DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

SAM CALLEJO
DIRECTOR AND CHIEF ENGINEER

IN REPLY REFER TO:

91-12-0530

November 18, 1991

Mr. Brian Choy, Director
Office of Environmental Quality Control
State of Hawaii
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Mr. Choy:

Subject: Negative Declaration for the Woodlawn Area Earth Stabilization Project, Manoa, Honolulu, Oahu, Hawaii, Tax Map Key: 2-9-25, 39, 50, 57 and 58

This letter is a notice of Negative Declaration by the proposing agency, the City and County of Honolulu, Department of Public Works. The subject action has been assessed according to Title 11, Chapter 200, Environmental Impact Statement Rules, and Chapter 343, HRS.

A determination has been made that an environmental impact statement is not required based on an environmental assessment which was prepared for the project. Four copies of the environmental assessment are enclosed.

The pertinent information for this notice of determination is summarized below.

1. *PROPOSING AGENCY*

City and County of Honolulu, Department of Public Works.

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2. *DESCRIPTION OF THE PROPOSED ACTION*

The project proposes to initiate design and construction of certain remedial measures to mitigate the ongoing damage to residential structures and public utilities from earthen slide movements within the Woodlawn residential area of Manoa, Oahu in the vicinity of Paty Drive, Alani Drive, Paty Drive Extension, Kahaloa Drive, Hulu Place, Woolsey Place and Lanikaula Street. The project includes the stabilizing of the Woodlawn area by implementing subsurface drainage improvements, surface drainage improvements and constructing a tieback anchor system (a mechanical restraint system). In addition to stabilization of the slides, reconstruction, replacement, and improvements to utilities and streets damaged by slide movement will also be completed in the project area. The total estimated costs to complete the project are $25.1 million in 1991 dollars. Completion of the proposed earth stabilization measures is expected to take approximately 2 years for each landslide area ("Paty-Alani Landslide" and "Hulu-Woolsey Landslide").

3. *DETERMINATION*

After preparing an environmental assessment and consulting with other agencies, we have determined that the proposed project will not have a significant impact on the environment, and an Environmental Impact Statement is not required.

4. *REASONS SUPPORTING DETERMINATION*

Reasons and conclusion supporting determination are based on the following criteria.

The proposed project will not:

a. Involve an irrevocable commitment to loss or destruction of any natural or cultural resource;

b. Curtail the range of beneficial uses of the environment;

c. Conflict with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 344, Hawaii Revised Statutes, and any revisions thereof and amendments thereto, court decisions or executive orders;

d. Substantially affect the economic or social welfare of the community or State;

e. Substantially affect public health;

f. Involve substantial secondary impacts, such as population changes or effects on public facilities;

g. Involve a substantial degradation of environmental quality;

h. Substantially affect a rare, threatened, or endangered species, or its habitat;

i. Detrimentally affect air or water quality or ambient noise levels; or

j. Detrimentally affect an environmentally sensitive area, such as a flood plain, tsunami zone, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters.

5. *CONTACT PERSON*

Melvin Takakura
Department of Public Works
Division of Engineering
Honolulu Municipal Building, 15th Floor
650 South King Street
Honolulu, Hawaii 96813

Telephone No.: 523-4931

Very truly yours,

SAM CALLEJO
Director and Chief Engineer

Attachment (4 copies)

cc: STV/Lyon Associates (w/o attach.)
Department of General Planning (w/attach.)

1991-12-08-OA-FBA

FILE COPY

FINAL ENVIRONMENTAL ASSESSMENT

* WOODLAWN AREA EARTH STABILIZATION PROJECT *

Manoa District, Honolulu, Hawaii
TMKs 2-9-25, 39, 50, 57 and 58

This environmental document was prepared pursuant to Chapter 343, Hawaii Revised Statutes

Proposing Agency:

Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Prepared By:

STV/Lyon Associates

FINAL ENVIRONMENTAL ASSESSMENT

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This environmental document was prepared
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Proposing Agency:

Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Prepared By:

STV/Lyon Associates

Responsible Official: _____ Date: 11-12-91
Sam Callejo
Director and Chief Engineer

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1.0 OVERVIEW

The City and County of Honolulu Department of Public Works (DPW) proposes to initiate design and construction of certain remedial measures to mitigate the ongoing damage to residential structures and public utilities from earthen slide movements within the Woodlawn residential area of Manoa, Oahu in the vicinity of Paty Drive, Alani Drive, Paty Drive Extension, Kahaloa Drive, Hulu Place, Woolsey Place and Lanikaula Street. DPW has contracted with STV/Lyon Associates to conduct necessary geotechnical studies and design stabilization projects. The project includes the stabilizing of the Woodlawn area by implementing subsurface drainage improvements (by installing horizontal and vertical drain wells), surface drainage improvements, and constructing a tieback anchor system (a mechanical restraint system). The construction of the tieback system in the Paty-Alani slide will require the acquisition of five lots: lot 3037 Kahaloa Place, lots 3089, 3110 and 3115 Kahaloa Drive and lot 3065 Kalawao Street.

Easements for the installations of tieback anchors and horizontal drainage wells would be required for virtually all owners along Alani Drive, Paty Drive and Paty Drive Extension whose properties lie within the slide or a short lateral distance from the slide. Easements would also be required of all owners above empty lot 3089 Kahaloa Drive and lots 3092 and 3104 Kahaloa Drive. Similar easements may be required from owners on the south side of Lanikaula Street, Woolsey Place and Hulu Place.

In addition to stabilization of the slides, reconstruction, replacement, and improvements to utilities and streets damaged by slide movement will also be completed in the project area. The utility replacement and improvements will include work on storm drains, sanitary sewer, and water supply. Coordination, minor relocation, and protection during construction of other utilities including electric, telephone, cable TV, and gas will also be included with this project.

Considering the costs for stabilization and the costs for utility and street reconstruction and improvements, and the additional drilling, monitoring and engineering services for final design, the total estimated costs to complete the project are $25.1 million in 1991 dollars.

Completion of the proposed earth stabilization measures is expected to take approximately 2 years for each landslide area ("Paty-Alani Landslide" and "Hulu-Woolsey Landslide").

The proposed project is subject to Chapter 343, Hawaii Revised Statutes (HRS), since it will involve the use of County funds and lands. This environmental assessment (EA) was prepared by Helber Hastert & Kimura, Planners under subcontract to STV/Lyon Associates, pursuant to Chapter 343, HRS and Chapter

11-200, Hawaii Administrative Rules. The report assesses the probable nvironmental impacts associated with the implementation of mitigative measures designed to stabilize the Manoa hillside area.

Adverse environmental impacts are expected to be limited primarily to increased dust, noise and traffic congestion generated during the construction phase of the project. The impact of construction activities will be mitigated by conforming to regulations governing erosion and noise control, and construction-activity traffic management.

Based on review and input from agencies and organizations identified in Chapter 6.0, DPW has determined that the project will not adversely affect the physical and social environment and that there will be no permanent degradation of existing ambient air and noise levels.

Table 1: PROJECT SUMMARY

1. Proposing Agency: Department of Public Works, City and County of Honolulu.

2. Location: Woodlawn Area, Manoa Valley, Honolulu, Hawaii.

3. Landowners: City and County of Honolulu and approximately 130 private landowners.

4. Summary Description of Proposed Action and Location: The proposed action involves the stabilization of earth by improving subsurface drainage, surface drainage and installing a mechanical restraint system. Implementation of these earth stabilization measures will include the acquisition of five residential lots and obtaining easements from numerous private property owners within the project area. In addition to earth stabilization, reconstruction, replacement, and improvements to utilities and streets damaged by slide movement will also be completed in the project area.

5. Cost of Project: Approximately $25.1 million in 1991 dollars.

6. Duration of Construction: Construction period expected to take 2 years for each slide area.

7. Project Area: Approximately 35 acres.

8. Existing Use: Residential.

9. Number of Residents Affected: Approximately 429.

10. State Land Use: Urban.

11. Development Plan Designation:

    a. Land Use Map: Residential.

    b. Public Facilities Map: Drainage improvements presently underway along Kahaloa Street and Kahaloa Place are shown on the City and County of Honolulu Development Plan Public Facilities Map.

12. Zoning: R-7.5 and R-10 Residential, and P-2 General Preservation.

2.0 DESCRIPTION OF THE PROJECT AREA AND HISTORY OF THE LANDSLIDE PROBLEM

The following description of the project area and history of the landslide problem was obtained largely from a number of geotechnical studies prepared by Geolabs-Hawaii (Refs. 4-9) and a report prepared by the U.S. Geological Survey (Ref. 30). Chapter 8.0 provides a complete listing of references used in this report.

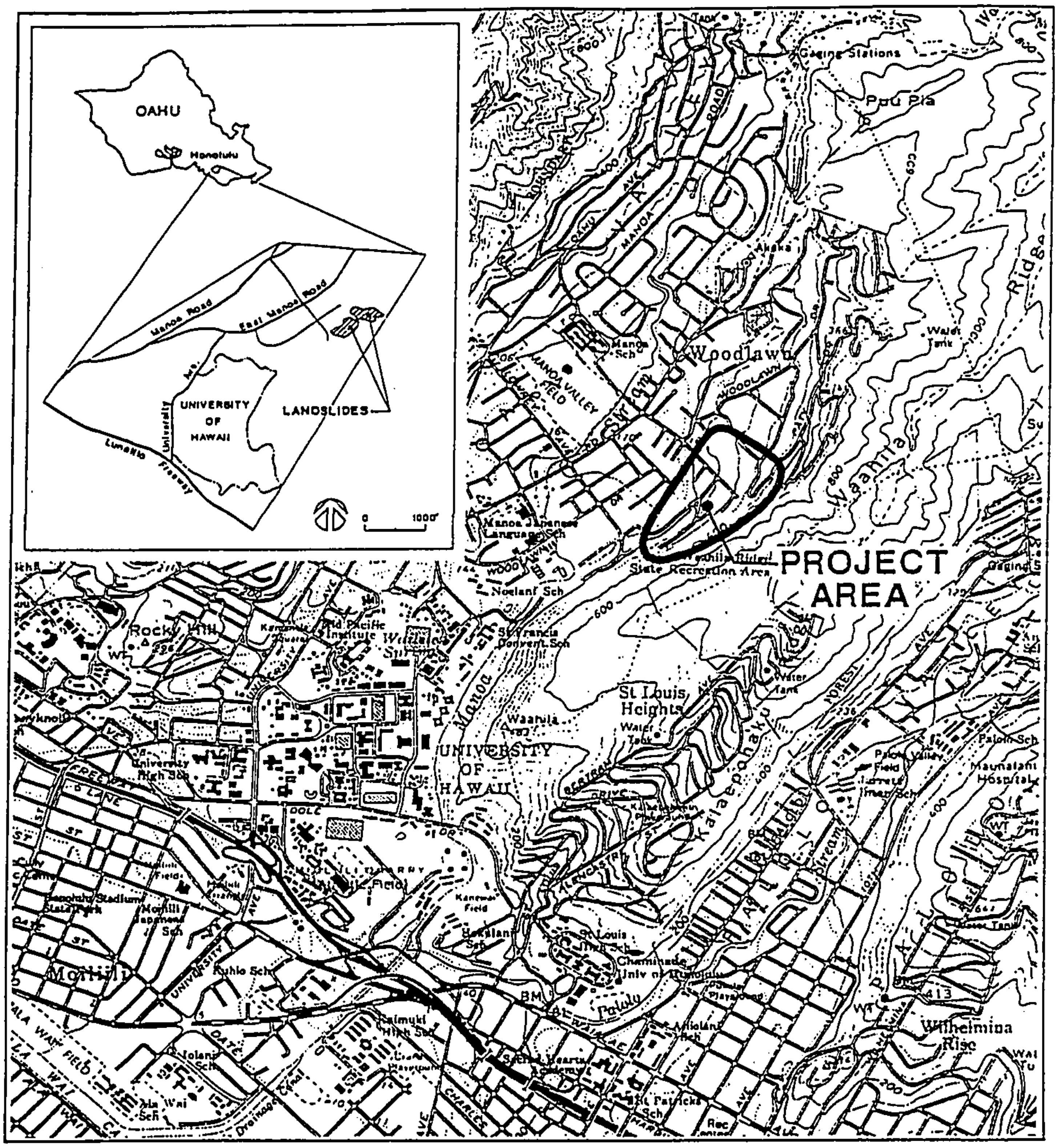
2.1 Project Location and Land Use Designations

The proposed project is located in an older residential area of Manoa Valley, once known as Veteran's Acres and Kanewaalau Tracts, and includes Paty Drive Extension, Kahaloa Place, Lono Place, Hulu Place, Woolsey Place, and portions of Paty Drive, Alani Drive, Kahaloa Drive, and Lanikaula Street (Figures 1 and 2). For the purposes of this report, the area is generally referred to as the "Woodlawn Area" in recognition of the major street by the same name which provides the principal access to this eastern side of Manoa Valley.

The project area comprises approximately 35 acres which roughly coincides with the two principal slide areas (Paty-Alani, Hulu-Woolsey) identified by the US Geologic Survey (Ref. 30). Discussion of the landslide areas is provided in Section 2.7.

The City and County of Honolulu Development Plan Land Use Map designation for the project area is Residential (Figure 3). The City and County of Honolulu Development Plan Public Facilities Map (Figure 4) shows drainage improvements in the project area along Kahaloa Drive and into Kahaloa Place. The City and County of Honolulu Department of Public Works recently completed the drainage improvements along Kahaloa Drive up to Lanikaula Street.

The project area is located within the State Urban District (Figure 5). The steeply-sloped lands mauka of the project area lie within the State Conservation District. The portion of the project area south of Kahaloa Drive is zoned R-7.5 Residential and the area north, within the project area, R-10 Residential. A small portion of the project (approximately 2.4 acres) is zoned P-2 General Preservation.



