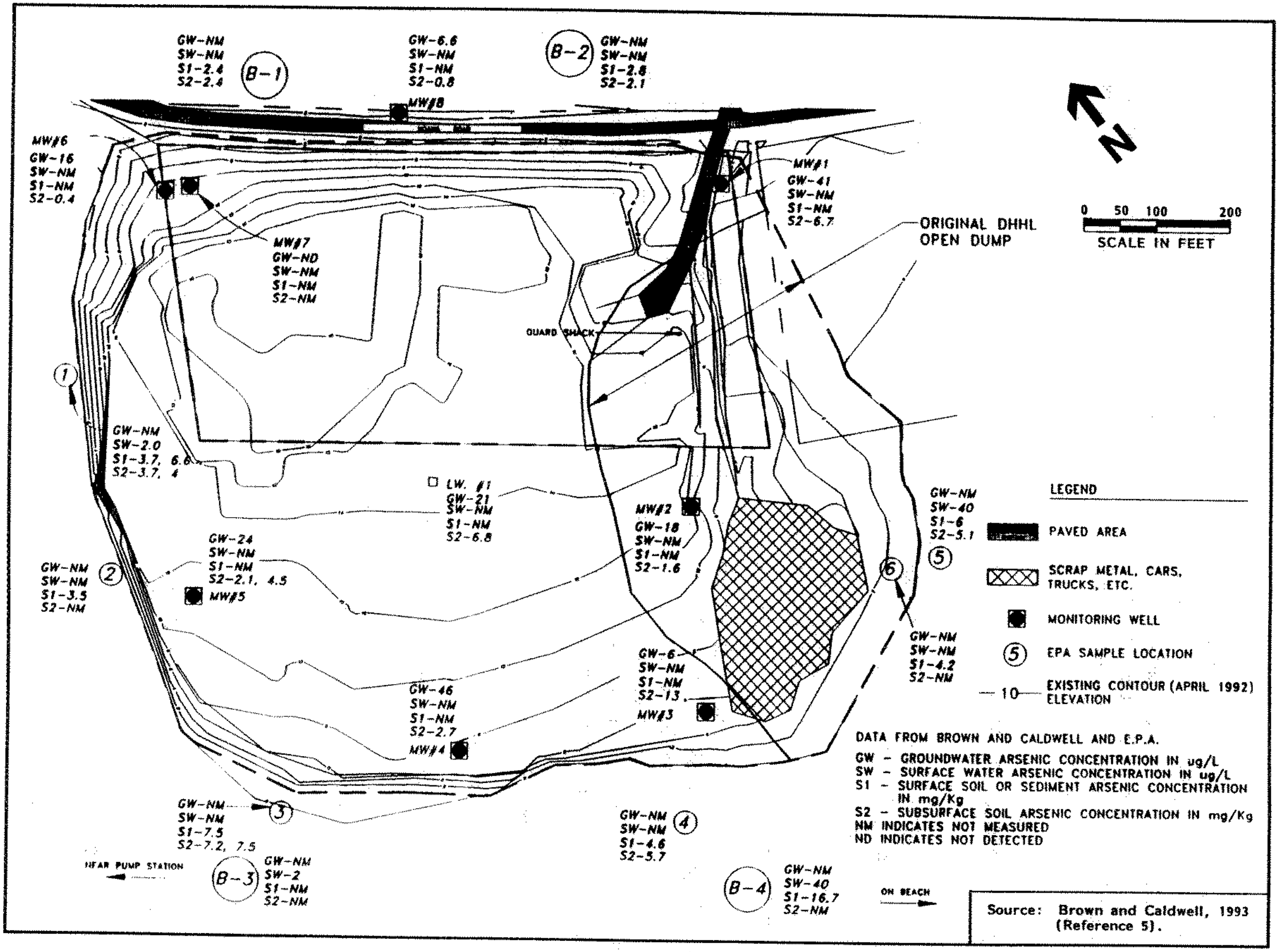
Evaluation of Landfill leachate constituents includes identifying the types of constituents that may be present and specifying those that could have a negative impact on local biological resources. On-site data were collected during the hydrogeologic assessment. These on-site data support EPA's conclusion that releases of contaminants have occurred. The concentrations of constituents are not uniform.

After observing the influence of tides on the groundwater elevations in MW-8, it appears that it is in an upgradient position; however, based on the chemical composition of the groundwater, it appears that MW-8 has been affected by Landfill leachate constituents. Therefore, it does not appear that MW-8 is a suitable upgradient well for landfill monitoring purposes.

For those identified leachate constituents, the relationship of magnitude and effect was evaluated by sampling and analyzing soils and biota surrounding the landfill. As will be discussed later in this chapter, the survey of wetland ecosystems concludes that the only contaminant found notably higher in Kalamaula specimens is arsenic.[6] Arsenic is a constituent of an estimated 245 mineral species, as reported by EPA publication 440/4-85-005. It occurs naturally, and will be transported with other minerals when eroded by wind or water. Arsenic is also used in many man-made products, with the majority of use being in pesticides.

On-site and off-site data from samples were evaluated for arsenic sources and possible pathways for movement from any identified source. Both groundwater and soil samples were analyzed for total arsenic. The arsenic on-site data from this assessment and the EPA expanded site inspection are summarized on Figure 4-15. These data show a random arsenic pattern with the highest groundwater concentrations of arsenic found in MW-1 and MW-4 (41 and 46 µg/L, respectively).

The background subsurface soil concentrations for arsenic range from 0.8 to 2.4 mg/kg in locations north of the Landfill. Background sediment or surface soil concentrations for arsenic range from 2.4 mg/kg north of the Landfill to 16.7 mg/kg at background location, B-4, located southeast of the Landfill in the Ohiapilo wetlands. This latter background concentration of arsenic (16.7 mg/kg) exceeded all other surface soil, sediment or subsurface soil samples collected from in or around the Landfill.



Source: Brown and Caldwell, 1993 (Reference 5).

Figure 4-15 Sample Locations and Arsenic Concentrations

Because arsenic was identified at higher concentrations in a background sediment sample than in or around the Landfill, the data do not clearly demonstrate that the Landfill is the source contributing to elevated concentrations of arsenic in soils or groundwater. Further studies on the arsenic issue are discussed in the next section on biological resources. Other potential sources are naturally occurring arsenic and various agricultural products that may have been used on Molokai crops.

IMPACTS AND MITIGATION MEASURES

The potential impacts of the proposed Project on the physical environment are addressed in this section. The analysis includes consideration of the soil borrow areas and enhancement of Ohiapilo Pond.

Significance Criteria

In determining whether an action may have a significant effect on the environment, every phase of a proposed project must be addressed. Both primary and secondary, cumulative, as well as short- and long-term effects of the action must be considered. According to the Environmental Impact Statement (EIS) rules contained in Hawaii Revised Statutes (HRS), Department of Health (DOH), Title II, Chapter 200, Subchapter 6, the proposed Project would have a significant effect on the physical environment if it:

1. Curtails the range of beneficial uses of the environment.
2. Involves a substantial degradation of water quality.
3. Detrimentally affects water quality.
4. Affects an environmentally-sensitive area such as a floodplain, tsunami zone, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters.

Landfill Closure

Landfill closure involves in-place closure of about 19 acres per the requirements of 40 Code of Federal Regulations (CFR), Part 258, and the DOH Interim Guidelines for Closure. Issues addressed below include topography and landform, drainage and erosion, effects on the Flood Hazard District, and water quality.

Topography and Landform. In accordance with minimum closure requirements set forth in 40 CFR, Part 258, a cover layer totaling 24 inches in depth will be required to close the Landfill. Vegetation suitable to the ecosystem will be selected for planting the vegetative layer of the final cover. Accordingly, the final form of the Landfill is anticipated to spatially encompass the existing Landfill area (Figure 2-3). Postclosure elevations at the Landfill surface will be slightly higher than existing surface elevations. The overall topographic landscape, therefore, will resemble the form and shape of the existing Landfill area, and no significant impacts to topography and landform will result.

Drainage and Erosion. Without provisions for control of drainage and surface water runoff, erosion of the final cover could occur which could damage the integrity of the Landfill and could result in water quality and biological impacts in surrounding areas. However, mitigation will be provided because the final grading and drainage plan will be designed to promote runoff and minimize erosion.

Design criteria for the Landfill closure include landfill grading, drainage, and final cover criteria. The selected closure concept involves minor regrading of the top and sides of the Landfill to achieve the necessary slopes for closure. Specifically, side slopes will be graded to obtain a maximum of 3:1 horizontal to vertical. The top of the Landfill will be gently sloped at 2 to 4 percent. This grading plan will effectively promote runoff, while minimizing the amount of erosion that takes place.

The drainage plan will closely follow the slopes and grades established by the final grading plan. It is anticipated that the majority of the runoff will take place via overland or sheet flow. Small drainage ditches will be used to collect runoff and direct the flow towards downchutes. These downchutes will consist of corrugated metal pipes or a similar material that is flexible and can withstand some settlement. Erosion control such as riprap will be provided at the base of the downchute. Additional erosion control may be provided in other areas, as needed.

The upper or vegetative layer of the final cover will consist of 6 inches of earthen material capable of sustaining vegetative growth which will further aid in minimizing erosion. The vegetative cover will be maintained and reseeded as necessary.

The postclosure maintenance and monitoring plan, discussed in Chapter 2, includes the final cover and drainage control system. Postclosure care requirements, contained in the DOH Interim Guidelines for Closure, require the County to maintain the integrity and effectiveness of the Landfill cover, including making repairs to the cover to correct the effects of any erosion that has occurred and to prevent run on and run off from eroding or otherwise damaging the final cover. Visual inspections will be performed on a quarterly basis and following significant rainfall events, and maintenance and repairs performed as needed. Monitoring and maintenance will help to maintain the long-term integrity and effectiveness of the cover.

Similarly, the drainage control system will be inspected quarterly and following significant rainfall events for erosion, overtopping, sediment buildup, debris, weeds, and other possible problems. Portions of the system that are in need of repair or maintenance will be noted and the work will be performed in a timely manner.

If erosion occurs in the ditches, repairs will be made, as needed, by regrading or reshaping the ditch. Soil will also be added, if necessary, and the area reseeded. Problem areas may need additional erosion control, such as matting or riprap.

Also, the deposition of solids or debris may prevent the ditch from effectively conveying surface water. Long-term ponding and ditch overtopping will require regrading of the affected area; sediments and debris will be removed as needed. Culverts and downchutes will be cleaned as necessary. The access road will require very little maintenance; potholes and ruts will be repaired as required.

Implementation of the mitigation measures discussed above will reduce potential drainage and erosion impacts to less than significant levels.

Settlement and Subsidence. Settlement and subsidence in the Landfill can occur as solid wastes decompose and consolidate. If excessive settlement occurs, the cover soil may crack and water may pond, or drainage ditch overtopping may occur. Thus, as with erosion, the integrity of the Landfill may be damaged resulting in water quality or biological impacts in surrounding areas.

Postclosure monitoring requirements include making repairs, as necessary, to correct the effects of settling and subsidence. If this occurs, the affected area will be filled with additional cover soil and graded for proper drainage. Visual inspection for settlement and subsidence will be performed on a quarterly basis and maintenance and repairs will be performed as needed.

Implementation of the mitigation measures discussed above will reduce potential settlement and subsidence impacts to less than significant levels.

Flood Hazard District. As discussed earlier in this chapter, the Landfill is outside of the area of the 100-year flood, except for a small eastern portion of the site. According to the FIRM, the eastern edge of the Landfill is within zones designated B and A2.

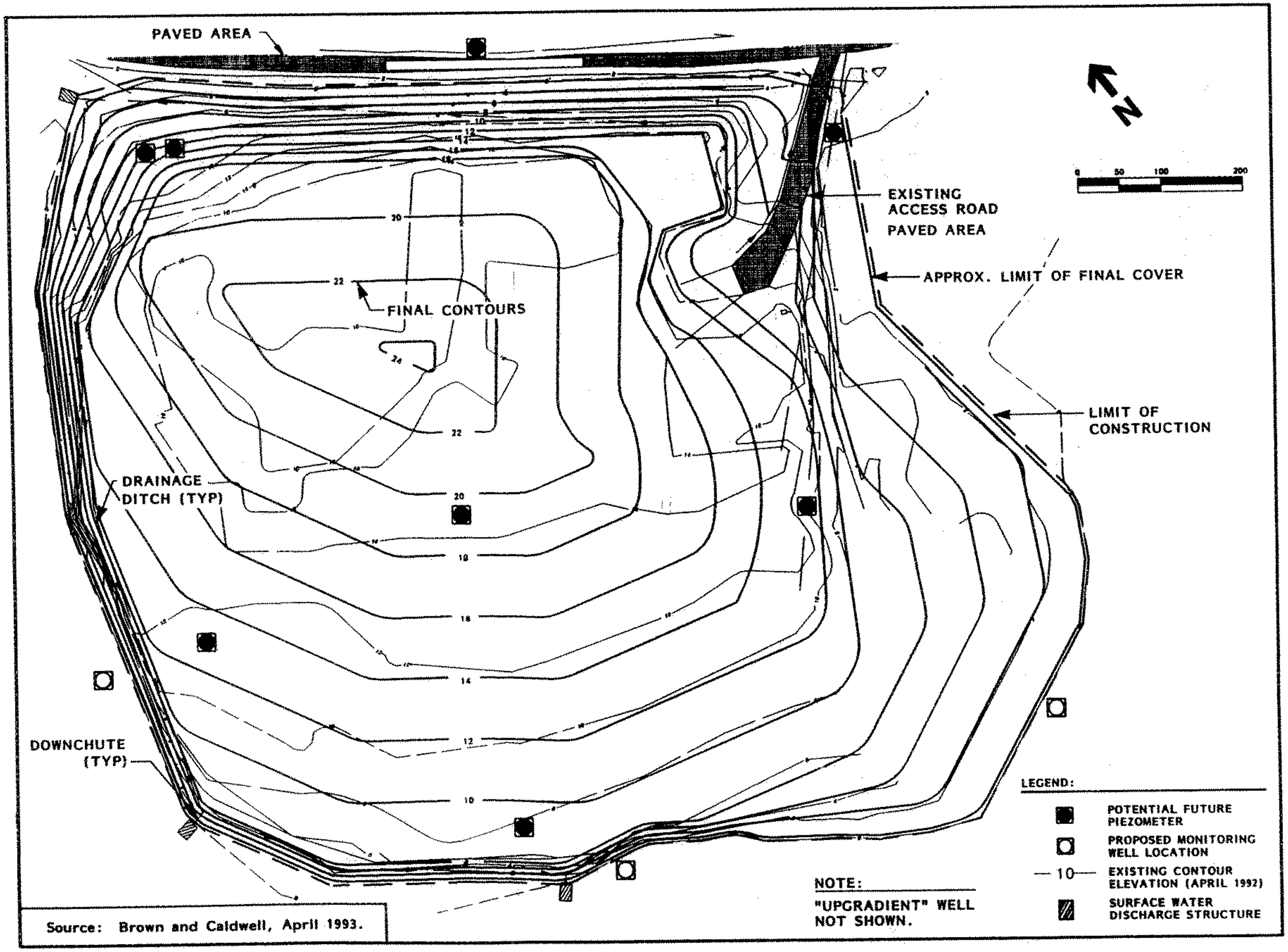
Based on the FIRM and on data provided by the U.S. Army Corps of Engineers,[58] the Zone A2 designation indicates only a 1.0-foot difference in flood elevation between the 10-year and the 100-year floods in the Landfill area. This small difference indicates the flow is spreading out over a large area onto the floodplain. Based on this small infringement and the small rise in the flood elevation, the Landfill would have a negligible effect on the 100-year flood water surface elevation. However, because of the potential effect on the Landfill during a 100-year flood, the affected area of the Landfill will include provisions for slope protection and stabilization capable of minimally withstanding the 100-year flood at specified base flood elevations.

Water Quality. Leachate is defined as liquid that has passed through or emerged from solid waste and contains soluble and suspended materials removed from such wastes. Sources of such leachate at the Landfill include surface water infiltration and groundwater infiltration. As discussed earlier in this chapter, the hydrogeologic study has identified leachate constituents in the soil and shallow groundwater beneath the Landfill.

The final cover system of the Landfill will be designed to meet the requirements of 40 CFR, Part 258, Subpart F, and thereby minimize infiltration. The bottom, or low permeability soil layer, will be a minimum of 18 inches of earthen material and have a permeability no greater than $1x10^{-5}$ centimeters per second (cm/sec). Thus, the proposed Landfill closure will provide substantial benefit over the existing situation and minimize the risk of water quality degradation.

Post-closure monitoring requirements for the Landfill require that a groundwater monitoring program be implemented to detect Landfill effects on the groundwater. The program, including number and location of wells and instituents and monitoring frequency, will be negotiated with the DOH and EPA. Once appropriate approvals have been obtained, at this time, the proposed monitoring program will likely include installation of three new downgradient wells placed in the wetlands, just off-site of the landfills as shown on Figure 4-16. Wells in this location would be subject to approval from the Corps of Engineers and the FWS. In addition, an unaffected background well will either be constructed at a suitable location away from the affect of the landfill or one of the existing off-site wells shown on Figure 4-3 will be designated as an background monitoring well. The existing wells used in the hydrogeologic investigation will be available for potential future use as piezometers which can be used to measure groundwater levels.

The proposed approach to groundwater monitoring is to monitor quarterly for the first two years and semi-annually for the third through fifth years unless the monitoring results demonstrate a reason for concern and the need for more frequent monitoring. Table 4-9 lists the recommended frequency and constituents to be analyzed for the 5-year monitoring program. The groundwater monitoring program approach is to initially sample and analyze all the constituents of concern identified in the Hydrogeological Assessment.[5] Because some of these compounds were not identified at significant concentrations, this initial round of sampling (first quarter) will help to verify the results of the hydrogeological assessment. After the first quarter, certain analyses may be discontinued, depending upon the results. However, if the monitoring program identifies degradation, the County will implement an appropriate corrective action program as would be required by the DOH. Such a corrective action program would include consideration of a containment wall, or groundwater pumping and treatment.



NOTE:
"UPGRADIENT" WELL NOT SHOWN.

Source: Brown and Caldwell, April 1993.

Figure 4-16 Location of Proposed Groundwater Monitoring Wells

Soil Borrow Areas

Once the excavation of the soil borrow areas is completed, the ultimate use of the site will be the responsibility of the landowner. Site 1 may be used as part of the Molokai Ranch wastewater treatment pond system. Site 4 may be developed as a water storage reservoir by Molokai Ranch. If these end uses do not occur immediately, runoff and wind and water erosion of exposed soils will occur. If development of these sites is delayed, the County will work with Molokai Ranch to assure that appropriate ground cover is used when excavation is completed.

Enhancement of Ohiapilo Pond

The activities necessary to enhance Ohiapilo Pond should not result in impacts to surface or groundwater. During development of the specific enhancement plan for the site, the County will give appropriate consideration to this matter, if necessary.

Table 4-9 Proposed Groundwater Monitoring Program

Year	Frequency	Constituents
1-2	Quarterly	VOCs[a] (EPA Method 8240) Volatile organic compounds[a] Extractable (semivolatile) organics[a] (EPA Method 8270) pH (EPA 9040) Specific Conductance (EPA 9050) Metals[b]
3-5	Semi-annual (second and fourth quarter)	Metals pH (EPA 9040) Specific Conductance (EPA 9050)

[a] Will continue to be analyzed if detected in the first quarter sampling event.
[b] The first quarter will include arsenic, selenium, iron, barium, and chromium. In addition, MW-4 and MW-5 will initially be analyzed for hexavalent chromium. These may be reduced after the first quarter.

Source: Brown and Caldwell, April 1993.

BIOLOGICAL RESOURCES

Biological resources are the second major consideration associated with closure of the Landfill. A survey of the wetland ecosystem was conducted by AECOS and Dr. Evangeline Funk and culminated in the preparation of Technical Memorandum Number 5 for the Landfill Closure Project.[6] The purposes of the survey, which is summarized in this section, was to determine whether any ecological effects have resulted from past Landfill operations and what risks would be associated with removal of fill from the area of encroachment.

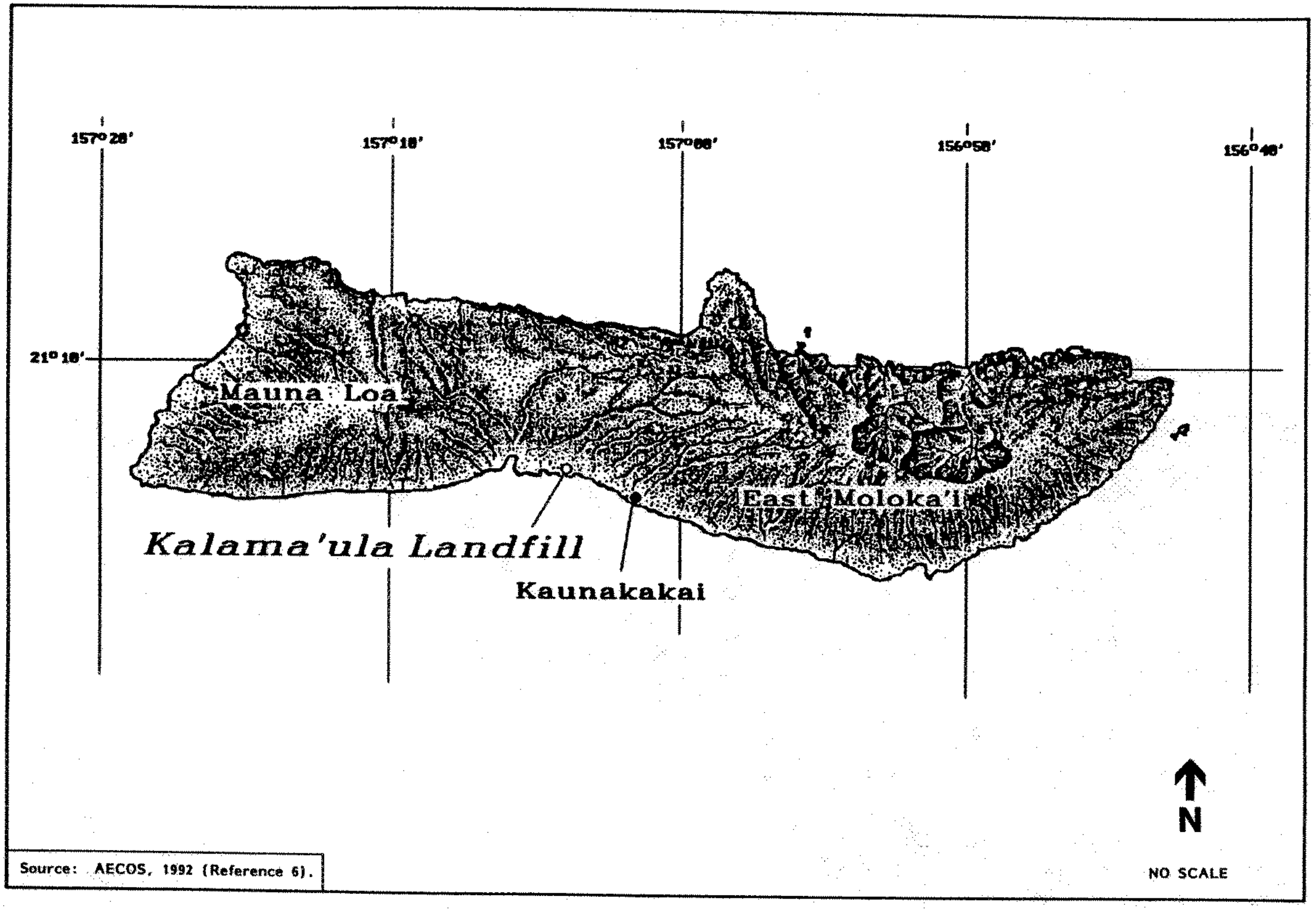
SETTING

Regional Setting

The Island of Molokai (Figure 4-17) was built by two shield volcanoes today known as East and West Molokai Mountains, the latter having the name Mauna Loa. The lava flows from East Molokai overlap Mauna Loa and form a high isthmus between the two mountains.[13] The Kalanianaole to Pakanaka Fishpond wetland feature (the descriptive name used by Elliott and Hall, 1977) is located along the south coast of the island at the isthmus.[14]

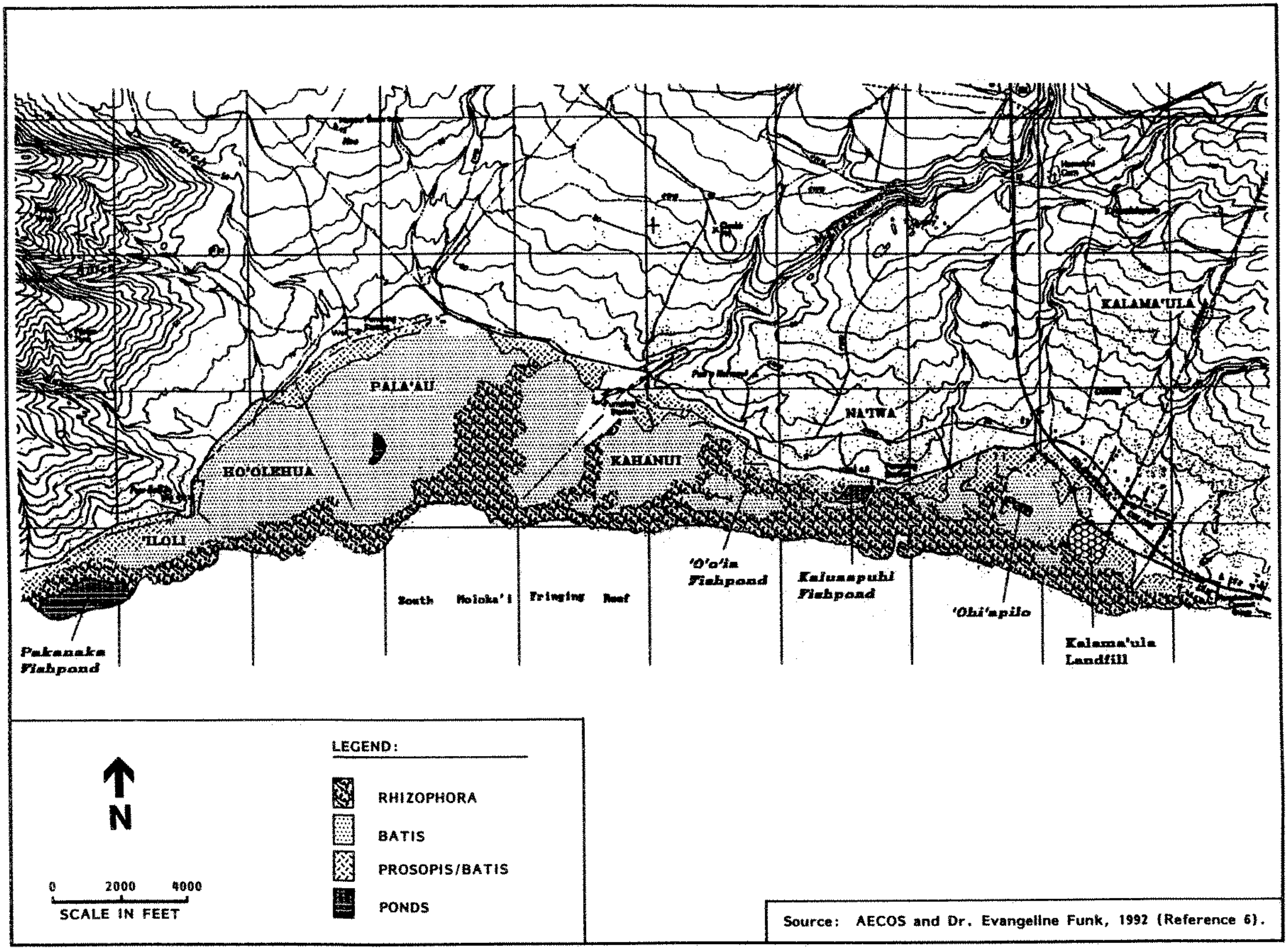
Land Drainage and Wetlands. This part of Molokai is arid, lacking perennial streams. Rainfall at the coast is less than 10 inches per year.[15,16] A number of dry gulches drain towards the wetland, but these contain flowing water only during heavy rain storms. Typically, these drainages become poorly defined as they reach the coastal plain, where the water flows tend to spread out.

Physiographically the wetland is divisible into two distinct alluvial fans (Figure 4-18). The larger alluvial deposit, in *na apana* (land sections, portions of *ahupuaa*) of Iloli, Hoolehua, Palaau, and Kahanui, is that which lies to the west between Pakanaka and Ooia Fishponds. This coastal deposit has derived from the combined outwash of several gulches draining the West Molokai mountain, from Kaluapeelua and associated gulches draining most of the Molokai Isthmus, and from Manawainui Gulch which drains a large portion of the western end of the East Molokai mountain. In terms of area, these combined drainage basins represent almost 10 percent of Molokai, although much of this area is the drier part of the island.



Source: AECOS, 1992 (Reference 6).

Figure 4-17 Shaded Relief Map of Molokai Showing Kalamaula Landfill



Source: AECOS and Dr. Evangeline Funk, 1992 (Reference 6).

Figure 4-18 The Kalanianaole to Pakanaka Fishpond Wetlands, Molokai, Hawaii

The more eastern alluvial fan, in the *ahupuaa* (land division) of Kalamaula and which includes the Landfill site, derives from a significantly smaller drainage basin than the western alluvial fan. The Kalamaula wetland is approximately 427 acres in area. Most of the gulches directing flow towards this wetland arise around the 1,000-foot elevation, where the median annual rainfall is on the order of 25 inches. However, the largest gulch draining towards the coastal plain at Kalamaula includes a drainage basin extending to the 2,500-foot elevation, where the median annual rainfall is closer to 40 inches. Above this elevation the climate is wetter, but all of the drainages feed into either Kaunakakai Gulch or Kahuaawi Gulch. These are both significant drainage systems of the western end of East Molokai. However, these drainages reach the coastal plain at points some distance from the Landfill. Kaunakakai Gulch drains into a leveed swale at the coast 1.5 miles east of the Landfill site. This area is outside of the wetland. Kahuaawi Gulch feeds into Manawainui Gulch (see above), which drains into the western alluvial fan, 2.4 miles west of the Landfill.

None of the several drainage systems which feed onto the alluvial plain at Kalamaula has a name. Therefore, these will be referred henceforth in the order of their presentation here, which is by decreasing area of drainage basin. All are capable of contributing to flooding around the Landfill site by directing surface flow into the coastal water table.

Of the several normally dry gulches which drain mauka lands towards the Landfill, the most significant in terms of drainage basin area are those systems feeding into a swale with man-made levees which reaches the coastal plain some 1,000 feet east of the Landfill site. The drainage basin for this system alone is estimated to be 53 percent of the total drainage basin feeding into the Kalamaula wetlands. In terms of outflow contribution, the percentage is probably much greater because this drainage alone arises in the wetter climate above 1,000 feet elevation. This system has built a substantial delta of sediment which projects into the mangrove belt along the shore. The mouth of the stream is within the mangroves and a distinct channel to the ocean is absent. During periods of high flow, water from this system floods the mangrove swamp and possibly low areas along the eastern margin of the Landfill. The swale between the highway and the mangroves is used as a local dumping area, perhaps at times when the Landfill is closed. The aquatic animal tissue collections for background trace metal burdens, discussed later in this section, were obtained from the mangrove swamp opposite the mouth of this drainage system.

The second largest drainage basin at Kalamaula arises on the southwest side of Puu Luahina and drains into the far western end of the wetlands some 3,150 feet west of the Landfill site. Surface water from this system probably does not reach the vicinity of the Landfill. A third drainage basin feeds the gully which enters the wetlands at Umipaa, some 1,640 feet west of the Landfill. This system arises around the 800-foot elevation and feeds a creek system on the coastal plain which is densely overgrown with mangrove. This system contributes water to the remnants of Ohiapilo Fishpond and the flats along the western edge of the Landfill.

A fourth, small drainage area arising around the 600-foot elevation enters about 560 feet west of the Landfill. This system feeds directly onto the flat which abuts the western edge of the Landfill. However, a levee directs some of the flow westward to the mangrove creek of the third drainage system.

Much of the water which reaches the Landfill area, either as runoff or as groundwater flow, leaves as seepage rather than surface flow. Few distinct outlets or tidal creeks can be seen to penetrate the dense mangrove which grows along the entire shoreline. During heavy floods, sheet flow through the mangroves probably occurs in many areas. Water fed onto the western portion of the wetland may drain towards a tidal creek system connected to Kaluaapuhi Fishpond. Curiously, a distinct tidal creek is present directly seaward of the Landfill. This feature can be traced inland to the southwest corner of the Landfill, where it terminates against the berm which forms the seaward wall of the suspected fishpond remnant. Here the berm is over 150-foot wide and covered by kiawe trees. Also at this point, the Landfill encroaches on the berm and it can no longer be seen if the creek once drained more inland areas through a culvert or opening across the berm. This creek is more or less aligned with the swale from the fourth drainage basin. The upper part of the tidal creek is brackish, indicating groundwater outflow. This creek was used as the collecting area for aquatic animal tissue samples presumed to be influenced by seepage from the Landfill.

Fish Ponds. No perennial streams feed the wetlands in the Kalamaula coastal area. Surface drainages are the gulches described above which flow only during periods of high rainfall. Much of what is now mangrove swamp was once fringing reef flat, coastal fishponds, and shallow inlets surrounded by sand spits and dry flats supporting native strand vegetation.

Between the two alluvial fans described above, Ooia and Kaluaapuhi fishponds (in *na apana* of Kahanui I and Naiwa I) were built along the shore by the ancient Hawaiians as *loko kuapa*;[17] that is, fishponds formed by placement of walls (boulders and fill materials) to enclose a portion of the shallow, nearshore (NS) reef flat (Figure 4-18). The extension of the shore seaward by growth of the mangroves and the subsequent accumulation of fine sedimentary material has resulted in the two alluvial fans becoming joined as a continuous coastal wetland feature.

Old maps show several fishponds east of Kaluaapuhi (in the direction of the Landfill), including Paahao, a small pond sharing a wall with Kaluaapuhi.[17,19] At Kalamaula at least four fishponds occupied portions of the coastal alluvial fan, including: Kahokai (?Kakokahi), Kamaloko, Ohiapilo or Ohia-pilo (Pukui, Elbert, and Mookini, 1974), and Umipaa. Ohiapilo Fishpond was formerly 39 acres in extent, according to Cobb (1902).[20]

Evolution of the Coastal Wetlands. The review of the limited information which exists for the Kalanianaole to Pakanaka Fishpond wetland does provide a basis for conclusions regarding changes which have occurred over the last 100 years in the nature of the coastal wetlands. Two factors have been particularly instrumental in affecting these changes: the introduction of the mangrove in 1902 and deposition of sediments, a process presumably enhanced by several factors including the growth of mangroves and increased erosion in upland areas. The two alluvial fans on which these wetlands have formed have become tied together as a single wetland by an extensive mangrove swamp which extends as a continuous feature along the 6 miles of shore from Pakanaka Fishpond to near the Kamehameha Coconut Grove at Kalanianaole.

Reef Flat Environment. The outer part of the mangrove belt and the shallow reef flat which extends for a considerable distance off the shore is a marine bottom of silty sand. The reef flat is very broad in this area, and is thus generally protected from large waves and strong tidal or wave driven currents. Nonetheless, wind waves frequently stir the bottom, creating conditions of high turbidity. It is the slow capture of these suspended sediments, derived partly from land runoff elsewhere along the coast, that promotes the steady seaward encroachment by mangrove.

The southern coast of Molokai is characterized by a broad reef that extends as a shallow platform off the shore, in places as much as 1.6 miles to the outer edge of the reef. Off the Kalamaula site, the reef platform is about 1 mile across. The reef flat environment is one of mostly sand bottom with scattered outcrops of limestone, the latter increasing in proportion to total area with distance from the shore. The areas of extensive sand bottom tend to harbor a less visible biota of species of fishes adapted to feeding on sand bottom, in faunal species (burrowing forms), and sparse coverage by algae.

A recent survey of the reef flat and reef front in the vicinity of Kaunakakai, Molokai was conducted by AECOS.[29] This survey provides the following descriptions of the reef and reef biota which is applicable to the marine environment found seaward of the Landfill site. NS stations were surveyed on the reef flat within 33 feet of the shoreline. Five NS stations extended from Station 1NS located 1.4 miles east of a point on the shore opposite the Kalamaula site to Station 5NS, located 2.9 miles east of the Kalamaula site.

> . . . On the NS and midreef zones of the reef flat the bottom types and dominant biota are substantially unchanged throughout the study area. . . . [T]he four NS transects from 2NS to 5NS [were found] to be essentially devoid of macroinvertebrates other than the blue clawed swimming crab, *Thalamita crenata*, which was occasionally observed moving along the bottom. No animals or macroalgae were observed in any quadrat on any of these NS transects. The composition of the bottom is entirely sandy mud with little hard substratum except rare blocks of coral rubble that have washed up near the shore. Small quantities of algae occur on these blocks, primarily *Acanthophora spicifera* and *Hypnea* at Station 2, and *Ulva* at Station 4. The only other indications of benthic life in this NS zone were numerous burrow openings on the bottom representing the subsurface presence of filter feeding species such as a polychaete worm or the ghost shrimp, *Callianassa* sp.

> . . . Station 1NS was located immediately seaward of the mouth of Kaunakakai Stream and near the harbor . . . The bottom sediment . . . was relatively clean, calcareous sand with a small silt component, and scattered areas of hard bottom which supported a few species of macroalgae . . . In addition to the crab, *Thalamita crenata*, alpheid shrimp, *Alpheus* sp., were seen at the entrances to their burrows and tubes of vermetid molluscs were common on the scattered occurrences of hard bottom.

Few species of fishes were observed at the NS stations. Mostly gobies (Family Gobiidae) were recorded in quantitative transects, with an unidentified species very abundant at some locations.[29] No doubt many other fishes transit the area, particularly forms such as mullet and goatfishes which are usually found over sand or mud bottoms. The mangroves also serve as a refuge for small fishes, and thus could be an important nursery area for many of the species found on the reef flat or off the front of the reef as adults. This role of mangroves has not been demonstrated in Hawaiian waters, but seems intuitively to be true, at least to some extent.

Although the green sea turtle (*Chelonia mydas*), an endangered species in Hawaii, inhabits the reefs off the south coast of Molokai, the reef flat directly off the mangroves at Kalamaula appears to lack resources that might attract these large, herbivorous reptiles. Sea turtles come into shallow waters, usually at night, to feed on macrothallic algae growing just below the shoreline. Algal growth of use to turtles is extremely rare along the mangrove shore. Most of the larger growths of algae seen here are fragments that have broken off hard substrata further out on the reef flat and drifted in by currents.

The characteristics of the benthic environment change gradually in the seaward direction as shown by the results of observations at midreef stations described as follows:[29]

> Further offshore at the midreef stations . . . , [the western] Station 1MR was also somewhat unique from the other midreef stations further east, having relatively high amounts of hard bottom and a variety of macroalgae and invertebrates. Small colonies of two species of corals (*Porites lobata* and *Pocillopora damicornis*) occurred on or near the transect, a yellow nudibranch, a bristleworm (*Phrecardia striata*), and some boring sea urchins (*Echinometra mathaei*) were found on the coral rubble. These were typical of the conditions throughout most of the reef flat from the 1NS to the 1MR stations . . . . .
>
> The midreef environment east of the harbor jetty was similar at all three of the sites surveyed. Going from the NS to the midreef stations the bottom composition changed gradually from silt to sand with a small silt component. This substratum is covered by the seagrass, *Halophila ovalis*, from about 488 to 975 feet offshore. Occurrences of hard substrata gradually become more abundant with distance offshore, reaching a maximum at about 1,138 to 1,300 feet offshore, then decreasing as sand becomes more prevalent in the vicinity of the midreef stations at 1,463 feet offshore.

> The midreef stations . . . [east of Kaunakakai pier] show roughly equal amounts of the bottom to be silty-sand and a complex association of *Halophila ovalis* with a variety of macroalgae, including *Acanthophora spicifera, Hypnea* sp., *Padina japonica, Spyridia filamentosa, Dictyota* sp. *Lyngbya* sp., *Neomeris annulata, Halimeda discoidea,* and *Turbanaria ornata.* A few macroinvertebrates were noted, especially *Alpheus rapax* in burrows, and small blue and lavender sponges. A single colony of the coral, *Pocillopora damicornis,* was noted near the transect at Station 3MR, and a single head of the coral, *Porites compressa,* was seen near Station 5MR.

As at the NS stations, the diversity of fishes was very low at the midreef stations. Again, several gobies were present, but only one of these (*Psilogobius mainlandi*) was abundant.[29] This species resides in the burrows of the pistol shrimp, *Alpheus* sp.

The following descriptions summarize the biological characteristics of the outer part or reef margin of the broad reef found off the south Molokai coast near Kaunakakai.[29] Opposite the Landfill, the reef margin is some 0.9 miles seaward of the mangrove shoreline and nearly 1.2 miles from the southern edge of the Landfill.

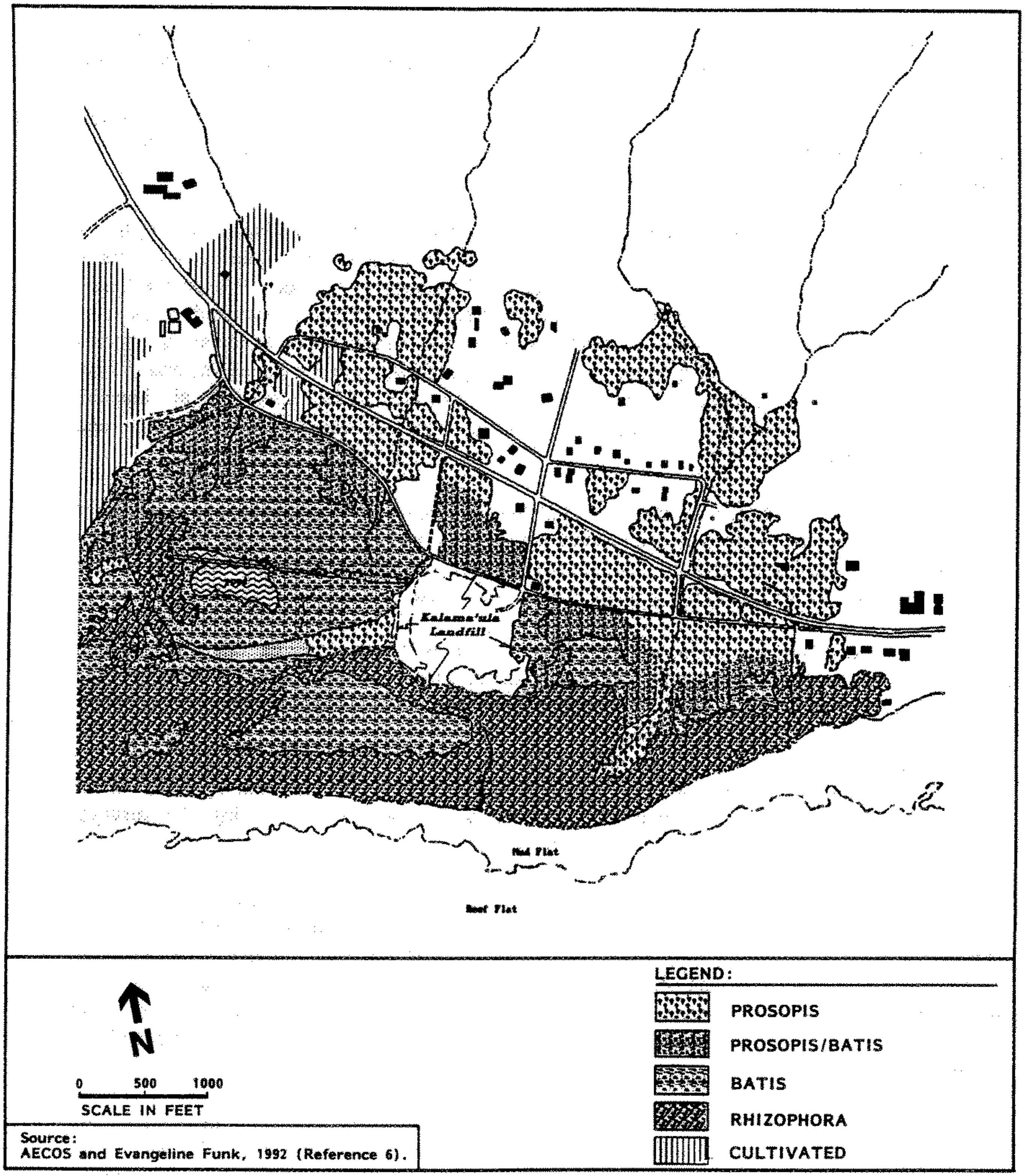
> The . . . [reef margin] stations . . . show a gradient of decreasing reef coral abundance going from the western most Station 1OS to Station 5OS at the eastern limit of the [Kaunakakai] study area. Mean total coral coverage decreased from a high of 50 to 60 percent at Stations 1OS and 2OS on either side of the Kaunakakai Harbor channel, to only 1.5 percent of the available bottom at Station 5OS. Maximum coral cover on the randomly placed quadrats ranged as high as 97 percent at Station 1OS and 85 percent at Station 2OS, but never exceeded 4.5 percent at Station 5OS.
>
> The coral community at Station 1OS most closely typified a normal assemblage for a leeward Hawaiian reef, being dominated by *Porites lobata* (37 percent), followed by *Montipora verrucosa* (6 percent), and *Montipora patula* (5 percent), with a few small *Pocillopora meandrina* colonies totaling about 2 percent coverage. Mean . . . [Shannon-Wiener] diversity was quite low at 0.73, due to the dominance by *Porites lobata.* At Station 2OS, just across the harbor channel, the species dominance was quite different, with high coverages of *Montipora verrucosa* (30 percent) and *Montipora patula* (19 percent), followed by about 5 percent coverage each for *Porites lobata* and *Pocillopora meandrina,* and about 1 percent each for *Porites compressa* and *Pavona varians.* This assemblage of species resulted in a moderately high [Shannon-Wiener] diversity of 1.02. This station is within a few meters of the dredged harbor channel, and the high abundance of *Montipora* in this area may be related to a higher tolerance by this genus to low to intermediate levels of turbidity and sedimentation. *Montipora* is the dominant coral in the more turbid areas of Kaneohe Bay and the few areas of Honolulu Harbor where reef corals may be found.

Site Setting

The flora of the Kalanianaole-Pakanaka Fishpond wetlands is primarily a mangrove/pickleweed (*Rhizophora/Batis*) complex. Since the first red mangrove was planted on this site in 1902[21], this species has spread until it now forms the only vegetation cover along the shore from Kamehameha Coconut Grove on the eastern boundary, to Pakanaka Fishpond at the wetland's westernmost boundary. The trees can be found from 250 feet to as much as 3,500 feet inland from the outer "shoreline". Immediately *mauka* or inland from the mangrove belt are wide flats of *Batis maritima* or pickleweed. Both pickleweed and red mangrove tend to form monotypic stands (single-species communities). However, the two species occasionally mix in the interface between the *Rhizophora* swamp and the *Batis* flat. Such areas may represent early encroachment by *Rhizophora*, or the *Rhizophora* growth may be stunted, and the plants widely separated, creating an open canopy where *Batis* can thrive.

Both red mangrove and pickleweed are obligate wetland plants which require brackish or even sea water to persist.[22] Mangrove requires surface water while pickleweed will survive where the water table is high or the soil is saturated. Both species thrive in locations (upper intertidal) regularly inundated by the ocean tide. Both are late introductions to the Hawaiian Islands.

Methods. The discussion of the flora and fauna inhabiting the Kalanianaole to Pakanaka Fishpond wetlands, the wetland portion around the wetland, and the adjacent areas is based on field surveys conducted in August and September 1992, by AECOS and Dr. Evangeline Funk, and literature citation. Field surveys included on-foot explorations of large portions of the wetlands, snorkeling within the tidal creek off the Landfill, and field observations made by patient occupation of specific sites to observe animals utilizing the wetland's many habitats. Handnets were used to collect aquatic animals which were later identified or the field identification confirmed from specimens preserved and returned to the laboratory. Broad area coverage was most valuable for defining the boundaries of ecosystem types and developing a listing of the plant species (flora). Figure 4-19 is an ecosystem map of the Kalamaula area. It was the occupation of specific sites for long periods of time that revealed the most information about the animals present at each site.



Source:
AECOS and Evangeline Funk, 1992 (Reference 6).

Figure 4-19 Ecosystem Map of the Kalamaula Area Along the South Shore of the Island of Molokai

The ornithological survey (birds) included the results of censuses in the Landfill area, Ohiapilo Pond, Kaluaapuhi Fishpond, Ooia Fishpond, the mudflats at Hoolehua, the Pakanaka Fishpond area, and along the unpaved road that separates the wetland from the fastland. Observations for one half hour were made at sunrise and sunset at the pond sites. Short observation periods of 10 to 20 minutes each were made at frequent intervals along the road during the morning and evening hours.

Marginal and Nonwetland Terrestrial Environments. Along old Maunaloa Highway and westward along the unpaved road that separates the wetland from fast land occurs a transitional plant community made up of pickleweed and scattered kiawe trees (*Prosopis pallida*). Some patches of this *Batis/Prosopis* association are also found within the wetland ecosystem. Where the land elevation rises, the *Batis* disappears and the understory changes to various species of grasses. Less common, but also representative of marginal areas is a *Pluchea/Batis* association comprised of scattered shrubs of Indian fleabane (*Pluchea indica*) surrounded by pickleweed. In some areas, dense stands of *Pluchea indica* occupy the narrow area between the *Batis* flat and the *Prosopis* forest.

Both kiawe and Indian fleabane are salt tolerant plants and will withstand some water logging. In fact, a long "sand bar" just west of the Landfill supports a dense stand of kiawe trees on sandy soil elevated only a foot or two above the *Batis* flats. The margin of this raised area is covered by almost impenetrable growth of *Pluchea indica.*

Pickleweed and mangrove are salt tolerant species which thrive in this environment. Many of the other plant taxa found during this survey exist at the fringe of the wetland. The wetland with its open water ponds naturally attracts many animals which are not really "wetland" species. Many of these species inhabit the nonwetland areas, but forage within the wetlands and marginal areas. The most evident animal inhabitants of the marginal and nonwetland areas are birds and arthropods (insects and spiders). Less conspicuous, but important in terms of the ecology of the areas, are the mammals. Insects were not collected during the surveys. Observations on birds and mammals are presented below.

The Landfill is a nonwetland environment. Because this site is a highly disturbed one, it was not surveyed in any detail. Nonetheless, the Landfill is an area of open ground with an abundance of food attracting a variety of species. This area is utilized by large numbers of cattle egrets, a large flock of mynas, doves—both barred and lace doves, finches, sparrows, and mannikins. In addition, unwanted, surplus household pets are sometimes disposed of by being left at the Landfill. Consequently, a variety of mammals inhabit the Landfill site and the surrounding area.

Prosopis/Batis is the habitat which forms the interface between wetland and fastland. The greatest variety of upland birds was found in this habitat. The largest of the birds seen were the wild turkeys. There were also doves, nutmeg and chestnut mannikins, common waxbills, warbling silverbills, house finches, English sparrows, quail, and many other introduced birds. These species are discussed further later in this section.

Pickleweed (*Batis maritima* L.) Salt Flats. The interior part of the wetlands is a broad flat covered by the pickleweed (Figure 4-19). This light green, spreading shrub with brittle stems attains a height of three feet. Characteristically, pickleweed inhabits low-lying areas subject to flooding during heavy rains or tidal inundation. In these low-lying areas, pickleweed forms monotypic stands. Few species of plants can tolerate this degree of water logging and the high salt content of both the water and the soil. Pickleweed is one of the few species adapted to these conditions.

All of these shallow ponds dry up during the dry season. One large pond, thought to represent the remnants of Ohiapilo Fishpond, is located between man-made berms in the Kalamaula area. This pond retains water well into the dry season as do the moats near the base of the berms. No fishes were observed to be residing in this pond, which may be explained by the fact that the pond is dry for long periods during the year. Diving beetles were noted to be abundant in the pond while water was present.

Any open water ponds and canals can be significant habitat for water birds. Coots, stilts, ducks, night herons, and a variety of other migratory, water dependent, species are found in these parts of the wetland ecosystem. The *Batis* provides hidden nesting and resting places for stilts. *Batis* flats are also frequented by cattle egrets, golden plovers and two species of doves.

Mangrove (*Rhizophora mangle* L.) Wetlands. The inner reef flat environment is seen to end abruptly at the line of dense mangrove growth along the "shore" (Figure 4-19). In fact, the line is not so sharp, because sea water extends well in under the mangrove. At this stage, the mangrove resemble large bushes with gracefully arching prop roots reaching out beyond the spread of the branches. This plant community is growing out across the reef flat. Along the seaward edge, the mangrove can be seen in large numbers of seedlings becoming established in the salty water which is 1- to 2-foot deep. Between the outer edge of the mangrove belt and the shoreline, is a tidal flat with tidal creeks. For the most part, this area is a fine mud bottom held in place by the mangrove. Depending upon the tide, the mud may be exposed or submerged. However, even at low tide, pools and creeks can be found, the latter possibly representing at their heads points of groundwater seepage.

The fauna of the tidal creeks and "forested" intertidal mudflat is dominated by several species of crabs, a snail, shrimp, and several species of small fishes. Sponges (Porifera), some algae (*Ulva*, *Enteromorpha*, and *Cladophora*), and barnacles (*Balanus* sp.) attach to prop roots in the more seaward areas. Juveniles of a number of reef fishes and perhaps nondemersal species as well utilize the prop roots and often turbid water for protection from predators. A number of predatory fishes including young barracuda (*Sphyraena barracuda*) visit the area, particularly at higher tides. Within the muds of the reef flat and extending back into the mangroves are numerous burrows of a type of alpheid (pistol) shrimp. Infaunal polychaetes and oligochaetes are no doubt present and perhaps even abundant. However, the species typically found in these fine muds in Hawaii are minute forms.

The tidal creek opposite the Landfill at Kalamaula proved to be a fruitful area for collecting a variety of estuarine and marine species characteristic of these coastal wetlands. Most of the species are indigenous marine organisms found in other NS environments in Hawaii and elsewhere in the tropical Pacific. At least one species is thought to be endemic to the Hawaiian Islands. A few of the species are naturalized exotics which, like the mangrove, were introduced to the Islands in the present century. Following is a discussion of the various species observed and collected from within the mangrove area and particularly the tidal creek located south of the Landfill (Figure 4-19).

> Among the crabs, the *alamihi* (*Metopograpsus thukuhar* [Owen]) is particularly abundant here. These shore crabs (Family Grapsidae) clamber around the prop roots and feed upon microscopic algae growing on the bark or on the mud bottom. *Alamihi* are true littoral or shore crabs, spending much time out of water. They also make burrows in the mud. These crabs probably do not travel far during their lifetime once the larva has settled out of the plankton.
>
> The other common crabs are members of the Family Portunidae: the swimming crabs. These are the *haole* crab (*Portunus sanguinolentus* [Herbst]) and the blue-clawed swimming crab (*Thalamita crenata*). The latter was far more abundant in the mangrove areas surveyed at Kalamaula. Swimming crabs are typically found on marine sand or mud bottoms, and their habitat extends out across the reef flat to where soft bottom is largely replaced by hard bottom. Some species inhabit burrows, although the two species common at Kalamaula off the mangroves and in the tidal creeks do not. These species will bury in the sediment if disturbed, but can also flee quickly or become quite aggressive, having long, sharp pinchers. These crabs may be predators on *alamihi* or small fishes, but like most crabs, probably feed opportunistically on recently killed carcasses. They are traditionally caught by fishermen using a ring-shaped net baited with a fish-head. Because they are scavengers, these crabs might range over wide areas including the NS reef flat. Other species of portunids probably occur either within the mangrove area or on the adjacent reef flat. The introduced Samoan crab (*Scylla serrata* [Forskal]) is known from this type of environment.
>
> A small glass shrimp or *opae* (*Palaemon debilis* [Stimpson]) is very abundant, particularly in areas where prop root densities are high and shallow water remains at low tide. These shrimp feed off the mud bottom, probably on detritus or microscopic algal cells. Collections made by sweeping with hand nets eventually revealed the presence of two other palaemonid shrimp (*Palaemon pacificus* and *Macrobrachium* sp.) and a penaeid

shrimp (*Penaeus marginatus*) all of which were, however, rare by comparison with *P. debilis* at this location.

A littorinid snail, *Littorina scabra* (L.), is present on prop roots of the mangroves. This is a common Indo-West Pacific littoral snail is usually found on rocks or pilings in protected waters. Known locally as *akolea*, these snails move up and down the "shore" with the tide, avoiding long periods of submergence. They feed by rasping microscopic algae off the substratum.

A fresh water fish, the sailfin mollie, *Poecilia latipinna* (Le Sueur) was found at the upper end of the tidal creek along the south side of the Landfill. This introduced fish is tolerant of saline water. The mollie population here probably does not move out of the area, at least during the dry months when the flats surrounding the creek are wetted only at high tides. The mollie is omnivorous. A single tilapia (probably *Sarotherodon mossambica*) was caught by net in the tidal creek. Although a fresh water fish, the introduced tilapia tolerates an extreme range of salinities and is sometimes reported from reef flat environments.

A common Hawaiian fish from NS waters known as the *aholehole* (*Kuhlia sandvicensis* [Steindachner]) lives as a juvenile in brackish to nearly fresh water pools and streams along the coast. The juveniles found at Kalamaula probably range in and out of the tidal creeks, moving along the seaward margin of the mangrove growth, while feeding on bits of algae, insects, and small crustaceans. Young of the *anae* or mullet (probably *Mugil cephalus* L.), another brackish water species, were caught by net in the tidal creek. This species feeds on bottom detritus.

An interesting find within the tidal creek was the *oopu akupa* an endemic eleotrid (*Eleotris sandwicensis* Vaillant and Savage). This species inhabits stream and estuarine environments. One of the specimens was parasitized by a "marine" leech (*Aestabdella abditovesiculata*).

A true shoreline can be found well inside the mangrove belt, resembling a low beach but covered with leaf litter and floating material of all manner of man-made items. The floating material has probably traveled downwind from Kaunakakai, the largest town on Molokai, which can be seen from the front edge of the mangroves at Kalamaula. Within the leaf litter, high on the small beach, is found the melampid pulmonate snail, *Melampus castaneus* (Muhlfeld). This species is found throughout the tropical Pacific in the superspray zone, under rocks and rubble or often under vegetable detritus accumulated near the shore in protected situations (embayments). Melampids are gregarious, with usually several species clustering together in the same area.[24]

The mangrove extends inland behind the tidal flat and the shoreline. These inner areas are in the process of becoming fast land, but presumably most areas do flood at exceptionally high tides and when runoff from the land is great. The older trees take on a columnar shape, with few strong prop roots, and reach heights of 65 feet. The environment of older, established mangrove stands is quite different in appearance from the intertidal stands and no doubt supports a very different biota, being a terrestrial, intermittently flooded swamp.

The mangroves along the coast, near the permanent ponds, and along the tidal channels vary from 15 to 70 feet in height. Inland from the mature, coastal mangrove stand, are broad areas where mangrove seedlings and saplings fill nearly every inch of growing space. In this same area are large numbers of mangrove tree skeletons that are rapidly being replaced by saplings. However the cause of the die-back or when it occurred is not clear.

Large *Rhizophora* trees provide resting and nesting sites for owls, egrets, mynas, and doves. An egret rookery is present in the mangroves some 1,600 feet west of the Landfill. Bird species found in and around the wetlands are discussed in the following section.

Avifauna. Appendix E includes a listing and brief description of the birds observed in all habitats surveyed at the wetland around the Landfill and westward to Pakanaka Fishpond. A total of 26 species of birds were found in this study area. Eight species are native or migratory birds and the remaining eighteen species are introduced or permanent residents of the site. The annotated species list presented in Appendix E includes all native and introduced species. The nomenclature follows that of The Birds of Hawaii and the Tropical Pacific.[25] As will be discussed in the following section, three listed endangered bird species were found during the bird survey.

Endangered Species. Three listed endangered bird species[26] were found during the bird survey of the Kalanianaole to Pakanaka Fishpond wetlands: five Hawaiian ducks or *koloa* (*Anas wyvillana*), twelve stilt or *aeo* (*Himantopus mexicanus*), and one Hawaiian coot or *alae keo keo* (*Fulica americana alai*). The *koloa* or ducks and *alae keo keo* or coot were seen in Kaluaapuhi Fishpond, a permanent body of water 0.9 mile west of the Landfill site. Both of these species prefer open bodies of fresh water (lakes and ponds). The *aeo* or stilt were observed in Ohiapilo Pond. This brackish water feature located within 1,000 feet of the Landfill is not permanently wet. However, stilt travel over relatively wide areas of the island seeking suitable habitat for resting and feeding, and show a preference for coastal ponds with saline water. Stilt are shallow water wading birds whose preferred feeding habitat is around the margin of pond(s) can be eliminated by encroachment of mangrove.

Flora. A listing of the plant species observed during August in and adjacent to the Landfill is presented as Table 4-10. The plant families in the species list have been alphabetically arranged within two groups: Monocotyledons and Dicotyledons. The genera and

Table 4-10 A Listing of Plants Found in the Kalanianaole to Pakanaka Fishpond Ecosystem

Scientific name	Common name	Abundance*
MONOCOTYLEDONS		
CYPERACEAE - Sedge Family		
**Bolboschoenus maritimus* (L.) Palla	Kaluha	Occasional
Schoenoplectus lacustris (L.) Palla	Great bulrush	Locally abundant
GRAMINEAE - Grass Family		
**Brachiaria mutica* (Firsk.) Staph	Paragrass	Locally abundant
**Cenchrus ciliaris* L.	Buffel grass	Locally abundant
**Cynodon dactylon* (L.) Pers.	Bermuda grass	Locally abundant
**Digitaria adscendens* (HBK) Henr.	Henry's crabgrass	Occassional
**Leptochloa uninervia* (K. Presl.) Hitch.		Occassional
**Eleusine indica* (L.) Gaertn.	Wiregrass	Common
**Panicum repens* L.	Torpedo grass	Locally abundant
**Paspalum conjugatum Bergius*	Hilo grass	Locally abundant
**Sorgum halepense* (L.)	Johnson grass	Occassional
Sporobolus virginicus (L.) Kunth	Seashore rush	Locally abundant
DICOTYLEDONS		
ACANTHACEAE - Acanthus Family		
**Asystasia gangetica* (L.) T. Anders	Chinese violet	Common
AIZOACEAE - Fig-marigold Family		
Sesuvium portulacastrum (L.)L.	Akulikuli	Locally abundant
AMARANTHACEA - Amaranth Family		
**Amaranthus spinosus* L.	Spiny Amaranth	Common
BATIDACEAE - Batis Family		
**Batis maritima* L.	Pickleweed	Abundant
CARICACEAE - Papaya Family		
**Carica papaya* L.	Papaya	Occasional

Table 4-10 A Listing of Plants Found in the Kalanianaole to Pakanaka Fishpond Ecosystem (continued)

Scientific name	Common name	Abundance[a]
CHENOPODIACEAE Goosefoot Family		
**Atriplex semibacatta* R. Br.	Australian salt bush	
COMPOSITAE - Sunflower Family		
**Conzya canadensis* Cronq.	Canadian fleabane	Occasional
**Pluchea indica* (L.)Less.	Indian fleabane	Common
**Pluchia symphytifolia* (Mill.)Gillis	Sourbush	Common
**Sonchus olerarceus* L.	Pualele	Occasional
**Verbesina encelioides* Cav.	Golden crown-beard	Occasional
**Vernonia cinerea* (L.)Less.	Little ironweed	Occasional
CUCURBITACEAE - Cucumber Family		
**Momordica charantia* Crantz	Balsam apple	Occasional
EUPHORBIACEAE - Spurge Family		
**Ricinus communis* L.	Castor bean	Occasional
LEGUMINOSAE Bean Family		
**Leucaena leucocephala* de Wit	Koa-haole	Common
**Prosopis pallida* Kuhth	Kiawe	Common
MALVACEAE - Hibiscus Family		
**Malvastrum coromandelianum* Garke	False marrow	Common
**Sida fallax* Walp.	'Ilima	Common
**Sida rhombifolia* L.	Cuba jute	Occasional
**Sida spinosa* L.	Prickly sida	Occasional
MORACEAE -Fig Family		
**Ficus microcarpa* L.	Chinese banyan	Occasional
MORIGACEAE - Moringa Family		
Moringa oleifera Lam.	Horseradish tree	Uncommon

Table 4-10 A Listing of Plants Found in the Kalanianaole to Pakanaka Fishpond Ecosystem (continued)

Scientific name	Common name	Abundance[a]
PASSIFLORACEAE - Passionflowers		
**Passiflora edulis* L.	Passion fruit	Uncommon
**Passiflora suberosa* L.	Haole huehue	Uncommon
PLUMBAGINACEAE Plumbago Family		
Plumbago zeylanica L.	'Ilie'e	Locally abundant
RHIZOPHORACEAE - Mangroves		
**Rhizophora mangle* L.	Red mangrove	Abundant
SOLANACEAE - Tomato Family		
Lycium sandwicense A. Gray	Ohelo kai	Uncommon

*Indicates a species which was introduced to the Hawaiian Islands since Cook or by the aborigines.

[a] Abundance ratings are for this site only and they have the following meanings:

Uncommon = a plant that was found less than five times.
Occassional = a plant that was found between 5 and 10 times.
Common = a plant considered an important part of the vegetation.
Locally abundant = plants found in large numbers over a limited area; for example, the plants found in grassy patches.

Source: Dr. Evangeline Funk, 1992 (Reference 6).

species are arranged alphabetically within the plant families. The taxonomy nomenclature follows that of St. John (1973)[27] and Wagner, Herbst, and Sohmer (1990).[28]

The species list is the result of an extensive survey of this site during the summer month of August 1992 and reflects the vegetative composition of the flora during a single season. Minor changes in the vegetation will occur due to introductions and losses, and a slightly different species list would result from a survey conducted during a different growing season.

Soil Borrow Areas. Site surveys were also conducted by Dr. Evangeline Funk for the potential soil borrow areas including Site 1 located just south of Kaulapuu, and Site 4 located along Route 460 near Mahana Nursery. Floral and fauna characteristics were identified.

> **Site 1.** Pineapple was formerly grown in the area of Site 1. Based on the site survey, the vegetation of the site is alien and of little value botanically. The vegetation is comprised entirely of introduced grasses, forbes, and shrubs, some introduced purposely and some accidentally, but none of great value. Appendix F lists the plants found at the site.
>
> No proposed or listed threatened or endangered species were found on this site. The results of the faunal survey are also included in Appendix F.
>
> **Site 4.** The general area of Site 4 is composed of fairly steep, rolling ridges and never used to grow pineapple. However, all of the land surrounding this soil borrow area is used to pasture cattle. Site 4 supports a single vegetation type, disturbed pastureland with all of the vegetation being introduced. Appendix G lists the plants found at the site.
>
> As with Site 1, no proposed or listed threatened or endangered plant species were found at this site. Appendix G also includes the results of the faunal survey.

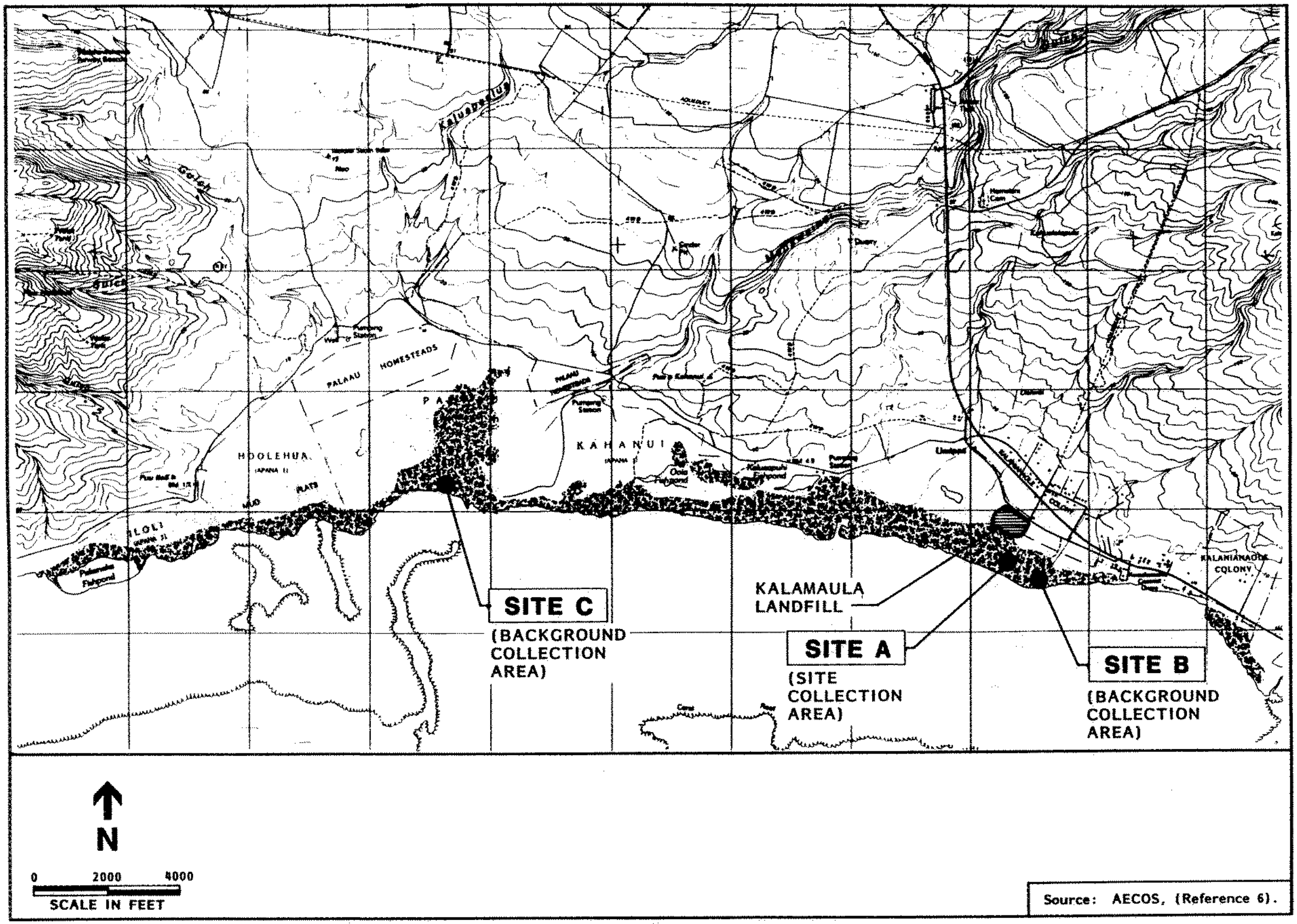
Animal Tissue Analyses

Common aquatic animals resident in the Kalamaula wetlands were collected for analysis of tissues to determine if potentially toxic substances were leaching from the Landfill into the surrounding environment. Results from other investigations are reported in the geology, soils, and water resources section of this chapter were used to assess whether contaminates were present at the site and whether movement of contaminants was occurring. However, many potentially toxic substances could be present in the Landfill in extremely low concentrations or be heterogeneously distributed and not be detected. Low concentrations may leach from the Landfill at certain times (e.g., during heavy rainfalls) and bioaccumulate or biomagnify through the food chain. In any event, the potential risk of known and unknown contaminants to the ecosystems of the south Molokai coast and to human health cannot be easily assessed from field samples of soils and groundwater. Looking for contaminants in biological material from potentially effected ecosystems is a logical first step in assessing the extent of environmental contamination.[30]

Methodology. Specimens of several species were collected from the mangrove and tidal creek due south of the Landfill and noted as Site A on Figure 4-20. Another set of collections were made in a similar environment 975 to 1,300 feet east of the Landfill and noted as Site B on Figure 4-20. These latter specimens were designated background or "Control" area samples. These species, their distributions and habits, were discussed earlier this section. A list of the species collected and the quantity (number and wet weight) are given in Table 4-11 below. Biological tissue samples were collected to assess levels of chlorinated hydrocarbons and trace metals.

Specimens were sorted by species in the field and frozen in separate plastic bags within hours of collection to be later shipped to the laboratory on Oahu. Specimens captured in August and early September were included in Batch No. 1 (A1 or B1); specimens from late September and October comprised Batch No. 2 (A2 or B2). A third batch was collected in early November from a background area within the mangroves at Palaau (designated batch C3) and shown as Site C on Figure 4-20. At the laboratory, specimens were thawed and washed with laboratory distilled-deionized water and then counted and weighed. Tissues were macerated in precleaned blenders, then refrozen for later analyses. In all cases, animals were macerated whole, except for the mollusks which were separated from their shells and reweighed, then further processed. This method incorporates both skeletal material and viscera (including gut contents) in the tissue samples. However, the screening was intended to detect environmental contamination by a comparison of concentrations in animals found near with those found far from the Landfill site. Any distinct differences would be of interest. Samples were digested or extracted before the recommended hold times for metals analyses (EPA Method 3050 and, for example, EPA Method 760) and chlorinated organics (EPA Method 8080) expired.[31]

Selected chlorinated hydrocarbons were analyzed by EPA Method 8080. A list of the selected compounds and the limits of detection based on instrument response and sample size are given in Table 4-12. The trace metals included in the analysis list were silver (Ag), arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), manganese (Mn), nickel (Ni), lead (Pb), selenium (Se), and zinc (Zn). Metal concentrations were determined by flame and flameless AAS methods after the macerated tissue samples were digested in ultrapure nitric acid. Not all samples were analyzed for all analytes because of limitations on the amount of tissue material which could be obtained or the use of some batches to validate earlier results.



Source: AECOS, (Reference 6).

Figure 4-20 Aquatic Animal Collection Areas

Table 4-11 List of Specimens From the Kalamaula Wetlands Collected and Processed for Chemical Contaminants Analyses

Specimen (species)	Collection area (batch)[a]	Number (count)	Wet weight (grams)	Weight/ individual
MOLLUSCA				
GASTROPODA				
Littorina scabra	Off landfill (A2)	40	105.0[c]	2.6[c]
'akolea (snail)	Control (B1)	38	81.5[c]	2.1[c]
	Control (B2)	52	132.1[c]	2.5[c]
	Control (C3)	6[a]	28.8[c]	4.8[c]
CRUSTACEA				
DECAPODA				
Panaeus marginatus	Off landfill (A2)	1[b]	2.4	2.4
Palaemon pacificus	Control (B2)	2[b]	1.1	0.6
Macrobrachium sp.	Control (B2)	1[b]	0.3	0.3
Palaemon debilis	Off landfill (A1)	130	17.0	0.13
glass shrimp	Off landfill (A2)	53	9.8	0.18
	Control (B1)	60	5.5	0.09
	Control (B2)	207	38.1	0.18
Metopograpsus thukuhar	Off landfill (A1)	65	180.0	2.8
'alamihi (crab)	Off landfill (A2)	24	81.4	3.4
	Control (B1)	37	113.0	3.0
	Control (B2)	44	138.6	3.2
	Control (C3)	38	148.8	3.9
	Control (C3)	44[b]	181.1	4.1
Portunus sanguinolentus	Off landfill (A1)	3	109.4	36.5
haole crab	Off landfill (A2)	11	432.1	39.3
	Control (B1)	5	197.5	39.5
	Control (B2)	3	146.1	48.7
	Control (C3)	1	89.2	89.2

Table 4-11 List of Specimens From the Kalamaula Wetlands Collected and Processed for Chemical Contaminants Analyses (continued)

Specimen (species)	Collection area (batch)[a]	Number (count)	Wet weight (grams)	Weight/ individual
Thalamita crenata	Off landfill (A1)	15	517.5	34.5
blue-pincher crab	Off landfill (A2)	2	131.2	65.6
	Control (B1)	2	136.5	68.2
	Control (B2)	24	395.0	16.4
	Control (C3)	3	207.3	69.1
VERTEBRATA				
PISCES				
Poecilia latipinna	Off landfill (A1)	30	34.23	1.1
sailfin mollie	Off landfill (A2)	114[b]	118.9	1.0
Kuhlia sandvicensis	Off landfill (A1)	7	19.4	2.8
aholehole	Off landfill (A2)	6	19.4	3.2
Eleotris sandwicencis *'o'opu 'akupa*	Off landfill (A2)	2	36.2	18.1
Mugil cephalus *mullet*	Off landfill (A2)	2[b]	22.3	11.2
Sarotherodon mossambica *tilapia*	Off landfill (A2)	1[b]	17.5	17.5

[a] See Figure 4-20 for collection area locations.
[b] Sample acquired for identification or a replicate, tissue not analyzed.
[c] Weight includes shell.

Source: AECOS, Reference 6.

Table 4-12 Listing of Selected Chlorinated Hydrocarbons Analyzed by GC-ECD and the Sample Limits of Detection (ppb) for Tissue Samples from Aquatic Organisms off Kalamaula

Compound	Detection limits, parts per billion	
	All other samples	Aholehole off landfill
Aldrin	10	32
Alpha BHC	10	32
Beta BHC	21	65
Delta BHC	10	32
Lindane	10	32
Chlordane	223	695
DDD	42	130
DDE	21	65
DDT	42	130
Dieldrin	10	32
Endosulfan I	10	32
Endosulfan II	10	32
Endosulfan sulfate	21	65
Endrin	21	65
Endrin aldehyde	21	65
Heptachlor	10	32
Heptachlor epoxide	10	32
Methoxychlor	62	195
Toxaphene	1050	3290
Aroclor 1016	700	2100
Aroclor 1221	700	2100
Aroclor 1232	700	2100
Aroclor 1242	400	800
Aroclor 1248	400	800
Aroclor 1254	200	400
Aroclor 1260	200	400

Source: AECOS, Reference 6.

Results. Samples analyzed for chlorinated hydrocarbons were those from alamihi (crab), blue-pincher crab, haole crab, mollie (fish), and aholehole (juvenile fish) from the tidal creek and reef flat off the Landfill, and akolea (snail), alamihi (crab), blue-pincher crab, and haole crab from the mangrove area to the east (background samples). That is, tissue samples indicated in Table 4-11 by batch numbers A1 and B1 (with the exception of Palaemon debilis). Table 4-12 lists the compounds included in the analysis and their respective detection limits. None of the compounds were detected in any of the samples.

The results of the analysis for trace metals are presented in Table 4-13. Values for tissues from animals collected in and around the tidal creek which flows beside the Landfill are presented in front of the values from animals collected from the control or background Area B. By comparison of the two values, the contribution to trace metal tissue burdens resulting from proximity to the Landfill site can be evaluated. For barium (Ba), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), manganese (Mn), nickel (Ni), selenium (Se), silver (Ag), and zinc (Zn) these comparisons show no appreciable differences between the two sources of tissue material. Tissue burdens for arsenic (As), on the other hand, are suggestive of contamination.

Overview of Water, Soil, and Sediment Analysis. Surface water, soil, and sediment samples were collected in January 1992 from the Landfill site and from various off-site locations and analyzed for potential contaminants, including semivolatile organic compounds, pesticides, PCBs, total and dissolved metals, and cyanide.[3] Additional sampling was conducted during the hydrogeologic assessment and reported earlier in this chapter[5]. The results of both of these efforts are briefly summarized below as an introduction to the discussion of the results of the aquatic animal tissue sampling and analyses. Sample locations used in these investigations are indicated on Figure 4-13.

> **Surface Waters**. Surface water samples from standing water on the *Batis* flats to the east and west of the Landfill were compared with background samples from off the beach at the Kamehameha Coconut Grove and at a pumping station described as located "approximately 1 mile east of the site[3]," but shown as west of the Landfill. Concentrations of analytes from site samples that exceeded the background concentrations by a factor of three were considered evidence of contaminant release. For the surface waters, analytes which met this EPA criterion were barium (at around 0.10 ppm), manganese (at around 0.15 ppm), and zinc (at around 0.014 ppm) as total metals. The phthalate, bis-(2-ethylhexyl) phthalate was detected in one sample (Location 5) at 16 µg/L, but was not found in a duplicate sample from that location.

Table 4-13 Heavy Metals Analyses of Animal Tissue Samples From Kalamaula, Molokai

	Concentration, mg/kg of wet tissue weight[a]							
Species	Ag		As		Ba		Cd	
Snail, *'akolea*	0.65	0.561	1.3	1.071[b]	3.4	2.3[b]	0.67	0.34[b]
Shrimp, glass	<0.25	<0.25	1.4	1.5	6.9	6.5	<0.12	<0.12
Crab, *'alamihi*	<0.25	<0.25	1.35[b]	1.01[b]	9.0	9.3	<0.12	<0.12
Crab, *haole*	<0.25	<0.25	8.0[b]	4.36[b]	4.7	3.7	0.12	<0.12
Crab, blue pincher	<0.25	<0.25	13.9[b]	14.0[b]	7.9	11	0.19	0.26
Fish, mollie	<0.25	--	<0.12	--	4.7	--	<0.12	--
Fish, *aholehole*	<0.25	--	0.471	--	1.7	--	0.12	--
Fish, *'o'opu 'akupa*	<0.25	--	0.68	--	2.9	--	<0.12	--
	Cr		Cu		Hg		Mn	
Snail, *'akolea*	0.74	1.1[b]	18	12.3[b]	0.12	0.074[b]	46	21[b]
Shrimp, glass	0.43	0.43	13	16	0.020	0.013	7.0	4.0
Crab, *'alamihi*	0.87	0.77	20	16	0.017	0.019	19	35
Crab, *haole*	0.44	0.50	14	16	0.024	0.020	13	16
Crab, blue pincher	0.68	0.71	15	15	0.031	0.034	50	42
Fish, mollie	0.49	--	2.0	--	0.026	--	19	--
Fish, *aholehole*	0.21	--	0.7	--	0.020	--	<1.2	--
Fish, *'o'opu 'akupa*	0.29	--	0.68	--	0.033	--	1.8	--
	Ni		Pb		Se		Zn	
Snail, *'akolea*	<1.2	<1.2[b]	<0.12	0.22[b]	1.0	<1	76	40.5[b]
Shrimp, glass	<1.2	<1.2	<0.12	<0.12	<1.0	<1.0	16	15
Crab, *'alamihi*	<1.2	<1.2	<0.12	<0.12	<4	<4	15	18
Crab, *haole*	<1.2	<1.2	<0.12	0.15	<4	<4	15	15
Crab, blue pincher	<1.2	<1.2	<0.12	0.12	<4	<4	16	20
Fish, mollie	<1.2	--	<0.12	--	<4	--	17	--
Fish, *aholehole*	<1.2	--	<0.12	--	<4	--	19	--
Fish, *'o'opu 'akupa*	<1.2	--	<0.12	--	<1.0	--	17	--

[a] For each animal, the first (left) value is for specimens collected from downstream of the Kalamaula Landfill (area A), the second (right) value represents specimens collected from the control area (B).
[b] Averaged value from two separate batches of specimens.

Source: AECOS, Reference 6.

The surface waters examined adjacent to the Landfill site are ephemeral, appearing after heavy rains or unusual high tides. These waters could be representative of the groundwater or of direct precipitation and runoff, depending upon when samples were collected relative to the rainfall events. Because of the low elevation, rainfall and runoff may eventually seep into the ground or evaporate from the pools. The soils here are considered permeable,[32] and water which is seen to be standing well after a rainfall represents the surface of the local groundwater lens.

Groundwaters. Groundwater samples were obtained from monitoring wells during the hydrogeologic investigation in July and August 1992.[5] Water samples from a total of eight wells were analyzed for total metals concentrations, volatile and semi-volatile organics, pesticides and PCBs, and a number of other groundwater parameters. With respect to the metals, detectable quantities were measured in some of the wells as shown in Table 4-8. A few other toxics were detected. The solvents dibromochloromethane, toluene, xylene, and cis-1,2-dichloroethene at parts per billion (ppb) in Well No. L-1, 1-2-dichlorobenzene at ppb in Well No. MW-5, toluene at ppb levels in Well No. MW-7 and MW-8, and toluene and xylene at ppb levels in Well No. MW-8. Detected at ppb levels In Well No. MW-4 were found phenanthrene and bis-(2-ethylhexyl) phthalate. The latter phthalate was also found in Well No. MW-5 and in one of two duplicate surface water samples reported by Bechtel (1992) from sample location 5.

Soils. Surface and subsurface soil samples were collected from around the Landfill in January 1992. Surface soil samples suggested the presence of a number of semi-volatile, pesticide, and heavy metals contaminants, including di-n-butylphthalate, fluoranthene, pyrene, butylbenzylphthalate, 4,4'-DDE. 4.4'-DDD, 4,4'-DDT, cadmium, copper, mercury, nickel, selenium, thallium, and zinc. These were, however, mostly at or below detection limits for the methods used. Subsurface samples detected lead and arsenic at concentrations that were used to demonstrate a release of contaminants from the Landfill. The highest values measured were 23.5 mg/kg for lead (Sample Location 5) and 7.5 mg/kg for arsenic (sample location 3).

Sediments. The distinction made by Bechtel (1992) between sediments and soils is simply whether surface water was present at the time of sampling.[3] From the January 1992 sampling event, sediment samples from sample locations 1 and 5 off the Landfill were compared with a background sediment sample from Location B-4, a beach sample from 150 yards west of the Kamehameha Coconut Grove. Sample location 1 had a barium concentration more than three times the background value of 19.1 mg/kg. Sample location 5 had concentrations of barium, copper, lead, manganese, and zinc that were between 5 times and 125 times the background concentrations.

The most interesting result in light of potential problems revealed by later studies was an arsenic concentration of 16.7 mg/kg from background sediment sample B-4 collected about 0.6 mile east of the tidal creek off the Landfill. This concentration exceeded the level of arsenic found by Bechtel in all other soil and sediment samples collected from in or around the Landfill (which varied between 2.4 and 7.5 mg As/kg).

Tissue Trace Metals. The various measurements made on water and soil samples from the lands surrounding the Landfill and the groundwater beneath the site implicate a number of trace metals as environmental contaminants. In order of decreasing "severity" (subjectively based on concentration and number of instances of occurrence, and without regard to toxicity) these can be listed as: arsenic, barium, chromium, lead, manganese, zinc, copper, silver, cadmium, mercury, nickel, thallium, and selenium. Only chromium and silver in this list were not found by Bechtel (1992) to be present at more than three times background in one or more soil, sediment, or surface water samples from the Landfill site. However, in a number of these cases data qualifiers render the results "estimates and usable for limited purposes" or, in most cases, "qualitatively acceptable" but not quantitatively acceptable. Silver was detected in the hydrogeologic assessment leachate sample.[5] Selenium was found by Bechtel in soil samples, including the "background" B2 sample, and in the "background" well sample taken in the same area as sample B2.

While the practice of comparing site samples with nearby background samples is a logical approach to assessing contamination, careful attention must be paid to the nature of the soil or sediment in the Hawaiian coastal environment. A number of heavy metals (including chromium, cadmium, copper, lead, nickel, and zinc) are relatively abundant in volcanic basalts and soils.[33,34,35] Iron and manganese are of course major components of these materials. Further, the heavy metals weather out differentially from the native rock and may concentrate differentially as both dissolved forms and particulates are carried and deposited as soils of alluvial fans, sediments in estuaries, or marine sediments. All of these coastal deposits may have varying proportions of carbonaceous minerals contributing generally small amounts of heavy metals (calcium and magnesium being principal components of the limestone materials).

Just as soils and sediments naturally contain varying and sometimes high levels of heavy metals, animal tissues too cannot be expected to be free of these chemical elements. Trace metal concentrations in Hawaiian marine environments were reported for harbor sediments, benthic crabs, molluscs, and fishes in a late 1970s study conducted by the DOH.[36] Some of the results of this study are summarized here in Table 4-14. The values are means in most cases and samples do not necessarily represent unpolluted environments. For most of the metals, concentrations are similar to those reported in Table 4-13 for the Kalamaula specimens. However, arsenic and possibly chromium were notably higher at Kalamaula, whereas lead and nickel appear particularly elevated in the DOH tissue data by comparison with samples from

Table 4-14 Summary of Heavy Metal Concentrations in Hawaiian Fish and Shellfish, 1977-78

	Concentration (mg/kg net weight)			
Species	As	Cd	Cr	Cu
Limpet, *opihi, Cellana sandwicensis*	<0.10	0.94	0.34	0.71
Oyster, *Crassostrea virginica*	0.32	0.04	0.04	51.1
Clam, littleneck, *Tapes japonica*	0.08	<0.05	0.56	1.78
Crab, blue pincher, *Thalamita crenata*	0.18	0.37	0.59	29.0
Crab, *haole, Portunus sanguinolentus*	0.13	0.29	0.75	15.5
Crab, *mo'ala, Podophthalmus vigil*	<0.10	<0.05	0.27	11.6
Fish, mullet, *Mugil cephalus,* flesh only	<0.10	<0.50	<0.10	0.53
Fish, mullet, *Mugil cephalus,* viscera only	2.75	0.08	1.92	22.2
	Hg	Ni	Pb	Zn
Limpet, *opihi, Cellana sandwicensis*	<0.02	2.73	0.57	5.58
Oyster, *Crassostrea virginica*	<0.02	0.34	<0.50	847
Clam, littleneck, *Tapes japonica*	<0.02	2.17	0.31	15.2
Crab, blue pincher, *Thalamita crenata*	0.07	1.59	0.87	26.7
Crab, *haole, Portunus sanguinolentus*	0.02	1.39	0.67	14.8
Crab, *mo'ala, Podophthalmus vigil*	0.04	1.69	0.52	20.8
Fish, mullet, *Mugil cephalus,* flesh only	<0.02	0.67	<0.50	1.96
Fish, mullet, *Mugil cephalus,* viscera only	<0.02	5.42	2.34	23.0

Source: State Department of Health, Reference 36.

Molokai. The DOH study also looked at the relationship between crab (*Portunus sanguinolentus*) tissue concentrations and sediment concentrations at eight locations around the islands and found no strong relationship except for lead. The DOH studies have been repeated recently, but tissue results were not available at the time of this writing.[37]

The U.S. Fish and Wildlife Service has included fishes from Hawaiian streams (Manoa and Waikele Streams) in a nationwide program assessing toxic contaminants in fresh water fishes.[38] In general, the trace metal tissue burdens for fishes at Kalamaula are below those reported for fishes from streams on Oahu. An exception was cadmium. The Oahu streams fish tissue range for cadmium was between 0.02 and 0.06 mg Cd/kg; arsenic was 0.06 to 0.34 mg As/kg wet tissue weight.

A variety of animals were tested from the Nuupia Ponds complex on the Kaneohe Marine Corps Air Stations (KMCAS) by AECOS.[39]. The aquatic environments found at Nuupia are very similar to those found at Kalamaula: brackish to saline wetlands and ponds. Mangrove (*Rhizophora*) and pickleweed (*Batis*) are the dominant vegetation types. The wetlands at KMCAS, surrounded by urban housing and a military base are probably subject to greater levels of urban pollutants than are the Kalamaula wetlands. Of the trace metals measured in tissue samples from the two locations, lead and chromium and possibly copper were particularly high at Nuupia relative to Kalamaula. Some of the Kalamaula tissue arsenic values appear elevated when compared with Nuupia aquatic animal tissues. The latter ranged between 0.29 and 0.82 mg As/kg wet tissue weight.

Heavy metals in marine fishes from Pago Pago Harbor in American Samoa were analyzed to assess whether pollutants were impacting local food resources.[40]. Samples of flesh and liver were analyzed separately for nine trace metals. Liver tissue concentrations were found to be greater than muscle tissue concentrations when averaged across all species. A comparison of the results with the Kalamaula aholehole tissue samples shows generally higher levels for all trace metals in Pago Pago marine fishes, except in the case of arsenic. The range of values for fishes from Samoa was <0.01 to 0.053 for muscle tissue and 0.057 to 0.79 for liver tissue; mean values were 0.034 and 0.334 mg As/kg.

Heavy metal burdens in marine animal tissues have been analyzed for mainland East and West Coast bivalves for several years under the National Status and Trends Program of NOAA. Small oysters (*Ostrea* spp.) from Hawaiian waters have been included in this national program in some years.[41] Samples have been collected from Honolulu Harbor and Barbers Point Harbor on Oahu, and Nawiliwili Harbor on Kauai. These samples have tended to be at or below mainland tissue values (from *Mytilus* spp.) for mercury, lead, and cadmium and above (generally well above) mainland tissue values in *Mytilus* for silver, copper, and chromium (particularly at Nawiliwili).

Arsenic. Of all of the substances measured in tissue samples from the mangrove wetland at Kalamaula, only arsenic appears to be high both by comparison with background samples (tissues from aquatic organisms captured away from the Landfill) and a variety of tissue analyses from aquatic organisms in Hawaii and American Samoa reviewed here for the purpose of comparison. Thus, additional chemical analyses on tissues from organisms collected in the wetlands and NS environments at Kalamaula and selected control sites focused on arsenic. A listing of the arsenic results from testing conducted for the Draft EIS is presented in Table 4-15. Additional testing for arsenic in marine biota and nearshore sediments was undertaken in March 1993 to futher define the extent of elevated arsenic in commonly eaten reef organisms on the south Molokai reef flat (see Appendix H). The combined studies brought to 76 the number of biological specimens analyzed for arsenic off Molokai in 1992-93.

Bioaccumulation of arsenic is thought to be unique in that marine organisms show significantly greater concentrations of arsenic than terrestrial (aquatic) organisms.[42,43] Levels in terrestrial or freshwater organisms seldom are above 1 mg/kg (dry weight) whereas the corresponding values for marine organisms vary from a few to more than 100 mg/kg (dry or wet weight).[43,44,45] According to Lunde (1977), bioaccumulation by marine animals is related to feeding habits, with bottom feeders and detrital feeders accumulating more arsenic.[42] Lunde (1977) regarded crabs as an exception, being least likely of the bottom feeders to biomagnify metals (including arsenic), although results from AECOS' investigation clearly dispute this point with respect to crabs.[42] Sadiq (1992)[43], citing data from KFUPM/RI, 1988[60] noted that shrimp are bioaccumulators. Marine macrophytes (limu or algae) also appear to be significant accumulators.[44,46,47]

Arsenic has received special attention in Hawaii because of the known contamination of Waiakea Pond behind Hilo Bay on the Island of Hawaii from the manufacture of canec products long ago. Sediment deposits in Waiakea Pond have given arsenic measurements of 6,000 ppm. The DOH (1978) study specifically noted that concentrations of arsenic were low in all tissue samples from crabs and mullet flesh, including samples from Hilo Bay.[36] Residue levels in mullet viscera were generally higher and ". . . the levels observed in the Waiakea Pond mullet are greater by a factor of ten as compared to that of mullet from either Molokai or Nawiliwili [Kauai]." Unfortunately, nowhere in the report is there indication that tissue samples were obtained from Molokai. The tissue concentrations of arsenic in haole crabs (*Portunus sanguinolentus*) did not correlate with sediment concentrations in a comparison of eight locations, and the level reported for crab tissue (0.17 ppm) from Hilo Bay was comparable with other relatively uncontaminated areas despite the high (82.2 ppm) sediment concentration measured there. The study notes that Samoan crab (*Scylla serrata*) caught off Waiakea Pond "..showed no residue of arsenic in flesh tissues but contained 0.39 ppm in the remaining viscera." In the study, only mullet viscera produced concentrations of arsenic greater than 0.4 ppm (Table 4-14).

Table 4-15 Results of Measurements for Arsenic in Estuarine and Marine Animal Tissue Samples From the South Coast of Molokai

Common name	Species	Collection site[a]	Count	Avg. wt. (gms)	Arsenic (µg/g)
Snail, *'akolea*	*Littorina scabra*	Mangrove A	40	1.08[c]	1.3
Snail, *'akolea*[b]	*Littorina scabra*	Mangrove B	38	--	0.74
Snail, *'akolea*	*Littorina scabra*	Mangrove B	52	1.09[c]	1.4
Shrimp, glass	*Palaemon debilis*	Creek A	183	0.15	1.4
Shrimp, glass	*Palaemon debilis*	Creeks B	267	0.16	1.5
Crab, *'alamihi*	*M. thukuhar*	Mangrove A	65	2.8	0.70
Crab, *'alamihi*	*M. thukuhar*	Mangrove A	24	3.4	2.0
Crab, *'alamihi*	*M. thukuhar*	Mangrove B	37	3.0	0.22
Crab, *'alamihi*	*M. thukuhar*	Mangrove B	44	3..2	1.8
Crab, *'alamihi*	*M. thukuhar*	Mangrove C	38	3.9	1.5
Crab, *haole*	*P. sanguinolentus*	Reef flat A	3	36.5	2.1
Crab, *haole*	*P. sanguinolentus*	Reef flat A	11	39.3	14
Crab, *haole*	*P. sanguinolentus*	Mangrove B	5	39.5	0.72
Crab, *haole*	*P. sanguinolentus*	Mangrove B	3	48.7	8.0
Crab, *haole*	*P. sanguinolentus*	Mangrove C	1	89.2	7.9
Crab, blue pincher	*Thalamita crenata*	Creek A	15	34.5	12.9
Crab, blue pincher	*Thalamita crenata*	Creek A	2	65.6	15
Crab, blue pincher	*Thalamita crenata*	Mangrove B	2	68.2	15.9
Crab, blue pincher	*Thalamita crenata*	Mangrove B	24	16.4	12
Crab, blue pincher	*Thalamita crenata*	Mangrove C	3	69.1	11
Crab, blue pincher	*Thalamita crenata*	Kaelepulu, O'ahu	4	42.2	0.48
Crab, blue pincher	*Thalamita crenata*	Kawainui, O'ahu	4	44.2	0.44
Fish, *sailfin mollie*	*Poecilia latipinna*	Creek A	30	1.1	ND
Fish, *aholehole*	*Kuhlia sandvicensis*	Creek A	7	2.8	ND

Table 4-15 Results of Measurements for Arsenic in Estuarine and Marine Animal Tissue Samples From the South Coast of Molokai (continued)

Common name	Species	Collection site[a]	Count	Avg. wt. (gms)	Arsenic (μg/g)
Fish, *aholehole*	*Kuhlia sandvicensis*	Creek A	6	3.2	0.83
Fish, *'o'opu 'akupa*	*Eleotris sandwicencis*	Creek A	2	18.1	0.68
Fish, *'o'opu 'akupa*	*Eleotris sandwicencis*	Kaelepulu, O'ahu	2	20.8	0.27
Fish, *'o'opu 'akupa*	*Eleotris sandwicencis*	Kawainui, O'ahu	2	16.5	0.44

[a] See Figure 4-20 for location of collection areas.
[b] This batch potentially contaminated by glass vial ground into tissue during blending.
[c] Tissue weight without shell.
ND = none detected.

Source: AECOS, Reference 6.

The most recent results from the Department of Health, Toxic Monitoring Program (See Appendix H) give tissue levels in crabs from various locations around the state in the range of 1.4 to 15 ppm. The highest value recorded is from the muscle tissue of haole or white crab (*Portunus sanguinolentus*) caught at Kahana Bay on Oahu. White crab from Hilo Bay had otherwise the highest tissue concentrations (around 7 ppm arsenic). These values are mostly below the Molokai tissue results, but seem to be higher than the average values reported by the Department of Health in 1978[36] by factors of 10 to 20.

Additional sampling included sediments, limu (algae), crabs, and octopus from as far west as Hale o Lono Harbor (over 13 miles from Kalamaula) and as far east as Honouli Wai (nearly 22 miles from Kalamaula). Sediment sampling suggested that the nearshore reef flat off the mangrove wetlands between Pakanaka Fish Pond and the Kamehameha Coconut Grove had generally higher amounts of arsenic than sediments from reef flat areas to the west or east. Only the crabs showed consistently high tissue levels of arsenic, although no clear pattern emerged with respect to areas of higher or lower arsenic tissue burdens. Arsenic was low in limu or algae samples tested, and variable in the octopus samples. Results are detailed in Appendix H.

The significance of the high arsenic values in most of the species collected from the mangrove and NS areas both off the Landfill and other parts of the Kalanianaole to Pakanaka Fishpond wetlands in light of these earlier studies would seem indicative of arsenic contamination. Particularly high values in *Thalamita crenata* might in part reflect the use of whole crabs instead of just flesh tissue, although values in Table 4-14 are also for whole crabs and should be directly comparable. The arsenic values for *T. crenata* in Table 4-14 are the mean of 106 measurements having a reported range of <0.10 to 0.35 ppm. Values for P. sanguinolentus represent the mean of 182 samples with a range from 0.10 to 0.29 ppm. The DOH study does not provide information on how many of the specimens were collected from which areas of the State, although presumably most came from harbors, bays, or estuaries, and polluted waters were represented.

Initial results of tissue analysis for arsenic implicated the Landfill as the source because (1) whole body burdens of arsenic in two crustacean species were three times greater in specimens from the tidal creek off the Landfill than in specimens from the control area in the same wetland; and (2) body burdens in three crustacean species were generally elevated when compared with values from the same or similar species collected elsewhere in the Hawaiian and Samoan Islands. However, one species of crab, *Thalamita crenata*, had equally high concentrations of arsenic in specimens collected from both the control area and off the Landfill. Analyses on a second batch of tissue samples revealed that most species found in both the control area and the mangroves directly off the Landfill showed comparably elevated arsenic levels. Specimens representing three different species were then collected from a second control area designated "Mangrove C" in the mangroves off Palaau, 2.9 miles west of the tidal creek off the Landfill. Tissue concentrations (Table 4-15) of arsenic in *alamihi* (crab), *haole* crab, and blue-pincher crab were elevated and very similar to the levels observed at both of the original collecting locations. Crabs collected from many additional locations off the south coast of Molokai (see Appendix H) showed that similar levels of arsenic could be found in many places unrelated to the Kalamaula Landfill.

From these results it would appear that arsenic contamination of the NS biota off the Molokai wetlands has occurred. To further confirm that the levels of arsenic reported here are excessive, samples of blue-pincher crab and *oopu akupa* (estuarine blennioid fish) collected earlier in 1992 from Kaelepulu and Kawainui Streams (estuarine canals in urban Kailua on the Island of Oahu) were processed and analyzed for heavy metals. These specimens had been stored frozen at the laboratory. Arsenic results are reported in Table 4-15. These tissues show levels of arsenic somewhat elevated by comparison with DOH (1978) values, but below (well below in the case of the blue-pincher crab) the Molokai tissue arsenic burdens.

The tissue results fail to define a source for arsenic contaminating this environment. Arsenic concentrations tend to be highest in those species which associate closely with the NS sediment. Much of the fine sediment along the NS area derives from terrestrial runoff and is rich in iron oxides and hydroxides which readily scavenge arsenic from saline solutions.[43] The range of movement of the *akolea* snail and glass shrimp are thought to be small. Movement ranges of the three crab species are not known specifically, but can be discussed in relative terms. *Alamihi* probably do not travel far during a lifetime, with species dispersion occurring through the larval form (as is the case for most benthic marine crustaceans). *Alamihi* live mostly above the sediment bottom, clinging to mangrove prop roots. Blue-pincher crabs may range over a somewhat wider area, but one that is thought to be small relative to the distances between our Landfill site and background control areas. This species shows the highest arsenic tissue burdens and lives most closely associated with the NS silts. The haole crabs prefer a bottom that is sandy and this species occurs farther out on the reef flat where the NS area is silt bottom. These crabs are probably the most far-ranging of the three species studied, and could conceivably move between control and site areas.

The bioaccumulation of arsenic is complex[43], and biogeochemical reactions involving arsenic may be especially complex within the transition zones between fresh and sea water regimes that characterize both the groundwater and the tidal creek which drains the wetland close to the Landfill site. Arsenic solubility has been found to be greater in brackish water than in either fresh or sea water.[48] Also, arsenic is scavenged relatively quickly from sea water, mostly by adsorption onto particulates.[49] This process seems to be enhanced in the presence of iron oxides,[43] which are plentiful in the turbid water along the south Molokai shore as a result of land erosion and runoff. Measurements of arsenic in five sediment samples from the tidal creek were used to assess whether the Landfill might be contributing at least some of the arsenic indicated as a contaminant in the biota. Additional samples were collected from NS sediments at the mouth of the tidal creek, 2.7 miles to the west at collection area "C" (Palaau), and 0.7 mile east off the Kamehameha Coconut Grove (near Bechtel's station B-4). An additional 26 sediment samples were collected for arsenic analysis from reef flat locations between Hale o Lono near the west end of Molokai and Honouli Wai near the east end (Appendix H).

Results of arsenic analysis from the tidal creek ranged from 6.0 to 10 mg As/kg dry weight of sediment (Figure 4-21). Concentrations of arsenic in sediments from the reef flat off the south coast of Molokai range from undetected (<0.11 mg/kg) to 20.8 mg/kg. This range applies to all the samples and to just the nearshore samples. The latter were the majority of samples collected. The offshore samples (beyond 325 feet from shore) ranged from 1.18 to 12.5 mg/kg. The sediment results suggest that arsenic concentrations tend to be highest on the reef off the mangrove swamp from Pakanaka Fish Pond on the west to the vicinity of Kaunakakai Harbor on the east. Sediment concentrations from within the described area are generally 2 to 3 times higher than sediment values from outside of the area, and some values from inside the area are comparable to sediment values found to the east and the west. Calculation of a mean value considering all of the sediment samples (n=20, excluding soil samples, and combining duplicates) from off the shoreline between Pakanaka Fish Pond and Kaunakakai Harbor (inclusive) gives 9.30 mg As/Kg; the mean of all of the other sediment samples (n=12) is 4.68 mg As/Kg. These results fail to provide any indication of where the arsenic is coming from, but point away from the Landfill as a current source. Two soil samples were analyzed from off Manawainui Gulch. This gulch is a significant drainage of agricultural lands on Molokai and drains into the Palaau portion of the wetlands. A sample of outwash material from the mouth of the gulch and a sample from the Batis flats behind the mangroves at collection site "C" both gave values of <1.8 mg/kg dry sediment weight.

Arsenic has not been detected in surface waters at the site, although the tidal creek was not sampled. Groundwater concentrations are presented earlier in this chapter. The State of Hawaii numeric standards for arsenic in surface waters greater than 0.5 ppm salinity are 0.069 mg/L (acute toxicity standard) and 0.036 mg/L (chronic toxicity standard) as the dissolved fraction.[50] As with most trace metals, toxicity is variable between species and life forms, different chemical forms of the metal, and perhaps other circumstances (temperature, salinity, etc.). Total arsenic is acutely toxic at concentrations in the range of 1 to 50 ppm, although some species can tolerate levels as high as 1,000 ppm.[43] Data for marine aquatic organisms summarized in Mance (1987) indicate larval and juvenile forms are more sensitive than adults, invertebrates are more sensitive than vertebrates, and crustacean are more sensitive than mollusks, which are more sensitive than annelids.[51] Anthropogenic sources of arsenic on Molokai are most likely from the widespread use in herbicide mixtures and as a preservative in treated wood.

Conclusions. The results of the tissue studies reported in this section provide evidence of arsenic contamination of marine and estuarine animals in the mangrove environment off the Landfill site. However, arsenic levels are equally high in specimens collected from as far as 16 miles from the landfill site. NS sediment samples demonstrate a similar pattern indicating that the Landfill operation is not the source of arsenic contamination.

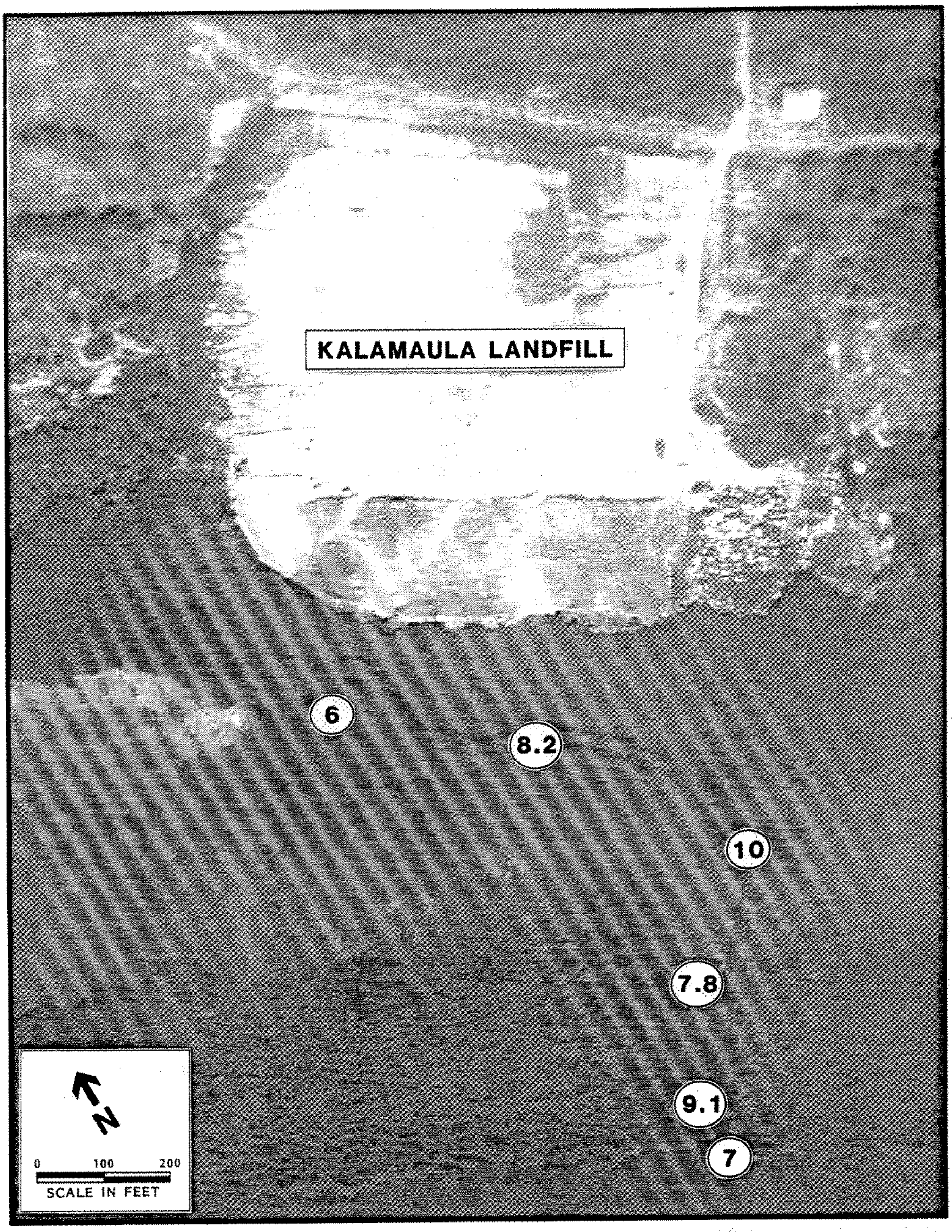


Figure 4-21 Results of Analysis of Sediment Samples for Arsenic in the Tidal Creek Off the Kalamaula Landfill, Values Expressed in mg As/Kg Dry Weight

Arsenic was the most widespread contaminant found in the Bechtel[3] survey of soil and surface waters around the Landfill, and in the groundwater samples analyzed in the hydrogeologic assessment.[5] However, these studies also provide evidence that the contamination is not limited to the Landfill. Thus, contamination by arsenic along the south coast of Molokai is suggested by two independent analytical studies without reference to the biological tissue results.

Studies for this EIS looked at limu (marine algae), he'e or tako (octopus), and several species of sand bottom crabs in an attempt to describe the distribution of arsenic in commonly eaten reef organisms. Only the crabs showed consistently high levels of arsenic. Although additional samples of bottom feeding fishes (such as goatfishes) might reveal another pathway of bioaccumulation leading to man, the limited results obtained to date do not provide indication that the flesh of fishes caught off Molokai have elevated levels of arsenic. Fishes are known to rapidly excrete organoarsenicals.

The species of crabs with high body burdens of arsenic are considered edible. Fishing for these portunids (*Thalamita crenata* and *Portunus sanguinolentus*) and others is common on Molokai where the proportion of native Hawaiians in the population is high. Although fishing efforts in this area would be classified as subsistence rather than commercial in nature, caught crabs might be shipped to Honolulu to be sold at market. Legal limits for arsenic in fishery products have not been established in the United States, but range between 0.1 and 10 ppm worldwide where countries have established limits.[52] Most countries regulate arsenic as a limit in the range of 1 to 3 ppm. Crustaceans are known to concentrate arsenic in many parts of the world, and arsenic concentrations in seafood from Molokai is not usually high when compared with concentrations found in some commercial shrimp and lobster (28 to 30 ppm). The arsenic in these crustaceans is present as organic forms (mostly arsenocholine) that are readily excreted by the human body. Over 80 percent of the arsenic may occur as arsenocholine (Appendix H).

IMPACTS AND MITIGATION MEASURES

The potential impacts of the proposed Project on biological resources are discussed in this section.

Significance Criteria

According to the EIS rules contained in HRS, DOH, Title II, Chapter 200, Subchapter 6, the proposed project would have a significant effect on the environment if it:

1. Curtails the beneficial uses of the environment.
2. Involves a substantial degradation of environmental quality.

3. Substantially affects a rare, threatened, or endangered species, or its habitat.

Landfill Closure

The proposed Project involves in-place closure of 19 acres at the existing Landfill. All activities will be contained within the existing site boundary. Accordingly, there would not be any direct impacts on biological resources.

Indirect impacts could occur on biological resources if contaminants from the Landfill migrated off-site and were bioaccumulated. However, as has been discussed in this section, site investigations have indicated that the Landfill has not impacted biological resources and that the arsenic contamination of the NS biota off the Molokai wetlands stems from other sources. Closure of the Landfill per federal requirements (40 CFR, Part 258) will enhance long-term compatibility of the facility with surrounding natural resources. Groundwater monitoring will be conducted at the Landfill. If the monitoring detects contaminants migrating from the site in the future, the County will implement an appropriate corrective action program as would be required by the DOH.

Soil Borrow Areas

Based on the results of the floral and faunal surveys conducted at Sites 1 and 4, excavation of these areas would not result in any significant biological impacts and mitigation is not required.

Enhancement of Ohiapilo Pond

As described earlier in this chapter, the vegetation of the Ohiapilo Pond site is all *Batis maritima L.*, a taxon introduced into the Hawaiian Islands before 1859 and native to the West Indies. The vegetation found along the proposed access road is kiawe trees, an introduction from Peru, and *Pluchea indica* (L.) Less, an adventive from southeast Asia. In summary, all of the vegetation found in the area of potential disturbance is alien to the Hawaiian Islands. As a result, excavation of this area for enhancement purposes will not result in any significant impacts. However, to help restore the natural cover, the access road and all building material will be removed at the end of construction, and at least a portion of the roadway will be replanted with *Batis* from the surrounding wetlands.

Three listed endangered bird species are known to inhabit this wetland ecosystem. The Hawaiian duck or koloa (*Anas wyvilliana*), the stilt or ae'o (*Himmantopus mexicanus*), and the Hawaiian coot or alae keo keo (*Fulica americana alai*). None of these birds were found in the proposed enhancement area. However, the stilt is known to breed and rear its young during the dry season in the vicinity of Ohiapilo Pond. This is also the most ideal time for construction to take place because the water table is lowest during the summer months. As a result, enhancement of Ohiapilo Pond, through disturbance activities, could result in a significant adverse impact to the stilt. To mitigate this impact to less than significant levels, restoration and enhancement of Ohiapilo Pond will be scheduled to not interfere with bird nesting and mating (March through July for Hawaiian stilt). In addition, consideration will be given to doing the enhancement work when migratory birds are away. Appropriate safeguards will also be implemented to deter predators such as dogs from gaining access to the site once enhancement activities are completed.

AIR QUALITY, ODOR, AND NOISE

SETTING

Aside from Landfill operations, there are no other significant sources of pollutants in the project vicinity and air quality in this portion of the Island can be characterized as good. Air quality in the immediate vicinity of the Landfill, however, may be reduced by dust generated from the placement and construction of the Landfill final cover and odors generated by decomposing refuse material.

As with air quality characteristics, there are no significant sources of noise in the vicinity of the Landfill other than that attributed to Landfill operations. Landfill operations include the use of trucks and a bulldozer for spreading and covering of the waste material.

IMPACTS AND MITIGATION MEASURES

According to HRS, Title II, Chapter 200, Subchapter 6, the proposed Project would have a significant effect on the environment if it detrimentally affects air quality or ambient noise levels, or involves a substantial degradation of environmental quality.

As discussed later in this chapter, vents will be installed in the final landfill cover to allow release of landfill gas (LFG) that would otherwise accumulate beneath the low permeability cover. Some increase in LFG production may occur because of increased anaerobic activity within the Landfill. However, the potential effects on air quality should not be significant.

Short-term construction-related impacts associated with the closure are anticipated with respect to air and noise quality. The placement of the cover material, specifically, will require the use of semi-trailers and earthmoving equipment to haul and spread the cover material over the entire Landfill area. These activities will generate dust and other air pollutant emissions. To mitigate impacts associated with dust, the contractor will have a water truck on site and frequent spraying will be conducted to minimize dust generation. Given the location and current operations of the Landfill, the temporary noise effects of cover installation is not anticipated to be adverse or significant. All construction activities will be conducted during normal daylight working hours. In the long-term, the closed Landfill will not generate adverse air or noise impacts. The installation of final cover will provide a benefit by eliminating any potential for nuisance odor conditions.

Similar effects would be associated with the soil borrow area and enhancement of Ohiapilo Pond. The soil borrow area is isolated and the excavation activities would be short-term in nature (estimated to take 74 days). The Ohiapilo Pond is near the Landfill and while the degree of earthmoving is not yet known, it is anticipated such activities will be minor compared to Landfill closure. Odor is not associated with soil excavation or enhancement of Ohiapilo Pond.

LITTER AND VECTOR CONTROL

SETTING

Litter and vectors are associated with Landfill operations. Vectors include any insect, rodent, or other animal capable of transmitting the causative agents of human disease, or disrupting the normal enjoyment of life by adversely affecting the public health and well being. Whether or not litter and vectors become a problem at a landfill is dependent on the operations at the facility and the regularity of waste compaction and use of soil cover.

IMPACTS AND MITIGATION MEASURES

According to HRS, Title II, Chapter 200, Subchapter 6, the proposed Project would have a significant effect on the environment if it involves a substantial degradation of environmental quality.

The closure of the Landfill will eliminate the facility as a source of litter. Additionally, vectors, and to a limited extent, wild dogs will no longer be attracted to the Landfill site. Thus, Landfill closure will provide a benefit relative to litter and vector control.

SCENIC AND OPEN SPACE RESOURCES

SETTING

The Landfill site is surrounded by wetlands to the west and south, which provide a scenic and open vista towards the coastline. Rangelands, together with the surrounding uplands, define the open space character to the north of the Landfill. The site is removed from Maunaloa Highway, the principal vehicular corridor in the area, although the Landfill is visible from the Highway approaching from the north.

IMPACTS AND MITIGATION MEASURES

According to HRS, Title II, Chapter 200, Subchapter 6, the proposed Project would have a significant effect on the environment if it involves an irrevocable commitment to loss or destruction of any natural resource curtails the range of beneficial uses of the environment, or involves a substantial degradation of environmental quality.

From a visual standpoint, the existing Landfill forms an abrupt and visually distinct element from the surrounding environs. The proposed closure of the Landfill will improve the overall scenic quality of the Landfill site by replacing an active Landfill with a covered and vegetated area.

The Landfill, located adjacent to the Ohiapilo Wetland, is visible from Maunaloa Highway. In terms of visual appearance, then, the closure of the Landfill will allow for the blending of the vegetation on the site with the surrounding environs, creating an aesthetically integrated open space.

The development of soil borrow area(s) 1 and 4 will be short-term activities. Ultimate end uses of the sites will be the responsibility of Molokai Ranch. Site 1 may become a wastewater treatment pond and Site 4 may become a water reservoir. These uses would be consistent with the scenic and open space value of the areas.

The specific plan for enhancement of Ohiapilo Pond will be defined with the U.S. Fish and Wildlife Service as 1993 proceeds. The purpose will be to enhance the habitat value of the area. Regardless of the final plan, the ultimate appearance of the area will be similar to existing conditions and compatible with surrounding areas. One of the objectives of the enhancement project will be to promote its educational value to local residents. A viewing platform or other suitable access will likely be provided, thus the scenic and open space value of the Ohiapilo Pond area will be enhanced.

INFRASTRUCTURE SYSTEMS AND PUBLIC SERVICES

SETTING

Roadway Systems

The project site is served by Maunaloa Highway, the primary roadway linking the east and west ends of Molokai. Maunaloa Highway is a two-lane State highway with a posted speed limit of 45 miles per hour. Access to the Landfill site is via Hoawa Road or Kahanu Place. Both Hoawa Street and Kahanu Place are paved two-way, two-lane roadways.

Water and Wastewater System

The Landfill site is not served by any domestic water and wastewater systems.

Police and Fire Protection

The Island of Molokai is served by the Maui Police Department's Molokai Patrol. The Molokai Station, located at the Mitchell Pauole Center, is staffed by 25 full-time personnel, including patrol officers and administrative support staff (County of Maui).

Fire prevention, protection, and suppression services are provided by the County's Department of Fire Control. The Kaunakakai Station, also located at the Mitchell Pauole Center, is staffed by 31 full-time personnel.

Medical Facilities

Kaunakakai General Hospital is the only major medical facility on the Island. The 30-bed hospital, which provides general and emergency care services, has a medical staff which includes eight physicians and five registered nurses.

IMPACTS AND MITIGATION MEASURES

According to HRS, Title II, Chapter 200, Subchapter 6, the proposed Project would have a significant effect on the environment if the project involves substantial secondary impacts, such as population changes or effects on public facilities.

As will be discussed below, closure of the Landfill will cause short-term increases in truck traffic because of the need to transport soil material to the site for use as final cover. Closure, however, will not affect other public infrastructure systems. Enhancement of the Ohiapilo Pond will have no effect on these systems. As noted above, the present site is not served by municipal water or wastewater systems, and there are no drainage improvements in the vicinity of the Landfill.

The Landfill closure will require that about 71,000 cubic yards (cu yd) of soil will be hauled in to the site. Of this amount, 45,700 cu yd will need to be low permeability clay soils from the Site 4 borrow site, and the remaining 25,300 cu yd can be obtained from Sites 1, 2, and 3 (see Figure 2-5). All borrow sites are located conveniently near Highway 460 and 470. In total, the about 3,550 off-site trips will be necessary to haul the soil to the site over a 74-day period. Based on this expected time requirement of 74 days to excavate the borrow site to meet the Landfill soil needs, approximately 48 truck trips per day will be necessary. This is a short-term impact, but is not considered to be significant. As noted in Table 3-3, most of the other closure options considered had substantially greater numbers of truck trips required.

ARCHAEOLOGICAL RESOURCES

SETTING

The Island of Molokai possesses a rich Hawaiian history. Settlement patterns on the Island before the coming of European missionaries indicate that the vast majority of Molokai's people lived in what was formerly known as the Kona District in the western half and southeastern portion of the Island. Evidence of this early settlement was found in the numerous fishponds which line the south coast of the Island.[54]

IMPACTS AND MITIGATION MEASURES

According to HRS, Title II, Chapter 200, Subchapter 6, the proposed Project would have a significant effect on the environment if the project involves an irrevocable commitment to loss or destruction of any cultural resource.

Closure of the Landfill will be contained within existing facility boundaries. Accordingly, no impacts to archaeological resources will occur.

Development of off-site borrow areas and enhancement of Ohiapilo Pond, however, will involve excavation in new areas. In order to obtain site-specific information on archaeological resources that could be impacted by these activities, an archaeological survey was conducted by BioSystems Analysis, Inc. Soil borrow area 1 was not included in the assessment because through consultation with the State Department of Natural Resources, the area was determined to have no cultural sensitivity. Sites 2 and 3 were omitted as they are existing borrow facilities.

The field investigation included a complete surface survey of Site 4 and the Ohiapilo Pond area. Survey areas were substantially greater than actual requirements to provide some flexibility as plans for these areas are defined. A complete surface survey was conducted. Eight subsurface cores were collected at the Ohiapilo Pond to determine the chronology of the pond. A full technical report on the survey work is included as Appendix J.

In summary, an archaeological site was discovered on top of the prominent hill and down its north slope within the Site 4 soil borrow site. The site consists of four feature areas and a light density basalt lithic scatter within an erosional cut on the north slope of the hill. Due to the potential significance of this site, this area will be avoided during borrow pit excavations. Basalt flakes and marine shells were also found in the western portion of Site 4. Since the archaeological site is centrally located within Site 4 and because the basalt flakes and marine shells probably represent sporadic prehistoric use of the project area, archaeological monitoring will be conducted during the initial ground disturbance of any portion of the borrow area site.

Based on testing conducted at the Ohiapilo Pond, this area may be significant for its potential to yield information to the understanding of traditional culture, history, and prehistory. As a mitigation measure, additional subsurface coring will be conducted once the zone of disturbance is identified and prior to construction to gather the additional information. This measure should be sufficient to ensure that archaeological deposits will not be damaged or destroyed without advanced identification. If such deposits are encountered, they will be avoided if possible. However, if the deposits cannot be avoided, work in the immediate area of the discovery will stop and the State Historic Preservation Division will be consulted to determine the types and amount of study that is appropriate prior to damage or destruction.

PUBLIC HEALTH AND SAFETY

SETTING

The use of heavy earthmoving equipment and the maneuvering of collection trucks and other vehicles at the Landfill site can create safety problems to on-site workers and visitors. However, the existing Landfill is a small facility and no documented health and safety problems have occurred.

Site investigations were also conducted at the Landfill to address potential subsurface fires and to investigate the potential for LFG migration.[7,8] The purpose of the subsurface fire investigation was to identify potential fire locations so they could be extinguished prior to Landfill closure. The purpose of the LFG investigation was to determine the potential for migration from the site and develop the appropriate monitoring program and containment system as necessary for closure. The methane component of LFG is explosive in the 5 to 15 percent range of concentrations when confined in a closed space with sufficient oxygen for burning. Accordingly, federal regulations establish allowable limits for concentrations of LFG at the Landfill boundary, and within structures of the Landfill. These are 5 and 1.25 percent (the lower explosive limit [LEL] and 20 percent LEL), respectively. Methane may also asphyxiate vegetation through oxygen starvation in the root zone. Also, in confined or semi-confined enclosures, methane gas and carbon dioxide (the other principal component of LFG) may accumulate and create an asphyxiation hazard through displacement of oxygen.

The subsurface fire investigation provided no indication of subsurface fire, thus a remediation program was not considered necessary.[7]

The LFG investigation concluded that the migration potential at the site is very low.[8] Groundwater was typically encountered between 1 and 3 feet along the Landfill boundary. Saturated soil conditions impede LFG migration. Because of the proximity of groundwater and the saturated soil conditions that surround the Landfill, especially along the three sides bordering the mangroves, it was felt during the investigation that any appreciable subsurface LFG migration would be through the north or Hoawa Road boundary. The four boreholes along this border showed essentially no LFG.

IMPACTS AND MITIGATION MEASURES

According to HRS, Title II, Chapter 200, Subchapter 6, the proposed Project would have a significant effect on the environment if it substantially effects public health.

All elements of the closure project, including Landfill closure, the excavation of off-site borrow areas, and enhancement of Ohiapilo Pond do have the potential for health and safety impacts stemming from the use of earthmoving equipment and soil haul trucks. Additionally, during the Landfill closure, there is a possibility of coming in contact with unknown hazardous waste material or being exposed to explosive or toxic gases. When compared to other closure alternatives, the proposed Project has the least risk in this regard because only minimal excavation of the Landfill side slopes will be required and only minor regrading of the surface is necessary. Nevertheless, pursuant to Title 29, CFR, Part 1910.120, the contractor will be required to prepare a health and safety plan to address these issues, thus mitigating potential health and safety impacts.

There is a potential that following closure, the low-permeability final cover will serve to restrict upward migration of LFG. Thus, LFG may tend to migrate laterally along areas with greater permeability. For the project site, this area is along the north boundary of the Landfill. As mitigation, the County will install and monitor three LFG probes along the northern property boundary, adjacent to the Hoawa Road. If LFG migration is ever detected, appropriate corrective measures will be undertaken. Such measures would likely include installation of an LFG extraction system in the fill area along the north boundary, or construction of a barrier wall.

SOCIOECONOMIC ENVIRONMENT

SETTING

Relative to the rest of the County, the Island of Molokai has experienced a relatively low rate of population growth over the past decade. The 1980 population of the Island was approximately 5,900.[55] Recent estimates place the Island's population for the year 1987 at 6,645, an increase of 12.6 percent over the 1980 figure.[56] Estimates of population to the year 2000 and 2010 are approximately 8,400 and 9,700, respectively.

The Island's economy is to a large extent driven by diversified agriculture and the visitor industry. The success of diversified agriculture on Molokai, in fact, has pushed the County past

Hawaii County as the largest producer of vegetables and melons.[57] It is noted that Molokai Ranch has reinitiated cattle operations to boost the agricultural sector of the economy. The visitor industry on the Island, while comprising only a small percentage of the County's visitor industry plant, nonetheless provides a stabilizing influence on the local economy. In 1988, the Island attracted 87,000 westbound visitors and approximately 10,000 Japanese visitors.

IMPACTS AND MITIGATION MEASURES

According to HRS, Title II, Chapter 200, Subchapter 6, the proposed Project would have a significant effect on the environment if it would substantially effect the economic or social welfare of the community or state.

The closure of the Landfill will not result in adverse impacts upon the local socioeconomic environment. The County is in the process of designing a new landfill at Naiwa, Molokai, to replace the existing Landfill. The new landfill will be designed and constructed in accordance with 40 CFR, Part 258. Accordingly, the solid waste disposal needs of the Island's residents will be accommodated in an environmentally-sound manner.

Because the Landfill will be replaced by a new municipal landfill, there will be no loss of employment associated with the closure. In the long term, impacts to other socioeconomic characteristics, such as population census and spatial distribution and household income, are not anticipated to be affected by the proposed Project.

Short-term effects of the closure would be principally limited to additional construction dollars being inputted to the local economy. The closure will require truckers and equipment operators, as well as a source of cover material. These construction-related needs will serve as short-term income generators for the Island of Molokai.

CHAPTER 5

RELATIONSHIP TO GOVERNMENTAL PLANS, POLICIES, AND CONTROLS

The proposed closure of the Kalamaula Sanitary Landfill (Landfill) was reviewed with respect to applicable government plans, policies, and controls. The analysis is summarized below.

HAWAII STATE PLAN

The Hawaii State Planning Act (Chapter 226, Hawaii Revised Statutes) sets forth goals, objectives, policies, and priority guidelines to guide the long-range development of the State of Hawaii. The proposed closure project is in keeping with the following objectives and policies of the Hawaii State Plan.

Objectives and Policies for the Physical Environment--Land-Based, Shoreline, and Marine Resources (Sec. 226-11)

Objective. Plan for effective protection of Hawaii's unique and fragile environmental resources.

Policies.

1. Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.
2. Take into account the physical attributes of areas when planning and designing facilities.
3. Encourage the protection of rare or endangered plant and animal species and habitats native to Hawaii.
4. Pursue compatible relationships among activities, facilities, and natural resources.

No further encroachment is occurring at the Landfill site. Closure of the Landfill per federal requirements (40 Code of Regulations [CFR], Part 258) will enhance long-term compatibility of the facility with surrounding natural resources. As part of the overall mitigation program, the County of Maui (County) proposes to enhance the Ohiapilo Pond site. Accordingly, the proposed closure will enhance wetland resource values on the Island of Molokai.

Objective and Policies for the Physical Environment--Scenic, Natural Beauty, and Historic Resources (Sec. 226-12)

Objective. Plan to achieve the enhancement of Hawaii's scenic assets, natural beauty, and multicultural/historical resources.

Policies.

1. Promote the preservation and restoration of significant natural and historic resources.
2. Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features.

From a visual standpoint, the existing landfill forms an abrupt and visually distinct element from the surrounding environs. The proposed closure of the Landfill will improve the overall scenic quality of the landfill site by replacing an active landfill with a covered and vegetated area.

The Landfill, located adjacent to the Ohiapilo Wetland, is visible from Maunaloa Highway. In terms of visual appearance, then, the closure of the Landfill will allow for the blending of on-site vegetative cover with the surrounding environs, creating an aesthetically-integrated open space.

Objectives and Policies for the Physical Environment--Land, Air, and Water Quality (Sec. 226-13)

Objective. Plan for the maintenance and pursuit of improved quality in Hawaii's land, air, and water resources.

Policies.

1. Promote the proper management of Hawaii's land and water resources.
2. Encourage actions to maintain or improve aural and air quality levels to enhance the health and well-being of Hawaii's people.

The closure of the landfill will result in the termination of solid waste disposal in an environmentally sensitive area. Furthermore, the closure will eliminate the following:

1. odors which are typically associated with refuse material;
2. windblown litter which is a common occurrence at active landfills; and
3. vectors such as rodents, flies, and birds.

Objectives and Policies for Facility Systems--Solid and Liquid Wastes (Sec. 226-15)

Objective. Plan for the maintenance of basic public health and sanitation standards relating to treatment and disposal of solid and liquid wastes.

Policy. Promote research to develop more efficient and economical treatment and disposal of solid and liquid wastes.

The County is in the process of designing a new landfill at Naiwa, Molokai, to replace the Landfill. The new landfill will be designed and constructed in accordance with the Environmental Protection Agency's (EPA) criteria for municipal solid waste landfills (40 CFR, Part 258). Accordingly, the solid waste disposal needs of the island's residents will be accommodated in an environmentally sound manner.

STATE CONSERVATION DISTRICT USE PERMIT

Chapter 2 of Title 13, Administrative Rules, provides that the use of land within the State Conservation District requires a State Conservation District Use Permit to be administered by the State of Hawaii, Department of Land and Natural Resources. A portion of the Landfill site falls within the General subzone of the Conservation District. In addition, wetlands mitigation and enhancement activities associated with the Ohiapilo Pond may affect the Conservation District. It is noted, however, that Chapter 2 of Title 13, Administrative Rules, does not apply to lands owned by the DHHL. Accordingly, a Conservation District Use Permit is not required for the Landfill closure and wetland mitigation actions.

STATE LAND USE DISTRICTS

Chapter 205, Hawaii Revised Statutes, relating to the Land Use Commission, establishes the four major land use districts in which all lands in the State are placed--Urban, Rural, Agricultural, and Conservation. It has been determined through a boundary interpretation by the

State Land Use Commission that the Landfill is located within the Agricultural, Rural, and Conservation Districts (see Figure 5-1). The original lease area of the landfill falls within the State Agricultural District, while the encroachment area falls within the Conservation and Rural Districts. The Ohiapilo Pond falls within the State Agricultural District. Since the pond lies near the Agricultural-Conservation District boundaries, the limits of wetland mitigation and enhancement would need to be defined to determine if Conservation lands will also be affected.

UNITED STATES DEPARTMENT OF THE ARMY, SECTION 404, PERMIT

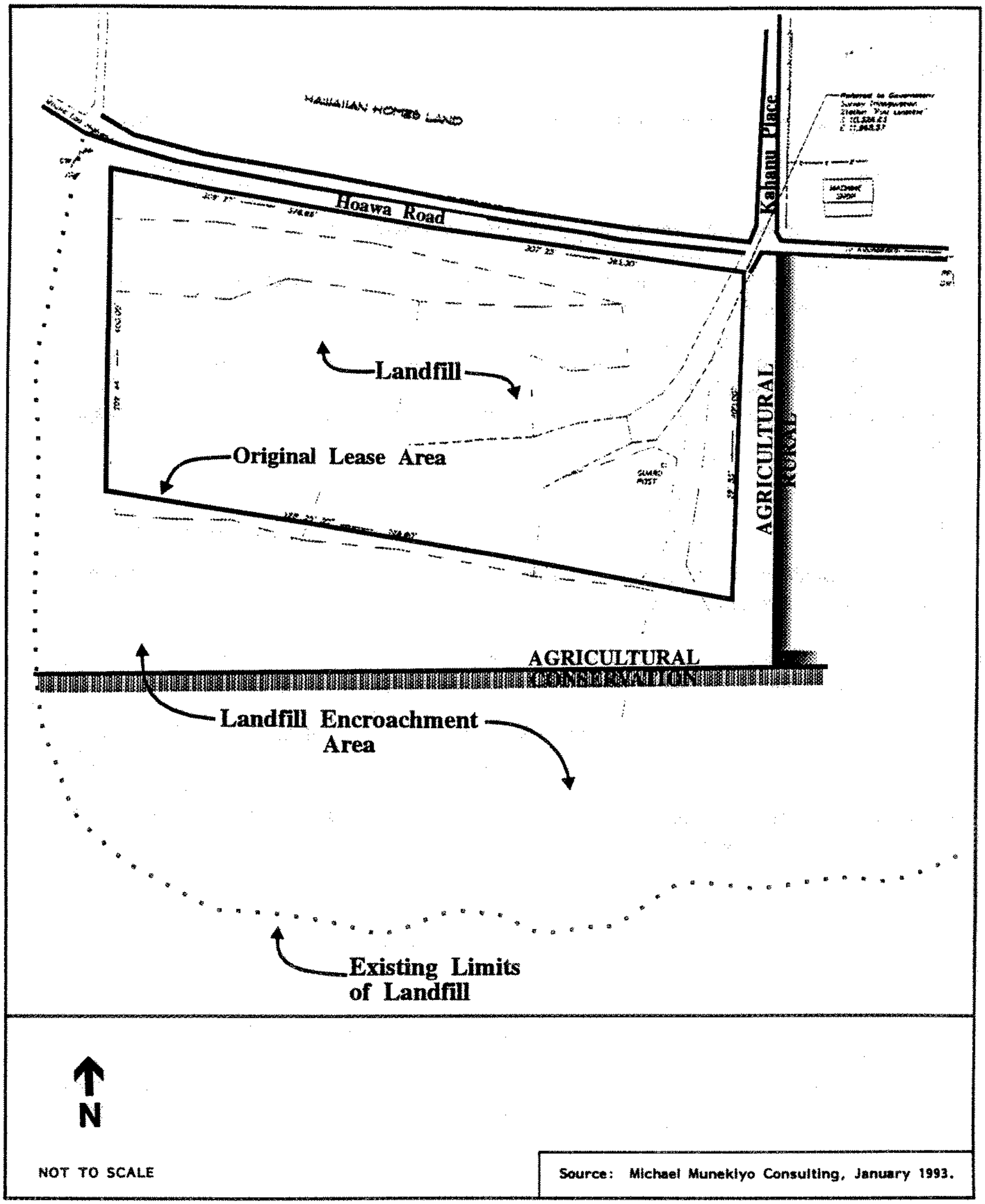
Under normal circumstances, the discharge of fill material into waters of the United States is regulated by the United States Department of the Army Corps of Engineers (U.S. Army Corps) (pursuant to Section 404 of the Clean Water Act). However, a U.S. Army Corps/U.S. EPA agreement (1986) states that the unauthorized discharge of solid waste into waters of the United States will be regulated by the EPA under Section 309 of the Clean Water Act. The encroachment of the Landfill upon the Ohiapilo Wetland area has been identified as an unauthorized discharging of solid wastes into waters of the United States, and is, therefore, under jurisdiction of the EPA.

In response to the unauthorized filling of the Ohiapilo Wetland, the EPA will issue a consent order enforcing the County to close the Landfill in accordance with prescribed terms and conditions. Inasmuch as a consent order will be issued, it has been determined that a United States Department of the Army Section 404 Permit will not be required for the proposed closure action. It is noted, however, that the proposed wetland enhancement activities for the Ohiapilo Pond will include construction activities for which a Corps of Engineers permit may be required. Proposed wetland enhancement activities will be reviewed with the U.S. Army Engineer District, Honolulu, to determine the applicability of the Corps' jurisdiction in the proposed action.

MAUI COUNTY GENERAL PLAN

The County General Plan (1990 Update) sets forth broad objectives and policies to help guide the long-range development of the County. As expressed in the County Charter:

> The purpose of the General Plan is to recognize and state the major problems and opportunities concerning the needs and the development of the County and the social, economic, and environmental effects of such development and set forth the desired sequence, patterns, and characteristics of future development.



Source: Michael Munekiyo Consulting, January 1993.

Figure 5-1 State Land Use Boundaries

Objective

To preserve and protect the County's unique and fragile environmental resources.

Policies.

1. Support programs to reduce air, land, and water pollution.

2. Support programs to protect rare and endangered species and programs which will enhance their habitat.

The closure of the Landfill will enhance environmental resource quality at the Landfill site and surrounding wetlands. Furthermore, proposed wetland mitigation measures will enhance wetland areas to replace wetlands lost by the encroachment of the Landfill upon the Ohiapilo Wetland.

Objective

To provide efficient, safe, and environmentally-sound systems for the disposal and reuse of liquid and solid wastes.

Policy. Explore new waste disposal methods that are safe, economical, environmentally sound, and aesthetically pleasing, and that minimize the disposal of waste in landfills.

The closure of the Landfill and the design and construction of the new landfill at Naiwa will be governed by the EPA's criteria for municipal solid waste landfills as set forth in 40 CFR, Part 258 (Federal Register Volume 56, Number 196). Part 258 establishes minimum national criteria for the location, design, operation, cleanup, and closure of municipal landfill facilities. Accordingly, the solid waste of the Island's residents will be managed in an environmentally-sound manner.

MOLOKAI COMMUNITY PLAN

The Landfill is located within the Molokai Community Plan region, one of nine Community Plan regions established in the County. Planning for each region is guided by the respective Community Plans, which are designed to implement the County General Plan. Each Community Plan contains recommendations and standards which guide the sequencing, patterns, and characteristics of future development in the region.

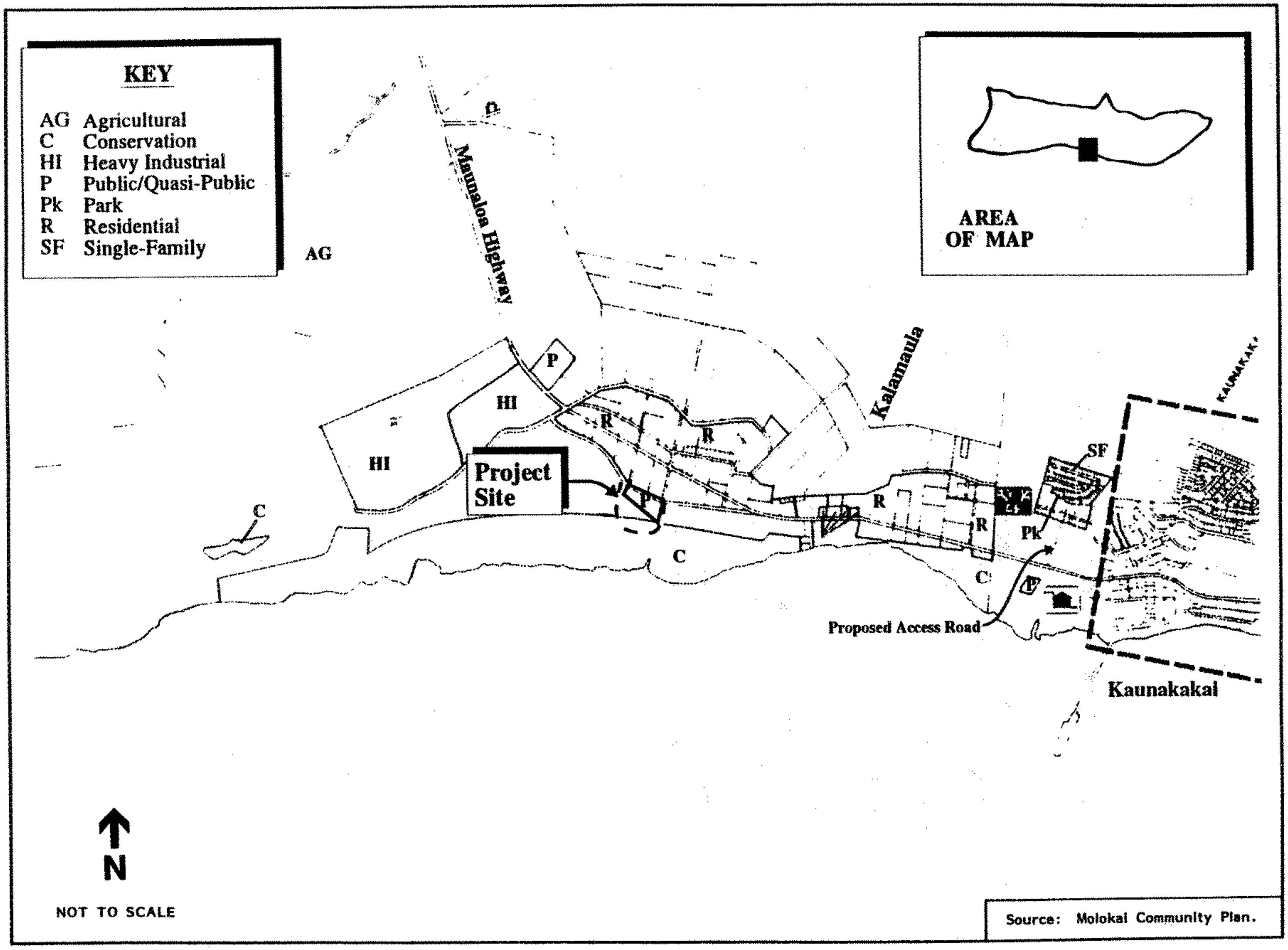
The original lease area of the Landfill is designated Public/Quasi-Public by the Molokai Community Plan, while the encroachment area is designated Agricultural and Conservation (see Figure 5-2).

HAWAII COASTAL ZONE MANAGEMENT PROGRAM

The Hawaii Coastal Zone Management Program (HCZMP), as formalized in Chapter 205A, Hawaii Revised Statutes, establishes objectives and policies for the preservation, protection, and restoration of natural resources of Hawaii's coastal zone areas. The objective of the HCZMP are as follows:

1. Provide coastal recreational opportunities accessible to the public.
2. Protect, preserve, and where desirable, restore those natural and man-made historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.
3. Protect, preserve, and where desirable, restore or improve the quality of coastal scenic and open space resources.
4. Protect valuable coastal ecosystems from disruption and minimize adverse impacts on all coastal ecosystems.
5. Provide public or private facilities and improvement important to the state's economy in suitable locations.
6. Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, and subsidence.
7. Improve the development review process, communication, and public participation in the management of coastal resources and hazards.

The closure of the Landfill is in keeping with the foregoing objectives. The closure will be governed by the EPA's criteria for municipal solid waste landfills (40 CFR, Part 258) and Section 309, of EPA's Clean Water Act, concerning the unauthorized discharging of solid waste into the waters of the United States.



Source: Molokai Community Plan.

Figure 5-2 Molokai Community Plan Map

The closure of a landfill located in an environmentally-sensitive area will advance the objectives of the HCZMP.

It is further noted that a U.S. Department of Army permit will not be required for the closure of the Landfill. Instead, the EPA will issue a consent order enforcing County closure of the Landfill in accordance with terms and conditions set forth by EPA. Under these circumstances, a Coastal Zone Management consistency review will not be required for Landfill closure. However, should a Department of the Army permit be required for activities associated with wetlands mitigation at the Ohiapilo Pond, a Hawaii CZM consistency certification would need to be obtained. The purpose of this certification is to review and confirm that the proposed activities (i.e. wetland enhancement at the Ohiapilo Pond) will be conducted in a manner consistent with the Hawaii CZM program. Processing and certification is administered by the State of Hawaii, Office of State Planning, Coastal Zone Management Program Office.

SPECIAL MANAGEMENT AREA OBJECTIVES AND POLICIES

Pursuant to Chapter 205A, Hawaii Revised Statutes, and the Rules and Regulations of the Molokai Planning Commission of the County, projects located within the Special Management Area (SMA) are evaluated with respect to SMA objectives, policies, and guidelines. This section addresses the project's relationship to applicable coastal zone management considerations, as set forth in Chapter 205A and the Rules and Regulations of the Planning Commission.

Recreational Resources

Objective. Provide coastal recreational resources accessible to the public.

Policies.

1. Improve coordination and funding of coastal recreation planning and management.
2. Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by:
    a. Protecting coastal resources uniquely suited for recreation activities that cannot be provided in other areas.

    b. Requiring replacement of coastal resources having significant recreational value, including but not limited to, surfing sites and sandy beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the State for recreation when replacement is not feasible or desirable.

c. Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value.

d. Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation.

e. Encouraging expanding public recreational use of county, state, and federally-owned or controlled shoreline lands and waters having recreational value.

f. Adopting water quality standards and regulating point and nonpoint sources of pollution to protect and where feasible, restore the recreational value of coastal waters.

g. Encouraging reasonable dedication of shoreline areas with recreational value for public use as part of discretionary approvals or permits, and crediting such dedication against the requirements of Section 46-6 of the Hawaii Revised Statutes.

The proposed closure of the Landfill will not affect coastal recreational opportunities. Accessibility to shoreline areas will not be impacted by the proposed action.

Historical/Cultural Resources

Objective. Protect, preserve, and where desirable, restore those natural and man-made historic and prehistoric resources in the coastal zone management areas that are significant in Hawaiian and American history and culture.

Policies.

1. Identify and analyze significant archaeological resources.

2. Maximize information retention through preservation of remains and artifacts or salvage operations.

3. Support state goals for protection, restoration, interpretation, and display of historic resources.

The Kalamaula region of Molokai contains several resources having cultural significance, including fishponds which are found in the vicinity of the Landfill. The Kakokahi, Ohiapilo, and the Umipaa Ponds, which are located west of the Landfill, are representative of the resources in this locale. Inasmuch as closure activities such as monitoring operations and placement of final cover material will be confined to the existing landfill site, cultural resources found nearby will not be affected by the Closure Plan.

It is noted that a surface survey at soil borrow Site 4 disclosed potentially significant features. This area will be avoided during excavation activities.

Scenic and Open Space Resources

Objective. Protect, preserve, and where desirable, restore or improve the quality of coastal scenic and open space resources.

Policies.

1. Identify valued scenic resources in the coastal zone management area.
2. Insure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of natural land forms and existing public views to and along the shoreline.
3. Preserve, maintain, and where desirable, improve and restore shoreline open space and scenic resources.
4. Encourage those developments which are not coastal dependent to locate in inland areas.

From a visual standpoint, the existing Landfill forms an abrupt and visually distinct element from the surrounding environs. The proposed closure of the Landfill will improve the overall scenic quality of the Landfill site by replacing an active landfill with a covered and vegetated area.

Coastal Ecosystems

Objective. Protect valuable coastal ecosystems from disruption and minimize adverse impacts on all coastal ecosystems.

Policies.

1. Improve the technical basis for natural resource management.
2. Preserve valuable coastal ecosystems of significant biological or economic importance.
3. Minimize disruption or degradation of coastal water ecosystems by effective regulation of stream diversions, channelization, and similar land and water uses, recognizing competing water needs.
4. Promote water quantity and quality planning and management practices which reflect the tolerance of fresh water and marine ecosystems and prohibit land and water uses which violate state water quality standards.

The closure of the Landfill will terminate further encroachment into the surrounding wetlands. To mitigate the impacts of encroachment, the County proposes to enhance the Ohiapilo Pond located to the immediate west of the Landfill.

Economic Uses

Objective. Provide public or private facilities and improvements important to the State's economy in suitable locations.

Policies.

1. Concentrate in appropriate areas the location of coastal dependent development necessary to the state's economy.
2. Insure that coastal dependent development such as harbors and ports, visitor facilities, and energy-generating facilities are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area.
3. Direct the location and expansion of coastal dependent developments to areas presently designated and used for such developments and permit reasonable long-

term growth at such areas, and permit coastal dependent development outside of presently designated areas when:

a. utilization of presently designated locations is not feasible,
b. adverse environmental effects are minimized, and
c. important to the state's economy.

The closure of the Landfill and the development of a new landfill at Naiwa, Molokai provides for a more desirable landfill location. The relocation of the Molokai's sanitary landfill will enhance coastal resources values.

Coastal Hazards

Objective. Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, and subsidence.

Policies.

1. Develop and communicate adequate information on storm wave, tsunami, flood, erosion, and subsidence hazard.

2. Control development in areas subject to storm wave, tsunami, flood, erosion, and subsidence hazard.

3. Ensure that developments comply with requirements of the Federal Flood Insurance Program.

4. Prevent coastal flooding from inland projects.

The project site is located on the flat coastal lowlands of Molokai's south shore. The eastern portion of the Landfill site encroaches into lands designated Zone B and Zone A2 on the Flood Insurance Rate Map. Lands designated Zone B are defined as areas between the limits of the 100-year flood and the 500-year flood. Areas designated Zone A2 are subject to the 100-year flood.

Those areas of the landfill site not falling within Zones B and A2 are designated Zone C, areas of minimal flooding.

The closure of the Landfill or enhancement of the Ohiapilo Pond is not anticipated to increase flood hazard to life or to downstream properties.

Managing Development

Objective. Improve the development review process, communication, and public participation in the management of coastal resources and hazard.

Policies.

1. Effectively utilize and implement existing law to the maximum extent possible in managing present and future coastal zone development.
2. Facilitate timely processing of application for development permits and resolve overlapping of conflicting permit requirements.
3. Communicate the potential short and long-term impacts of proposed significant coastal developments early in their life cycle and in terms understandable to the general public to facilitate public participation in the planning and review process.

Early consultation is provided through the Environmental Impact Statement preparation process. Public input opportunity is also afforded during consideration of the County's SMA permitting and other regulatory processes.

Applicable federal, state, and County requirements will be adhered to in the design and construction of the proposed project.

SECTION 401 WATER QUALITY CERTIFICATION

As required by Section 401 of the Clean Water Act, "Any applicant for a federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may result in any discharge into the navigable waters, shall provide the licensing or permitting agency a certification...that any such discharge will comply with the applicable provisions...of this Act." Inasmuch, an EPA consent order will be filed in lieu of a Department of the Army Section 404 permit, the County is not anticipated to seek a Section 401 Water Quality Certification for the Landfill closure. In the event a Corps of Engineers permit is determined to be required for the wetlands mitigation activities at Ohiapilo Pond, a 401 Water Quality Certification may be required. The Director of the State of Hawaii, Department of Health (DOH) is the designated issuing authority for the 401 Water Quality Certification.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT

Pursuant to the Clean Water Act, discharge of pollutants into the waters of the United States shall require a permit issued under the National Pollutant Discharge Elimination System (NPDES). The County intends to file required notices and documentation to comply with the State of Hawaii's NPDES regulations as set forth in Hawaii Administrative Rules, Title 11, DOH, Chapter 55, relating to water pollution control.

STATE LAND USE COMMISSION SPECIAL USE PERMIT

Cover material for the Landfill closure will be obtained from off-site sources. Sites 2 and 3 (Figure 2-6) represent existing excavation activities. Site 1 (Kualapuu) and Site 4 (Maunaloa) represent potentially new sources of borrow soil. Both Kualapuu and Maunaloa are located within the State Agricultural District. The Maunaloa borrow site will ultimately be used for an agricultural reservoir which is a permitted use in the Agricultural District. The Kualapuu borrow site, once excavated, will be used for effluent holding ponds for domestic wastewater treatment and disposal. Domestic wastewater treatment facilities are not a permitted use within the Agricultural District. Accordingly, as provided by Section 15-15-95 of the Hawaii Land Use Commission Rules, a Special Use Permit would be required from the Molokai Planning Commission should this borrow site be selected. Guidelines for granting of a Special Use Permit application include the following:

1. The use shall not be contrary to the objectives sought to be accomplished by Chapters 205 and 205A, HRS, and the rules of the commission.
2. The desired use would not adversely affect surrounding property.
3. The use would not unreasonably burden public agencies to provide roads and streets, sewers, water drainage and school improvements, and police and fire protection.
4. Unusual conditions, trends, and needs have arisen since the district boundaries and rules were established.
5. The land upon which the proposed use is sought is unsuited for the uses permitted within the district.

CHAPTER 6

IMPACT OVERVIEW

Title II, Department of Health, Chapter 200, Environmental Impact Statement Rules, Section 11-200-17 requires certain sections to be prepared. These are discussed below.

RELATIONSHIP BETWEEN SHORT-TERM USES AND MAINTENANCE OF LONG-TERM PRODUCTIVITY

The proposed project includes closure of the Kalamaula Landfill (Landfill), development of off-site soil borrow areas, and enhancement of Ohiapilo Pond. Landfill closure and use of off-site soil will need to occur together while enhancement of Ohiapilo Pond will be subject to different constraints and probably will be subject to a separate schedule.

Landfill closure will eliminate solid waste disposal activities in the short term. However, long-term disposal needs of Molokai residents will be accommodated in an environmentally-sound manner because Maui County (County) is currently in the process of siting a new landfill that should be operational by October 1993. Closure of the Landfill will provide long-term benefits by serving to minimize the risk of water quality degradation; enhancing long-term compatibility of the site with surrounding natural resources; eliminating litter, odor, and vectors as potential nuisances; and creating an aesthetically-integrated open space.

Closure will require about 71,000 cubic yards (cu yds) of soil in the short term for construction of the final cover. This activity will serve to reduce soil resources at the borrow areas, but will contribute to the long-term beneficial activity of Landfill closure. Based on discussions with representatives of Molokai Ranch, two of the borrow sites (Sites 1 and 4) may be converted to a wastewater treatment pond or a water reservoir, respectively, thus providing a long-term beneficial use of the sites.

Through the process of sedimentation, the Ohiapilo Pond area has lost much of its value as open-water habitat for bird life. Thus, through implementation of the enhancement project, long-term benefits to bird life should occur, including several endangered species that exist within the area. In addition, an objective of the enhancement project will be the use of the area as an educational tool for local residents.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

No significant unavoidable impacts have been identified for the proposed project. Landfill closure will require the use of about 71,000 cu yds of soil, as well as money, manpower, and energy. Soil borrow areas that have been identified can easily accommodate this need. The range of potential uses of the environment will not be curtailed by this action. A new landfill is being sited to accommodate the solid waste disposal needs of Molokai residents, and the value of borrow Sites 1 and 4 and the Ohiapilo Pond will be increased as a result of the project. Because of the use of heavy equipment, and the risk of encountering either hazardous materials or toxic or explosive gases at the Landfill, there is a potential health and safety concern for workers. However, the contractor is required to prepare a health and safety plan to address these issues.

OFF-SETTING CONSIDERATIONS OF GOVERNMENTAL POLICIES

The County is siting a new landfill on Molokai to replace the Kalamaula Landfill. The County proposes to close the existing facility in conformance with federal regulations (40 Code of Federal Regulations, Part 258). Because of the wetland encroachment that has occurred, the County is under a consent order process by the U.S. Environmental Agency which dictates the requirements and schedule for closure. In-place closure is the least impacting and most cost-effective alternative for Landfill closure. No significant unavoidable impacts have been identified for the project. Substantial environmental benefits, however, will occur.