Location Map

Figure 1

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Woodlawn Area Earth Stabilization Project

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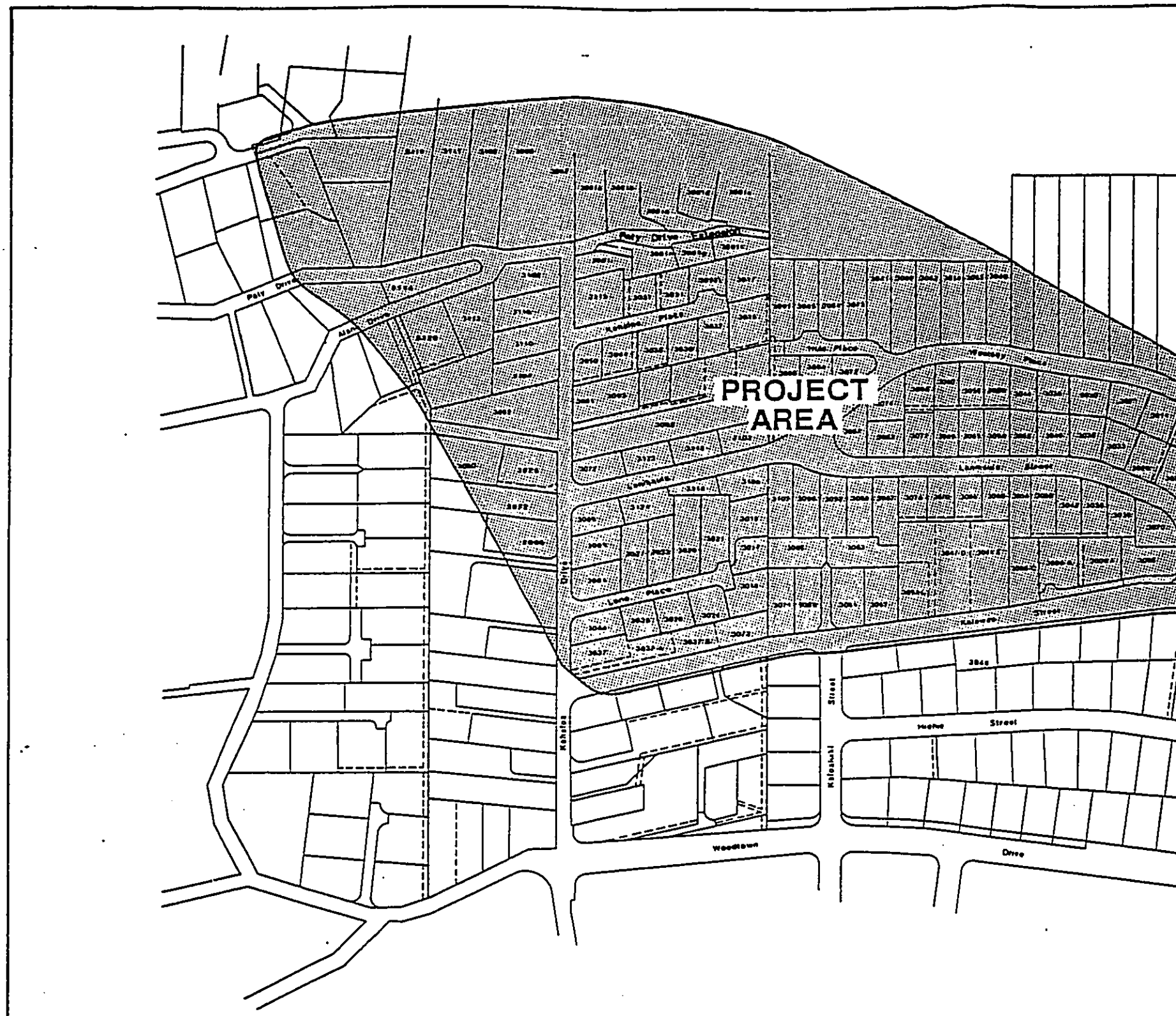

Project Area

Woodlawn Area Earth Stabilization Project

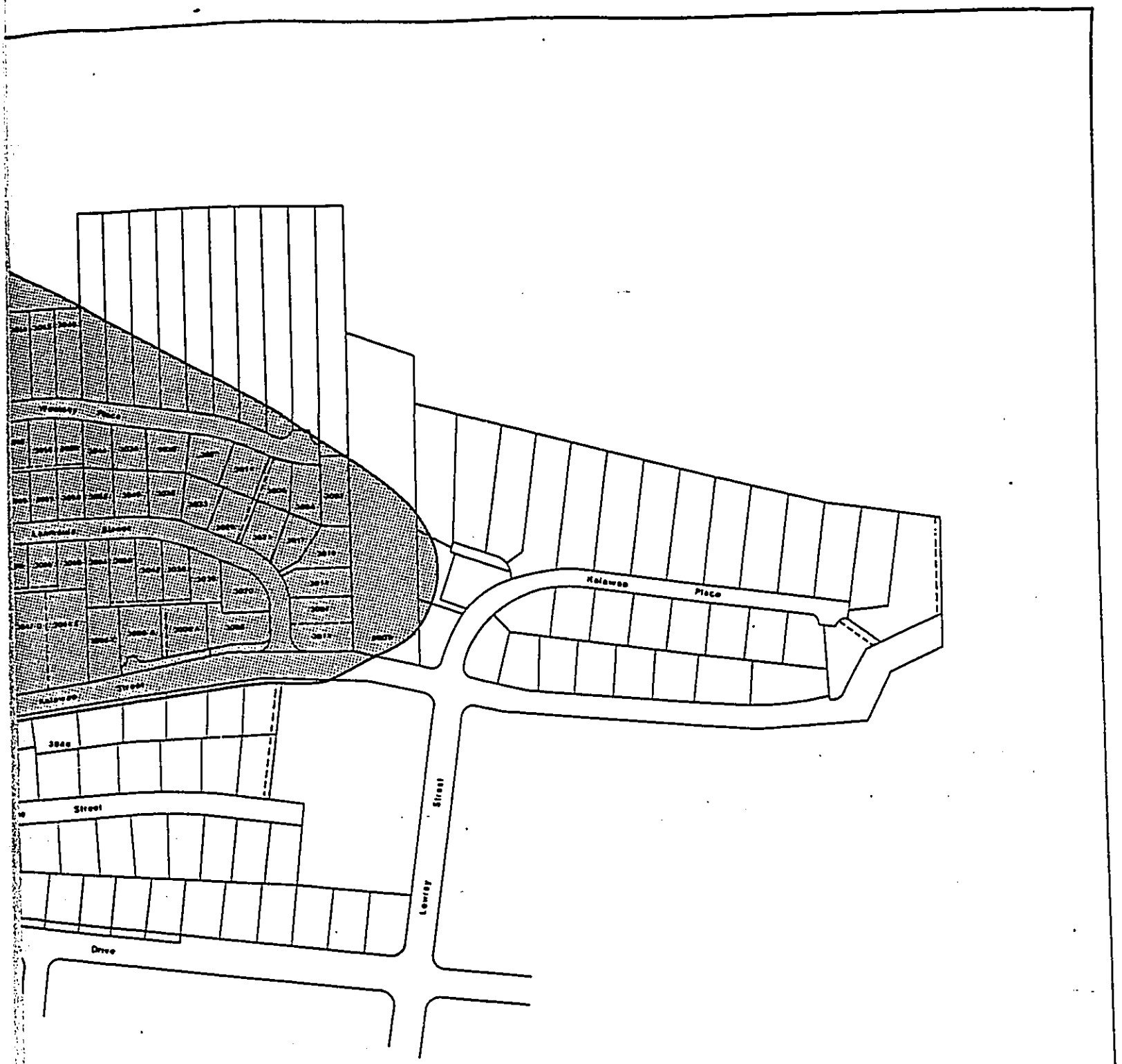

Figure 2

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CORRECTION

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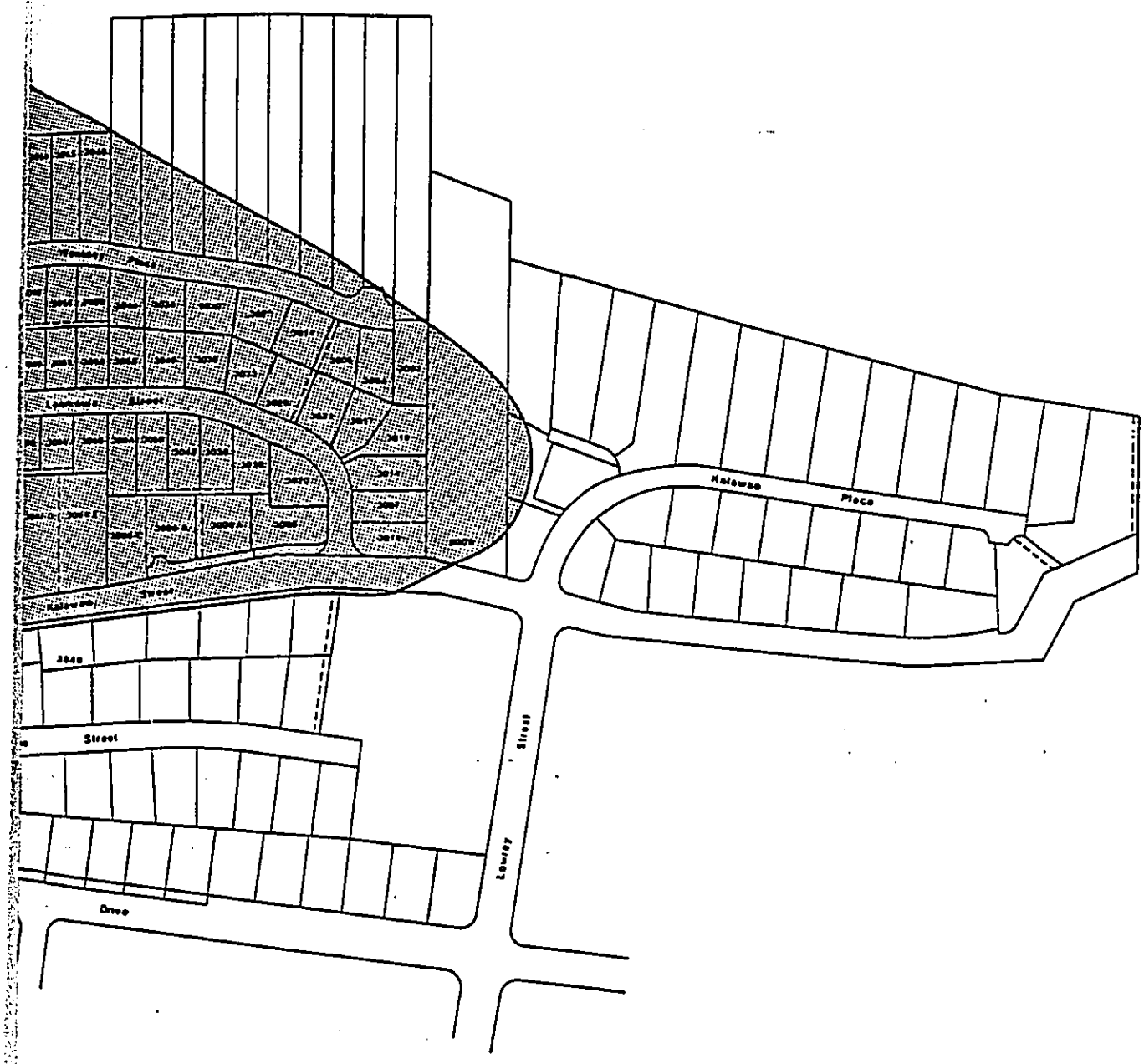

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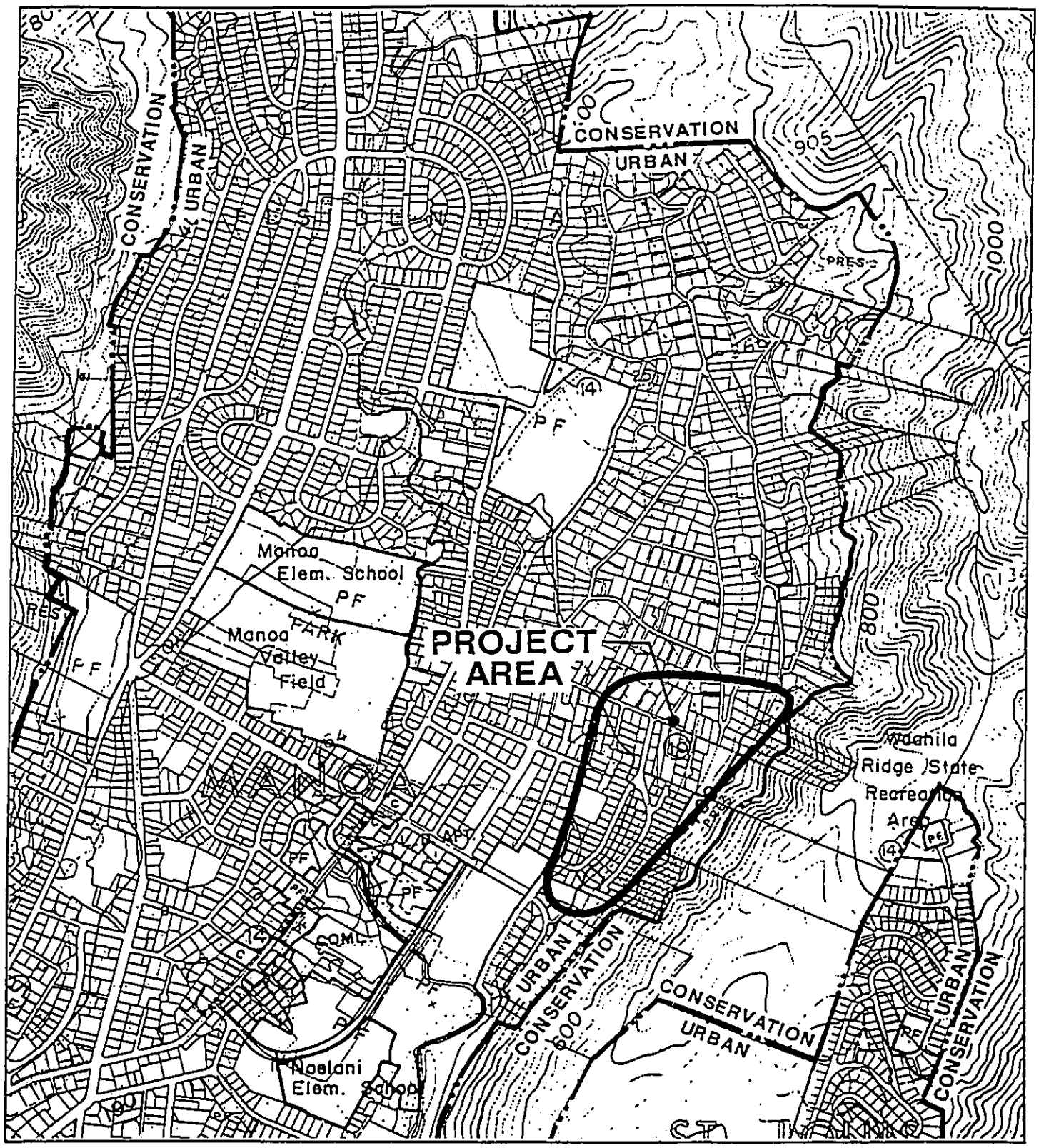