CUMULATIVE IMPACTS

Cumulative impacts refers to two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts. No significant cumulative impacts have been identified for the proposed project.

CHAPTER 7

LIST OF EIS PREPARERS

LEAD AGENCY

County of Maui
Department of Public Works
Solid Waste Division
200 South High Street
Wailuku, Maui, Hawaii
(808) 243-7875

CONSULTANTS

Prime EIS Contractor

Brown and Caldwell Consultants
485 Waiale Drive
Wailuku, Maui, Hawaii 96793

Subconsultants

AECOS
970 North Kalaheo Avenue, Suite C311
Kailua, Oahu, Hawaii 96734

Dr. Evangeline Funk
Botanical Consultants
P.O. Box 90765
Honolulu, Hawaii 96835

Michael T. Munekiyo Consulting, Inc.
1823 Wells Street, Suite 3
Wailuku, Maui, Hawaii 96793

Biosystems Analysis, Inc.
1051 Keolu Drive, Suite 1046
Kailua, Oahu, Hawaii 96734

CHAPTER 8

COMMENTS RECEIVED DURING THE ENVIRONMENTAL IMPACT STATEMENT (EIS) REVIEW PERIOD AND RESPONSES

The Draft EIS was submitted to the Office of Environmental Quality Control (OEQC) and notice of its availability published in the OEQC Bulletin on March 8, 1993. The deadline for receipt of comments was April 22, 1993. Written comments received on the Draft EIS are included in this chapter. The comment letter is first included, followed by the responses. In addition, a meeting was held on Molokai on March 31, 1993, to obtain comments on the Draft EIS. A transcript of the meeting is also included in this chapter. Comments made by the public were addressed during the meeting.

COMMENTS RECEIVED ON THE
KALAMAULA LANDFILL CLOSURE EIS

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
FT. SHAFTER, HAWAII 96858-5440

DTW
c/c to B&C

REPLY TO
ATTENTION OF

March 15, 1993

Planning Division

Mr. Richard Haake, Managing Director
Office of the Mayor
County of Maui
200 South High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Haake:

Thank you for the opportunity to review and comment on the Draft Environmental Impact Statement for the Kalamaula Landfill Closure Project, Molokai. We do not have any additional comments beyond those provided in our last letter dated July 30, 1992.

Sincerely,

James A Nakamura
for
Kisuk Cheung, P.E.
Director of Engineering

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
AARON SHINMOTO, P.E.
Chief Staff Engineer

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
LLOYD P.C.W. LEE, P.E.
Engineering Division
DAVID WISSMAR, P.E.
Solid Waste Division
BRIAN HASHIRO, P.E.
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

May 06, 1993

Mr. Kisuk Cheung
Director of Engineering
Department of the Army
U.S. Army Engineer District, Honolulu
Ft. Shafter, Hawaii 96858-5440

Subject: Kalamaula Landfill Closure
Draft Environmental Impact Statement (EIS)

Dear Mr. Cheung:

Thank you for your participation in the Draft EIS review process. Your letter and this letter will be appended to the Final EIS.

Very truly yours,

GEORGE N. KAYA
Director of Public Works

05/06/93\E:\LRE\7009\7009-14\LETTERS\LTR-1.WP5
QMS-PS825

United States Department of the Interior

TAKE PRIDE IN AMERICA

GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
677 ALA MOANA BLVD., SUITE 415
HONOLULU, HI 96813

April 21, 1993

Mr. Richard Haake
Managing Director
Mayor, County of Maui
200 South High Street
Wailuku, HI 96793

Dear Mr. Haake,

At the request of the State of Hawaii, Office of Environmental Quality Control, we have reviewed the Draft Environmental Impact Statement (DEIS), "Kalamaula Sanitary Landfill Closure Project" prepared by Brown and Caldwell Consultants. Our comments are outline below:

1

(1) MW-8 may not be an appropriate background site.--The DEIS states that "after observing the influence of high and low tides on the groundwater elevations in MW-8, there is a basis for questioning the suitability of MW-8 as an upgradient well" (page 4-23). We agree with this statement, but question why wells significantly upgradient of the Landfill were not sampled to justify the use of MW-8 as a background site. Wells east of Kualapuu and inland of Kaunakakai could be used for this purpose.

2

(2) Averaging of background concentrations.--"background concentrations were established by averaging the two EPA background locations (B-1 and B-2) and MW-8" (page 4-17). The use of an average may be acceptable, but it would be more informative to show individual values for the various constituents as well as the average. This approach would provide a better indication of the natural variability of the constituents.

3

(3) Table 4-5 Soil Analytical Results for Metals.--This table is located on page 4-19. The soils in the boreholes clearly reveal the influence of calcareous material (reef/limestone, magnesian calcite) on the soil composition. These data are not particularly useful other than to show that calcareous material is an important contribution to the subsurface soil. The DEIS does not identify the analytical methods used or their detection limits. This is information is necessary to interpret the data, particularly for Pb values at the 3.8-5 mg/kg level quoted for the background and for MW-2. The data for As and Pb can be compared to the following additional reference data obtained from:

DeCarlo, E.H., K.J. Spencer, and G.M. McMurtry, 1992, Heavy metals and Pb isotopes in estuarine sediments as indicators of anthropogenic inputs to the environment: EOS, 73, p. 228.

Salomons, W., and U. Foerstner, 1984, Metals in the Hydrocycle: Springer Verlag, Berlin, 349 p.

Stoeppler, 1992, Hazardous metals in the environment: Techniques and Instrumentation in Analytical Chemistry, Elsevier, Amsterdam, 541 p.

Type of material	As (ug/g)	Pb (ug/g)
mafic and basaltic rocks	0.5-2.5	3-6
argillaceous soils	13	10-30
volcanic soils	2.1-11	1.5-18 (Big Island)
sandy soils	<0.1-30	n.a.
marine sediments	11-13	34-80
Ala Wai Canal sediments	n.a.	3.6-750
contaminated soils (U.S.)	31-625	up to several 1000's

4 (4) <u>Table 4.8 Groundwater Analytical Results for Metals</u>.--This table is located on page 4-22. As with the analytical results for the soils, the methods and detection limits are not mentioned. The data for Ag in L-1 is extraordinarily high, is this spurious? is it repeatable? and if so to what is this high concentration attributed? One should note a strong correlation between dissolved As and dissolved Fe data. This clearly indicates remobilization/reductive dissolution of soil Fe oxides under anoxic conditions with a concomitant release of AsO_4^{3-}. This metal is well-known to have very strong affinity for the surface of amorphous and poorly crystalline Fe oxide surfaces.

5 (5) <u>Source of As</u>.--Based on available data, the source of As in the area is probably the weathering of volcanic soils and a subsequent enrichment in the Fe oxide phase of the weathering products combined with an anthropogenic input as a result of the application of agricultural chemicals. The background levels of 0.6-2.4 mg/kg are typical of mafic rocks, low for their weathering products. Hence the range of 2.4-16.7 mg/kg As is reasonable and does not appear to be overly contaminated. The higher value found in the wetlands may be attributed to Fe oxides or Fe sulfides (under anoxic conditions an arsenopyrite type mineral can form). The concentrations in ground water of 41-46 ug/kg are, however, of greater concern because they are above the State of Hawaii chronic levels for saltwater.

In conclusion, the data provided in the DEIS are not sufficient to substantiate the conclusion that "the Landfill is not contributing significant contaminants to the groundwater or soils beneath the Landfill" (page 4-24). Furthermore, the accuracy and validity of the analytical work remain to be demonstrated.

Sincerely,

for William Meyer
District Chief

cc: David Wissmar, Department of Public Works, County of Maui
Bob Armstrong, Brown and Caldwell Consultants
Office of Environmental Quality Control

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
AARON SHINMOTO, P.E.
Chief Staff Engineer

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration
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LLOYD P.C.W. LEE, P.E.
Engineering Division
DAVID WISSMAR, P.E.
Solid Waste Division
BRIAN HASHIRO, P.E.
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

May 21, 1993

Mr. William Meyer, Chief
United States Department of the Interior
Geological Survey, Water Resources Division
677 Ala Moana Boulevard, Suite 415
Honolulu, Hawaii 96813

Dear Mr. Meyer:

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Thank you for your letter of April 21, 1993, regarding the subject project and the Draft EIS. To facilitate responses, your comments have been numbered and are addressed below:

1. The section on geology, soils, and water resources in Chapter 4 has been revised for the Final EIS to reflect re-evaluation of the existing water level data and collection of long-term water level fluctuations as part of the tidal influence study that has been done since the Draft EIS was published. The groundwater contour data indicate that MW-8 could serve as a suitable background well a majority of the time because groundwater flow is generally from MW-8 toward the ocean. However, there are instances when this may not be the case. In addition, the water quality data indicate that the landfill has had some effect on MW-8. Thus, the EIS recognizes that MW-8 would not be a suitable background well for use during post closure monitoring of the landfill.

   The Final EIS now indicates that a new background well should be located for use during postclosure monitoring. Such a well should be located in an area of brackish water similar to that which exists in the landfill area, thus, providing for a direct comparison of constituent levels. Such a location may be lateral to the landfill and not upgradient. Installing a background well upgradient in an area of "fresh" groundwater is not appropriate for the brackish water situation at this landfill. A well monitoring "fresh" groundwater would provide a false indication of landfill leakage because all constituents would be expected to be higher when compared to"fresh" groundwater unaffected by seawater. The use of MW-8 in the hydrogeological assessment does not invalidate the data or closure approach. The details of the postclosure monitoring program will be negotiated with the State Department of Health (DOH) and the U.S. Environmental Protection Agency (EPA).

2. The section in geology, soils, and water resources in Chapter 4 of the Final EIS has been revised to include revised background concentrations that include only the values from EPA locations B-1 and B-2 because of the uncertainty of MW-9 as a background location. The average consists of four values per constituents and it is believed that the average is representative of the natural variability. It should be noted that EPA's contractor took soil, sediment, and surface water samples. No groundwater samples were collected.

3. The EIS is intended to be a summary document. The supporting information on analytical methods and detection limits are contained in TM No. 4, a copy of which is attached for your information.

   Recalculation of background concentration without MW-8 resulted in the background concentration for lead increasing from 3.8 milligrams per kilogram (mg/kg) to 7.7 mg/kg, thus, MW-2 does not exceed background at a concentration of 5 mg/kg.

   The Final EIS includes a comparison in Chapter 4 of the background lead concentration to the information provided. The arsenic discussion has also been revised to reflect new information.

4. See response to comment No. 3 regarding your comment on analytical methods and detection limits.

   The silver concentration in the leachate well L-1 is high, however, additional data area not available to evaluate whether or not it is spurious or repeatable. The explanation of the relationship of arsenic and iron is appreciated.

5. Again, thank you for your comments regarding the probable sources of arsenic. As you note, arsenic concentrations in several wells exceed State of Hawaii chronic levels for salt water. For your information, since the Draft EIS was published, additional arsenic evaluations have been conducted of the biota in the coastal area. Appendix H in the Final EIS contains the full report and appropriate sections in Chapter 4 of the Final EIS have been modified accordingly. The results do not indicate a health hazard exists. This is confirmed by the DOH in their letter dated March 5, 1993, regarding this issue which is included in Appendix I.

Thank you for your comments and participation in the Draft EIS review process. Your letter and this letter will be appended to the Final EIS.

Very truly yours,

George N Kaya

GEORGE N. KAYA
Director of Public Works

DFW:jip

Attachments

xc: Mr. Brian Choy, Office of Environmental Quality Control

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO:
11010
Ser N42/1040
17 MAR 1993

Mayor
County of Maui
Attn: Richard Haake, Managing Director
200 South High Street
Wailuku, HI 96793

Dear Mr. Haake:

KALAMAULA SANITARY LANDFILL CLOSURE PROJECT

We have reviewed the subject Draft Environmental Impact Statement (DEIS) and have no comments to offer. We will retain one copy for our records and return the other copy to the Office of Environmental Quality Control.

Thank you for the opportunity to review the draft.

Sincerely,

W.K. Liu

W. K. Liu
Facilities Engineer
By direction of
the Commander

RECEIVED
1993 MAR 19 PM 3:58
OFFICE OF THE MAYOR

Copy to:
Dept of Public Works, County of Maui
(Mr. David Wissmar)
Brown and Caldwell Consultants
(Mr. Bob Armstrong)
OEQC (w/DEIS)

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
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AARON SHINMOTO, P.E.
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Solid Waste Division
BRIAN HASHIRO, P.E.
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

May 06, 1993

Mr. W. K. Liu
Facilities Engineer
Department of the Navy
Naval Base Pearl Harbor
Box 110
Pearl Harbor, Hawaii 96860-5020

Subject: Kalamaula Landfill closure
Draft Environmental Impact Statement (EIS)

Dear Mr. Liu:

Thank you for your participation in the Draft EIS review process. Your letter and this letter will be appended to the Final EIS.

Very truly yours,

George Kaya

GEORGE N. KAYA
Director of Public Works

DFW:jip

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
HONOLULU, HAWAII 96809

Keith W. Ahue, Chairperso
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

11

REF:OCEA:SKK

FILE NO.: 93-473/514
DOC. NO.: 2507

APR 7 1993

The Honorable George Kaya, Director
Department of Public Works and Waste Management
County of Maui
200 South High Street
Wailuku, Maui, Hawaii 96793

4/11

Dear Mr. Kaya:

SUBJECT: Kalamaula Sanitary Landfill Closure Project, Kalamaula, Molokai, TMK: 5-2-11: por. 1, 21; 5-2-08: 24

We have reviewed the information for the subject landfill closure project transmitted by your letter dated March 22, 1993, and have the following comments:

Office of Conservation and Environmental Affairs

The Office of Conservation and Environmental Affairs (OCEA) comments that the Department of Land and Natural Resources does not have any zoning jurisdiction over Hawaiian Homes lands even though portions of the subject project may appear to be designated within the State Conservation District.

1 Accordingly, the Conservation District Use Permit (CDUP) requirements pursuant to Chapter 183-41, Hawaii Revised Statutes and Section 13-2, Hawaii Administrative Rules do not apply to the subject project.

OCEA suggests that the Department of Hawaiian Homelands be consulted on this matter.

Division of Aquatic Resources

The Division of Aquatic Resources (DAR) comments that the Draft Environmental Impact Statement states on page 4-28 "the study has demonstrated that the landfill has not contributed significant contaminants to the groundwater, soils, and surrounding surface waters." Lack of contradicting information leads DAR to accept this statement as true.

2 However, arsenic levels in animal tissue (pages 4-56 to 4-68) did suggest some contamination. It is suggested that the Department of Health be notified, if they are not already aware, of this potentially hazardous condition.

3 Further, it is recommended that the groundwater and ocean water quality, and animal tissue monitoring programs be continued to assess long-term impacts to the water and associated aquatic resources.

Division of Forestry and Wildlife

4 The Division of Forestry and Wildlife comments that the proposed project is an in-place closure of a landfill with regrading of the top and sides of the landfill and placement of final cover with a vegetative layer. Because the content of the landfill is not known, future seepage into the adjacent wetlands might negatively impact the area, particularly the aquatic life and wildlife that inhabit the wetland. In January of this year, 48 Hawaiian stilts (Himantopus mexicanus knudseni) were recorded at a seasonal ponding area (Ohiapilo) approximately 300 yards west of the landfill. Stilts were still present at the pond during a site visit in March. It is recommended that the area be regularly monitored to detect any hazardous seepage from the landfill into the adjacent wetlands that could negatively affect the wetlands and its inhabitants, particularly the Hawaiian stilt.

5 A mitigative alternative is the enhancement of Ohiapilo Pond. The U.S. Fish and Wildlife Service in their Mitigation Recommendations for the Kalamaula Sanitary Landfill Closure has addressed Ohiapilo Pond enhancement as a mitigative measure with a three acres of enhanced wetlands for every one acre of wetland destroyed requirement.

We will forward our Historic Preservation 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 contact 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

KEITH W. AHUE

cc: Richard Haake
Bob Armstrong
OEQC

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
AARON SHINMOTO, P.E.
Chief Staff Engineer

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
LLOYD P.C.W. LEE, P.E.
Engineering Division
DAVID WISSMAR, P.E.
Solid Waste Division
BRIAN HASHIRO, P.E.
Highways Division

May 21, 1993

Mr. Keith W. Ahue
State of Hawaii
Department of Land and Natural
Resources
Post Office Box 621
Honolulu, Hawaii 96809

Dear Mr. Ahue:

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Thank you for your letter of April 7, 1993, regarding the subject project and the Draft EIS. To facilitate responses, your comments have been numbered and are addressed below:

1. Comment noted. Thank you for your review of this matter.

2. The State Department of Health was consulted on the arsenic issue and does not consider there to be a public health hazard. A letter to this effect is attached and is included in Appendix I of the Final EIS.

3. The Kalamaula Sanitary Landfill has been in operation since the early 1970's and an extensive monitoring program has shown it not to be an environmental hazard, nor is it expected to become one. However, the County is currently negotiating with the State Department of Health (DOH) and the U.S. Environmental Protection Agency (EPA) on a suitable post-closure monitoring program. As discussed in Chapter 4 of the Final EIS, based on these negotiations, quarterly monitoring for an initial 2-year period, followed by semi-annual monitoring for a 3-year period, (unless the monitoring results demonstrate a reason for concern and the need for more frequent monitoring), may be acceptable.

4. The value of Ohiapilo Pond to the Hawaiian stilt is recognized and was a major consideration in selecting this pond area as the preferred enhancement project. The monitoring program discussed in response to Comment No. 3 will provide the quickest mechanism of identifying contaminant migration from the closed landfill before any effect would be noticed on the biota. The necessary remediation would then be conducted as required by the DOH.

5. You are correct regarding the recommendations of the U.S. Fish and Wildlife Service (FWS). The recommendations will be considered by the EPA in the consent order they are preparing.

Thank you for your comments and participation in the Draft EIS review process. Your letter and this letter will be appended to the Final EIS.

Very truly yours,

George NKaya

GEORGE N. KAYA
Director of Public Works

DFW:jip

Attachments

xc: Mr. Brian Choy, Office of Environmental Quality Control

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HAWAIIAN HOME LANDS
P. O. BOX 1879
HONOLULU, HAWAII 96805

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

OFFICE OF THE MAYOR	FYI	COMMENTS	CALL ME	SEE ME	FILE	DRAFT RESPONSE
MAYOR	☐	☐	☐	☐	☐	☐
RICHARD	☐	☑	☐	☐	☐	☐
SHERI	☐	☐	☐	☐	☐	☐
DAVE	☐	☐	☐	☐	☐	☐
NOLAN	☐	☐	☐	☐	☐	☐
GEORGINA	☐	☐	☐	☐	☐	☐
PAMELA	☐	☐	☐	☐	☐	☐
BOB J.	☐	☐	☐	☐	☐	☐
GEORGE	☐	☐	☐	☐	☐	☐
BRIAN	☐	☐	☐	☐	☐	☐
CHARMAINE	☐	☐	☐	☐	☐	☐
GUY	☐	☐	☐	☐	☐	☐
SECTY	☐	☐	☐	☐	☐	☐

TODAY'S DATE 4/1
DATE DUE 4/7
BY

P+C

MAYOR
-1 PM 2:14

March 31, 1993

The Honorable Linda Lingle, Mayor
County of Maui
200 High Street
Wailuku, Hawaii 96793

Dear Mayor Lingle: Aloha!

Kalamaula Landfill Closure
Draft Environmental Impact Statement

Thank you for providing the Department of Hawaiian Home Lands with a copy of the draft Environmental Impact Statement for the subject closure.

As the owner of the land underlying the landfill and our concern for the surrounding homestead community, we want to insure that the closure of the Kalamaula Landfill is conducted in a way that minimizes risks and maximizes protection of the health and safety of the people and environment.

While we concur with the recommendation for in-place closure of the landfill, we are concerned about the adequacy of the post-closure monitoring plan. The DEIS mentions a five-year monitoring program on page 2-14. According to 40CFR, Sections 258.16 and 258.61, landfills located in the 100-year floodplain require post-closure care for 30 years. Our discussions with your staff on this matter have confirmed the County's commitment to the long-term monitoring and maintenance of the landfill. We feel its important that this be made clear. We request that you clarify your timetable for closure and maintenance. We would also like to receive copies of all monitoring reports sent to the Department of Health.

Should you have any questions regarding our comments, please feel free to call Ray Soon, Land Development Administrator at 586-3815 or Ben Henderson, Planning Administrator at 586-3838.

Warmest Aloha,

Hoaliku L. Drake

Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

HLD:bh/2788L

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
AARON SHINMOTO, P.E.
Chief Staff Engineer

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
LLOYD P.C.W. LEE, P.E.
Engineering Division
DAVID WISSMAR, P.E.
Solid Waste Division
BRIAN HASHIRO, P.E.
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

May 21, 1993

Ms. Hoaliku L. Drake, Chairperson
State of Hawaii
Department of Hawaiian Home Lands
P.O. Box 1879
Honolulu, Hawaii 96805

Dear Ms. Drake:

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Thank you for your letter of March 31, 1993, regarding the subject project and the Draft EIS. Your letter addresses a concern over adequate long-term monitoring and maintenance of closed landfill.

The County of Maui will stop receiving wastes at the Kalamaula Sanitary Landfill on October 8, 1993, and will have six (6) months to complete final cover installation. Therefore, pursuant to 40 CFR Part 258.1, the County will be exempt from all requirements of Part 258 except the final cover requirements specified in Part 258.60.

The post closure maintenance plan was discussed in Chapter 2 of the Draft EIS. This post closure monitoring plan is currently being negotiated with the State Department of Health (DOH) and U.S. Environmental Protection Agency (EPA). The preliminary plan is included in Chapter 4 of the Final EIS. At this time, quarterly testing for an initial 2-year period followed by semi-annual monitoring for a 3 year period (unless the monitoring results demonstrate a reason for concern and the need for more frequent monitoring), may be acceptable to the agencies. Copies of all monitoring reports sent to the DOH will also be sent to the Department of Hawaiian Home Lands.

Thank you for your comments and participation in the Draft EIS review process. Your letter and this letter will be appended in the Final EIS.

Very truly yours,

George N Kaya

GEORGE N. KAYA
Director of Public Works

DFW:jip

xc: Mr. Brian Choy, Office of Environmental Quality Control

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/1590

April 5, 1993

The Honorable Linda Crockett Lingle
Mayor, County of Maui
200 South High Street
Wailuku, Hawaii 96793

Attn: Mr. Richard Haake, Managing Director

Dear Mayor Lingle:

Re: Draft EIS for the Kalamaula Sanitary Landfill Closure Project

Thank you for the opportunity to review the subject draft EIS. We have no comments to offer.

Sincerely,

JOSEPH K. CONANT
Executive Director

c: Office of Environmental Quality Control
Mr. David Wissmar
✓ Mr. Bob Armstrong

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
AARON SHINMOTO, P.E.
Chief Staff Engineer

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
LLOYD P.C.W. LEE, P.E.
Engineering Division
DAVID WISSMAR, P.E.
Solid Waste Division
BRIAN HASHIRO, P.E.
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

May 06, 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, Hawaii 96813

Subject: Kalamaula Landfill Closure
Draft Environmental Impact Statement (EIS)

Dear Mr. Conant:

Thank you for your participation in the Draft EIS review process. Your letter and this letter will be appended to the Final EIS.

Very truly yours,

GEORGE N. KAYA
Director of Public Works

DFW:jip

05/07/93\E:\LRE\7009\7009-14\LETTERS\LTR-6.WPS
QMS-PS825

JOHN WAIHEE
GOVERNOR

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
JOYCE T. OMINE
AL PANG
JEANNE K. SCHULTZ
CALVIN M. TSUDA

IN REPLY REFER TO:

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HARBORS DIVISION
103 ALA LUINA STREET
KAHULUI, HAWAII 96732-0216

'93 APR -5 A11:11

APRIL 1,1993

TO: COUNTY OF MAUI, PLANNING DEPT.

FROM: DOT/HARBORS DIVISION, MAUI DISTRICT

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE

Subject project reviewed without comment.

HC:ss

DEPT OF PLANNING

uty Dir. ☐ Assign ☐
cretary ☐ Rush ☐
rrent Div. ☐ See Me ☐
ng Range ☐ Comments ☐
nergy Div. ☐ Draft ☐
min. ☐ Handle ☐
Clay ☐ File ☐
☐ FYI ☒
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Today's date 4/6/93
Date Due
By

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
AARON SHINMOTO, P.E.
Chief Staff Engineer

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
LLOYD P.C.W. LEE, P.E.
Engineering Division
DAVID WISSMAR, P.E.
Solid Waste Division
BRIAN HASHIRO, P.E.
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

May 12, 1993

State of Hawaii
Department of Transportation
Harbors Division, Maui District
103 Ala Luina Street
Kahului, Hawaii 96732-0216

Subject: Kalamaula Landfill Closure
Draft Environmental Impact Statement (EIS)

Gentlemen:

Thank you for your participation in the Draft EIS review process. Your letter and this latter will be appended to the Final EIS.

Very truly yours,

George N Kaya

GEORGE N. KAYA
Director of Public Works

DFW:jip

STATE OF HAWAII
1959

JOHN WAIHEE
Governor
MUFI HANNEMANN
Director
BARBARA KIM STANTON
Deputy Director
RICK EGGED
Deputy Director
TAKESHI YOSHIHARA
Deputy Director

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 PHONE: (808) 587-3800 FAX: (808) 587-3820

March 10, 1993

The Honorable Linda Crockett Lingle
Mayor, County of Maui
200 South High Street
Wailuku, Hawaii 96793

Dear Mayor Lingle:

SUBJECT: Kalamaula Sanitary Landfill Closure Project
Island of Molokai , District of Kalamaula
Tax Map Key: 5-2-11:por. 1, 21 and 5-2-08:24

We wish to inform you that we have no comments to offer on the subject Draft Environmental Impact Statement (DEIS).

Thank you for the opportunity to submit any concerns or comments.

Sincerely,

Maurice H. Kaya
Energy Program Administrator

MHK:eis75hk

cc: DPW, County of Maui
✓Brown and Caldwell Consultants

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
AARON SHINMOTO, P.E.
Chief Staff Engineer

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
LLOYD P.C.W. LEE, P.E.
Engineering Division
DAVID WISSMAR, P.E.
Solid Waste Division
BRIAN HASHIRO, P.E.
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

May 06, 1993

Mr. Maurice H. Kaya
Energy Program Administrator
State of Hawaii
Department of Business, Economic
Development and Tourism
Energy Division
335 Merchant Street, Room 110
Honolulu, Hawaii 96813

Subject: Kalamaula Landfill Closure
Draft Environmental Impact Statement (EIS)

Dear Mr. Kaya:

Thank you for your participation in the Draft EIS review process. Your letter and this letter will be appended to the Final EIS.

Very truly yours,

George N Kaya

GEORGE N. KAYA
Director of Public Works

DFW:jip

05/07/93\E:\LRE\7009\7009-14\LETTERS\LTR-8.WP5
QMS-PS825

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
JOYCE T. OMINE
AL PANG
JEANNE K. SCHULTZ
CALVIN M. TSUDA

IN REPLY REFER TO:
STP 8.5099

March 10, 1993

The Honorable Linda Crockett Lingle
Mayor
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Attention Richard Haake

Dear Mayor Lingle:

Subject: Draft Environmental Impact Statement
Kalamaula Sanitary Landfill Closure Project

We have no objections to Maui County's proposal to close the Kalamaula landfill, development of off-site borrow areas, and enhancement of the Ohiapilo Pond. These actions will not adversely impact our transportation facilities.

Thank you for the opportunity to provide comments.

Sincerely,

Rex D. Johnson
Director of Transportation

c: Mr. David Wissmar, Maui County Dept. of Public Works
✓ Mr. Bob Armstrong, Brown and Caldwell Consultants

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
AARON SHINMOTO, P.E.
Chief Staff Engineer

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
LLOYD P.C.W. LEE, P.E.
Engineering Division
DAVID WISSMAR, P.E.
Solid Waste Division
BRIAN HASHIRO, P.E.
Highways Division

May 06, 1993

Mr. Rex D. Johnson
Director of Transportation
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Subject: Kalamaula Landfill Closure
Draft Environmental Impact Statement (EIS)

Dear Mr. Johnson:

Thank you for your participation in the Draft EIS review process. Your letter and this letter will be appended to the Final EIS.

Very truly yours,

George Kaya

GEORGE N. KAYA
Director of Public Works

05/06/93\E:\LRE\7009\7009-14\LETTERS\LTR-11.WP5
QMS-PS825

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE ADJUTANT GENERAL
3949 DIAMOND HEAD ROAD, HONOLULU, HAWAII 96816-4495

EDWARD V. RICHARDSON
MAJOR GENERAL
ADJUTANT GENERAL

MYLES M. NAKATSU
~~COLONEL~~
~~DEPUTY ADJUTANT GENERAL~~
BRIGADIER GENERAL (HI)
DEPUTY ADJUTANT GENERAL

March 8, 1993

Engineering Office

Mr. Richard Haake
Managing Director
County of Maui
200 South Highway
Wailuku, Hawaii 96793

Dear Mr. Haake:

Subject: Kalamaula Sanitary Landfill Closure Project

Thank you for providing us the opportunity to review the above mentioned environmental assessment.

We have no comments to offer at this time regarding the project.

Sincerely,

Jerry M. Matsuda

Jerry M. Matsuda
Lieutenant Colonel
Hawaii Air National Guard
Contacting and Engineering Officer

cc: Department of Public Works, County of Maui
Mr. David Wissmar
✓Brown and Caldwell Consultants
Mr. Bob Armstrong

NATIONAL GUARD
★ ★ ★ ★ ★ ★ ★ ★ ★ ★
Americans At Their Best.

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
AARON SHINMOTO, P.E.
Chief Staff Engineer

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
LLOYD P.C.W. LEE, P.E.
Engineering Division
DAVID WISSMAR, P.E.
Solid Waste Division
BRIAN HASHIRO, P.E.
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

May 06, 1993

Lieutenant Colonel Jerry M. Matsuda
State of Hawaii
Department of Defense
Office of the Adjutant General
3949 Diamond Head Road
Honolulu, Hawaii 96896-4495

Subject: Kalamaula Landfill Closure
Draft Environmental Impact Statement (EIS)

Dear Lieutenant Colonel Matsuda:

Thank you for your participation in the Draft EIS review process. Your letter and this letter will be appended to the Final EIS.

Very truly yours,

George Kaya

GEORGE N. KAYA
Director of Public Works

DFW:jip

05/06/93\E:\LRE\7009\7009-14\LETTERS\LTR-12.WP5
QMS-PS825

(P)1252.3

APR 30 1993

The Honorable Linda Crockett Lingle
Mayor
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Dear Mayor Lingle:

Subject: Kalamaula Sanitary Landfill Closure Project
Kalamaula, Molokai

We have reviewed the subject document and have no comments to offer.

If there are any questions, please have your staff call Mr. Ralph Yukumoto of the Public Works Division at 586-0488.

Respectfully,

Robert P Takushi

ROBERT P. TAKUSHI
State Comptroller

RY:jy
cc: Dept. of Public Works, County of Maui
✓Brown and Caldwell Consultants

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
AARON SHINMOTO, P.E.
Chief Staff Engineer

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
LLOYD P.C.W. LEE, P.E.
Engineering Division
DAVID WISSMAR, P.E.
Solid Waste Division
BRIAN HASHIRO, P.E.
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

May 21, 1993

Mr. Robert P. Takushi
State Comptroller
1151 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Takushi:

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Thank you for your participation in the Draft EIS review process. Your letter and this letter will be appended to the Final EIS.

Very truly yours,

George N Kaya

GEORGE N. KAYA
Director of Public Works

DFW:jip

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

RECEIVED
MAY 10 1993
BROWN AND CALDWELL

In reply, please refer to:
92-239/epo

May 3, 1993

The Honorable Linda Crockett Lingle
Mayor, County of Maui
200 South High Street
Wailuku, Maui, Hawaii 96793

Attn: Mr. Richard Haake
Managing Director

Dear Mayor Lingle:

Subject: Draft Environmental Impact Statement (DEIS)
Kalamaula Sanitary Landfill Closure Project
Molokai
TMK: 5-2-11: por. 1, 21 and 5-2-08: 24

Thank you for allowing us to review and comment on the subject document. We have the following comments to offer:

Solid Waste

Maui County is planning to close the subject landfill, which is located in a wetland, and open a new integrated solid waste (ISW) facility in Naiwa, Molokai. The new ISW facility will consist of both a landfill and a recycling center.

The closure of the Kalamaula Landfill is subject to the requirements of the State Administrative Rules, Title 11, Chapter 58, and federal regulations 40 CFR 258, Solid Waste Disposal Facility Criteria, Section 60; "Closure Criteria," provided that the landfill stops accepting waste and begins the closure process before October 9, 1993. The Department of Health is presently reviewing the closure plan for the Kalamaula Landfill and will reserve the right to submit further comments to County of Maui at a later date.

1 It appears that monitoring well No.8 is a little too close to the landfill boundary to be considered an upgradient well. This is especially significant because of the very flat water table. **2** The arsenic levels detected in MW-3 may indicate that there could be hot spots in the landfill which will need to be addressed.

If you should have any questions on this matter, please contact Gary Siu of the Office of Solid Waste Management at 586-4227.

Nonpoint Source Pollution

After removing soils from the borrow sites, the following conservation measures should be ~~should be~~ considered to revegetate the area and prevent erosion:

a. Grub area sequentially so that only a small portion of the borrow site is bare at any one time.

3 b. Replant or cover bare areas as soon as construction is completed. Since topsoil will be removed from the borrow sites, rates of fertilizers and soil amendments should be applied according to soil test recommendations to assist new plantings during the period of establishment. Use high seeding rates to ensure rapid stand establishment.

If you should have any questions on this matter, please contact Ms. Shirley Kaneshiro of the Environmental Planning Office at 586-4337.

Hazard Evaluation

4 At this time, Kalamaula Landfill, South Molokai (HID980497192), is listed in the Environmental Protection Agency's (EPA's) Comprehensive Environmental Response, Compensation, and Liability Information System (CERLIS) database, dated April 5, 1993. Based on the EPA Expanded Site Inspection conducted by Bechtel Environmental, Inc., (January 1992), sampling showed a release of contaminants to the wetlands. However, as long as EPA and County of Maui cooperation continues, the landfill will remain a low priority for further Superfund action.

If anyone wish to review the site-specific file on the Kalamaula Landfill, please contact Liz Galvez of the Hazard Evaluation and Emergency Response Office at 586-4695.

Very truly yours

Bruce Anderson for

JOHN C. LEWIN, M.D.
Director of Health

c: Office of Solid Waste Management
Environmental Planning Office
Hazardous Evaluation & Emergency Response Office
Office of Environmental Quality Control
County of Maui, Department of Public Works
Brown & Caldwell Consultants
Maui, District Health Office

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
AARON SHINMOTO, P.E.
Chief Staff Engineer

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
LLOYD P.C.W. LEE, P.E.
Engineering Division
DAVID WISSMAR, P.E.
Solid Waste Division
BRIAN HASHIRO, P.E.
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

May 21, 1993

Dr. John C. Lewin
Director of Health
State of Hawaii
Department of Health
Post Office Box 3378
Honolulu, Hawaii 96801

Dear Dr. Lewin:

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Thank you for your letter of May 3, 1993, regarding the subject project and the Draft EIS. To facilitate responses, your comments have been numbered and are addressed below:

1. The section on geology, soil, and water resources in Chapter 4 has been revised for the Final EIS to reflect re-evaluation of the existing water level data and collection of long-term water level fluctuations as part of the tidal influence study that has been done since the Draft EIS was published. The groundwater contour data indicate that MW-8 could serve as a suitable background well a majority of the time because groundwater flow is generally from MW-8 toward the ocean. However, there are instances when this may not be the case. In addition, the water quality data indicate that the landfill has had some effect on MW-8. Thus, the EIS recognizes that MW-8 would not be a suitable background well for use during postclosure monitoring of the landfill.

   The Final EIS now indicates that a new background well should be located for use during postclosure monitoring. Such a well should be located in an area of brackish water similar to that which exists in the landfill area, thus, providing for a direct comparison of constituent levels. Such a location may be lateral to the landfill and not upgradient. Installing a background well upgradient in an area of "fresh" groundwater is not appropriate for the brackish water situation at this landfill. A well monitoring "fresh" groundwater would provide a false indication of landfill leakage because all constituents would be expected to be higher when compared to "fresh" groundwater unaffected by seawater. The use of MW-8 in the hydrogeological assessment does not invalidate the data or closure approach. The details of the postclosure monitoring program will be negotiated with the State Department of Health (DOH) and the U.S. Environmental Protection Agency (EPA).

2. The monitoring results to date will serve to focus the postclosure monitoring program.The postclosure monitoring program will determine at a future time the existence and extent of any problems and any remediation action necessary.

3. Comment noted. The conservation measures suggested would have varying applications in the soil borrow areas under consideration. Site 4 is under consideration for low permeability soils but its end use would be a reservoir as desired by Molokai Ranch. Only selected areas would be subject to revegetation.

   Sites 1, 2, and 3 are available for obtaining soils for supporting vegetative growth. Site 1 may be used for expansion of wastewater ponds owned by Molokai Ranch and, as such, only selected areas would be subject to revegetation. Sites 2 and 3 are existing quarry operations and the need for revegetation would be controlled under permits that regulate these facilities.

4. Comment noted.

Thank you for your comments and participation in the Draft EIS review process. Your letter and this letter will be appended to the Final EIS.

Very truly yours,

George N Kaya

GEORGE N. KAYA
Director of Public Works

DFW:jip

14

April 3, 1993

Mr. George Kaya, Director
Department of Public Works and Waste Management
200 South High Street
Wailuku, Maui, Hawai'i 96793

Subject: KALAMAULA LANDFILL CLOSURE PROJECT - DRAFT ENVIRONMENTAL IMPACT STATEMENT

DW

Dear Mr. Kaya,

1 Having reviewed the Kalamaula Landfill Closure Project-Draft Environmental Impact Statement, I remain concerned about the mitigation actions and enhancement plan for the Ohiapilo Wetlands. I would like to recommend using restoration of Kaluaapuhi Fishpond instead. The positive impact would be much better for the wildlife, and the greater public good would also be better served. Hawaiian fishponds are Hawaiian cultural treasures and not simply "wetlands."

2 I would also like to see the rubbish removed from the Kalamaula dump and placed at the new landfill, once it's constructed with an impermeable liner. The Kalamaula site should be cleaned and restored to its original state. The threat to our ocean food chain is too great with this dump sitting there like a time bomb waiting to go off.

3 I am not satisfied with having only one consultant's opinion regarding contaminants from the dump, especially when they are a private firm hired by Maui County. Two opinions and findings are needed due to the sensitive ocean food chain and the groundwater under the dump. The answers regarding contaminants, especially arsenic, found in our food chain does not sit well with those of us who get our food from the ocean.

4 More input from the State Department of Health is needed. The consultants' answers on March 31, 1993 to our questions here on Moloka'i included the statement that DOH sent a letter saying there was nothing to worry about because of the arsenic. Could I please be sent a copy of that letter?

Thank you for your attention to these concerns.

Sincerely,

Walter Ritte
P.O. Box 486 Kaunakakai, Hawai'i 96748

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
AARON SHINMOTO, P.E.
Chief Staff Engineer

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
LLOYD P.C.W. LEE, P.E.
Engineering Division
DAVID WISSMAR, P.E.
Solid Waste Division
BRIAN HASHIRO, P.E.
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

May 21, 1993

Mr. Walter Ritte
Post Office Box 486
Kaunakakai, Hawaii 96748

Dear Mr. Ritte:

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Thank you for your letter of April 3, 1993, regarding the subject project and the Draft EIS. To facilitate responses, your comments have been numbered and are addressed below:

1. Comment noted. The Kaluaapihi Fishpond was considered as a mitigation option by the U.S. Fish and Wildlife Service (FWS), the County, and our consultants as discussed in Chapter 3 of the Final EIS. However, this site was not recommended because the initial cost of restoration would be prohibitive and the mangrove would be a hindrance to long-term maintenance and management of the site as an endangered species habitat which is a key consideration to the FWS. Mangrove is nonindigenous to the area, has taken over the wetlands in many areas, and it is impossible to remove mangroves from fishpond areas as they are too well established. However, the FWS will receive of a copy of your letter by virtue of the EIS process and consideration will be given to your concerns.

2. Your suggestion regarding removal of all the refuse from the Kalamaula Landfill and restoration of the area to its original state was considered as Alternative 3 in Chapter 3 of the Draft EIS. This alternative, however, was rejected because of greater concern for environmental impacts and cost. Excavation of the wastes has the risk of remobilizing heavy metals that might otherwise remain bound and isolated from the surrounding environment. If remobilization were to occur, unknown and potentially significant environmental and public health and safety impacts could occur.

This is a concern shared by the FWS, the State Department of Health (DOH), the U.S. Environmental Protection Agency, the County, and our consultants.

3. The consultants were retained by the County for this project because they possess the engineering, technical, and environmental expertise to address the complex issues surrounding the Kalamaula Sanitary Landfill Closure project in a fair and objective manner. The various regulatory agencies have reviewed the studies prepared by the consultants and support their recommendations.

4. The letter from the DOH is enclosed for your review and is included as Appendix I to this Final EIS. For your information, additional studies on the arsenic issue in the coastal area have also been conducted since the Draft EIS was published and these results are included as Appendix H.

Thank you for your comments and participation in the Draft EIS review process. Your letter and this letter will be appended to the Final EIS.

Very truly yours,

George N Kaya

GEORGE N. KAYA
Director of Public Works

DFW:jip

xc: Mr. Brian Choy, Office of Environmental Quality Control

Sarah E. Sykes

March 30, 1993

Mr. George Kaya, Director
Department of Public Works and Waste Management
200 South High Street
Wailuku, Maui
Hawai'i 96793

Subject: KALAMAULA LANDFILL CLOSURE PROJECT -
DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Kaya:

Thank you for the opportunity to review the subject document.

1 While I greatly appreciate Moloka'i staff cooperation in facilitating access to most technical study documents, TM-5, which I believe is the "Survey of Wetland Ecosystems," has not been available on Moloka'i for appropriate and timely review. Please make this available at your earliest convenience, certainly within sufficient time to permit careful review and comment before the April 22, 1993 response deadline.

2 As the commentor questioning the "appropriateness of using MW-8 as a background well," I was relieved to note, on page 4-23 of the document, expressed reservations about "the suitability of MW-8 as an upgradient well." Recent data from existing upgradient wells indicates far worse problems attributable to the Landfill. These are detailed in the attached analysis. As the DEIS now reads, based on invalid data, I believe your conclusions and consequent planning are indefensible.

3 May I properly request an addendum to this DEIS, utilizing new and more valid background sample data? Certain conclusions may change in light of better information, and I believe it is important to get all the facts out to the public to make the best clean-up and closure plan possible. Such an official addendum would require appropriate response time, as well as another public meeting on Moloka'i, but in fairness to all, and respect to citizens' need to know, such a delay in your implementation timetable is certainly justifiable.

(con'd.)

P.O. Box 370 Kaunakakai, Hawai'i 96748 1-808-553-3831

4 Delighted to note on page 1-5 of the DEIS, "Construction-related needs for closure will serve as short-term income generators for the local economy. . . ." and on page 4-78, "The closure will require truckers and equipment operators, as well as a source of cover material. These construction-related needs will serve as short-term income generators for the Island of Molokai." To make certain this positive impact is actually accomplished, please direct the project managers to hire Moloka'i folks only, for every job.

5 Having read all the on-island-accessible appropriate documents, I request that you revise your containment and remediation construction closure plans to include a full-depth, complete-surround containment wall; removal of those wastes within the 100-year flood hazard area; and, incorporation of an impermeable synthetic liner inter-layered in the final cover. I further request that Maui County plan to implement full 30-year monitoring and appropriate financial assurances; and, provide timely and complete community education and warning relative to the potential dangers remaining in the environment due to the subject Landfill.

6 It was enlightening to read the early documents, then the Technical Memoranda, then the DEIS. I can't quite tell if it was the folks in Finance or the folks in the Mayor's office who had the most say in editing to the DEIS version. In any case, the DEIS base assumption is clear: Maui County is committed to stonewalling their position that no contaminant in the environment is directly attributable to the Landfill, and I personally find that stance repugnant.

7 We all know we have a dirty little dump on Moloka'i. We need to work together to clean it up to the greatest degree possible, we need to contain the leachate to the greatest extent possible, and the community needs to be appropriately warned about possible health hazards. Whether or not all the contamination problems are attributable to the Landfill should be the least of your worries. Maui County can be sued under RCRA Section 7002 regardless. But a lawsuit solves no problems. The dirty little dump still needs work, whoever wins the suit.

8 EPA recommended that "the Landfill be placed on the low priority Superfund list as long as work progresses by the County towards containment and remediation." (TM-3) Containment and remediation must include a containment wall and the impermeable cover, or all contaminants

(con'd.)

continue to enter the environment. From TM-3, "The function of the containment wall will be to limit possible leakage of contaminants beyond the closure boundary. The containment wall would be a low permeability material keyed into a natural impermeable layer under the Landfill. The slurry would be placed in a 2-foot-wide trench. Based on the data from Well W-7, the depth would be approximately 45 feet. The length could vary."

9 Only easy, except the wall never made it into the final closure plan recommendations. That's where the folks in Finance must have made their first edit. At estimated costs between $330 to $350 per linear foot, it isn't cheap to make the wall. But it is less expensive than costs associated with the loss of human and animal health, damage to the environment, loss of subsistence resources, loss of safe recreational resources, loss of air, water and land quality, etc., ad nauseam.

10 We are still going 'round and 'round with the County about whether or not we will have a new landfill that lives up the letter and intent of the law (40 Code of Federal Regulations [CFR], Part 258). It will not qualify for the exemptions as a small landfill, and therefore must be lined and groundwater must be monitored from the start. The County has known this all along, and still wants to start the new facility as cheaply as possible. Therefore, I am not at all assured that plans detailed in this DEIS will proceed to reality, or that the County will in fact implement real containment and remediation, as required by EPA. Historically, Maui County has treated Moloka'i as a poor step-sister, and if you can do this clean-up and closure on the cheap, you will. But that's short-sighted self-interest, miserably failing the public trust.

More details raising red flags from the DEIS:

11 Page 2-14: LFG monitoring system. Since LFG production is likely to increase with time as decomposition proceeds, it is later years which may produce the most dangerous conditions. Please do not plan to monitor for only a year or two. The full 30-year monitor must be part of the plan.

Page 2-14: "Based on the Hydrogeological assessment by Brown and Caldwell, the impact of the Landfill on groundwater resources is not significant." The consultant assessment was based on invalid data from a

(con'd.)

12 background sample well located almost within the dump, not at all upgradient from the Landfill. There was observed tidal mixing in all test wells. "Water levels in the basal lens along the coast are influenced by ocean tides. . . . The sands encountered in most of the boreholes are assumed to have very high permeability. . . . Visible recovery occurred in all wells almost immediately after development pumping ceased. . . . The landfill is located within the nearly level Kealia silt loam of the Kealia soil series. Ponding of the water after heavy rains is typical of this soil series . . . . Because the Landfill is not lined and groundwater is shallow, it is probable that leachate from the landfill has entered and mixed with the groundwater below the landfill. . . . These gradients suggest a nearly horizontal water table. . . . Shallow wells dug along the southern coast of the island for irrigation purposes tap this brackish water. . . . (Please bear with me, keeping in mind that the general flow direction of any contaminant plume is seaward during low tide and most of the high tide, and that water flow is 200 times faster horizontally than it is vertically) . . . . During some periods of high tide there may actually be a reversal of groundwater flow direction (that is, pushing the contaminant plume inland). . . . The data collected during the field investigation supports EPA's conclusion that releases of contaminants have occurred. . . . Contaminants were found in surface water, stream channel, and sediment, surface and subsurface soil at concentrations a minimum of three times the background levels. . .these constiuents can be used to quantify and qualify an observed release from the Kalamaula Landfill to the wetlands. . . . (and they didn't even have a valid background sample site sufficiently upgradient from the Landfill, which means it's quite probably worse than first thought). . . ." (TM-3 and TM-4)

13 I do not understand how the DEIS say all of this, and then have the audacity to say, "However, the slow movement of the groundwater causes leachate contaminants to move slowly after reaching groundwater, allowing contaminant dilution to take place. . . . The results of the hydrogeologic study have demonstrated that the Landfill is not contributing significant contaminants to the groundwater or soils beneath the Landfill." (DEIS 4-23, 4-24)

The scene under the Landfill may be a little like a very leaky washtub filled almost to the brim. The tide comes in and the tide goes out, it sloshes the washtub water around and some spills out, some leaks out, some leaks in. But the dirty water in the washtub remains for a long, long time, slowly

(con'd.)

leaking, slowly sloshing the dirty water all around, until, over time, the water in the tub is the same as the water around the tub. . . all a little bit dirtier forever. We're going to have the effects of this dirty little dump with us for a long, long time. 14

15 Page 2-20: I am uncomfortable with your proffered enhancement plan, but assured that there will be a process for further public review of that portion of the project. Perhaps you might want to discuss options with the Governor's Subsistence Task Force, as well as the Fishponds Task Force, before deciding what to propose.

16 Pages 3-12, 3-14, 3-15: Re: time constraints on completion of closure, costs, and continuing to stonewall that there is no contamination attributable to the Landfill: Maui County, please, rather than fight against cleaning up, containing and remediating this dirty little dump properly, please put all your efforts and resources to work to keep the sloshing and spilling of the identified contaminants at a sufficiently low rate to avoid killing our fish, our kids, our water. You're losing time, you deserve no exemption. This is not a newly discovered problem. Too much time has been wasted trying to hide the truth from the public. Better to spend the time educating the public so we don't get sick, so we don't lose our resources, so we start cleaning up our own act in what we take to the dump.

17 (We should be just as worried that the County's sewage treatment plant near town, located on the site of the old dump, is exacerbating leachate transfer from that old site into the environment by the injection well pumping. . . and perhaps also contributing to the observed contamination.)

18 Page 4-21, Page 4-28: The DEIS concedes on page 4-23 that MW-8 is not a valid upgradient background sample site, but still says, "It should be noted that toluene and xylene were also detected in MW-8, located upgradient of the Site. . . . the hydrogeologic study has demonstrated that the Landfill has not contributed significant contaminants to the groundwater, soils, and surrounding surface waters." Either you didn't proof the DEIS or you're hoping nobody notices that you know you're basing improper conclusions on invalid data, and still using them in your planning justifications. Cut it out.

(con'd.)

19 Page 4-28: I would prefer that you remove waste from the identified 100-year flood hazard zone, rather than leave at greater risk the land, water and reef. It's not a lot to move.

20 Page 4-31: Please monitor for all 40 CFR, Part 258 Appendix I and Appendix II constituents for the full 30-year period specified by EPA in order that Moloka'i residents might have some assurance of your concern for their health and safety.

Pages 4-56 through 4-68: Biological Resources: "Tissue burdens for arsenic, on the other hand, are suggestive of contamination. . . . Subsurface samples detected lead and arsenic at concentrations that were used to demonstrate a release of contaminants from the Landfill (that is, at least three times higher than background sample, and they never compared with a clean background sample). . . . Sediments section, Tissue Trace Metals section. . . . Bioaccumulation of arsenic is thought to be unique in that marine organisms show significantly greater concentrations of arsenic than terrestial (aquatic) organisms. . . . The significance of the high arsenic values in most of the species collected from the mangrove and NS areas both off the Landfill and other parts of the Kalanianaole to Pakanaka Fishpond wetlands in light of these earlier studies would seem indicative of arsenic contamination. . . . From these results it would appear that arsenic contamination of the NS biota off the Molokai wetlands has occurred. . . . Arsenic solubility has been found to be greater in brackish water than in either fresh or sea water. . . "

All the data, all the information. . . add to it the fact that the Kaunakakai town sewage disposal plant discharges only partially treated sewage into the ocean, and sometimes does it at the well near the plant which is built on the site of the old town dump. . . . significant contaminants are coming from County facilities. Some is from the Kalamaula Landfill, some is from the old dump, some is from the sewage treatment plant. . .and some is precipitating out of the soil or added as agricultural non-point source pollution. It all mixes with the currents and tides.

21 Rather than excuse and exempt the Landfill as the source because of the widespread contamination occurrence. . . please, clean it up, contain it, slow it down! It's poisoning Moloka'i's best, most-relied on refrigerator, and the people who go to that refrigerator to feed their families.

(con'd.)

22 Page 4-68: "Although fishing efforts in this area would be classified as subsistence rather than commercial in nature, caught crabs might be shipped to Honolulu and sold at market there." What? You don't care if you poison Moloka'i folks, but you wouldn't want to sell the food on Oahu?

23 I really did hope, after talking with the consultants and the County in February, that Maui County was going to close this dirty little dump right. This DEIS only says you're going to try to get away with doing it as quick, cheap and dirty as the community lets you. 'A'ole loa!

Thank you for the opportunity to hold you accountable for your decisions.

Sincerely,

Sarah E. Sykes

PARTIAL DATA COMPARISON/GROUNDWATER - mg/l milligrams/liter
1 *u*g/l = .001 mg/l *u*g/l micrograms/liter

Constituent	Kualapuu	MW-1	MW-3	MW-5	MW-6	MW-8 (DEIS "background")
Arsenic	<.001	.041	.006	.042	.016	.0066
NO2+NO3	.28	<.4	<.4	<.4	<.4	<.4
Calcium	9.6	930	180	630	360	68
Magnes.	11	210	58	140	110	60
Potass.	3	70	34	85	55	30
Chloride	64	2100	920	2000	1700	1000
Sulfate	11	260	130	300	120	160
Barium	<.1	.33	<.05	.31	<.05	<.05
Chromium	<.01	<.05	<.05	.07	<.05	<.05

The special case of Kalamaula

(p. 51000) "The purpose of part 258 is to establish minimum national criteria for municipal solid waste landfills. . . . for the location, design, cleanup, and closure of MSWLF units. . . . A MSWLF unit that does not meet the part 258 Criteria will be considered to be engaged in the practice of "open dumping" in violation of section 4005 of RCRA. . . . Owners and operators of MSWLFs that stop receiving waste between October 9, 1991 and October 9, 1993 are exempt from all of the requirements of part 258 except the final cover requirements cited in §258.1 (d)."

24 If the Kalamaula dump is still receiving waste on or after October 9, 1993, it must meet the national protection standards, which must be reflected in the State performance standards to protect groundwater. It can't.

25 If the current dump opens a new dumping area laterally (that is, stops building the Pu'u o Opala), it must meet part 258 Criteria. It can't.

And if groundwater, or, in certain cases, if surface water is contaminated, there is a real problem. That real problem is clean-up (corrective action) and who pays for it.

The final closure must begin no later than November 8, 1993. It "must be completed within 180 days of the beginning of closure activities." And post-closure care must continue for at least 30 years. Corrective action, if necessary, must continue until the contaminants are not present for three consecutive years.

26 (p. 51102) ". . .the Agency (EPA) is unwilling to grant less stringent requirements or exemptions to small landfills that otherwise do not meet the criteria for exemptions to today's rule as discussed in Section IV.A of the preamble. Without post-closure care, the probability of future contamination greatly increases. In addition, the costs of cleaning up a release that might occur in the absence of post-closure care would likely be much greater than if the site had been properly maintained and monitored and under constant surveillance."

(p. 51096) "The Agency continues to believe that the level of detail required in the plans represents the minimum level necessary to ensure adequate planning by the owner or operator, to provide criteria for evaluating the adequacy of these plans, and to ensure the enforceability of closure requirements by citizen suits."

27 Kalamaula must be closed properly, possibly cleaned up, and kept under care for at least 30 years. Not because it's filling up, but because it's too dirty to stay open.

28 And, the public must be informed about all the closure and post-closure plans, all the possible contaminants and confirmed contaminants, and any and all corrective action proposals and progress.

(p. 50994) Recognizing certain drawbacks, EPA recognizes "without qualified State oversight (meaning EPA-approved rules), owners and operators intent upon circumventing the regulations may find it easier to do so."

Alphabet soup terms such as MCLs (Maximum Contaminant Levels), background ground-water quality, GWPS (ground-water protection standard), FWPCA (Federal Water Pollution Control Act), CWA (Clean Water Act) and CAA (Clean Air Act). . . all relate to laws and rules designed to protect surface and ground waters and air from contamination. They are all there to protect human health and the environment.

One thing we need to remember: we are the source of that contamination. We simply need to clean up our own act. If we do, if we re-cycle, re-use, reduce the waste stream. . . if we're careful with our own household hazardous wastes, if we clean up our own house first (and, no, I still haven't started sorting all my own garbage). . .then at least the new sanitary landfill has a chance to remain a clean safe depository for that waste we just can't avoid creating. And the kids won't have to face another Kalamaula clean-up in 30 years.

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
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Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

May 21, 1993

Ms. Sarah Sykes
Post Office Box 370
Kaunakakai, Hawaii 96748

Dear Ms. Sykes:

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Thank you for your letter of March 30, 1993, regarding the subject project and the Draft EIS. To facilitate responses, your comments have been numbered and are addressed below:

1. Per your request of copy of TM-5, Survey of Wetland Ecosystem, has been provided for your review by Ric Guinther of AECOS. A copy is also available at the library and at the Maui County Administration building in Kaunakakai.

2. The section on geology, soils and water resources in Chapter 4 has been revised for the Final EIS to reflect reevaluation of the existing water level data and collection of long-term water level fluctuations as part of the tidal influence study that has been done since the Draft EIS was published. The groundwater contour data indicate that MW-8 could serve as a suitable background well a majority of the time because groundwater flow is generally from MW-8 toward the ocean. However, there are instances when this may not be the case. In addition, the water quality data indicates that the landfill has had some effect on MW-8. Thus, the EIS recognizes that MW-8 would not be a suitable background well for use during post-closure monitoring of the landfill.

   The Final EIS now indicates that a new background well should be located for use during post-closure monitoring. Such a well should be located in an area of brackish water similar to that which exists in the landfill area, thus providing for a direct comparison of constituent levels. Such a location may be lateral to the landfill and no upgradient. Installing a background well upgradient in an area of "fresh" groundwater is not appropriate for the brackish water situation at this landfill. A well monitoring "fresh" groundwater would provide a false indication of landfill leakage because all constituents would be expected to be higher when compared to "fresh" groundwater unaffected by seawater. The use of MW-8 in the hydrogeological assessment does not invalidate the data or closure approach. The details of the post-closure monitoring program will be negotiated with the State Department of Health (DOH) and the U.S. Environmental Protection Agency (EPA).

3. We do not believe there is a need to prepare an EIS addendum as additional water level data have been collected and evaluated for the EIR and the issue of the background well is being further addressed in the Closure Plan. See response to comment number 2.

4. Comment noted. The County will use local contractors and materials to the extent possible for completion of the work.

5. A number of issues are included in this comment:

   Containment Wall. Relative to a containment wall, neither the County, the consultants, DOH, or EPA believe one is necessary at this time. Monitoring will be conducted and if degradation is identified, the County will implement an appropriate corrective action program as required by the DOH. It should be noted that a "full-depth" containment wall may not be feasible in areas where volcanic rock exists because it would not be possible to provide positive impermeable cutoff in fractured bedrock.

   Wastes Within Flood Hazard Area. Removal of wastes within the 100-year flood hazard area is not considered necessary for reasons that were discussed in the Draft EIS. The closure plan will include provisions for slope protection and stabilization capable of nominally withstanding the 100-year flood at specified base flood elevations.

   Synthetic Liner. Preliminary investigations indicate that suitable low-permeability soils exist on Molokai for use in the final cover. Thus, the County will meet the EPA (40 CFR 258.60) and DOH final cover requirements without use of a synthetic liner and will provide the necessary environmental protection.

   30-year Monitoring and Financial Assurances. The details of the monitoring program will be negotiated with the DOH and EPA. Based on ongoing conversations with DOH, provisions for quarterly monitoring for a 2-year period followed by semi-annual monitoring for a 3-year period (unless the monitoring results demonstrate a reason for concern and the need for more frequent monitoring), may be acceptable. Financial assurance is not required by Subtitle D because of the County's intention to closure the Kalamaula Sanitary Landfill within 180 days of last receipt of waste (October 8, 1993).

Community Education and Warning. The Kalamaula Sanitary Landfill has been in operation since the early 1970's and an extensive monitoring program has shown it not to be an environmental hazard, nor should it become one. however, if post-closure monitoring demonstrates that a significant hazard or danger exists, then appropriate community notification will be given as required by regulations.

6. Comment noted. In reality, the County had very few editorial comments on the Administrative Draft EIS provided by the consultants.

7. Comment noted. See response to comment number 5.

8. EPA supports in-place closure without a containment wall based on their review of the preliminary closure plan and supplemental technical memoranda. Also, see response to comment number 5.

9. Comment noted. See response to comment numbers 5 and 6.

10. Comments regarding the new landfill are outside the scope of this EIS. The County is under a consent order process by the EPA, as well as a solid waste facilities permitting process of the DOH, which will assure that closure and mitigation will proceed as outlined in the Final EIS. Failure to do so would result in initiation of an enforcement order process by the EPA.

11. The landfill gas investigations conducted at the landfill site in 1992 concluded that the potential for landfill gas migration is very low. Since the microorganisms that feed on the wastes and produce gas need water to survive, gas production is expected in decrease as a result of constructing the low permeability final cover. Future trends in gas production and migration would be identified by the proposed gas monitoring program. The program consists of quarterly monitoring of permanent landfill gas probes along the northern property boundary for the first year following closure. The monitoring will be adjusted in subsequent years based on the results of the first year's monitoring.

12. Groundwater data are not invalid because there are questions about the background well. See response to comments 2 and 3.

    Also, clarification of several of your comments in necessary. First, reference is made to tidal mixing. While there is tidal influence, it is not correct to call it mixing because all wells rise and fall together. Second, reference is made that "water flow is 200 times faster horizontally than it is vertically." This is not absolutely true. In general, horizontal flow is greater than vertical flow in sediments that contain clay because the clay particles are like plates and they stack up and interlock horizontally, thus reducing vertical flow. In clean sands and silts, there may be little or no difference between horizontal and vertical flow.

13. We agree with your comment regarding contribution of contaminants to groundwater and have changed the appropriate text in Chapter 4 of the Final EIS.

14. The purpose of the groundwater monitoring program will be to identify whether or not affected groundwater from beneath the landfill is moving outside the landfill and causing significant environmental impact. If significant impact is identified, then additional control measures will be required by DOH.

15. The proposed enhancement plan is preferred by the U.S. Fish and Wildlife Service (FWS), EPA, and the County, based on the review of mitigation options. However, the U.S. Fish and Wildlife Service anticipates that implementing the enhancement plan will be an involved process and input, such as you suggest, will likely be solicited.

16. The County is proposing to close the Kalamaula Sanitary Landfill in conformance with all applicable regulations. As indicated in response to your comment number 5, the landfill has been in operation since the early 1970's and an extensive monitoring program has shown it not to be an environmental hazard, nor should it become one.

17. Comments regarding the County's sewage treatment plan located on the site of the old landfill are outside the scope of this EIS.

18. See response to comments number 2, 3, and 12.

19. See response to comment number 5.

20. See response to comment number 5.

21. See response to comments number 5 and 16.

22. Since the Draft EIS was published, additional arsenic evaluations have been conducted of the biota in the coastal area. Appendix H of the Final EIS contains the full report and appropriate sections in Chapter 4 of the Final EIS have been modified accordingly. The results do not indicate a health hazard exists. This is confirmed by the DOH in their letter dated March 5, 1993, regarding this issue (see Appendix I).

23. See response to comment number 16.

24. Comment noted.

25. Comment noted. There is no proposal to expand the existing Kalamaula Sanitary Landfill.

26. Post-closure care will be provided as discussed in Chapter 2 of the Final EIS.

27. See response to comments number 5 and 16.

28. See response to comment number 5.

Thank you for your comments and participation in the Draft EIS review process. Your letter and this letter will be appended to the Final EIS.

Very truly yours,

George N Kaya

GEORGE N. KAYA
Director of Public Works

DFW:jip

xc: Mr. Brian Choy, Office of Environmental Quality Control

Sarah E. Sykes

While I understand that Friday's LUC meeting concerns itself with Molokai's new landfill — the enclosed is submitted re: the old landfill & continuing problems we experience with Maui County's refusal to address problems truthfully —

Mahalo for your time and attention to these concerns.

Sincerely,

LAND USE COMMISSION
STATE OF HAWAII
APR 21 12 45 PM '93

P.O. Box 370 Kaunakakai, Hawai'i 96748 1 808 553 3831

Sarah E. Sykes

April 20, 1993

(13)

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DEPT OF PUBLIC WORKS

	Info	Action	Reply	See Me	Comments	Copy	File
DIRECTOR	☑	☐	☐	☐	☐	☐	☐
DEP. DIR.	☐	☐	☐	☐	☐	☐	☐
PERS.	☐	☐	☐	☐	☐	☐	☐
STAFF OE	☐	☐	☐	☐	☐	☐	☐
LUCA	☐	☐	☐	☐	☐	☐	☐
WW RECL.	☐	☐	☐	☐	☐	☑	☐
SOLID W.	☑	☑	☐	☐	☐	☐	☐
ENGR.	☐	☐	☐	☐	☐	☐	☐
HWYS.	☐	☐	☐	☐	☐	☐	☐
SECTY.	☐	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐	☐

dj 7

Return to: ____________

By: ____________ Date 4/21

Mr. George Kaya, Director
Department of Public Works and Waste Management
200 South High Street
Wailuku, Maui
Hawai'i 96793

Subject: KALAMAULA LANDFILL CLOSURE PROJECT -
DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Kaya:

Continuing reading on trace metals in the environment causes me to write to you with an additional concern about the contaminants released to the environment from the Kalamaula dump. The long-term negative impacts on the economic viability of Moloka'i leeward shore fishponds may be significant.

Please incorporate by reference my letter to you of March 30, 1993, the actual analytical reports from Brown and Caldwell, and the article entitled "The Killing Fields," *Sports Illustrated*, March 22, 1993.

1 The DEIS claims no identified health problems with selenium, yet experts agree that in high concentrations, selenium is more poisonous than arsenic. It has been identified as the culprit in massive wild bird kills, embryo deaths and deformities. I'm curious if it is identifiable as a potential cause of the turtle tumors we all witness. While some of the contamination levels may be attributable to landfill leachate, and some attributable to naturally occurring selenium, it is even more important to act now to remediate the problem with real containment and clean-up of every potential source of the contaminant.

Page 4-59: "Selenium was found by Bechtel in soil samples, including the 'background' B2 sample, and in the 'background' well sample taken in the same area as sample B2." Earlier, the report stated that it was more than three times that anticipated. At 4.2 micrograms/liter at MW-8,

(con'd.)

P.O. Box 370 Kaunakakai, Hawai'i 96748 808-553-3831

perhaps it's at a dangerously high level. At concentrations of as little as 2.3 ppb, selenium in water is capable of making plants and invertebrates deadly to waterfowl that eat them. Islanders' complaints of headaches and upset stomachs, what we think of as island-wide flu, may be as attributable to selenium pisoning as it might be to arsenic contamination.

2 Once again, please, rather than fight against cleaning up, containing and remediating this dirty little dump properly, put all your efforts and resources to work to keep the sloshing and spilling of the identified contaminants at a sufficiently low rate to avoid killing our fish, our kids, our water.

3 I continue to be concerned that the County's sewage treatment plant, located on the site of the old dump, is exacerbating leachate transfer from that old site into the environment by the injection well pumping. . . and perhaps also contributing to the observed contamination.

4 Rather than excuse and exempt the Landfill as the source because of the widespread contamination occurrence. . . please, clean it up, contain it, slow it down! It's poisoning Moloka'i's best, most-relied on refrigerator, and the people who go to that refrigerator to feed their families.

5 Please monitor for all 40 CFR, Part 258 Appendix I and Appendix II constituents until they are no longer found in the environment as directed by EPA in order that Moloka'i residents might have some assurance of your concern for their health and safety. Close this dirty little dump right.

Again, thank you for the opportunity to hold you accountable for your decisions.

Sincerely,

Sarah E. Sykes

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
AARON SHINMOTO, P.E.
Chief Staff Engineer

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
LLOYD P.C.W. LEE, P.E.
Engineering Division
DAVID WISSMAR, P.E.
Solid Waste Division
BRIAN HASHIRO, P.E.
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

May 28, 1993

Ms. Sarah Sykes
Post Office Box 370
Kaunakakai, Hawaii 96748

Dear Ms. Sykes:

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Thank you for your letter of April 20, 1993, regarding the subject project. To facilitate responses, your comments have been numbered and are addressed below.

1. In the review of the results of all of the soil, sediment, and water quality data available by AECOS (Draft EIS, page 4-59), AECOS ranked selenium as the trace metal least showing evidence of site contamination, and while the ranking was very crude, no compelling reason is seen to change the position of selenium in the order. The only curious value is that from off the landfill site to the west (Bechtel, Soil Sample 2) which is more than five times the soil concentration found in the vicinity of MW-8. However, no "dangerously high levels" were seen in any of the samples. The biological tissue measurements likewise show no problems with selenium, although detection limits were a bit higher than for most of the other trace metals. Selenium is not particularly toxic to marine animals, although as you correctly state, at high concentrations selenium causes severe problems to biological systems. The indicated concentration is well below both State of Hawaii and EPA water quality criteria for fresh and marine environments. The conclusion to be drawn from the available data is that no evidence of selenium contamination emanating from the landfill was found and, therefore, no remedial action is warranted for this trace metal.

2. See responses to comment numbers 5 and 16 in your March 30, 1993, letter.

Ms. Sarah Sykes
May 28, 1993
Page 2

3. See response to comment number 17 in your March 30, 1993, letter.

4. See responses to comment numbers 5 and 16 in your March 30, 1993, letter.

5. See response to comment number 5 in your March 30, 1993, letter.

Thank you for your comments and participation in the Draft EIS review process. Your letter and this letter will be appended to the Final EIS.

Very truly yours,

for GEORGE N. KAYA
Director of Public Works

DFW:jip

xc: Mr. Brian Choy, Office of Environmental Quality Control

Hawaiian Electric Company, Inc. • PO Box 2750 • Honolulu, HI 96840-0001

William A. Bonnet
Manager
Environmental Department

RECEIVED
APR 28 1993
BROWN AND CALDWELL

April 16, 1993

Mr. Richard Haake
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Dear Mr. Haake:

Subject: **Draft Environmental Impact Statement**
Kalamaula Sanitary Landfill Closure Project

We have reviewed the subject DEIS, and have no comments on the proposed landfill closure project. MECO shall reserve further comment pertaining to the protection of existing power line facilities surrounding the landfill area until construction plans are finalized.

Sincerely,

cc: David Wissmar, Dept. of
Public Works, County of Maui
Bob Armstrong, Brown and
Caldwell Consultants

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
AARON SHINMOTO, P.E.
Chief Staff Engineer

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration
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Engineering Division
DAVID WISSMAR, P.E.
Solid Waste Division
BRIAN HASHIRO, P.E.
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

May 06, 1993

Mr. William A. Bonnet, Manager
Environmental Department
Hawaiian Electric Company
P.O. Box 2750
Honolulu, Hawaii 96840-0001

Subject: Kalamaula Landfill Closure
Draft Environmental Impact Statement (EIS)

Dear Mr. Bonnet:

Thank you for your participation in the Draft EIS review process. Your letter and this letter will be appended to the Final EIS.

Very truly yours,

GEORGE N. KAYA
Director of Public Works

DFW:jip

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RECEIVED
COUNTY OF MAUI
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SOLID WASTE DIVISION
DEPT. OF PUBLIC WORKS

University of Hawaii at Manoa

Environmental Center
A Unit of Water Resources Research Center
Crawford 317 • 2550 Campus Road • Honolulu, Hawaii 96822
Telephone: (808) 956-7361

RE:0624
April 22, 1993

Mayor Linda Lingle
County of Maui
Attention: Richard Haake
200 South High Street
Wailuku, Hawaii 96793

Dear Mayor Lingle:

Draft Environmental Impact Statement (EIS)
Kalamaula Sanitary Landfill Closure Project
Kalamaula, Molokai

The County of Maui, Department of Public Works proposes to close the Kalamaula Sanitary Landfill in Kalamaula, Molokai. The proposed project will involve the in-place Landfill closure of 18.9 acres, the development of off-site soil borrow areas, and enhancement of the Ohiapilo Pond near the Landfill. The Landfill is situated on land that is owned by the State of Hawaii, Department of Hawaiian Homelands and located on the south-central portion of Molokai, along the island's southern coastline, approximately 1.5 miles west of Kaunakakai. The potential soil borrow areas are located from 2.5 to 9 miles from the Landfill site (near Kualapuu and Maunaloa, respectively) while the Ohiapilo Pond area is adjacent to the site.

The in-place closure of the Landfill will include minor regrading of the top and sides of the Landfill and the placement of a final cover. The final cover will consist of a low permeability layer that will reduce the amount of infiltration into the Landfill. A vegetative layer will also be provided to promote evapotranspiration and to minimize erosion of cover. In addition, the Landfill will be graded to allow surface water to drain away from the filled areas.

The borrow sites will provide soils necessary for the final Landfill cover. Two types of soils are required for the final cover: (1) a low permeability layer for the bottom of the final cover, and (2) an earthen top material capable of supporting vegetative growth.

A wetlands delineation revealed that the Landfill has encroached upon 6.5 acres of wetlands since the enactment of Section 404 of the Clean Water Act of 1975. Based on the results of several technical studies, the enhancement of Ohiapilo Pond was selected for mitigation of this encroachment.

The project is under regulatory direction by the U.S. Environmental Protection Agency (EPA) through a consent order process. In addition, the closure will be in accordance with EPA's criteria for municipal solid waste landfills (40 Code of Federal regulations, Part 258).

The Environmental Center has reviewed the Draft EIS with the assistance of Roy Takekawa, Environmental Health and Safety; Frank Peterson, Geology and Geophysics; Yu-Si Fok and Henry Gee, Water Resource Research Center; Michael Beug, Environmental Chemistry UH Hilo; and Andrew Tomlinson of the Environmental Center.

General Comments

1 In general, we commend the proposed actions to close the Kalamaula Sanitary Landfill, halt its encroachment on the wetlands, and enhance Ohiapilo Pond. However, our reviewers have expressed great concern as to the accuracy of some of the statements in the Draft EIS and the validity of the background sampling data. Specifically, we question the conclusions reached regarding the migration of hazardous substances and the contamination of the area; the permeability of soils for the Landfill cap layer; and, the general procedures outlined for the Landfill's closure. These conclusions have been based on highly questionable data derived from incomplete sampling of the existing environment at the Landfill and the surrounding area. This sampling indicates contamination of the area, but gives no indication of its exact origins. The assumption that the contamination of the area, particularly with arsenic, is not due to the Landfill is not supported by the data. Furthermore, the description of the Ohiapilo Pond enhancement is also vague and its potential impacts are left undefined and inadequately discussed. The Final EIS should address these inaccuracies and inadequacies so as to meet the required standards for acceptance.

Ohiapilo Pond Enhancement

In the project description the agencies propose to implement an enhancement program for the Ohiapilo Pond, but the Draft EIS fails to include specific plans for its implementation and do not discuss any specific potential environmental impacts. A general description is offered in the Draft EIS, and states, "The activities necessary to enhance Ohiapilo Pond could range substantially depending on the planning process to be concluded by the FWS and the County." In addition, the Draft EIS generally states that, "The activities necessary to enhance Ohiapilo Pond should not result in impacts to surface or groundwater. During the development of the specific plan for the site, the County will give appropriate consideration to this matter, if necessary." Since enhancement of Ohiapilo Pond is one of the three stated purposes of the project, this general description seems inappropriate and contrary to the content requirements of Section 11-200-17 (E,I,J,K,L,M,N) Hawaii Administrative Rules of the Department of Health (HAR), for preparation of a Draft EIS. Chapter 343-6, Hawaii Revised Statues and Section 11-200-17, HAR, clearly require that all phases or sections of a proposed project must be included in the project description and discussed in terms of their potential environmental impacts so that the cumulative impacts of the proposed project can be assessed. Consequently, what are the specific project plans for the Ohiapilo Pond enhancement, how much will it cost, and what are the potential environmental impacts?

1A The Final EIS should include the finalized plans for the implementation of the enhancement program and a complete discussion of the potential environmental impacts of the intended enhancement. We suggest, if it is infeasible to include specifics for the pond enhancement in the Final EIS, the enhancement program should be deleted from the proposed project and be resubmitted as a supplemental EIS, pursuant to Chapter 343, HRS and Section 11-200, Subchapter 10, HAR. If the development of specific plans for the pond enhancement cannot be included in the Final EIS, will a supplemental EIS be prepared and submitted pursuant to Chapter 343, HRS?

Sampling

In general, the Draft EIS states that the Landfill has not contributed significant contaminants to the groundwater, soils, and surrounding surface waters. Our reviewers do not concur with this statement on the basis of the sampling results and the questionable background data used in the sampling survey.

Soils

2 Soil samples taken from locations B-3 and B-4 are characterized in the Draft EIS as background sites. However, these sites are located only 150 feet away from the Landfill in a generally downgradient direction. Clearly, these sampling sites are probably indicative of migrations of wastes from the Landfill, and do not represent background areas. Consequently, the high arsenic levels recorded at sampling site B4 are not indicative of background levels, but strongly indicates that arsenic and possibly other contaminants have moved down-gradient toward B4. Furthermore, sampling sites B1 and B2, even though upslope of the Landfill, are too close to the Landfill to be considered genuine background, especially considering the tidal fluctuations that cause a demonstrated back flow in the area. This tidal backflow could carry wastes into upslope areas otherwise uncontaminated by the Landfill. The sampling sites B1-B4 are valuable sites to monitor the migration of Landfill contaminants, but genuine background sampling sites clearly need to be incorporated in the survey and included in the Final EIS.

Groundwater

3 The validity of the hydrogeologic assessment (page 4-13 to 4-24) of soil and groundwater contaminants is open to serious question, primarily due to the almost certain contamination of the "background" samples. The subsequent use of these samples in arriving at conclusions of non-significance pursuant to the EPA Hazard Ranking System (page 4-17) is inappropriate. The HRS was designed to be used as a means of ranking relative risks to human health or environmental damage and the criteria are applied on a nationwide basis for the sole purpose or ranking hazardous waste sites for possible placement on the National Priorities List. It was not designed to be used in assigning "significance" of contaminants for purposes of preparing an EIS. What was the rationale for using EPA's HRS as a measure of significance for this specific site?

4 The Draft EIS states that no significant groundwater contamination has occurred. This statement is contrary to the results of the groundwater sampling that documents the existence of contaminants to the underlying groundwater, including high levels of arsenic, silver, and chromium that exceed the EPA chronic marine criteria. What criteria were used to define significant contamination? 5 Secondly, the Draft EIS concludes that contaminated groundwater essentially has not moved off-site, but there are no sampling wells located downgradient in the wetland area to confirm this conclusion. Background well MW8 cannot be considered a true indicator of background levels due to its location. While MW8 is upslope from the Landfill, the Draft EIS states that it is also affected by tidal fluctuations that could cause contaminants to flow back into the area. As a consequence, we recommend that test wells be established in the area between the Landfill and the coast. While we recognize the difficulty in establishing test wells in the wetland area, this is the only valid technique to confirm groundwater contamination and migration rates. Test wells emplaced for the completion of the Final EIS could then serve as monitoring wells for the post-closure groundwater monitoring program.

Arsenic

6 The Draft EIS concludes that the survey test results for arsenic, "fail to provide any indication of where the arsenic is coming from, but point away from the Landfill as a source." The Final EIS needs to explain this conclusion in a comprehensive manner. While it can be seen that elevated levels of arsenic are found as far away as 4 miles, the Final EIS must give specific evidence to indicate that the landfill does or does not significantly contribute to the arsenic levels other than immediately on the Landfill site. What evidence is there to support the statement that the Landfill is not the source of the

elevated levels of arsenic, in light of insufficient background sites and parameters for determining significant levels of contamination?

7 Furthermore, we suggest that background tissue samples of organisms collected 950 to 1300 feet east of the Landfill, that registered elevated levels for arsenic, cannot be considered representative of background conditions. The test results from the organisms are more likely to be indicative of the migration of contaminants from the Landfill site. It should be noted that in those countries that regulate arsenic contamination levels for food, the snails, shrimp, and crabs of Kalamaula would be labeled as unfit for human consumption. While the Landfill may or may not have contributed to this fact, the Final EIS should address this situation.

Closure Soil Cap

8 The Draft EIS identifies the Mahana site (#4) as the probable source of soil for the impermeable cap layer in the closure plan. However, it appears that the sampling used to judge the adequacy of the soil does not justify the conclusions. At the Mahana site(#4), only two 5 gallon samples were taken for permeability testing. One sample averaged $2.54x10^{-4}$ cm/sec, above the required maximum of $1x10^{-5}$ cm/sec. The second sample yielded only $3.8x10^{-6}$ cm/sec, but both samples were single grab samples and neither were composite samples designed to reveal average clay composition of the site. Sample two indicates that there may be some suitable soil at site #4. What evidence is there to indicate there are adequate quantities at site #4? Furthermore, what evidence is there to support the assumption that sample #2 is more representative of the site than sample #1?

In addition, due to the description of Waihuna clay soils as moderately well-drained, it is doubtful that it alone is suitable as an impermeable cap layer. We suggest that bentonite be added to the soil, and that it should be tilled to produce an adequate impermeable layer.

Alternatives

9 The Draft EIS discusses various alternatives for the closure of the Landfill, and proposes that the first alternative, in-place closure, is the preferred. The other alternatives, involving removal of various quantities of wastes from the wetlands, were rejected based on the hydrogeological assessment and biological survey that indicated no significant contamination of groundwater, soils, or local biota had occurred from the Landfill. Due to the aforementioned questions concerning the possible contamination of the area from the Landfill and the existence of a 100 year flood plain in the area, we suggest that the Landfill material that has encroached on the wetland, particularly the waste in the 100 year flood plain, should be removed and disposed of at an off-site disposal area. The wastes should

not be placed in the Kalamaula Landfill as part of the closure project due to possible erosion problems stemming from the increased height of the Landfill.

Groundwater Monitoring

10 We further suggest that the proposed post-closure groundwater monitoring program should include a few additions. While the plan includes the first quarter monitoring of volatile substances, it does not include future testing for contaminants not found in the initial monitoring. We suggest that the first year of monitoring should include testing for all possible contaminants, even if they are not found in the initial testing. In addition, monitoring should not only be conducted quarterly but should be conducted more frequently during the heavy rainfall months of December, January, February, and March.

Minor Comments

11 Page 4-1, bottom. Although it has little significance on the overall Draft EIS, the geologic time description is incorrect. First, the Pliocene is one of five epochs that comprise the Tertiary, and is not a separate time unit. More importantly, Molokai was not formed by lava flows beginning 70 million years ago, but came much later, and activity certainly did not stop at the beginning of the Pliocene 10 million years ago. In fact, the oldest rocks dated from Molokai are less than 2 million years old (see Macdonald, et al, 1983).

12 Page 4-4, paragraph 2. The statement is made that all surface water of significance is derived from rainfall. This is true, but all surface water (as well as all fresh groundwater) is derived from rainfall. There is no other source of surface water on Molokai.

13 Page 4-11. Could the sulfur in the groundwater have come from the landfill? If not, why not?

14 References. There are many errors in the list of references, for example, reference 12, 13, and 53 all cite H.S. Stearns and G.A. Macdonald but their names are spelled differently in all three references.

Conclusion

15 The Final EIS for the proposed action needs to include substantial revisions so that an accurate assessment of the project, the existing environment, and the potential impacts can be rendered. Without a complete project description, valid background sites, tests, and data that lend to the complete discussion and evaluation of the local environmental conditions and their relationship to the proposed project, it is impossible to adequately evaluate the various potential impacts of the project and its alternatives. We also suggest

16 that people in the area be advised of the arsenic problem in the biota found in the coastal area and warned of the potential public health hazards.

Thank you for the opportunity to comment on this Draft EIS. We hope our comments have been helpful.

Sincerely,

Jacquelin Miller

Jacquelin N. Miller
Associate Environmental Coordinator

cc: OEQC
Department of Public Works, County of Maui ✓
Brown and Caldwell Consultants
Roger Fujioka
Henry Gee
Yu-Si Fok
Michael Beug
Lani Stemmerman
Roy Takekawa
Frank Peterson
Andrew Tomlinson

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
AARON SHINMOTO, P.E.
Chief Staff Engineer

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
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LLOYD P.C.W. LEE, P.E.
Engineering Division
DAVID WISSMAR, P.E.
Solid Waste Division
BRIAN HASHIRO, P.E.
Highways Division

May 21, 1993

Ms. Jacquelin N. Miller
Associate Environmental Coordinator
Environmental Center
University of Hawaii at Manoa
2550 Campus Road
Honolulu, Hawaii 96822

Dear Ms. Miller:

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Thank you for your letter of April 22, 1993, regarding the subject project. To facilitate responses, your comments have been numbered and are addressed below:

1. Comment noted. Your general concerns are addressed below in the context of your more specific comments.

1A. You are correct to note that detailed plans for enhancement of Ohiapilo Pond have not yet been developed. Some basic parameters for enhancement were recently recommended to the U.S. Environmental Protection Agency (EPA) by the U.S. Fish & Wildlife Service (FWS). Formal requirements for enhancement will be developed by the EPA in a consent order which has not yet been issued. The FWS recognizes that development of detailed plans for enhancement of Ohiapilo Pond will be an involved process, probably involving multiple agencies and organizations. The Draft EIS provided an overview of an enhancement concept as a first step in the overall plan and potential impacts to biotic and archaeological resources, two areas of obvious concern, were evaluated with site surveys and assessments. However, as discussed on page 2-20 of the Draft EIS, once detailed enhancement plans are developed, further environmental review will be necessary and appropriate permits will need to be obtained.

2. Comment noted. Your comment refers to EPA's Site Inspection Report prepared by Bechtel Environmental in early 1992. The report served as part of the data base for the Kalamaula Sanitary Landfill site technical studies that were conducted in the latter part of 1992. At that time, the procedures used to develop the monitoring program for the Site Inspection Report were judged to be adequate. Additional sediment and soil sampling, however, were done in support of the biological tissue monitoring program conducted by AECOS and this information was included in Chapter 4 of the Draft EIS.

3. The EPA Hazard Ranking System (HRS) guidance states that an observed release is established if the contaminant in question is three times the background sample concentration. The HRS system was only one of several evaluation tools used in the site technical studies to provide an indication of contaminant release. Because the site is within brackish groundwater, EPA acute and chronic marine criteria were also used. The HRS system and the marine criteria are the only evaluation criteria available for the landfill environment which provide an indication of whether or not contaminants are entering the groundwater underlying the landfill. As indicated in Chapter 4 of the Final EIS, our data supports EPA's conclusion that release of contaminants has occurred. However the true measure of significance are the results of the extensive biological tissue analytical program that was conducted by AECOS. The results of the EPA's Site Inspection Report and our consultant's hydrogeological assessment formed most of the data base that was used in scoping the biological tissue analytical program. The results of that work revealed that the landfill has not impacted local biota even though release of contaminants into shallow groundwater underlying the landfill has occurred.

4. The text regarding significance of affect on groundwater has been revised in Chapter 4 of the Final EIS to identify impact on groundwater beneath the landfill. Also, see response to comment number 3.

5. You are correct regarding the use of MW-8 as a background well and the need for additional off-site down gradient wells for use in the post-closure groundwater monitoring program. The section on geology, soils and water resources in Chapter 4 has been revised for the Final EIS to reflect reevaluation of the existing water level data and collection of long-term water level fluctuations as part of the tidal influence study that has been done since the Draft EIS was published. The groundwater contour data indicate that MW-8 could serve as a suitable background well a majority of the time because groundwater flow is generally from MW-8 toward the ocean. However, there are instances when this may not be the case. In addition, the water quality data indicate that the landfill has had

some effect on MW-8. Thus, the EIS recognizes that MW-8 would not be a suitable background well for use during post-closure monitoring of the landfill.

The Final EIS now indicates that a new background well should be located for use during post-closure monitoring. Such a well should be located in an area of brackish water similar to that which exists in the landfill area, thus providing for a direct comparison of constituent levels. This location may be lateral to the landfill and not upgradient. Installing a background well upgradient in an area of "fresh" groundwater is not appropriate for the brackish water situation at this landfill. A well monitoring "fresh" groundwater would provide a false indication of landfill leakage because all constituents would be expected to be higher when compared to "fresh" groundwater unaffected by seawater. The use of MW-8 in the hydrogeological assessment does not invalidate the data or closure approach. The details of the post-closure monitoring program will be negotiated with the State Department of Health (DOH) and the U.S. Environmental Protection Agency (EPA). Chapter 4 of the Final EIS also contains a revised post-closure groundwater monitoring plan which may be acceptable to the regulatory agencies. Off-site downgradient wells, in addition to the background well mentioned above would be used. As you point out, installing wells in the wetland area may be difficult, but the land requirements will be very small. Both the U.S. Army Corps of Engineers and the FWS will be contacted regarding the feasibility of this proposal.

6. Since the Draft EIS was published, additional arsenic evaluations have been conducted of the biota in the coastal area. Appendix H in the Final EIS contains the full report and appropriate sections in Chapter 4 of the Final EIS have been modified accordingly. The results support that the landfill is not the source of arsenic and that a health hazard does not exist. This is confirmed by the DOH in their letter dated March 5, 1993, regarding this issue which is included in Appendix I. Also, for your information, the U.S. Geological Survey (USGS) in a letter commenting on the Draft EIS, discussed the probable source of arsenic. Based on available data, the USGS believes the source of arsenic is probably the weathering of volcanic soils and a subsequent enrichment in the iron oxide phase of the weathering products combined with an anthropogenic input as a result of the application of agricultural chemicals.

7. The measurements of arsenic in sediment and tissue samples was greatly expanded in the supplemental arsenic investigations referenced above. The new results directly address the concern that insufficient numbers of background sites were sampled, and substantiate the Draft EIS conclusion that the landfill is not

presently a source of the arsenic observed in the reef flat environment.

The possibility cannot be denied that the first control site (Site B) is close enough to the Kalamaula Sanitary Landfill to have been influenced by contaminants migrating from the landfill. The site was correctly selected based upon the assumption that animals in this area would be more influenced by runoff from the watershed above the landfill and less influenced (relative to Site A specimens) by runoff and groundwater from the landfill. Animals from directly off the landfill (our Site A) would, conversely, be more influenced by runoff from the surrounding watershed. It is neither necessary nor desirable to go as far away as possible to obtain "background" samples. In fact, if background samples are collected too far away, the presence of contaminants in specimens from off the landfill may not be useful as an indication of chemicals migrating from the landfill.

Where a contaminant (such as arsenic) appears elevated in both the near background and site samples (suggesting either contamination from diverse sources or migration of the substance from the landfill), additional samples are collected to assess the probable source. This was done (Site C and later work detailed in Appendix H of the Final EIS). It is not reasonable to assume that no matter how wide spread the contaminant is, the landfill must be the source.

8. Preliminary soil testing was conducted on soils from Borrow Site No. 4 in September and again in November 1992. The first round of testing was performed at 90 percent compaction and yielded permeabilities on the order of 2.54 x 10-4 cm/sec. The second round of testing was conducted at 95 percent compaction on four samples. A total of 12 tests were performed with results ranging from 8.6 x 10-6 to 1.8 x 10-6 cm/sec. An average permeability of 3.8 x 10-6 cm/sec was reported. Additional testing at the borrow site will be performed prior to the start of construction activities. This testing will be designed to obtain samples that are representative of the entire borrow site needed for final cover. In addition, construction Quality Assurance Plan will be prepared to ensure that the required permeabilities will be obtained during the final cover construction.

9. The rationale for not excavating the in-place waste were discussed in Chapter 3 of the Draft EIS. In addition to the hazards involved in excavating and removing solid waste, complete removal of all contaminants is difficult to ensure. The 100-year flood plain is shown to be on the eastern fringe of the landfill; removing this waste would have little or no impact on the elevation of the flood plain. Because

the velocity of water within the flood plain is not expected to be high, the engineered fill placed on the very mild slopes of the landfill in the flood plain area should provide adequate protection and stabilization. Relative to the wastes within the 100-year flood hazard area, the closure plan will include provisions for slope protection and stabilization capable of nominally withstanding the 100-year flood at specified base flood elevations.

10. Comment noted. The post closure monitoring program is being developed with the DOH and EPA. Your comments will be considered in the final monitoring program.

11. Thank you for this clarification. The Text in Chapter 4 of the Final EIS has been revised to reflect your comment.

13. It is possible that sulfur could come from the landfill; however, the available data do not indicate the source at this time.

14. Thank you for correcting the spelling of H.S. Stearns and G.A. Macdonald on the list of references. These corrections have been made in the Final EIS.

15. Comment noted. Your comments have been addressed directly in this letter and appropriate revisions have been made in the text of the Final EIS.

16. Public meetings have been held on Molokai and the arsenic issue has been discussed. See response to comment number 6.

Thank you for your comments and participation in the Draft EIS review process. Your letter and this letter will be appended to the Final EIS.

Very truly yours,

George N Kaya

GEORGE N. KAYA
Director of Public Works

DFW:jip

xc: Mr. Brian Choy, Office of Environmental Quality Control

April 22, 1993

Mr. Richard Haake
Managing Director
County of Maui
State of Hawaii
Tel: (808)-243-7800
Fax: (808-243-7870

Re: Comments of Kalamaula Homestead Community Association Regarding the Adequacy of the Environmental Impact Statement Re the Closure of the County Operated Landfill near Kalamaula, Molokai

Thank you for allowing us to file comments after today and until May 5, 1993. On behalf of the Kalamaula Community Association I convey their appreciation such that legal counsel can assist them in determining their position.

I am presently a Professor of Law at the University of San Francisco, licensed to practice in both California and Hawaii and am now representing the Kalamaula Homestead Association in this matter. I have only had two days to review these materials so these comments represent preliminary concerns. I just have spoken with Mrs. Wilma Grambusch, the elected President of the Kalamaula Homestead Association and this letter conveys her concerns as well. Prior to May 5th we hope to supplement these concerns with more detailed comments.

The Kalamaula Homestead Association, has jurisdiction as a homestead association over the lands that are presently used for the landfill. Kalamaula Homestead Association finds the EIS to be inadequate as to a number of critical issues. These deficiencies are sufficient to warrant re-examination of these concerns before any governmental action is taken. Briefly, the concerns are as follows:

1. There is no attempt in the EIS to inventory the types and nature of the wastes that are in the dump site. Evidence of highly toxic substances does exist. An article appeared several weeks ago in the Honolulu Advertiser where it was noted that amounts of arsenic had been discovered in the landfill. Today Mrs. Grambusch stated to me over the phone that she recalled such an article and that, to the best of her knowledge, the disclosure to the reporter from the Honolulu Advertiser was made by the team preparing the EIS.

1 In my review of the EIS in the past two days there has been no mention of arsenic or other specific items. Rather, the importance of a specific inventory of the site downplayed, conveying a sense that none of the possible substances are of great concern.

It is our understanding that the site was the single or primary dump site for all of Molokai for the past twenty years, having resulted from a consolidation of a Hawaiian Homes dumpsite and a County dumpsite. Thus, one would assume that all waste products on Molokai were placed in this site and that there was no segregation of more hazardous substances. Common sense would seem to indicate that every waste product normally used by the island thus including the full range of activities of a whole society, must be contained within this one site. Thus, it is highly probable that highly toxic pesticides as well as industrial chemicals [particularly since the dump site is twenty years old] are present. Most significantly, we assert that the EIS is not complete in failing to determine whether the pineapple industry dumped chemical wastes at the site or even whether containers, ostensibly empty, which stored pesticides or other chemicals, were dumped at the site.

2 2. The Community disputes the EIS which indicates that the existing dumpsite did not affect many people. Rather, Kalamaula Homestead Association contends that the fumes and noxious odors affected a much larger community than that conveyed by the report. The EIS must also take into consideration the fact that the dumpsite was undoubtedly a deterrent to efforts to homestead nearby lands within the jurisdiction of Kalamaula.

3 3. Third, the new site appears dangerously close to the present population of Kalamaula Homesteaders, as well as to lands scheduled to be settled in the immediate future. A change of direction of the winds, a frequent occurrence, would constitute an environmental threat to those with homes or existing rights to build, near the proposed site. Moreover, the community is concerned that the groundwater monitoring is insufficient to meet the threat of a long-term pollution of groundwater sources.

4 4. Fourth, the EIS is inadequate in assessing the impact of proposed closure alternatives for dumpsite on reef life, particularly as it affects the diets of the population. A number of homesteaders who rely on reef fishing and use of estuarial resources as part of their diet have asked why there is no present plan to restore the damaged wetlands. Undoubtedly, these wetlands must bear the affects of toxic leakage as evidenced by tumors discovered on sea turtles [see testimony of Mr. Vanderbilt]. [1]

5 5. Fifth, the EIS is inadequate in failing to assess the state, county and federal roles in a possible breach of fiduciary duty to Hawaiian Homesteaders. Both ceded lands and Hawaiian Homelands designate Hawaiian Homesteaders,

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[1] In reviewing the testimony of Mr. Vanderbilt, the Community is also concerned that the increasing incidence of ciguatera, a disease that affects reef fish, may be a result of the lax operation of the site. Since reef fish constitute a significant element of the subsistence diet of Molokai people in general as well as Kalamaula Homesteaders, the community asserts that the existence of deformities in turtles is indicative that the reef life was adversely affected over the past two years by leakage of toxic chemicals from the site.

as beneficiaries of ceded and Hawaiian lands. Under the state Ahuna decision, as well as various state constitutional and statutory provisions, the state has a fiduciary duty towards homesteaders such as Kalmaula Homestead Association. The **Ahuna** decision strongly implies that the interests of others are not to be weighed in meeting this duty. Moreover, as federal land set aside much like federal parks [see Cappeart v. United States] or reservations for native Americans [see Winters v. United States] the "reserved water rights" doctrine as been applied such that state or private activities outside of the boundaries of the federal reserved lands may not undermine the purpose of the lands reserved by Congress. For example, in Cappeart, the U.S. Supreme Court stopped private parties from pumping from their own wells when such pumping endangered wildlife in the Devil's Hole National Monument, even though such pumping took place on their own fee land. Hence, the EIS is inadequate in failing to address the unique nature of Hawaiian Homestead rights, rights which may apply are more stringer degree of care than when a dumpsite is closed in other neighborhoods, where reserved federal lands are not involved.

Specifically, the EIS failed to determine whether the damaged wetlands are, or ever where within the inventory of "available lands" under the Hawaiian Homes Commission Act. Second, the EIS failed to note that the Kalmaula Homestead Association has a right to sue for a breach of fiduciary duty as to "ceded" lands under Chapters 673 and 674 of the Hawaii Revised Statutes. This is a major omission particularly in light of the delegation of environmental management to Native Americans on the continent in recognition of their sovereignty.

6 5. Sixth, the Community Association opposes all three remedies. They are inadequate in light of the failure of the EIS to fully disclose the inventory of the dumpsite. An inventory should be required and would not be unreasonable. Even if a continuing inventory of the dumpsite was not maintained on a regular basis by its operators, the history of wastes stored can be historically reconstructed by interviewing residents of the island. Without knowing the nature of the wastes, any comment on approval of remedies is simply a shot in the dark. The purpose of an EIS is provide information to avoid such quandaries.

7 In conclusion, the Community would, at a minimum, seek much stringent groundwater monitoring and much more strenuous efforts to clean up the site and ensure that closure will be completely safe. We are presently seeking our own experts to review the bore samplings and to examine the other specialized aspects of the report.

I can be reached at the University of San Francisco, Kendrick Hall, School of Law, 2130 Fulton St, San Francisco, California, 94117. My telephone number is 415-751-4763. Thank you for allowing us this additional time to file, I apologize if this fax arrives a few hours late.

Sincerely yours,

[signed- copy to be mailed]
Williamson B.C. Chang, Esq.
Counsel, for Kalmaula Homestead Ass'n

LINDA CROCKETT LINGLE
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GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
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Solid Waste Division
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COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
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200 SOUTH HIGH STREET
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May 21, 1993

Mr. William B. C. Chang, Esq.
Counsel, Kalamaula Homestead Association
University of San Francisco
Kendrick Hall, School of Law
2130 Fulton Street
San Francisco, California 94117

Dear Mr. Chang:

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Thank you for your letter of April 22, 1993, regarding the subject project. To facilitate responses, your comments have been numbered and are addressed below:

1. You are correct to note that waste inventory records have not been maintained at the Kalamaula Sanitary Landfill since it began operation in the 1970's. Please note, however, that Molokai is not a highly urbanized and industrialized area such as is common in many areas of the mainland where hazardous wastes from households is common in the solid waste stream. Even in those cases, the household hazardous waste component is a very small percentage of the total waste stream. In California, for example, household hazardous waste comprises less than 0.5 percent of municipal solid waste in landfills and in many areas this percentage is much lower. For the Kalamaula Sanitary Landfill, where the specific components of the historical waste stream are not known, an extensive monitoring program has shown there not to be an environmental hazard after 20 years of operation, nor should it become one.

   Since the draft EIS was published, additional arsenic evaluations have been conducted on the biota in the coastal area. Appendix H in the Final EIS contains the full report and appropriate sections in Chapter 4 of the Final EIS have been modified accordingly. <u>The results do not indicate a health hazard exists.</u> This is confirmed by the DOH in their letter dated March 5, 1993, regarding this issue which is included in Appendix I. Also, for your information, the U.S. Geological Survey (USGS) in a letter commenting on the Draft EIS, discussed the probable source of arsenic. Based on available data, the USGS believes the source of arsenic is probably the weather of volcanic soils in a subsequent enrichment in the iron oxide phase of the weathering products combined with an anthropogenic input as a result of the application of agricultural chemicals.

The County will be closing Kalamaula Sanitary Landfill in place according to state and federal requirements, which is a concept endorsed by the DOH, the U.S. Environmental Protection Agency (EPA), and the U.S. Fish and Wildlife Service (FWS). A post closure maintenance and monitoring plan, approved by the regulatory agencies, will be followed once the landfill is closed. It is the judgment of the County and our consultants that further historical information on the Kalamaula Sanitary Landfill waste stream would not alter the assumptions used in the technical studies completed nor would it affect the closure plan.

2. There is not documented evidence that past landfill operations have created fumes and noxious odor which have affected the local community. However, closure of the landfill as proposed with a 2-foot soil cap will eliminate the potential for the landfill to affect the local community in the manner you indicate.

   You also state the EIS must also take into consideration that the landfill was a deterrent to efforts to homestead nearby lands within the jurisdiction of Kalamaula Homestead Association. Your comment would be relevant in the context of the initial siting of the landfill but is not within the scope of the Kalamaula Sanitary Landfill Closure EIS. You should be aware that there are now many environmental laws such as the federal Clean Water Act which include strict controls for development within wetlands such as exist around the landfill site.

3. This comment concerns the proposed new landfill site which is not within the scope of this EIS.

4. Your comment seems to suggest that the landfill site is causing both ciguatera and tumors in turtles. No links between these "environmental problems" and anything found or not found in the landfill exist. The cause of the tumors in turtles is unknown, and conditions promoting ciguatera are poorly understood but seem not to be related to chemicals from human activities on the land.

Whether or not these two concerns are valid for Molokai, is really beside the point, because no evidence has been found of toxic chemicals leaking from the landfill, and no evidence can be produced that toxic chemicals cause either the tumors or increases in the incidence of ciguatera.

Plans for improving wetlands in this area are being formulated by the EPA and FWS as part of the "penalty" for the Kalamaula Sanitary Landfill encroaching on wetlands. Restoration of the old wetlands now buried beneath the landfill would have the potential of creating additional environmental damage including the possible release of harmful substances in to the near shore environment. Therefore, it is considered more logical to restore nearby wetlands and avoid this risk, than to remove the landfill simply for the sake of saying the damaged wetlands were restored.

5. The County does not believe that the EIS is the appropriate vehicle to address a possible breach of fiduciary duty owed to Hawaiian Homesteaders by the State of Hawaii.

   Chapters 673 and 674 of the Hawaii Revised Statutes, as referred to by you, create causes of action for native Hawaiians and native Hawaiian organizations against the State, its agents, officers and employees for any breach of trust or fiduciary duty in the management and disposition of trust funds and resources. There is no mentioned of even potential liability to County in these chapters.

   With respect to the County encroachment onto Hawaiian Home Lands, the County is presently working with the Hawaiian Homes Commission to resolve this matter. A settlement regarding past rents due has been agreed to with future rents still in issue. The County is confident resolution to the encroachment will be reached.

   Finally, the County is unaware of any specific authority which places a greater duty of care on the County when closing a sanitary landfill located on Hawaiian Home Lands.

6. See response to comment number 1.

7. Comment noted. The details of the groundwater monitoring program are being negotiated with the DOH and EPA. Chapter 4 of the Final EIS includes the most recent iteration of the groundwater monitoring program. The landfill will be closed in conformance with state and federal requirements and will provide the

necessary environmental protection.

Thank you for your comments and participation in the Draft EIS review process. Your letter and this letter will be appended to the Final EIS.

Very truly yours,

George N Kaya

GEORGE N. KAYA
Director of Public Works

DFW:jip

xc: Mr. Brian Choy, Office of Environmental Quality Control

MINUTES OF THE MARCH 31, 1993
WORKSHOP ON MOLOKAI

KALAMAULA LANDFILL CLOSURE
DRAFT ENVIRONMENTAL IMPACT STATEMENT

... We are here this evening in order to listen to your comments regarding the Environmental Impact Statement

... all of you (inaudible) some of you haven't (inaudible) here this evening. (inaudible) we have the people from Brown and Caldwell (inaudible) last time. (inaudible)

... what I'd like to tell you about is that we are in a formal (inaudible) of the EIS process. As a result of that, we would welcome any comments you may have tonight, but we also need for you to send in written comments. That particular written comment or question that you have will be answered by us and will be a part of the EIS. You have until April 22, 1993, in order to send in a written request that we will answer in a written fashion. One week after we answer you and have gone back and forth a couple times on a written form, then we will publish this particular document in the appropriate register. At this time, any citizen would have the opportunity or 60 days in which to challenge the EIS. That is where we are at tonight. What we would like to do is listen to your concerns. We have consultants and Larry and Ray Matasci, from Brown and Caldwell, (inaudible) from (inaudible). (inaudible) from our Solid Waste branch. My name is Richard (inaudible). We also have a planner here. I'm not sure who he is. If you have any questions, please ask me. (inaudible) is going to address the arsenic (inaudible). Does anyone have any questions.

I think we should have planners come forward. I think there should be a round table with questions (inaudible) because we don't come to all of them all the time. There are a few great concerns that we have, and I think that is the way (inaudible) people.

The consultants who are preparing the EIS...

Introduction

My role on this project is that of a solid waste professional. I am assisting our EIS person, Paul Scheidegger, project manager. He is the principal author of a lot of materials that you are reading here.

Eric Guinther, Biological Consultant, AECOS. I looked at impacts of the landfill to see if there was things coming out of the landfill that might be getting into the animals and plants that people might be eating.

David Wissmar, Chief, Solid Waste Division, County of Maui.

Ray Matasci, Manager, Brown and Caldwell, Maui, and Principal-in-Charge.

(inaudible) I am here this evening to put several things on the record. The Kalamaula dump site is on native Hawaiian land. I was born and raised in that area. There are two-part vested interests in the property that is being studies for closure. The first priority of the vested interest is the native Hawaiian Homesteaders at Kalamaula Community. The first community under the

Act of 1920, (inaudible). The second vested priority is the general public of which native Hawaiians belong to both. I would like to place that on record so that we know that particular area that has been documented in four volumes of this public library as to whether the proposed new site, and leaving the present Kalamaula Landfill, in the middle is land owned by Michigan???? State. There have been others in here who have dealt into much research as part of the shared community on recycling. I place my position as protective rights for the native Hawaiian Community of Kalamaula.

(inaudible) right now the Army Corps of Engineers is (inaudible). They have delegated a responsibility for the care of the wetlands (inaudible). They have just recently provided us with a series of options, some of which are listed in the EIS, in order to (inaudible). The fishpond (inaudible), there is one alternative. What Fish and Wildlife did in a letter to the EPA states that their primary alternative is enhancement of Ohiapilo Pond, which is right next to the landfill. The fishponds are identified as possible alternatives in order to allow a bird to come back to that particular area. The whole premise of the wetlands is that a nesting site, a breeding site, and the ability to live unmolested has been lost by the native birds, specifically the Hawaiian Stilt. They need a brackish water environment in order to live and (inaudible) so the fishpond serves as a natural (inaudible). The next step in the equation is, and this has nothing to do with the closure of the landfill, (inaudible) the closure and the (inaudible).

Other public interests (inaudible) fishpond.

The public is not locked out of (inaudible), you can certainly address your concerns to the EPA in San Francisco as far as what they want to do. We have to enter what we call an Agreement Consent on what we will do. Let me make it clear that in 1975, the United States (inaudible) that need to be preserved because that's where the (inaudible) light comes from. We encroached on 6.5 acres of pristine (inaudible). As a result, we broke the Federal Law and for that we need to be punished. We broke it in 1975. There is two ways to punish us: (1) you can throw us all in jail; or (2) (inaudible), in other words, you broke the law, now you have to pay back. Paying back is done in ecology. We paid back the loss to the birds and to that particular area. The way you do it is try to bring back an area. Nothing can ever be brought back totally because the areas have changed, so what FWS said was that the primary alternative is to widen Ohiapilo Pond (inaudible) for the Hawaiian Stilt.

Question? (inaudible)

It is not a question of what do we want, it is what does the council want? what does Molokai want? what does EPA want? The recommendations that are going to be done have been made by FWS. Those recommendations have been reported to the EPA.

I'm trying to figure out how (inaudible)?

Like I told you, you can write to the EPA in San Francisco and tell them that we would like to see this particular fish pond restored because of XYZ, or we don't feel that (inaudible)

I think it would be a good idea to (inaudible)

Somebody (inaudible)

(inaudible), but the community (inaudible)

Before you go on, what do you guys want?

We would like to see (inaudible)

That's the reason. And what would you use the pond for?

A fish pond for (inaudible), birds, and everything else that would use a pond.

The mitigation has to do with the level of loss, not (inaudible)

There is no law that says you can't have people and birds in the same places. (inaudible). This is a wetland.

These are fishponds, Ohiapilo is a fishpond, it is not a wetland.

It is a designated wetland area.

But it is a fishpond (audible).

Before we get into an argument, (audible) you want people to utilize it because a lot of (audible) and certainly the way that the (audible) book is set up, and someday the fishpond may come into production. In our particular case, the penalty that we have to pay is for the birds.

I understand that, (audible), I am trying to get more use out of this situation.

I think that is good.

We need an avenue for us, the community, to make that statement. We are not going to be able to do it (inaudible), we need the council's support to (inaudible).

(inaudible).

(inaudible) whether or not what you propose and what you come to (inaudible) are you going to be publishing an EIS on that (inaudible).

No. That will not be a part of the (inaudible). The mitigation is (inaudible).

So, there is no EIS (inaudible).

That is correct. Even though the EIS doesn't address it in there, as far as an alternative recommendation.

But that is another avenue to address this issue to and from (inaudible) put the concern into writing in direct response to the draft, and then when the final comes out, again (inaudible).

I think that is an excellent point. In other words, (inaudible), is talking about a response. (inaudible) in our EIS (inaudible) is what that mitigation leads to. We have to respond to every concern that people write to us. You say I have a concern and I'd like you to consider utilizing this particular fishpond as a mitigation measure. When we publish the EIS, your comments and our response also get (inaudible).

The final gets (inaudible). It gets (inaudible) on the final.

Yes, there is a time period. Right now, you have until April 22, 1993, in order to input. We have actually until (inaudible). We would respond now (inaudible) because of people that control the consent order are the EPA. In other words, what we want and what you want may be the same thing. What the EPA wants (inaudible) FWS (inaudible) different. So you (inaudible), the (inaudible) has to come from EPA. If you were going to write directly to the EPA, they would take you up on your (inaudible). As Sarah suggested, you put it into the EIS (inaudible).

April 22, 1993, is the deadline to respond to the to the Draft EIS. Now I would like to get back to the bulk of concern about the use of the pond. Wetland federal law, however, there is a link missing here that is not in this document. What you have in this document, you have the pond, you have the closure, you have the new site, it is just overbearing. What I want to point out to Walter is this wetland is a little bit different that wetland closures in the whole United States, and I will tell you the reason why I think so. This wetland is native Hawaiian, native American. Use of wetland, the pond itself, there shouldn't be any problem in a written statement to that fact (inaudible) EPA. The EPA has to make a judgement. We are not dealing with wetlands in New Mexico. Dry land, whatever. Or in Florida, with alligators. We are dealing with a wetland that is native Hawaiian. That is the issue here. That is the difference. I think that April 22 is too soon to respond to some of the concerns that the community has, although, (inaudible) whether we get it or not. Going back to the basic premise, the landfill, the pond, it is not in an area where there are private ownerships. The (inaudible) Hawaiian Homeland of which the beneficiary won't benefit. The wetlands (inaudible). It's a federal guideline. Maybe, at the next meeting, the County should invite the EPA.

They won't come.

Well then we should pursue that directly to her office. Because it is a little bit different on this wetland. I would like to comment on the document itself. There are no pages listed. It is a very difficult document to find what you want to look for. It is not complete.

I have to apologize. You have my draft.

Well, it's in here too. There are no pages. The (inaudible). How many books (inaudible), red, white, and blue. Is that the newest one or the first one, what is that?

She has the published document.

The compilation of the data that has been comprised in this booklet has three sections: (1) (inaudible) site closures; (2) the palm nests; (3) the new dump site. This really is highly technical, and you expect the community to respond to this. This is worse than a college course. (inaudible) some kind of other material. It is very difficult to imagine. And the only way I can imagine this is (inaudible). That is what is being proposed.

(inaudible)

Three sites that have been proposed in this document are (inaudible) and I'm sure that the County has to purchase it. Whether we go up, whether we down, whether we smash, whether we burn, the concern is as to whether the seepage goes in that water. There is nothing in this document that protects the native Hawaiian right as far as (inaudible), the effect of those living things in the ocean. I don't know if the crabs are purple, orange, red. There is no documentation as to if the squid is good enough to eat. We are talking about the Stilts, they have to eat (inaudible). There is nothing in here that says that there is algae (inaudible). I am a little bit disturbed that there is a whole section of omittance of the continuance of the people by those of things that are in the mudflats.

Maybe Dr. Guinther can shed some light on the studies that he did as a result of our last meeting?

For the EIS (inaudible), Brown and Caldwell did studies to see if there was anything chemically leaching from the (inaudible). That was the purpose of (inaudible).

Is it in yet?

It should be, I haven't looked at their ...

What page is it on?

We did a study on the marine and estuarine animals in front of that landfill area to see if things were affecting those creatures, to see if there were things we could find in those animals that we could attribute to the landfill. We did find that there was arsenic...

I heard that part.

We found that it wasn't coming from the landfill. We have done further studies. We have looked at (inaudible), lemu, we have looked at a lot more crabs, and we have looked at sediments. We have done this for the whole south coast of Molokai, not just the area of the landfill because one concern that came out of one of the meetings last time was if it is not because of the landfill, then what is the reason for all of this. I can show you some maps to describe what we did, but in a nutshell we found that the values for arsenic are high in the crabs here. We know that arsenic in shellfish is not an unusual thing. They are high relative to what we find throughout much of Hawaii. They are not necessarily high relative to what can be found other places in the world. The arsenic that occurs in shellfish is largely nontoxic. We have more tests to do, specifically on Molokai crabs, to verify what the ratio of toxic and nontoxic forms of arsenic are in the particular crab. The lemu had almost no arsenic at all. The (inaudible) had levels that are very comparable to arsenics that we find everywhere in the States.

Did you find any information about the turtles that exists with the lumps?

We have turned in a proposal and have given a cost to National Marine Fisheries to analyze turtles. They haven't gotten them back to us yet. I suspect part of the problem is that they can't go out and kill a turtle to bring the materials to us. They do have to wait until an accident befalls in a turtle in the right area. I think what that means is that we will have some measurements in the near future, but it is not something that is immediately pending, probably for the lack of tissue.

Your testing is done every 3 months?

We did the extended study since we were here last, which I believe was a little more than a month ago. It has been in the last 3 weeks that we have collected the samples, took them back to the lab, processed them, analyzed them, and produced a report, which right now is in draft form. We will be able to provide you with a complete report on the level of everything we found eventually.

This report will become part of the EIS document?

(inaudible).

Largely, because of the distribution. We tried to answer three questions. The first thing we did was look at animals from immediately off the landfill and animals from a little closer to the (inaudible) Road area and said we are going to compare, not just arsenic, but all metals, pesticides, and things like that. If we find that the levels are high in animals closer to the landfill, then we suspect that the landfill is the cause. The only thing that came out as being potentially higher near the landfill was the arsenic. So we said let's get some more crabs from a little bit further away because those two sites aren't that far apart. We went down to (inaudible), almost down to (inaudible) Fishpond. On the map, A & B were the two that I just described to you. At the C location, arsenic is even higher down there. That is where we were at last time. What that tells us is that it is not likely the landfill because we are getting higher values down there. We also did a little bit of sediment work close to the landfill to see if there was some kind of pattern of higher arsenic in the soils. We didn't find any. This time, we covered the whole coast line from (inaudible) to (inaudible). We took about 20 samples on the whole reef. The highest values in that area from (inaudible) Fishpond, which is way down on the left to about the pier at (inaudible). They are only about twice as high as the values from everywhere else. There not a big difference. We also collected crabs from as much of that area as we could. Unfortunately, you can't always get the crabs you want. We collected (inaudible) from as much of that area as we could. The crabs show no pattern. The octopus are a little bit higher in the sea area, but that is in the (inaudible) and the guts and stuff, not in the (inaudible). It is very variable, it is either it ate a crab that had a lot of arsenic, or maybe he has a liver or something in there. The meat was not a problem. It was pretty much the same everywhere.

Where is the arsenic coming from?

Well, again, we didn't know if we could answer that question.

I think there was a panic when that article came out.

Yes. I think you have to realize that the levels that we are finding are not skyrocket levels compared to what people (inaudible). I have some charts for the statewide study. The state just finished a study and the results are just coming out now. As we pointed out last time, Molokai wasn't included in that study. They only have about 10 or 15 places that they go. So right now Molokai has more arsenic work done on its marine animals than anywhere in the State. We do have higher values, particularly in the blue (inaudible) crab. That seems to be the one that is consistently high.

You don't know where it's coming from?

We don't know, because in the crab, it seems to be consistently high everywhere. About three times the levels that are generally found.

What is arsenic, and how much can one sediment get to kill you?

You are not going to eat the sediment I presume. The sediment comes out much lower. I can't answer the amount because I am not a toxicologist. I have talked to the toxicologist at the Department of Health. They point out, and one of the things they are going to be testing, is that 80 to 90 percent of the arsenic that occurs in the crabs tested elsewhere is nontoxic. You eat it, it goes right through your body, and comes out the next time you have a beer. The remaining part will build up in your body, but slowly, so if you ate a lot of crabs that were very high, then potentially, you would see some affects. Arsenic is not like lead and some of the other heavy metals where you are going to be suffering brain damage. It is a poison, but it's not in the same category.

Is that going to be in a statement in black and white in the book?

Well, I think the Department of Health needs to answer those questions. (inaudible). I don't know how widespread that letter is right now. We are going to be forwarding the additional data. They have not seen the study we have done in March. I presume they will be responding to those numbers. I have talked to them on the phone, but I haven't...

In your sediment samples you did from (inaudible) to (inaudible), (inaudible) sewer treatment plant (inaudible) now? That was the original landfill dump. There was a dump there. Were any samples taken from there, as far as toxic waste?

In the landfill itself, or in the reef? All of our sampling was done at the shoreline and out across the reef, both sediments and crabs, and (inaudible). We didn't look at soils or anything back on the land, actually one of the lowest values for arsenic and sediment was right off of the wastewater treatment plant in the soil. Probably because there is a stream there. We earlier tested for (inaudible)...

We are trying to figure out where it's coming from, so one of the things we did was look at (inaudible) Gulch and said if it's coming from land drainage, then it's going to be high in the soils that are coming down. It wasn't. It was low in the soils.

(inaudible).

We didn't look specifically at the dump site. We looked at sediment off the shore. I don't know how close we were to the old dump.

I don't even know where the old dump is.

Exactly where the sewer treatment plant is now.

I took a sample right where the outfall from the city treatment plant is.

How far down did you go? Did you go to the (inaudible) Homestead area? (inaudible) to the mangrove, no covers or nothing.

Remember, we are trying to cover the whole south shore so we can't look at...

It doesn't really matter if the arsenic is higher at the (inaudible) Flats in comparison to where the present dump site is because Hawaiian people go all along the shore...

I think you are talking about two different things. One is the question "where is the arsenic."

What I really want to know is black and white. (inaudible) continue to eating crab, whether it's by the dump site, the coconut grove, or further down by (inaudible), what is the contamination.

Again, you need a toxicologist.

Are you going to get one.

We will get the Department of Health toxicologist's response to the new numbers.

(inaudible).

Can you put that in writing?

Yes, there is a letter that points out 80 to 90 percent of the arsenic is nontoxic. I have asked them what about the other 10 or 20 percent, and they will presumably respond to that. Could you briefly describe this book with everything in it. Let's take the dump site. Could you briefly describe how you are going to cover it.

I am going to refer you back to page 4-13, which is about the middle of Chapter 4 of the EIS. This chapter talks about soil and groundwater contaminants. The other thing that I want to clarify before I describe the landfill is the document is broken into three sections that you described, but what you reference as ...

Just talk in simple terms! What are you going to do?

The portion that you were describing as new landfill is not landfill. It is borrow area. It is where we are going to borrow the soils to put on top of it.

I know that.

I wanted to make that clear. This EIS does not deal with the new landfill site. What we are talking about here when we talk about moving the soils and the areas that we have looked at for getting the soils. There will be no waste materials put in those places where the soils are taken from. The soils will be taken and placed on the Kalamaula site. We are going to do some grading work on the sides of the existing site to eliminate the exposed materials and to reslope the sides so that they are not as vertical as they are today. We are going to move that material back onto the existing landfill. Then we are going to come in and place 18 inches of low-permeability soil, meaning soils that won't let water through them very easily. On top of those 18 inches, we are going to place 6 inches of more permeable top soil, typically, what we see around the community as the soils that plants are growing on to sustain plant growth. The less permeable soils, the soils that won't let water through, also will not let vegetation grow because the soil is like a tight clay. The plants can't get enough oxygen, the roots can't penetrate, and the plants can't grow. That is basically what the earth movement portion of the closure is.

Could you just describe what the mounds look like with you hands?

(inaudible)

The EIS describes the choices that we have, I don't know the names of the grasses and plants.

For the side view of the landfill looking from here, what we want to do is put dirt on top of the landfill. We want to put dirt that doesn't allow water to come down inside. What the water does is goes down and grabs the arsenic and iron and goes sideways and out into the ocean. Because the landfill is being compressed all the time, all this stuff is bound up. What Larry just talked about on the side, the sides aren't quite like this, this is too much of an angle. We need to make it more of a gentler slope. We need to do it on the other side too. What we want to do is keep everything together. We want to put more dirt on the top, so it will be like you see it, a little bit higher. It won't be like the rectangle that you see over here. It will be something like this. The key is that when the water comes down on top of that stuff, you want the water to go off, not to soak down. As soon as you soak down you allow the bad stuff to go down. The soil that we have we put down for growing. We get this other kind of soil that doesn't permit water to soak down. That is the one that is going to go down here. Eventually, it will grass over. You haven't seen it yet, on Maui, (inaudible), what happened on that one is that bulldozers, dirt, grass seed, and then irrigation to get the grass going. You want to keep the grass (inaudible) because that is where the water comes on and the grass sucks it up. It doesn't penetrate down inside this area. We have it in (inaudible) so Kalamaula, Oluwalu, and Makani will look about the same. We are obligated to put native Hawaiian (inaudible). I don't know if Bermuda is native Hawaiian.

We want to be very careful with the irrigation. There is a danger of overirrigating and water getting inside.

(inaudible) about 6 inches of top soil (inaudible) then you end up (inaudible) again because you burn the soil. Whose responsibility will (inaudible) top soil. Every 10 years I see the trees becoming all yell and the trees burning (inaudible) wash off the mud.

I think that's a real good point. Because of the federal recognition that landfills are a potential for hazardous materials seeping, you cannot actually get that. Unfortunately, it becomes the responsibility of the County of Maui. Even though we finished this off and (inaudible), we retain that responsibility.

(inaudible).

There is a post-closure maintenance plan that will describe, based on the soils put on, we as the engineers and the technical people prescribe for the County what needs to be done. That will be put in writing and then that plan will be approved by the State of Hawaii. The State of Hawaii will be the first agent who is responsible for monitoring the County.

We become responsible for this thing. We have to submit a closure plan and a post-closure plan to the State of Hawaii. We also submit it to the EPA because they have asked us for the same thing.

(inaudible) what happens then, who will be monitoring it (inaudible) make sure the soil is top grade, make sure the grass is (inaudible)

I think that is a good point. One of the things that we would like to do would be to the (inaudible) you are still going to have compression created when something done over hear compresses... we have an obligation, by we I mean the County of Maui, when something like that does occur under what we call the post-closure plan, we have to go in, we have to go replace whatever the dirt is, the clay kind of dirt and the regular dirt for the grass. We have that responsibility. That will be outlined in the post-closure plan. The agency that watches us and will continue to watch us will be the State of Hawaii.

How long? 8, 10, 18 years?

Well, unfortunately, we may have to do this for the rest of our lives.

I want to know why did the State say no to building a wall around it.

That is an excellent question.

Why was that idea dumped?

It wasn't dumped. Maybe Larry can explain.

We were looking at the benefit of a containment wall. In using such a technical device or physical feature, it is important to have identified as clearly as you can what it is that you are trying to keep contained.

The contaminated soil.

The soil doesn't move. The contaminants move. So what we try to contain is what might move. What contaminants might move. Once we identified what the contaminants were, we did not identify significant levels for concentrations of contaminants that we felt a wall would hold in place.

It's not that (inaudible) it's not in here. That's why people reading this don't know why you disregarded the plan.

That was the reason.

My first thing was that it was too costly.

No, it was a technical question. A technical reason, but we included the cost. The reason we did that was that we aren't sure because we are only human and things happen that we don't control, that something will not happen in the future. So a containment of some sort may be required if the monitoring 5 years from now shows that maybe a drum corroded and something started to move. If it does, it may be necessary to build a containment of some sort for that purpose that is detected in the future and to pump or clean up what appears. We put the cost in, and we put that information in the EIS so that it would be there for the people and the agencies to read and for that information to be available for future use.

Has this happened at any other dump site in the U.S.? They wait until there is a corrosion and then build a wall.

Yes.

Where.

Los Angeles County. What's called the BKK Landfill.

Where is that?

In Los Angeles. A little bit to the east of the County.

Riverside?

East Los Angeles. It is part of the City of Los Angeles.

I cannot imagine that when something is corroded and dangerous that all of a sudden you build a wall here. They are making a door and is going to be corroded materials and they are going to run down there and build a wall there?

(inaudible).

The worst possible thing that we can think of happening is contaminants going outside of the (inaudible). That is the worst possible thing that we can think of happening.

(inaudible) to try to figure out what contaminants (inaudible).

I think you would have allowed Larry to continue he would have told you that even with a containment wall in a mudflat area, you cannot guarantee...if we had a wall in Arizona where it is dry, it is not too bad...but, over hear, we have some very peculiar problems. I just want to say one thing, I agree with Mrs. Granbush, she doesn't know this, this land is very special because it is native Hawaiian. Somehow, there is something else attached to this thing over here and that is why we are concerned. That is why we are here tonight. One other thing that (inaudible) what we want to do is come up with a worst-case scenario. Our feeling is that even if you put the thing around there, there is no guarantee that the thing wouldn't leak out or come under. Mainly because it is mud. What we are doing in order to look for this drum (inaudible) in 5 or 10 years, is the fact that we have more than normal monitoring wells that are set up around the landfill and (inaudible). What that will show us is that if something is coming out, we will pick it out as far as a contaminant. Our obligation as a county is to go back into the landfill and take away or (inaudible) that particular area that the contaminant may be coming from. We will go back and look for the drum.

One more point on the wall, with the installation of a containment wall, you do not stop water. You will not stop it in the ground. That is why a containment wall by itself will not protect what it is you want to protect, but if you can identify what the problem is, if it is some kind of a gasoline product, hydrocarbons, organic, some kind of solvent, or pesticide that shows up in the monitoring well then, when we put in containment, we must also pump. That is why I was calling it remediation, the cleaning up. The combination of the containment wall and some other actions is what is necessary to provide the protection that you are talking about and we don't know, at this point, what it is we would be pumping for because we have nothing today in those significant levels that endanger the animals that are here.

I don't think that this is the best.

No, what is the best? If you look in the EIS (inaudible). One of the things would be to take all of the rubbish out and put it somewhere else. When we do that (inaudible).

On the new land site (inaudible).

To control the liquids.

(inaudible).

Underneath, that is the problem.

(inaudible).

That is a good point.

(inaudible).

You can't use that comparison Billy. You have the new site up on the hill.

(inaudible).

Why don't you take a look at the (inaudible). That's what I'm getting at.

(inaudible).

Read your book.

(inaudible). You guys are supposed to know. We get a lot of people coming from the mountain. That should be very true. We are not talking about (inaudible).

One of the things that you guys can do is to address this in writing and say I think that the best solution is with the wall around it. (inaudible). Larry is here as our advisor.

You mean he is going to do what we want?

No. We have to answer. The reason for this meeting tonight is to ask, "what are your concerns?" You have the concerns, now what I really need is for it to come back to me in writing so that we can answer in writing so that it becomes part of the EIS. I would have to answer you, Mrs. Granbush, I have to answer Walter on this issue. Then you (inaudible). As Larry has said, the wall doesn't do us too much good. But there are some other alternatives. When you talk about what is the best, because I'm concerned about the food chain, those are good examples. Put it into the EIS because this will have to be reviewed by all the people in the state.

(inaudible).

Your children (inaudible) on top of this landfill site.

On the side? in the back? in the front?

(inaudible) worst-case scenario (inaudible) my children could be affected by that.

What would you want us to do?

(inaudible).

But that is the kind of comment that we need to have in writing.

(inaudible).

No, this is an EIS process, this is not a yell-and-scream process.

(inaudible) if all the people around the dump site...

Mrs. Granbush lives over...

I was born and raised there.

(inaudible)

(inaudible) on issues that need to be resolved. We should try to resolve it realistically. I think everybody wants to keep it as clean as we can. The more realistic way. We are not magicians. We are dealing with mother nature and water that is below it. We don't know which way it's going to go. We don't know how directly its going to go from the mountain and comes out.

We don't know. The agency isn't going to tell us. But, the problem we have to deal with is now. We have federal and state regulations that say, clean up your mess and do it the best you can. The mess is not created by the County. The mess was created by us and Molokai people. Who dumped the dump? We did. All of us. We contributed to the problem. Let's stop pointing fingers and figure out how can we best resolve it. The problem exists. It is real. We have the responsibility for the future to clean it up. I liked some of the suggestions I heard. I will submit my suggestions in writing also. I like the idea of moving the rubbish, dig down deep, without irritating more contaminants. (inaudible) a liner that seals it on the bottom of the site. Maybe that would be the easiest way. I don't know how it will affect EPA. The wetlands will be allowing the County to dig down below the (inaudible) level to get the rubbish out. They may not. (inaudible) creating more of a problem (inaudible), but I think what we have to do is look at a solution. (inaudible) I like the (inaudible) put it in a sealed bag so that it doesn't affect everything else around it. Liner (inaudible). I don't know what the cost factor may be, but I think everybody gets the feeling that we want to close them up, put them in a bag so it doesn't come out.

(inaudible)

I would rather not have my rubbish sealed in a bag, I'd rather bury it. I'd rather get rid of them and clean them so I don't have to see them no more.

What I am trying to get across to you is that if you don't put your concerns in writing then we can't address it.

I am going to put this in a letter to you. If I were going to through rubbish away, I would get a container like they do with the soda cans, wall it, dump it. You have got the stuff there. We need to get some more money to wall it and secure it. Even if it is a lot of bucks. I think that is the simplest problem. To contain it as best as we know how.

That is the kind of concern that should come out in the letters.

We have to go back to the EPA and tell them that's what the community wants. Give us some more money.

Well, they aren't giving any money I don't think.

We will just have to call them.

We need to get your concerns, even your friends. You can write up until April 22.

I have an idea, who else has an idea? Just throw them all in.

(inaudible).

The top soil is a liner. No artificial liner.

What is that a magic soil? What is that?

It is a clay.

(inaudible).

We felt that the proposal would provide the amount of protection that is keeping the water out that might move the contaminants as Rich and Mr. (inaudible) was describing. We took into consideration the fact that the groundwater is moving, it has moved under the site. It is a part of the natural condition. Over the years that that has happened, there have been certain contaminants that are in garbage that have leached out that have been a part of what has moved away from the site. Our data clearly indicates that. Not at a critical level, neither a toxic level or a level that our biological studies indicated were harmful to the animal life. Maybe sometime in the future it might be something else, but not that we have discovered. So, given all of those considerations, we felt that this was the solution that fit the problem that we could define. We didn't really deal with the most economical as much as we did technical what fits what we have found. Once we identified what we felt we should do from an engineering standpoint, we then went ahead and did the cost estimates.

(inaudible).

We would go ahead and develop a cost estimate and also estimate the quantity of material that would be moved, how long it would be exposed, how many days we would have that material exposed, much as is presently done in the EIS where we describe the environmental effects as well as the costs. We would do the same.

(inaudible).

Where the materials have been moved? Yes, it has been done before.

(inaudible).

At this site?

At this size.

Yes, and larger. Just as it has been removed and purified. That is going on in Florida right now on a much larger size, but at a very high cost. It is run through some machines, and the metals, the batteries, things like that are taken out. What is remaining is usually burned. But what they are doing, they are not leaving the site clean. Your grandchildren would not be safe because they are coming back after they excavate it and clean it. Then they put down the liner and put down new material and placing it on top of the liner so that they are rebuilding the site with new garbage, but with a liner underneath. So they are not making it safe. I agree with you on making it safe for your grandchildren. In order for it to be safe, it has to be gone.

(inaudible).

No, we are going to have a gambling casino over there. We need to look at the future. We are throwing out ideas. Nobody wants to be poisoned and nobody's grandchildren want to be poisoned. We are just normal people. We don't know if lining is best, walling is best. We have to make a decision and go for it. Try it out.

In the sense of the people of Molokai and what the County has been doing. We are not trying to be bad people on this landfill. As long as I've been around here; I've started with the Water Department in 1978, we have always had a permit from the DOH on these landfills. There is a certain set of conditions. We have been trying to build the landfill, both on Maui and Molokai, as a whole bunch of cells. Your municipal solid waste is bound up into one cell, compacted, tight, so that it is stabilized and won't move. That is the theory behind it, it may not be perfect, but that is what I've seen that we have been trying to do on all of our islands. We are lucky that here in Hawaii that we have so-called clean municipal waste. We don't have chrome-plating factories. You don't have a huge slaughtering house. You don't have a paint manufacturing plant.

But that may not be in the future.

That is right.

Towards the left of the dock, 200 acres is under light industry zoning for Molokai Ranch. Now, they may want to have a tire factory. We don't know.

Could be, but right now my feeling is that we have pretty clean stuff in there that you people haven't really been that dirty. There may be a few batteries because people weren't as careful in the past as we are now. We are going to have a household hazardous waste program now.

I wouldn't say this (inaudible) is healthy, they have done nothing to monitor that dump at all. They have Clean Air Act people and Clean Water Act people looking in the water and there have been no reports to this community. So now you are going to tell me that the DOH is going to prove this and monitor that. Uh-ha. I don't believe that.

I think what David is saying is that the state of the art is that you bind the materials. In other words, you put them together and we keep them in small areas or cells. Basically, that (inaudible) is how all of the landfills are done in Molokai and Maui and places like that. The concept is that the materials will not leach out mainly because you have compression. Every day you have bulldozers going out and pushing them down. They have a binding over there. When we are talking about excavating we run into another set of problems which we can address in our letters back to you. The whole concept about what we have been doing (inaudible) and then to close this place. We buy a lot of soil from the Department of Hawaiian Homelands over the years.

(inaudible) close the dump, put dirt over it and then it (inaudible) for 15 years. (inaudible).

That is EPA's regulation which wasn't here 15 years ago. You make a very good point. This is part of engineering and technical argument that we are going through with EPA right now with what they call entombment of waste. It is like putting it in a casket. Creating a tomb for the waste. Keep it dry. Keep the air inside. As engineers, we view that as a potential problem. A potential big problem because the gases will build up so you have to have a gas system, or if you put a cover on and the decomposition is not finished, you will start getting the cover breaking and sagging. Then there is a long-term maintenance cost with finding and bringing in that same clay material that we are calling the top seal, because the County is not going to be able to bring back just top soil if the top seal is broken. They are going to have to bring back the equivalent material and make sure that the seal is put back on. Right now there is a debate in the engineering community about the wisdom or the benefit to a community of this sealing of a landfill when it is still very active, when it is still digesting (so to speak), or the organics are still breaking down. But regulations don't allow us to change that at the moment. We have new regulations.

We said we could close a landfill like we would normally want to. When you take the best idea that you have and then do it. There is a 15-year breathing period. We could certainly try it and redeem it to be the best, and if the engineer says yes, maybe this would be the best way to get rid or detox the waste that we have. Fortunately, for some other communities, the federal government has stepped in and said the local communities have not done a good job with their municipal landfill and, as a result, we are making a federal regulation. Those just recently came out in the past year. We are forced to abide by those particular regulations. We didn't dream this cover thing, the 18 inches, or all that other stuff. It came to us in the form of regulation. The regulations of Florida and Molokai are the same. It doesn't matter. We don't care where you live, we will comply. As a result, what the federal government feels is the best way to handle municipal or rubbish (this is Countrywide) (inaudible). Like somebody did build one above (inaudible) Canal and it was a toxic waste dump. People did die and that is because people didn't care. Developers said, level the land and use garbage, and don't tell anybody. Now, because of those types of situations where greed was involved, the feds stepped in. Like they do in everything. They said no, we make an even playing field and now we have to play on that field. Even though we feel that we would be responsible, the answer is that we have to abide by the federal regulations.

(inaudible).

You can as long as you comply with federal regulations.

(inaudible).

One time on (inaudible), they wanted us to go 30 feet of impermeable soil because we didn't meet the federal criteria. If you don't know where that rubbish dump is, just think of 30-feet higher, almost level with (inaudible) Street. But that is what the DOH wanted. At that time, the DOH was calling the shots. That was 2 years ago. We said, "why?" They said, "because it is better." So I said, "what is the difference between 30 feet and 100 feet." They said, "100 feet is better." What about 200 feet? Where do we go? Engineering-wise, we followed the federal guidelines (inaudible).

(inaudible).

It is if you can identify what the toxic is. I would expect he would tell you that. You use a certain method for a certain type of gas or a certain type of petroleum. You might use some type of stripping or you might use a heat process. It would drive the toxic and then capture it and can do something with it. We would have to know what it was because doing that over 19 or 20 acres is...if you don't know what it is you are working on, you might do something that has no effect on the particular toxic or poisoned gas. Should you try all of the different methods?

Is it possible to do it all?

It would be a very long process.

I think what Larry is saying is that (inaudible). We went after one particular thing. Arsenic. Unfortunately, there is arsenic in the landfill, but there is other stuff inside the landfill. Over hear by the coconut grove you get more arsenic over there. That is the highest concentrations of arsenic, but that is not realistic. What Larry is saying is if iron was one bad thing, you could go in after the iron, but we have to identify what is the bad stuff. What we have done and what the reports show is that because you don't have heavy industry over here and never have, you don't have those kind of problems. It would be difficult for your friend or his company to go in and grab something (inaudible). If we had, based upon all of the studies that these guys have done, something concrete like cobalt or something like that, then we can go in and grab it.

Have you done a study (inaudible).

Yes.

(inaudible).

I think if you could be specific, it would be very helpful in the EIS process.

I am familiar with products where they have done that where there is a place called Super Block in Honolulu where they have found lots of different things under the ground (PCBs, etc.). There is a company there now doing exactly that. The first thing they do is say how much PCBs is in this area, and roughly how big the area is. Here is the concentration it is now, and here is the concentration we are going to accept. You can't go on forever. You have to say, all of the results that we have gotten from this landfill are this lower number. That means that you don't have this area to work in where you are going to be pulling all this toxic out until it's almost all gone. You are already at the almost all gone. That is why it isn't practical to bring in that equipment and try to go a little bit lower. It probably could be done, but it gets very expensive as you get closer and closer to those bottom numbers. It starts out cheap because they are working on places where there is lots of a bad substance in there. For a little bit of money you can get it down fairly quickly. When you get down to the bottom, and you want to pull it down a little bit more, it gets a lot more expensive for every little bit you take out because of the difficulty of getting that last little bit out. I think that is why it is not real practical until you have a monitoring system that reveals that in the downpour in areas around the dump, something is suddenly appearing. Whether it is a drum that rusted or whatever. The monitoring is a very important part of the closure. It will tell you when you have suddenly gone from this little bit of something to a level where you need to get in and do something. Those kinds of methods then become very practical and can solve the problem, assuming you have caught them with your monitoring system.

I think Dr. Guinther mentioned a real good point. I think we would be very concerned in this particular plan in the EIS, in the closure plan, and in the post-closure plan if we had no monitoring. Without monitoring, we said that when the fish die, then we go in. When somebody (inaudible) from eating crab, then we will go in. What we have done is gone through and adopted the federal regulations for monitoring and said, "yes, we want to do monitoring over hear because it is in a special site." It is in a wetland area. There is the possibility, this is a crabbing ground for all you guys, that something else can come up. Maybe not arsenic, may be some other kind of (inaudible), but with the monitoring wells that are there, we feel that we can actually detect and go after whatever comes out. To me, that is the real big key to what he is talking about. The other thing is that this is not Chicago, this is not San Francisco where you have cultural mills or heavy industry going on. The most you have is the plantations. That is about it. I guess you have fertilizers, too. We are very fortunate that we don't have those types of conditions that the mainland does have, but we still follow the same regulations, which is (inaudible) for the Love Canal.

(inaudible).

PCBs probably. That is what would probably be in the transformers. We looked for PCBs in the animals. That is one of the things we looked for animals.

We looked for PCBs also in the surface water and soils.

(inaudible).

Yes, but realize that a lot of the looking that they did wasn't necessarily for things that escaped, they looked right into the dump to see what was there. You always have the problem that you can't look everywhere because it's underground.

You could always miss it. The majority of the wells are in the dump and not outside the dump. They aren't looking for stuff that has actually escaped, but for what is in the dump, which is better because things could be escaping at a very low rate which means that it would be hard to find outside.

So what you are telling me is (inaudible).

Yes. I think it is probably 3 years by this time. With the initial EPA work that we have done.

(inaudible).

With respect to the arsenic now, you have more knowledge by the sediment (inaudible) and octopus from this reef, and the total of everything that is known to the State of Hawaii. So it has been very thorough in that area because we did find one substance that was of potential concern. For the other stuff, there are certain protocols that the EPA has established as far as how many wells and how many test (inaudible).

(inaudible).

They are hired by the County to do this. Therefore, from what I got that you were saying about tonight about the contaminants and arsenic, I would really like to see it on paper. Maybe I don't understand it, but maybe I have a friend that I could take the paper to. I would like to focus your attention to page 3-10, the Post-Closure Monitoring Wells and Probes. Who dug the nine wells?

(inaudible).

I am not telling you it's ok. I am a biologist, I study water quality problems, animals, and impacts on animals. I know it is not killing the crab, but when you get to the next step which is when you are eating the crab and how it affects your life, that requires a toxicologist, a person who specializes in the risks of different chemicals in the environment to people. All we have right now is a letter from DOH's toxicologist pointing out that the majority of the arsenic in shellfish is not at all harmful to humans. We are going to do a few more tests to determine that these specimens that we have been looking at fit that pattern, that is based on work done elsewhere in the U.S. I have also approached them and talked to them about the consequences of eating crabs because even though 90 percent of it is not harmful, 10 percent could be. There must be a level at which that become a deterrent. I personally don't know what that is. I tried to get some information today from the toxicologist and he said he would get back to me, he couldn't tell me over the phone. They are looking at it a little bit further. We are going to produce a report and I guess they will distribute that.

I would like to suggest that you come with a group of us and you show us what you found down there.

I have all my charts, I can show you.

That is all on paper. Let's go for real.

You want to go see the arsenic there. You don't see these things. We collect animals, take them back to the lab, and process them, measure them, and then write down the numbers. There is nothing I can show you in the field.

(inaudible).

We did some on crab from (inaudible) Fishpond.

(inaudible).

She sent me one crab finally. We just processed him the other day. He had arsenic a little bit high relative to crabs.

(inaudible).

Pakanaka is where he came from.

(inaudible).

That is what I say.

Go get some more, there are some right next to the pond.

(inaudible) that you know a whole lot, but I think let's come out and smell the roses with the people and show us what you are talking about down there.

I don't think there is anything I can show you. That is the trouble.

We want to know if it's real.

There is nothing that I can show you.

Well, let's go take a walk down there.

The crabs look all the same.

No they don't, they have different colors.

Let's listen to Walter, he has a concern.

What about chromium?

I can show you what the numbers are. I don't think it was particularly high. Chromium is prominent in Hawaiian soil so it shows up in soil samples at quite high levels. In fact, Hawaiian soil would be classified as contaminated just on the basis of chromium (inaudible).

(inaudible).

Yes. In the first study we did.

(inaudible).

We looked at silver, arsenic, barium, cadmium, chromium, copper, mercury, manganese, nickel, lead, (inaudible), and zinc. (inaudible) snails, black shrimp, alamini crab, (inaudible) crabs, (inaudible). These are all the animals that we could find in that area right off the (inaudible).

(inaudible).

Not initially, we did look at nemu in the artic studies. Somebody brought that up. Nemu is (inaudible) some studies in England that it can pick up arsenic. (inaudible).

(inaudible).

Yes, the one case brought along (inaudible) arsenic in the DOH's 1991 study, you can see most of the bars are real low, and there is one real high one, that is (inaudible) from (inaudible) Bay. Looking at the liver of that series. That level is (inaudible). For this arsenic study here, we caught (inaudible).

(inaudible).

I think what we are up against, is that we did some 48 tests on specimens from the reef. We could certainly do another 48 and cover a whole other group of animals. We have certain questions that we were going to try to answer. What you are saying is let's look at another level (inaudible).

(inaudible).

We aren't really done with it. (inaudible) are the fish inhabited by (inaudible) we weren't looking for anything.

(inaudible).

Well, for this study, if we had decided to go for fish, the fish you are mentioning would be much more possible. But we were doing the octopuses, alligator, and crab.

(inaudible).

(inaudible) because everything that is in that surrounding ocean is what we eat. I don't think that all of these studies are accurate, precisely if you only did a sampling for this and a sampling for that. You don't know what we eat.

The reason that we haven't done this is that during the first study, we included both species that we mentioned. Those fish show either no arsenic or very low levels. They are not good candidates for studying what the extent of the arsenic is from. Plus, they move around so much. If I go out and get several fish, you aren't going to be able to tell me when I analyze that fish where he ate the last week. From a human health standpoint, the main thing that we have looked at in this study so far is what is the distribution of this. Is it coming from the landfill or the harbor? Can we pin it down to where it is coming from? So from answering those kinds of questions, the fish are not good candidates for the human health questions. It is simply another question that would have to be addressed...

So, how did you get it on crabs.

No. We have lots of crabs. Number 1, they are eaten so it answers some human health questions. Number 2, they are more local, they don't move around that much so when we get the high levels up at the east end and in the harbor, then you know the arsenic is widespread. If it was only high around the harbor then you could say that the harbor is where the arsenic is. Unfortunately, the sediments point to this area and a little bit more to the east as being higher in the sediments. The crabs are high everywhere.

How about chromium?

Chromium was about the same in everything we looked at. It was not at levels that were unusual for Hawaii or the Pacific. Chromium is not particularly of concern. If you want a real number, it was between .2 and 1 ppm.

In your conclusion, everything you found in their intestines is edible and not contaminated.

No, my personal feeling is that there is a suggestion of contamination by arsenic in the crabs on Molokai. The levels, particularly in the blue pincher crab are high compared with levels that we have found anywhere else in the state. But they are not so high, for instance lobsters from Maine have more arsenic in their tissues than do your crabs on Molokai. Probably people that have lobster dinner from Maine are getting more arsenic than you are when you eat the crabs.

Do blue crabs absorb arsenic more than other species?

It does certainly look that way, but we don't know exactly why.

How many times did you go out there, and how many periods of times did you check?

We have only checked, as far as the detail study, this month. We have analyzed a total of 48 different types of sand tissues. In all, between the first and second study, which the first study started in August extending through to November, we have now done about 76 different tissue studies from around the landfill.

(inaudible).

(inaudible) south shore of Molokai. We have several ways to check against it. We have what is called Quality Control in the laboratory. There are samples that the labs run all of the time to make sure that they are getting accurate results. When we were in the middle of the first study and were starting to see high arsenic values, I put in some samples of blue pincher crab (inaudible) and they came out low normal. (inaudible) there are some other checks. That is the real concern to (inaudible).

(inaudible).

So, enough of the crab. You say we can still eat them, right?

I say that I am not the one to tell you one way or another. The levels are slightly high compared to crab everywhere in Hawaii. To me, that would be somewhat of a concern. I guess the last thing the DOH told me was that he wouldn't eat a bunch. I asked him if he could be more specific, he said, "no I can't right now." He obviously is a little concerned. I think we need to get a little more (inaudible).

TAPE CHANGE

No, the fishpond is not over here. In the ancient maps, the fishpond is over here.

What he is saying is that where is the mitigation going to be? It is going to be in the upper area.

This is our area for mitigation, the fishpond is actually over here.

How big of an area is Fish and Game encompassing?

22 (inaudible).

So they are aim to (inaudible) of the fishpond area.

What they want us to do is in this area.

A lot of the old fishpond that you knew has been filled in over the years when the sediment has come down from the plains. That is what hurt the area.

(inaudible) mangrove.

Yes, that is probably the worst part. Mangroves are terrible.

(inaudible).

(inaudible) trying to protect this fishpond for the birds, but yet (inaudible).

(inaudible) can we have a multi-use type thing. That is Walter's question about the fishpond. Why should you guys put money into the thing when birds (inaudible). There is a lot that they do, but we don't see it. If we can do something what you guys did at (inaudible), then maybe it will actually benefit some people. There area two-legged birds that walk around now. That is the type of input and also EPA needs to know about. When I talked to you about November when we went out, we told them that this is a special place. We wanted to make it known to them that this Hawaiian Homelands, this is not lands, this is Hawaiian Homelands. I am the one that told them that. I said, I don't know what it is about these lands, even though they were the first to come onto the homestead, but these are special lands. They may be special to Fish and Wildlife, which they are, but these are special to our native people. We made that point to the EPA people that were listening. They are not native Hawaiians or Indians, but I think that as a community, in the EIS you say, "these are special lands, can we do a multi-use type thing?" If fish comes back, can my grandchildren be allowed to go in and harvest just like the ancient Hawaiians did. That is the part of our cultural that we respect. Now, the FWS is saying that they don't trust us because man is bad. We are going to let the cats and dogs to come in. That is why the thing is there. If you input to us, that is the purpose of this meeting, and say that we have somebody else to consider. In the fishpond that you are talking about, Walter...

(inaudible).

The reason why (inaudible) as far as the mitigation measures that we thought of, we made them because of the County of Maui, it wasn't because of EPA or FWS.

(inaudible).

Yes, and that may be a possibility, but the problem is that we have a loss. We have to get over this hurdle. How do we do that? Do we do it by the community coming together?

(inaudible).

I understand that. Please understand the wetland issue is separate from the closure issue. They are two separate things. We have to attack them two separate ways. Part of it can come into the EIS, but (inaudible) my bright idea, that is why we are having these series of meetings. Walter, you hit it on the head saying we existed over here. When he grew up (inaudible) they took care of it in balance and I think that is the key. That is what has been missing.

The balance is not the birds are over there by themselves. The balance is that in the low-lying areas, the Hawaiians have always gone over there and have always respected that.

(inaudible). We are talking about 3 feet of water. (inaudible)

We are not talking about (inaudible) fishponds.

That is the problem, they clean the fishponds.

The shoreline is actually over here. This is not the shoreline. The shoreline from 1932 is right over here.

A report I read says that they are go into the fishpond. That is not correct?

No. The mitigation is to do the fishpond.

Between the berms. The wetlands, not fishpond.

That was one of the alternatives.

It is an alternative. We listed different alternatives in the EIS because we wanted to give ourselves a range of things that we would be able to do. However, FWS have the responsibility to advise EPA. FWS then sets the alternatives, which are not in the EIS because the EIS is concerned about closing the landfill. The EIS is about the closure of Kalamaula Landfill. This is not the opening of fishponds or wetlands.

(inaudible).

That was our idea.

Have they chose any of those or is it still wide open what they are going to do?

Yes, the fishpond is in there as far as an alternative. It is a recommendation from FWS. FWS wants 19.5 acres. FWS doesn't want...

Once the (inaudible) they aren't in a hurry. We are going to have a lot of time to work on this wetland thing because they don't want us to rush in. They don't want a lot of bulldozing. They don't want a lot of construction activity. They want us to do it very carefully and easily. We are going to have time to do it right.

We are coming up now on the breeding season, so there is not going to be any work until that is past.

Well, that is still the Department of Hawaiian Homelands, and certainly the Hawaiians can make an issue as to whether that agency chooses to give the right demands or...

Well, we are working with Hawaiian Homelands and (inaudible) on Monday.

What does it say?

It says thank you for the information.

That is why Kalamaula is constantly fighting. Because the commission, they do not protect the (inaudible) responsibility of the beneficiary. That is in the (inaudible). They make all these decisions, then when all of these people move in, (inaudible).

Well, they haven't made a decision.

(inaudible). She's the commissioner. Are we moving from the park up to the new site now? That is all in that book. I think it's not written clearly.

Does anybody have any other questions on the mitigation measures or the wetland issue?

(inaudible) closing statement is that we have to write a letter to you saying that the wetlands border the present dump site belong to (inaudible) rights of Native Hawaiians to control the ecosystem of birds, fish, people. To continue a class of people to the future. I think the determination of the use of that would be (inaudible). They should have a safe with FWS...

FWS is asking for 19.5 acres, right?

Same thing.

They are using a factor 3, Walter. 6.5 times 3.

(inaudible) who have you been talking to? What man?

We have been dealing with a lady named Karen Evans.

Do we write a letter to her?

No, you should write a letter to her boss. He is in the 9th region.

Could you give me that address?

I don't have it now.

(inaudible)

Karen Evans is the local contact that we utilize over here. (inaudible) her boss is in San Francisco.

(inaudible)

(inaudible) that Kalamaula is so expensive in that area because the native people have given, given, given, given and the agencies keep taking, taking, taking. (inaudible) if something is not in sync, we will put it on paper and place it on the record because it's not fair. It is not fair to have impositions because this is a community. That is why we are really looking at that whole thing.

One of the things that I would like to emphasize is that our primary concerns of this evening is the closure if Kalamaula.

You are not going to talk about the new one.

We can, but I want to emphasize that the EIS is based upon the closure of the landfill. Those are the types of questions or concerns that we would like to see. The other side would be the wetland issue. Certainly we can address that within the EIS. The last ones would be, which are separate and distinct, but the new landfill has nothing to do with this.

Why didn't you put it in the book?

That's not the new landfill, that is where we are going to get some soil to use on the old landfill at the new site.

That has nothing to do with the closure. All we are saying on the new landfill is ...

I want to know if the association would like to be considered for an extension to review the EIS of the landfill and to write the statements to which we may agree or disagree. April 22nd is only 3 weeks away.

Why don't you send me a letter and tell me how much time you need.

Our lawyers around the world...

(inaudible). I know you want us to write you a letter. I know that is the great process, and I know..., but if you truly like the opinions of the people (inaudible).

We already have people that are qualified to take the notes. We have Mrs. Wrightfield, who is a very qualified secretary. I think that she should be paid to take the notes.

Mrs. Granbush, we don't need (inaudible).

I know, but they need a consultant. We should get some money to pay the secretary.

(inaudible)

I am sorry I had to make that statement, but unfortunately that is our process.

How come the process and all the laws don't match the people. The laws need to be challenged. The laws are not forever.

One of the reasons why we came is to allow you the opportunity to talk in person because some of the concerns that you expressed, we can address some of them immediately, like the health concern on arsenic. We certainly want to get the DOH involved.

Rick has actually been talking to them (inaudible) about his recent studies. We tried to get a DOH person here tonight.

(inaudible)

I don't know if Becky caught all the stuff herself or not. We are using local residents. She is not Hawaiian.

(inaudible)

She has an ocean graphics degree.

(inaudible)

Just for this job. She was working for me when she lived in Honolulu.

(inaudible)

We have people on all of the outer islands if we need them.

So what conclusions have we come to tonight.

I don't know, you tell me Mrs. Granbush.

Number 1, those who want to write letters of their opinions of how it should be compacted, smashed, and surrounded should write it. I know that is important, but that is not the most important. The most important is where did you get that arsenic. I eat that food, I want that food, and I want my kids to enjoy that food. I want you to give me accurate information about all of that stuff coming down.

(inaudible)

You don't need to put it in writing. If you really want me to do a fish, you give Becky the fish and I'll do the fish for you.

(inaudible)

You go out there and catch the fish.

(inaudible)

For the Samoan Crab. The reason that we didn't take anything from anybody this time is that we decided that for this study, Becky would collect all of the stuff. We initially thought that we would get stuff from fishermen, then we said no, we will just get everything and take a look. We only had 3 weeks to get all the animals, test them, and come up with some kind of report. You can always do more.

(inaudible)

How come only 3 weeks, you decided to go find some crab.

(inaudible)

If we had decided to use fishermen-caught stuff, she would have got in touch with you guys.

(inaudible)

How can I get in touch with you.

Call the State Health Department office.

OK, give me your number and I will get you Becky's number.

I'd like to know what is DHHL's position in all of this.

(inaudible) I think we should let everybody else know, the County, the EPA, the FWS so everybody knows where we stand. I think it should be done that way. I will address it to the different people, but I will carbon copy all the parties in this issue so all parties know where I am coming from. Although it is separate, (inaudible). I am very concerned about the delineation, and that may be adjustable, I don't know. (inaudible)

One of the things that I want to emphasize is that the EPA got bad mouthed earlier in our discussion. They are concerned with the people. In 1992, (inaudible), they responded to an individual complaint about the Kalamaula Landfill. They commissioned the Bechtel Corporation to come over here and conduct a study regarding the landfill.