State and County DP Land Use Districts

Woodlawn Area Earth Stabilization Project

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Figure **3**

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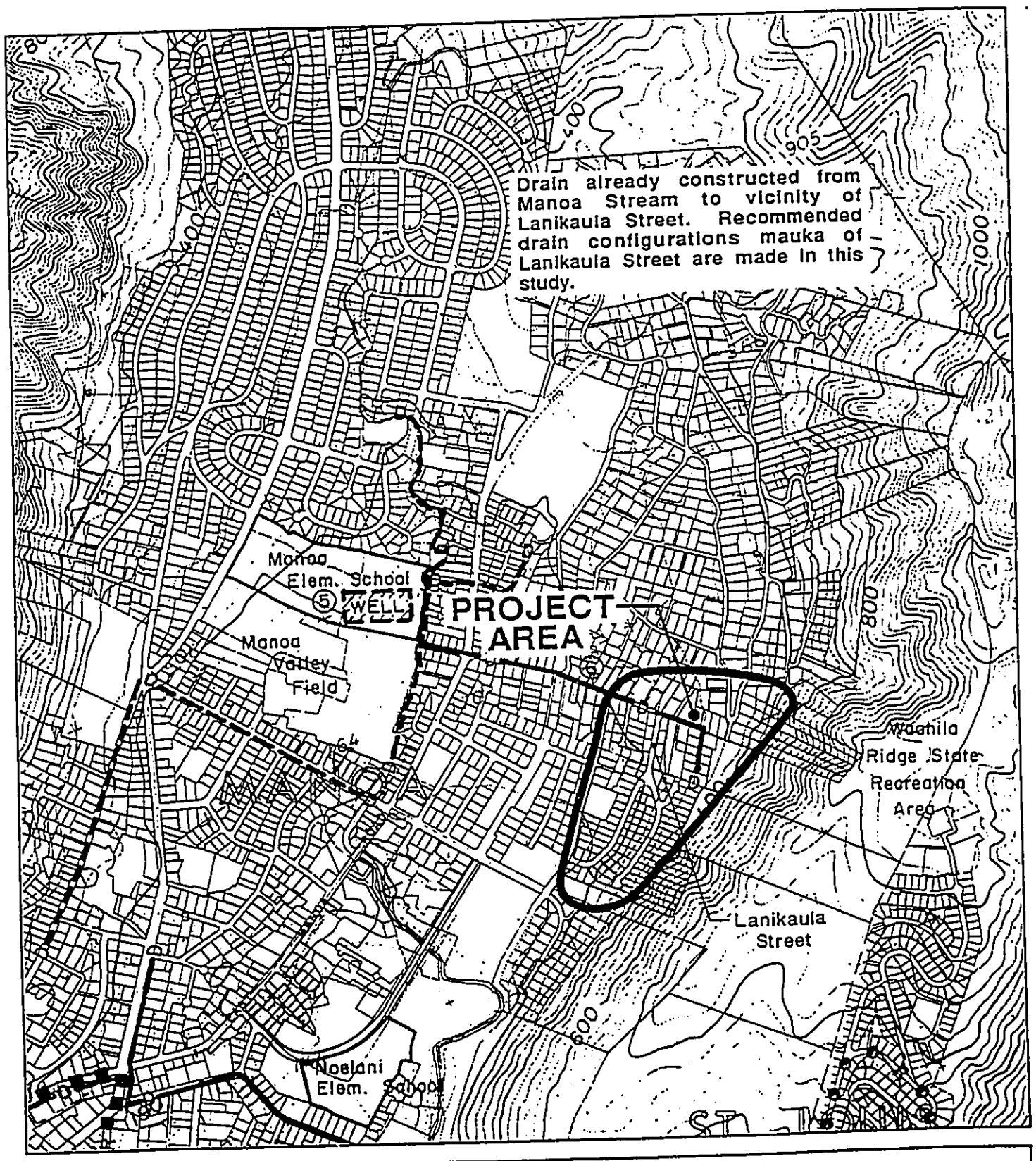

DP Public Facilities Map

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Figure 4

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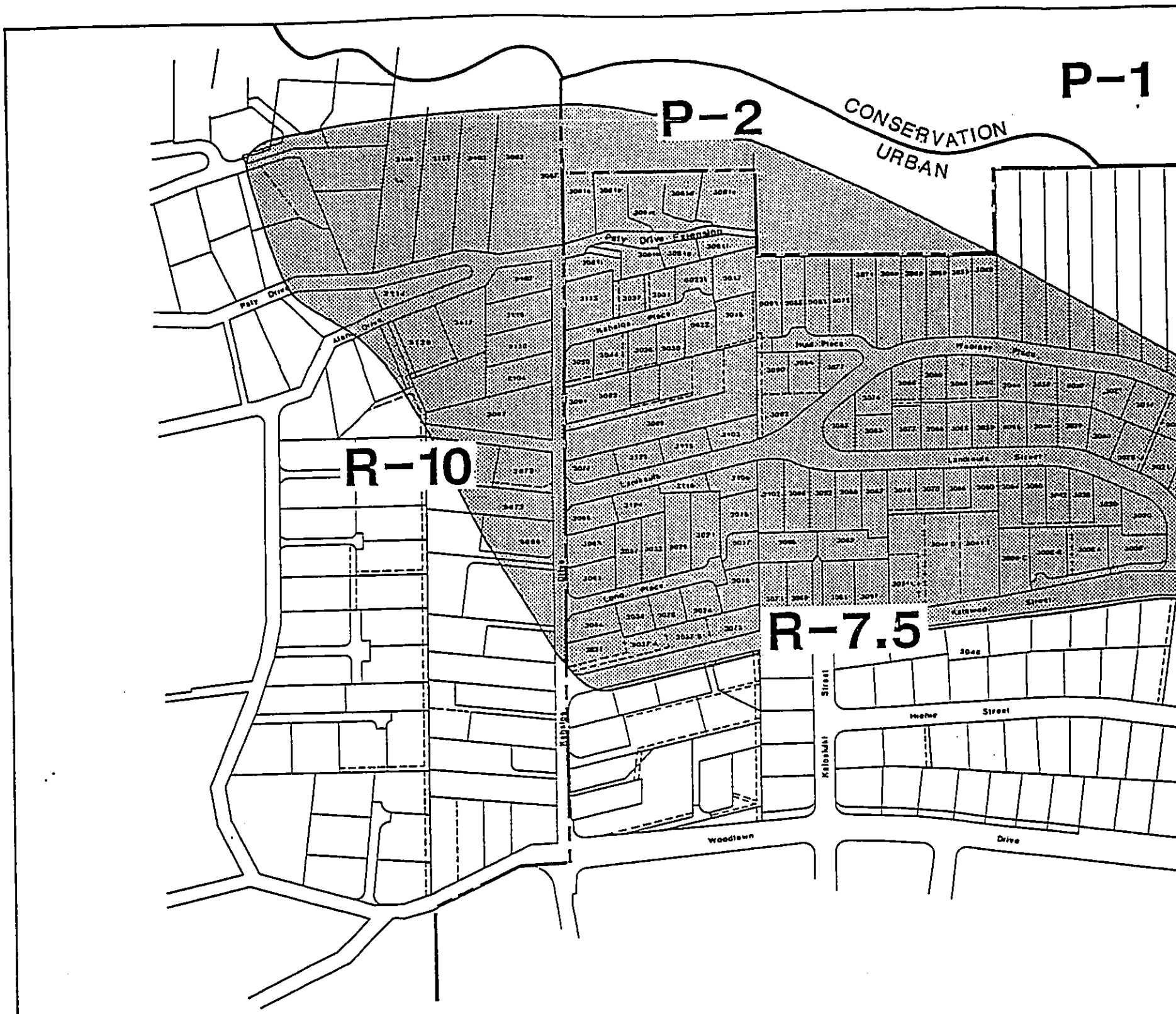

State Land Use and County Zoning

Woodlawn Area Earth Stabilization Project

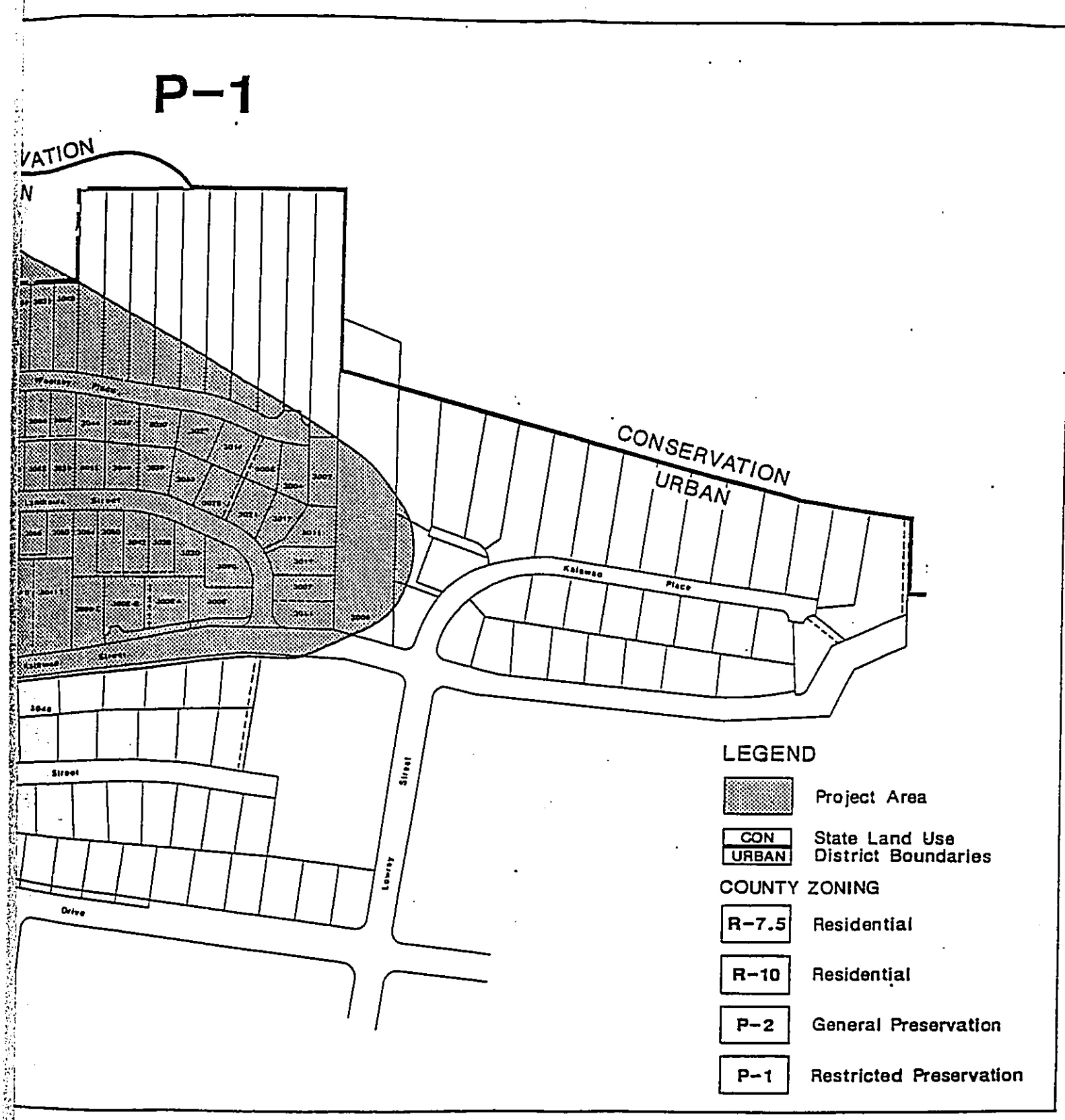

Figure 5

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2.2 Climate

Average temperature for the area ranges from 69.4 degrees Fahrenheit (F) during the winter to 75.2 degrees F during the summer (Lyon Arboretum Station). Annual precipitation varies with elevation as indicated by the summary of four nearby rainfall stations shown in Table 2. Due to the variation in elevation within the project area (160 feet to 400 feet), the average annual rainfall is estimated to vary somewhere between that indicated at the Manoa Station (71.88 inches) and the Lyon Arboretum station (158.07 inches).

Table 2: RAINFALL RECORDS SUMMARY

Name/ State Station I.D. No.	Elevation (feet)	Average Rainfall Per Year 1979-1988 (inches)	Maximum Rainfall Year (1982) (inches)	Normal Average Rainfall Per Year (inches)
University of Hawaii/713.00	79	38.75	57.98	N/A
Manoa/712.00	200	71.88	90.25	66.66
Lyon Arboretum/785.20 (HSPA 785)	500	158.07	213.04	N/A
Manoa Tunnel 2/716.00	650	152.67	203.96	144.21

2.3 Geology

The project site is located on the side of a ridge of the Koolau Range, along the eastern side of Manoa Valley. This ridge is an erosional remnant from the Leeward flank of the Koolau Range and consists of steep rocky slopes of relatively unweathered, dense basalt (Ref. 5). The upper steep to near-vertical slopes consist primarily of massive basalt outcrops. At the foot of the slopes where the project area is located, material of the upper valley sides has been deposited as large quantities of colluvium.

The colluvium deposits consist of angular to subangular boulders, cobbles and pebbles of basalt that are poorly sorted, ranging in size from 1 to 2 feet to less than 1 inch in a matrix of fine-grained, partly weathered material. The colluvial material represents the shedding of erosional debris from the steeper slopes by landslides, soil avalanches or by other means of mass transfer (ibid.). Some of the colluvium has been partly consolidated (cemented) into a fairly coherent rocky mass that may be called a gravel/cobble breccia or conglomerate. The lower part of Manoa Valley was subsequently covered with a surface layer of younger alluvium consisting of gray clay with cobbles and boulders locally termed adobe, or "taro-patch clay" (Ref. 28).

2.4 Topography/Slope

Ground elevations over the project area range from 160 to 400 feet above mean sea level, with an average slope of approximately 20 to 33 percent. Slopes directly mauka of the project area become near-vertical.

2.5 Soils

Borings undertaken in the project area by Geolabs-Hawaii have generally encountered a clayey or sandy surface fill layer from the grading of streets and driveways overlying the "adobe" clay which is then underlain by silty, gravelly and boulderly colluvium to the drilled depths of the borings. The fill layer varies in quality and thickness with location, but the clay layer generally increases in thickness towards the bottom of the valley. The fill material was found to be a variable mixture of sand, gravel and clayey silt, generally reasonably well-compacted. Some (Ref. 7) view the upper "adobe" clay as alluvium and consider it a generally weak soil, particularly when saturated, whereas the underlying colluvium is stiff to hard in consistency and is considered a competent formation. Others view both soils within the slide area as colluvium.

2.6 Drainage

The tributary drainage area, bounded approximately by Waahila Ridge, Kahaloa Drive and Kalawao Street, encompasses approximately 62 acres (Ref. 3). The predominant topographic condition causes surface runoff to flow towards lateral streets including Kahaloa Place, Woolsey Place, Hulu Place and Lanikaula Street. The storm runoff generated within the project area flows into and through a series of drainage facilities and eventually flows or is directed into Manoa Stream.

2.7 History of Landslide Problem within Project Area

Development of the Woodlawn area of Manoa Valley began in the late 1940's. The roadway system for the project area was completed during the early 1950's (Ref. 5). Grading generally involved excavating the uphill side of the roadway and probably using the excavated materials for the fill embankment construction on the lower side. The initial site grading for the subdivision development appears to have been limited to the areas adjacent to roads. The majority of the excavations appear to have been in the upper clay deposits of highly plastic clays mixed with cobbles and boulders. The cut slope at the southeasterly end of Woolsey Place appears to be partially into basalt bedrock.

A series of underground water and sewer utility lines were probably installed at about the same time the roads were constructed with other utilities added

later. Within 2 to 3 years after completion of infrastructure improvements, a number of houses had been built in the subdivision with more homes added in subsequent years. As more time elapsed, other construction activity, such as lot regrading and the construction of retaining walls, garages and houses, probably further altered the original slope configuration considerably.