What year was that?

1991. The results of that particular study, Kalamaula qualified as a Superfund site. What that means is that the Feds would close Kalamaula with Federal money. What we said in our meetings with the Federal Government was, "when will you close Kalamaula." They said, "we don't know because it's not that bad. The only thing we found was arsenic on the landfill." We wanted to know when they were going to close it. What Superfund does is that they make the person that had the arsenic (inaudible). The instructions were very clear from our mayor. She said that if that's a problem, we, the County, needs to step in and actually begin the closure of Kalamaula. In 1993, the reason you see all of us here is because of the mayor's concern that the Bechtel study showed that something was wrong in this area, however, what the fish, (inaudible). So we said that this landfill is on Hawaiian Homeland property and next to people. That is why we are here today. The EPA listened. So we took on the responsibility. EPA responded to a single complaint saying maybe the landfill (inaudible). The study was released on January 1992. We used part of it and it is referenced in our EIS. So the EPA is not the bad guy. They responded. Their criteria is for the entire U.S., and it is not for just the State of Hawaii.

(inaudible)

My concern is that Kalamaula has always been on water. On page 3-10, you have nine wells, where are they? Even (inaudible) you are tapping from the main source, which is from the mountains. Those areas used to have a lot of springs.

These are monitoring wells, not the wells that we are getting fresh water from.

Where is it? Is it down there at the dump itself? Who dug those wells?

Yes.

What was the purpose of digging the wells?

To collect soil and water samples for contamination.

What kind of water is in there?

It is primarily brackish water. It is not potable water.

You had permission to dig those wells.

Yes.

Did you have to go the State Water Commission?

(inaudible)

Did you notice any spring water in the mudflats?

No, well, there are areas where water is obviously coming out. It is not in great quantities, but...

Where did you notice that?

Tidal Creek. When you get up to the top of it, the water is brackish. It is ocean water down here, so water is coming out and flowing down.

Are we moving up to the new dump site now? I don't know whether you are going to come back any more. The new dump site. (inaudible). I haven't read yet of how you are going to do that. Are you going to rubber line, and throw stuff in there, and burn it? The drifts of the smell, the buildup, the wind, will blow down to the new Kalamaula subdivision, schools... The new landfill is (inaudible). (inaudible) Flats, which is all down in these areas. The grave site is there. Bishop Estate is there. How do we know that in 10 years from now, Bishop Estate won't build a shopping center. I don't think people there would like to smell the dump. Neither would the 250 awardees below Red Hill that are going to be living there. First increment for the DHHL is going to be the roads, oakleaf, and water, and here we have a new dump site. The concern is you came from down and going to up. There will still be pollutants. It is going to drift where the residential area is going to be.

What is your concern?

I think it's the wrong site.

What do you propose?

First of all, it is too far from (inaudible). Isn't there any other state land that could have been looked into so that the County wouldn't have to pay so much money to purchase it? We are paying Molokai Ranch a big (inaudible) and they want a new subdivision as (inaudible) junction, which is what a 1/4 mile up. Here is the dump site.

Perhaps you can identify a practical area.

OK, when you come down from the airport, the old-scale house and the flat land, when you have the junction there, the church wants some acreage from Molokai Ranch, it is in the talking stage. Molokai Ranch is in the talking stage with Maui Community College. Molokai Ranch wants to develop a subdivision around those two areas. Am I right or wrong?

Are you talking about the Del Monte waste station?

Well, this is the talk of the town. This is the talk within the community.

If you find an area that you feel is suitable, and a long time ago, a number of dump sites were selected, in fact we did a study on the sites that were available. If you want us to look at them all again, we certainly can. However, in this particular incident, we are going to open a landfill. We may close it at (inaudible) based upon your concerns, but we are certainly going to open it.

I think people didn't really get into site selection because the information was being shared by agency people, small groups of community people.

If you can find an alternate location, we certainly would look at it. Right now, our planning is such that (inaudible).

Signed, sealed, and delivered.

(inaudible)

(inaudible) where they broke down the bridge. Inside that valley.

(inaudible) going up the street it is on your left. (inaudible) that is the old cemetery. (inaudible) going up a dirt road.

The left of the crest (inaudible)

Yes.

Well, what happens when it rains and the runoff goes down?

They are supposed to build a berm to contain all runoffs.

That is part of the Federal regulation.

No burning?

No burning.

The wind changes, and the smell moves.

That was brought up when we went to (inaudible) permit public areas, they will be using herbs to cover (inaudible).

How big is it?

(inaudible).

That is what I said, if you can come up with an alternate, we may open the 2-acre site. The reason we have Federal guidelines and dates that we are into.

If you don't open this, then we will have a problem opening the Kalamaula Landfill. The concern was that we don't any more (inaudible).

The Kalamaula Landfill was leased to the County for $1 per year, and know they have to pay big bucks.

They have already paid DHHL a $1 million for the encroachment, how much more do you want?

NO. All of the years of appreciation is what I meant, give, give, give, dollar, your fine, now they have to move. The $1 million doesn't benefit me. You could have paid $10 million dollars. Where does the money go?

Money will be spent here on Molokai. That was a condition that the County (inaudible).

I think you are going to have some concerns with the dump site, but you got it. Do it. Whatever.

Go look for an alternate. (inaudible) but it is a 2-acre site.

Something that can't sink.

If something better can come up, that would be great, but in the mean time, we have to move on so that we can close Kalamaula before something worse happens.

The thing is that wherever the new one is, (inaudible) to discuss proper liners. It is better for the community.

I personally looked at about 10 different sites, and this is the best one to try to satisfy everybody. It was either too far or too close to a cemetery, too close to a highway where the litter would blow over the highway. I think this is a good solution. We are going to be under what they call a small community exemption for the new regulations which means we have to stay under 20 tons per day, which is just a tiny little amount of garbage in comparison with 700 tons per day that we have on Central Maui. We are going to compost so you are not going to see the amount of garbage as you are presently. We have to do other things. Let's say we are mandated to do other things.

I think what David is talking about is that the State Government has actually mandated all the counties to come up with a recycling plan that has to be adopted within the next several months. They must show within 1 year (1994) a reduction of 25 percent.

By the first of 1995.

Thereafter, 25, 25. We need to cut down the amount that goes in there by an appreciable number. That is statewide directed. We have the draft of that plan that has gone out already. It is something that these guys did a lot of work on. I think it is do-able with the community help.

I think this book could have been made easier reading if it was really sectioned off and there was some kind of order of the pages. I think it is really lacking in your documentation. The sources of information where the documents were gathered from. While you are writing in here, you are referring to something in here. There is some alphabet in here I don't get. You don't explain it. FWS, what does that mean.

Fish and Wildlife Service.

Why don't you have it explained in here.

(inaudible).

Bring the accurate information. (inaudible).

(inaudible) it will probably be in May or June.

(inaudible).

APPENDIX A

REFERENCES

REFERENCES

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APPENDIX B

LETTERS AND COMMENTS FROM THE EIS PREPARATION NOTICE

Letters having substantive comments:

1. Letters having substantive comments
2. Response to letters

1. Mr. Kisuk Cheung, P.E.
   Department of the Army
   U.S. Army Engineer District

2. Mr. Warren M. Lee
   U.S. Dept. of Agriculture
   Soil Conservation Service

3. Mr. John C. Lewin, M.D.
   State of Hawaii
   Dept. of Health

4. Mr. Brian Miskae
   County of Maui
   Dept. of Planning

5. Mr. Don Hibbard
   State of Hawaii
   Dept. of Land and Natural Resources
   State Historic Preservation District

6. Mr. DeGray Vanderbilt

7. Mr. Brian Hashiro
   County of Maui
   Dept. of Public Works

b&c.002.le4

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
BUILDING 230
FT. SHAFTER, HAWAII 96858-5440

12

REPLY TO
ATTENTION OF:

July 30, 1992

'92 AUG -7 P1:35

Planning Division

DEPT OF PUBLIC WORKS	Info	Action	Rush	See Me	Comments	Copy	[illegible]
DIRECTOR	☑	☐	☐	☐	☐	☐	☐
DEP. DIR.	☐	☐	☐	☐	☐	☐	☐
PERS.	☐	☐	☐	☐	☐	☐	☐
STAFF OF.	☐	☐	☐	☐	☐	☐	☐
LUCA	☐	☐	☐	☐	☐	☐	☐
WW RECL.	☐	☐	☐	☐	☐	☐	☐
SOLID W.	☐	☑	☐	☐	☐	☐	☐
ENGR.	☐	☐	☐	☐	☐	☐	☐
HWYS.	☐	☐	☐	☐	☐	☐	☐
SEC'Y	☐	☐	☐	☐	☐	☐	☐
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REMARKS

Date 8/7

Mr. George N. Kaya, Director
County of Maui Department of Public Works
200 South High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Kaya:

Thank you for the opportunity to review and comment on the Environmental Impact Statement Preparation Notice for the proposed closure of Kalamaula Sanitary Landfill, Kalamaula, Molokai (TMK 5-2-11: por. 1, 21; and TMK 5-2-08: 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. The landfill closure action, including the issue of encroachment into adjacent wetlands, is subject to regulation by the U.S. Environmental Protection Agency (EPA) and the Hawaii State Department of Health. By Memorandum of Agreement between the Secretary of the Army and the EPA, the latter is the lead federal regulatory agency for solid waste disposal projects and issues. If you have any questions on this, please call Operations Division at 438-9258.

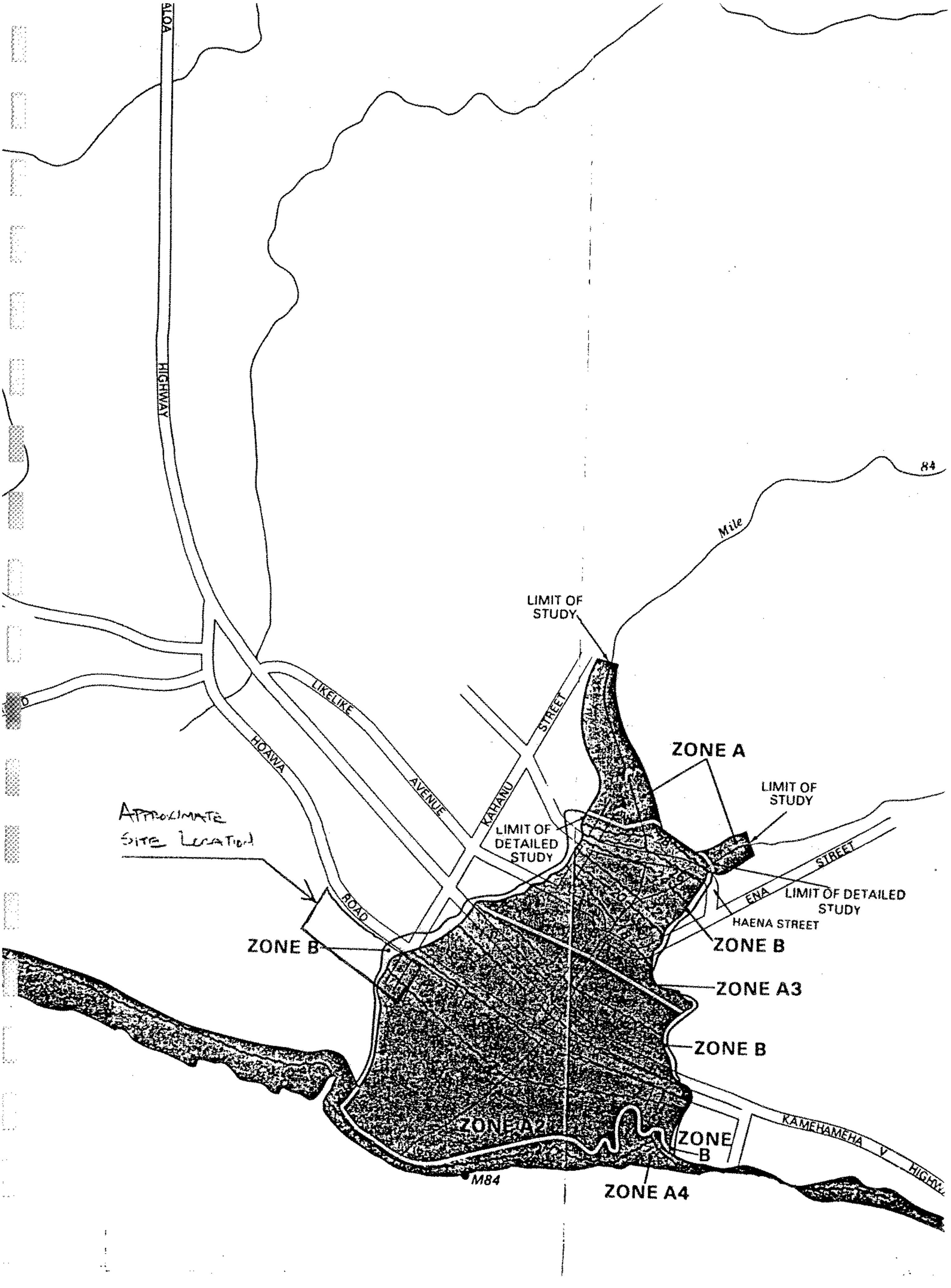
b. The flood zone designations stated on page 11 of the Environmental Assessment are correct; however, base flood elevations ranging from 7 to 8 feet above mean sea level for the 100-year flood (Zone A2) have been determined (copy enclosed) and should be included.

Sincerely,

C. Fujii

Kisuk Cheung, P.E.
Director of Engineering

Enclosure



ALOA
HIGHWAY
LIKELIKE
AVENUE
KAHANU
STREET
HOAWA
ROAD
LIMIT OF STUDY
ZONE A
LIMIT OF STUDY
LIMIT OF DETAILED STUDY
ENA STREET
LIMIT OF DETAILED STUDY
HAENA STREET
Approximate Site Location
ZONE B
ZONE B
ZONE A3
ZONE B
ZONE A2
ZONE B
ZONE A4
M84
KAMEHAMEHA V HIGHWAY
Mile
84

INDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
ARLES JENCKS
eputy Director
LLOYD P.C.W. LEE, P.E.
Chief Staff Engineer

AARON SHINMOTO, P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
RALPH NAGAMINE, P.E.
Engineering Division
BRIAN HASHIRO, P.E.
Solid Waste Division
MELVIN HIPOLITO
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

October 28, 1992

Kisuk Cheung, P.E.
Director of Engineering
Department of the Army
U.S. Army Engineer District
Building 230
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE

Thank you for your comments on the Environmental Impact Statement Preparation Notice for the subject project.

We are in the process of preparing the Draft Environmental Impact Statement (DEIS) and will address the following items in the DEIS:

1. Clarification of regulatory jurisdictional issues affecting the U.S. Department of the Army and the U.S. Environmental Protection Agency; and

2. Inclusion of base flood elevations at the project site.

A copy of the DEIS will be provided to your office for review and comment. If there are any questions or additional comments, please contact Mr. Dave Wissmar of our Solid Waste Division at 243-7875.

Very truly yours,

GEORGE N. KAYA
Director of Public Works

xc: Westley Chun, Brown and Caldwell
Michael Munekiyo, Michael T. Munekiyo Consulting

12

UNITED STATES
DEPARTMENT OF
AGRICULTURE

SOIL
CONSERVATION
SERVICE

P. O. BOX 50004
HONOLULU, HAWAII
96850

August 3, 1992

Mr. George N. Kaya, Director
Department of Public Works
County of Maui
200 South High Street
Wailuku, Hawaii 96793

DEPT OF PUBLIC WORKS

	Info	Action	[illegible]	[illegible]	Comment	[illegible]	[illegible]
DIRECTOR	☑	☐	☐	☐	☐	☐	☐
DEP. DIR.	☐	☐	☐	☐	☐	☐	☐
PERS.	☐	☐	☐	☐	☐	☐	☐
STAFF OE	☐	☐	☐	☐	☐	☐	☐
LUCA	☐	☐	☐	☐	☐	☐	☐
WW RECL.	☐	☐	☐	☐	☐	☐	☐
SOLID W.	☐	☑	☐	☐	☐	☐	☐
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SECRT.	☐	☐	☐	☐	☐	☐	☐
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Rec'd By ________ Date 8/5

Dear Mr. Kaya:

Subject: Environmental Impact Statement Preparation Notice (EISPN)
For the Proposed Kalamaula Sanitary Landfill Closure

We have reviewed the EISPN for the Kalamaula Sanitary Landfill Closure and would like to offer the following comments:

We support the use of plant species normally found in the area for the vegetative cover for the landfill. This would allow the landfill to easily blend into the surrounding area.

We support the requirement for groundwater monitoring wells to detect any potential leachates as they move from the landfill to the sensitive coastal waters.

Thank you for the opportunity to review this document.

Sincerely,

Warren M Lee

WARREN M. LEE
State Conservationist

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
LLOYD P.C.W. LEE, P.E.
Chief Staff Engineer

AARON SHINMOTO, P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
RALPH NAGAMINE, P.E.
Engineering Division
BRIAN HASHIRO, P.E.
Solid Waste Division
MELVIN HIPOLITO
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

October 26, 1992

Warren M. Lee
State Conservationist
U.S. Department of Agriculture
Soil Conservation Service
P.O. Box 50004
Honolulu, Hawaii 96850

Dear Mr. Lee:

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE

Thank you for your comments on the Environmental Impact Statement Preparation Notice for the subject project.

We are in the process of preparing the Draft Environmental Impact Statement (DEIS) which will provide additional details regarding final cover, landscaping and groundwater monitoring.

A copy of the DEIS will be provided to your office for review and comment. If there are any questions or additional comments, please contact Mr. Dave Wissmar of our Solid Waste Division at 243-7875.

Very truly yours,

GEORGE N. KAYA
Director of Public Works

xc: Westley Chun, Brown and Caldwell
Michael Munekiyo, Michael T. Munekiyo Consulting

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

10

DEPT OF PUBLIC WORKS
DIRECTOR
DEP. DIR.
PERS.
STAFF CE
LUCA
WW RECL.
SOLID W.
ENGR.
HWYS.
SECTY.
Return to________
By______ Date______

8/20

In reply, please refer to:
92-239/epo

August 14, 1992

Mr. George N. Kaya
Director, Department of Public Works
County of Maui
200 S. High Street
Wailuku, Maui 96793

Dear Mr. Kaya:

Subject: Environmental Impact Statement Preparation Notice (EISPN) for the Proposed Kalamaula Sanitary Landfill Closure

Thank you for allowing us to review and comment on the subject document. We have the following comments to offer:

Solid Waste

Overall, we feel that the Environmental Assessment (EA) adequately addresses the critical issues involved in the closure of Kalamaula Landfill. We do, however, feel the Environmental Impact Statement should provide more detailed discussion in the following areas.

Page 20: Locations of nearest potable water sources and potential for any future uses in the immediate area.

Page 20: Add a section on Solid Waste Infrastructure including a discussion of the location/capacity of the proposed replacement landfill.

Page 21: An assessment of any potential for horizontal intrusion of off-site surface water percolation.

Page 23: A discussion of the negative environmental impacts of the attempted removal and remediation of encroaching waste.

Page 25: A discussion of the socio-economic impacts of any removal and remediation efforts, including impacts on development of an Integrated Waste Management Facility at the new landfill site.

If you should have any questions on this matter, please contact Mr. John Harder of the Office of Solid Waste Management at 586-4227.

Very truly yours,

Bruce Anderson for

JOHN. C. LEWIN, M.D.
Director of Health

c: Office of Solid Waste Management
Maui District Health Office (David Nakagawa)

INDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
LLOYD P.C.W. LEE, P.E.
Chief Staff Engineer

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

AARON SHINMOTO, P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
RALPH NAGAMINE, P.E.
Engineering Division
BRIAN HASHIRO, P.E.
Solid Waste Division
MELVIN HIPOLITO
Highways Division

October 28, 1992

John C. Lewin, M.D.
Director of Health
Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801

Dear Dr. Lewin:

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE

Thank you for your comments on the Environmental Impact Statement Preparation Notice for the subject project.

We are in the process of preparing the Draft Environmental Impact Statement (DEIS) which will address the following issues:

1. Relationship of the project site to potable water sources;
2. Description of proposed replacement facilities for the Kalamaula Landfill;
3. Surface water percolation in to the landfill site;
4. Impacts and mitigation associated with encroachment of solid waste into the adjacent wetland areas; and
5. Socio-economic impacts associated with encroachment mitigation, and the relationship of mitigation efforts to integrated waste management facility needs.

A copy of the DEIS will be provided to your office for review and comment. If there are any questions or additional comments, please contact Mr. Dave Wissmar of our Solid Waste Division at 243-7875.

Very truly yours,

GEORGE N. KAYA
Director of Public Works

xc: Westley Chun, Brown and Caldwell
Michael Munekiyo, Michael T. Munekiyo Consulting

LINDA CROCKETT LINGLE
Mayor

BRIAN W. MISKAE
Director

ROBERT K. KEKUNA, JR.
Deputy Director

BILL MEDERIOS
Long Range Division

COLLEEN M. SUYAMA
Current Planning Division

KALVIN KOBAYASHI
Energy Division

COUNTY OF MAUI
PLANNING DEPARTMENT
250 S. HIGH STREET
WAILUKU, MAUI, HAWAII 96793

(19)

'92 AUG -7 P1:42

August 5, 1992

DEPT OF PUBLIC WORKS	Info	Action	Rush	See Me	Comments	Copy	File
DIRECTOR	☑	☐	☐	☐	☐	☐	☐
DEP. DIR.	☐	☐	☐	☐	☐	☐	☐
PERS.	☐	☐	☐	☐	☐	☐	☐
STAFF CE	☐	☐	☐	☐	☐	☐	☐
LUCA	☐	☐	☐	☐	☐	☐	☐
WW RECL.	☐	☐	☐	☐	☐	☐	☐
SOLID W.	☐	☑	☐	☐	☐	☐	☐
ENGR.	☐	☐	☐	☐	☐	☐	☐
HWYS.	☐	☐	☐	☐	☐	☐	☐
SECTY.	☐	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐	☐

Return to: ____________

Date 8/7

Mr. George N. Kaya
Director of Public Works
County of Maui
Department of Public Works
200 South High Street
Wailuku, Hawaii 96793

Dear Mr. Kaya:

Subject: Environmental Impact Statement Preparation Notice for the Proposed Kalamaula Sanitary Landfill Closure

We have reviewed your draft Environmental Assessment and Environmental Impact Statement Preparation Notice (June 1992) for the closure of the Kalamaula Sanitary Landfill on Molokai. The total area occupied by the landfill is estimated at 18 acres. The landfill has encroached into the surrounding Ohiapili Wetlands. The Ohiapili Wetland is host to a number of waterbirds, including the endangered Hawaiian stilt, Hawaiian coot, Newell's shearwater, Oloma'o, and Molokai creeper.

The landfill closure program will consist of conducting field investigations to assess the existence and significance of landfill leachate, fire, and gas and the placement of cover material in accordance with Part 258. In accordance with the minimum closure requirements set forth in 40 CFR Part 258, a cover layer totalling 24-inches in depth will be required to close the landfill.

We have commented previously to you in a letter dated June 23, 1992 on the applicability of a Special Management Area Use Permit, Shoreline Setback Variance, and State Land Use Commission Special Use Permit for the landfill closure (Exhibit A). You should also check with the State Land Use Commission regarding further requirements for a State Land Use Commission Special Use Permit if the affected project area within the State Agricultural District is more than 15 acres.

We have no further comments to offer. Thank you for providing us with an opportunity to comment on the draft EA. Should you have any further questions, please contact Mr. Clayton Yoshida of this office.

Very truly yours,

for Brian Miskae
Planning Director

cc: Colleen Suyama
Clayton Yoshida, AICP

Mayor

RIAN W MISKAE
Director

OBERT K. KEKUNA, JR.
Deputy Director

Long Range Division

COLLEEN M. SUYAMA
Current Planning Division

KALVIN KOBAYASHI
Energy Division

COUNTY OF MAUI
PLANNING DEPARTMENT
250 S. HIGH STREET
WAILUKU, MAUI, HAWAII 96793

June 23, 1992

Mr. George Kaya, Director
Department of Public Works
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Dear Mr. Kaya:

Subject: Kalamaula (Molokai) Sanitary Landfill - Applicability of Special Management Area Permit, Shoreline Setback Variance, and State Land Use Commission Special Use Permit

We have reviewed your letter regarding the closure of the Kalamaula Sanitary Landfill and offer the following comments:

1. The subject landfill site is located more than 800 feet mauka of the proposed shoreline. Under the Molokai Planning Commission's Shoreline Setback Rules, the maximum distance for a shoreline setback is 150 feet from the certified shoreline. Since the landfill site is located at a distance much greater than the 150 feet from the shoreline, a Shoreline Setback Variance will not be required for the proposed action. However, the current shoreline should be certified as such by the Department of Land and Natural Resources.

2. The proposed action is to close an existing nonconforming use, a landfill, in the State Agricultural District and therefore we feel that a Land Use Commission Special Use Permit should not be required for the closing of the landfill.

3. Due to amount of soil to be brought in to cover the entire landfill site, we feel that a SMA major permit would have to be obtained from the Molokai Planning Commission. An application form is attached. The Molokai Planning Commission could conduct a public hearing on the application no less than six weeks after receiving a complete application from your office. Please be advised that this department may need some assistance from your office in obtaining comments from public agencies in a timely manner as it did for your State Land Use Commission Special Use Permit for the Lahaina Wastewater Treatment Plant and Highways Division Maintenance Baseyard site. (91/SUP-008)

4. The compliance with Chapter 343, HRS, should be completed prior to the submission of the SMA application. If the Department of Public Works decides to do an EIS for the closure action, then this process should be completed prior to the submittal of the SMA application and documentation of its completion should be submitted as part of the SMA application.

Should you have any questions, please contact Clayton Yoshida of this office.

Very truly yours,

Brian Miskae
Director of Planning

cc: Robert Kekuna, Deputy Planning Director
Colleen Suyama
Clayton Yoshida, AICP

NDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
HARLES JENCKS
Deputy Director
LLOYD P.C.W. LEE, P.E.
Chief Staff Engineer

AARON SHINMOTO, P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
RALPH NAGAMINE, P.E.
Engineering Division
BRIAN HASHIRO, P.E.
Solid Waste Division
MELVIN HIPOLITO
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

October 28, 1992

MEMO TO: BRIAN MISKAE, DIRECTOR OF PLANNING

FROM: GEORGE N. KAYA, DIRECTOR OF PUBLIC WORKS

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE

Thank you for your comments on the Environmental Impact Statement Preparation Notice for the subject project.

We are in the process of preparing the Draft Environmental Impact Statement (DEIS) which will address land use and environmental regulatory requirements needed for project implementation.

A copy of the DEIS will be provided to your office for review and comment. If there are any questions or additional comments, please contact Mr. Dave Wissmar of our Solid Waste Division at extension 7875.

xc: Westley Chun, Brown and Caldwell
Michael Munekiyo, Michael T. Munekiyo Consulting

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

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES

JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION DIVISION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

July 20, 1992

LOG NO.: 5771
LOG NO.: 2393a

Mr. George N. Kaya, Director
County of Maui
Department of Public Works
200 South High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Kaya:

SUBJECT: Chapter 6E Compliance, Historic Preservation Review of the Environmental Impact Statement Preparation Notice for the Proposed Kalamaula Sanitary Landfill Closure
Kalamaula, Molokai
TMK: 5-2-11: por. 1, 21; 5-2-08: 24

Thank you for the opportunity to comment on this document.

Closure of the existing landfill is proposed. There are no known historic sites in the landfill area itself, but there are several known significant historic sites in the general vicinity. This document has adequately summarized these sites on pages 16 and 17, with the site locations shown on Figure 7, page 18. Since the proposed closure activities will be confined to the boundaries of the existing landfill, we concur with this document's determination that the proposed project will have "no effect" on any of the significant historic sites (three fishponds) which are closest to the landfill.

It appears that this document has adequately addressed historic preservation concerns. If you have any questions, please have your staff contact Ms. Annie Griffin at 587-0013.

Sincerely,

DON HIBBARD, Administrator
State Historic Preservation Division

AG:aal

INDA CROCKETT LINGLE
Mayor

GEORGE N. KAYA
Director

CHARLES JENCKS
Deputy Director

LLOYD P.C.W. LEE, P.E.
Chief Staff Engineer

AARON SHINMOTO, P.E.
Land Use and Codes Administration

EASSIE MILLER, P.E.
Wastewater Reclamation Division

RALPH NAGAMINE, P.E.
Engineering Division

BRIAN HASHIRO, P.E.
Solid Waste Division

MELVIN HIPOLITO
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

October 28, 1992

Don Hibbard, Administrator
State Historic Preservation Division
Department of Land and Natural Resources
33 South King Street, 6th Floor
Honolulu, Hawaii 96813

Dear Mr. Hibbard:

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE

Thank you for your comments on the Environmental Impact Statement Preparation Notice (EISPN) for the subject project.

We are in the process of preparing the Draft Environmental Impact Statement (DEIS) which will incorporate cultural resources documentation contained in the EISPN.

A copy of the DEIS will be provided to your office for review and comment. If there are any questions or additional comments, please contact Mr. Dave Wissmar of our Solid Waste Division at 243-7875.

Very truly yours,

GEORGE N. KAYA
Director of Public Works

xc: Westley Chun, Brown and Caldwell
Michael Munekiyo, Michael T. Munekiyo Consulting

Mr. Brian Hashiro
Solid Waste Division Chief
County of Maui
200 South High Street
Wailuku, Maui, Hawaii 96793

August 5, 1992

Re: Closure Kalamaula Landfill

Dear Mr. Hashiro:

Thank you for the copy of the Environmental Assessment document which I requested. I received it July 31, 1992. You indicated that responses must be in by August 5, 1992. Hopefully my response, which is a day late, will be accepted and passed on to all the parties involved with the closure process.

As you recall, due the Council sticking to strict parliamentary procedures, the opportunity to discuss the important closure of the landfill slipped by at a recent meeting on Molokai.

After reading the EA, I have several comments. Within the last 45 days, I had a coincidental opportunity to talk with an engineer visiting Molokai on vacation who has been extensively involved in landfill closures on the Mainland.

He estimated that because of the sensitive area where the landfill is located that costs could range dramatically from $3,000,000 up to as high a $20,000,000. The amount of the cost would be directly related to the the extent of the closure improvements made to maximize the future protection of the surrounding, fragile environmental resources.

On page 26 of the EA, it is pointed out six major concerns dealing with landfill closures. It appears that all will apply to the Kalamaula landfill which is built over tidal flows, is partially in a flood plain, and encroached on the Ohiapili wetlands.

Due to the current financial difficulties faced by the state and the county, there is a concern on Molokai, and especially with the Kalamaula homesteaders, that the County will be forced to try and cut as many corners as possible in order to keep the closure costs at a minimum. This is fine as long as cost saving strategies are not at the expense of environmental protection.

The comments on page 3 of the EA concern me. It appears that the County is trying to make sure that the Kalamaula landfill stops receiving wastes by October 9, 1993 so that the the closure procedures will be exempt from the stricter EPA closure guidelines set for in 40 CFR Part 258 (Federal Register Volume 56, No. 196). Again, I hope avoiding the exemption will not be to avoid necessary costs that may be required to insure protection of the environment.

As you know one of the most widely used ocean gathering spots on Molokai is at Palaau, just south of the landfill site. In addition to other activities it is one of the best crabbing grounds on Molokai. You might recall that recent sea turtle studies in the area have confirmed the presents of tumors on nearly all the turtles observed. The cause of the tumors has not been determined.

I was surprised that no Molokai organizations (i.e. Molokai Cares, Molokai Chamber, etc.) have been involved in the loop in preparing the EA and none are projected to be involved in the preparation on the EIS. Possibly you might want to check and see if you want to include some of these organizations. I know that Molokai CARES and the Chamber would like to be kept current on matters. Info to Molokai CARES can be sent to Lynn Bonk, President, and for the Chamber info can be sent to me. I am Chairman of the Chambers Economic and Community Development Committee.

Please give me a call if you have any questions on the enclosed. Also I would appreciate it if you would sent to me the following: County's cost estimates for closing the old landfill and opening a new one; the current detailed schedules for the closure and the opening; the addresses and contact persons for the agencies listed on pages 28 and 29 of the EA, a copy of 40 CFR Part 258 (Federal Register Volume 56, No. 196.), as well as, any comments you received on the EA from the agencies listed on page 28 or other parties. Mahalo.

Sincerely,

DeGray Vanderbilt

DeGray Vanderbilt
Box 1348
Kaunakakai, Molokai, HI 96748
553-3716

DV:mdb disk-2.4

cc: Councilman, Pat Kawano
Lynn Bonk,
Molokai CARES
Molokai Chamber

LINDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
CHARLES JENCKS
Deputy Director
LLOYD P.C.W. LEE, P.E.
Chief Staff Engineer

AARON SHINMOTO, P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
RALPH NAGAMINE, P.E.
Engineering Division
BRIAN HASHIRO, P.E.
Solid Waste Division
MELVIN HIPOLITO
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

October 28, 1992

Mr. DeGray Vanderbilt
Box 1348
Kaunakakai, Hawaii 96748

Dear Mr. Vanderbilt:

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE

Thank you for your comments on the Environmental Impact Statement Preparation Notice (EISPN) for the subject project. We appreciate your calling to our attention the interest of the Molokai Chamber of Commerce and Molokai C.A.R.E.S. in the EIS preparation process. Copies of the Draft Environmental Impact Statement (DEIS) will be provided to these organizations for review and comment.

As you are probably aware, we are in the process of preparing the DEIS which will provide additional details regarding the closure program. Please be assured that the final closure plan and mitigation activities will be designed to address, to the maximum extent practicable, environmental resource needs, as well as public health and safety concerns. We are working closely with State and Federal Agencies towards this end.

The costs and schedule for the closure of the Kalamaula Landfill are being developed as part of the closure plan design and will be documented in the DEIS.

As requested, we are enclosing herewith the mailing list for agencies contacted for the DEIS preparation phase. Substantive comments have been received from several of these agencies. Copies of the letters, as well as our responses, will be included in the DEIS.

We are also enclosing for your use, a copy of 40 CFR Part 258, as requested. If there are any questions or additional comments, please contact Mr. Dave Wissmar of our Solid Waste Division at 243-7875.

Very truly yours,

George N Kaya

GEORGE N. KAYA
Director of Public Works

xc: Westley Chun, Brown and Caldwell
Michael Munekiyo, Michael T. Munekiyo Consulting

SEP 30 1992

NDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
RLES JENCKS
puty Director
LOYD P.C.W. LEE, P.E.
Chief Staff Engineer

AARON SHINMOTO, P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
RALPH NAGAMINE, P.E.
Engineering Division
BRIAN HASHIRO, P.E.
Solid Waste Division
MELVIN HIPOLITO
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

September 27, 1992

Westley Chun, Ph.D.
Brown and Caldwell Consultants
485 Waiale Drive
Wailuku, Hawaii 96793

Dear Dr. Chun:

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE - EIS PREPARATION NOTICE

The following comment is from our Land Use and Codes Administration Division regarding the above subject matter.

"The portion of the landfill within the flood hazard district should be removed or analyzed for its impact on the flood hazard district and a grading permit obtained for work done. A flood hazard certification would be required."

Should there be any questions, please call Mr. Francis Cerizo of the Land Use and Codes Administration Division.

Very truly yours,

Brian Hashiro

BRIAN HASHIRO, P.E.
Engineering Program Manager

BH:bh

cc: Michael Munekiyo, Michael T. Munekiyo Consulting

NDA CROCKETT LINGLE
Mayor
GEORGE N. KAYA
Director
HARLES JENCKS
Deputy Director
LLOYD P.C.W. LEE, P.E.
Chief Staff Engineer

AARON SHINMOTO, P.E.
Land Use and Codes Administration
EASSIE MILLER, P.E.
Wastewater Reclamation Division
RALPH NAGAMINE, P.E.
Engineering Division
BRIAN HASHIRO, P.E.
Solid Waste Division
MELVIN HIPOLITO
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

October 28, 19992

MEMO TO: RALPH NAGAMINE, LAND USE AND CODES ADMINISTRATOR

F R O M: DAVE WISSMAR, SOLID WASTE DIVISION CHIEF

SUBJECT: KALAMAULA SANITARY LANDFILL CLOSURE

Thank you for your comments on the Enviromental Impact Statement Preparation Notice (EISPN) for the subject project.

The impacts of the existing landfill upon the flood hazard district will be addressed in the Draft Environmental Impact Statement. Appropriate construction permits and certifications will be obtained prior to project implementation.

A copy of the final closure plan will be provided to your office for review and necessary construction permit approvals.

If there are any questions, please do not hesitate to contact me.

xc: Westley Chun, Brown and Caldwell
Michael Munekiyo, Michael T. Munekiyo Consulting

Letters with no substantive comments:

These letters need not be included in DIES

1. Mr. David J. Welhouse
   FAA

2. Mr. Jerry M. Matsuda
   State of Hawaii
   Department of Defense

3. Mr. Gordon Matsuoka
   State of Hawaii
   Dept. of Accounting and General Services

4. Mr. Rex D. Johnson
   State of Hawaii
   Dept. of Transportation

5. Mr. Charles T. Toguchi
   State of Hawaii
   Dept. of Education

6. Ms. Stephanie Aveiro
   County of Maui
   Dept. of Human Concerns

7. Mr. David Craddick
   County of Maui
   Dept. of Water Supply

8. Ms. Charmaine Tavares
   County of Maui
   Dept. of Parks and Recreation

9. Mr. Edward L. Reinhardt
   Maui Electric Company, Ltd.

b&c.001.le4

U.S. Department
of Transportation
**Federal Aviation
Administration**

AIRPORTS DISTRICT OFFICE
BOX 50244
HONOLULU, HI 96850-0001
Telephone: (808) 541-1243
Fax: (808) 541-3462

⑨

'92 JUL 10 [illegible]

July 9, 1992

DEPT OF PUBLIC WORKS	Info	Action	Rush	See Me	Comments	Copy	File
DIRECTOR	☐	☐	☐	☐	☐	☐	☐
DEP. DIR.	☐	☐	☐	☐	☐	☐	☐
PERS	☐	☐	☐	☐	☐	☐	☐
y ~~STAFF CE~~	☐	☐	☐	☐	☐	☐	☐
LUCA	☐	☐	☐	☐	☐	☐	☐
WW RECL.	☐	☐	☐	☐	☐	☐	☐
SOLID W.	☐	☒	☐	☐	☐	☐	☐
ENGR.	☐	☐	☐	☐	☐	☐	☐
HWYS	☐	☐	☐	☐	☐	☐	☐
SFTY.	☐	☐	☐	☐	☐	☐	☐
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Return to: ________

By y Date 7-10-92

Mr. George N. Kaya, Director
Department of Public Works
County of Maui
200 South High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Kaya:

We have reviewed the EIS Preparation Notice for the Closure of Kalamaula Sanitary Landfill transmitted June 30, 1992.

We have no comments.

Sincerely,

David J. Welhouse

David J. Welhouse
Airport Engineer/Planner

Henry A. Sumida
Airports District Office Manager

JUL 22 1992

JOHN WAIHEE
GOVERNOR

EDWARD V. RICHARDSON
MAJOR GENERAL
ADJUTANT GENERAL

MYLES M. NAKATSU
COLONEL
DEPUTY ADJUTANT GENERAL

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE ADJUTANT GENERAL
3949 DIAMOND HEAD ROAD, HONOLULU, HAWAII 96816-4495

July 16, 1992

Engineering Office

Mr. George N. Kaya
Department of Public Works
200 South High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Kaya:

Subject: Environmental Impact Statement Preparation Notice for the Proposed Kalamaula Sanitary Landfill Closure

Thank you for providing us the opportunity to review the above mentioned environmental impact statement preparation notice.

We have no comments to offer at this time regarding the project.

Sincerely,

Jerry M. Matsuda
Lieutenant Colonel
Hawaii Air National Guard
Contracting and Engineering Officer

c: Westley Chun, Brown & Caldwell Consultants
Mike Munekiyo, Michael T. Munekiyo Consulting, Inc.

NATIONAL GUARD
Americans At Their Best.

OHN WAIHEE
GOVERNOR

⑤

RUSSEL S. NAGATA
COMPTROLLER
ROBERT P. TAKUSHI
DEPUTY COMPTROLLER

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
DIVISION OF PUBLIC WORKS
P. O. BOX 119, HONOLULU, HAWAII 96810

LETTER NO. (P)1650.2

'92 JUL 21

JUL 17 1992

DEPT OF PUBLIC WORKS	Info	Action	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DIRECTOR	☐	☐	☐	☐	☐	☐	☐
DEP. DIR.	☐	☐	☐	☐	☐	☐	☐
PERS.	☐	☐	☐	☐	☐	☐	☐
ST[illegible]OE	☐	☐	☐	☐	☐	☐	☐
LUCA	☐	☐	☐	☐	☐	☐	☐
WW RECL.	☐	☐	☐	☐	☐	☐	☐
SOLID W.	☐	☐	☐	☐	☐	☐	☐
ENGR.	☐	☐	☐	☐	☐	☐	☐
HWYS.	☐	☐	☐	☐	☐	☐	☐
SECTY.	☐	☐	☐	☐	☐	☐	☐
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Return to: ____________

Mr. George N. Kaya
Director
Department of Public Works
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Dear Mr. Kaya:

Subject: Kalamaulu Sanitary Landfill Closure
EIS Preparation Notice

Thank you for the opportunity to review the subject document. We have no comments to offer.

Should there be any questions, please have your staff contact Mr. Ralph Yukumoto of the Planning Branch at 586-0488.

Very truly yours,

Gordon Matsuoka

GORDON MATSUOKA
State Public Works Engineer

RY:jk
cc: Mr. Westley Chun
Mr. Mike Munekiyo

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
JOYCE T. OMINE
AL PANG
JEANNE K. SCHULTZ
CALVIN M. TSUDA

IN REPLY REFER TO:

HWY-PS
2.2924

JUL 21 1992

DEPT OF PUBLIC WORKS

Mr. George N. Kaya, Director
Department of Public Works
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Dear Mr. Kaya:

Environmental Impact Statement Preparation Notice,
Proposed Kalamaula Sanitary Landfill Closure,
Kalamaula, Molokai, TMK: 5-2-11: por. 1, 21; 5-2-08: 24

Thank you for your letter of June 30, 1992, requesting our review of the subject preparation notice.

The proposed closure of the Kalamaula Sanitary Landfill will not impact our State highway facilities.

Sincerely,

for Rex D. Johnson
Director of Transportation

OH WAIHEE
GOVERNOR

CHARLES T. TOGUCHI
SUPERINTENDENT

STATE OF HAWAII
DEPARTMENT OF EDUCATION
P. O. BOX 2360
HONOLULU, HAWAII 96804

FICE OF THE SUPERINTENDENT

July 13, 1992

Mr. George N. Kaya
Director of Public Works
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Dear Mr. Kaya:

SUBJECT: Environmental Assessment and Environmental Impact Statement Preparation Notice (EISPN) <u>Kalamaula Sanitary Landfill Closure</u>

We have no comment to make at this time regarding the subject EISPN.

Thank you for the opportunity to comment.

Sincerely,

Charles T. Toguchi

Charles T. Toguchi
Superintendent

CTT:hy

cc: A. Suga
L. Lindsey

AN AFFIRMATIVE ACTION AND EQUAL OPPORTUNITY EMPLOYER

DEPARTMENT OF
HUMAN CONCERNS
COUNTY OF MAUI

LINDA CROCKETT LINGLE
Mayor
STEPHANIE AVEIRO
Director
HENRY OLIVA
Deputy Director

200 SOUTH HIGH STREET, WAILUKU, HAWAII 96793
(808) 243-7805

(17)

'92 JUL 24 P1:04

M E M O R A N D U M

TO: GEORGE KAYA, DIRECTOR OF PUBLIC WORKS

FROM: STEPHANIE AVEIRO, DIRECTOR OF HUMAN CONCERNS

DATE: JULY 17, 1992

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE FOR THE PROPOSED KALAMAULA SANITARY LANDFILL CLOSURE

The Department of Human Concerns has concluded its review of the "Environmental Assessment and Environmental Impact Statement Preparation Notice" for the proposed closure of the Kalamaula Sanitary Landfill.

We have no comments to make at this time.

We are returning the notice copy for your further use.

DEPT OF PUBLIC WORKS	Info	Action	Rush	See Me	Comments	Copy	File
DIRECTOR	☐	☐	☐	☐	☐	☐	☐
DEP. DIR.	☐	☐	☐	☐	☐	☐	☐
PERS.	☐	☐	☐	☐	☐	☐	☐
STAFF CE	☐	☐	☐	☐	☐	☐	☐
LUCA	☐	☐	☐	☐	☐	☐	☐
WW RECL.	☐	☐	☐	☐	☐	☐	☐
SOLID W.	☐	☒	☐	☐	☐	☐	☐
ENGR.	☐	☐	☐	☐	☐	☐	☐
HWYS.	☐	☐	☐	☐	☐	☐	☐
SECTY.	☐	☐	☐	☐	☐	☐	☐
________	☐	☐	☐	☐	☐	☐	☐

Return to ____________

By ________ Date 7/[illegible]

DEPARTMENT OF WATER SUPPLY
COUNTY OF MAUI
P.O. BOX 1109
WAILUKU, MAUI, HAWAII 96793-7109

August 6, 1992

Mr. George Kaya, Director
Department of Public Works
200 South High Street
Wailuku, Maui, Hawaii 96793

Re: Environmental Impact Statement Preparation Notice For The Proposed Kalamaula Sanitary Landfill Closure

Dear Mr. Kaya,

Thank you for the opportunity to review the subject EISPN. We have little to add to this document, but have enclosed some maps which may be helpful during your EIS preparation.

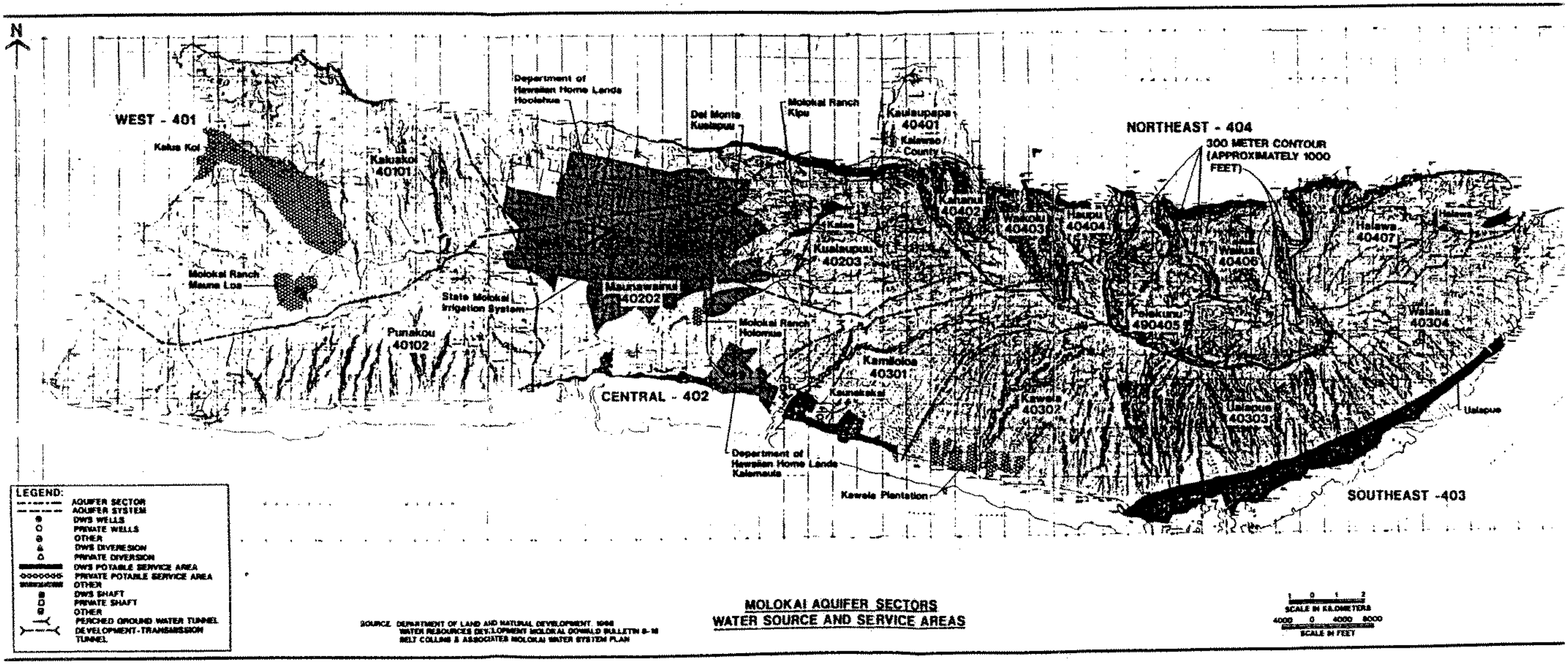
Sincerely,

FOR David Craddick
Director

elk

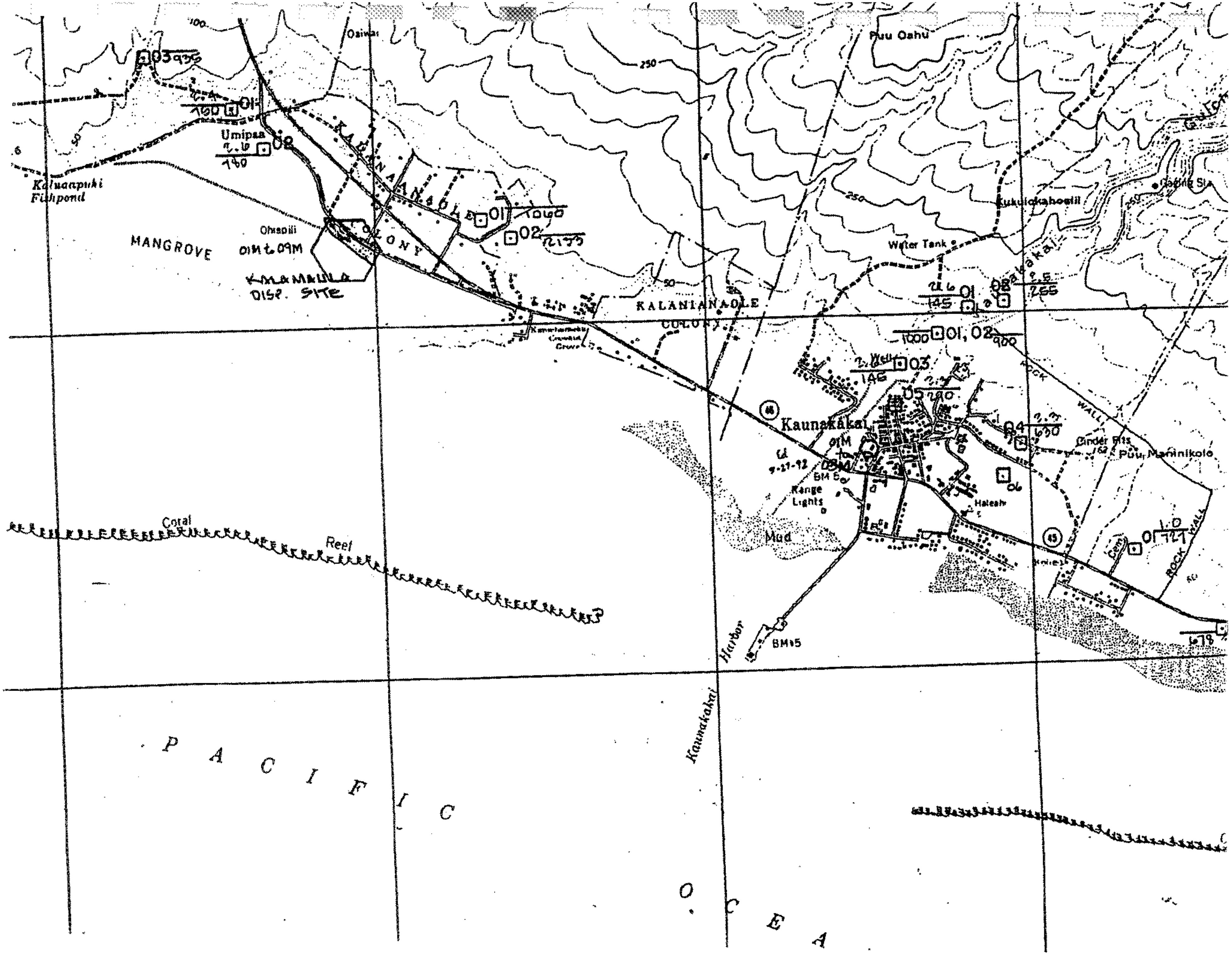
enclosures

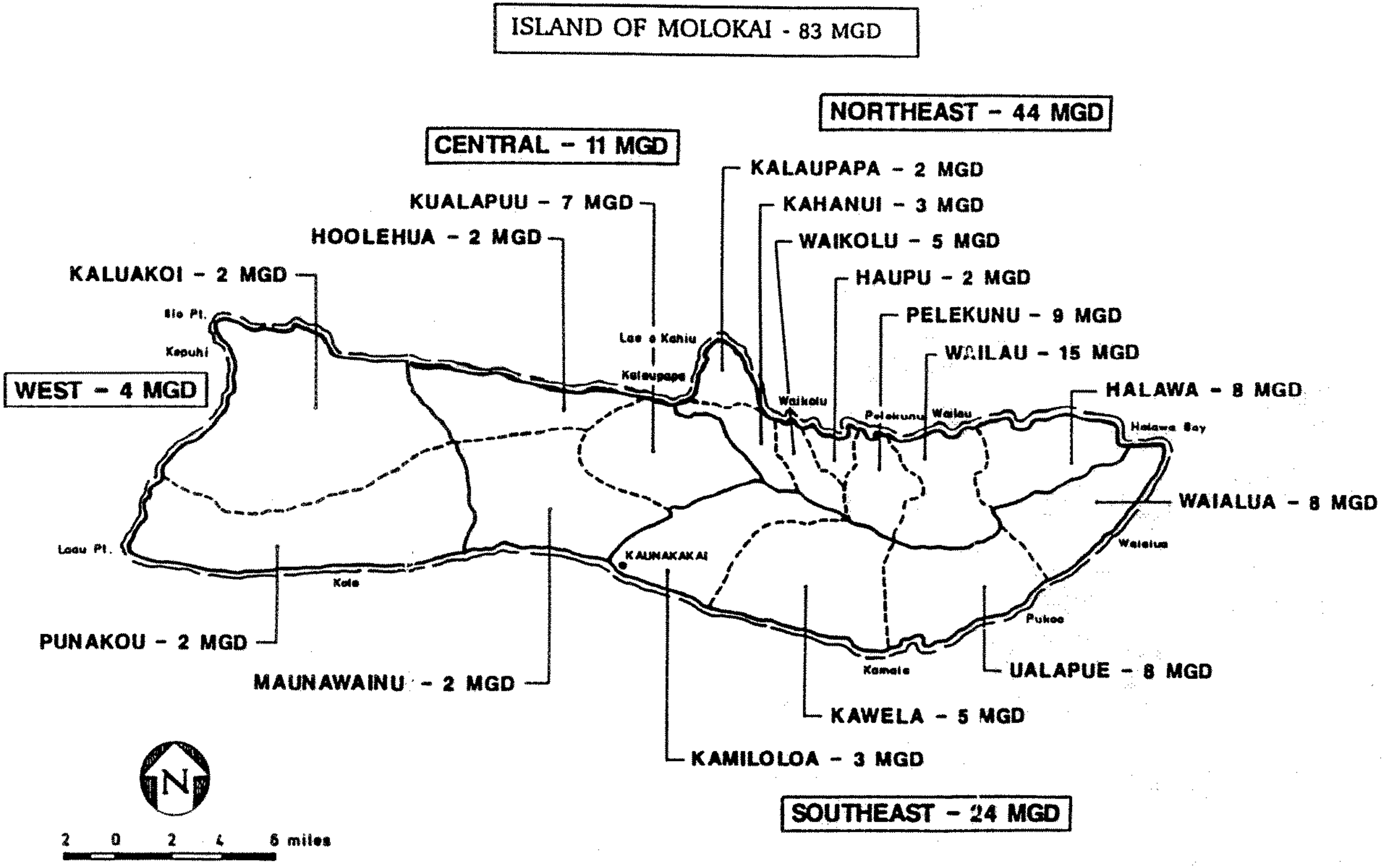
"By Water All Things Find Life"



MOLOKAI AQUIFER SECTORS
WATER SOURCE AND SERVICE AREAS

SOURCE: DEPARTMENT OF LAND AND NATURAL DEVELOPMENT, 1990
WATER RESOURCES DEVELOPMENT MOLOKAI DONALD BULLETIN 8-18
BELT COLLINS & ASSOCIATES MOLOKAI WATER SYSTEM PLAN


Puu Oahu
Oaiwai
250
100
50
Kaluaapuhi Fishpond
Umipaa
MANGROVE
Ohiapilii
01M 6.09M
KAMAKAULA DISP. SITE
KALANIANAOLE COLONY
KALANIANAOLE COLONY
Kukuiokahoalii
Water Tank
Kaunakakai
Kaunakakai Harbor
BM 5
BM 15
Range Lights
Mud
Halealii
Cinder Pits
Puu Maninikolo
ROCK WALL
ROCK WALL
Cem
Coral Reef
P A C I F I C   O C E A
03 935
01 160
02 160
01 1060
02 2175
01 145
08 765
1000 01, 02 900
03 146
05 240
04 630
06
01 121
678
Well
9-21-92



NOTE: Base map, hydrologic units and sustainable yield data adopted from Water Resources Protection Plan, Hawaii Water Plan, June, 1990.

FIGURE 1
ISLAND OF MOLOKAI
GROUND WATER RESOURCES

DEPARTMENT OF
PARKS AND RECREATION
COUNTY OF MAUI

LINDA CROCKETT LINGLE
Mayor
CHARMAINE TAVARES
Director
ARMAND PADUA
Deputy Director

1580 KAAHUMANU AVENUE, WAILUKU, HAWAII 96793
(808) 243-7230

DEPT OF PUBLIC WORKS

814

July 30, 1992

Mr. George Kaya, Director
Dept. of Public Works
200 South High Street
Wailuku, Hawaii 96793

Subject: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN) FOR THE PROPOSED KALAMAULA SANITARY LANDFILL CLOSURE

Dear Mr. Kaya:

We have reviewed the subject EISPN and have no comments to offer at this time.

Thank you for allowing us to comment on the project.

Sincerely,

Charmaine Tavares

CHARMAINE TAVARES
Director

(4

'92 JUL 21 P1:45

DEPT OF PUBLIC WORKS	Info	Action	Rush	See Me	Comment	Copy	File
DIRECTOR	☐	☐	☐	☐	☐	☐	☐
DEP DIR.	☐	☐	☐	☐	☐	☐	☐
PERS.	☐	☐	☐	☐	☐	☐	☐
✓ ~~STAFF OE~~	☐	☐	☐	☐	☐	☐	☐
LUCA	☐	☐	☐	☐	☐	☐	☐
WW RECL.	☐	☐	☐	☐	☐	☐	☐
SOLID W.	☐	☑	☐	☐	☐	☐	☑
ENGR.	☐	☐	☐	☐	☐	☐	☐
HWYS.	☐	☐	☐	☐	☐	☐	☐
SECTY.	☐	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐	☐

Return to:

By: ✓ Date:

July 17, 1992

Mr. George Kaya
Director of Public Works
County of Maui
Department of Public Works
200 South High Street
Wailuku, HI 96793

Dear Mr. Kaya:

Thank you for the opportunity to review the Environmental Assessment and Environmental Impact Statement Preparation Notice for the proposed Kalamaula Sanitary Landfill Closure.

We have reviewed this document and have no comments regarding this site.

Sincerely,

Edward L. Reinhardt

Edward L. Reinhardt
Manager, Engineering

ELR:rt

An HEI Company

APPENDIX C

SOIL BORROW AREA INVESTIGATION

APPENDIX C

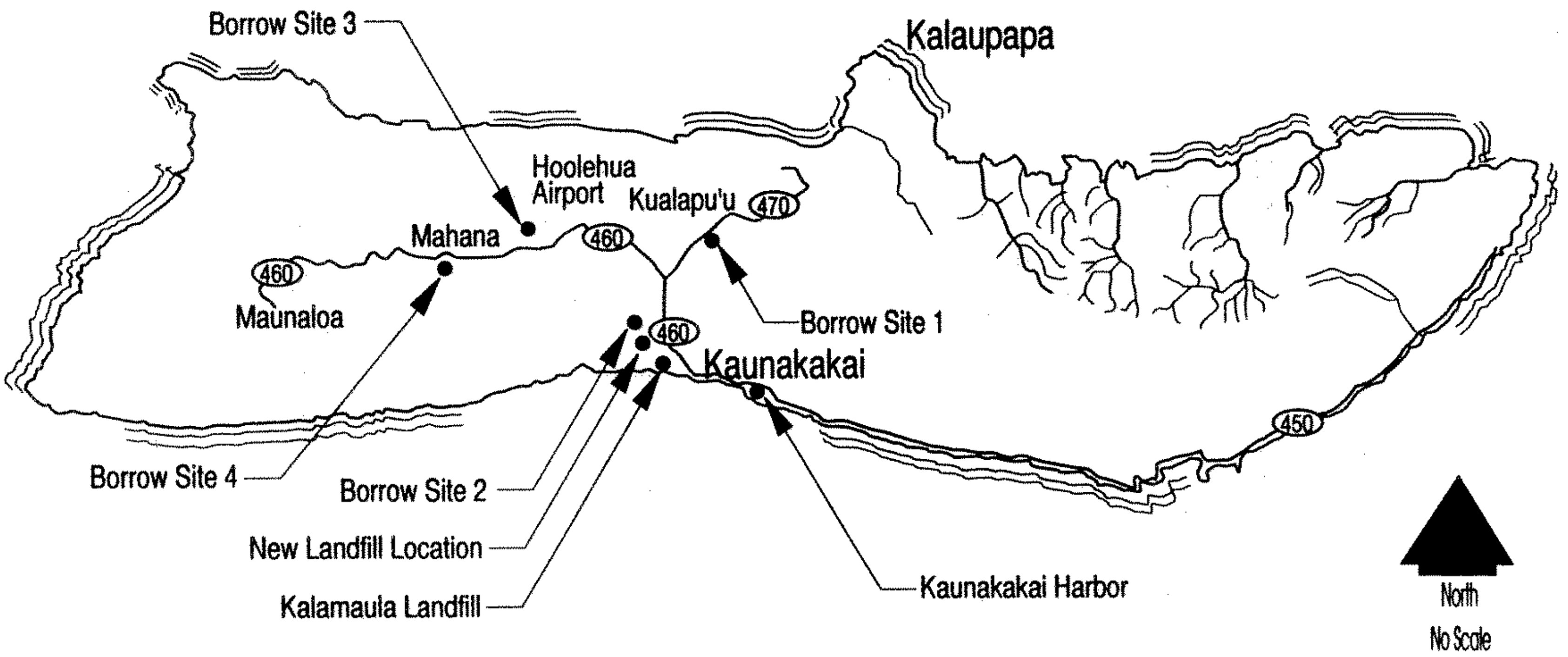
SOIL BORROW SITE INVESTIGATION

As part of the hydrogeologic assessment of the Kalamaula Landfill (Landfill) conducted under Task 2.2.6, we surveyed possible soil borrow areas on the Island of Molokai (Molokai). One possible borrow area that was identified was a site owned by the State of Hawaii, Department of Hawaiian Homelands (DHHL). This site is adjacent to and west of the Molokai Airport near Hoolehua. The objective of our survey was to identify at least two sites in addition to the DHHL site, from which suitable soils could be excavated and transported to the Landfill to serve as a final cover. Final cover requirements are 2 feet of soil; an 18-inch infiltration layer with a permeability no greater than 1×10^{-5} centimeters per second (cm/sec) and a 6-inch erosion layer of earthen material that can sustain plant growth. An additional objective was to interview local contractors, landowners, and DHHL officials in order to determine the availability of specific prospective soil borrow sites. A fourth site, located near Mahana Nursery, was identified using soils maps prepared by the U.S. Department of Agriculture Soil Conservation Service (SCS).

Site Visits and Interviews

From August 12 through August 14, 1992, we met with representatives of the two major landowners on Molokai, Molokai Ranch, and DHHL, as well as local contractors, to discuss the availability of soil borrow sites and to initiate an assessment of the suitability of the soils and the costs involved. Further telephone conversations with these contacts and other contractors were conducted in the ensuing weeks. A visit was also made on August 12, 1992, to the Molokai field office of the SCS in order to consult soils maps and data and to discuss possible borrow area with an SCS scientist.

Molokai Ranch. On August 12, 1992, we met with Mr. Ian Hurst, chief executive officer, and Mr. Steve Herbert, project engineer, at the Molokai Ranch office in Maunaloa. Hurst and Herbert felt the most suitable sites were near the Molokai Ranch wastewater treatment ponds just south of Kualapuu, shown as Site 1 on Figure C-1, and the area near Patterson's Quarry, Site 2 on Figure C-1, which is also owned by Molokai Ranch. Both of these sites are located close to the Landfill and are adjacent to major roadways. These areas, they felt, contained large amounts of the red silty clayey loam that predominate the Hoolehua Plain, which makes up the lowlands area of central Molokai. Excavation at Site 1 would also benefit Molokai Ranch by facilitating the construction of additional wastewater treatment ponds. Visits were conducted to



Location	Approximate One-Way Driving Distance to Kalamaula Landfill, Miles
Kaunakakai Harbor	2
New Sanitary Landfill	2.5
Borrow Site 1	3.5
Borrow Site 2	2.5
Borrow Site 3	6
Borrow Site 4	9

Figure C-1 Borrow Site and Landfill Locations, Molokai, Hawaii each of these sites on August 14, 1992. Site 4 was identified through surveys of available SCS soils maps and through conversations with SCS soils scientists. This site was initially not targeted as one of the two additional sites other than the DHHL Hoolehua Airport site due to it's greater distance from the Landfill and because of access concerns.

There are two facultative wastewater ponds, which are operated in series, at Site 1. Each pond encompasses an approximate surface area of 20,000 square feet and a depth of approximately 8 feet. Molokai Ranch would like to extend a string of such ponds, in series, heading downgradient along Route 470. This would provide sufficiently polished effluent for drip irrigation of nearby agricultural areas. The limiting factor to the construction of additional ponds is a gulley that runs parallel to Route 470. Without the implementation of significant and probably unfeasible fill slopes on the gulley side, no more than two additional ponds could be constructed. This would involve approximately 12,000 cubic yards of soil that could potentially be used as cover at the Landfill. Hurst also suggested a location with virtually identical soil and slope conditions situated across the gulley from the wastewater ponds. This site would yield an approximate volume of 20,000 cubic yards. This would bring the potential Site 1 volume to about 32,000 cubic yards.

Access to Site 1 can be made via a well-traveled dirt road that is a right turn off of Route 470 approximately 1 mile from the intersection of Routes 470 and 460. The road appears adequate to handle heavy equipment and truck traffic. Previous access has been made as indicated by the presence of the Molokai Ranch wastewater treatment ponds.

Site 2, located closest to the Landfill, is on Molokai Ranch land that is leased to Patterson Construction and Trucking, which operates a quarry on the site. There were two types of soils in abundance at this location. One is a grey silty loam that contains many large aggregates and cobbles. The other is a red silty clayey loam resembling the soil found at Site 1. Approximately 5 acres of the latter, to a depth of 4 to 5 feet, appeared to be available for excavation. The grey silty loam was not considered suitable for cover material.

When traveling from the Landfill, access to Site 2 can be made via the Patterson Quarry gate which is located on the left side of Route 460, just before it crosses the Manawainui Gulch, approximately 2 miles from the Landfill. The actual borrow site is located approximately 1/2 mile from Route 460. Access and road conditions within the quarry area appear suitable for heavy equipment and truck traffic.

Site 4, which was deemed to be potentially suitable for a borrow site in an area owned by Molokai Ranch is located approximately midway between Hoolehua Airport and Maunaloa along Route 460, near Mahana Nursery. At the time of the August 12 meeting, this site was briefly discussed, but the emphasis by Molokai Ranch was placed on Sites 1 and 2. The Mahana site was the topic of a telephone conversation between us and Hurst on August 28, 1992. It was communicated to Hurst that because of the soil types present, this location may provide the best possible borrow site on the island. Hurst gave verbal permission to investigate this and any other potential sites on Molokai Ranch property as we saw fit. He said a possible benefit of excavation at the Mahana site to Molokai Ranch would be in the construction of a water reservoir. Soil samples were taken at the Mahana site on September 9, 1992.

DHHL. On August 14, 1992, we met with Greg Helm. The historical excavation from Site 3 has been from soil covering World War II era storage bunkers. There are approximately eight bunkers remaining to be excavated. Helm also discussed 9.3-mile and 15-mile water pipelines that will be constructed in September 1992 and the summer of 1993, respectively. These pipelines will be in the Hoolehua area and potentially constitute a total displaced volume of 8,000 cubic yards. These pipeline sites are currently not considered as potential borrow sources.

The bunkers at Site 3 are approximately 100 feet long by 50 feet wide and were covered with soil to a thickness of approximately 3 feet. The bunkers are distributed in a 128-acre plot at the west end of the Molokai Airport runway. Many of the bunkers are obscured by stands of Koa trees. The estimated available volume from the bunker soil cover is 6,400 cubic yards. If surficial soil were excavated to a depth of 2 feet in the open areas that contain the bunkers, which is estimated to encompass approximately 20 acres that would not require clearing of trees and brush, an additional 65,000 cubic yards of soil could be available. This would bring the total estimated soil available at Site 3 to approximately 71,400 cubic yards. Access to and from the site is good. The site has a flat topography and contains a network of packed dirt roads wide enough to handle heavy equipment and trucks. There are also some paved roadways within the site area. Access to the site can be made directly via Haukea Avenue, Route 460, or the airport access road.

Classification of Soils

Generally, the soils in the Hoolehua Plain area, where all of the prospective sites are located, are of the Molokai-Lahaina association. This association is characterized by nearly level to moderately steep, well-drained soils that have a moderately fine-textured or fine-textured subsoil; on uplands (SCS, 1972). Preliminary soil classification for each of the sites has been made using available SCS documents. Table C-1 lists by site, soil series that are present and some physical and chemical properties of each.

Table C-1 Borrow Sites and Soil Characteristics[a]

Borrow site	Location	SCS soil series	Unified classification	In-place conductivity, cm/s	Moist bulk density, g/cc
1	Molokai Ranch, near Kualapu'u	Molokai silty clay loam	ML	4.4EE-4 - 1.4EE-3	0.9-1.40
		Lahaina silty clay	CL - ML	4.4EE-4 - 1.4EE-3	1.10-1.50
2	Molokai Ranch, Patterson Quarry	Holomua silt loam	ML	4,4EE-4 - 1.4EE-3	0.95-1.30
3	DHHL, west of Hoolehua Airport	Molokai silty clay loam	ML	4.4EE-4 - 1.4EE-3	0.9-1.40
		Holomua silt loam	ML	4.4EE-4 - 1.4EE-3	0.95-1.30
4	Molokai Ranch, south of Mahana Nursery	Lahaina silty clay	CL - ML	4.4EE-4 - 1.4EE-3	1.10-1.50
		Waihuna clay	CH	1.4EE-4 - 4.4EE-4	1.15 - 1.30

[a]Source: United States Department of Agriculture, Soil Conservation Service, "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii." August 1972.

Soil Sampling

On August 19, 1992, soil samples were taken at Sites 1, 2, and 3. A limited right of entry permit was obtained by DHHL before Site 3 was accessed. Soil samples at each site were taken by hand shovel and were placed in high-density polyethylene 5-gallon buckets for storage and shipment. Two 5-gallon buckets were filled at each site. At all sites, soil material exposed to the open air and the elements was removed prior to sampling.

Site 1. Samples were taken at the south end of the southernmost of the two treatment ponds. An existing excavation was used to facilitate sampling. Samples 1-A and 1-B were taken from the soil horizon located between 1 and 3 feet below grade. Upon gross analysis, the soil was reddish brown with many fines, slightly moist and appeared to be a silty clay loam. SCS soils maps indicate that the Site 1 area is underlain with Molokai silty clay loam and Lahaina silty clay.

Site 2. Samples 2-A and 2-B were taken from an existing borrow site where past excavations into a hill had cut an 8- to 10-foot vertical face approximately 200 feet in length.

Samples were taken from soil that was sloughed off by shovel at the 4- to 6-foot depth level. The soil appeared to be a reddish brown clayey silty loam exhibiting the same properties as the

Site 1 samples. SCS soils maps show that the area soils in the vicinity of Site 1 are of the Holoma silty loam series.

Site 3. Samples 3-A and 3-B were taken toward the southern portion of the 128-acre site in a location where existing excavation activities appeared to be taking place. No bunkers were visible at the sampling location, but soil had been scraped and piled. The soil exhibited the same macroscopic characteristics as that encountered at Sites 1 and 2 except the Site 3 samples were not as moist. Samples where taken at a depth of 1 foot beneath ground surface. Based on SCS soils maps, the samples are of the Holomua silt loam series. SCS soils maps also indicate that the remainder of the soils at this location are of the Molokai silty clay loam series.

Site 4. Samples were taken on September 1992 at the Mahana site. Based on SCS data and field observations, the soil encountered at the sampling site, a ridge area between Kakaako Gulch and Kamakahi Gulch was considered to be Waihuna Clay, which is characterized by low soil permeability. The subject soil that was sampled was a dark brown organic clay that exhibited medium to high plasticity.

The Waihuna soil series was considered to be the last of the soil types on the Island of Molokai that is available in significant and accessible quantities and could potentially serve as suitable cover materials. Molokai- and Lahaina-series soils were already sampled (Samples 1-3). Research indicated that, with the possible exception of some clays situated in coastal wetland areas west of the Landfill, there appears to be no other potential cover soil on the island. This is based on accessibility, perceived environmental impact, and amount of soil available.

The soil samples from Sites 1, 2, and 3, placed in sealed 5-gallon sample buckets, were shipped via air cargo to the Hirata lab on Oahu for the following analyses:

- Sieve analysis per Unified Soil Classification.
- Lab permeability tests on samples remolded to 90 percent compaction.
- Atterberg Limit tests.
- Standard Proctor tests.
- Soil type classifications.

Only Standard Proctor and permeability testing was conducted on the soil samples from Site 4.

The laboratory testing report prepared by Hirata is included as Appendix B of this report.

The analysis of particular interest was permeability. Subtitle D regulations (40 Code of Federal Regulations, Part 258) require a landfill cover material with permeability less than or equal to 1 x 10^{-5} cm/sec. The permeabilities attained from soil samples taken at the four sites in August and September are listed below.

Site	k, cm/s[a]	Location
1	3.14 x 10^{-4}	Molokai Ranch
2	1.76 x 10^{-4}	Molokai Ranch
3	3.49 x 10^{-4}	DHHL
4	2.54 X 10^{-4}	Mahana site

The permeability tests were performed at optimum moisture and 90 percent compaction using the falling head procedure, which is generally applicable for finer soils with 10 percent or more particles passing a number 200 sieve. In this test, water is allowed to permeate through the sample until a minimum of 20 ml of flow has occurred. Measurement of permeate through the sample until a minimum of 20 ml of flow has occurred. Measurement of permeate volume is not made until a constant flow, steady state condition is achieved.

The results from the initial testing for all four sites yielded permeabilities that exceeded the 1 x 10^{-5} cm/sec criteria. The soils at these sites represent the most prevalent sources of potential cover materials on the Island of Molokai. Because of the costs associated with alternative cover materials, whether they be soil amendments such as bentonite or synthetic liners, it was felt that confirmatory permeability testing on an additional soil taken from at lease one of the four sites was in order.

The Site 4, or Mahana Site soil, was chosen for this confirmatory permeability testing. This soil contains a greater percentage of clay and less of the sand encountered at the other sites. In addition the Modified Proctor test was used to determine the optimum moisture content and dry density of the sample. The Modified Proctor test typically results in a denser soil which is more representative of compaction densities available from modern equipment. The services of Dr. Peter Nicholson of Kailua, Oahu, Hawaii were contracted for this additional testing.

On October 19, 1992, we collected a soil sample from the Mahana Site and shipped, by air freight, the sealed 5-gallon bucket containing the sample to the lab of Dr. Nicholson. The soil, classified on SCS soils maps as Waihuna Clay, was a reddish brown silty clay.

Dr. Nicholson performed two to four permeability tests on four soil samples for a total of 12 tests. The average coefficient of permeability was reported as **3.8 x 10^{-6} cm/sec.** This falls within Subtitle D requirements since it is less than 1 x 10^{-5} cm/sec. Additional testing of multiple samples from Site 4 will be conducted prior to construction of the final Landfill cover. Plans and specifications for excavating, hauling, placing, compacting, and testing of this low permeability layer will be provided in the final closure plan documents.

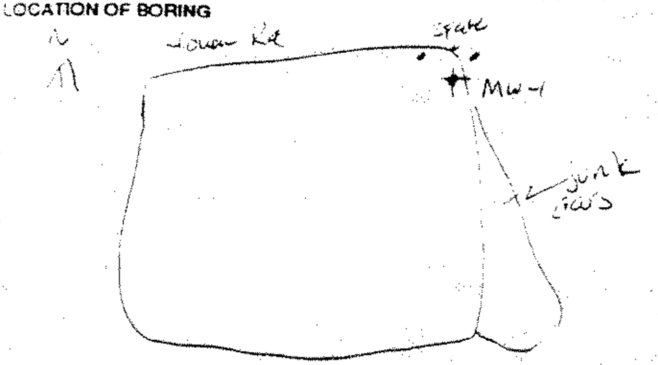
APPENDIX D

BOREHOLE LOGS

BC Brown and Caldwell Consultants

BOREHOLE/WELL LOG

LOCATION OF BORING



CLIENT Co of Maui
BORING NO. MW-1
LOCATION Kalmaui LF
JOB NO. 6070
SHEET 1 OF 1
WATER LEVEL AT TIME OF DRILLING | SECOND | THIRD | FOURTH
TIME
DATE
DRILLING START TIME 12:45 FINISH TIME 13:45
DRILLING START DATE 8/4/92 FINISH DATE 8/4/92
DRILLING CONTRACTOR Hirata3 Assoc.
RIG TYPE Mobile Drill B-53
DRILLING METHOD. FLUID USED 10" Hollow Stem auger
WELL CONSTR. START TIME 14:30 FINISH TIME 15:45
WELL CONSTR. START DATE 8/4/92 FINISH DATE 8/4/92
SOIL SAMPLING METHOD 18" x 2.5" split spoon - 6" Brass tubes
SURFACE ELEV.
MONITORING INSTRUMENT Gas Tech landfill monitor
SURFACE CONDITIONS dirt, weeds

DRILLER Owen Oldam
DATE
CHECKED BY
DATE 8/4/92
LOGGED BY Tina Bauer

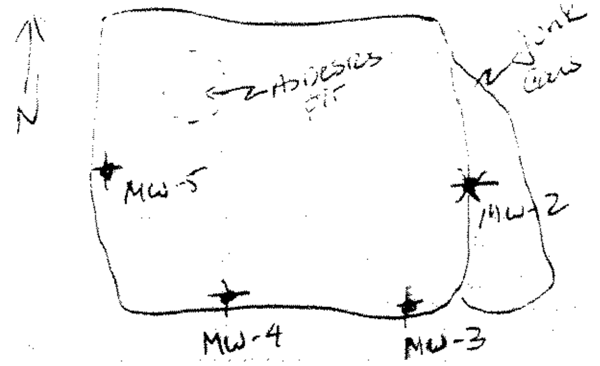
WELL CONSTRUCTION: CASING: 4" PVC SCH 40 Blank; 4" SCH 40 PVC .020" screen
ANNULUS: BENT CEMENT GROUT; BENT PELLET SEAL; SAND NO 3

WELL CONSTRUCTION		SOIL SAMPLING						ESTIMATED PERCENT					
CASING	ANNULUS	SAMPLER TYPE	MARSH FUNNEL/ MUD WEIGHT	INTERVAL SAMPLED RECOVERY	SEIVE ANALYSIS	DEPTH IN FEET	INSTRUMENT READING (ppm)	GRAVEL	SAND	FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL	DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other
						0							
						1							
						2							
		SS		X X X	X	3			30	70	5YR2/2	ML	3-4 Sandy silt, Dusky brown (5YR 2/2) moist, med. plasticity, soft
						▽4						SP	4-4.5 sand; lt olive gray (5Y 6/1) moist, sl loose, fine to med grns, shells, volcanics, corals, poorly graded.
						5							
						6							
						7							
						8							
						9							
		SS		X X X		10			95	5	N7	SP	10-11.5 SAND, fine to coarse coral & shell sand, lt. gray (N7), loose saturated same as all other wells poorly graded. Coral chunks in very bottom.
						1							
						2							
						3							
						4							
		SS		X X X		5		80	~~95~~ 15	05	N7	GW	15-16.5 Sandy gravel w/some fines 80% coarse coral gravel, 15% fine sands, 5% silts or other fines
						6							
						7							
						8							
						9					N7	GW	20-21.5 Coral gravel
						20							TD = 20 FT

BC Brown and Caldwell Consultants

BOREHOLE/WELL LOG

LOCATION OF BORING



CLIENT Co of Maui

BORING NO. MW-3

LOCATION Kalamaulu LF

JOB NO. 6670

WATER LEVEL | AT TIME OF DRILLING | SECOND | THIRD | FOURTH

SHEET 1 OF 2

TIME

DATE

DRILLING	
START	FINISH
TIME 07:55	TIME 0930
DATE 8/4/92	DATE 8/4/92

WELL CONSTR.	
START	FINISH
TIME 09:30	TIME 11:00
DATE 8/4/92	DATE 8/4/92

DRILLING CONTRACTOR Hirata & Assoc

RIG TYPE Mobile Drill B-53

DRILLING METHOD, FLUID USED 10" Hollow stem auger

SOIL SAMPLING METHOD 18" x 2.5" split spoon

SURFACE ELEV.