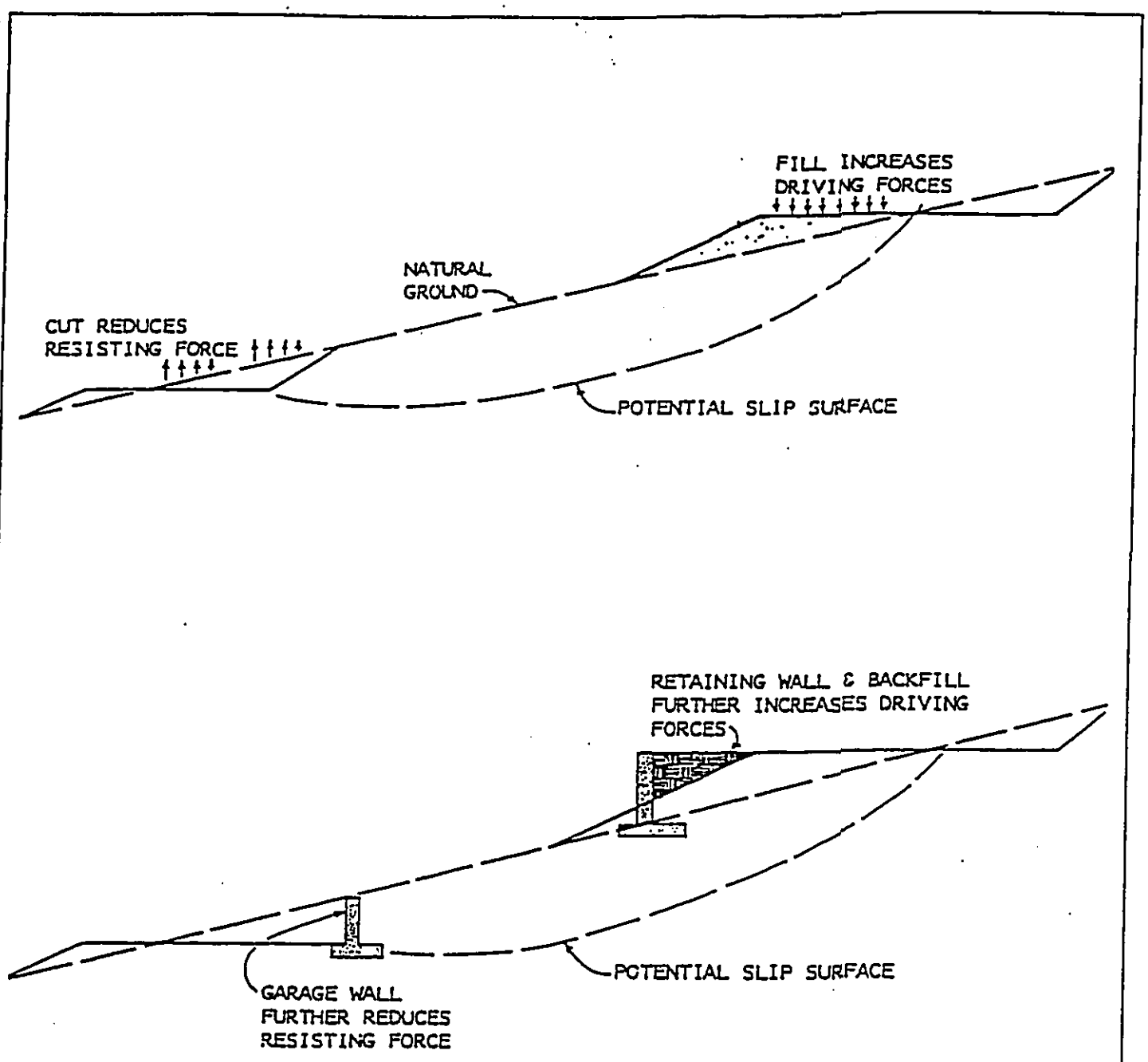
It is probable that some slight ground movements had occurred soon after the residential area was built up. The initial movements were probably small. Records indicate that the first utility line repair occurred sometime in 1974 when the Board of Water Supply made water line repairs on Woolsey Place. The next available repair records were in early 1979. From 1979 to the present, the frequency of repairs to utility lines and pavement has increased substantially. For some houses in the Paty Drive, Alani Drive, Kahaloa Street, Woolsey Place, Lono Place area, movement became very severe during the heavy rains of December 1987 (Appendix A, Photos 1 and 2). A ground movement survey by the City and County of Honolulu Department of Public Works was begun in June 1980. By April 1984, the results of their optical survey readings along a stretch of Woolsey Place indicated lateral movements up to 22 inches.

It is believed that the colluvial aprons produced at the base of the ridges by deposition of basalt rock fragments and soil particles and subsequent alteration by weathering have probably been in a marginally stable condition for thousands of years. The slow soil movements downslope generally go undetected in the natural state due to vegetation and to the lack of fixed reference points which come into place with development. The gradual development of the hillside has altered the natural state and has further degraded slope stability. Water infiltration into the subsurface soil has been another cause or exacerbation of movement. Water infiltration increases the weight of the soil and decreases the shear strength. These factors may affect the stability of the existing slopes by reducing the resisting force and inducing additional driving force.

Figure 6 illustrates the effect of development on hillside stability by showing how typical residential improvements such as the construction of retaining walls and the placement of fill can increase the potential for major earth slippage.

2.8 Description of Landslide Areas

The City and County of Honolulu, in cooperation with the U.S. Geological Survey, has systematically mapped landslide features and have identified three landslides in the project area. The following description of landslide areas was summarized from the U.S. Geological Survey Open File Report 89-290 (Ref. 30).



Source: Geolabs–Hawaii, 1984 (Ref. 5)

Effect of Development on Hillside Stability (Schematic Sections)

Figure **6**

Woodlawn Area Earth
Stabilization Project

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Specific terms used to describe landslide features are defined and illustrated in Appendix B.

For convenience the landslides are named "Paty-Alani" and "Hulu-Woolsey" after the streets that occupy their upper parts (Figure 7). It should be noted that the Paty-Alani landslide comes within 30 feet of joining the Hulu-Woolsey landslide, but a definitive pattern of damage revealing an actual connection between these two slides is lacking.

The landslides appear to be similar in many respects. The landslide material is a dark gray, clay-rich colluvium containing numerous clasts of volcanic rock. This soft colluvium appears to overlie a stiff colluvium. Concentrations of boulders that may be related to past landslide or debris flow activity occur at the ground surface in different parts of the landslide.

2.8.1 Paty-Alani Landslide

The Paty-Alani landslide is the northernmost landslide in the complex. The main body of the Paty-Alani landslide includes about 8.2 acres. The length is about 1,000 feet and the maximum width is about 550 feet. Elevation of the head and toe are about 375 and 170 feet, respectively. Overall slope angle is about 12 degrees; the slope is significantly steeper in the upper part, so the slope profile is concave upward. There are 60 lots affected by the main body of the landslide. Damage to structures in the head of the landslide results from stretching and sagging. Sagging is particularly obvious on the uphill side of the intersection of Paty and Alani Drives.

2.8.2 Hulu-Woolsey Landslide

The surface area of the main body of the landslide is about 8.0 acres. It is about 650 feet long and as much as 950 feet wide. The elevation difference between head and toe is about 120 feet (290 to 170 foot elevation); thus, the average slope is about 10.5 degrees. The slope is steepest at the head and gradually flattens downslope, creating a concave-upward profile. There are about 66 lots involved in the main body of the landslide.

Vertical displacements of about 3 feet are typical in the Hulu-Woolsey landslide head area. Farther downslope, in the main body of the landslide, there has been much repair work to houses, streets and curbs. Homeowners, however, report lateral displacement of 6 feet measured by surveying at a property line midway between Woolsey Place and Lanikaula Streets. Along the lower part of Woolsey Place and Lanikaula Street, accurate measurements of displacement are made difficult because of repairs, but it appears that lateral offsets are about 3 feet. Amounts of displacement decrease farther downslope until, at the

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

IN COOPERATION WITH
THE CITY AND COUNTY OF HONOLULU
DEPARTMENT OF PUBLIC WORKS

MAP SHOWING LANDSLIDE BOUNDARIES AT THE LANDSLIDE COMPLEX IN THE WOODLAWN AREA OF THE

Maps by City and County of Honolulu, Department of Public Works, 1968.

Landslide Boundaries

Woodlawn Area Earth Stabilization Project

OPERATION WITH
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ENT OF PUBLIC WORKS

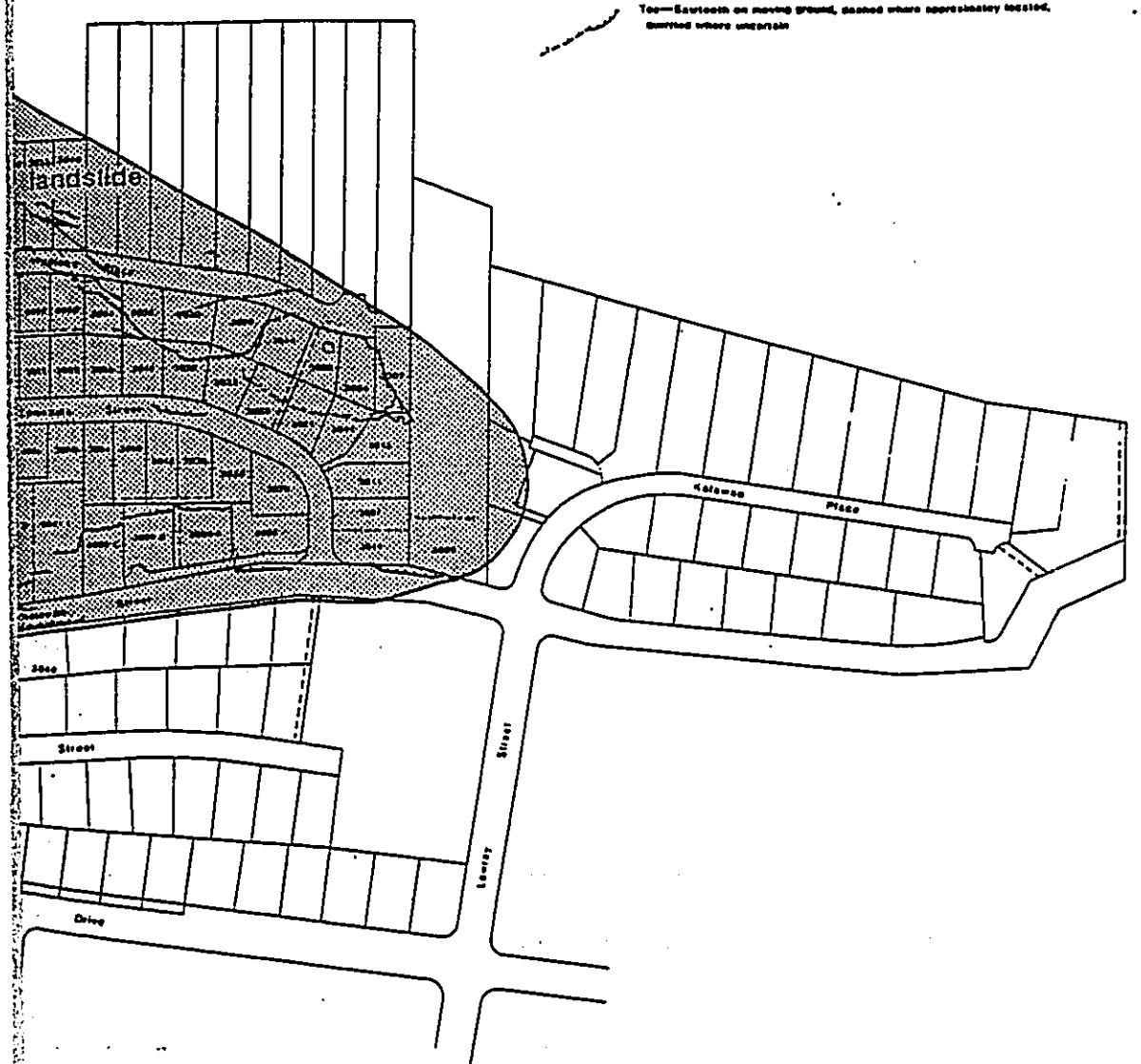
OPEN FILE REPORT 89-290
PLATE 1

EXPLANATION

Scarp—Hachures on downdropped side, dashed where approximately located, line dashed line where indistinct or weakly developed, queried where uncertain

Flank—Arrow on moving ground, dashed where approximately located, queried where uncertain

Toe—Sawtooth on moving ground, dashed where approximately located, queried where uncertain



LEX IN THE WOODLAWN AREA OF THE MANOA VALLEY, HONOLULU, HAWAII

This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards.

Figure 7

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toe, the offset of structures is 18 inches or less. Overall, the Hulu-Woolsey landslide is moving slower than the Paty-Alani landslide.

2.9 Chronology of Recent Studies and Improvements

1979-1984

As repairs to utility lines and pavement within the project area became more frequent in 1979, the City and County of Honolulu Department of Public Works (DPW) began trying to define the extent of the landslide problem. A ground movement survey was begun in June 1980. In April 1984, Geolabs-Hawaii completed a report on the "Soil Engineering Investigation for the Study of Earth Movement in the Vicinity of Kahaloa Drive, Kahaloa Place, Hulu Place, Woolsey Place and Lanikaula Street, Manoa Valley, Oahu, Hawaii" (Ref. 4). The purpose of the investigation was to explore the subsurface soil conditions and to determine the characteristics of the soil movements in order to provide an understanding of the probable causes and nature, and the effects of these movements on the City streets and utility facilities. The investigation stated that the major cause of the soil movement in this part of Manoa Valley is the poor, in-place soil conditions consisting of very weak "adobe" clay which is located on relatively steep slopes and subject to saturation by rainfall and seepage. Several general methods to restrain the ground movements within the City's roadway rights-of-way were presented in Geolabs-Hawaii's 1984 report.

September 1985

Subsequent to the completion of the previous report, DPW contracted Geolabs-Hawaii to provide a more detailed description of possible methods to restrain the earth movements on the roadway creep area in the eastern portion of Woolsey Place and Hulu Place. In September 1985, Geolabs-Hawaii completed the "Geotechnical Engineering Investigation Remedial Work for Earth Movement Areas Vicinity of Hulu and Woolsey Place, Manoa Valley, Oahu, Hawaii" (Ref. 5). Geolabs-Hawaii concluded that because of the large thickness of the upper "alluvium" encountered and the fact that very deep and extensive excavations would be required, it did not appear feasible to use buttress fill to retain movement within the roadway area studied. Geolabs-Hawaii recommended the use of caisson walls to stabilize roadways. (It should be noted here that the present investigators (STV/Lyon Associates) believe there may be deeper zones, or multiple failure surfaces. Their investigation will determine if this is the case.)

December 1985

In December 1985, Fujita & Associates, Inc. prepared the report, "Drainage Improvements in the Vicinity of Paty Drive, Kahaloa Place, Hulu Place, Woolsey Place and Lanikaula Street" for DPW (Ref. 3). The objectives of this report were to: investigate and evaluate the adequacy and condition of the existing

drainage systems; develop alternative design schemes to replace the drainage system in the vicinity of Hulu Place, Woolsey Place, Lanikaula Street and Kahaloa Drive; and develop alternate design schemes for stabilizing Woolsey Place and Hulu Place through the use of caissons placed within street rights-of-way to protect the City facilities therein.

July 1986

Responding to a request made by the Honolulu City Council in July 1986, University of Hawaii professors, John R. Evans and Paul L. Hummel provided comments and recommendations relative to the earth movement affecting Woolsey Place, Hulu Place, Lanikaula Street and Kalawao Street. The report, entitled "Review of Proposed Improvements to the area near Woolsey Place, Manoa Valley, Oahu, Hawaii" (Ref. 2) concluded that: reinforced concrete caissons should not be used as a soil stability measure; proper use of drainage should play a major role in stabilizing the moving soil, instrumentation and monitoring of the slide is necessary for effective planning and to measure effects of modifications made to the area; maintenance and repair of leaking lines should be improved in slide prone areas; and that home repairs be limited to those required to maintain safety and function.