MONITORING INSTRUMENT GasTech LF monitor

SURFACE CONDITIONS very soft & dusty soil

DRILLER Owen Cola...

DATE 8/4/92

CHECKED BY

LOGGED BY Tina Bauer

WELL CONSTRUCTION: CASING	ANNULUS	SAMPLER TYPE	MARSH FUNNEL/ MUD WEIGHT	INTERVAL SAMPLED RECOVERY	SEIVE ANALYSIS	DEPTH IN FEET	INSTRUMENT READING (ppm)	GRAVEL	SAND	FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL	DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other
4" SCH 40 PVC BLANK	Bent cement grout					0							0-9 Trash, plastic, wood, rubber. Smelly.
						1							
						2							
						3							
	Bent pellet Seal					4							
						5							
						6							
4" SCH 40 PVC .030" Screen	No. 3 Lonestar Sand					7							
						8							
					X	9			50	50	N1	ML	9-10.5 Sandy silt fine to coarse sand w/in silt; low plasticity, lots of organic material: roots, ~~tw~~ twigs trash on very upper sample. Black N1 to moderate reddish brown 10R 4/6 black color seems to intrude native red color - perhaps HC's - slight HC odor - could be organics though. Sl. moist
				X	X	10					10R 4/6		
						1							
						2							
						3							
						4 ▽							
					X	5	*500				N1	OL	15-15.5 Silt w/ organics, ~~[illegible]~~ Black N1, saturated, roots, old leaves, smelly
					X	6					N5	PT SM	15-16.5 Sand w/ silt, coral chunks 1/3 sand loose, gray N5
					X								
						7							
						8							
						9							
						20							

BC Brown and Caldwell Consultants

BOREHOLE/WELL LOG

LOCATION OF BORING

SEE PG 1

CLIENT County of Maui

BORING NO. MW-2

LOCATION

JOB NO.

WATER LEVEL	AT TIME OF DRILLING	SECOND	THIRD	FOURTH
TIME				
DATE				

SHEET 2 OF 2

DRILLING	
START	FINISH
TIME	TIME
DATE	DATE

DRILLING CONTRACTOR Hirata & Assoc

RIG TYPE

DRILLING METHOD, FLUID USED

WELL CONSTR.	
START	FINISH
TIME	TIME
DATE	DATE

SOIL SAMPLING METHOD

SURFACE ELEV.

MONITORING INSTRUMENT

SURFACE CONDITIONS

DRILLER Owen Colon

DATE 8/4/92

CHECKED BY

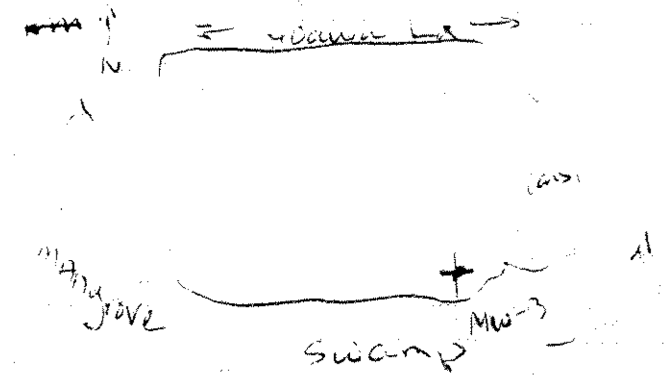
LOGGED BY Tina Bauer

WELL CONSTRUCTION		SOIL SAMPLING					ESTIMATED PERCENT					
CASING	ANNULUS	SAMPLER TYPE	MARSH FUNNEL/ MUD WEIGHT	INTERVAL SAMPLED RECOVERY SEIVE ANALYSIS	DEPTH IN FEET	INSTRUMENT READING (ppm)	GRAVEL	SAND	FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL	DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other
4" Sch40 .020" Slotted	NO 3 Lonestar sand			X X X	20						GW	20-21.5 Coral sand & gravel, gravel to 60mm, sand v. fine to fine, seashells
					1							
					2							
					3							
					4							
				X X X	5							25-26.5 Same as above
					6							TD = 26.5 Casing starts @ 25'
					7							
					8							
					9							
					30							
					1							
					2							
					3							
					4							
					5							
					6							
					7							
					8							
					9							
					0							

Brown and Caldwell
Consultants

BOREHOLE/WELL LOG

LOCATION OF BORING



CLIENT County of Maui
LOCATION Kalamaula Landfill
JOB NO. 6070
BORING NO. MW-3
SHEET 1 OF 2

WATER LEVEL | AT TIME OF DRILLING | SECOND | THIRD | FOURTH
TIME
DATE

DRILLING START TIME 0800 FINISH TIME 10:15
DATE 7/28/92 DATE 7/28/92

DRILLING CONTRACTOR Ernest Hirata
RIG TYPE Mobile Drill 53 wireline
DRILLING METHOD, FLUID USED 10" Hollow Stem Auger

WELL CONSTR. START TIME 11:50 FINISH TIME 15:00
DATE 7/28/92 DATE 7/28/92

SOIL SAMPLING METHOD 18" X 2½" Split Spoon
SURFACE ELEV. + 20'
MONITORING INSTRUMENT Gastech landfill, Draeger tubes
SURFACE CONDITIONS dirt, trash, metal parts

DRILLER Chris ...
LOGGED BY I-na Brewer DATE 7/28/92 CHECKED BY DATE

WELL CONSTRUCTION:
CASING: 4" SCH 40 PVC BLANK; 020" ~~slot~~ Slotted Casing Sch 40 PVC
ANNULUS: Cement + bent. grout; BENTONITE; NO 3 Lonestar Sand

DEPTH IN FEET	SAMPLER TYPE	INTERVAL SAMPLED / RECOVERY	GRAVEL	SAND	FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL	DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other
0				5	95	5YR 4/4	ML	0-6" cover soil, moderate brn, dry, powdery, 80% silt, 20% basalt sand
1								
2								6" - ~~9.5~~ 10' Not logged, no cuttings, just plastic bags, plastic jugs, garbage.
3								Drove sampler 10-11½ - came back wet - 'shoot'
7 ▽								
10		X X						
11	SS	XX	70	20	10	SW	GP	10-11.5 Sandy Gravel, med gray (N5) Gravel well graded 5-30 mm, subrounded (basalt), coarse to fine basalt sands. Some clay, & organic material, roots, no odor, sample brown at very top (10 ft) then turns gray - like cement color - coral probably
20								

BC Brown and Caldwell Consultants

BOREHOLE/WELL LOG

LOCATION OF BORING

See pg 1

CLIENT

BORING NO. MW-3

LOCATION

JOB NO.

WATER LEVEL: AT TIME OF DRILLING / SECOND / THIRD / FOURTH

SHEET 2 OF 2

TIME

DATE

DRILLING: START / FINISH

TIME / TIME

DATE / DATE

DRILLING CONTRACTOR

RIG TYPE

DRILLING METHOD, FLUID USED

WELL CONSTR.: START / FINISH

TIME / TIME

DATE / DATE

SOIL SAMPLING METHOD

SURFACE ELEV.

MONITORING INSTRUMENT

SURFACE CONDITIONS

DRILLER Owen Adams

CHECKED BY

DATE

LOGGED BY

DATE

WELL CONSTRUCTION (CASING / ANNULUS): 4" SCH 40 PVC .020" slotted screen; #3 Lonestar sand

DEPTH IN FEET	SAMPLER TYPE	INTERVAL SAMPLED / RECOVERY / SEIVE ANALYSIS	SAND	MUNSELL COLOR NO.	USCS GROUP SYMBOL	DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other
20	SS	X X X X X				20-21.5 Coral Sand, lt gray N7, 100% fine to coarse sand. Samples for sieve analysis & Atterberg limits
1			100	N7		
3						TOOK EQUIPMENT blank after deconning from this sample event.
5					SP	
30			100	N7		
3						TD = 30 FT
8						30 FT Drill bit covered w/ gray Coral Sand
40						

DATE

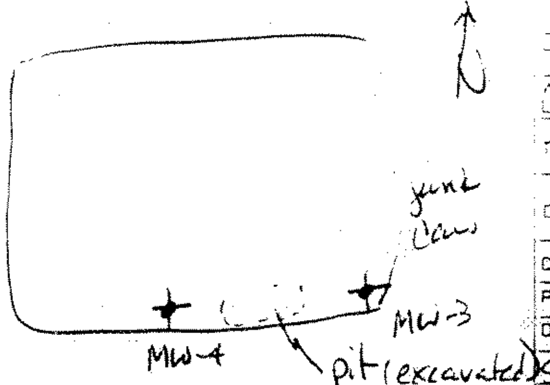
CHECKED BY

LOGGED BY

BC Brown and Caldwell Consultants

BOREHOLE/WELL LOG

LOCATION OF BORING



CLIENT Co. of Maui
BORING NO. MW-4
LOCATION Kalamaula LF JOB NO. 6070
SHEET 1 OF 2
WATER LEVEL AT TIME OF DRILLING | SECOND | THIRD | FOURTH
TIME
DATE

	START	FINISH
DRILLING TIME	08:05	10:30
DRILLING DATE	7/29/92	7/29/92
WELL CONSTR. TIME	10:45	14:00
WELL CONSTR. DATE	7/29/92	7/29/92

DRILLING CONTRACTOR Hyata & Associates
RIG TYPE Mobile Drill 53
DRILLING METHOD. FLUID USED 10" Hollow Stem Auger
SOIL SAMPLING METHOD 18" X 2.5' Split Spoon
SURFACE ELEV. ~+10
MONITORING INSTRUMENT GasTech landfill, draeger tub
SURFACE CONDITIONS dry, dusty, trash

DRILLER Owen Adams
LOGGED BY Tina Bauer DATE 7-29-92 CHECKED BY

WELL CONSTRUCTION: 4" SCH 40 PVC Blank | Bent. cement grout | BENT. chip seal (Holeplug)
4" SCH 40 PVC 020" slotted screen | No 3 Lonestar Sand

DEPTH IN FEET	INTERVAL SAMPLED / RECOVERY	GRAVEL	SAND	FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL
5–6.5	X					
7.5–8.5	X	20	50	30	5YR 3/4 N1	SW
9 (▽ water level)						
15.8–16.5	X		60	40	N5	ML

DESCRIPTION: Soil Type. Color. Moisture. Consistency. Density. Other

0-5' Trash, plastic, paper bags, wood fibers

7-8.5 Trash at 7-7.5 moist

7.5-8 analytical sample - moist

8-8.5 Gravely silty sand; 50% basalt coarse sand, 30% fines, 20% coarse to subrnd basalt gravel. Black (N1) to moderate brown (5YR 3/4) black seems to be from burned material. Charred wood. no nasty odors V. moist

15-15.8 no recovery

15.8-16.5 silty sand, coral, med. gray (N-5), saturated,

Mercaptan drager - ND

BC Brown and Caldwell Consultants

BOREHOLE/WELL LOC

LOCATION OF BORING

See pg 1

CLIENT Co of Maui

LOCATION

JOB NO.

BORING NO. MW-4

WATER LEVEL AT TIME OF DRILLING | SECOND | THIRD | FOURTH

SHEET 2 OF 2

TIME

DATE

DRILLING START | FINISH

TIME | TIME

DATE | DATE

DRILLING CONTRACTOR

RIG TYPE

DRILLING METHOD, FLUID USED

WELL CONSTR. START | FINISH

TIME | TIME

DATE | DATE

SOIL SAMPLING METHOD

SURFACE ELEV.

MONITORING INSTRUMENT

SURFACE CONDITIONS

DRILLER Owen Acian

DATE

LOGGED BY Tom Bauer

DATE 7-29-2

CHECKED BY

WELL CONSTRUCTION: CASING	WELL CONSTRUCTION: ANNULUS	SOIL SAMPLING: SAMPLER TYPE	SOIL SAMPLING: MARSH FUNNEL/ MUD WEIGHT	SOIL SAMPLING: INTERVAL SAMPLED RECOVERY SEIVE ANALYSIS	DEPTH IN FEET	INSTRUMENT READING (ppm)	ESTIMATED PERCENT: GRAVEL	ESTIMATED PERCENT: SAND	ESTIMATED PERCENT: FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL	DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other
4" PVC SH 40 .020" Slotted screen	NO 3 Monterey sand				20		15	75	10	N6	SW	20-21.5 No recovery - Just a bit. gray coral sand w/ shells. Coral chunks - well graded, SAT. fine to v. Coarse (N6)
					1							
					2							
					3							
					4					N6 ↓	SW	25 - Coral sand as above.
Slipcap					5							TD = 25 FT
					6							
					7							Finished above ground w/ monument.
					8							
					9							
					30							
					1							
					2							
					3							
					4							
					5							
					6							
					7							
					8							
					9							
					0							

BC Brown and Caldwell Consultants

BOREHOLE/WELL LOG

LOCATION OF BORING: See pg 1

CLIENT: Co of Maui

BORING NO.: MW-5/2

LOCATION:

JOB NO.:

WATER LEVEL: AT TIME OF DRILLING | SECOND | THIRD | FOURTH

SHEET 2 OF 2

TIME

DATE

DRILLING: START | FINISH
TIME | TIME
DATE | DATE

DRILLING CONTRACTOR

RIG TYPE

DRILLING METHOD, FLUID USED

WELL CONSTR.: START | FINISH
TIME | TIME
DATE | DATE

SOIL SAMPLING METHOD

SURFACE ELEV.

MONITORING INSTRUMENT

SURFACE CONDITIONS

DRILLER: Owen [illegible]

DATE

CHECKED BY

DATE

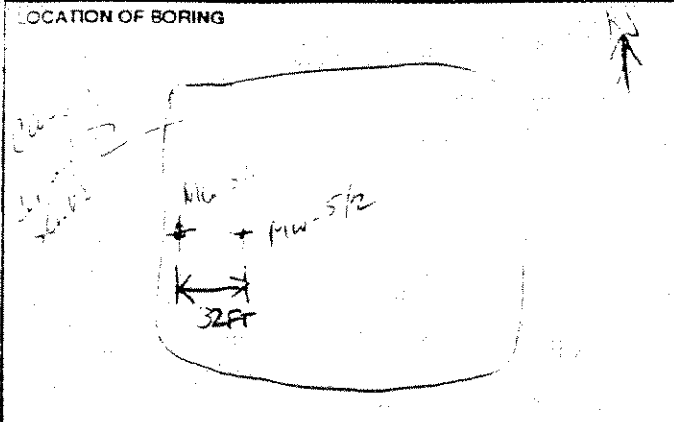
LOGGED BY

WELL CONSTRUCTION: CASING	WELL CONSTRUCTION: ANNULUS	SOIL SAMPLING: SAMPLER TYPE	SOIL SAMPLING: MARSH FUNNEL/ MUD WEIGHT	SOIL SAMPLING: INTERVAL SAMPLED RECOVERY	SOIL SAMPLING: SEIVE ANALYSIS	DEPTH IN FEET	INSTRUMENT READING (ppm)	ESTIMATED PERCENT: GRAVEL	ESTIMATED PERCENT: SAND	ESTIMATED PERCENT: FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL	DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other
4" SCH 40 PVC .020" Slotted screen						20		15	80	05	NT	SP	20-21.5 Coral Sand, chunks of Coral – maybe drilling thru old veg. lt. gray (N7)
						1							
						2							
						3							Bottom of Casing at ~24.5'
						4							TD=25', some (1-1.5') heaving sands
						5							
	Coral sands					6							
						7							
						8							
						9							
						0							
						1							
						2							
						3							
						4							
						5							
						6							
						7							
						8							
						9							
						0							

BC Brown and Caldwell Consultants

BOREHOLE/WELL LOG

LOCATION OF BORING



CLIENT County of Maui

BORING NO. MW-5/2

LOCATION Kalamaula LF

JOB NO. 0010

WATER LEVEL AT TIME OF DRILLING | SECOND | THIRD | FOURTH

SHEET of 2

TIME

DATE

DRILLING	
START	FINISH
TIME 08:30	TIME 10:10
DATE 7/30/92	DATE 7/30/92

WELL CONSTR.	
START	FINISH
TIME 10:20	TIME 12:10
DATE 7/30/92	DATE 7/30/92

DRILLING CONTRACTOR Hirata & Assoc.

RIG TYPE Mobile Drill 53

DRILLING METHOD, FLUID USED Hollow Stem Auger

SOIL SAMPLING METHOD 18" x 2.5" Split spoon

SURFACE ELEV. ±15

MONITORING INSTRUMENT Gastech LF, draeger tubes

SURFACE CONDITIONS dry soil, trash

DRILLER Owen Adams

DATE 7/30/92

CHECKED BY

LOGGED BY Lina M. Bauer

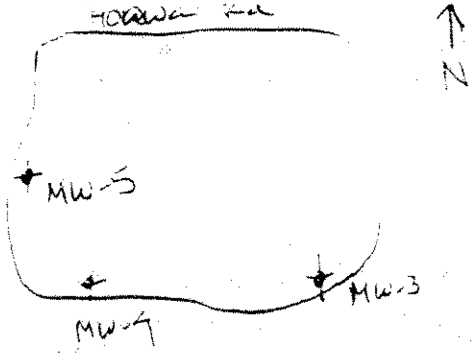
WELL CONSTRUCTION: Sch 40 4" PVC .020 screen; NO 3 Lonestar Sand; 4" SCH 40 PVC Screen; Bent Chips; Bent; Cement Grout

DEPTH IN FEET	SAMPLER TYPE	INTERVAL SAMPLED / RECOVERY	INSTRUMENT READING (ppm)	GRAVEL	SAND	FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL	DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other
0									0-10 - trash & cover soil, lots of plastics, wood, metal pieces
8									10-11 Silt, moderate brown to black, volcanic silts, low plasticity, sl. moist, mod. dense, black color from charcoal, more red than black, few pebbles ≤ 10 mm, trace of basaltic sand
10	SS	X X XX		1	4	95	5YR 4/1 N1	ML	
3									13 possible metal object like a refrigerator or washing machine
∇ 5	Split S	XX XX			70	30	N5	SM	15-16.5 silty sand med-gray to light gray, saturated, loose, organic/stale odor, fine to coarse sand - coral & some volcanic
6					80	20	N6	SM	
20									

BC Brown and Caldwell Consultants

BOREHOLE/WELL LOG

LOCATION OF BORING



CLIENT County of Maui

LOCATION Kalamaula LF JOB NO. 1620

BORING NO. MW-5/1

WATER LEVEL AT TIME OF DRILLING | SECOND | THIRD | FOURTH

SHEET 1 of 2

TIME

DATE

DRILLING START	DRILLING FINISH
TIME 15:20	TIME 08:20
DATE 7/29/92	DATE 7/30/92

WELL CONSTR. START	WELL CONSTR. FINISH
TIME	TIME
DATE	DATE

DRILLING CONTRACTOR Hirata & Assoc.

RIG TYPE Mobile Drill 53

DRILLING METHOD, FLUID USED 18" x 2.5" Split Spn, 10" OD Hollow Stem Auger

SOIL SAMPLING METHOD

SURFACE ELEV.

MONITORING INSTRUMENT Gas Tech landfill, Drager

SURFACE CONDITIONS dirt, trash, dusty

DRILLER Owen Williams

LOGGED BY Tina M. Bauer DATE 7/31/92 CHECKED BY DATE

WELL CONSTRUCTION CASING	ANNULUS	SAMPLER TYPE	MARSH FUNNEL/ MUD WEIGHT	INTERVAL SAMPLED	RECOVERY	SEIVE ANALYSIS	DEPTH IN FEET	INSTRUMENT READING (ppm)	ESTIMATED PERCENT GRAVEL	SAND	FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL
							0						
							1						
							2						
							3						
							4						
							5						
							6						
							7						
							8						
							9						
			X	X X X			10		50	40	[illegible]		
							1						
							2						
							3						
							4						
							5						
							6						
							7						
							8						
							9						
							20						

DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other

0-9.5 Trash

9.5-10 Analytical sample

9.0-10.5 Sandy gravel w/ charcoal. mod. brown to black, moist loose

TD = 10.5 FT

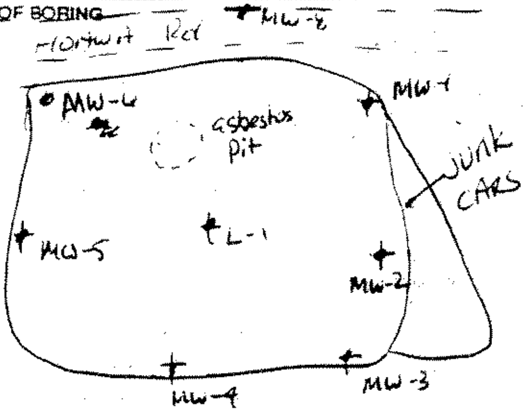
This hole abandoned

Backfilled w/ cuttings

BC Brown and Caldwell Consultants

BOREHOLE/WELL LOG

LOCATION OF BORING



CLIENT Co. of Maui

BORING NO. MW-6

LOCATION Kalamaua LF

JOB NO. 6670

WATER LEVEL AT TIME OF DRILLING | SECOND | THIRD | FOURTH

SHEET 1 OF 2

TIME

DATE

DRILLING START	DRILLING FINISH
TIME 08:00	TIME 09:30
DATE 8/6/92	DATE 8/6/92

DRILLING CONTRACTOR Hirata & Assoc.

RIG TYPE Mobile Drill B-53

DRILLING METHOD. ~~FLUID USED.~~ 10" OD Hollow Stem Auger

WELL CONSTR. START	WELL CONSTR. FINISH
TIME 09:45	TIME 11:30
DATE 8/6/92	DATE 8/6/92

SOIL SAMPLING METHOD 18" x 6" x 2.5" Splitspn

SURFACE ELEV.

MONITORING INSTRUMENT Gas Tech Landfill monitor

SURFACE CONDITIONS dirt, weeds

DRILLER Aaron Awai

DATE 8-6-92

CHECKED BY

LOGGED BY Tina Bauer

WELL CONSTRUCTION:
4" SCH 40 PVC Blank
BENT-cement grout
1/4" BENT. PELLETS
4" SCH 40 PVC ~1,005 slotted screen
NO. 3 Lonestar Sand

DATE	WELL CONSTRUCTION CASING	WELL CONSTRUCTION ANNULUS	SOIL SAMPLING SAMPLER TYPE	MARSH FUNNEL/MUD WEIGHT	INTERVAL SAMPLED	RECOVERY	SEIVE ANALYSIS	DEPTH IN FEET	INSTRUMENT READING (ppm)	ESTIMATED PERCENT GRAVEL	ESTIMATED PERCENT SAND	ESTIMATED PERCENT FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL	DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other
								0							0-10 Tires alum cans, plastic, garbage
								1							
								2							
								3							
								4							
								5							
								6							
								7							
								8							10-11.5 Clayey silt, Dusky Brn (5YR 2/2) soft, mod. plasticity, moist, some weaved sack (nylon), lots of roots & tree ~~stuff~~ pieces. no uncommon odors
								9							
						X		10				80	5YR 2/2	ML	
					X	X X		1							
								2							
								▽ 3							
								4							15-16" sandy coral gravel w/silt, med. lt. gray (N6) Saturated, some volcanic sands, mostly coral sands, chunks, loose
						X X ■		5		50	30	20	N6	GM	
								6							
								7							
								8							
								9							
								20							

BC Brown and Caldwell Consultants

BOREHOLE/WELL LOG

LOCATION OF BORING

See pg 1

CLIENT Co [illegible]man

LOCATION Kalamazoo LF

JOB NO. 6670

BORING NO. MW-6

WATER LEVEL AT TIME OF DRILLING | SECOND | THIRD | FOURTH

SHEET 2 OF 2

TIME

DATE

DRILLING START | FINISH
TIME | TIME
DATE | DATE

DRILLING CONTRACTOR

RIG TYPE

DRILLING METHOD, FLUID USED

WELL CONSTR. START | FINISH
TIME | TIME
DATE | DATE

SOIL SAMPLING METHOD

SURFACE ELEV.

MONITORING INSTRUMENT

SURFACE CONDITIONS

DRILLER Owen Helane

DATE

CHECKED BY

DATE 8/6/92

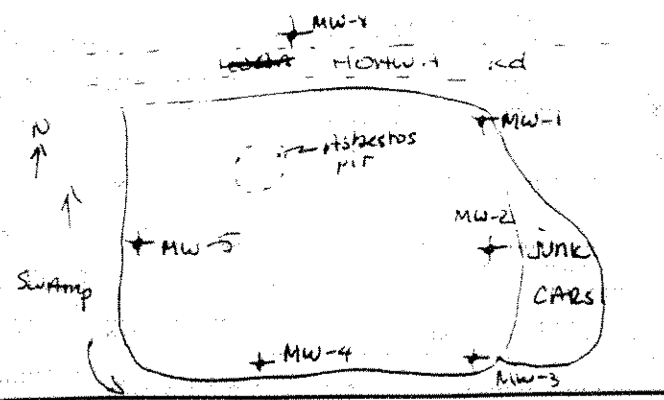
LOGGED BY Tina Bauer

WELL CONSTRUCTION: CASING	ANNULUS	SOIL SAMPLING: SAMPLER TYPE	MARSH FUNNEL/ MUD WEIGHT	INTERVAL SAMPLED/ RECOVERY/ SEIVE ANALYSIS	DEPTH IN FEET	INSTRUMENT READING (ppm)	ESTIMATED PERCENT: GRAVEL	SAND	FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL	DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other
4" SCH 40 PVC .020" Slotted screen	NO. 3 Sand			X XX XX	20					NO	GM	20-21.5 Same as 15-16, samples collected for sieve analysis.
					1							
					2							
					3							
					4							
					5		50	15	35	NO	GM	25-26.5 Same as above but more fines, med gray (N5)
					6							
					7							
					8							TD = 26.5 CASING AT 25FT BGS
					9							
					30							
					1							
					2							
					3							
					4							
					5							
					6							
					7							
					8							
					9							
					0							

BC Consultants

BOREHOLE/WELL LO(

LOCATION OF BORING



CLIENT Co. of Maui

BORING NO. MW-8

LOCATION Kalamaula LF

JOB NO. 660 70

SHEET 1 OF 2

WATER LEVEL: AT TIME OF DRILLING | SECOND | THIRD | FOURTH

TIME

DATE

	DRILLING START	DRILLING FINISH	WELL CONSTR. START	WELL CONSTR. FINISH
TIME	07:35	08:40	0845	10:00
DATE	8/5/92	8/5/92	8/5/92	8/5/92

DRILLING CONTRACTOR Hirata & Assoc.

RIG TYPE Mobile Drill B-53

DRILLING METHOD, FLUID USED 10" Hollow Stem Auger

SOIL SAMPLING METHOD 18" x 6" x 2.5" Split Spoon

SURFACE ELEV.

MONITORING INSTRUMENT Gas Tech Landfill Monitor

SURFACE CONDITIONS grass

DRILLER Owen [illegible]

DATE

CHECKED BY

DATE 8/5/92

LOGGED BY Tina Bauer

WELL CONSTRUCTION:

4" SCH 40 BLANK

Bentonite grout

Bent pellets

4" SCH 40 PVC .020" slotted scrn

#3 Sand

CASING	ANNULUS	SAMPLER TYPE	MARSH FUNNEL/ MUD WEIGHT	INTERVAL SAMPLED	RECOVERY	SEIVE ANALYSIS	DEPTH IN FEET	INSTRUMENT READING (ppm)	GRAVEL	SAND	FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL
							0						
							1		50		50		GM
							2						
					X X		3			02	98	5 YR 3/4	ML
				X	X		4						
							5						
							6						
							7						
							8						
							9						
					X X X		10		90		10	N6	GM
							1						
							2						
							3						
							4						
							5						
							6						
							7						
							8						
							9						
							20						

DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other

0-3 gravelly silt road base - logged by cuttings, 50% gravel, 50% silt, loose, soft, gravel up to 40 mm

3-4.5 clayey silt w/ some sand, moderate brown (5 YR 3/4), mod. plasticity, soft, lots of roots, few volcanic ~~sa~~ coarse sand, moist

10-11.5 silty gravel, 90% coral gravel up to 30 mm, 10% fines, shells, med. lt. gray (N6), loose, reef zone (?)

15-16.5 no recovery; coral chunks

next page

20-21.5 gravely silty clay - 40% coral gravel 50% fines, 10% sand

BC Brown and Caldwell Consultants

BOREHOLE/WELL LOG

LOCATION OF BORING: See pg. 1

CLIENT: Co. of Marin

BORING NO.: MW-8

LOCATION

JOB NO.

SHEET 2 OF 2

WATER LEVEL: AT TIME OF DRILLING | SECOND | THIRD | FOURTH

TIME

DATE

DRILLING: START | FINISH — TIME | TIME — DATE | DATE

DRILLING CONTRACTOR

RIG TYPE

DRILLING METHOD, FLUID USED

WELL CONSTR.: START | FINISH — TIME | TIME — DATE | DATE

SOIL SAMPLING METHOD

SURFACE ELEV.

MONITORING INSTRUMENT

SURFACE CONDITIONS

DATE	WELL CONSTRUCTION: CASING	ANNULUS	SOIL SAMPLING: SAMPLER TYPE	MARSH FUNNEL/ MUD WEIGHT	INTERVAL SAMPLED RECOVERY SEIVE ANALYSIS	DEPTH IN FEET	INSTRUMENT READING (ppm)	ESTIMATED PERCENT: GRAVEL	SAND	FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL	DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other
		No SAND				20		40	10	50	N5	CL	20-20.5 - gravelly silty clay, med. gray (N5)
						1		60		40	5YR 7/2	GM	20.5 - 21.5 gravelly silty clay, grayish orange pink (5YR 7/2), less fines than above.
						2							
						3							
						4							TD = 21.5 Bottom of casing at 19.5
						5							
						6							
						7							
						8							
						9							
						0							
						1							
						2							
						3							
						4							
						5							
						6							
						7							
						8							
						9							
						0							

DRILLER [illegible]

CHECKED BY

DATE 8/5/92

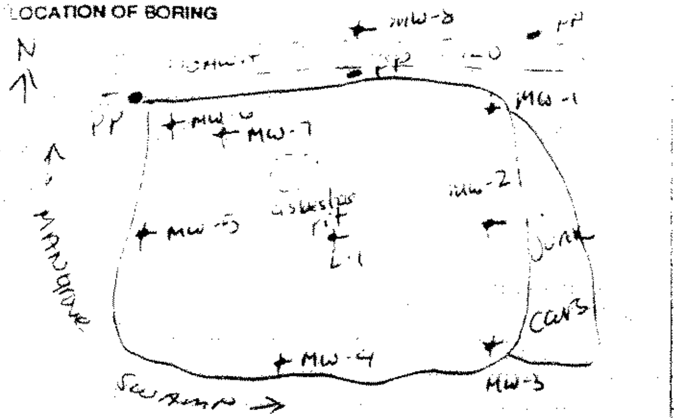
LOGGED BY Ima Bauer

BC Brown and Caldwell Consultants

BOREHOLE/WELL LOG

DRILLER Ullen Huhn

LOCATION OF BORING



CLIENT Co. of Maui

LOCATION Kalmanu LF

JOB NO. 2670

BORING NO. MW-7 (Deep)

SHEET 1 OF 3

WATER LEVEL: AT TIME OF DRILLING | SECOND | THIRD | FOURTH

TIME

DATE

DRILLING	
START	FINISH
TIME 13:45	TIME 16:30
DATE 8/6/92	DATE 8/6/92

DRILLING CONTRACTOR Hyata 3 Assoc.

RIG TYPE Mobile Drill B-53

DRILLING METHOD, FLUID USED 10" OD Hollow Stem Auger

WELL CONSTR.	
START	FINISH
TIME 0700	TIME 09:25
DATE 8/7/92	DATE 8/11/92

SOIL SAMPLING METHOD 18" x 2.5" x 6" Split Spn

SURFACE ELEV.

MONITORING INSTRUMENT Gas Tech Landfill monitor

SURFACE CONDITIONS dirt, weeds

WELL CONSTRUCTION: 4" SCH 40 PVC BLANK CASING

BENTONITE - CEMENT GROUT

DEPTH IN FEET	INSTRUMENT READING (ppm)	GRAVEL	SAND	FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL	DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other
0							0 - ~~30~~ 10 FT; Trash; plastic, rubber, metal pieces
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							10 - ~~30~~ 25 not logged — see borehole log from MW-6
1							
▽ 2							
3							
4							
5		50	30	20	(N6)	GC	
6							
7							
8							
9							
20							

LOGGED BY Tina Baker DATE 8/6/92 CHECKED BY

BC Brown and Caldwell Consultants

BOREHOLE/WELL LOG

LOCATION OF BORING: See P5

CLIENT: Co. of Maui

LOCATION

JOB NO.

BORING NO.: MW-7

WATER LEVEL: AT TIME OF DRILLING | SECOND | THIRD | FOURTH

SHEET 2 OF 3

TIME

DATE

DRILLING: START | FINISH; TIME | TIME; DATE | DATE

DRILLING CONTRACTOR

RIG TYPE

DRILLING METHOD, FLUID USED

WELL CONSTR.: START | FINISH; TIME | TIME; DATE | DATE

SOIL SAMPLING METHOD

SURFACE ELEV.

MONITORING INSTRUMENT

SURFACE CONDITIONS

LOGGED BY: Tina Bauer

DATE: 8/6/92

CHECKED BY

DATE

DRILLER: Chris Adam

WELL CONSTRUCTION:

CASING: 4" SCH 40 PVC Blank (20–32); 4" SCH 40 PVC .020" slotted screen (32–40)

ANNULUS: Bent. cement grout (20–24); Fine clean silica sand (24–30); NO. 3 Sand. (30–40)

CASING	ANNULUS	SAMPLER TYPE	MARSH FUNNEL/ MUD WEIGHT	INTERVAL SAMPLED RECOVERY	SEIVE ANALYSIS	DEPTH IN FEET	INSTRUMENT READING (ppm)	GRAVEL	SAND	FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL	DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other
						20							
						1							
						2							
						3							
						4							
						25		70		30	N5	GM	25-26.5 silty gravel, med gray (N5), small gravel sized coral & shells, loose
						6							
						7							
						8							
						9							30-31.5 silty gravel as above but coarser (up to 40 mm) sea slime
						30		70		30	N5	GM	
						1							
						2							
						3							35–35.5 Silt w/some sand; dusky brn (5YR 2/2), soft, saturated (layer of sa 1/2)
						4							35.5-36 silty gravel; silt is grayish orange pink (5YR 7/2), coral & flakes are dark yellowish orange (10 YR 6/6)
						35			5	95	5YR2/2	ML	
						6		80		20	10YR 6/6	GM	
						7							
						8							
						9							
						40							

BC Brown and Caldwell Consultants

BOREHOLE/WELL LOG

LOCATION OF BORING: See pg 1

CLIENT: Co. of Maui

BORING NO. MW-7 (Deep)

LOCATION: Kalamaula LF

JOB NO. 6670

SHEET 3 OF 3

WATER LEVEL: AT TIME OF DRILLING | SECOND | THIRD | FOURTH

TIME

DATE

DRILLING: START | FINISH — TIME | TIME — DATE | DATE

DRILLING CONTRACTOR

RIG TYPE

DRILLING METHOD, FLUID USED

WELL CONSTR.: START | FINISH — TIME | TIME — DATE | DATE

SOIL SAMPLING METHOD

SURFACE ELEV.

MONITORING INSTRUMENT

SURFACE CONDITIONS

DRILLER Ache Hunt

CHECKED BY

DATE 8/6/92

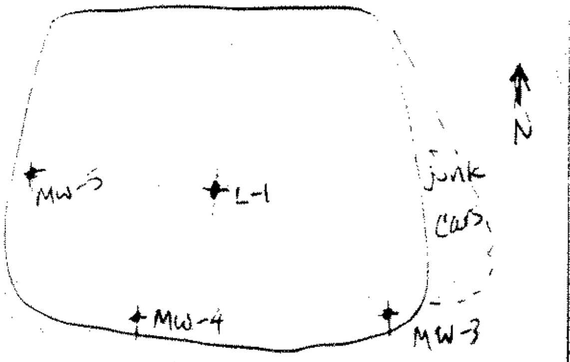
LOGGED BY Tina Bauer

WELL CONSTRUCTION: CASING	WELL CONSTRUCTION: ANNULUS	SOIL SAMPLING: SAMPLER TYPE	SOIL SAMPLING: MARSH FUNNEL/MUD WEIGHT	SOIL SAMPLING: INTERVAL SAMPLED / RECOVERY / SEIVE ANALYSIS	DEPTH IN FEET	INSTRUMENT READING (ppm)	ESTIMATED PERCENT: GRAVEL	ESTIMATED PERCENT: SAND	ESTIMATED PERCENT: FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL	DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other
4" SCH 40 PVC .020" slotted screen	NO 3 SAND			X X X X	40			5	95	5YR 7/2	ML	40 - sandy silt - same as 35-35.5 45 , sand is fine to med. Coarse
					1							
					2							
					3							
					4							
				X X X X X	45			95	05	10YR 8/2	SW	45-46.5 Sand w/some silt, fine to coarse coral, shell and volcanic sands, sub rnd to rnd, pebbles up to 5 mm. (overall) color is very pale orange (10 YR 8/2) wet and pinkish gray (5 YR 8/1) dry. Looks like beach sand
					6							
					7							
	NO. 3 SAND				8							
					9							49-
					50				100		CL	50 FT Clay, moderate brn, v. stiff, dense, impermeable v. moist.
					1							
					2							TD = 50'
					3							
					4							
					5							
					6							
					7							
					8							
					9							
					0							

Consultants

BOREHOLE/WELL LOG

LOCATION OF BORING



CLIENT Co. of Maui

BORING NO. L-1

LOCATION Kalamaula LF **JOB NO.** 6670

SHEET 1 OF 1

WATER LEVEL AT TIME OF DRILLING | SECOND | THIRD | FOURTH

TIME

DATE

DRILLING	
START	FINISH
TIME 15:10	TIME 16:30
DATE 7/30/92	DATE 7/30/92

DRILLING CONTRACTOR Hirata Drilling

RIG TYPE Mobile Drill B-53

DRILLING METHOD, FLUID USED 10" OD Hollow Stem Auger

WELL CONSTR.	
START	FINISH
TIME 07:30	TIME 09:15
DATE 7/31/92	DATE 7/31/92

SOIL SAMPLING METHOD 18" X 2.5" split spoon

SURFACE ELEV.

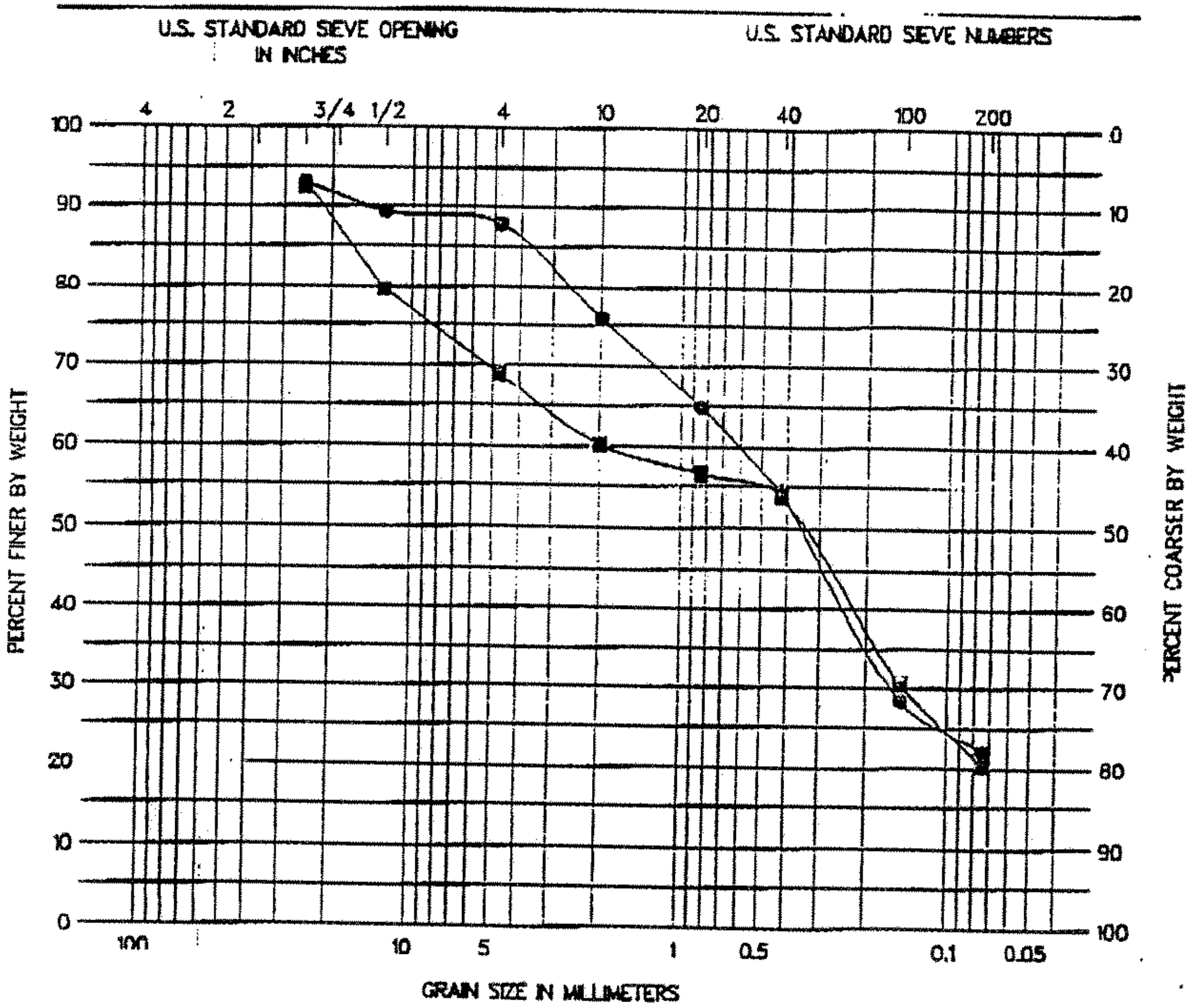
MONITORING INSTRUMENT Gas Tech

SURFACE CONDITIONS dry soil, trash, metal parts

DRILLER Oren Adam

LOGGED BY Lima McBrawn DATE 7/30/92 CHECKED BY

WELL CONSTRUCTION: CASING	ANNULUS	SOIL SAMPLING: SAMPLER TYPE	MARSH FUNNEL/ MUD WEIGHT	INTERVAL SAMPLED RECOVERY	SEIVE ANALYSIS	DEPTH IN FEET	INSTRUMENT READING (ppm)	ESTIMATED PERCENT: GRAVEL	SAND	FINES	MUNSELL COLOR NO.	USCS GROUP SYMBOL	DESCRIPTION: Soil Type, Color, Moisture, Consistency, Density, Other
4" SCH 40 PVC Blank	BENT. CEMT. GROUT					0							0-5 trash; bad, plastics, diapers
						1							
						2							5-10 trash - same as above
						3							
	HOLE PLUG					4							10-15 trash.
						5							About 17' hit some soil - Black
						6							
						7							Very smelly borehole - Monitor for gases in future
4" SCH 80 .020" Slotted screen	NO. 3 Lonestar sand					8							
						9							
						10							
						1							
						2							
						3							
						4							
			X	X		5	15LEL						
						6							
						7							
						8							
						9							
						0							



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

— ● Sample # 1	Location	MW-3-20
	Description	Light Tan Silty Sand with Gravel
—■ Sample # 2	Location	MW-6-21
	Description	Light Gray Silty Sand with Gravel

DR 172

Molokai Landfill

Ernest K. Hirata
& Associates, Inc.

GRADATION CURVES

Plate A1

APPENDIX E

BIRDS OBSERVED AT KALAMAULA AND WEST TO PAKANAKA FISHPOND

APPENDIX E

BIRDS OBSERVED AT KALAMAULA AND WEST TO PAKANAKA FISHPOND

Family Ardeidae: Herons and Egrets

Cattle Egret: *Bulbulcus ibis*

A late introduction to the Hawaiian Island (1958), the cattle egret population has exploded. Today a large flock of these white birds with yellow bills and feet can be seen foraging in the Landfill. The Landfill birds are approximately two feet in height and their white plumage appears dirty brown.

Black crowned night-heron: *Nycticorax nycticorax*

One adult and one juvenile black crowned night-heron were observed near the open water of the site. These are big birds, no more than two feet in height, with yellow feet and bills. The younger was speckled brown and the adult was pearly gray. Usually they are seen along the edge of waterways where they silently wait for prey (shrimp, fish, and probably crabs).

Family Anatidae: Waterfowl

Hawaiian duck: *Anas wyvilliana*

A group of five Hawaiian ducks appear to be at home in the Kaluaapuhi Fishpond. These golden-brown animals are fairly secretive and spent some time behind the mangrove islands of the pond.

Family Phasianidae: Gallinaceous Birds

Erckel's Francolin: *Francolinus erckelii*

This is as large chicken-like bird which is more often heard than seen. It is streaked brownish gray and was seen and heard in the open grassland along the northern boundary of the study site.

Common Ring-necked Pheasant: *Phasianus colchicus*

The male is a large, decorative bird with a long pointed tail and white band around its neck. He is barred black/brown with red cheeks. The female is smaller, duller, and more secretive. Pheasants are common in the grassland along the northern edge of the site.

Wild Turkey: *Meleagris gallopavo*

A small flock of turkeys is present near the western edge of the wetlands. Wild turkeys are large, heavy birds which are commonly seen in the *kiawe* trees. They are very similar to domestic turkeys in appearance.

Japanese Quail: *Coturnix japonica*

A small flock of these small, secretive birds was seen in the grassland at the northern boundary of the site. Their habit of running under dry grass and their buff color can make them difficult to observe.

Family Rallidae: Rails and Coots

Hawaiian Coot: *Fulica alai*

A single Hawaiian coot was seen in Kaluaapuhi Fishpond. This water bird, with its dark gray feather and distinctive white bill which extends upward to its crown, was swimming with the Hawaiian ducks in this location. The coot was even more secretive than the ducks.

Family Charalidriidae: Plovers and Dotterels

Lesser Golden-plover: *Pluvialis dominica*

Many long legged, mottled gold and bluff plovers were seen on the mud flats of the study site. All displayed non-breeding plumage.

Family Recurvirostridae: Avocets and Stilts

Black-necked Stilt: *Himantopus mexicanus*

At least twelve of these black and white birds with long, thin, pink legs and straight dark bills inhabit the Ohiapilo Pond.

Family Scolopacidae: Sandpipers, Phalaropes, and Related Birds

Curlew Species

Two large, orange-brown birds with long curved bills were seen on the sand bars around Ohiapilo Pond.

Ruddy turnstone: *Arenaria interpres*

The small size and bright white breast of the Ruddy Turnstone are distinctive among the other shore birds seen on the sand bars around Ohiapilo Pond. Eight birds were seen, although more may have been in the area.

Wandering Tatler: *Heteroscelus brevipes*

A small appearing, solitary bird that looks hunched over as it bobs along hunting prey. A single bird was seen in on the sand bar in Ohiapilo Pond.

Family Columbidae: Pigeons and Doves

Spotted Dove: *Streptopelia chinensis*

The spotted dove is a large bird which is grayish brown with rosy blushed breast feathers. At the sides and back of the neck is a patch of black with white spots. The low, repetitive cooing of the spotted dove is common on this site. Several pairs and individuals were seen and appear to be an important part of the bird community of the area. They appeared to favor the mangrove trees for roosting and the open area around the Landfill for feeding.

Zebra Dove: *Geopelia striata*

This ground dwelling, seed eating dove is smaller and even more abundant than the spotted dove. Zebra doves were found in large flocks near the Landfill and in open areas near the grassland and in weedy places along the roads.

Family Tytonidae: Barn-owls

Common Barn-Owl: *Tyto alba*

One common barn-owl was seen in the early evening near Ohiapilo Pond in the mangrove trees. This pale bird with its distinctive face is easy to recognize.

Family Sturnidae: Starlings and Mynas

Common myna: *Acridotheres tristis*

The myna is a plump brown bird with a dark head and tail. It has a yellow bill, legs and eyes. It has white markings on its wings and tail which flash when it flies. Its walk is distinctive. Mynas are usually seen in large groups. A very large flock of mynas feed in the Landfill and roost in the mangrove trees west of the site.

Family Zosteropidae: White-eyes

White eye: *Zosterops japonicus*

White-eyes are one of the most widespread introduced bird species in Hawaii. This is an ideal site for these tiny birds. There is water nearby at the agricultural fields and the flowering trees provide some nectar. White-eyes nests are common in the *kiawe* trees.

Family Emberizidae: Emberizine Finches

Brazilian or red crested cardinals: *Paroaria coronata*

Many adult and juvenile Brazilian cardinals were seen in the *kiawe* trees and on the ground near the Landfill and along the dirt road just north of the wetlands. The bright red heads of this species make them very easy to recognize.

Northern Cardinal: *Cardinalis cardinalis*

The cardinal is a familiar garden bird in most of the lowlands of Hawaii where it feeds on fruits and seeds. Both male and female cardinals were found in low numbers on this site.

Family Fringillidae: Cardueline Finches

House finch: *Carpodacus mexicanus*

The house finch is a small, sparrow like bird with a streaked appearance. The head, throat and breast of male birds may vary from dull yellow to bright red. The females and the bodies of the males are similar with gray to black streaks of color. Introduced into Hawaii during the last century, the house finch has adapted and is now widespread throughout the islands. Pairs of birds were seen in the *kiawe* trees and near the Landfill.

Family Passeridae: Old world Sparrow

House sparrow: *Passer domesticus*

House sparrows are sometimes called feathered mice. These streaky brown and gray birds are a familiar commensal species and were seen among the *kiawe* trees and on fences. No nests were seen.

Family Estrildidae:Waxbills, Mannikins and Parrotfinches

Common Waxbill: *Estrilda astrild*

The common waxbill is a small, red-billed finch with a prominent re streak from its bill to its eye. Waxbills have a long tail and brown rump. They feed on grass seeds. A small flock of waxbills were seen feeding on the grass near the Landfill.

Nutmeg Mannikin: *Lonchura punctulata*

Small birds with brown faces and gray breasts and sides, these mannikins form large flocks and are often seen feeding on grass and weed seeds. Nutmeg mannikins are widespread at all elevations and on all of the islands. A small flock was seen feeding on grass under the *kiawe* trees.

Chestnut Mannikin: *Lonchura malacca*

This mannikin is a tiny, dark bird with a large, shiny bill. A large flock of these little birds was seen in the weeds and grasses at the northern boundary of the wetlands.

Warbling Silverbill: *Lonchura malabarica*

These tiny, sandy colored birds are more often heard than seen. They have a dark rump and a large bill and congregate into large flocks. Flocks of these birds are seen in the grassy areas, cultivated areas, and among the *kiawe* trees at the northern boundary of the wetland.

APPENDIX F

FLORA AND FAUNA OBSERVED AT THE SOIL BORROW SITE 4

Checklist of Plants found on the Proposed Route 460 Borrow Pit Site

The plant families in the following species list have been alphabetically arranged within two groups, Monocotyledons, and Dicotyledons. The genera and species are arranged alphabetically within families. The taxonomy and nomenclature follow that of St. John (1973) and Wagner, Herbst and Sohmer (1990). For each taxon the following information is provided:

1. An asterisk before the plant name indicates a plant introduced to The Hawaiian Islands since Cook or by the aborigines.
2. The scientific name.
3. The Hawaiian name and or the most widely used common name.
4. Abundance ratings are for this site only and they have the following meanings:

   Uncommon = a plant that was found less than five times.
   Occasional = a plant that was found between five to ten times.
   Common = a plant considered an important part of the vegetation.
   Locally abundant = plants found in large numbers over a limited area. For example the plants found in grassy patches.

This species list is the result of an extensive survey of this site during the winter (January 1993) and it reflects the vegetative composition of the flora during a single season. Minor changes in the vegetation will occur due to introductions and losses and a slightly different species list would result from a survey conducted during a different growing season.

Scientific Name	Common Name	Abundance
MONOCOTYLEDONES		
GRAMINEAE - Grass Family		
**Cenchrus ciliaris* L.	Buffel grass	Locally abundant
**Bothriochloa bladhii* (Retz.) Blake	Beardgrass	Locally abundant
**Chloris barbata* (L.) Sw.	Swollen fingergrass	Occasional
**Chloris divaricata* R. Br.	Stargrass	Occasional
**Chloris radiata* (L.) Sw.	Radiate fingergrass	Occasional
**Cynodon dactylon* (L.) Pers.	Bermuda grass	Common
**Digitaria adscendens* (HBK) Henr.	Henry's crabgrass	Occasional
**Eleusine indica* (L.) Gaertn.	Wiregrass	Common
**Paspalum scrobiculatum* L.	Ricegrass	Uncommon
**Paspalum dilatatum* Poir.	Dallis grass	Occasional
**Rhynchelytrum repens* Hubb.	Natal redtop	Common
**Themeda villosa* (Poir.) A Camus	Lyon's grass	Locally abundant
DICOTYLEDONES		
ANACARDIACEAE - Mango Family		
**Schinus terebinthifolius* Raddii	Christmas berry	Common
ASCLEPIADACEAE - Milkweed Family		
**Gumphocarpus physocarpus* E. Mey.	Balloon plant	Locally abundant
COMPOSITAE - Sunflower Family		
**Acanthospermum australe* Kuntze	Spiny bur	Occasional
**Cirsium vulgare* (Savi) Ten.	Bull thistle	Occasional
**Conyza canadensis* Cronq.	Canadian fleabane	Occasional
**Emilia sonchifoloa* (L.) DC	Flora's paintbrush	Occasional
**Hypochoeris glabra* L.	Smooth cat's ear	Occasional
**Vernonia cinerea* (L.) Less.	Little ironweed	Occasional
CONVOLVULACEAE - Morningglory Family		
Jacquemontia sandwicensis Gray	Pau-o-hiiaka	Occasional
LEGUMINOSAE - Bean Family		
**Acacia farnesoama* (L.) Willd.	Klu	Occasional
Acacia koa A. Gray	Koa	Uncommon
**Canavalia cathartica* Thouars	Maunaloa vine	Uncommon
**Chamaecrista nictaitans* (L.) Moench	Partridge pea	Occasional
**Crotalaria incana* L.	Fuzzy rattle pod	Occasional
**Crotalaria pallida* Aiton	Smooth rattlepod	Occasional
**Desmanthus virgatus* (L.) Willd.	Virgate mimosa	Occasional

Scientific Name	Common Name	Abundance
LEGUMINOSAE - Bean Family con't		
**Desmodium incanum* DC	Spanish clover	Occasional
**Desmodium sandwicense* E. Mey.	Chili clover	Occasional
**Desmodium triflorium* (L.) DC	Beggar weed	Locally abundant
**Glycine wightii* Verdc.		Occasional
**Leucaena leucocephala* deWit	Koa-haole	Common
**Macroptilium atropurpureum* (DC) Urb.	Occasional	
**Macroptilium lathyroides* (L.) Urb.	Wild bean	Occasional
**Medicago lupulina* L.	Black medic	Occasional
LAMIACEAE - Mint Family		
**Hyptis pectinata* (L.) Poit.	Comb hyptis	Uncommon
MALVACEAE - Hibiscus Family		
**Malvastrum coromandelianum* Garcke	False marrow	Occasional
**Sida fallax* Walp.	'Ilima	Common
**Sida rhombifolia* L.	Cuba jute	Occasional
**Sida spinosa* L.	Prickly sida	Occasional
MYRTACEAE - Myrtle Family		
**Psidium guajava* L.	Guava	Uncommon
PLANTAGINACEAE - Plantain Family		
**Plantago lanceolata* L.	Narrow-leafed plantain	Common
STERCULIACEAE - Cacao Family		
Waltheria indica L.	'Uhaloa	Common
VERBENACEAE - Verbena Family		
**Lantana camara* L.	Lantana	Occasional
**Stachytarpheta jamaicenasis* (L.)Vahl	Jamaica vervain	Common
**Stackytarpheta urticifolia* (Salsb.) Sims		Occasional

FAUNA SURVEY

RESULTS

Mammals - Because the study site is so isolated, the only mammals seen in the area were cattle grazing in the nearby pastures. The usual animals such as dogs, cats, mice, rats, mongoose and pigs were not seen nor was there any evidence of their presense. Undoubtedly pigs and axis deer use the site, but none were seen.

Birds - As with the mammals, the size, isolation and disturbed condition of the site all contributed to the dearth of avian species found during the ornithological survey. Only three kinds of birds were seen. A one half hour observation period at sunrise and shorter observation periods - 10 to 20 minutes - were made as well as a circular transect around the periphery of the ridge.

Avian Habitat. This pasture land appears to be poor bird habitat. There are no trees for nesting and the cattle eat the grass and weeds before they produce seed, so there is little incentive for birds to use this area. Cattle egrets, zebra doves and one francolin were the only birds seen on this rain soaked, windswept slope.

The nomenclature follows that of The Birds of Hawaii and the Tropical Pacific (Pratt et al 1987).

Family Ardeidae: Herons and Egrets

Cattle egret: *Bubulcus ibis*

A late introduction to the Hawaiian Islands (1958), the cattle egret population has exploded. A small flock of these white birds with yellow bills and feet were seen flying over the site. These birds are approximately two feet in height and often feed on the flies that bedevil the cattle.

Family Phasianidae: Gallinaceous Birds

Gray Francolin: *Francolinus pondicerianus*

This is a nondescript chicken-like bird which is more often heard than seen. Two of these birds were heard calling in the woody thickets and open grassland above the site.

Family Columbidae: Pigeons and Doves

Zebra Dove: *Geopelia striata*

This small, ground dwelling, seed eating dove is usually found around places of human habitation. It probably thrives in this area because of the usually abundant grass and weed seeds. Zebra doves were found in small flocks along the highway and in open areas near the grassland.

Endangered Species. No listed endangered bird species were found (USFWS 1990).

APPENDIX G

FLORA AND FAUNA OBSERVED AT THE SOIL BORROW SITE 1

Checklist of Plants found on the Proposed Manawainui Gulch Borrow Pit Site

The plant families in the following species list have been alphabetically arranged within two groups, Monocotyledons, and Dicotyledons. The genera and species are arranged alphabetically within families. The taxonomy and nomenclature follow that of St. John (1973) and Wagner, Herbst and Sohmer (1990). For each taxon the following information is provided:

1. An asterisk before the plant name indicates a plant introduced to The Hawaiian Islands since Cook or by the aborigines.
2. The scientific name.
3. The Hawaiian name and or the most widely used common name.
4. Abundance ratings are for this site only and they have the following meanings:

Uncommon = a plant that was found less than five times.

Occasional = a plant that was found between five to ten times.

Common = a plant considered an important part of the vegetation.

Locally abundant = plants found in large numbers over a limited area. For example the plants found in grassy patches.

This species list is the result of an extensive survey of this site during the winter (January 1993) and it reflects the vegetative composition of the flora during a single season. Minor changes in the vegetation will occur due to introductions and losses and a slightly different species list would result from a survey conducted during a different growing season.

Scientific Name	Common Name	Abundance
MONOCOTYLEDONES		
GRAMINEAE - Grass Family		
**Cenchrus ciliaris* L.	Buffel grass	Locally abundant
**Bothriochloa pertusa* (L.) Camus	Pitted Beardgrass	Locally abundant
**Chloris barbata* (L.) Sw.	Swollen fingergrass	Occasional
**Chloris divaricata* R. Br.	Stargrass	Occasional
**Chloris gayana* Kunth	Rhodes grass	Occasional
**Cynodon dactylon* (L.) Pers.	Bermuda grass	Common
**Digitaria adscendens* (HBK) Henr.	Henry's crabgrass	Occasional
**Eleusine indica* (L.) Gaertn.	Wiregrass	Common
**Panicum maximum* Jacq.	Guinea gass	Common
**Panicum repens* L.	Torpedo grass	Locally abundant
**Rhynchelytrum repens* Hubb.	Natal redtop	Common
DICOTYLEDONES		
AMARANTHACEAE - Ameranth Family		
**Amaranthus spinosus* L.	Spiny amaranth	Common
**Amaranthus viridus* L.	Slender amaranth	Locally abundant
ANACARDIACEAE - Mango Family		
**Schinus terebinthifolius* Raddii	Christmas berry	Common
COMPOSITAE - Sunflower Family		
**Cirsium vulgare* (Savi) Ten.	Bull thistle	Occasional
**Conyza canadensis* Cronq.	Canadian fleabane	Occasional
**Emilia sonchifoloa* (L.) DC	Flora's paintbrush	Occasional
**Tridax procumbens* L.	Coat buttons	Occasional
**Verbesina enceliodes* (Cav.) B & H	Golden crown-beard	Uncommon
**Vernonia cinerea* (L.) Less.	Little ironweed	Occasional
**Wedelia trilobata* (L.) Hitchc.	Wedelia	Locally abundant
CONVOLVULACEAE - Morningglory Family		
**Ipomoea cairica* (L.) Sweet	Koali 'ai	Occasional
Jacquemontia sandwicensis Gray	Pau-o-hiiaka	Occasional
**Merremia aegyptia* (L.) Urb.	Hairy merremia	Uncommon
EUPHORBIACEAE - Euphorb Family		
**Ricinus communis* L.	Castor bean	Occasional

Scientific Name	Common Name	Abundance
LEGUMINOSAE - Bean Family		
**Acacia confusa* Merr.	Formosa koa	Uncommon
**Acacia farnesoama* (L.)Willd.	Klu	Occasional
**Chamaecrista nictaitans* (L.) Moench	Partridge pea	Occasional
**Crotalaria incana* L.	Fuzzy rattle pod	Occasional
**Desmanthus virgatus* (L.) Willd.	Virgate mimosa	Occasional
**Desmodium incanum* DC	Spanish clover	Occasional
**Desmodium triflorium* (L.) DC	Beggar weed	Locally abundant
**Indigofera suffruticosa* Mill.	Indigo	Occasional
**Leucaena leucocephala* deWit	Koa-haole	Common
**Medicago lupulina* L.	Black medic	Occasional
MALVACEAE - Hibiscus Family		
**Malva parviflora* L.	Cheese weed	Occasional
**Malvastrum coromandelianum* Garcke	False marrow	Occasional
**Sida fallax* Walp.	'Ilima	Common
**Sida rhombifolia* L.	Cuba jute	Occasional
**Sida spinosa* L.	Prickly sida	Occasional
MYRTACEAE - Myrtle Family		
**Psidium guajava* L.	Guava	Uncommon
PLANTAGINACEAE - Plantain Family		
**Plantago lanceolata* L.	Narrow-leafed plantain	Common
STERCULIACEAE - Cacao Family		
Waltheria indica L.	'Uhaloa	Common
VERBENACEAE - Verbena Family		
**Lantana camara* L.	Lantana	Occasional
**Stachytarpheta jamaicenasi* (L.) Vahl	Jamaica vervain	Common
**Stackytarpheta urticifolia* (Salsb.) Sims		Occasional

FAUNA SURVEY

RESULTS

Mammals. No evidence of mammal activity was seen on this site. The close proximity of the site to a well travelled highway probably accounts for the absence of animal sign. However, there are several animal species present on Molokai which probably use the area. Among these are the mongoose (*Herpestes auropunctatus*). One animal was seen crossing the highway south of the site and because of the seed rain from the grasses and forbs, mongoose prey such as mice and rats are probably abundant during part of the year.

Mice and Rats. Here again, although they were not seen on site during the survey, there are, no doubt, populations of the House mouse (*Mus museulus*), Norway rat (*Rattus norvegicus*), Roof rat (*Rattus rattus*), and the Pacific rat (*Rattus exulans*) in the area. These commensals are usually present where human activities occur (two existing oxidation ponds just north of the study site).

No pigs (*Sus scrofa*) or Axis deer were seen in the area, but it is concievable that these animals use the site. Both species are known from this part of the island.

Birds - the ornithological survey includes the results of a circular transect of the site and fifteen to twenty minute observation periods within the site. Four bird species were found.

The nomenclature follows that of The Birds of Hawaii and the Tropical Pacific (Pratt et al 1987).

Avian Habitat. There is a single avian habitat on the study site it is Koa haole Scrub with mixed grass understory. There are no big trees or other nesting sites to attract birds, however the abundant grass seed will be an attractant later in the growing season.

Family Ardeidae: Herons and Egrets

Cattle egret: *Bubulcus ibis*

A late introduction to the Hawaiian Islands (1958), the cattle egret population has exploded. A few scattered individuals were seen approaching the settling ponds. These are large, white birds with yellow bills and feet that stand approximately two feet in high and often they appear dirty brown because the mud darkens their white plumage .

Family Columbidae: Pigeons and Doves

Spotted Dove: *Streptopelia chinensis*

The spotted dove is a large bird which is grayish brown with rosy blushed breast feathers. At the sides and back of the neck is a patch of black with white spots.

The low, repetitive cooing of the spotted dove is common on this site. Several individuals were seen both on the ground and on the wing near the study area.

Zebra Dove: *Geopelia striata*

This ground dwelling, seed eating dove is smaller and even more abundant than the spotted dove. Zebra doves were seen along the highway, near the settling ponds, and on the ground where they feed on various types of small seeds.

Family Sturnidae: Starlings and Mynas

Common myna: *Acridotheres tristis*

The myna is a plump brown bird with a dark head and tail. It has a yellow bill, legs and eyes. It has white markings on its wings and tail which flash when it flies. Its walk is distinctive. Although Mynas are usually seen in large large flocks, only two individuals were seen on the study site.

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APPENDIX H

RESULTS OF ADDITIONAL ARSENIC INVESTIGATIONS OFF THE SOUTH COAST OF MOLOKAI

AECOS No. 688B

ARSENIC IN SEDIMENTS AND BIOLOGICAL TISSUE SAMPLES FROM OFF THE SOUTH COAST OF MOLOKA'I

Prepared for

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and
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INTRODUCTION

This report provides results of sediment and marine biological tissue sampling and analysis conducted in March 1993 on the reef flat off the south shore of the island of Moloka'i. Analysis was limited to total arsenic as elemental arsenic. The study was prompted by the finding of elevated arsenic body burdens in several species of crabs inhabiting the nearshore sand and mud bottom areas off the mangrove wetlands that extend between Kalaniana'ole Colony and Pakanaka Fishpond (*AECOS*, 1992). Arsenic body burdens were deemed elevated in these species by comparison with results from statewide studies reported by the Department of Health (1978, 1992) and by comparison with regulatory limits where established (see Nauen, 1983). The health hazards of arsenic in shellfish is mitigated by the fact that a significant proportion (80 to 90%) of the metalloid occurs as arsenocholine and other organoarsenic compounds that are rapidly excreted from the human body. Nonetheless, crabs from the south coast of Moloka'i are a significant dietary item for many residents, and crabs from this area may be shipped to markets elsewhere in the State of Hawaii.

The County of Maui, through contractual agreements with the consulting firm of Brown & Caldwell, provided funding to expand upon the 1992 study conducted for closure of the Kalama'ula landfill site. The latter was designed to assess whether contaminants had leached or were leaching from the Kalama'ula Landfill on Moloka'i and impacting aquatic biological resources in the area. The study concluded that while evidence of arsenic contamination could be found, the landfill did not appear to be a source of this contamination. The extended study reported here attempts to determine: (1) how the elevated arsenic levels are distributed along the south Moloka'i coastline; (2) whether other commonly eaten reef organisms are similarly high in arsenic; and (3) where and in what form the arsenic occurs in the crabs found to have high arsenic levels.

A total of 26 sediment samples collected from locations along 37 linear miles of fringing reef off the south Moloka'i coastline were analyzed for arsenic for this extended study. A total of 48 tissue samples were analyzed for arsenic. The total number of arsenic analysis on biological specimens from off Moloka'i for 1992-93 is 76.

METHODS

Sediment samples were collected from 23 different locations on the reef flat between Hale o Lono Harbor and Honouliwai (Figure 1). Two samples were collected at each station to provide the laboratory with a backup or field replicate. Samples were mostly collected from just off the shoreline, but at some locations, samples were obtained from between 200 and 400 meters seaward of the shore.

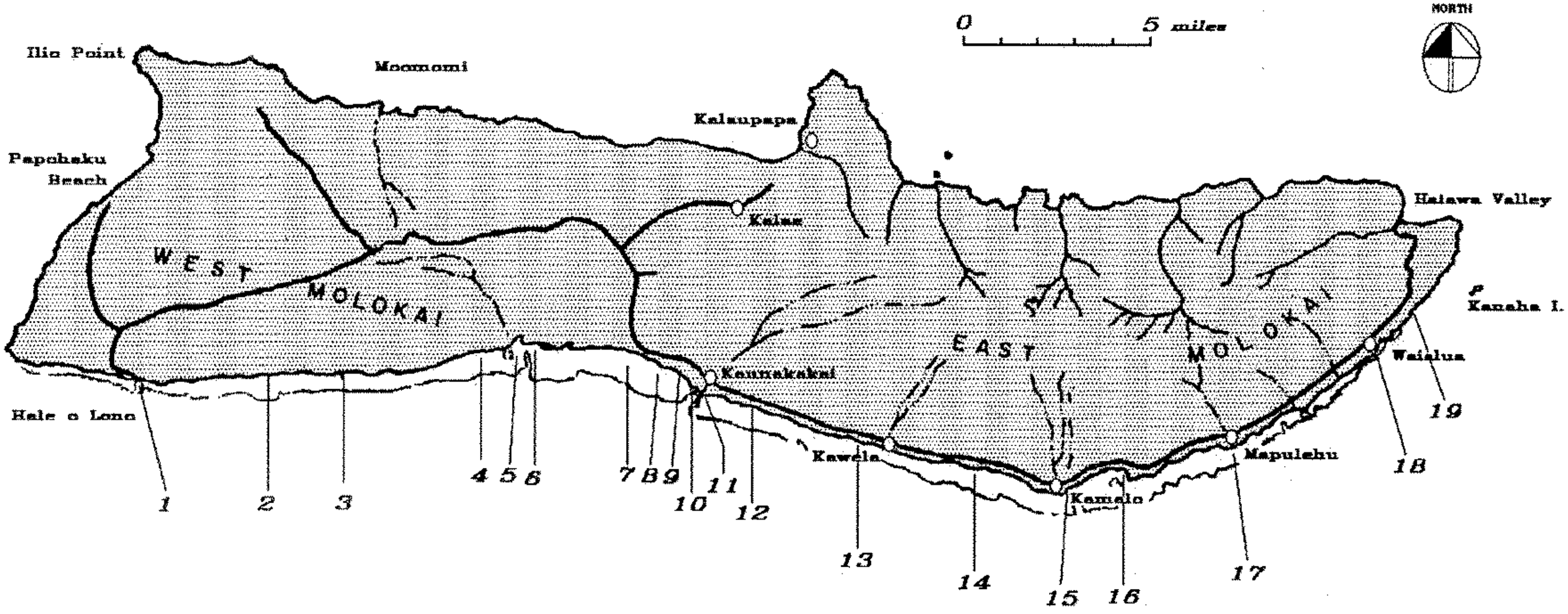


Figure 1. Sampling station locations on the south Moloka'i reef.

Sediments were subjected to a rigorous digestion (EPA Method 3050) and the digest filtered and then analyzed by graphite furnace atomic absorption spectrophotometer (GFAA). Dry weight was determined on two or more subsamples and the average value used to convert the analytical concentration to a sample dry-weight concentration. Laboratory QA/QC for these samples included method blanks, two spikes (Samples 8c and 13) and three duplicates (Samples 5, 9, and 14). Duplicates were actually field replicate samples which were independently digested and for which independent dry weights were determined. Matrix spike recovery results were as follows:

Arsenic by GFAA

SAMPLE	DATE	% Recovery	% Bias
Sediment sample 8c	03.11.93	88	-12
Sediment sample 13	03.30.93	113	+13

Various methods were used to collect biological specimens ranging from hand gathering to baited crab nets to spear-fishing. Locations were generally as indicated in Figure 1, but more dispersed than the sediment samples. All specimens were collected by Becky Bishop-Yuen and Mark Yuen and frozen as soon as possible after collection. Samples were shipped in batches to the laboratory on Oahu, where they were identified, sorted, and partitioned (if more than sufficient material were present), then processed. A listing of the biological samples collected and processed for analysis is presented in Table 1.

Processing usually consisted of rinsing with laboratory distilled/de-ionized water, towel drying, recording the weight of individual specimens, and then mashing or blending to a slurry. Mashing was accomplished in a pre-cleaned mortar with a pestle, blending was accomplished using a pre-cleaned commercial blender. In some cases, material was finely chopped with a single-edged razor or grated while still frozen. Where differentiation between flesh and viscera was required, dissection preceded blending. In the case of crabs, "flesh" consisted of muscle tissue removed from the large claws, and "viscera" included all of the soft tissues and gills from within the carapace. Octopods were dissected prior to freezing on Moloka'i. Flesh consisted of portions of the tentacles, and viscera included all of the soft tissues pulled from the body sac. All or a portion of the material resulting from the processing was then digested, filtered, and analyzed by GFAA. Laboratory QA/QC for these samples consisted of method blanks, matrix spikes, and duplicates; the latter are reported in the results tables. Matrix spike recovery results were as follows:

TABLE 1. List of biological specimens and tissues collected from the reef environment off the south coast of Moloka'i in March 1993 and processed for analysis of arsenic.

Specimen Identification	Collection Location (map number)	Count	Wet Weight (grams)	Ind. Weight (grams)
MARINE ALGAE *(limu)*				
CHLOROPHYTA				
Enteromorpha sp.	Kamehameha Grove (8b)	--	54.2	--
'ele'ele	Pakanaka Fishpond (4b)	--	23.8	--
Ulva fasciata	Kanukuawa Fish Pond (14)	--	143.6	--
RHODOPHYTA				
Gracilaria bursapastoris	Kaunakakai Harbor (10)	1	18.0	
MOLLUSCA				
CEPHALOPODA				
Octopus cyanea, flesh	Hale o Lono (1)	1	--	
" " , viscera	Hale o Lono (1)	"	--	
" " , flesh	Pala'au (5b)	1	--	
" " , viscera	Pala'au (5b)	"	--	
" " , flesh	Kamehameha Grove (8c)	2	--	
" " , viscera	Kamehameha Grove (8c)	"	--	
" " , flesh	Kapa'akea (12)	2	--	
" " , viscera	Kapa'akea (12)	"	--	
CRUSTACEA				
DECAPODA				
Charybdis erythrodactyla 'ala'eke	Hale o Lono Harbor (1) †	1	144.4	144.4
Scylla serrata, flesh	Pakanaka Fishpond (4a)	1	510.3	510.3
Samoan crab, viscera	Pakanaka Fishpond (4a)	"	"	"
Macrophthalmus	Kahanui (6b)	3	15.8	5.3
telescopicus, maka 'aloa	Kanukuawa Fish Pond (14)	1	4.2	4.2
Portunus sanguinolentus	Kahanui (6b)	1	11.0	11.0
haole crab	Kaunakakai Harbor (10)	3	42.5	14.2
Thalamita crenata	Pakanaka Fish Pond (4b)	2	75.9	38.0
blue pincher crab	Pakanaka Fish Pond (4b) ‡	2	89.1	44.6
" ", flesh	Pakanaka Fish Pond (4b) ‡	2	178.4	89.2
" ", viscera	Pakanaka Fish Pond (4b) ‡	"	"	"
" ", flesh	Pakanaka Fish Pond (4b) ‡	2	148.7	74.4
" ", viscera	Pakanaka Fish Pond (4b) ‡	"	"	"
" "	Pala'au (5b)	6	143.5	23.9
" ", flesh	Pala'au (5b)	3	124.3	41.4
" ", viscera	Pala'au (5b)	"	"	"

TABLE 1. (Continued).

Specimen Identification	Collection Location (map number)	Count	Wet Weight (grams)	Ind. Weight (grams)
Thalamita crenata	Kahanui (6b)	8	181.0	22.6
" ", flesh	Kahanui (6b)	2	141.3	70.6
" ", viscera	Kahanui (6b)	"	"	"
" "	Kamehameha Grove (8b)	2	37.5	18.5
" "	Kamehameha Grove (8a)	2	71.5	35.8
" "	Kapa'akea (12)	1	68.1	68.1
" "	Kanukuawa Fish Pond (14)	2	73.3	36.6
" "	Mapulehu (17)	3	115.2	38.4
Thalamita integra	Pakanaka Fish Pond (4b)	1	7.7	7.7
" "	Kamehameha Grove (8b)	3	14.0	4.7
" "	Kamehameha Grove (8c)	3	24.2	8.1
" "	Kanukuawa Fish Pond (14)	3	24.7	8.2
VERTEBRATA				
PISCES				
Caranx ignobilis				
ulua, liver only	Hale o Lono (1)	1	--	~16 kg

† - Specimen collected from within the fish pond or harbor.
‡ - field replicate

Arsenic by GFAA

SAMPLE	DATE	% Recovery	% Bias
'ele'ele (*Enteromorpha* sp.) (8b)	03.27.93	82	-18
Ulua, liver (1)	03.27.93	72	-28
crab (*T. integra*), whole (4b)	03.27.93	82	-18
maka'aloa crab, whole (14)	03.27.93	72	-28
blue-pincher crab, viscera (4b)	03.29.93	90	-10
Samoan crab, flesh (4a)	03.29.93	113	+13
sea lettuce (*Ulva fasciata*) (14)	03.30.93	113	+13
octopus, viscera (12)	03.30.93	124	+24
octopus, flesh (8c)	03.30.93	124	+24
crab (*T. integra*), whole (14)	03.30.93	102	+2

Spike recovery values were mostly within acceptable criteria (75-125%) for accuracy. Reported tissue results may be biased low because spike recovery values on March 30 were obtained after replacement of a leaking graphite furnace cell. The results of duplicates demonstrate that for some materials, considerable variation in results can occur, presumably reflecting the non-homogeneous nature of these samples as prepared.