February 1987

In February 1987, DPW initiated a project to replace the existing drainage system along Kahaloa Drive and Kahaloa Place with a new system of a larger capacity as the existing drainage system was unable to intercept all of the rainfall runoff flowing along Kahaloa Drive and Kahaloa Place, resulting in shallow flooding of several properties along the roadways (Ref. 24). Properties along the mauka area of Kahaloa Drive were experiencing soil instability which was attributed to the underlying upper clay material and it was believed that reducing infiltration from flooding would help in the stabilization of the area. The project involved the replacement of approximately 2,300 feet of the existing drainage system consisting of reinforced concrete pipe (RCP) ranging from 18 inches to 30 inches in diameter with larger (up to 60-inch) RCP. Existing inlets were modified and connected to the new system. Approximately eight new drain inlets were constructed. The drainage system capacity was increased from 50 cubic feet per second (cfs) to 160 cfs.

July 1987

In July 1987, DPW initiated a project for drain and sewer reconstruction in the vicinity of Woolsey Place, Hulu Place, Lanikaula Street and Kalawao Street (Ref. 25). The purpose of the project was to minimize any leakage from dislocated drain and sewer lines which may aggravate any ground movements in the affected area and to provide temporary remedial measures needed to improve the roadway conditions along Woolsey Place.

The proposed drain reconstruction consisted of the replacement of the existing drainage system along Lanikaula Street and the rerouting of an existing drain located in private properties between Lanikaula Street and Kalawao Street to a relocated outlet near the intersection of Lanikaula Street and Kalawao Street. The intercepted flows would continue to be discharged into the same ditch located makai of Kalawao Street. The reconstructed drain has a length of about 1,300 feet and pipe sizes range from 60- to 18-inch diameter. Branch drain lines were constructed on Woolsey Place and at the intersection of Lanikaula Street and Woolsey Place. Along Hulu Place, Launikaula Street and Woolsey Place, approximately 430 feet of trench drains were laid to intercept subsurface flows. Near the end of Woolsey Place, another 200 feet of trench drains were installed. Trench drains consist of pairs of 6-inch diameter perforated and non-perforated pipes connected to the drain lines at appropriate elevations. Roadways along Woolsey Place and Lanikaula Street were to be repaired and adjusted in a later phase if the affected area is stabilized.

The existing sewer system to be reconstructed consists mostly of 8-inch vitrified clay pipes with appurtenant 6-inch laterals and sewer manholes. The replacement sewer lines are located on Lanikaula Street, Woolsey Place, Hulu Place and in easements through private properties. A network of sewers through private properties is required as the steep terrain of the area only allows sewering the higher lots from the streets.

February 1988

In February 1988, Geolabs-Hawaii, completed the first in a series of instrumentation and monitoring reports in or near the project area (Refs. 6, 7, 8 and 9) to determine the extent of movement).

May 1988

In May 1988, DPW initiated a plan to acquire easements and lands in fee within the project area to be utilized in the construction of improvements to alleviate earth movement (Ref. 23). In an effort to mitigate slide damage, DPW also initiated projects to control surface and some of the subsurface water within the Woodlawn area. The initial phase included the Hulu Place, Woolsey Place, Lanikaula Street and Kahaloa Drive drainage improvements. Construction of these improvements began in April 1988. The second phase included drainage improvements in the Paty Drive, Alani Drive, Kahaloa Drive and Kahaloa Place areas (Appendix A, Photo 5). Four (4) lots were acquired in 1988. Three of these lots (3004, 3008 and 3014 Woolsey Place; TMK: 2-9-58: 12, 13 and 14) were used to construct the crib wall and trench drain on the makai side at the end of Woolsey Place (Appendix A, Photos 3 and 4). A fourth lot (3075 Hulu Place; TMK: 2-9-57: 6) is being used to construct drainage improvements (Appendix A, Photo 6). Three additional lots (3049 and 3055

Woolsey Place; TMK: 2-9-57: 12 and 11; and 3102 Alani Drive; 2-9-39:49) were acquired in 1989 for drainage improvements.

December 1988

In December 1988, DPW contracted Okada Trucking to monitor the drainage improvements. Harding Lawson Associates (HLA), Okada Trucking's subcontractor, conducted inclinometer and piezometer monitoring for the drainage improvements in the vicinity of Hulu Place, Woolsey Place and Lanikaula Street. The eighth and final HLA report, "Monitoring Report No. 8, Inclinometers and Piezometers, Drainage Improvements in the Vicinity of Hulu Place, Woolsey Place, and Lanikaula Street, City and County Job No. 29-87, Manoa Valley, Oahu, Hawaii" (Ref. 10) was completed in December 1988.

Also in December 1988, the Honolulu City Council authorized the City to enter into an intergovernmental agreement with the U.S. Geological Survey to conduct studies of landslides and debris flows within certain portions of the Honolulu area, including Manoa (Resolution 88-472, CD-1). As part of a cooperative study between the U.S. Geological Survey (USGS) and DPW, the USGS systematically mapped landslide features within the project area. The map and accompanying report, "Maps Showing Landslide Features and Related Ground Deformation in the Woodlawn Area of the Manoa Valley, City and County of Honolulu, Hawaii" were completed in September, 1989 (Ref. 30).

April 1989

In April 1989, the Honolulu City Council requested that the City Administration conduct a comprehensive study of soil movement problem areas on Oahu, with the assistance of appropriate State and Federal agencies (Resolution 89-138, CD-1). On September 5, 1989, the City Council passed a bill for an ordinance (Ordinance No. 89-150), prohibiting urban development within certain Oahu hillsides (including the project area) for a temporary period of time until permanent controls can be adopted.

May 1989

In May 1989, DPW contracted with STV/Lyon Associates to prepare plans and specifications for the stabilization of the Woodlawn area, including: evaluating all utility systems; designing remedial work at the Paty-Alani Drive and Paty Drive Extension areas; preparing a hydrologic analysis of the Woodlawn area; conducting a topographic survey of the project area; coordinating all geotechnical studies; conducting a geological movement monitoring program; designing the proposed project; and providing consultation and field engineering services during construction.

The STV/Lyon Associates contract included deeper investigations (than earlier geotechnical investigations, which were concentrated in the upper 20 feet or so below the surface) and the installation of instrumentation at much greater

depths to determine if, in addition to the shallow movements, slides at greater depths also were occurring.

The field investigation included picket line surveys of horizontal and vertical ground movements. Drilling consisted of six sets of instrumentation borings to 120 feet with one inclinometer casing (to measure lateral movement at depth) and several piezometers (to measure pore water pressure) at varying depths at each set. Also included in the drilling were 5 angle holes and 3 diamond drill holes to 120 feet depth into the basalt bedrock.

The field investigation found that landslide activity in the Woodlawn area initially developed within a relatively narrow zone within which the colluvium wedges out against the basalt. Several geologic and hydrologic factors were found to contribute to making this zone predisposed to landslide development (Ref. 27):

1. Proximity to sources from which efficient ground water recharge and surface runoff infiltration can occur.

2. Thin cover of colluvium over basalt; transmission of high cleft water pressure.

3. Ground water recharge by surface stream discharge.

4. Antecedent landslide at Paty-Alani, revealed in 1941 aerial photos, which has grown progressively into the present landslide.

5. Adverse effects on stability by extensive grading and disruption of natural surface drainage.

Based on the results of the field investigation and the engineering geological analysis of the area, it was determined that three classes of landslides are present in the Woodlawn area (Ref. 27). These are defined below:

Class I: Deep seated slide, maximum 50 feet deep, which is represented by mapped boundaries.

Class II: Subsidiary nested slides located within the Class I slide boundaries. Maximum depth of these slides is approximately 25 feet.

Class III: Superficial landslides due to landscaping and filling operations at individual properties. These vary in depth from 3 to 10 feet.

A draft report on this study, "Woodlawn Area Earth Stabilization Landslides and Facilities Evaluation Report., Volume I," (Ref. 27) was completed in June 1990. The report included recommendations to stabilize Class I and Class II landslides.

3.0 GENERAL DESCRIPTION OF THE PROPOSED ACTION'S TECHNICAL, ECONOMIC, SOCIAL AND ENVIRONMENTAL CHARACTERISTICS

Measures for stabilizing earth slides at Woodlawn can be categorized into three major areas; subsurface drainage, surface drainage, and mechanical restraint system (Ref. 27).

Subsurface drainage measures recommended for stabilization include large-diameter vertical drainage wells, 60 feet in depth and 2 feet in diameter located as shown on Figure 8. These will intercept the high confined pore water pressures and flows in the alternating aquifers and aquitards of the stratified colluvium. These drains will be equipped with submerged electrically powered pumps. The pumps, equipped with a level/pressure switch, will be activated as needed. Horizontal drains, near the head of Paty-Alani slide, also shown on Figure 8, will drain cleft water infiltrating the tension cracks around the crown scarp of the landslide and contribute to stabilizing the slide periphery (Ref. 27). Water collected from the vertical and horizontal drain wells will be directed into the public storm drain system.

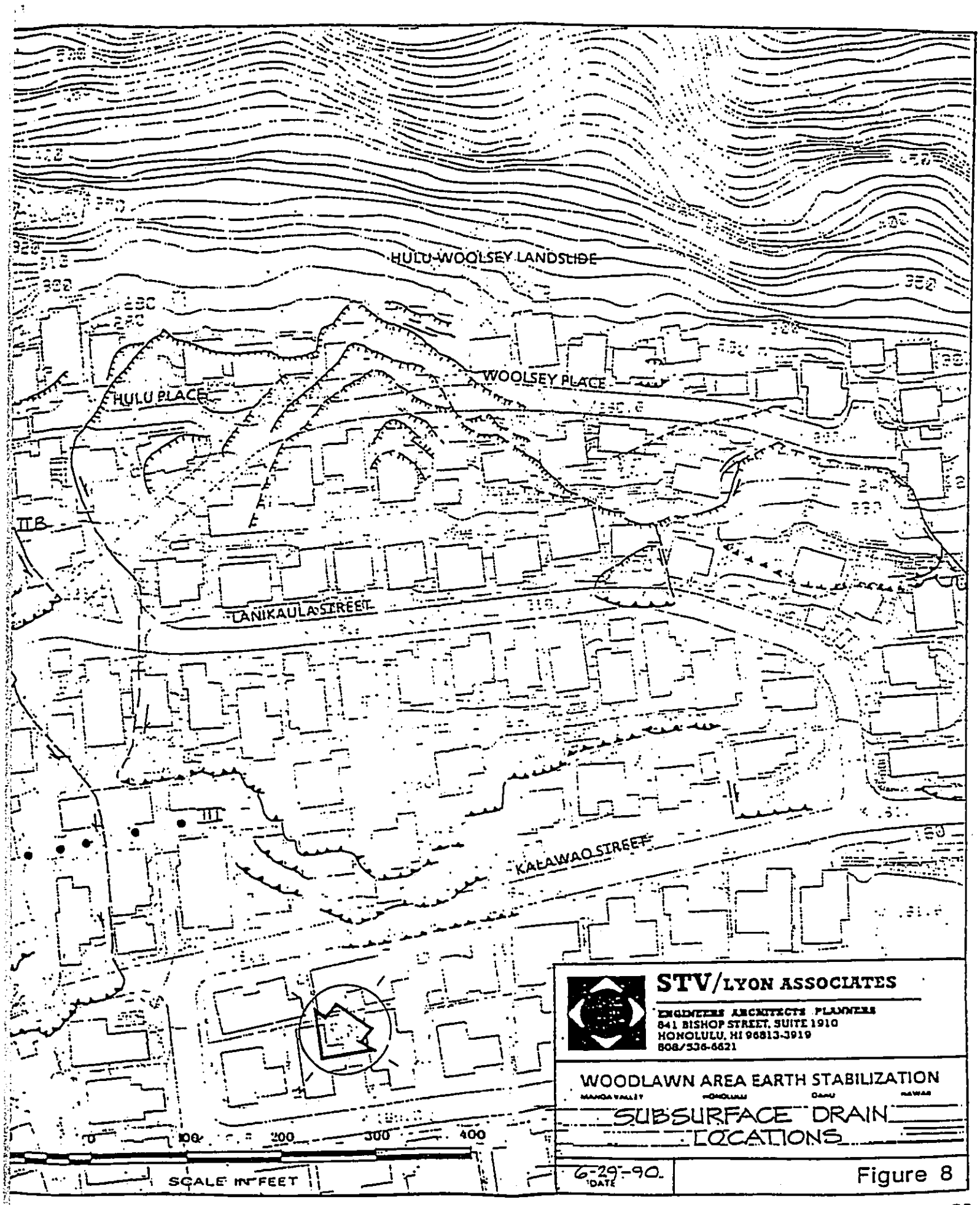
Recommended surface drainage measures for stabilization include collection of upper watershed surface runoff near the heads of the slides (as shown on Figures 9 and 10). In the Hulu-Woolsey slide area where some properties at the head of the slide have been acquired, an up-slope collection system is being proposed.

Direct mechanical restraints to prevent further landslide displacement will be by a tieback anchor system. In the tieback system, a continuous cap is constructed at or near the surface through which a series of tiebacks is installed as an array at several angles, equally spaced along the longitudinal direction of the cap. The angles for the tiebacks are selected to apply some restraining force upslope while applying additional normal loading on the slide plane or planes (Ref. 27).

A preliminary schematic design of the tieback anchor system is shown on Figure 11. A trench to a depth of 10 feet below ground surface serves to remove the softer, more plastic and compressible upper colluvium while serving as a bed on which to form a continuous cap at an angle of 45° or so. The underlying crushed rock also acts as an interceptor drain to intercept ground water and provide drainage, also an important contributing factor in overall stabilization.

At each tieback location along the longitudinal axis of the cap, a series of tieback anchors fan out perpendicular to the cap axis and at angles of 35


LEGEND
VERTICAL DRAIN WELLS
HORIZONTAL DRAIN WELLS
ALANI DRIVE
PATY DRIVE
PATY - ALANI LANDSLIDE
KAHALOA DRIVE
LANIKAULA
KAHALOA PLACE
LONO PLACE
LONO STREET
HULU PLACE
A
B
IIA
IIB
III
IV
300
350
400
100
0
100
SCALE IN FEET



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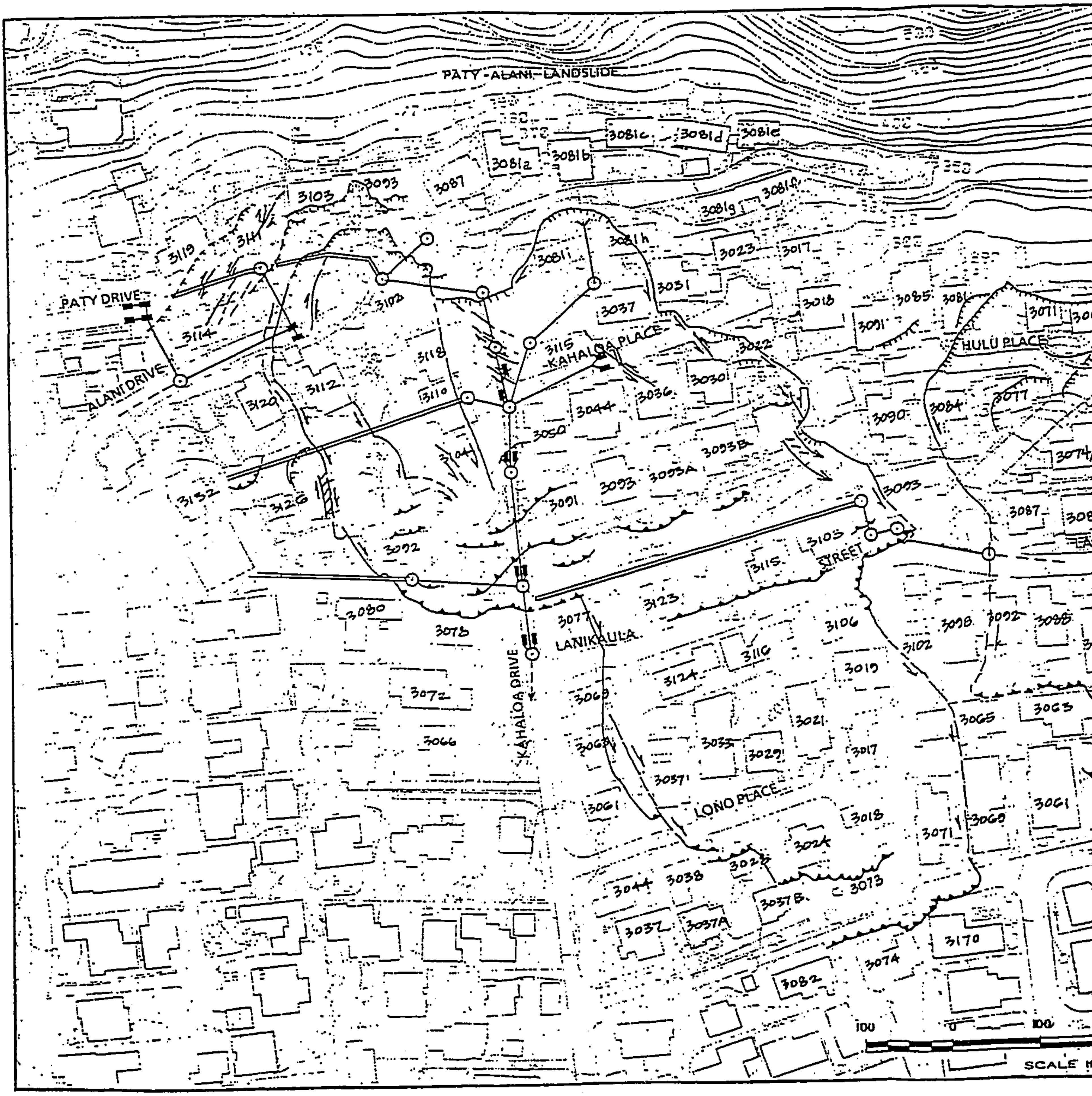
WOODLAWN AREA EARTH STABILIZATION
MANOA VALLEY HONOLULU OAHU HAWAII

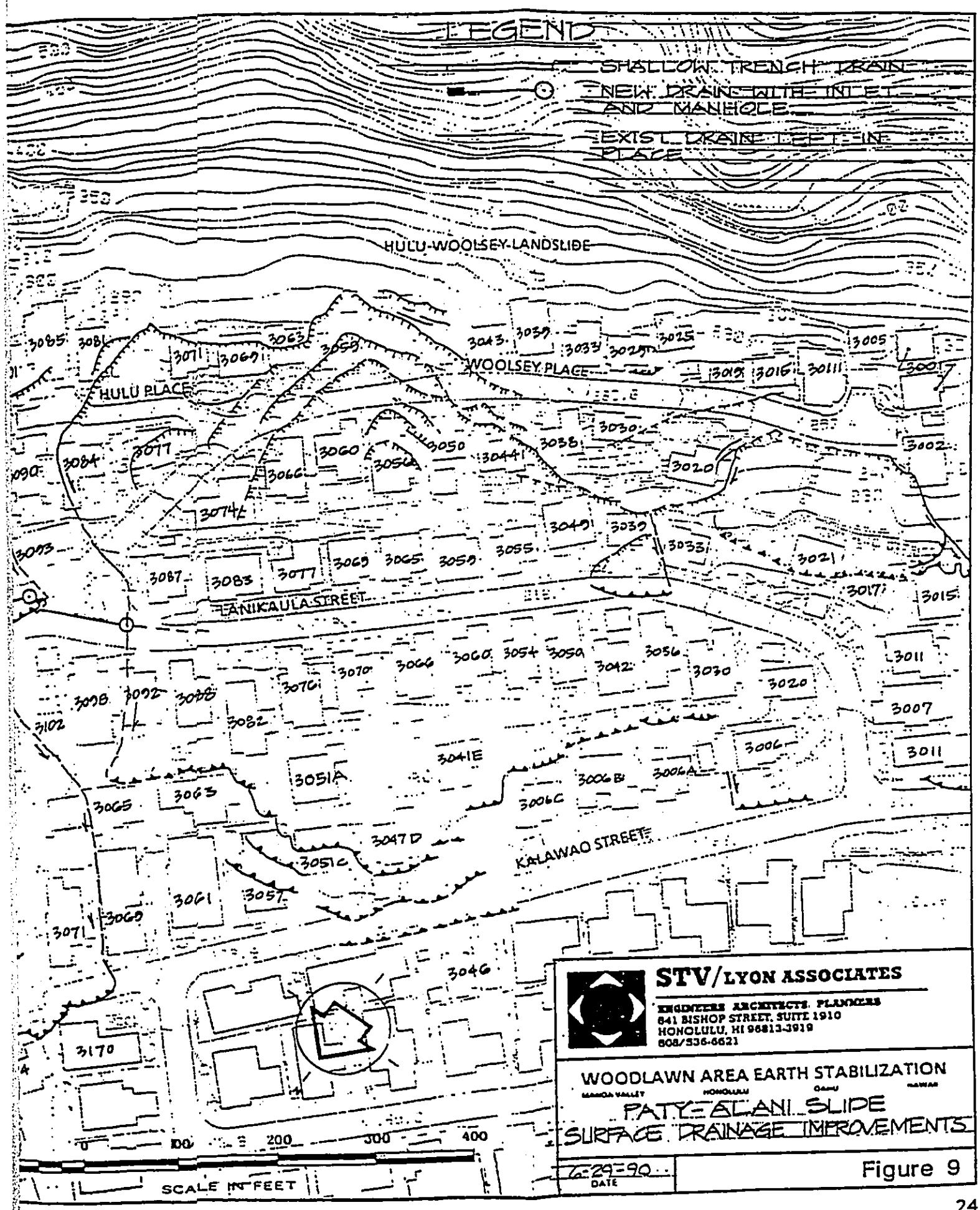
SUBSURFACE DRAIN LOCATIONS

6-29-90.
DATE

Figure 8



PATY-ALANI-LANDSLIDE
PATY DRIVE
ALANI DRIVE
KAHALOA PLACE
HULU PLACE
STREET
LANIKAULA
KAHALOA DRIVE
LONO PLACE
SCALE



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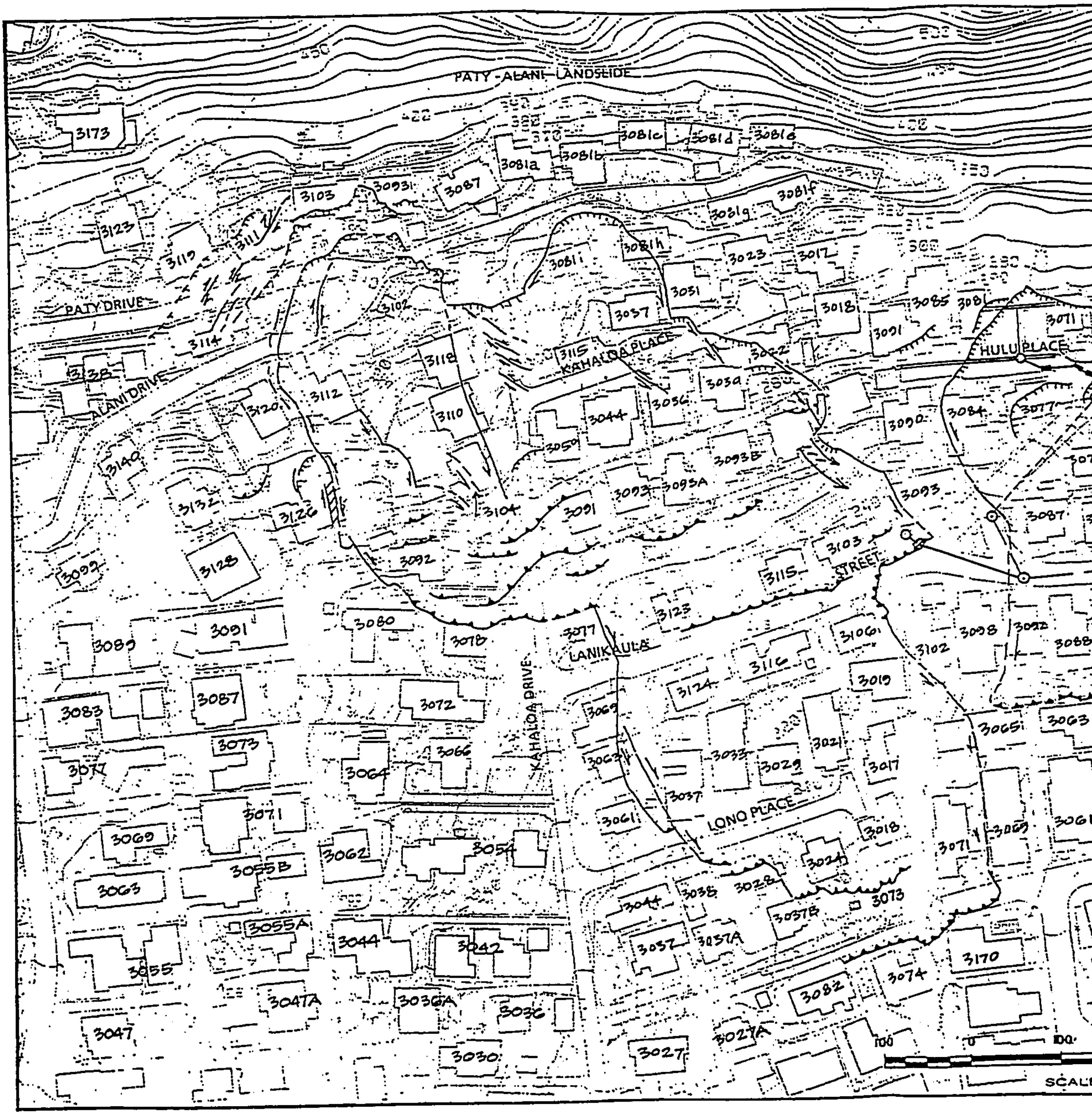
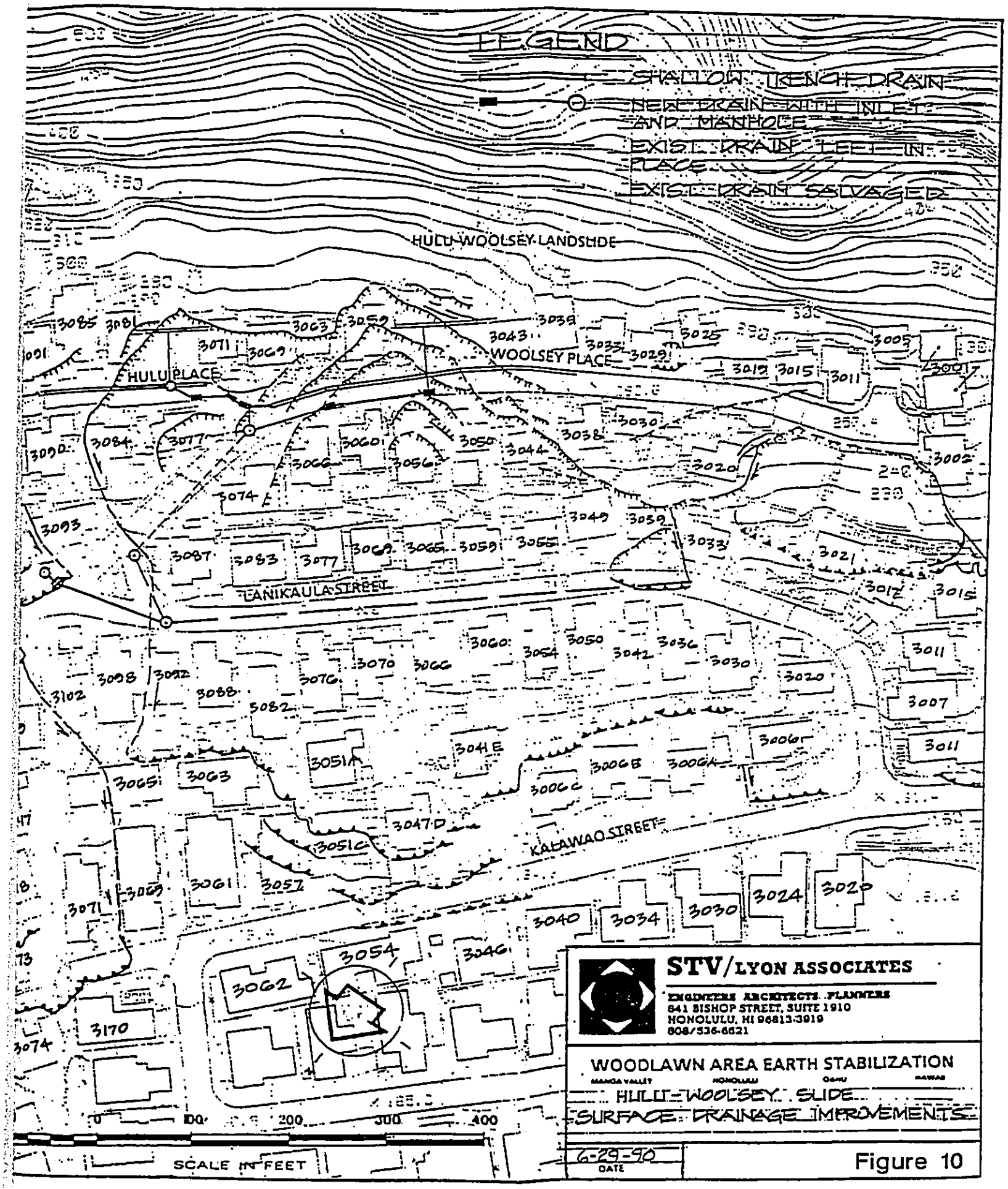
WOODLAWN AREA EARTH STABILIZATION
MANOA VALLEY HONOLULU OAHU HAWAII