RESULTS

Sediment Samples

The results of the measurement of arsenic in reef sediment samples are given in Table 2. Included in this table are samples analyzed by *AECOS* (1992) and a sediment sample from the beach near Kamehameha Grove reported in Bechtel (1991). Sample numbers are the "MAP" numbers in column 1 and refer to the locations shown in Figure 1. The lowercase letters affixed to some map numbers differentiate between samples collected from the same general area, but at different distances off the shore.

Concentrations of arsenic in sediments from the reef flat range from undetected (<0.11 mg/Kg) to 20.8 mg/Kg. This range applies to all the samples and to just the nearshore samples. The latter were the majority of samples collected. The offshore samples ranged from 1.18 to 12.5 mg/Kg. Figure 2 shows sediment arsenic values arranged by sample location on a map of the island of Moloka'i. Values have been rounded to the nearest part per million (ppm) and, where more than one sample or subsample were analyzed, a mean value given for the location. Results are also arranged by distance from shore in three categories: nearshore (within 50 m), from 100 to <250 m off shore, and greater than 250 m off shore.

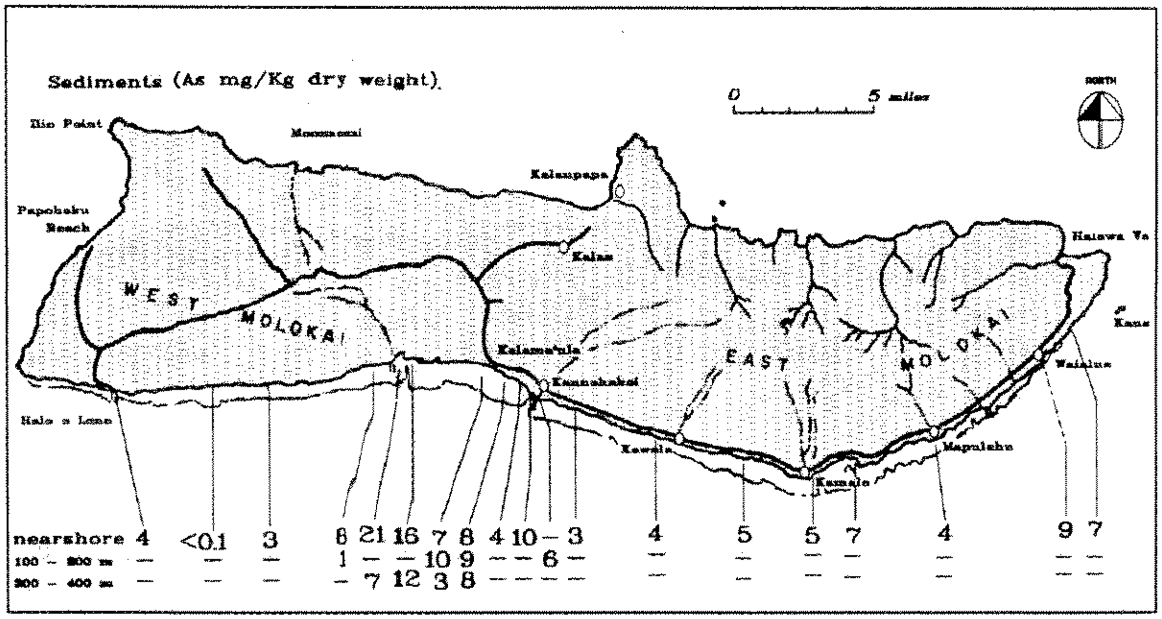


Figure 2. Arsenic in reef flat sediments off the south coast of Moloka'i

TABLE 2. Arsenic in sediment from the reef flat and fish ponds along the south coast of Moloka'i. Stations arranged from west to east.

MAP No.	LOCATION	DISTANCE OFFSHORE (meters)	DATE COLLECTED	FIELD ID	PERCENT SAND	PERCENT SOLIDS	ARSENIC (mg/Kg)[1]
1	Hale o Lono Harbor	Ns	03/18/93	"9"		78.0	3.52
2	Oneohilo Gulch	Ns	03/10/93	"9.5"		83.8	<0.112
3	Kolo Wharf	Ns	03/18/93	"10"		79.0	2.85
4a	Pakanaka Fishpond†	Ns	03/13/93	"12"		70.6	7.93
4b	Pakanaka Fishpond	200	03/13/93	"11"		66.7	1.18
5a	Pala'au (Apana I)	Ns	03/22/93	"13i"		48.5	20.8
5b	Pala'au (Apana I)	400	03/22/93	"13"		70.0	7.26
	Manawainui Gulch	SOIL	10/07/92	C-C		79.2	< 1.8
	Pala'au, mudflat	SOIL	10/07/92	C-B		84.1	< 1.8
6a	Kahanui (Apana I)	Ns	10/07/92	C-A		60.5	16.0
6b	Kahanui (Apana I)	400	03/17/93	"14"		75.4	12.5
	Kalama'ula, creek	Ns	10/06/92	A-E		14.1	6.0
	Kalama'ula, creek	Ns	10/06/92	A-D		17.0	8.2
	Kalama'ula, creek	Ns	10/06/92	A-C		20.3	10.0
	Kalama'ula, creek	Ns	10/06/92	A-B		25.7	7.8
	Kalama'ula, creek	Ns	10/06/92	A-A		37.3	9.1
7a	Kalama'ula	~3	10/06/92	"A"		64.5	7.0
7b	Kalama'ula	100	03/07/93	"6"		67.5	10.4
7c	Kalama'ula	300	03/07/93	"7"		69.6	2.65
8	Kamehameha Grove	Ns	01/24/92	"B-4"		?	16.7
8a	Kamehameha Grove	Ns	10/06/92	—		76.5	13.0
8b	Kamehameha Grove	200	03/22/93	"5A"		76.4	7.94
8b	Kamehameha Grove [DUP]	200	03/22/93	"5B"		76.2	9.86
8c	Kamehameha Grove	400	03/07/93	"8"		73.0	7.59
9	Off WWTP	Ns	03/07/93	"4A"		73.5	3.37
9	Off WWTP [DUP]	Ns	03/07/93	"4B"		76.4	2.63
10	Kaunakakai Harbor	Ns	03/06/93	"1"		73.9	10.1
11	East of Harbor	200	03/15/93	"3"		70.3	5.83
12	Kapa'akea	Ns	03/09/93	"2"		71.5	2.86
13	Kanoa Fish Pond†	Ns	03/09/93	"15"		73.8	3.86
14	Kanukuawa Fish Pond	Ns	03/09/93	"16A"		66.6	5.76
14	Kanukuawa Pond [DUP]	Ns	03/09/93	"16B"		73.6	5.13
15	Kamalo	Ns	03/15/93	"17"		58.2	4.88
16	Keawanui Fish Pond†	Ns	03/24/93	—		57.2	6.69
17	Mapulehu	Ns	03/15/93	"18"		76.4	4.15
18	Waialua	Ns	03/20/93	"19"		71.0	8.85
19	Honouli Wai	Ns	03/20/93	"20"		75.4	7.13

† - Sample collected from inside of the named fishpond wall.
Ns = Near shore; immediately off the shore, in mangroves, or in fish pond.
1 - mg per kg dry weight of sediment.

The sediment results suggest that arsenic concentrations tend to be highest on the reef off the mangrove swamp from Pakanaka Fish Pond on the west to the vicinity of Kaunakakai Harbor on the east (Station No.s 4 to 10). Sediment concentrations from within the described area are generally 2 to 3 times higher than sediment values from outside of the area. However, a few higher values occur in samples from outside of this area, and some values from inside the area are comparable to sediment values found to the east and the west. Calculation of a mean value considering all of the sediment samples (n=20, excluding soil samples, and combining duplicates) from off the shoreline between Pakanaka Fish Pond and Kaunakakai Harbor (inclusive) gives 9.30 mg As/Kg; The mean of all of the other sediment samples (n=12) is 4.68 mg As/Kg.

Tissue Samples

Results of tissue analysis for arsenic are given in Table 3. This table includes only those samples analyzed for the present report. Arsenic analysis of aquatic animal tissues undertaken for the Kalama'ula Landfill Closure (*AECOS*, 1992) are given here in Table 4. As was found by the earlier study, the concentration of arsenic is quite variable from species to species. In general, algae (*limu*) show low arsenic tissue values (0.4 - 0.7 ppm), octopus (*he'e*) show medium values (3 - 6 ppm) with some exceptions, and crabs tend to show high values (3 - 18 ppm). Results reported in Table 4 indicate that whole fishes, at least in the Kalama'ula area, tend to show low values (<0.1 - 0.8 ppm).

Three species of marine algae were tested from the nearshore environment. Two (*'ele'ele* and *ogo*) are popular limu varieties collected and eaten by local residents. All of the samples showed relatively low concentrations of arsenic.

Concentrations of arsenic in octopus (*Octopus cyanea*) were measured because this favored food item (known as *he'e*, *tako*, or squid) feeds on molluscs and crabs. Octopus were collected from a wide area and the flesh (tentacles) and viscera analyzed separately. Tissue concentrations ranged from 3.5 to 14.6 ppm arsenic, with most values under 6.0 ppm. The highest concentrations were found in the homogenized viscera of an octopus caught off Pala'au (Station 5b). Although the material appeared to be well blended, repeated digestions and analysis of portions of this material gave values ranging from 4.2 to 14.6 ppm. Arsenic in this specimen was apparently elevated in an internal organ. The viscera of these animals is not ordinarly eaten by humans.

A number of crab species were tested, in part because different species were obtained in different areas. For this study, only swimming crabs (Family Portunidae) and one species of ocypode crab (*Macrophthalmus telescopicus*) were tested. These crabs inhabit

TABLE 3. Measurements of arsenic in marine animal tissues from the reef flat environment off the south coast of Moloka'i, Hawai'i.

Common name	Species	Collection Site	Count	Avg. Wt. (gms)	Arsenic (µg/g)
'ele'ele	*Enteromorpha* sp.	Pakanaka Fish Pond (4b)	--	23.8	0.60
'ele'ele	" "	Kamehameha Grove (8b)	--	54.2	0.36
'ele'ele	" "	Kamehameha Grove (8b)	--	[DUP]	0.56
palahalaha	*Ulva fasciata**	Kanukuawa Fish Pond (14)	--	143.6	0.68
ogo	*Gracilaria bursapastoris*	Kaunakakai Harbor (10)	1	18.0	0.40
he'e	*Octopus cyanea*, flesh	Hale o Lono Harbor (1)	1	--	7.09
he'e	*Octopus cyanea*, viscera	Hale o Lono Harbor (1)	1	--	5.76
he'e	*Octopus cyanea*, flesh	Pala'au (5b)	1	--	3.63
he'e	*Octopus cyanea*, viscera	Pala'au (5b)	1	--	4.24
he'e	*Octopus cyanea*, viscera	Pala'au (5b)	1	[DUP]	11.4
he'e	*Octopus cyanea*, viscera	Pala'au (5b)	1	[DUP]	14.6
he'e	*Octopus cyanea*, flesh	Kamehameha Grove (8c)	2	--	5.56
he'e	*Octopus cyanea*, viscera	Kamehameha Grove (8c)	2	--	3.46
he'e	*Octopus cyanea*, flesh	Kapa'akea (12)	2	--	5.75
he'e	*Octopus cyanea*, flesh	Kapa'akea (12)	2	[DUP]	3.52
he'e	*Octopus cyanea*, viscera	Kapa'akea (12)	2	--	4.42
crab, *'ala'eke*	*Charybdis erythrodactyla*	Hale o Lono (1)	1	144.4	14.5
crab, Samoan	*Scylla serrata*, flesh	Pakanaka Fish Pond (4b)	1	510.3	10.1
crab, Samoan	*Scylla serrata*, viscera	Pakanaka Fish Pond (4b)	"	"	6.11
crab, *maka'aloa*	*Macrophthalmus*	Kahanui (6b)	3	5.3	4.62
crab, *maka'aloa*	*M. telescopicus*	Kanukuawa Fish Pond (14)	1	4.2	3.08
crab, *haole*	*Portunus sanguinolentus*	Kahanui (6b)	1	11.0	15.1
crab, *haole*	" "	Kaunakakai Harbor (10)	3	14.2	8.36
crab, blue-pincher	*Thalamita crenata*	Pakanaka Fish Pond (4b)	2	38.0	12.3
crab, blue-pincher	" "	Pakanaka Fish Pond (4b) ‡	2	44.6	11.8
crab, blue-pincher	" ", flesh	Pakanaka Fish Pond (4b) ‡	2	89.2	21.6
crab, blue-pincher	" ", viscera	Pakanaka Fish Pond (4b) ‡	"	"	30.6
crab, blue-pincher	" ", flesh	Pakanaka Fish Pond (4b) ‡	2	74.4	20.1
crab, blue-pincher	" ", viscera	Pakanaka Fish Pond (4b) ‡	"	"	11.6
crab, blue-pincher	" "	Pala'au (5b)	6	23.9	16.8
crab, blue-pincher	" ", flesh	Pala'au (5b)	3	41.4	21.8
crab, blue-pincher	" ", viscera	Pala'au (5b)	"	"	18.1
crab, blue pincher	" "	Kahanui (6b)	8	22.6	14.3
crab, blue-pincher	" ", flesh	Kahanui (6b)	2	70.6	20.1
crab, blue-pincher	" ", viscera	Kahanui (6b)	"	"	13.8
crab, blue-pincher	" ", viscera	Kahanui (6b)	"	[DUP]	16.7
crab, blue-pincher	" "	Kamehameha Grove (8a)	2	35.8	16.8
crab, blue-pincher	" "	Kamehameha Grove (8b)	2	18.5	9.20

Table 3 (Continued).

Common name	Species	Collection Site	Count	Avg. Wt. (gms)	Arsenic (µg/g)
crab, blue-pincher	" "	Kapa'akea (12)	1	68.1	18.1
crab, blue-pincher	" "	Kapa'akea (12)	1	[DUP]	16.3
crab, blue-pincher	" "	Kanukuawa Fish Pond (14)	2	36.6	8.98
crab, blue-pincher	" "	Mapulehu (17)	3	38.4	11.7
crab, swimming	*Thalamita integra*	Pakanaka Fish Pond (4b)	1	7.7	8.48
crab, swimming	" "	Kamehameha Grove (8b)	3	4.7	11.3
crab, swimming	" "	Kamehameha Grove (8c)	3	8.1	10.7
crab, swimming	" "	Kanukuawa Fish Pond (14)	3	8.2	3.35
crab, swimming	" "	Kanukuawa Fish Pond (14)	3	[DUP]	3.12
fish, *ulua*	*Caranx ignobilis*, liver	Hale o Lono Harbor (1)	1	--	2.82

* - Sample included much *'ele'ele* (*Enteromorpha* sp.).
‡ - Field replicate
[DUP] - Laboratory (analytical) duplicate

soft bottom (sand or silt) environments. Results reported in Table 4 from the previous study indicated that shrimp and grapsid crabs were not bioaccumulating arsenic to an unusual degree. Also, the swimming crabs are among the more popular crustaceans taken for food by Moloka'i residents from the reef flat areas

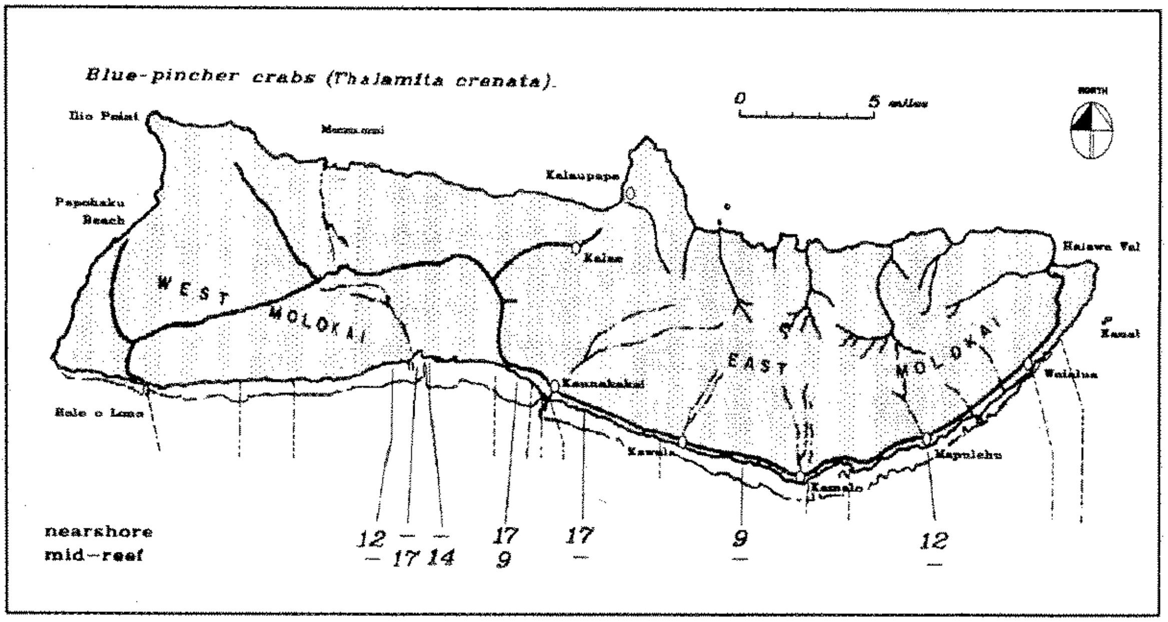


Figure 3. Arsenic in blue-pincher crabs off the south coast of Moloka'i

Table 4. Results of measurements for arsenic in estuarine and marine animal tissue samples from the south coast of Moloka'i (after *AECOS*, 1992).

Common name	Species	Collection Site	Count	Avg. Wt. (gms)	Arsenic (µg/g)
Snail, *'akolea*	*Littorina scabra*	Mangrove A	40	1.08[1]	1.3
Snail, *'akolea*[2]	" "	Mangrove B	38	--	0.74
Snail, *'akolea*	" "	Mangrove B	52	1.09[1]	1.4
Shrimp, glass	*Palaemon debilis*	Creek A	183	0.15	1.4
Shrimp, glass	" "	Creeks B	267	0.16	1.5
Crab, *'alamihi*	*M. thukuhar*	Mangrove A	65	2.8	0.70
Crab, *'alamihi*	" "	Mangrove A	24	3.4	2.0
Crab, *'alamihi*	" "	Mangrove B	37	3.0	0.22
Crab, *'alamihi*	" "	Mangrove B	44	3..2	1.8
Crab, *'alamihi*	" "	Mangrove C	38	3.9	1.5
Crab, *haole*	*P. sanguinolentus*	Reef flat A	3	36.5	2.1
Crab, *haole*	" "	Reef flat A	11	39.3	14
Crab, *haole*	" "	Mangrove B	5	39.5	0.72
Crab, *haole*	" "	Mangrove B	3	48.7	8.0
Crab, *haole*	" "	Mangrove C	1	89.2	7.9
Crab, blue pincher	*Thalamita crenata*	Creek A	15	34.5	12.9
Crab, blue pincher	" "	Creek A	2	65.6	15
Crab, blue pincher	" "	Mangrove B	2	68.2	15.9
Crab, blue pincher	" "	Mangrove B	24	16.4	12
Crab, blue pincher	" "	Mangrove C	3	69.1	11
Crab, blue pincher	" "	Kaelepulu, O'ahu	4	42.2	0.48
Crab, blue pincher	" "	Kawainui, O'ahu	4	44.2	0.44
Fish, sailfin mollie	*Poecilia latipinna*	Creek A	30	1.1	ND
Fish, *aholehole*	*Kuhlia sandvicensis*	Creek A	7	2.8	ND
Fish, *aholehole*	" "	Creek A	6	3.2	0.83
Fish, *'o'opu 'akupa*	*Eleotris sandwicencis*	Creek A	2	18.1	0.68
Fish, *'o'opu 'akupa*	" "	Kaelepulu, O'ahu	2	20.8	0.27
Fish, *'o'opu 'akupa*	" "	Kawainui, O'ahu	2	16.5	0.44

1 - Tissue weight without shell.

2 - This batch potentially contaminated by glass vial ground into tissue during blending.

The species showing the greatest bioaccumulation of arsenic is the blue-pincher crab (*Thalamita crenata*). This species was collected from Pakanaka Fish Pond eastward to Mapulehu (a distance of some 22 linear miles) at 5 nearshore and 3 offshore locations. Tissue arsenic concentrations ranged from 8.9 to 18.1 ppm in whole crabs. The distribution of values relative to sample collection sites is shown in Figure 3 (values are rounded and averages used where more than one analysis was performed for a location). The results do not present any striking geographical pattern, perhaps in part because only two collections were made outside of the reef area from Pakanaka Fish Pond to Kaunakakai. The average arsenic concentration considering all of the measurements on whole crabs collected from just the latter area (n = 11, including results in Table 4) is 13.4 ppm; considering all of the blue-pincher crabs analyzed (n = 15) gives a mean of 13.5 ppm.

Thalamita crenata was used (along with one Samoan crab) to assess the distribution of arsenic within the crab body by analyzing muscle and internal organs separately. The range and mean values obtained were as follows:

Tissue type	Range	Mean
Thalamita crenata (blue-pincher crab)		
Whole crabs (n = 15)	8.98 - 18.1	13.5 ppm
Viscera & gills (n = 5)	11.6 - 30.6	18.2 ppm
Muscle (claw meat) (n = 4)	20.1 - 21.8	20.9 ppm
Scylla serrata (Samoan crab)		
Viscera & gills (n = 1)	--	6.11 ppm
Muscle (claw meat) (n -= 1)	--	10.1 ppm

The apparent increases in concentration over whole body values can be explained by exclusion of the carapace which certainly comprises a significant fraction of the bulk of the crab's body. Most of the arsenic in these crabs is present in the soft tissues. Also, as much or more arsenic is found in the muscles as in the internal organs of the carapace.

Several other species of reef flat crab were analyzed (Table 1) and the results are displayed in Figure 4 by species and location. Each species was collected from only two or three locations along the south shore and therefore patterns in distribution of arsenic are not recognizable, although as was the case for most of the other specimens analyzed, values west of Kaunakakai tended to be higher than values east of Kaunakakai.

Only one sample of fish tissue was analyzed: liver from an ulua (*Caranx ignobilis*) caught at Hale o Lono Harbor. At 2.8 mg/Kg, the concentration is perhaps above "average" for marine fishes in Hawaii, but liver tissue may typically contain 70 to 80% of the total body burden in fishes (Penrose et al., 1977, in D'Itri, 1990). Analysis of fishes from American Samoa showed that the liver concentration averaged 10 times the flesh concentration for arsenic (*AECOS*, 1991). The earlier Moloka'i study (*AECOS*, 1992) had concluded that fishes from the vicinity of Kalama'ula were not bioaccumulating arsenic (see Table 4).

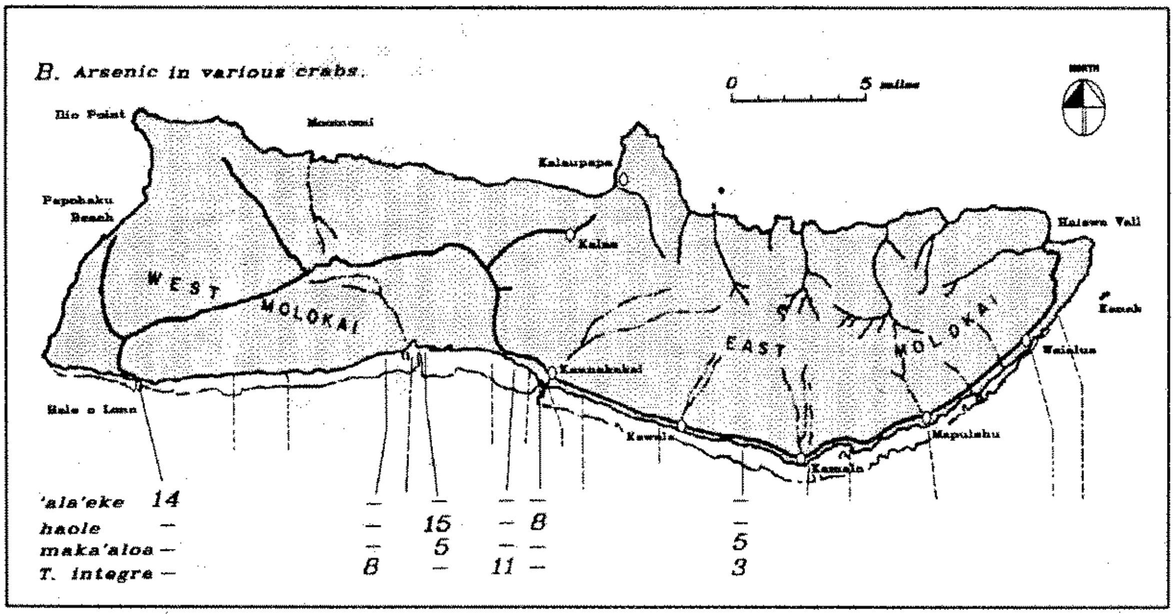


Figure 4. Arsenic in reef flat crabs off the south coast of Moloka'i

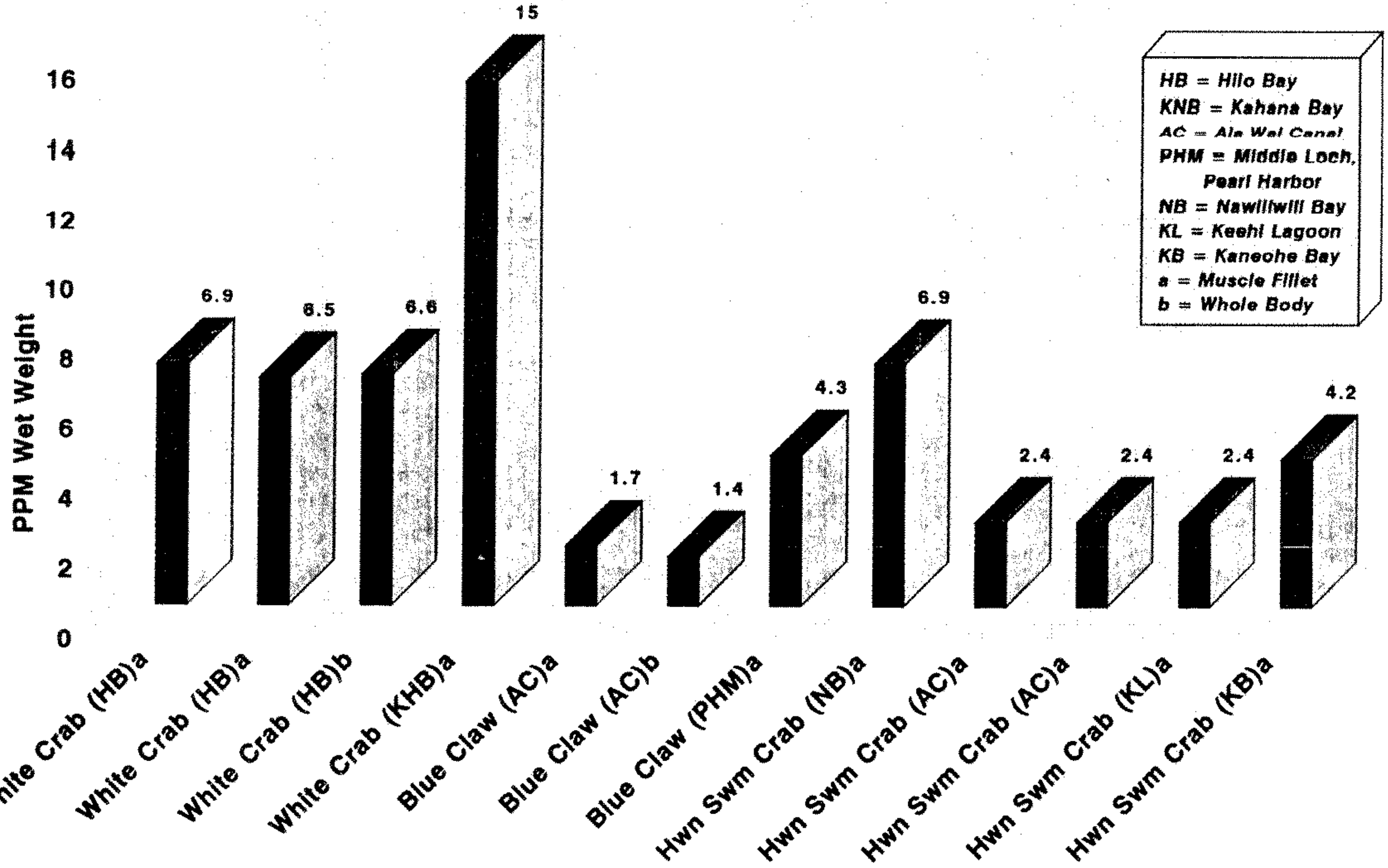
CONCLUSIONS

The arsenic found in marine crabs off the south coast of Moloka'i is elevated relative to most crab tissue concentrations reported previously for other areas of the State of Hawaii. The most recent results of the Department of Health, Toxic Monitoring Program are graphed in Figure 5. Note that these results show blue-pincher crab (*Thalamita crenata*) having lower body burdens of arsenic than white crab (*Portunus sanguinolentus*), although both species were not collected together at any one location. White crab from Kahana Bay (O'ahu) demonstrated arsenic tissue concentration (muscle tissue only) comparable to the Moloka'i results reported herein.

With respect to arsenic distribution along the south coast of Moloka'i, the tissue and sediment results both point to the reef and nearshore areas off the mangrove coastline between Kaunakakai and Pakanaka Fish Pond as an area of generally higher arsenic levels, but the degree of elevation is not great relative to other locations sampled in this study. However, were tissue and sediment concentrations everywhere on Moloka'i about that level which was usually observed in samples taken from areas east of Kaunakakai, the results would not be considered unusual in comparison with other parts of the State

Arsenic Concentrations in Crab, 1991

White Crab (Portunus sanguinolentus)
Blue Claw Crab (Thalamita crenata)
Hawaiian Swimming Crab
(Podophthalmus vigil)



Source: Department of Health Toxics Monitoring Program.

of Hawaii. The results from this extensive sampling support the conclusion (*AECOS*, 1992) that the Kalama'ula landfill is not a significant source of arsenic to adjacent aquatic environments. The sediment results do not provide a sufficiently sharp picture of the distribution of arsenic on the south Moloka'i reef flat to determine a probable source. Additional measurements on the sediment samples need to be undertaken to determine if the arsenic is associated with particular fractions or properties of these sediments. Samples in this study ranged from relatively clean, fine sands to organic-rich silts. Concentrations in reef flat and fish pond sediments were not high compared with sediments measured by many years ago by the Department of Health from bays and estuaries around Hawaii. Results ranged from <4 to 20 ppm, excluding Hilo Bay where the level was 675 ppm (DOH, 1978). Reservoir sediments on Oahu from a non-agriculture area ranged from 2 to 17 ppm (*AECOS*, 1984); and sediments in Kahana Stream ranged from 3 to 12 ppm, while Kahana Bay sediments were found as high as 29 ppm (Lau, et al., 1973).

The arsenic might be coming from natural deposits in the volcanic soils or from uses (primarily as a pesticide) on the watershed. The fact that sediment concentrations tend to be higher off the mangrove wouldt seem to point to agriculture on Moloka'i as the source because the major agricultural areas mostly drain towards the shore between Pakanaka Fish Pond and Kalama'ula. However, arsenic seems to concentrate in certain marine and estuarine sediments as a consequence of the chemical properties of the sediments. In Lake Michigan, Seydel (1972) found that the type of sediment and its ability to bind arsenic explained sediment arsenic distribution better than a knowledge of local pollution sources. A similar phenomenon may be occurring off Moloka'i: the input of arsenic from the land might be fairly uniformly distributed, but the arsenic accumulates in certain types of sediments which are more typical of the reef flat off the mangrove coast than elsewhere.

This study looked at limu (marine algae), *he'e* or *tako* (octopus), and several species of sand bottom crabs in an attempt to describe the distribution of arsenic in commonly eaten reef organisms. Only the crabs showed consistently high levels of arsenic. Although additional samples of bottom feeding fishes (such as goatfishes) might reveal another pathway of bioaccumulation leading to man, the limited results obtained to date do not provide indication that the flesh of fishes caught off Moloka'i have elevated levels of arsenic. Fishes are known to rapidly excrete organoarsenicals (Penrose, 1974).

Two other questions are important when considering arsenic in animals utilized as food by man: 1) where in the animal's body does the arsenic occur, and 2) in what chemical form is the arsenic present?. A small number of tests conducted on crabs for this study suggest that the arsenic in blue-pincher crabs is found mostly in the soft tissues, and perhaps mostly in the muscle tissue (that is, the tissue preferred for eating).

Crustaceans are known to concentrate arsenic in many parts of the world, and arsenic concentrations in seafood from Moloka'i is not unusually high when compared with concentrations found in some commercial shrimp and lobster (28 to 30 ppm). The arsenic in these crustaceans is present as organic forms (mostly arsenocholine) that are readily excreted by the human body. Over 80% of the arsenic may occur as arsenocholine. Attempts are underway to measure organoarsenicals in crabs from Moloka'i to confirm that these crabs have the same high proportion of non-toxic arsenic as described in the literature.

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APPENDIX I

STATE DEPARTMENT OF HEALTH LETTER REGARDING ARSENIC CONTAMINATION ON MOLOKAI

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

In reply, please refer to:
File: EMD CWB
M0304EA

OFFICE OF
THE MAYOR
MAYOR
RICHARD X
SHERI
DAVE
NOLAN
GEORGINA
PAMELA
[illegible]
GEORGE X
[illegible]
CHARMAINE
GUY
SECTY
TODAY'S DATE 3/15
DATE DUE 3/18
BY

DEPT OF
PUBLIC
WORKS
DIRECTOR ☐
DEP. DIR. ☐
PERS. ☐
STAFF OE ☐
LUCA ☐
WW RECL. ☐
DFW SOLID W. ☑
ENGR. ☐
HWYS. ☐
SECTY. ☐

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March 5, 1993

The Honorable Linda Crockett Lingle
Mayor, County of Maui
Office of the Mayor
County of Maui
Wailuku, Maui, Hawaii 96793

Dear Mayor Lingle:

This is in response to your letter of February 16, 1993, regarding your concerns on the arsenic contamination on the Island of Molokai. We have reviewed the findings of arsenic levels on Molokai and have concluded that the levels do not represent a serious public health problem.

3/16

Our State survey has shown that the arsenic concentrations and distributions, including other metals, are highly variable in the nearshore marine sediments and biota. The tests on some fish and crab samples have recorded arsenic similar to levels found at Molokai.

With respect to the public health concerns, the scientific literature indicates that arsenic in elevated amounts consist primarily the organic fraction that is relatively harmless. The potentially toxic inorganic form may range between 2 - 10 percent of the total arsenic. The remainder of arsenic is highly stable and physiologically inactive form.

We appreciate your concerns over the landfill and the potential impact of toxic contaminants in the environment. Although it may be desirable to have additional studies to locate the potential source of arsenic or other leachate or runoff-associated contaminants in the area, we are constrained by our limited resources on further studies at this time.

If you wish further information on this matter, please contact Mr. Denis Lau, Chief of the Clean Water Branch, at 586-4309.

Sincerely,

Bruce S. Anderson

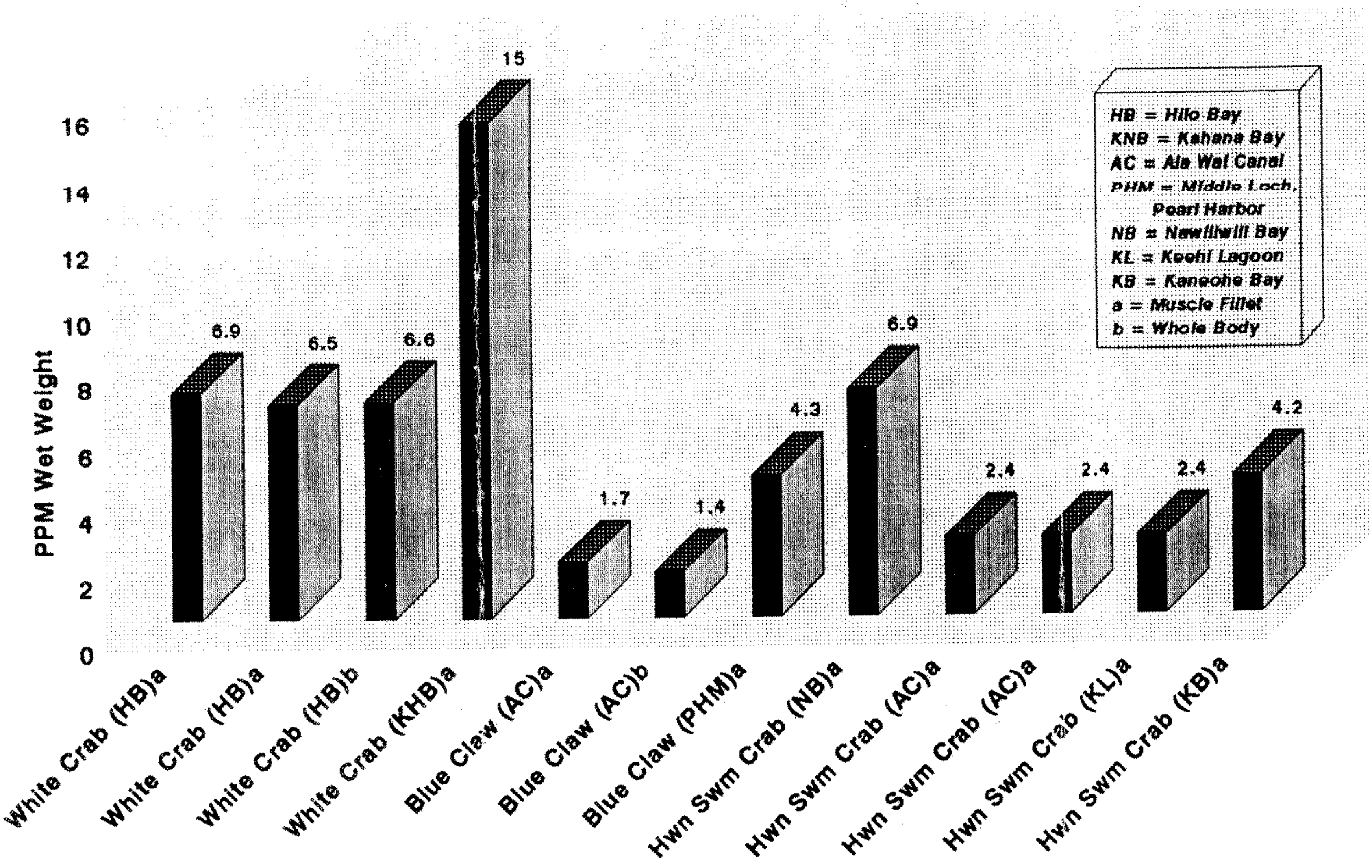
BRUCE S. ANDERSON, Ph.D.
Deputy Director for
Environmental Health

ETA/rg

Enclosures: Arsenic Concentrations in Crab, 1991
Arsenic Concentrations in Fish, 1991

Arsenic Concentrations in Crab, 1991

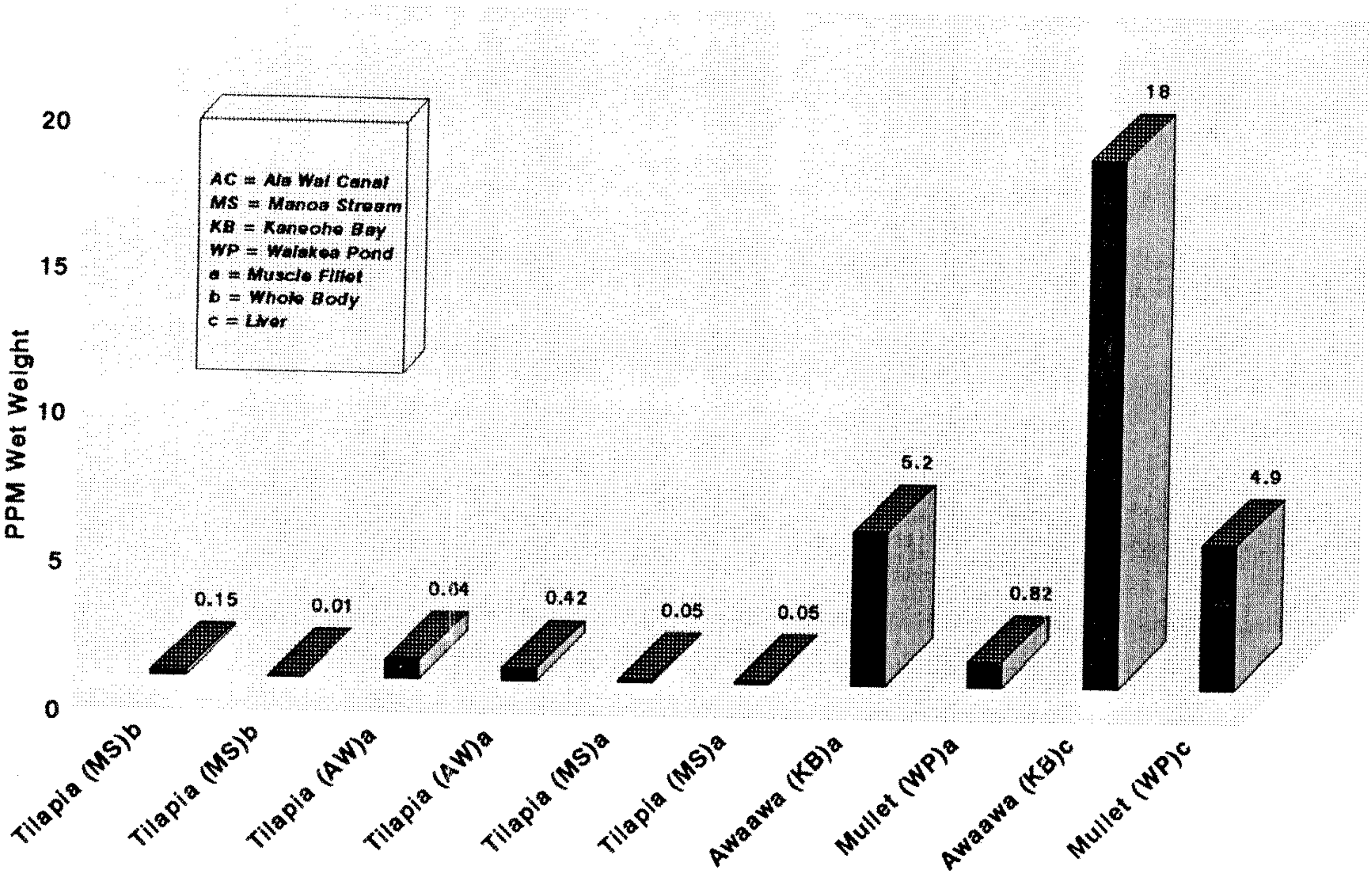
White Crab (Portunus sanguinolentus)
Blue Claw Crab (Thalamita crenata)
Hawaiian Swimming Crab
(Podophthalmus vigil)



Source: Department of Health Toxics Monitoring Program.

Arsenic Concentrations in Fish, 1991

Tilapia (Tilapia mosambique)
Mullet (Mugil cephalus)
Awaawa (Elops Hawaiiensis)



Source: Department of Health Toxics Monitoring Program.

APPENDIX J

ARCHAEOLOGICAL TECHNICAL REPORT

ARCHAEOLOGICAL INVENTORY SURVEY OF THE MAUNA LOA BORROW SITE AND OHIPILI POND PROJECT AREAS FOR THE KALAMAULA LANDFILL ON WEST MOLOKA'I, HAWAI'I

Submitted to:

Brown and Caldwell Consultants
485 Waiale Drive
Wailuku, Hawaii 96793

Prepared by:

William Shapiro, Paul Cleghorn, Rey Quebral, and Lisa Shapiro
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1051 Keolu Drive, Suite 104-B
Kailua, Hawaii 96734
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May 1993

J-4042

Printed on recycled paper

EXECUTIVE SUMMARY

BioSystems Analysis, Inc., conducted an archaeological inventory survey for a proposed wetland mitigation of the Ohiapili Pond (TMK 5-2-11; c. 32 acres) and the potential Mauna Loa Borrow Pit (TMK 5-1-2:32; c. 40 acres) which will be used as cover material for the Kalamaula Landfill in West Moloka'i. The survey was done from January 12-16, 1993 at the request of Brown and Caldwell Consultants to determine if potentially significant archaeological resources were located within the project areas prior to development.

A surface survey of an additional 10 acres adjacent to the original 40-acre Mauna Loa Borrow Pit locale was conducted on 20 April 1993. The results of this survey are presented in Appendix B.

The proposed wetlands mitigation project requires review and permitting from the Army Corps of Engineers (COE), and has the potential to affect historic properties. Therefore, the project is subject to Section 106 of the National Historic Preservation Act of 1966, as amended. This report was prepared to comply with Section 106, which requires Federal agencies to "...take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. The head of any such Federal agency shall afford the Advisory Council on Historic Preservation...a reasonable opportunity to comment with regard to such undertaking" (16 U.S.C.§ 470f). Section 106 is met by following the provisions of 36 CFR Part 800.

During the archaeological survey of the Area of Potential Effects, BioSystems' archaeologists identified a possible religious complex with multiple features, and a basalt lithic scatter within the Mauna Loa Borrow Pit site area. This site is recommended as eligible for the National Register of Historic Places under 36 CFR 60.4(d) since it has the potential to yield information significant for our understanding of traditional culture, history, prehistory, and/or foreign influences on traditional culture and history. The resource may also be significant under proposed Criterion E, a criterion applied in the state historic preservation review process, which applies to sites perceived by the contemporary community as having traditional cultural value. BioSystems recommends avoiding this resource and advises monitoring the initial ground disturbance within the borrow pit site. If the site can be avoided, the undertaking will have no effect on this historic property.

Results of the core samples from the Ohiapili Pond did not indicate any cultural deposits or datable material. It was hoped that materials from the cores could indicate when the pond may have been utilized. Although no cultural material was identified within the cored areas of Ohiapili Pond, submerged and buried cultural materials may be present in the area. If such deposits are present, then Ohiapili Pond may be significant under 36 CFR 60.4(d) for its potential to yield information to our understanding of traditional culture, history, and prehistory. Prior to any ground alterations within the Ohiapili Pond, additional core sampling of the disturbance area is recommended. This should ensure that cultural deposits will not be affected, or if such deposits are encountered, that they can be studied prior to damage or destruction. This recommendation constitutes a plan for unanticipated discoveries consistent with 36 CFR 800.11.

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1.0 BACKGROUND

1.1 INTRODUCTION

The project area consists of two locations in West Moloka'i, Hawai'i: the Mauna Loa Borrow Site and the Ohiapili Pond. The Mauna Loa Borrow Site is located approximately 5 mi. west of the Moloka'i Airport adjacent to and north of the Mauna Loa Highway, Route 460 (Figure 1). This potential borrow pit site is planned for use as cover material at the existing Kalamaula Landfill in Kaunakakai. The Ohiapili Pond is located approximately 2 mi. west/northwest of Kaunakakai and is adjacent and northwest of the Kalamaula Landfill (Figure 2). The project areas depicted in Figures 1 and 2 comprise the area of Potential Effects (APE), which are the areas within which the undertaking may cause changes in the character or use of historic properties (36 CFR 800.2(c).

Brown and Caldwell Consultants requested an archaeological survey of the two project areas in order to assess any potential adverse impacts the proposed development (i.e., soil excavation activities and the wetland enhancement) may have on archaeological resources. The State Historic Preservation Division requires that an archaeological inventory survey be conducted on lands proposed for development as part of the permitting process. An archaeological inventory survey is the first step in treating archaeological resources that may be present in a project area. The purpose of an archaeological inventory survey is to determine if potentially significant archaeological resources are located within a project area prior to development. If potentially significant resources are present, then a set of procedures must be implemented to manage these resources to mitigate any adverse effects of proposed development.

As stated in the proposal (BioSystems 1993: 2-3), the archaeological inventory survey included the following tasks:

- a synthesis of previous archaeological research that has been conducted in the area;
- limited archival research including review of historic documents and maps pertinent to the project;
- a pedestrian survey over the two project areas to locate archaeological sites;
- recording of archaeological sites by written descriptions, scaled plan maps, photo documentation;
- limited subsurface coring of Ohiapili Pond to determine if cultural materials are present within the deposit;
- laboratory analysis of core samples and collected artifacts with the goal of determining site chronology and function; and
- preparation of the summary and final reports to be included in the draft environmental impact statement for the County of Maui.

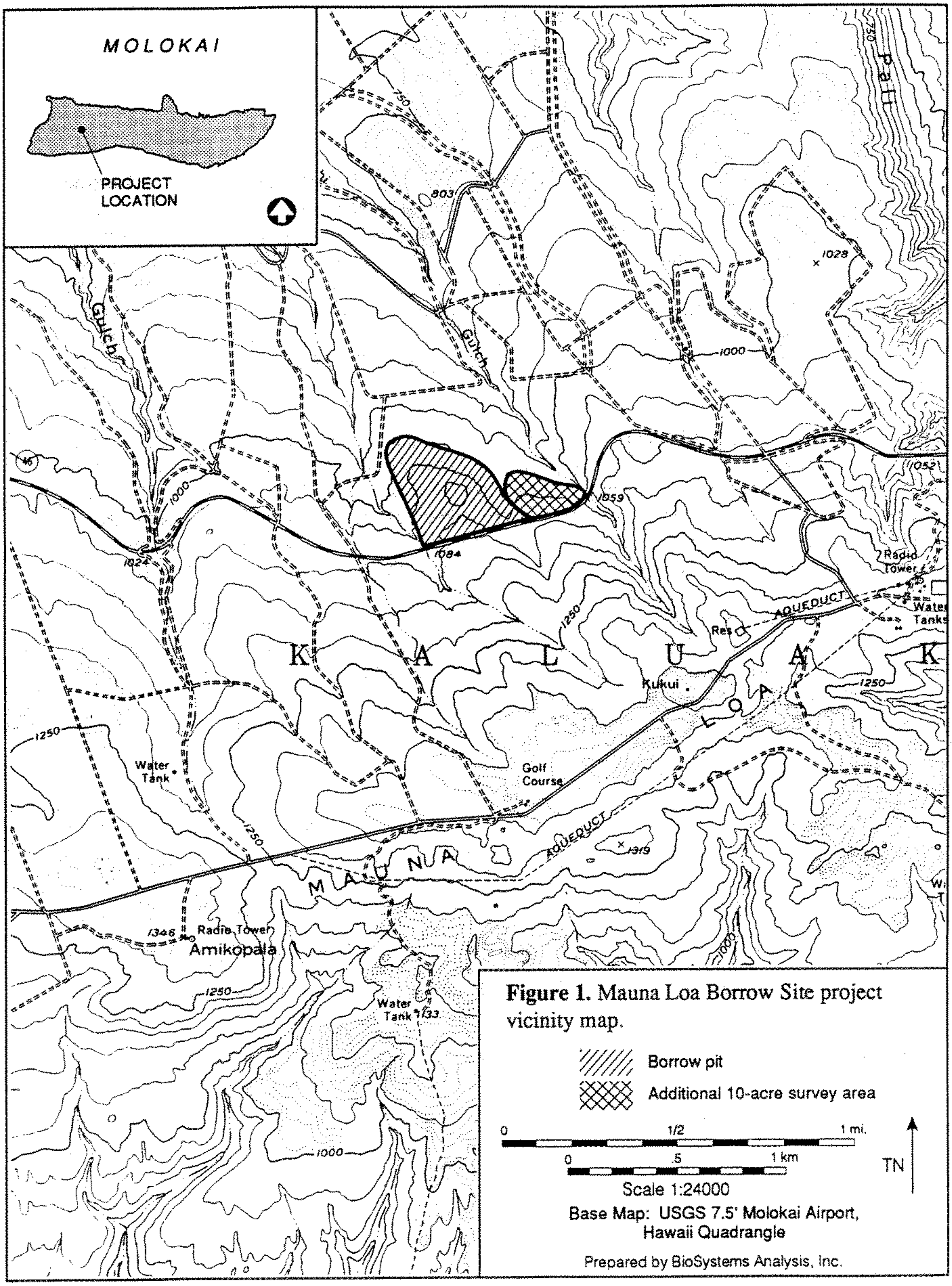

Figure 1. Mauna Loa Borrow Site project vicinity map.

Base Map: USGS 7.5' Molokai Airport, Hawaii Quadrangle

Prepared by BioSystems Analysis, Inc.

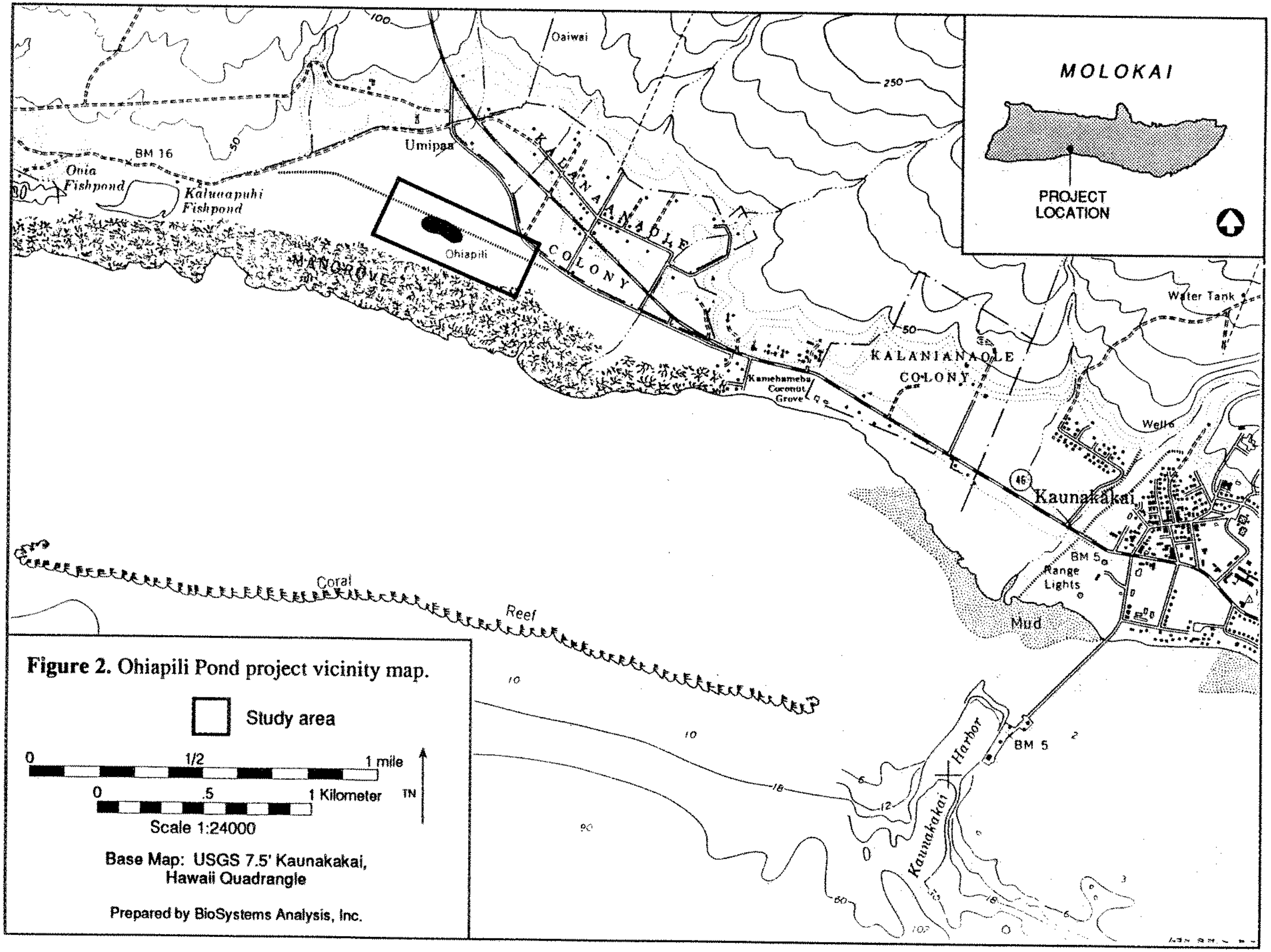

Figure 2. Ohiapili Pond project vicinity map.

Base Map: USGS 7.5' Kaunakakai, Hawaii Quadrangle

Prepared by BioSystems Analysis, Inc.

The archival, field, and laboratory tasks were oriented towards recovering enough data so that the significance of the archaeological resources within the project areas could be assessed in terms of National Register of Historic Places (NRHP) and State Register criteria. An initial site significant assessment is included in this report.

Several personnel were involved with the fieldwork and report preparation. Dr. Paul L. Cleghorn acted as the Principal Investigator and project manager. Dr. Cleghorn, who has over 19 years of archaeological experience in Hawai'i, was responsible for all aspects of the work. He spent one day in the field, and also contributed to the summary and final reports. William Shapiro served as Project Director and was present in the field 100 percent of the time. Mr. Shapiro coordinated the analysis of the core samples from Ohiapili Pond, and co-authored the summary and final reports. He has an M.A. degree with over 14 years of archaeological experience, including two years of directing fieldwork in Hawai'i. Rey Quebral conducted and wrote the historical and background research sections for this report. Robert Jackson, Senior Archaeologist in BioSystems' Sacramento office, greatly assisted in legal compliance sections of the report. Archaeological field technicians included James Brendt and Tim Coleman, each of whom has extensive experience in Hawaiian archaeology. Mr. Walter Mendes from Moloka'i acted as Community Monitor and assisted with the fieldwork. Report production, including word processing and editing, was organized by Pete Woodside in BioSystems' Santa Cruz office. Final drafting and illustrating was done by Mary Engbring in Santa Cruz.

2.0 HISTORICAL BACKGROUND

Historical background investigations of the two study areas, Ohiapili Pond (TMK 5-2-11:1; ca. 32 acres) and Mauna Loa Borrow Site (TMK 5-1-2:34; ca. 40 acres) reveals a minimal amount of land ownership transaction and land utilization over the past century, despite recent homestead development in the surrounding areas. Archival research does not indicate that the study areas are historically significant, other than their association to the unique island of Moloka'i and its rich traditional and post-contact history. However, a previous archaeological study conducted near the Mauna Loa Borrow Site may link it to the 'Amikolapa Quarry Complex.

2.1 TRADITIONAL HISTORY

Summers (1971), Athens (1985) and Tomonari-Tuggle (1990) have provided well documented presentations of the traditional history of Moloka'i. A brief overview of Molokai's traditional history incorporates their summaries.

Molokai's traditional history highlights great prophets and counselors rather than politically powerful *ali'i*. Between the 13th and 17th centuries, Moloka'i's political strength, if any, was due mainly to marriage ties with *ali'i* of other islands (Summers 1971:11-15).

After the 13th century reign of Kamauaua, the first *ali'i-nui* of Moloka'i, internal warfare began between the *ali'i* of Ko'olau and Kona—traditional district designations of Moloka'i (Summers 1971:11; Tomonari-Tuggle 1990:9). The prehistoric economic viability of the southern coast's rich fishing grounds probably provoked the conflict and warfare between the two chiefdoms (Athens 1985:6).

By the end of the 18th century, more than 360 [fish] ponds were owned by high chiefs alone. Hawaiian royalty owned the largest and most carefully constructed fish ponds. Ownership of a fishpond was one of the status symbols in ancient Hawaii (Dept. of Education 1986:1).

The lack of water and other natural resources also helped sway emphasis onto the rich Moloka'i fishponds. The chief agricultural produce of Moloka'i was sweet potato, which was grown throughout the island but mainly on the slopes of Mauna Loa, the plains of Ho'olehua and the fields of Kalama'ula (Athens 1985:8; Summers 1971:38). By the late 17th century, the internal divisions and quarrels—significantly but indirectly influenced by the rich fishponds and fishing grounds—drove the *ali'i* of Moloka'i to seek outside support from other islands (Summers 1971:15). The opening up of Moloka'i to outside influence eventually led to the conquest of Moloka'i by the *ali'i* of other islands.

The conquest of Moloka'i during the 18th century was devastating. Because Moloka'i had a rich resource base and a relatively small population, warring *ali'i* of other islands saw Moloka'i as an attractive target to seize and control (Tomonari-Tuggle 1990:9). Moloka'i fell to the rule of the three largest islands: Peleioholani of O'ahu, Kahekili of Maui (with the help of Ka'eokulani of Kaua'i), and Kamehameha of the island of Hawai'i (Summers 1971:18-20). In 1790 Kamehameha's invasion of Moloka'i decimated the countryside and two years later Moloka'i still "had not yet recovered its former state of population" (Menzies in Summers 1971:19). After a brief reoccupation by Kahekili, Kamehameha regained Moloka'i in 1795 and by the early 19th century all of the islands were united under one ruler and have remained so since then.

While the earlier ruling *ali'i* of Moloka'i did little to enhance their island's political viability, Moloka'i gained a widespread reputation as having powerful and revered *kahuna*. The latter part of the 16th century gave rise to a famous prophet named Lanikaula, who was widely respected and sought by people from all of the islands (*ibid*.:13). In one memorable incident, Kamalalawalu, the king of Maui, decided to invade the island of Hawai'i. Under pressure to please the king, other *kahuna* foretold of favorable outcome while only Lanikaula insisted that Kamalalawalu and his men not proceed. Lanikaula's persistence infuriated Kamalalawalu, who was determined to conquer, and the king's parting words to Lanikaula were: "When I return I will burn you alive" (Fornander in Summers 1971:13). The king did not return.

It is likely that the small number of inhabitants of Moloka'i cultivated the reputation of their powerful *kahuna* and relied heavily on the fear their *kahuna* inspired to prevent enemy attack (Cooke 1949:124). Consequently,

> ...Moloka'i gained the reputation of having one of the strongest schools of sorcery, which instilled fear in the people of the other islands. From this came the saying "*Moloka'i pule o'o*" (Moloka'i of the potent prayers), a "figurative reference to Moloka'i's fame in sorcery." (Summers 1971:15)

Legends of Moloka'i not only successfully instilled fear of sorcery, they also perpetuated respect and appreciation of the *kahuna*. The traditions of Moloka'i live on through these legends.

2.2 POST-CONTACT HISTORY

The post-contact history of Moloka'i is as rich as its traditional history. "Moloka'i's contact with the western world began in 1778 when Captain James Cook sighted the island on November 26" (Cook in Deloach 1970:124-125). During the subsequent centuries, western influence changed the lives of the people of Moloka'i through introduced crops, fauna, diseases, and written laws.

After western contact, agricultural markets changed drastically. With the introduction of a moneyed economy, Moloka'i searched for a suitable cash crop (Deloach 1970:130). Sugar, tobacco, honey, white potato, corn, grapes and cotton were grown but each eventually failed (*ibid*.:131-133). Finally, with the coming of the pineapple industry in 1923, Moloka'i's economy began to boom and its population increased at a growth rate of 508 percent from 1920 to 1935 (*ibid*.:135).

As the human population increased, so did the population of introduced fauna. The early popularity of cattle ranching brought about the introduction of numerous breeds of cattle, sheep and deer. In January, 1868, axis deer were brought to Moloka'i by Kamehameha V and soon after became established at Kaluako'i where they are hunted even today (KHSAC 1987:19). In addition, numerous safari animals were brought over to populate a wildlife preserve.

The leprosy settlement on the Kalaupapa Peninsula of Moloka'i is a constant reminder of the devastating impact of western contact with the indigenous people of Hawaii. Leprosy, influenza, scarlet fever, whooping cough, bubonic plaque, mumps, measles and tuberculosis caused epidemics throughout the islands of Hawaii (Nordyke 1977:17-18). The indigenous people of Hawaii were easy victims of contagious illnesses because they possessed no natural immunity to the diseases of Westerners (*ibid.*:17). By conservative estimates, from 1778 to 1835 the indigenous Hawaiian population decreased approximately 50 percent and continued to decline steadily for nearly a century after contact (Atlas of Hawaii 1973:99,105).

The advent of written laws also impacted life in the Hawaiian Islands. With the Great Mahele (land redistribution) in 1849, "the ownership of land by *alii*...formally changed to a legal division of land among government, *alii*, and *maka'ainana* (commoners)" (Nordyke 1977:115). In 1921, the Congress of the United States passed the Hawaiian Homes Commission Act to make more land available for the indigenous people of Hawaii (Summers 1971:25). Under the authority of the Hawaiian Homes Commissions Act, the Kalaniana'ole settlement colony was established in Central Moloka'i (Athens 1985:10).

2.3 OHIAPILI POND (KALAMA'ULA)

Ohiapili Pond (TMK 5-2-11:1) lies on the south shores of Kalama'ula Ahupua'a. Kalama'ula was claimed as crown lands by Kamehameha III during the Great Mahele (Athens 1985:10). Review of early land survey maps and canceled tax maps revealed no Land Commission Award for Kalama'ula other than LCA 11095, a small 10.02 acre award outside the study area (Tomonari-Tuggle 1983:4). Through the Hawaiian Homes Commission Act of 1921, tax map key Parcel 1 (inclusive of Ohiapili pond) was controlled by the Hawaiian Homes Commission. According to the tax history sheet for Parcel 1, Hawaiian Homes Commission placed Parcel 1 under the control of Hawaiian Home Lands. Ohiapili Pond and the surrounding parcel still remain under the control of Hawaiian Homes Land.

July 1922 marked the successful beginning of the first Hawaiian Homesteads at the Kalaniana'ole settlement in Kalama'ula (Summers 1971:25). In 1924 the Kalaniana'ole fields were thriving but by 1930 the saline level in the soil (from pumped irrigation water) caused a significant decline in the area's agricultural productivity (Deloach 1970:136). However, according to the Land Study Bureau, ca. 1959 Ohiapili Pond (situated on the shoreline area of Kalama'ula) lies on Class A land—classified as well suited to intensive agriculture (University of Hawaii 1959:5). Despite the hardships due to decreased agricultural productivity, the Kalaniana'ole settlement developed into a fairly populated residential area.

Ohiapili Pond does not appear on survey maps of Moloka'i until 1959 (Monsarrat 1886; USGS Maps 1922, 1952, 1959; O'Neal 1915). In contrast, the nearby fishponds of Kakokahi and

Ohia'pilo appear labeled or featured on every survey map of Moloka'i except the 1959 USGS map. According to Summers (1971:84), both Kakokahi (ca. 20 acres) and Ohia'pilo (ca. 39 acres) fishponds were mud filled.

It is not known whether Ohiapili Pond was stocked with fish or used for agricultural purposes. In a study conducted by Russel Anderson Apple and William Kenji Kikuchi (1975), Ohiapili Pond was not among the fishponds considered worthy of preservation. In that study, the fishponds that were judged to have deviated the least from their original working conditions were given the highest value rating for preservation. Most of the highly valued fishponds were located on the Southeast or Eastern shores of Moloka'i (Apple and Kikuchi 1975:3,142). Ohiapili Pond, if at all used as a fishpond, was never used intensely. However, it may still be part of the system of fishponds discussed by Kikuchi:

> Strung along the southern shore of Moloka'i are a series of prehistoric fishponds whose remains can still be seen within the calm shoal waters. These remnants are only a fraction of the extensive aqua-cultural system that was evident on all of the major inhabited islands of the Hawaiian Archipelago around the turn of the century...quite recently fishponds have been filled and destroyed by commercial and industrial development. Some of the sites are now fringed with houses and industrial parks—foreign and incompatible environments that exhibit these sites as oddities, fossils of the past. (Kikuchi 1976:295)

2.4 MAUNA LOA BORROW SITE (KALUAKO'I)

Mauna Loa Borrow Site (TMK 5-1-2:34, ca. 40 acres) lies on Kaluako'i lands formerly owned by King Kalakaua. "In 1848, at the time of the Mahele, the lands of Kaluako'i [Apana] 1 and 2 became government lands" (KHSAC 1987:17). Subsequently, in January, 1875, Kalakaua granted (through Royal Patent 3146) ca. 46,500 acres of Kaluako'i lands to Charles Reed Bishop for five thousand dollars. According to Monsarrat's 1886 map of Moloka'i, the Mauna Loa Borrow Site was included among the lands granted to Charles R. Bishop. On November 14, 1893, Kaluako'i lands of Grant 3146 was granted to the Estate of Bernice Pauahi Bishop by Charles R. Bishop and Co. (B.C. Libre 146:12). According to George Paul Cooke (1949:2), Molokai Ranch, formed by a group consisting of Judge Alfred S. Hartwell, Alfred W. Carter, and A.D. McClellan, purchased 70,000 acres of fee simple land from B. P. Bishop. Kaluako'i land was among the lands purchased. On February 5, 1898, various parcels of land, leasehold, and livestock were granted (by deed) to Molokai Ranch Co. Ltd. from the Estate of Bernice P. Bishop (B. C. Libre 177:170; also Kent 1965:170). Through Land Court Application 1683, Molokai Ranch Co. Ltd. subdivided the lands owned on Kaluako'i into smaller lots. Since February 10, 1981, Molokai Ranch Co. Ltd. has been listed as the owner of Lot 118 (155.371 acres), which bounds the Mauna Loa Borrow Site.

Kaluako'i is both the name of a district and the largest *ahupua'a* on the island of Moloka'i (Alexander in Hammett 1978:7). Vancouver (Deloach 1970:124) describes West Moloka'i (in contrast to East Moloka'i) as showing "...gradual decrease in population, uncultivated, barren soil." In explaining the settlement of the dry and desolate areas of West Moloka'i (inclusive of Kaluako'i), Bonk (n.d.:139) suggests that "fishing and the quest for adze stone brought people into the area". Numerous fishing shrines and adze quarries support Bonk's view (Summers 1971, Dye et al. 1985). However, emphasis on fishing and adze making gave way to cattle ranching after western contact.

The introduction of cattle coupled with royal interests soon brought cattle ranching to the grazing lands of Kaluako'i. Kamehameha IV first established a sheep ranch here in 1859 while Kamehameha V started a cattle ranch (Deloach 1970:128). Cattle raising, which grazed off a large percentage of the entire island and practically all of the west end, was the major industry until the coming of the pineapple industry in 1923 (Bottenfield 1958:90-91; Deloach 1970:135). The Mauna Loa pineapple fields lie within the boundaries of a cattle ranch, and the area generally consists of arid trees formerly considered suitable only for the grazing of cattle and sheep (Norbeck 1959:16).

In the 1920s the growth of the pineapple industry instigated the lease of large tracts of land on West Moloka'i for cultivation. As Cooke (1949:3) states, "Since 1920, we have leased seven thousand, two hundred forty six acres to Libby, McNeill and Libby on Kaluakoi...for the raising of pineapples". Also,

> The Libby lease was executed January 1, 1923. This lease allowed Libby to use any of the lands of Kaluako'i above the five hundred ft. level, on a per acre basis. In February, 1923, the first field of nine hundred seventy seven acres was broken on Mauna Loa. (*ibid.*:90)

Although Mauna Loa Borrow Site is located above 500 ft. ASL (meeting the altitude requirement of the Libby lease), canceled State of Hawaii tax maps show that it was circumvented by the pineapple industry. From 1923 onward the area inclusive of the Mauna Loa Borrow Site was not leased for pineapple growing. According to the Land Study Bureau, ca. 1959 Mauna Loa Borrow Site lies on Class C land classified as marginally suited for intensive agriculture while the Mauna Loa pineapple fields lie on Class B land considered moderately suitable for intensive agriculture (University of Hawaii 1959:5).

During and for a short time after World War II the U.S. Armed Forces used the west end of Moloka'i as a bombing range and for military maneuvers. These activities resulted in widespread destruction to the Kaluako'i area (KHSAC 1987:19).

2.5 PREVIOUS ARCHAEOLOGICAL WORK

The large number of archaeological studies done on the island of Moloka'i is mainly due to the abundance of archaeological sites found throughout the island as depicted in the lengthy inventory provided by Summers (1971). Archaeological sites found and added to the National Register of Historic Places range from clusters of mounds to massive *heiau* complexes. Because of this abundance of studies and sites, a summary table of selected previous investigations regarding relevant archaeological work has been included (Table 1). Its purpose is to provide a sample of the studies near the project study areas.

The earliest radiocarbon dates for archaeological sites in the Kalama'ula region date back to the latter part of the developmental period—ca. A.D. 600-1100, while the earliest dates in the Halawa region date back to the latter part of the colonization period—ca. A.D. 500-600 (Weisler 1989:125). The earliest radiocarbon dates for the Kaluako'i region date back to the early expansion period—ca. A.D. 1100-1400. However, dating limitations seem to be prevalent in most of the archaeological studies. Athens (1985:99) suggests more empirical research, excavation and dating of sites should be conducted in order to establish an adequate basis for interpretation.

2.6 KALAMA'ULA

Previous archaeological investigations in Kalama'ula and adjacent *ahupua'a* include studies by EISC (1980, 1981), Tomonari-Tuggle (1983, 1990), Athens (1985), Hommon and Ahlo (1985). The studies conducted by EISC (1980, 1981) and Tomonari-Tuggle (1983), located in areas relatively close to Ohiapili Pond and most likely to yield similar finds, are discussed below.

Tomonari-Tuggle (1983) conducted a reconnaissance survey of a road corridor mauka of Ohiapili Pond and Kalaniana'ole colony homestead. In her survey, she found three sites: the closest being a historic cattle wall already impacted by the formation of a dirt road (Site 803), a complex of walls, terraces and cairns later excavated by Athens in 1985 (Site 800), and a group of cairns with a short amorphous wall (Site 801). Athens (1985:97) concluded that Site 800 was utilized for habitation and agriculture. The site was utilized for agriculture from A.D. 1400 and used for habitation until A.D. 1750. Athens also notes the likelihood that the site was temporary used as a shelter in A.D. 1155.

Environment Impact Survey Corp. (1980, 1981) conducted studies on Lot 31 and 32, located just northwest of the Ohiapili Pond study area. Two sites were located on Lot 31: a small series of terrace fragments with possible associated agricultural clearing mounds, and a possible stacked wall structure in poor condition (EISC 1981:11-12). No further archaeological work was recommended for these sites. Two sites were located on Lot 32, located adjacent to Lot 31 but slightly further away from the study area: a pecked petroglyph resembling an inverted "L" and an enclosure roughly measuring 32 m by 28 m (EISC 1980:4). The highly dilapidated enclosure contained scatterings of midden and various types of coral with a yellow glazed pottery sherd with hand-painted flowers near its makai wall. The enclosure is further described as having walls:

> constructed of stacked core-filled construction, of which the makai and mauka walls have been damaged. Largely intact portions of the wall measure up to 90 centimeters (cm.) high and 60 cm. wide, with the sides and base consisting of large flat slabs with internal fill, while the top has larger stones and fill. The wall is perpendicular, with care taken to present a smooth internal facing. (EISC 1980:5)

Table 1. Selected Previous Archaeological Work Near Current Study Areas

Project Location/Date	Scope of Field Work	Area Covered	Results and Recommendations	Author/ Date
KALAMA‘ULA				
Lot 32, Na‘iwa, Central Molokai, TMK:5-2-11:7; August 1980	Reconnaissance survey	50 acres or 20.3 hectares	Located a petroglyph and a large enclosure (possibly the missing Piliwale Heiau); no dates	EISC 1980
Lot 31, Na‘iwa, Central Molokai, TMK:5-2-11:29; March 1981	Biological and archaeological reconnaissance survey	90 acres or 36.5 hectares	Located two sites: a small series of terrace fragments and a possible stacked wall; none of the biota inventoried are rare or endangered species; no dates	EISC 1981
Kalaniana‘ole Colony (West), Kalama‘ula, TMK:5-2-10:1; Jan. 1983	Reconnaissance survey	ca. 2.6 - 3.9 acres or 1.1 - 1.6 hectares	Three sites located: a complex of walls, terraces and cairns (Site 50-60-03-800); a group of seven cairns and a short amorphous wall (Site 801); and a probable historic cattle wall (Site 802); no dates	Tomonari-Tuggle 1983
Site 50-60-03-800, Upland Kalama‘ula, Central Molokai; Aug. 1984 - Jan. 1985	Intensive survey, instrument mapping, excavations, monitoring	?	Temporary A.D. 1155 use of site, agricultural use from A.D. 1400 to historic period, habitation ended prior to A.D. 1750; more empirical research, excavation and dating of sites needed to provide an adequate basis for interpretation.	Athens 1985
Kalama‘ula, Kapa‘akea, Kamililoa and Makakupaia, Molokai, Nov. 1982 - Feb. 1983	Reconnaissance survey	7,275 acres or 2,945 hectares	Recorded 71 sites and 212 individual features (203 of these features are of indigenous origin); only one probable fireplace (Fe. 921-A) found -- possible dating limitations; believed 57 sites qualify for National Register of Historic Places	Hommon Ahlo 1985
Upland Kalama‘ula, Central Molokai, TMK:5-2-8, 5-2-9 and 5-2-10; Oct. - Nov. 1989	Inventory survey	ca. 300 acres or 121.5 hectares	Identified 54 sites and site complexes, including 170 discrete features and 41 sets of features not individually counted; C13/12 calibrated date ranges are: Site 1711 (semi-enclosure) A.D. 1450-1676 (84% probability), and Site 1716 (habitation terrace) A.D. 1718-1814 (44%)	Tomonari-Tuggle 1990

Table 1. Continued.

Project Location/Date	Scope of Field Work	Area Covered	Results and Recommendations	Author/ Date
KALUAKOʻI				
West Molokai; June - Sept. 1952	Research excavations and study	?	Excavated nine sites: six rock shelters, two house sites and one camp site; cultural remains support prehistoric origins and occupation but charcoal samples collected were not yet dated	Bonk 1954
Kaluakoʻi, West Molokai, TMK:5-1-03:various parcels; June 1974	Walk-through (preliminary) survey	?	Located a historical site (brick walls, cement foundations, etc.) and nine archaeological complexes (multiple enclosures, platforms, curved wall structures, lithic workshops, cairns, a previously recorded *heiau*, and a cave shelter); no dates	Cleghorn 1974
Coastal segment, Kaluakoʻi, West Molokai, TMK:5-1-3:1,3; Oct. 1978	Inventory survey	92+ acres or 37.2+ hectares	15 sites recorded, with salvage excavation recommended for 10 of these sites including Site 38 [identified as a *heiau* by Summers (1971)]; no dates	Hammatt 1978
Sites 50-60-01-38, 1606, and 1607 of Kawakiu-Nui, Kaluakoʻi, West Molokai, TMK:5-1-02; Dec. 1978 - Jan. 1979	Salvage excavations	?	Refuted Site 38's function as a *heiau*, appears to be a habitation dwelling with two phases of prehistoric occupation; over 500 artifacts, most associated with all stages of fishhook manufacture, were collected; determined Site 1606 to be a stone enclosure of brief historical occupation, Site 1607 an enclosure and platform; basaltic glass hydration rind measurements yield dates for: Site 38, ca. A.D. 1750 - 1815, Site 1606 ca. A.D. 1805	Hammatt 1979
Kawaʻaloa Bay, Moʻomomi, West Molokai, TMK:5-1-02:1*; July 1981	Reconnaissance survey	20 acres or 8.1 hectares	No archaeological sites were found in survey area; adjacent proposed access road area contained cultural deposits (Site 50-Mo-B6-80) of possible prehistoric age; no dates	Schilt and Shun 1981

Table 1. Continued.