PATY-ALANI SLIDE
SURFACE DRAINAGE IMPROVEMENTS

6-29-90
DATE

Figure 9


PATY-ALANI LANDSLIDE
PATY DRIVE
ALANI DRIVE
KAHALOA PLACE
HULU PLACE
STREET
LANIKAULA
KAHALOA DRIVE
LONO PLACE
SCALE



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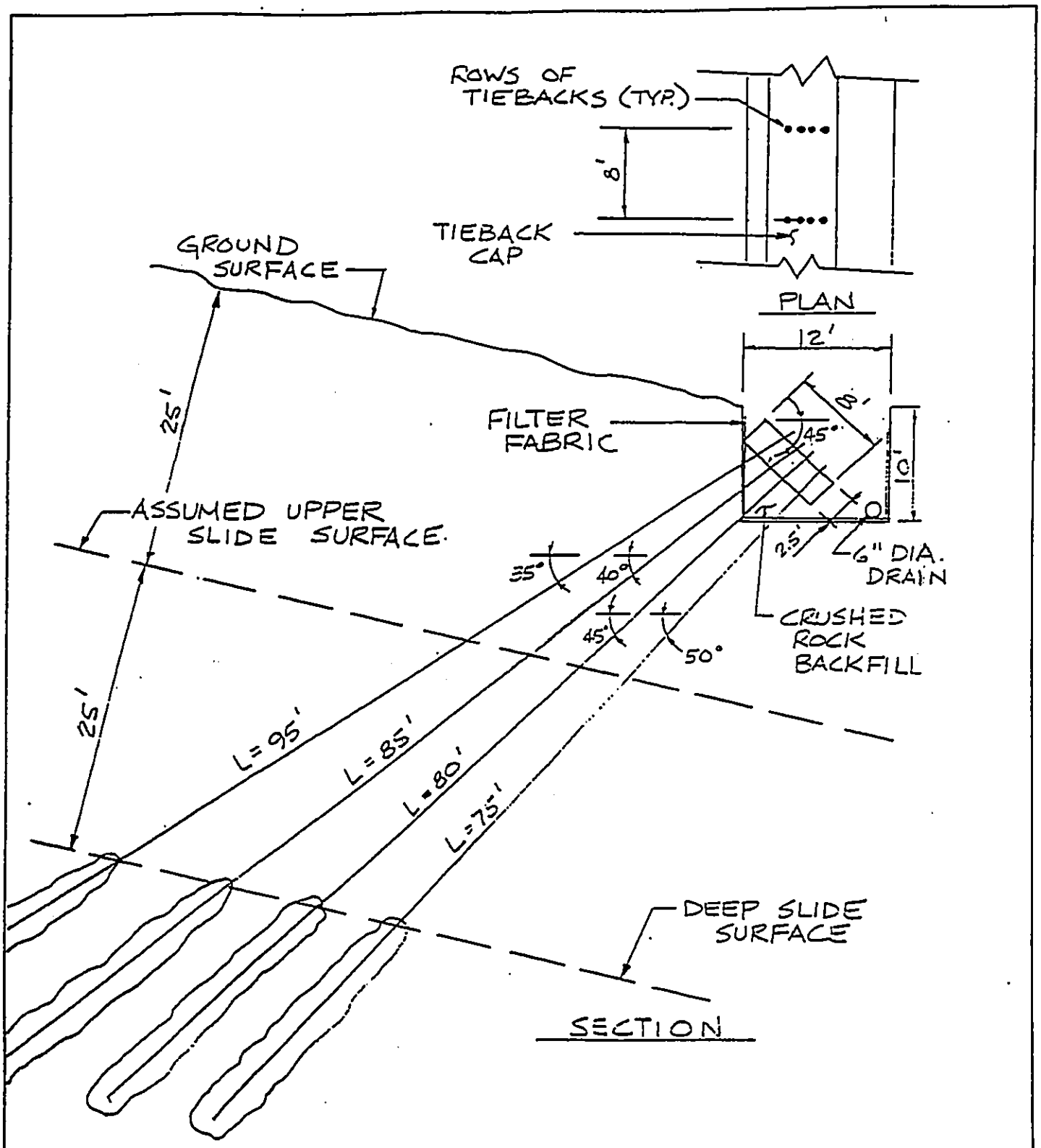
WOODLAWN AREA EARTH STABILIZATION
MANOA VALLEY HONOLULU OAHU HAWAII

HULU-WOOLSEY SLIDE
SURFACE DRAINAGE IMPROVEMENTS

6-29-90
DATE

Figure 10



Schematic Plan and Section of Proposed Tieback System

Woodlawn Area Earth Stabilization Project

Figure **11**

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degrees, 40 degrees, 45 degrees, 50 degrees to the approximate lengths shown to reach stable colluvium in which to install the anchors. This is the equivalent vertical depth of 60 feet plus the required anchor length. The slope of the cap, or 45 degree downslope, is approximately perpendicular to the resultant force applied to the tieback series. Anchor capacity is assumed limited to 25 tons each, due to the possibility of creep.

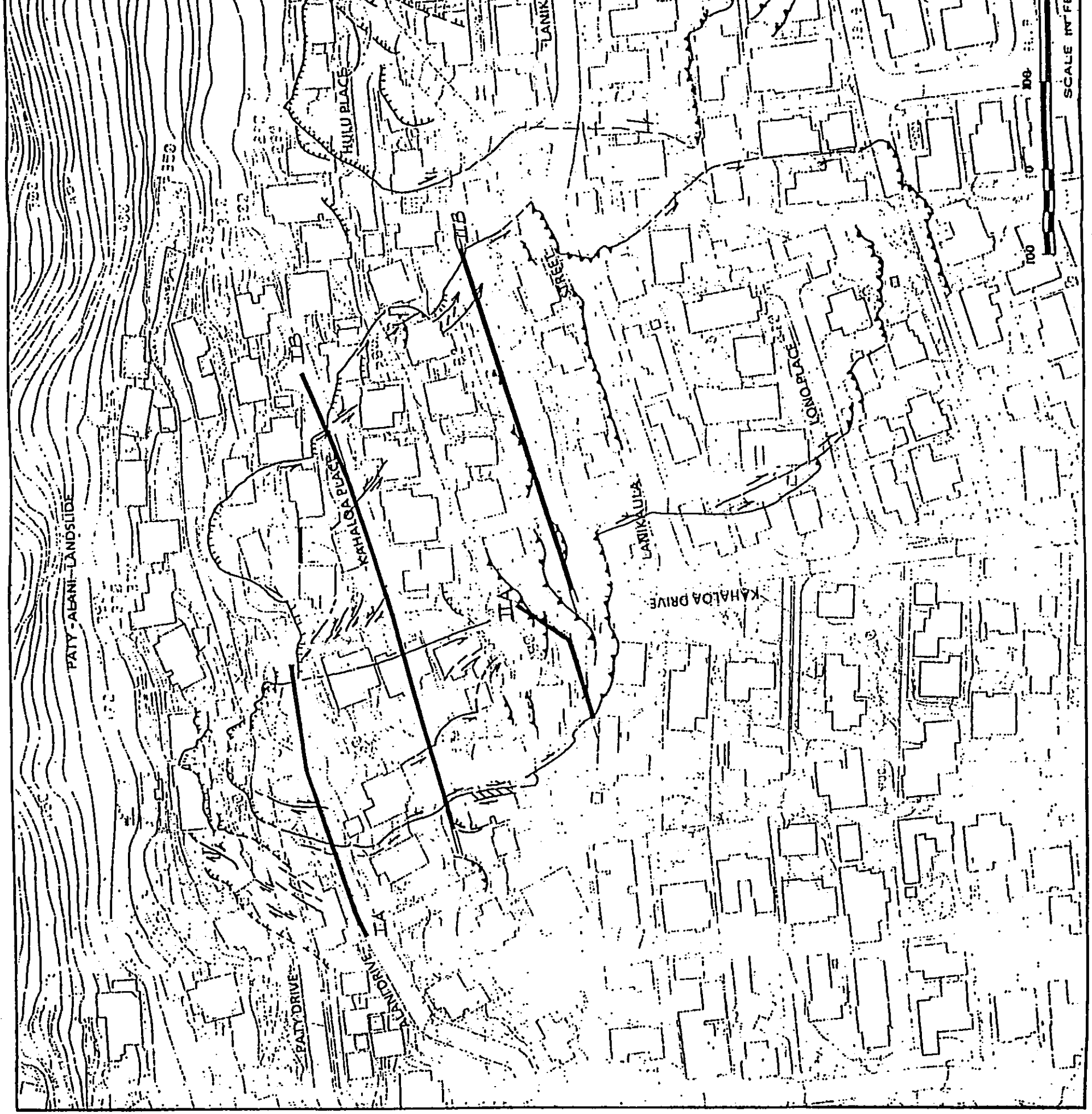
This array of anchored tiebacks will apply sufficient force to the sliding mass to restrain movement if the horizontal spacing between arrays is 8 feet. Load tests and creep tests will be performed during construction at selected locations which may indicate higher anchor capacities are possible. Proof testing will be performed on all anchors.

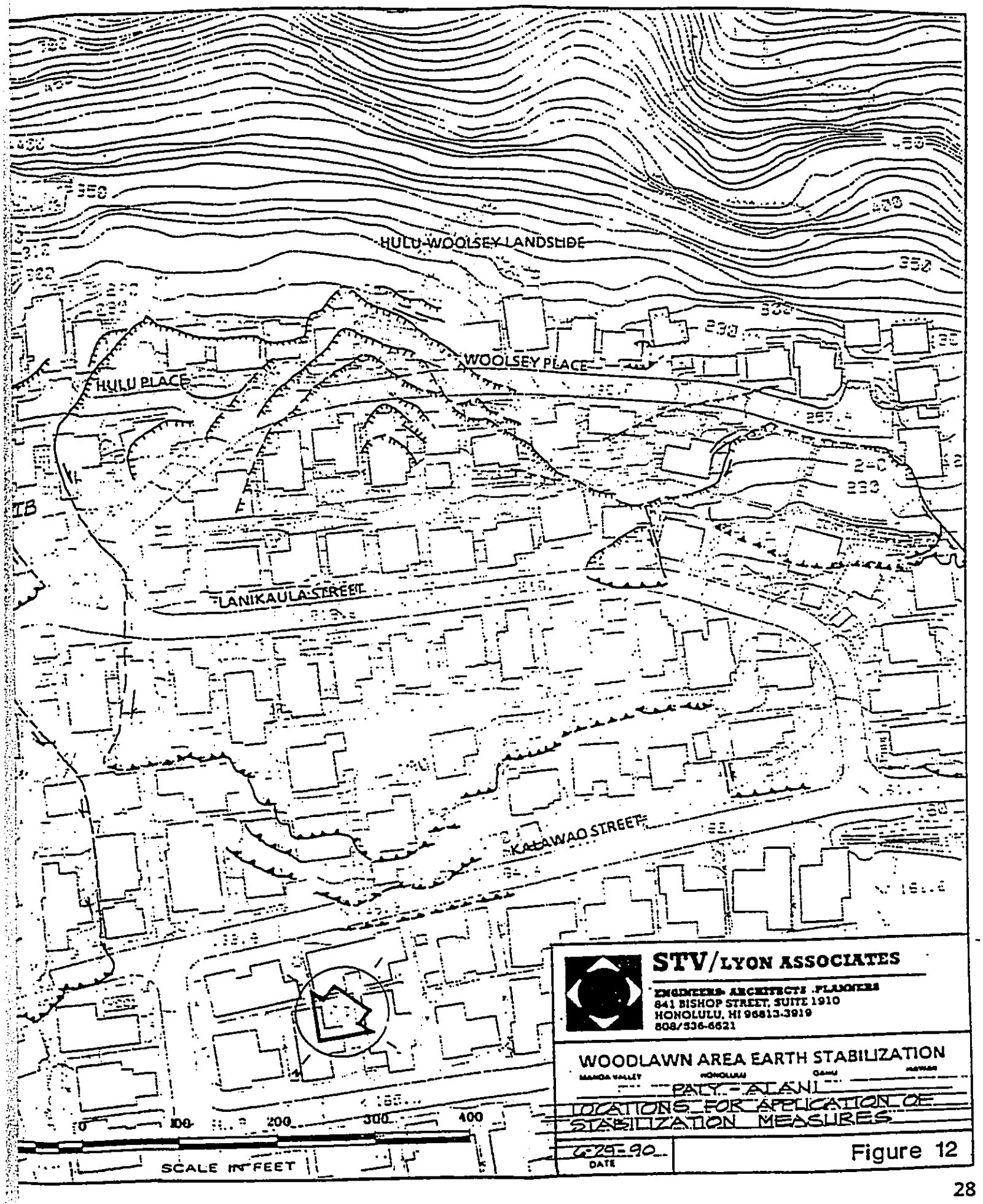
Locations for the applications of these restraining structures are shown on Figures 12 and 13. There are two major bands crossing the slide more or less perpendicular to the principal direction of movement and a shorter band near the head or along Alani Drive and empty lot 3102 Alani Drive. The upper major band extends along Kahaloa Place eastward 50 feet beyond the boundary of the slide. The lower major strip extends mostly through empty lot 3089 Kahaloa Drive. These locations are fortuitous in that most of the construction can be accomplished in empty lots and city streets. These are also extremely good locations in the geological sense to contain further slide movement downslope and to prevent continuing growth at the head.

The construction of the tieback system in the Paty-Alani slide will require the acquisition of five lots: lot 3037 Kahaloa Place, lots 3089, 3110 and 3115 Kahaloa Drive and lot 3065 Kalawao Street. Cooperation and easements from the owners of seven lots will be required for access. Damage would be generally restricted to grounds and out-buildings and would be repaired in the contract.

Easements for the installations of tieback anchors and horizontal drainage wells would be required for virtually all owners along Alani Drive, Paty Drive and Paty Drive Extension whose properties lie within the slide or a short lateral distance from the slide as shown on Figure 10. Easements would also be required of all owners above empty lot 3089 Kahaloa Drive and lots 3092 and 3104 Kahaloa Drive. If similar restraining structures are applied in the Hulu-Woolsey landslide, similar easements would be required from owners on the south side of Lanikaula Street, Woolsey Place and Hulu Place.

In addition to stabilization of the slides, reconstruction, replacement,. and improvements to utilities and streets damaged by slide movement will also be completed in the project area. The utility replacement and improvements will include work on storm drains, sanitary sewer, and water supply. Coordination, minor relocation, and protection during construction of other utilities including


HULU PLACE
LANIKALUA STREET
LONO PLACE
LANIKALUA
KAHALOA DRIVE
KAHALOA PLACE
PATY DRIVE
PATY-ALANI-LANDSLIDE
SCALE IN FEET
0
100
200