Project Location/Date	Scope of Field Work	Area Covered	Results and Recommendations	Author/ Date
Site 50-Mo-B6-80, Mo'omomi, West Molokai TMK:5-1-02:1; Oct. 1982	Survey, map, record stratigraphy, collect artifactual, faunal, and carbon samples; also survey 4 acres of surrounding area	4+ acres or 1.6+ hectares	Relocated two previously noted cultural strata and found a slab-lined hearth (associated with midden/lithic scatter) and a "scoop" hearth; assessed Site B6-80 as significant; corrected C14 date range is A.D. 1505-1950	Collins 1983
Sites 50-Mo-B5-29, 34, 40, and 43 of the 'Amikopala Quarry Complex, Mauna Loa, West Molokai, TMK:5-1-02:4; June 1985	Clear three sites, map and photograph four sites, excavate portion of a stone-lined hearth (Site B5-29), make research collection of tools and debitage from adze manufacture	2+ acres or 0.8+ hectares	Recommended Sites B5-29 (compartmented compound), B5-43 (possible *heiau* and associated features), and B5-34 (the Piko Stone and associated quarry areas) be added to State and National Registers of Historic Places; Site B5-29 corrected radiocarbon date range is A.D. 1420-1650	Dye *et al.* 1985
Site 50-Mo-B6-101 of the Mo'omomi Quarry Complex, West Molokai, TMK:5-1-02-1; June 1985	Map and photograph, locate 30 1m square random sampling units, collect 100% samples of debitage and rejected tools from 20 random sampling units, make research collection	6.8 acres or 2.75 hectares	8,118 debitage flakes (467,304 grams) were collected; the number and weight of flakes per square meter were noted as not normally distributed; recommended Site B6-10 (major quarry area within Mo'omomi Complex) be added to State and National Registers of Historic Places; Site B6-5 corrected C14 date ranges are A.D. 1490-1670 and A.D. 1725-1795 (dual dates due to atmospheric C14 fluctuations)	Dye *et al.* 1985

* Parcel 1 was since renumbered to Parcel 35 (pers. comm. Agnes Estioko-Griffin, State Archaeologist for Moloka'i, State Historical Preservation Division, Honolulu, January 1993).

The surveyors commented that the enclosure may be the Piliwale Heiau. Summers (1970:83) describes the *heiau* as being in the area, but was not previously located by Stokes. Therefore no description of the *heiau* could be provided.

On Lot 31, EISC (1981:6-8) also observed species and the surrounding habitat in order to provide a biota inventory of the area. The fauna inventory included barred dove, spotted dove, northern cardinal, myna, house sparrow, mongoose, and other common and non-endangered species. The flora inventory also listed common species found throughout the State.

2.7 KALUAKO'I

Though several archaeological investigations have been conducted near the Mauna Loa Borrow Site study area (Bonk 1954; Cleghorn 1974; Hammett 1978, 1979; Schilt and Shun 1981; Collins 1983; Dye et al. 1985) only two of them will be discussed at length here, as they are most pertinent to the study area.

Hammett (1979:4) concluded that Site 50-60-01-38 was not a *heiau* but possibly a *hale mua* or men's house. Site 38 had been identified by Emory and inventoried by Summers (1971) as a *heiau* with the following description:

> The structure is located to the E of Site 37 on the S point of Kawaikiunui Bay. Large stone slabs on edge or on end are in the first course of the wall. There is one large limestone slab on end in the first course of the S wall. The upper stones are mostly water-worn. Large pieces of branch coral are found throughout the heiau. Fifty ft. N of the N corner is a large grindstone. (Emory in Summers 1971:47)

Hammett relocated Site 38 in 1978 and later conducted salvage excavations in 1979. Hammett stated that there was "definite evidence that its main function was as a habitation dwelling..." (1979:4). Basaltic glass hydration rind measurements yield dates of ca. 1750-1850 for Site 38.

Although Site 38 is relatively far from the Mauna Loa Borrow Site, the entire Mauna Loa/Kaluako'i region may contain structures like that of Site 38. Many structures in the region appear *heiau*-like on the surface but thorough excavations increases the validity of the classification.

A study on adze quarries conducted by Dye (et al. 1985) included the 'Amikopala Quarry Complex located on the slopes of Mauna Loa. According to the project map, Mauna Loa Borrow Site fringes the boundaries designating the approximate extent of quarrying activity of 'Amikopala Quarry Complex (Dye et al 1985:Fig.1). The Mauna Loa Borrow Site is located just north of 'Amikopala Quarry at an elevation of ca. 1,000—1,100 ft. ASL. The following of 'Amikopala Quarry Complex may link it to the Mauna Loa Borrow Site area:

> The ‘Amikopala Quarry Complex is located above the 1000 ft. level on the southwest ridge of West Moloka‘i Dome, known locally as Mauna Loa. It consists of scattered remains left form quarrying boulders and outcrops for rock suitable for adze manufacture, debitage from reducing cores and primary flakes, and rejected blanks and preforms. It covers an area of 1,350 ha. Within the boundaries of the quarry complex are numerous archaeological sites and features that attest to a prehistoric community that, in addition to quarrying rock and making adzes, farmed, engaged in sports and worshipped. (*ibid.*:2)

It is possible that the Mauna Loa Borrow Site area is associated to the quarry complex because of its proximity, similar altitude and ground cover.

> Craftsmen at ‘Amikopala Quarry Complex found raw material even closer to hand, for here boulders suited to adze manufacture are strewn throughout dryland agricultural fields and several shelters and probable house sites that dot the ridge of Mauna Loa (Dye et al. 1985:91).

If this was the case, the boundaries of the quarry complex may extend to include Mauna Loa Borrow Site.

2.8 SUMMARY

The historical research combined with previous archaeological research in the two study areas suggest different settlement patterns for the two study areas.

The south coast of Moloka‘i is known to have been highly transformed into a series of artificial fishponds used for the raising of fish. It is highly probable that the Ohiapili Pond was one of the series of artificial ponds along this coastline, given its location and the fact that it has a traditional name attached to it.

It seems probable that the Mauna Loa Borrow Site may contain traditional cultural resources that are associated with the large stone adze quarry located at Amikopala. Cultural resources that may be present include flaking stations associated with stone adze manufacture, or shelters used by people making their way from coastal habitations to the adze quarry. The historical research also indicated that the Mauna Loa area was used for the cultivation of sweet potato, and it is possible that agricultural features may be located in the study area. It does not seem likely that permanent habitation sites will be located in the study area, because previous archaeological studies suggest that permanent habitations were located along the coast.

3.0 PROJECT DESCRIPTION

3.1 MAUNA LOA BORROW SITE

The proposed Mauna Loa Borrow Site project area is located adjacent to, and to the north of the Mauna Loa Highway (Route 460) between mile markers 13 and 14, about 5 mi. west of the Moloka'i Airport (Figure 1). It is approximately 40 acres in size and is bordered by the highway on the south, Kaakako Gulch to the west, and a branch of Kamakahi Gulch to the east. The northern boundary is the point of lowest elevation which is approximately 1,000 ft. above sea level. The point of highest elevation is just over 1,100 ft. above sea level and is located at the southern edge of the parcel adjacent to the highway. A prominent hill is situated in the center of the parcel which also reaches an elevation of just over 1,100 feet.

An additional 10 acre area located adjacent to the proposed borrow site area was also surveyed (see Appendix B). This area consists of a small hill bordered on three sides (north, east, and west) by steep gulches—Kamakahi Gulch and two tributaries.

The property is currently owned by the Molokai Ranch which uses the parcel as rangeland for cattle. A barbed wire fence parallels the north side of the Mauna Loa Highway on the south edge of the parcel. Apparently, the project area has never been used for cultivation.

Three soil types dominate the study area: Hoolehua silty clay (7-15% slopes), Waihuna Clay (7-15% slope), and Waihuna Clay (15-25% slope) (Foote et al. 1972:Map 73). Hoolehua silty clay is developed in old alluvium and is generally well drained. Runoff is slow and the erosion hazard is slight to moderate (Foote et al.: 1972:45). The Waihuna clay is formed in old alluvium and is generally moderately drained. In clays with 7-15 percent slopes, runoff is slow to moderate and the erosion hazard is slight to moderate (Foote et al. 1972:130). Waihuna clays with 15-25 percent slopes "occur as narrow bands along steep slope breaks and on foot slopes. Runoff is medium, and the erosion hazard is moderate" (ibid.).

Rainfall in the study area ranges between 15 to 25 in. per year, with most of the rainfall in October through March (Armstrong 1983:62). Vegetation within the project area is comprised primarily of various grasses, including *pili*. Other vegetation within the parcel includes *ilima* (*Sida fallax*), lantana (*Lantana camara*), Christmas-berry (*Schinus terebinthifolius*), *haole koa* (*Leucaena glauca*), *panini* (*Opunta megacantha*), guava (*Psidium guajva*), milkweed (*Asclepias curassavica*) and other grasses. On the east edge of the parcel, within the branch of Kamakahi Gulch, are scattered trees of *wiliwili* (*Erythrina sandwicensis*) and *kukui* (*Aleurites moluccana*). Ground visibility is good in the southern portion of the parcel, but dense grasses obscure visibility in the northern section.

The Mauna Loa Borrow Site project area is currently undeveloped. The proposed plan is to use approximately 6 acres of this parcel as a source of impermeable fill to cover the Kalamaula Landfill. The six acre area would be excavated to a depth of 6 to 8 ft., and the area planned for this excavation is comprised primarily of the top of the ridge located next to the highway. This area is the highest point of elevation and the most accessible since it is adjacent to the highway.

3.2 OHIAPILI POND

The Ohiapili Pond wetland mitigation project area is located adjacent to and northwest of the Kalamaula Landfill, approximately 2 mi. west/northwest of Kaunakakai (Figure 2). The project area is approximately 32 acres in size, but the pond size is variable. The standing water in the pond is currently about two acres and 1.5 to 3 ft. deep, and is surrounded by at least 30 to 40 acres of marsh with pickleweed vegetation and water 0.5 to 1.5 ft. deep (Figure 3). The elevation of the project area is at or only slightly above sea level.

A modern levee bisects the marsh area, with the current open water area adjacent and to the south of the levee. The levee is approximately 2 to 3 m wide at the top with a 2 m slope on each side. Large basalt boulders have been placed on the levee. It begins at the west edge of the Kalamaula Landfill and heads northwest through the marsh area into a dense mangrove thicket northwest of the pond.

The soils in the study area are classified as Kealia silt loam (Foote et al 1972:Map 77). This soil is described as

> "poorly drained and has a high salt content. Ponding occurs after heavy rain. When the soil dries, salt crystals accumulate on the surface. The soil has a brackish water table that fluctuates with the tides; the water table is nearer the surface along the shoreline than in inland areas. The slope ranges from 0 to 1 percent" (Foote et al. 1972:67).

Rainfall in the study area is less than 15 in. per year with the majority falling between November and April (Armstrong 1983:62). Pickleweed (*Batis maritima*) grows over the levee, as well as dense patches of *kiawe* (*Prosopis pallida*), *haole koa* (*Leucaena glauca)*, and mangrove (*Bruguiera* spp.). The mangrove thicket northwest of the pond contains a break in the levee with concrete footings (Figure 3). This probably represents the remains of a bridge on the levee which allowed water to flow from one side of the levee to the other. The break in the levee is approximately 8.5 m wide, with a 3.4 m long by 0.6 m wide concrete footing in the center with bolts imbedded into the concrete. The levee in this area resembles a road with alignments of basalt boulders placed on each edge of the levee top (this helped confirm the contemporary age of the levee). The marsh on each side of the levee is at least 1 ft. deeper at the base of the levee, and consists of a much softer mud than elsewhere in the marsh. A meter away from the levee base, the marsh bottom is more compacted and rises slightly in elevation. This may indicate that the area on each side of the levee was dredged at one time, with the muck from the adjacent marsh being placed on top of the levee.

Paralleling the levee, approximately 200 m to the south, is a sand dike. The sand dike is approximately 50 cm above the level of the marsh and is difficult to delineate on the southern and eastern edge. The sandy mud soil is dry on the dike with scattered vegetation of *kiawe* and

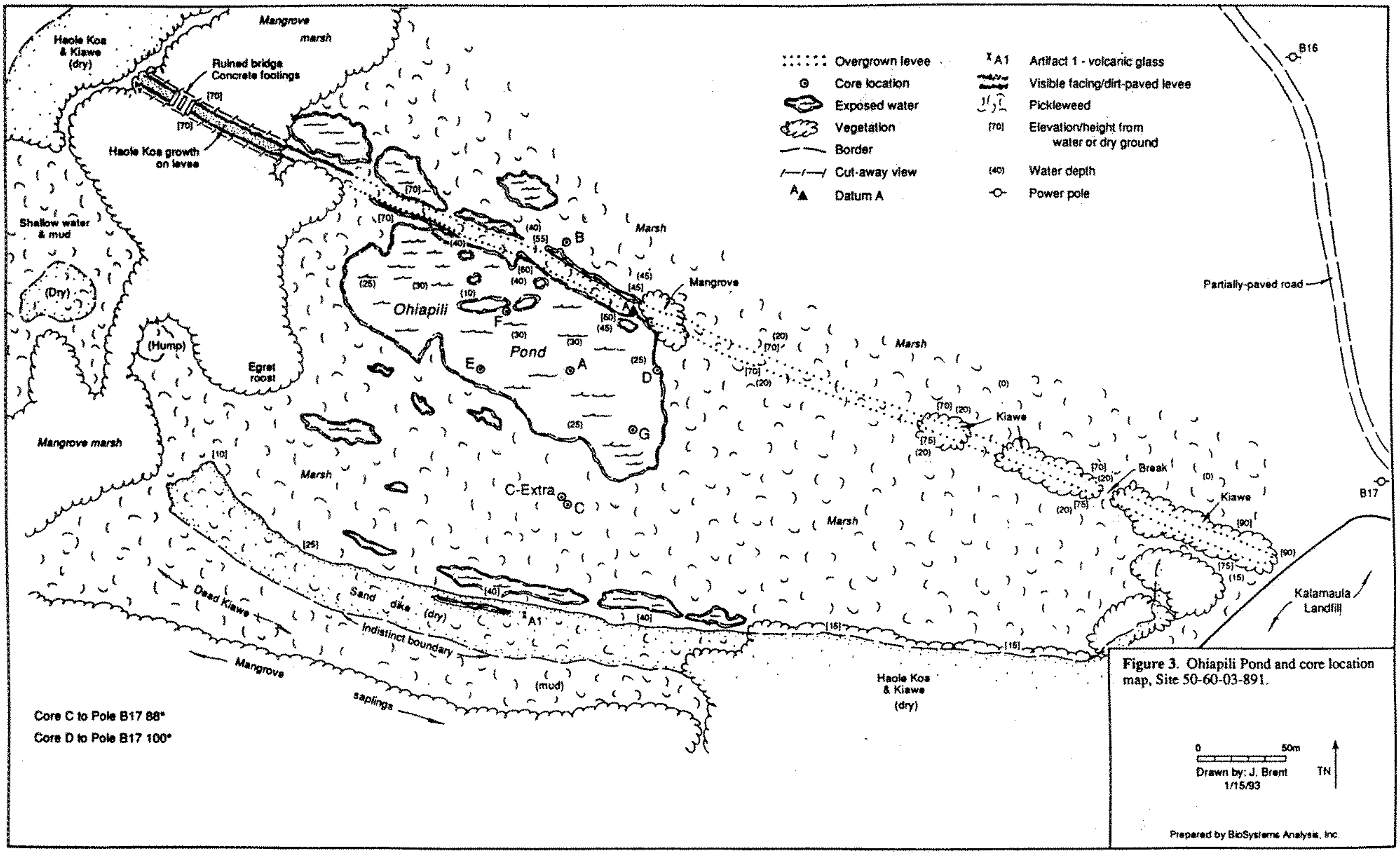

Figure 3. Ohiapili Pond and core location map, Site 50-60-03-891.

haole koa. To the south of the dike are mangrove saplings which lead to denser stands of mangrove bordering the Pacific Ocean. West and northwest of the sand dike are marshy stands of mangrove upon which Egrets roost. East of the sand dike is a dense area of *kiawe* and *haole koa* on dry sandy mud which extends to the edge of the Kalamaula Landfill (Figure 3). Thus, the Ohiapili Pond project area is roughly bordered by the Kalamaula Landfill on the east, the levee and marsh on the north, a mangrove stand and marsh to the west, and the sand dike on the south.

4.0 METHODS

A mixed field strategy was used during the archaeological inventory survey of the Mauna Loa Borrow Site and the Ohiapili Pond projects. The techniques varied primarily as a result of the different nature of the two project areas (one being on dry ground and the other within a marsh and pond). Various methods were employed in order to achieve the field tasks so that an assessment of potentially significant archaeological resources could be made.

4.1 MAUNA LOA BORROW SITE

The field reconnaissance involved a complete surface survey of the proposed Mauna Loa Borrow Site. Field archaeologists systematically walked three to five abreast, with 10 to 15 m spacings between archaeologists, over the entire project area. The spacing of the field crew varied according to the surface visibility. Visibility was good over most of the southern half of the parcel, but dense grasses obscured visibility in the north. Surface clearing of vegetation with machetes was necessary within archaeological feature and site areas in order to determine the extent and type of the cultural resources present.

Cultural resources identified during the survey were plotted on the Moloka'i Airport, Hawai'i, 7.5 Minute USGS Quadrangle Map, 1968 version. Archaeological sites were documented on standardized forms and scaled maps were made using a compass and fiberglass tape measure. All related features were measured, described, and photographed, and selected features were drawn to depict measurements and/or pertinent information. Black and white photographs were taken of all site and feature areas. Weather-proof aluminum tags were used as site and feature datums. Inscribed onto the tags were the temporary site and feature designation, the date and "BioSystems" so that identified datums could be easily relocated.

Identified artifacts were plotted onto the site map and given a temporary designation. A sample of the discovered artifacts were collected and taken to BioSystem's Kailua, O'ahu office for analysis.

4.2 OHIAPILI POND

The Ohiapili Pond project area was covered with water measuring 0.5 to 3 ft. deep, making a systematic surface survey of the region impractical. Dense pickleweed vegetation in the marsh also hindered visibility. BioSystems conducted a complete surface inspection of the rock levee forming the north pond boundary and of the sand dike which parallels the levee to the south. We also examined the mangrove swamp west of the existing pond between the levee and the dike. We used 4-ft.-long metal probes on the sand dike and in the marsh and pond to determine the presence of rock or coral walls buried beneath the mud deposits.

Limited subsurface coring in Ohiapili Pond was conducted to determine the presence of cultural deposits and to collect samples which could provide chronological data. Coring, rather than auguring, was the selected method for recovery of sediment samples in the pond. Auguring involves the collecting of bulk soil samples in a toothed cylinder by screwing it down into the deposit. Once the auger cylinder is full it must be extracted and emptied. Conversely, coring involves the driving of a pipe down into the deposit to remove an intact vertical column. Experiments with coring techniques have been conducted in other ponds in Hawai'i with successful results (Hammatt et al. 1985). Coring was determined advantageous over auguring because the original depositional characteristics, structure, stratigraphic boundaries and secondary pedogenic effects were preserved in a vertical column without the mixing of layers which often occurs from auguring (Hammatt et al 1985:7). Except for compaction of the layers which may result as the samples enter the pipe, coring provides a much clearer picture of the relationship of the layers present within the deposit.

The coring at Ohiapili Pond was done manually by pounding 4 to 5-ft.-long sections of 2-in. diameter PVC pipe vertically into the pond deposit. A 4-in. metal cap was placed on top of the PVC pipe and a sledge hammer was used to drive the pipe into the deposit. Sections of PVC were joined together with primer, cement, and small screws so that a deeper core sample could be collected as needed. Prior to the removal of the core sample, a cap was placed on top of the PVC pipe to create a vacuum when extracting the pipe. The PVC pipes with intact core samples were extracted from the pond by using a wooden framework of 10-ft.-long two-by-fours. A come-a-long was then hooked to the framework which was placed above the core location. A rope was then tied to the PVC pipe and attached to the come-a-long. The come-a-long was then used to extract the pipe from the pond, while the vacuum in the pipe kept the core sample intact during the extraction. Core samples were then drained of excess water, sealed with PVC caps, primer and cement, and labeled for transport to BioSystems' Kailua laboratory for analysis.

A detailed site map of the Ohiapili Pond was drawn to scale using compasses and fiberglass metric tapes (Figure 3). All core locations were plotted onto the site map, as were the current boundary limits of the pond, the rock levee, the sand dike, the mangrove swamp west of the pond, and the Kalamaula Landfill and access road to the east.

A site mapping datum was established on the rock levee and a weather proof aluminum tag was placed at this location. Inscribed onto the datum tag was the datum designation, the date, and "BioSystems" so that it could be easily relocated. A similar datum tag was tied to a mangrove branch and stuck into the mud at the location of Core A. Collected artifacts were plotted onto the site map, given a temporary designations, and taken to the Kailua laboratory for analysis.

At the Kailua laboratory, the core samples were opened be cutting a groove down the length of both sides of the PVC pipe. This allowed for removal of one section of the pipe length, which revealed the core and kept it supported by the other half of the pipe. Analysis of each core included a stratigraphic designation of each sediment layer, its depth provenience below surface of the pond bottom, a Munsell color notation of each layer, and standard soil descriptions (including texture, structure, consistence, presence of roots and rocks, boundary, presence or absence of cultural material, and comments).

5.0 FINDINGS

5.1 MAUNA LOA BORROW SITE

An archaeological site (State Site No. 50-60-02-892) was identified during the archaeological inventory survey of the Mauna Loa Borrow Site project area. The site is located in the center of the project approximately 275 m north of the Mauna Loa Highway between Kamakahi Gulch and Kaakako Gulch. The resource is situated on top of a prominent hill and extends down the north and eastern slopes (Figure 4). The site consists of four feature concentrations and a light density lithic scatter within an erosional cut on the north slope of the hill (Figure 5).

Feature A consists of a roughly rectangular rock-walled enclosure with maximum dimensions of approximately 12 by 10 m (Figure 6). The walls vary in size but average about 1.2 to 1.6 m wide (4 to 7 courses) and 20 to 40 cm high (1 to 2 courses) and are constructed from basalt boulders and rock. Scattered rocks and boulders are located in the Feature's interior, with some rocks forming a rough alignment along its southwest portion. A single basalt flake (Artifact A) was located in the feature.

Feature B is a rectangular rock platform which measures approximately 6 by 6.5 m. In the southwest corner of the feature is a section of finely paved rock forming an interior platform that measures 2 by 2.5 m (Figure 7). Feature B is roughly one to two courses high and is constructed of basalt rock and boulders. No artifacts or manuports were observed on the surface of the feature. Features A and B are located on the highest point of the hill, which offers a panoramic view of the surrounding area and of the Pacific Ocean to the north.

Feature C consists of four ambiguous rock concentrations at the northeast base of the hill below Features A and B. The rock piles are constructed of basalt boulders which occur naturally in the surrounding area. The area of Feature C measures roughly 24 by 12 m. The largest rock concentration measures 6.6 by 4.0 m and is 30 to 40 cm high. The remaining rock concentrations average 3 by 3 m and 10 to 40 cm high. The rock concentrations do not appear to be stacked, but may have been more recently disturbed by cattle and erosional activity.

Feature D is a rock mound located 62 degrees and 143 m from the site datum (the northeast corner of Feature A). Feature D measures approximately 4 by 3 m wide and 90 cm high.

On the northwest slope of the hill is a large erosional cut which measures approximately 45 m north-south by 90 m east-west (Figure 5). Within this eroded area is a light density lithic scatter of fine grained basalt cores and flakes. Three artifacts were collected from this area for further analysis: Artifact B is a basalt core measuring approximately 9.0 x 7.0 x 3.8 cm; Artifact C is a basalt flake measuring 5.5 x 4 x 0.7 cm; Artifact D is a vesicular basalt hammerstone with battering at the proximal and distal ends, measuring approximately 13.0 x 7.0 x 4.5 centimeters.

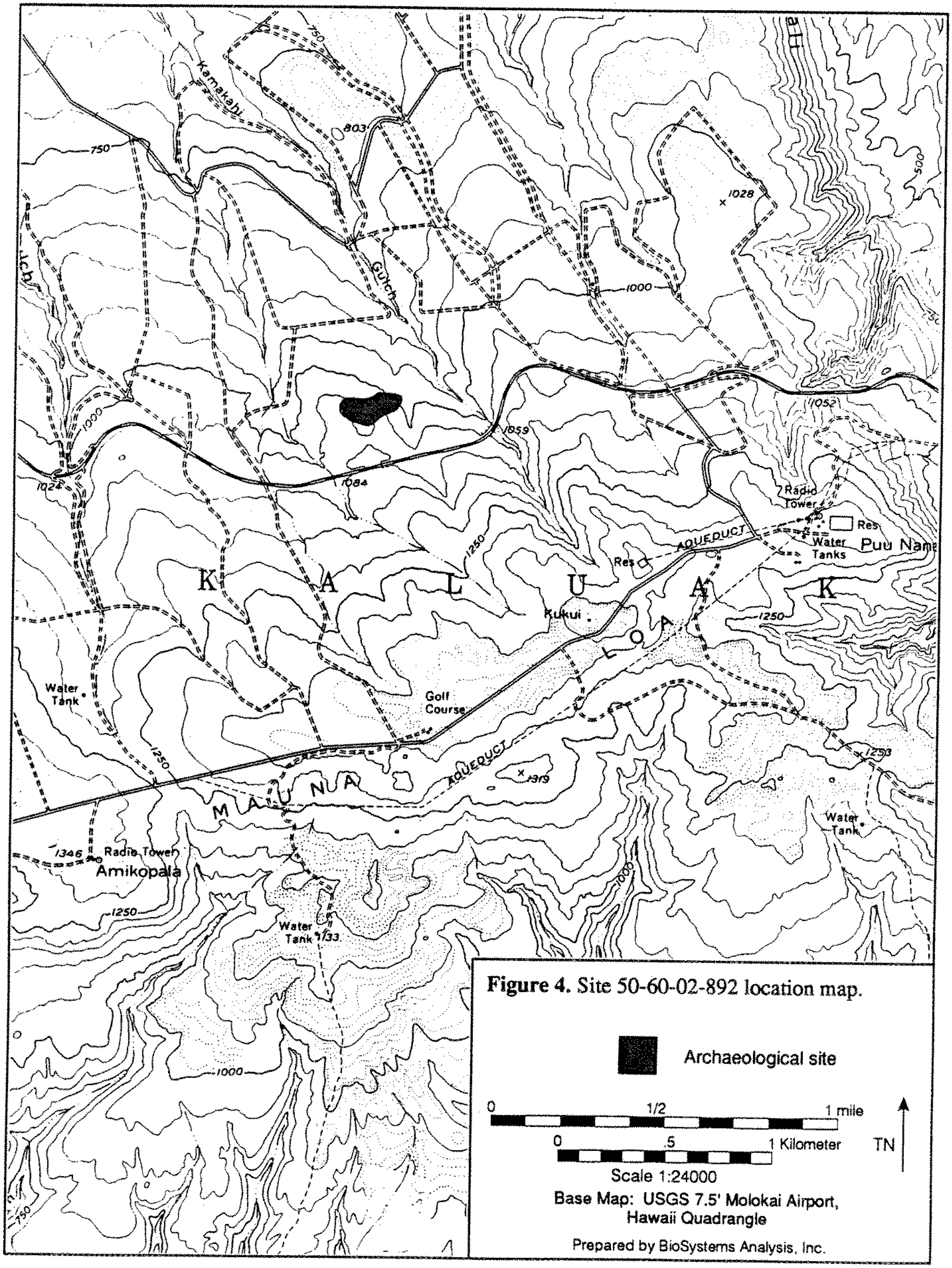

Figure 4. Site 50-60-02-892 location map.

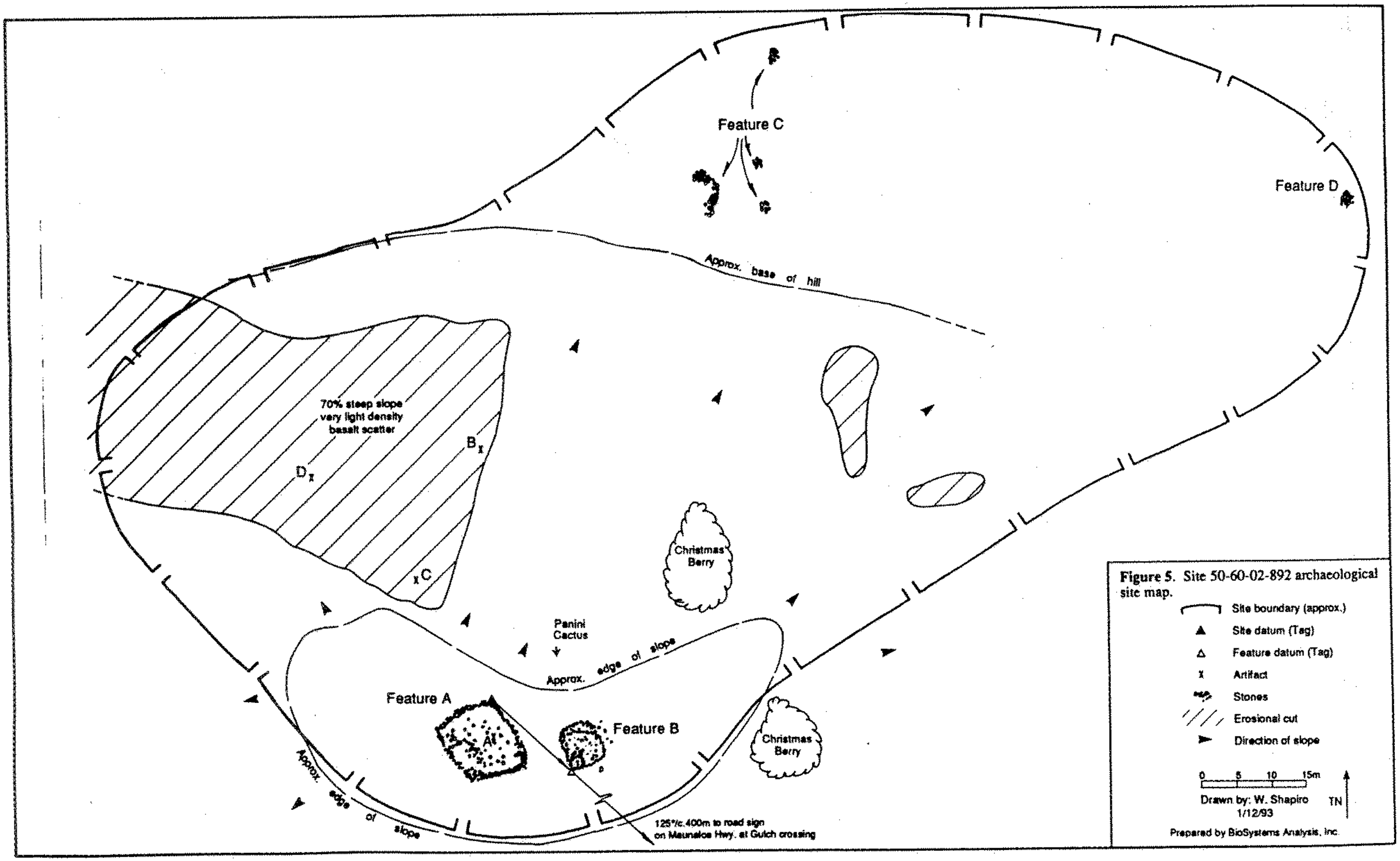

Figure 5. Site 50-60-02-892 archaeological site map.

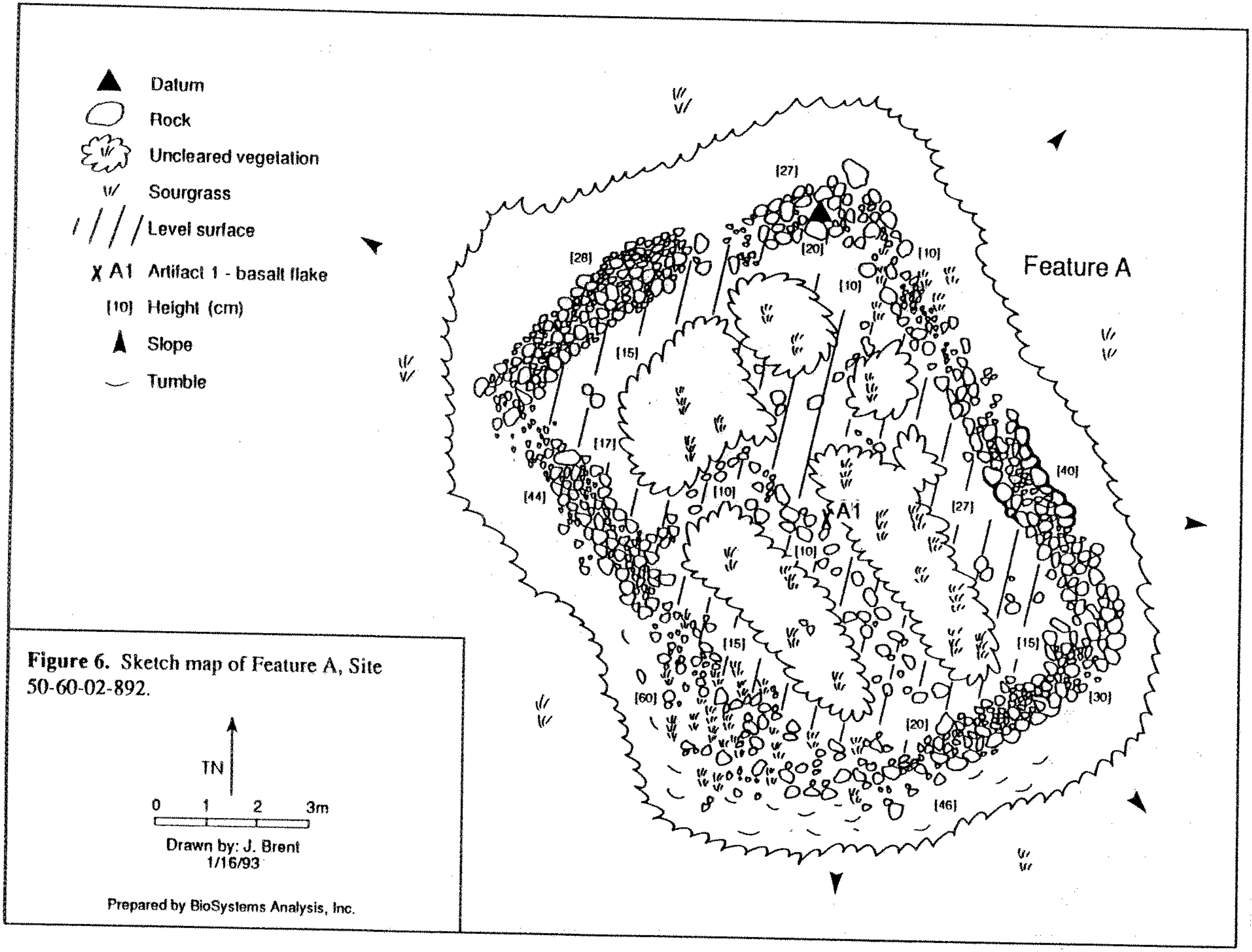

Figure 6. Sketch map of Feature A, Site 50-60-02-892.

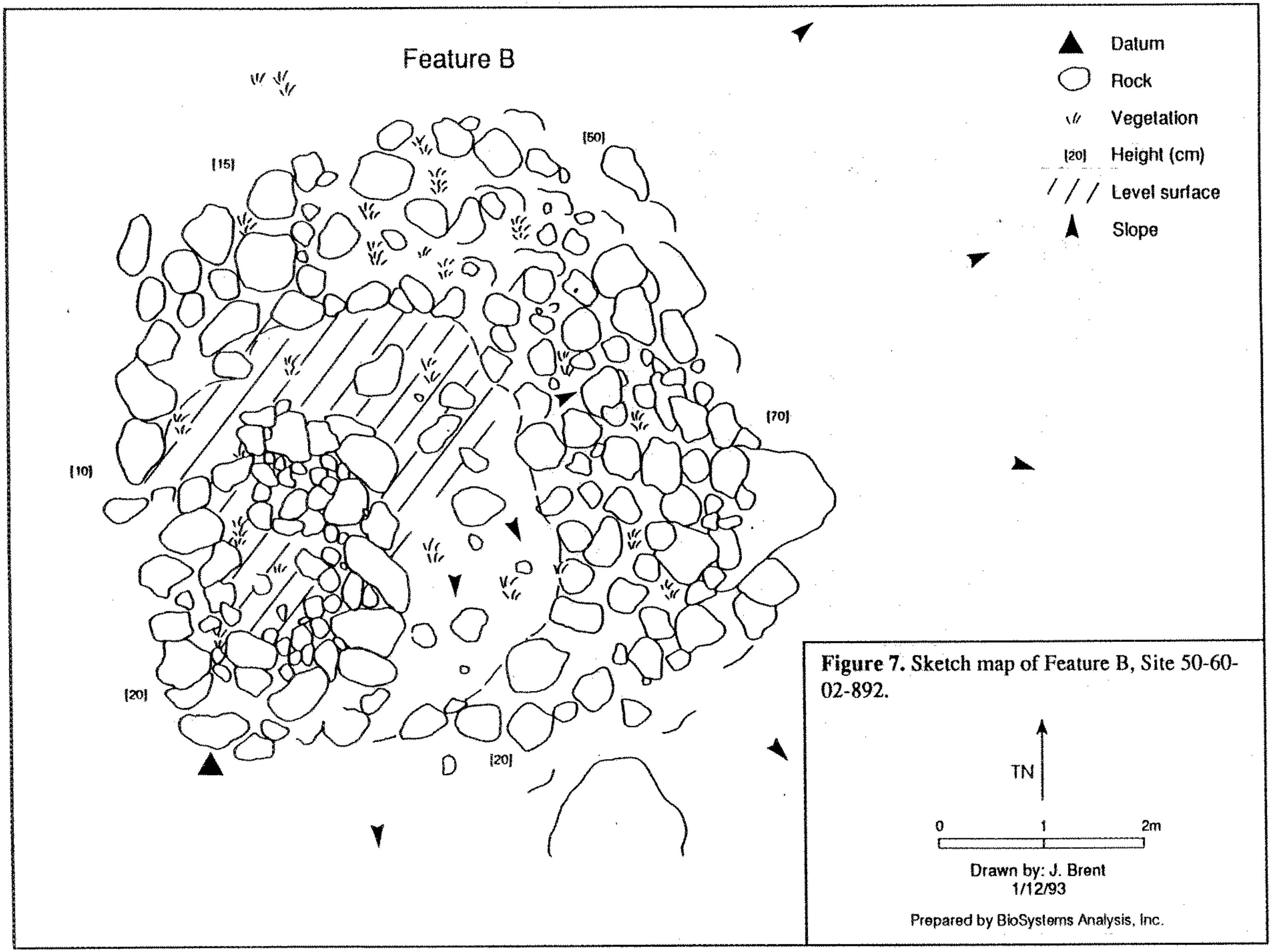

Figure 7. Sketch map of Feature B, Site 50-60-02-892.

Drawn by: J. Brent
1/12/93

Prepared by BioSystems Analysis, Inc.

The archaeological survey of the additional 10 acre parcel identified two locations of cultural material: (1) a cluster of three basalt flakes; and (2) two marine shells eroding out of an erosional cutbank (Appendix B).

5.2 OHIAPILI POND

This pond has been designated site 50-60-03-891 based primarily on the fact that this pond has an associated traditional Hawaiian name—Ohiapili. A total of eight core samples were recovered from the Ohiapili Pond project. The cores were located primarily in the center of the pond and along the pond edge; one core was located on the north side of the rock levee (Figure 8). The cores were spaced 50 to 75 m apart and were positioned to recover an overall sample of the deposit within the pond. The results of the core tests are summarized below, and the reader is referred to Appendix A for detailed descriptions.

Core A was located in the center of the existing pond at a distance of 49.4 m at 220 degrees from datum A (which was placed on the rock levee to the west of the mangrove stand). The water depth was approximately 35 cm at this location. The total length of the core sample measured 220 cm and the top of the core was void of pickleweed vegetation. Layer I extended from 0 to 19 cm below surface (cmbs) of the mud, and consisted of a dark reddish-brown to dark-brown silty clay. It is structureless, very fine and blocky, sticky and plastic in consistency, is void of roots and rocks, has an abrupt and smooth boundary with the following layer, and is non-cultural. Layer II extended from 19 to 52 cmbs, has a pale brown to grayish-brown loamy sand texture, is structureless, very fine, granular to single grain, and is slightly sticky and slightly plastic. This layer is void of roots and rocks, has a diffuse and irregular boundary, and is non-cultural. Layer III extends from 52 to 77 cmbs, has a dark gray sand texture, is structureless, fine, and single grain, is non-plastic and non-sticky, is void of roots and rocks, has a gradual and irregular boundary, and is non-cultural.

Core B was located 75 m north of Core A on the north side of the rock levee. It is situated in an area of pickleweed vegetation with 25 to 35 cm of standing water. Core B has a length of 74 centimeters. Layer Ia consists of a pickleweed root mass extending from 0 to 5 cmbs with an abrupt and smooth boundary. Layer Ib represents a transition between Layer Ia and Ic and extends from 5 to 6 cmbs, has a grayish-brown silty clay texture, is structureless, very fine, and blocky, it is slightly sticky and slightly plastic, contains numerous roots and rootlets with no rock, shows a gradual boundary, and is non-cultural. Layer Ic extends from 6 to 46 cmbs, has a dark reddish-brown clay to silty clay texture, is structureless, very fine and blocky, has a sticky and plastic consistence, contains numerous roots and rootlets, has a gradual boundary, and is non-cultural. Layer II measures from 46 to 74 cmbs, consists of a dark gray loamy sand texture; is structureless, very fine, and single grain, is non-sticky and non-plastic, is void of roots and rock but contains a few pieces of Tellinidae shell, and is non-cultural.

Core C is located 75 m south of core A in the pickleweed marsh with 15 to 20 cm of standing water. It has a total length of 275.5 centimeters. Layer Ia extends from 0 to 4.5 cmbs of the mud, and is a dark brown to black pickleweed root mass with an abrupt, smooth boundary.

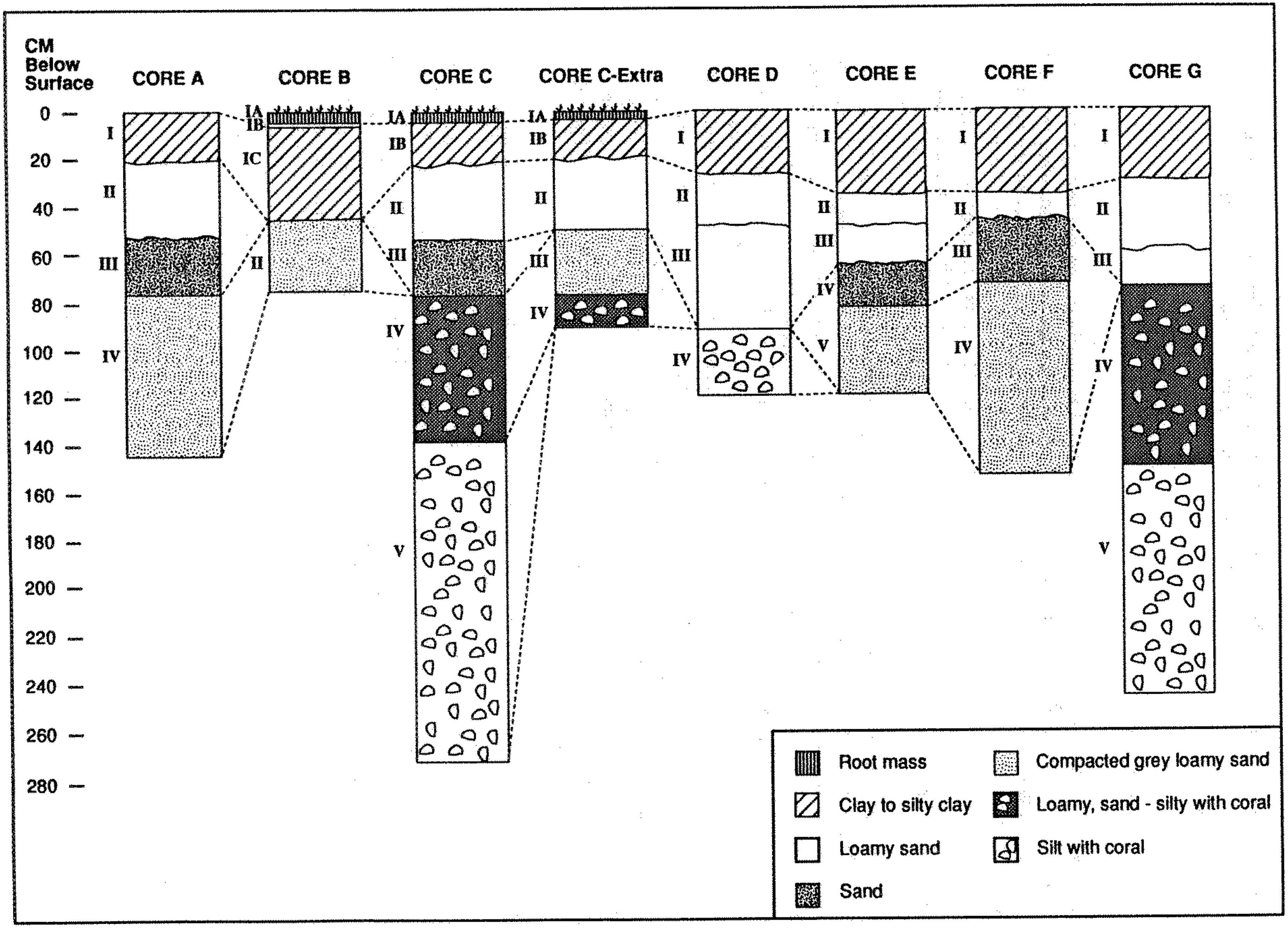

Figure 8. Sediment columns from Ohiapili Pond with stratigraphic correlations.

Layer Ib measures 4.5 to 21.5 cmbs, has a dark reddish-brown clay to silty clay texture, is structureless, very fine, and blocky, is sticky and plastic in consistence, contains roots and rootlets but no rock, has a gradual and irregular boundary, and is non-cultural. Layer II extends from 21.5 to 53.5 cmbs, has a grayish-brown loamy sand texture, is structureless, very fine and granular, is slightly sticky and slightly plastic, has a few rootlets in the upper section but no rock, has a gradual to diffuse and irregular boundary, and is non-cultural. Layer III measures from 53.5 to 76.5 cmbs, has a grayish-brown to pale brown sand texture, is structureless, very fine to fine, and single grain, is non-sticky and non-plastic, contains no roots but has a few pieces of coral, has a clear and irregular boundary, and is non-cultural. Layer IV extends from 76.5 to 136.5 cmbs, has a gray loamy sand texture, is structureless, very fine, and single grain, is slightly sticky and slightly plastic, has no roots but over 70 percent coral and shell fragments, has a gradual to diffuse boundary, and is non-cultural. Layer V extends from 136.5 to 275.5 cmbs, has a light gray to gray silt texture, is structureless, extremely fine, and single grain, is slightly sticky and slightly plastic, contains no roots but has 50 percent coral, is non-cultural, and is very-slip like and may represent a gley deposit.

An additional core sample was collected from the Core C location. This "extra" Core C had a total length of 90 cm and was located within 2 m of Core C. Layer Ia represented a 4 cm thick pickleweed root mass with an abrupt and smooth boundary. Layer Ib extends from 4 to 19 cmbs, has a dark brown silty-clay to clay texture, is structureless, very fine, and blocky, is sticky and plastic in consistence, contains roots and rootlets but no rock, has an abrupt and smooth boundary, and is non-cultural. Layer II measures from 19 to 49 cmbs, consists of a dark grayish-brown loamy sand texture, is structureless, very fine, and granular, is slightly sticky and slightly plastic, has a few rootlets and no rock, has a gradual to diffuse boundary, and is non-cultural. Layer III extends from 49 to 76 cmbs, is a pale brown sand in texture, is structureless, fine, and single grain, is non-sticky and non-plastic, contains no root and less than 5 percent coral, has an abrupt and smooth boundary, and is non-cultural. Layer IV measures from 76 to 90 cmbs, is a dark gray loamy sand in texture, is structureless, very fine, and single grain, has a non-sticky and non-plastic consistency, contains no roots but has 60 percent coral, and is non-cultural.

Core D is situated on the edge of the existing pond at 50 m due east of Core A. Core D has a maximum length of 119 centimeters. Layer I extends from 0 to 26 cmbs, is a dark reddish-brown clay to silty clay, is structureless, very fine, and blocky, is sticky and plastic in consistence, contains minor rootlets and no rock, has a clear and smooth boundary, and is non-cultural. Layer II measures from 26 to 47 cmbs, represents a grayish-brown loamy sand, is structureless, very fine, and granular, is slightly sticky and slightly plastic, contains a few rootlets but no rock, has a gradual and irregular boundary, and is non-cultural. Layer III extends from 47 to 91 cmbs, has a dark gray loamy sand texture, is structureless, very fine, and single grain, is non-sticky and non-plastic, contains no roots but has less than 5 percent coral and shell fragments, has a gradual and irregular boundary, and is non-cultural. Layer IV measures from 91 to 119 cmbs, represents a gray sandy silt, is structureless, extremely fine, and single grain, is slightly sticky and slightly plastic in consistency, contains no roots but 60 percent coral, and is non-cultural.

Core E is located 50 m to the west of Core A. Core E is located within the standing water of the pond, with a water depth of 25 centimeters. The total length of Core E is 119 centimeters. Layer I extends from 0 to 33 cmbs, it consists of a dark reddish-brown clay to silty clay, it is structureless, very fine, and blocky, is sticky and plastic in consistency, is void of roots and rocks, has a diffuse and broken boundary, and is non-cultural. Layer II measures from 33 to 47 cmbs, is a grayish-brown loamy sand/clay mix in texture, is structureless, very fine, and granular to blocky, is slightly sticky and slightly plastic in consistency, is void of roots and rocks, has a gradual and irregular boundary, and is non-cultural. Layer III extends from 47 to 63 cmbs, consists of a dark gray to very dark gray loamy sand, is structureless, very fine, and single grain, is non-sticky and non-plastic in consistency, contains no roots or rocks but a few Tellinidae shells, has an abrupt and smooth boundary, and is non-cultural. Layer IV measures 63 to 80 cmbs, consists of a gray to dark gray sand in texture, is structureless, very fine to fine, and single grain, is non-sticky and non-plastic, is void of roots and rocks, has an abrupt and smooth boundary, and is non-cultural. Layer V extends from 80 to 119 cmbs, represents a dark gray loamy sand in texture, is structureless, very fine, and single grain, is non-sticky and non-plastic in consistence, contains no roots or rock, and is non-cultural.

Core F is located 50 m to the northwest of Core A, within the standing water of the pond. The water depth in the vicinity of Core F is about 25 cm and the total length of the core sample is 150 centimeters. Layer I extends from 0 to 34 cmbs, consists of a dark reddish-brown clay to silty clay in texture, is structureless, very fine, and blocky, is sticky and plastic in consistency, is void of roots and rocks, has a diffuse and broken boundary, and is non-cultural. Layer II measures 34 to 44 cmbs, is a dark grayish-brown loamy sand with clay in texture, is structureless, very fine, and granular to blocky, is slightly sticky and slightly plastic, is void of roots and rocks, has a diffuse and irregular boundary, and is non-cultural. Layer III extends from 44 to 70 cmbs, consists of a dark gray sand in texture, is structureless, very fine, and single grain, is non-sticky and non-plastic in consistency, is void of roots but contains a few coral fragments, has a clean and smooth boundary, and is non-cultural. Layer IV measures from 70 to 150 cmbs, represents a dark gray loamy sand in texture, is structureless, very fine, and single grain, is non-sticky and non-plastic, is void of roots and rocks but contains a few shell fragments, and is non-cultural.

Core G is located 50 m to the southeast of Core A within the standing water of the pond. The water depth in this area is about 25 cm, and the total length of Core G is 247 centimeters. Layer I extends from 0 to 28 cmbs, consists of a dark brown to dark grayish-brown silty clay with sand, it is structureless, very fine, and blocky to granular, is sticky and plastic in consistency, is void of roots and rocks, has a diffuse and irregular boundary, and is non-cultural. Layer II measures from 28 to 57 cmbs, represents a pale brown to grayish-brown loamy sand, is structureless, very fine, and granular, is slightly sticky and slightly plastic in consistency, is void of roots and rocks, has a gradual and irregular boundary, and is non-cultural. Layer III extends from 57 to 72 cmbs, consists of a dark gray loamy sand in texture, is structureless, very fine, and single grain, is non-sticky and non-plastic in consistency, is void of roots and rocks, has a clean and smooth boundary, and is non-cultural. Layer IV measures from 72 to 147 cmbs, consists of a dark gray loamy-sandy silt, is structureless, very fine, and single grain, is non-sticky and non-plastic in consistency, contains no roots but has 50 percent coral and shell

(Turbo), has a diffuse and irregular boundary, and is non-cultural. Layer V extends from 147 to 247 cmbs, consists of a dark gray to gray silt in texture, is structureless, extremely fine, and single grain, is non-sticky and non-plastic in consistency, is void of roots but contains 25 percent coral, and is non-cultural. This layer may represent a gley deposit.

These core samples provided a stratigraphic profile of the pond (Figure 8). Although there were slight variations in the sediment columns from different locations of the pond, no cultural material or direct evidence of the pond being used for cultural purposes (e.g., as a fish pond) were evident from the core tests. The core samples consistently revealed that the upper layer of the pond is a clay to silty clay (from 0 to 45 cmbs). Below this layer is a loamy sand, which gives way to a pure sand, a loamy sand, or a loamy, sandy silt with coral. The deepest core samples (C and G) were consistent in that their deepest layer was a fine silt with coral, which was gley-like.

A single artifact (a piece of volcanic glass, Artifact 1) was collected from the surface of the sand dike at 197 degrees and 185 m from the pond datum. It measures approximately 1.5 x 1.0 x 0.3 cm and was found 6 m onto the sand bar from the edge of the marsh. This may not represent its original location as recent debris and garbage from the Kalamaula Landfill occurs in the artifact's vicinity. This was the only cultural material recovered from the Ohiapili Pond project.

6.0 SUMMARY AND INITIAL SITE SIGNIFICANCE ASSESSMENTS

BioSystems Analysis, Inc., conducted an archaeological inventory survey and limited subsurface coring for a proposed wetland mitigation project at the Ohiapili Pond (TMK 5-2-11; c. 32 acres) and the Mauna Loa Borrow Site (TMK 5-1-2:32; c. 40 acres and 10 acres) in West Moloka'i. The survey was done from January 12 to 16, 1993 at the request of Brown and Caldwell Consultants. This work was conducted to determine if potentially significant archaeological resources are located within the project areas prior to development.

The proposed wetlands mitigation project requires review and permitting from the COE, and has the potential to affect historic properties. Therefore, the project is subject to Section 106 of the National Historic Preservation Act of 1966, as amended. This report was prepared to comply with Section 106, which requires Federal agencies to "...take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. The head of any such Federal agency shall afford the Advisory Council on Historic Preservation...a reasonable opportunity to comment with regard to such undertaking" (16 U.S.C. § 470f). Section 106 is met by following the provisions of 36 CFR Part 800.

An archaeological site (50-60-02-892) was discovered on top of the prominent hill and down its north slope in the Mauna Loa Borrow Site project. The site consists of four feature areas and a light density basalt lithic distribution. Features A and B (a rock enclosure and platform) are located on the hilltop and have a panoramic view. This location and setting suggest that the features represent part of a religious complex. Although no coral or offerings were located within these features, the site setting and impression they have are reminiscent of other religious sites in Hawai'i. Features C and D are located at the northeastern base of the hill. They represent ambiguous piles of boulders and may represent the remains of agricultural mounds which have more recently been disturbed from cattle grazing and erosional activity. A light density lithic scatter in an erosional cut on the north slope of the hill is evidence that tool manufacturing was also part of the site function. This tool manufacturing may be associated with the 'Amikopala Quarry Complex as mentioned in the background section. Thus, site 50-60-02-892 may have been a site where many different activities took place: religious, agricultural, and tool manufacture.

Site 50-60-02-892 is recommended as eligible for the National Register of Historic Places under 36 CFR 60.4(d). While the structures have incurred some degradation and damage through time, the remains retain integrity of location and setting, important prerequisites for National Register consideration. This site appears to be significant for its potential to yield information significant for our understanding of traditional culture, history, prehistory, and/or foreign influences on traditional culture and history (36 CFR 60.4(d)).

Finally, the site may be important as a traditional cultural property of importance to contemporary Native Hawaiians under proposed Criterion 'E', an evaluative criterion used in state historic preservation review. Under Criterion E, 50-60-02-892 can provide a sense of identity and continuity to contemporary Hawaiians, a visible reminder of their ancestry and cultural heritage.

Avoidance of impacts to this resource is recommended. Because the site is National Register eligible for its information values, off-site impacts to the environment should not affect the qualities that may render 50-60-02-892 NRHP eligible. Therefore, if the site can be physically avoided the proposed undertaking would have no effect on this historic property, pursuant to 36 CFR 800.5. To ensure that the site will not be affected, archaeological monitoring of initial ground disturbance within the borrow pit site is advised.

The minor amount of cultural material found in the additional 10 acre parcel (Appendix B) does not appear to meet any of the significance criteria. However, given its proximity to a potentially significant site (50-60-02-892), it is recommended that archaeological monitoring be conducted during initial ground altering activities in this area.

A detailed site map was created for the Ohiapili Pond vicinity. Analysis of eight core samples provided a stratigraphic profile of the pond, but did not provide a cultural indication of the pond's use. A piece of volcanic glass was collected from the surface of the southern sand bar or dike, which represents the edge of the pond area. Scattered boulders occur on the sand bar, but do not appear to be in any alignment. At this point, it is difficult to determine whether or not the sand bar represents a natural or cultural feature. Archaeological testing of this area may reveal the presence of buried rock walls or alignments which would help classify the feature. The northern levee has been historically built-up and modified. At the western end of the levee and within the dense mangrove is a concrete support which appears to represent an abandoned bridge crossing where a stream-channel flowed through the levee. It is impossible to determine if a prehistoric rock fish wall is located underneath the historically-modified levee, but it would not be unlikely. Although the analysis of the core samples did not yield information as to the prehistoric nature of the Ohiapili Pond, it does not necessarily mean that the pond was not used prehistorically or that a cultural deposit is not located somewhere within the pond.

Ohiapili Pond is named as a Native Hawaiian fishpond and it is possible that undisclosed cultural remains are present at the site. Such deposits may render the site eligible for inclusion on the National Register of Historic Places (NRHP) for its potential to yield information important to an understanding of traditional culture, history, and prehistory (36 CFR 60.4(d)). Although the presence and extent of potentially submerged and/or buried cultural deposits cannot be ascertained, BioSystems' investigations should constitute a "reasonable and good faith effort to identify historic properties that may be affected by the undertaking" (36 CFR 800.4(b)). The implementing regulations for Section 106 advise the development of plans for the treatment of properties discovered during implementation of an undertaking, particularly when there is a potential that undisclosed properties may exist within the project area (36 CFR 800.11). The following proposed measures should provide adequate assurance that such discoveries are handled in an appropriate manner.

BioSystems recommends additional coring of the areas to be impacted by the wetland mitigation prior to construction activity. This measure should be sufficient to ensure that archaeological deposits will not be damaged or destroyed without advanced identification. If such deposits are encountered, they should be avoided during wetlands mitigation activities. If discovered properties cannot be avoided, work in the immediate area of the discovery should stop and the State Historic Preservation Division should be consulted to determine the types and amount of study that is appropriate prior to damage or destruction.

Review and concurrence by the State Historic Preservation Division that the proposed undertaking will have no effect on historic properties will satisfy COE's responsibilities under Section 106 of the National Historic Preservation Act, pursuant to 36 CFR 800.5(b).

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APPENDIX A

OHIAPILI POND CORE SAMPLE DATA

Appendix A. Ohiapili Pond core sample data.

OHIAPILI POND CORE SAMPLE - CORE A

Layer	Thickness centimeters below surface (CMBS)	Color (Munsell)	Texture	Structure (all massive)	Consistence			Root	Rocks	Boundary	Cultural Material	Comments
					Dry	Moist	Wet					
I	19 CM (0-19 CMBS)	5 YR 3/3 dark reddish brown to 7.5 YR 3/2 dark brown	silty clay	structureless very fine blocky	n/a	n/a	sticky plastic	none	none	abrupt smooth	non-cultural	Core located in center of existing pond, no vegetation on surface.
II	33 CM (19-52 CMBS)	10 YR 6/3 pale brown to 10 YR 5/2 grayish brown	loamy sand	structureless very fine granular to single grain	n/a	n/a	slightly sticky - slightly plastic	none	none	diffuse irregular	non-cultural	Layer is mottled with different colors of sand.
III	25 CM (52-77 CMBS)	7.5 YR 4/0 dark gray	sand	structureless fine single grain	n/a	n/a	non-sticky non-plastic	none	none	gradual irregular	non-cultural	Layer is slightly mottled with pale colored sand.
IV	143 + CM (77-220 CMBS)	7.5 YR 4/0 dark gray	loamy sand	structureless very fine single grain	n/a	n/a	non-sticky non-plastic	none	none	n/a	non-cultural	Layer is very compacted, extremely fine grained sand. No coral encountered, but an occasional shell of Mytilidae. (Branchidontes crebristriatus)

(Two PVC sections)
TOTAL LENGTH = 220 CM

Appendix A. (Continued)

OHIAPILI POND CORE SAMPLE - CORE B

Layer	Thickness centimeters below surface (CMBS)	Color (Munsell)	Texture	Structure (all massive)	Consistence			Root	Rocks	Boundary	Cultural Material	Comments
					Dry	Moist	Wet					
Ia	5 CM (0-5 CMBS)	10 YR 2/1 black	---	structureless massive	n/a	n/a	---	root mass	none	abrupt smooth	non-cultural	This consists of pickle weed root mass. Core located north of levee in pickle weeds and 8" of standing water.
Ib	1 CM (5-6 CMBS)	10 YR 5/2 grayish brown	silty clay	structureless very fine blocky	n/a	n/a	slightly sticky - slightly plastic	numerous roots and rootlets	none	gradual	non-cultural	Represents transition from root mass to layer Ic.
Ic	40 CM (6-46 CMBS)	5 YR 3/4 to 5 YR 3/2 dark reddish brown	clay to silty clay	structureless very fine blocky	n/a	n/a	sticky plastic	numerous roots and rootlets	none	gradual	non-cultural	
II	28 CM + (46-74 CMBS)	2.5 Y 3/0 very dark gray	loamy sand	structureless very fine single grain	n/a	n/a	non-sticky non-plastic	none	none	n/a	non-cultural	No coral, but at bottom section are pieces of shell - Tellinidae (Macoma dispar?)

(One PVC section)
TOTAL LENGTH = 74 CM

Appendix A. (Continued)

OHIAPILI POND CORE SAMPLE - CORE C

Layer	Thickness centimeters below surface (CMBS)	Color (Munsell)	Texture	Structure (all massive)	Consistence			Root	Rocks	Boundary	Cultural Material	Comments
					Dry	Moist	Wet					
Ia	4.5 CM (0-4.5 CMBS)	10 YR 4/3 dark brown to 10 YR 2/1 black	----	structureless massive	n/a	n/a	--	root mass	none	abrupt smooth	non-cultural	This consists of a pickleweed root mass. Core located in pickleweed near edge of pond with 6-8" of standing water.
Ib	17 CM (4.5-21.5 CMBS)	5 YR 3/4 dark reddish brown	clay to silty clay	structureless very fine blocky	n/a	n/a	sticky plastic	roots and rootlets	none	gradual irregular	non-cultural	
II	32 CM (21.5-53.5 CMBS)	10 YR 5/2 grayish brown	loamy sand	structureless very fine granular	n/a	n/a	slightly sticky - slightly plastic	a few rootlets in upper section	none	gradual to diffuse irregular	non-cultural	
III	23 CM (53.5-76.5 CMBS)	2.5 Y 5/2 grayish brown to 10 YR 6/3 pale brown	sand	structureless very fine to fine single grain	n/a	n/a	non-sticky non-plastic	none	a few small pieces of coral	clear irregular	non-cultural	Layer III has much larger sand grain size that layer II.
IV	60 CM (7.65-136.5 CMBS)	2.5 Y 5/0 gray	loamy sand	structureless very fine single grain	n/a	n/a	slightly sticky - slightly plastic	none	70% coral & shell fragments	gradual to diffuse	non-cultural	
V	139 CM + (136.5-275.5 CMBS)	5Y 6/1 light gray to gray for gley	silt	structureless extremely fine single grain	n/a	n/a	slightly sticky - slightly plastic	none	50% coral	n/a	non-cultural	This layer is very slip-like (watered down clay). Probably a gley deposit.

(Two PVC sections)
TOTAL LENGTH = 275.5 CM

Appendix A. (Continued)

OHIAPILI POND CORE SAMPLE - CORE C "EXTRA"

Layer	Thickness centimeters below surface (CMBS)	Color (Munsell)	Texture	Structure (all massive)	Consistence			Root	Rocks	Boundary	Cultural Material	Comments
					Dry	Moist	Wet					
Ib	15 CM (4-19 CMBS)	7.5 YR 3/2 dark brown	silty clay to clay	structureless very fine blocky	n/a	n/a	sticky plastic	roots and rootlets	none	abrupt smooth	non-cultural	Core located in area of pickelweed & 8-12" of standing water (upper 4 CM of this layer is in pickleweed root mass Layer Ia).
II	30 CM (19-49 CMBS)	10 YR 4/2 dark grayish brown	loamy sand	structureless very fine granular	n/a	n/a	slightly sticky - slightly plastic	a few rootlets	none	gradual to diffuse	non-cultural	Layer II gradually blends into Layer III.
III	27 CM (49-76 CMBS)	10 YR 6/3 pale brown	sand	structureless fine single grain	n/a	n/a	non-sticky non-plastic	none	a few pieces of coral < 5%	abrupt smooth	non-cultural	Layer III has much larger sand grain size as compared to Layer II.
IV	14+ CM (76-90 CMBS)	2.5 Y 4/0 dark gray	loamy sand	structureless very fine single grain	n/a	n/a	non-sticky non-plastic	none	pieces of coral 60%	n/a	non-cultural	Thin layer of fine grained gray sand gives way to sand mixed with large pieces of coral.

(One PVC section)
TOTAL LENGTH = 90 CM

Appendix A. (Continued)

OHIAPILI POND CORE SAMPLE - CORE D

Layer	Thickness centimeters below surface (CMBS)	Color (Munsell)	Texture	Structure (all massive)	Consistence			Root	Rocks	Boundary	Cultural Material	Comments
					Dry	Moist	Wet					
I	26 CM (0-26 CMBS)	5 YR 3/3 dark reddish brown	clay to silty clay	structureless very fine blocky	n/a	n/a	sticky plastic	minor rootlets	none	clear smooth	non-cultural	Core taken within standing water of pond, near edge of pickleweeds.
II	21 CM (26-47 CMBS)	10 YR 5/2 grayish brown	loamy sand	structureless very fine granular	n/a	n/a	slightly sticky - slightly plastic	a very few rootlets	none	gradual irregular	non-cultural	Mottled layer representing transition from I to II.
III	44 CM (47-91 CMBS)	2.5 Y 4/0 dark gray	loamy sand	structureless very fine single grain	n/a	n/a	non-sticky non-plastic	none	a few small coral & shell fragments <5%	gradual irregular	non-cultural	
IV	28 CM (91-119 CMBS)	5 Y 5/1 gray from gley chart	sandy-silt	structureless extremely fine single grain	n/a	n/a	slightly sticky - slightly plastic	none	60% coral fragments	n/a	non-cultural	Layer IV is finer and more slip-like in consistency than Layer III, with a higher coral content.

(One PVC) section)
TOTAL LENGTH = 119 CM

Appendix A. (Continued)

OHIAPILI POND CORE SAMPLE - CORE E

Layer	Thickness centimeters below surface (CMBS)	Color (Munsell)	Texture	Structure (all massive)	Consistence			Root	Rocks	Boundary	Cultural Material	Comments
					Dry	Moist	Wet					
I	33 CM (0-33 CMBS)	5 Y 3/3 dark reddish brown	clay to silty clay	structureless very fine blocky	n/a	n/a	sticky plastic	none	none	diffuse broken	non-cultural	Core located in standing water of pond 12" ±.
II	14 CM (33-47 CMBS)	10 YR 5/2 grayish brown	loamy sand/clay mix	structureless very fine granular to blocky	n/a	n/a	slightly sticky - slightly plastic	none	none	gradual irregular	non-cultural	Mottled Layer - transition between Layer I and Layer III
III	16 CM (47-63 CMBS)	2.5 Y 4/0 dark gray to 2.5 Y 3/0 very dark gray	loamy sand	structureless very fine single grain	n/a	n/a	non-sticky non-plastic	none	none	abrupt smooth	non-cultural	A few shells. Tellinidae (Macoma dispar?)
IV	17 CM (63-80 CMBS)	2.5 Y 5/10 gray to 2.5 Y 4/0 dark gray	sand	structureless very fine to fine single grain	n/a	n/a	non-sticky non-plastic	none	none	abrupt smooth	non-cultural	Sand particles much coarser than Layer III.
V	39+ CM (80-119 CMBS)	2.5 Y 4/0 dark gray	loamy sand	structureless very fine single grain	n/a	n/a	non-sticky non-plastic	none	none	n/a	non-cultural	Sand particles are extremely fine and compacted.

(One PVC section)
TOTAL LENGTH = 119 CM

Appendix A. (Continued)

OHIAPILI POND CORE SAMPLE - CORE F

Layer	Thickness centimeters below surface (CMBS)	Color (Munsell)	Texture	Structure (all massive)	Consistence			Root	Rocks	Boundary	Cultural Material	Comments
					Dry	Moist	Wet					
I	34 CM (0-34 CMBS)	5 YR 3/3 dark reddish brown	clay to silty clay	structureless very fine blocky	n/a	n/a	sticky plastic	none	none	diffuse broken	non-cultural	Core located in standing water of pond.
II	10 CM (34-44 CMBS)	10 YR 4/2 dark grayish brown	loamy sand with clay	structureless very fine granular to blocky	n/a	n/a	slightly sticky - slightly plastic	none	none	diffuse irregular	non-cultural	Very mottled layer, transition between Layer II and Layer III.
III	26 CM (44-70 CMBS)	2.5 Y 4/0 dark gray	sand	structureless very fine single grain	n/a	n/a	non-sticky non-plastic	none	a few coral fragments	clean smooth	non-cultural	Slightly mottled with pockets of Layer II at the upper end. Probably result of coring.
IV	80+ CM (70-150 CMBS)	2.5 Y 4/0 dark gray	loamy sand	structureless very fine single grain	n/a	n/a	non-sticky non-plastic	none	none	n/a	non-cultural	Similar to Layer III, but much more compacted and finer grain size. Minor shell fragments.

(One PVC section)
TOTAL LENGTH = 150 CM

Appendix A. (Continued)

OHIAPILI POND CORE SAMPLE - CORE G

Layer	Thickness centimeters below surface (CMBS)	Color (Munsell)	Texture	Structure (all massive)	Consistence			Root	Rocks	Boundary	Cultural Material	Comments
					Dry	Moist	Wet					
I	28 CM (0-28 CMBS)	10 YR 3/3 dark brown to 10 YR 4/2 dark grayish brown	silty clay with sand	structureless very fine blocky to granular	n/a	n/a	sticky plastic	none	none	diffuse irregular	non-cultural	Core located in standing Layer I has more clay at top end and gradates into Layer II.
II	29 CM (28-57 CMBS)	10 YR 6/3 pale brown to 10 YR 5/2 grayish brown	loamy sand	structureless very fine granular	n/a	n/a	slightly sticky - slightly plastic	none	none	gradual irregular	non-cultural	Mottled
III	15 CM (57-72 CMBS)	2.5 Y 4/0 dark gray	loamy sand	structureless very fine single grain	n/a	n/a	non-sticky non-plastic	none	none	clean smooth	non-cultural	
IV	75 CM (72-147 CMBS)	2.5 Y 4/0 dark gray	loamy sandy silt	structureless very fine single grain	n/a	n/a	non-sticky non-plastic	none	50% coral & shell	diffuse irregular	non-cultural	Similar to Layer III, except for presence of shell and coral. Some shell may be Turbo.
V	100 CM (147-247 CMBS)	2.5 Y 4/0 dark gray or 5 Y 5/1 gray on the gley chart	silt	structureless extremely fine single grain	n/a	n/a	non-sticky non-plastic	none	25% coral	n/a	non-cultural	Soil is a slip-like silty gley - extremely fine in consistency.

(Two PVC sections)
TOTAL LENGTH 247 CM

APPENDIX B

SUMMARY REPORT FOR AN ARCHAEOLOGICAL INVENTORY SURVEY OF AN ALTERNATIVE AREA FOR THE MAUNA LOA BORROW SITE FOR THE KALAMA‘ULA LANDFILL ON WEST MOLOKA‘I, HAWAI‘I

INTRODUCTION

BioSystems Analysis, Inc., at the request of Brown and Caldwell Consultants, conducted an additional archaeological survey for the proposed Mauna Loa Borrow Pit in West Moloka'i. This work supplements an initial cultural resources survey for the project (Shapiro et al. 1993) in which an archaeological site (50-60-02-892) was identified and recorded. In order to avoid impacts to the archaeological site and to expand the available area that would accommodate the end use of the site, Brown and Caldwell proposed an additional 10-acre parcel of land adjacent to the initially proposed Borrow Pit site. This report documents the archaeological inventory survey of the expanded project area.

The archaeological fieldwork was conducted on April 20, 1993. The purpose was to determine the presence or absence of potentially significant cultural resources within the project prior to development.

The Principal Investigator is Paul L. Cleghorn, Ph.D, who managed all aspects of the archaeological work. The fieldwork was directed by Lisa Shapiro, M.A., with assistance from field archaeologist James McIntosh.

PROJECT DESCRIPTION

The project is characterized by a small, grass-covered knoll, approximately 10 acres in size, and bordered on three sides by steep gulches (i.e., Kamakahi Gulch and two of its smaller ravines border the east, north and west portions of the project). The south boundary occurs at a steep cutbank formed by State Route 460, the Mauna Loa Highway. A barb-wire fenceline parallels State Route 460 across the knoll-top in this area to contain cattle within the Moloka'i Ranch property.

A continuous cover of various grasses (including *pili*) averaging one foot tall, *ilima*, and bunch grasses growing as tall as five feet characterize the understory in the project. Numerous Christmas-berry bushes dot the landscape. A sparse surface distribution of basalt cobbles and boulders occurs throughout the parcel.

The eroding walls of the gulches, occasional erosional surfaces, the road cutbank, and the ground beneath the Christmas-berry provide the only mineral soil visibility in the project. These surface conditions are important in that ground visibility provides evidence of small cultural elements (e.g., lithic tools, shell, bone) and larger prehistoric features (e.g., rock alignments, *ahu*, and platforms).

METHODS

A complete pedestrian survey of the project was achieved by two archaeologists walking systematic transects at intervals spaced approximately 15 meters apart over the entire parcel. The transects were conducted in a north-to-south direction using the road as a south boundary. The eroding cutbanks of the gulches and road were closely examined for cultural constituents to identify potential buried deposits.

The locations of cultural resources were plotted onto the Moloka'i Airport, HI., 7.5 minute USGS quadrangle map and were recorded using a compass and 50-meter fiberglass tape. General project overviews and cultural resource areas were photographed in black-and-white film using a 35-mm camera. Collected specimens were placed in plastic bags with provenience information for subsequent analysis.

The fieldwork included a visit to archaeological site 50-60-02-892, located about 0.1 miles west of the parcel, in order to verify and photograph its location, components, and proximity to the new project area.

RESULTS

The archaeological survey identified two locations of cultural material within the new project. Three basalt flakes were discovered on the inside of the barb-wire fence in the south project area near State Route 460 on the west edge of the knoll-top. The flakes were found within one meter of each other and along a grass-covered ephemeral trail (probably a deer or cattle trail) paralleling the base of the fenceline. Ground visibility in the immediate area is obscured by surface grasses and vegetation. The best visibility is afforded by the road cutbank located 18 meters south and by the exposed ground surface beneath a large stand of Christmas-berry located about four meters to the north. No other cultural materials were observed in these locales. The flakes may have been brought to the surface by digging postholes for the fenceline. The flakes were collected for subsequent analysis.

The second location of cultural material occurs in the northeast project area within an erosional cutbank approximately 15 meters south of Kamakahi Gulch. Two marine shells (*'Opihi; Cellana* sp.) were discovered approximately 1.5 meters downslope (30 degree slope) from the grass-covered surface. No other cultural material was discovered (including changes in soil color and texture). The shells have probably eroding from the cutbank. The shells were collected for subsequent identification and analysis.

A small trench (seven feet long by three feet wide and five feet deep), recently excavated in the knoll-top on the south side of the barb-wire fence, was examined by the archaeologists. The trench walls revealed a lack of stratigraphy, were characterized by a homogenous brown colored soil, and contained no cultural material.

CONCLUSION

A complete archaeological inventory survey of an alternative 10-acre parcel for the proposed Mauna Loa Borrow Pit was conducted. Two locations of cultural material were discovered in the project area. One location containing three basalt flakes was identified in the south project near State Route 460. The terrain is characterized by dense grass cover. The flakes could have been displaced to their location through the process of digging post holes for the barb-wire fence. The second location consists of an eroded cutbank near Kamakahi Gulch in the northeast project area from which two marine shells were identified. The shells may be eroding from the cutbank. These cultural items represent sporadic prehistoric use of the project area, probably in relation to a larger archaeological resource located 0.1 miles west (Site 50-60-02-892).

No archaeological sites were identified in the proposed new project area. The three flakes and two marine shells found in the parcel, in conjunction with the dense grass cover and close proximity to 50-60-02-892, warrants archaeological monitoring during the initial construction phase of the Mauna Loa Borrow Pit site. The monitoring will insure that any undetected cultural resources or buried cultural deposits are not impacted by the development.

RECOMMENDATIONS

The survey results suggest sporadic prehistoric use of the parcel in probable association with site 50-60-02-892 located about 0.1 miles west. Due to the potential significance of 50-60-02-892 (cf. Shapiro et al. 1993) and the cultural material recovered from the new project area (i.e., three basalt flakes and two marine shells), it is recommended that an archaeologist monitor the initial ground disturbing activities for the new borrow pit site. Specifically, the monitoring should focus on the careful mechanical removal of vegetation from the project area in order to identify surface features and artifacts. In addition, the archaeologist should monitor initial ground disturbing activities to verify that buried cultural deposits are not present.

If buried cultural deposits are discovered during the construction of the borrow pit site, work in the immediate area of the find should stop and the State Historic Preservation Division should be consulted. This action is necessary to determine the types and amount of study that is appropriate prior to damage or destruction.

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