HULU-WOOLSEY LANDSLIDE
WOOLSEY PLACE
HULU PLACE
LANIKAULA STREET
KALAWAO STREET
0
100
200
300
400
SCALE IN FEET
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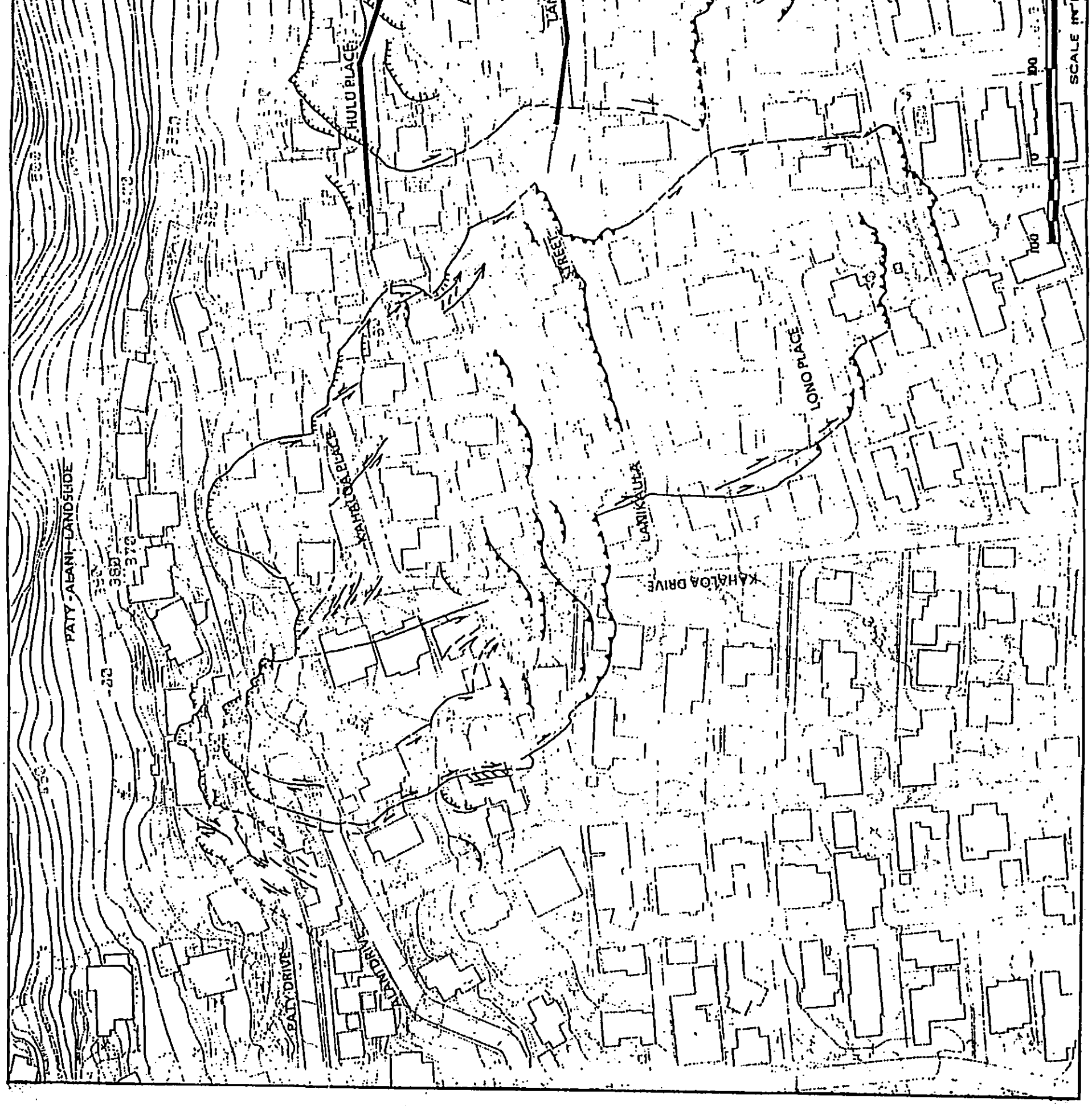
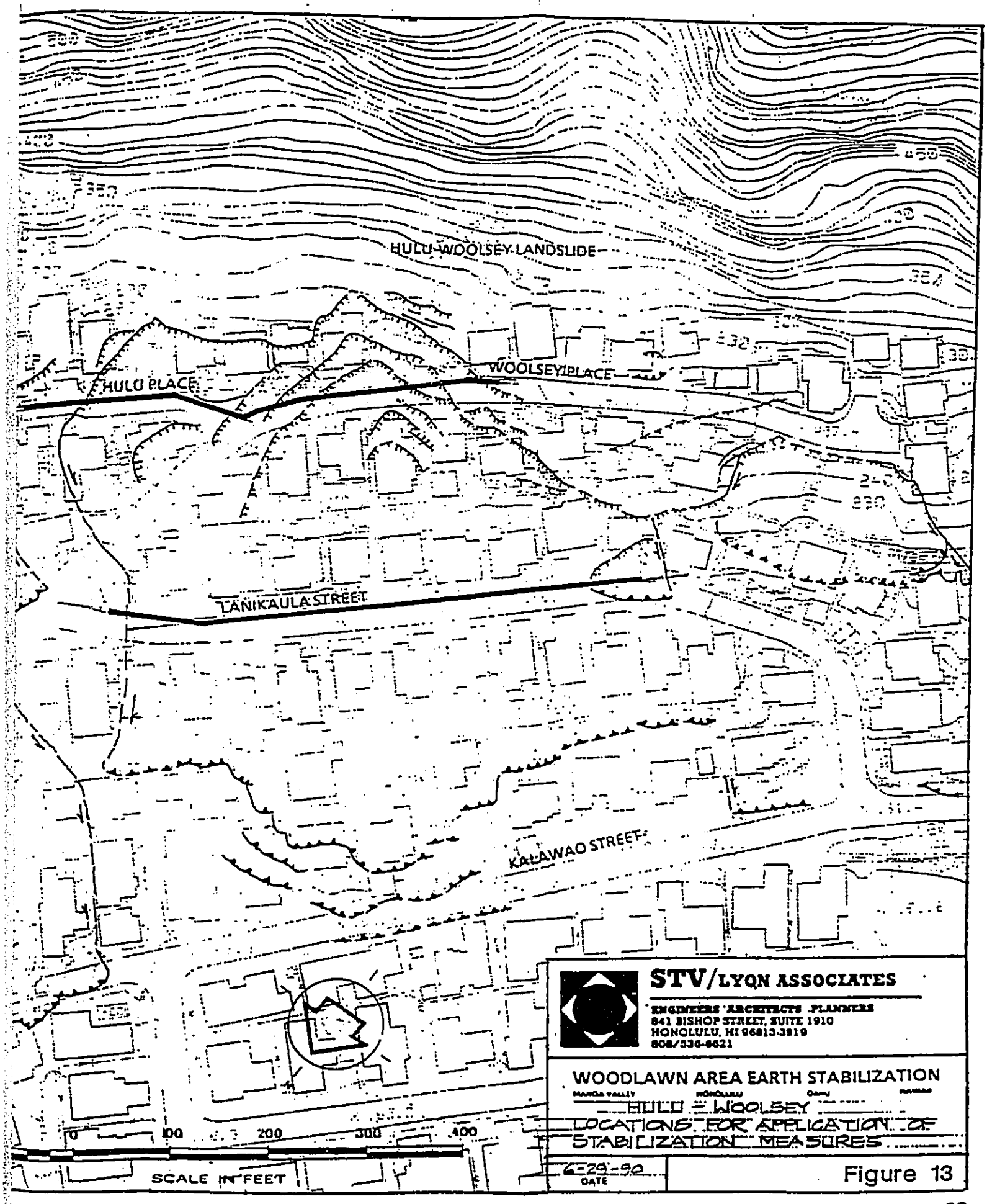
WOODLAWN AREA EARTH STABILIZATION
MANOA VALLEY HONOLULU OAHU HAWAII
PALY - ALANI
LOCATIONS FOR APPLICATION OF STABILIZATION MEASURES
6-29-90
DATE
Figure 12


HULU PLACE
LONO PLACE
LANIKEALA
KAHALOA DRIVE
PATY DRIVE
PATY-ALANI LANDSLIDE
SCALE IN FEET
100
0


HULU-WOOLSEY LANDSLIDE
HULU PLACE
WOOLSEY PLACE
LANIKAULA STREET
KALAWAO STREET
0
100
200
300
400
SCALE IN FEET
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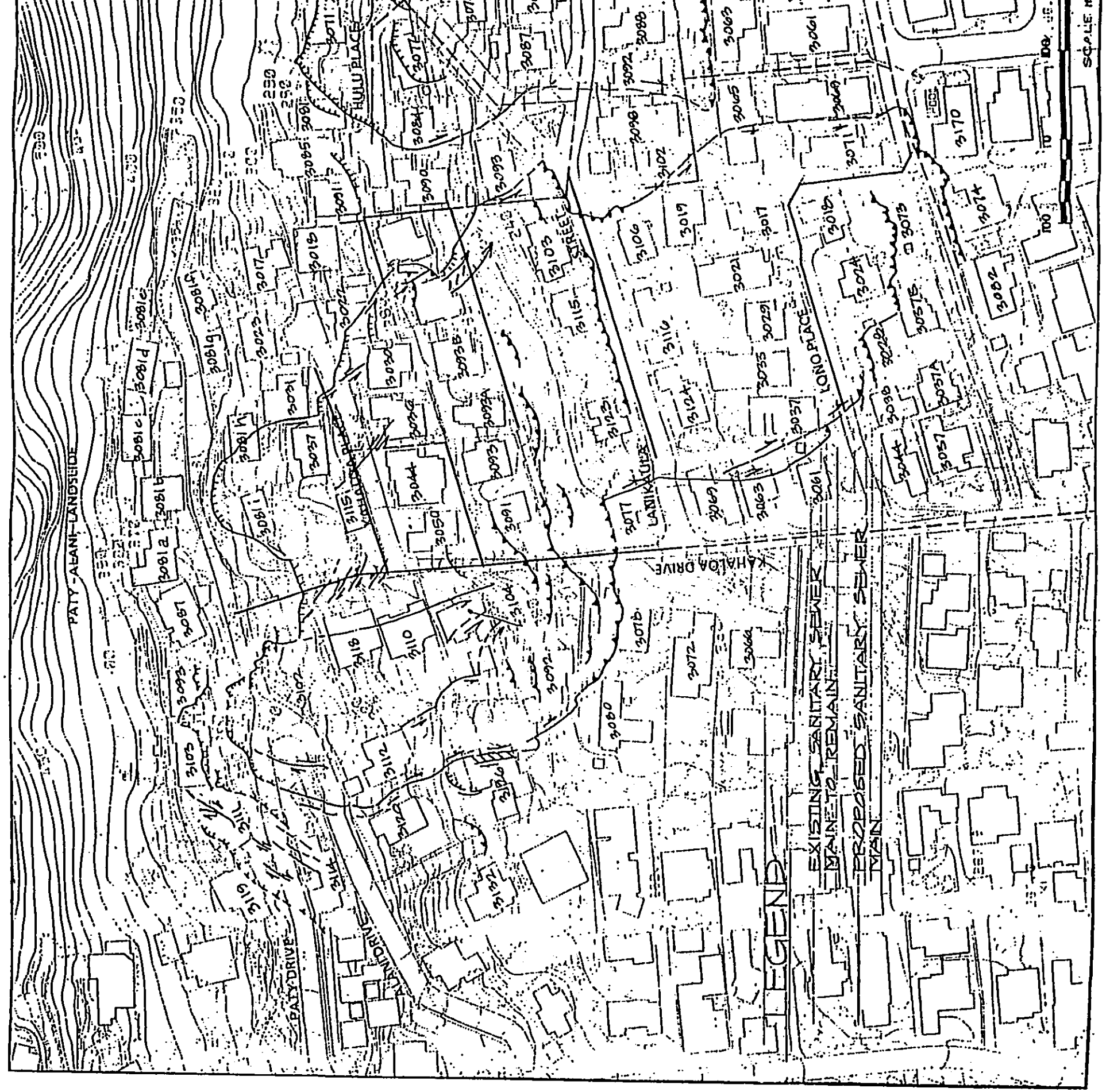
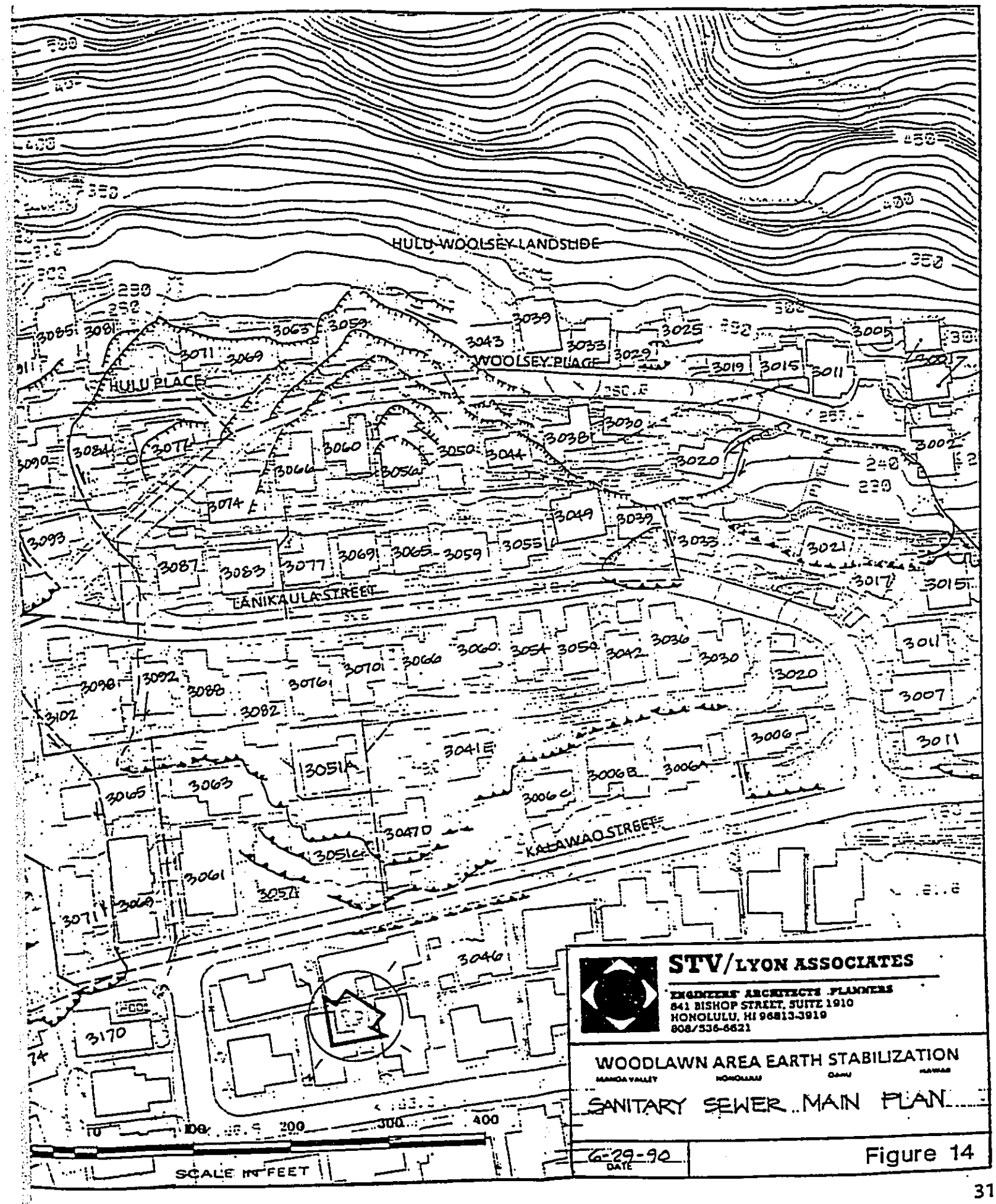
MANOA VALLEY HONOLULU OAHU HAWAII
HULU - WOOLSEY
LOCATIONS FOR APPLICATION OF
STABILIZATION MEASURES
6-29-90
DATE
Figure 13

electric, telephone, cable TV, and gas will also be included with this project. Improvements to the storm drain system in the Paty-Alani slide are shown on Figure 9. Figure 10 shows the storm drain improvements in the Hulu-Woolsey slide area. The proposed sanitary sewer system improvements are shown on Figure 14 and the water supply improvements are shown on Figure 15. Figure 16 shows the proposed street improvements and reconstruction.

Considering the costs for stabilization and the costs for utility and street reconstruction and improvements, and the additional drilling, monitoring and engineering services for final design, the total estimated costs to complete the project are $25.1 million in 1991 dollars.

Completion of the proposed earth stabilization measures is expected to take approximately 2 years for each landslide area.


PATY-ALANI LANDSLIDE
HULU PLACE
KAHALOA DRIVE
LONO PLACE
PATY DRIVE
ALANI DRIVE
LEGEND
EXISTING SANITARY SEWER
MAIN TO REMAIN
PROPOSED SANITARY SEWER
MAIN
SCALE



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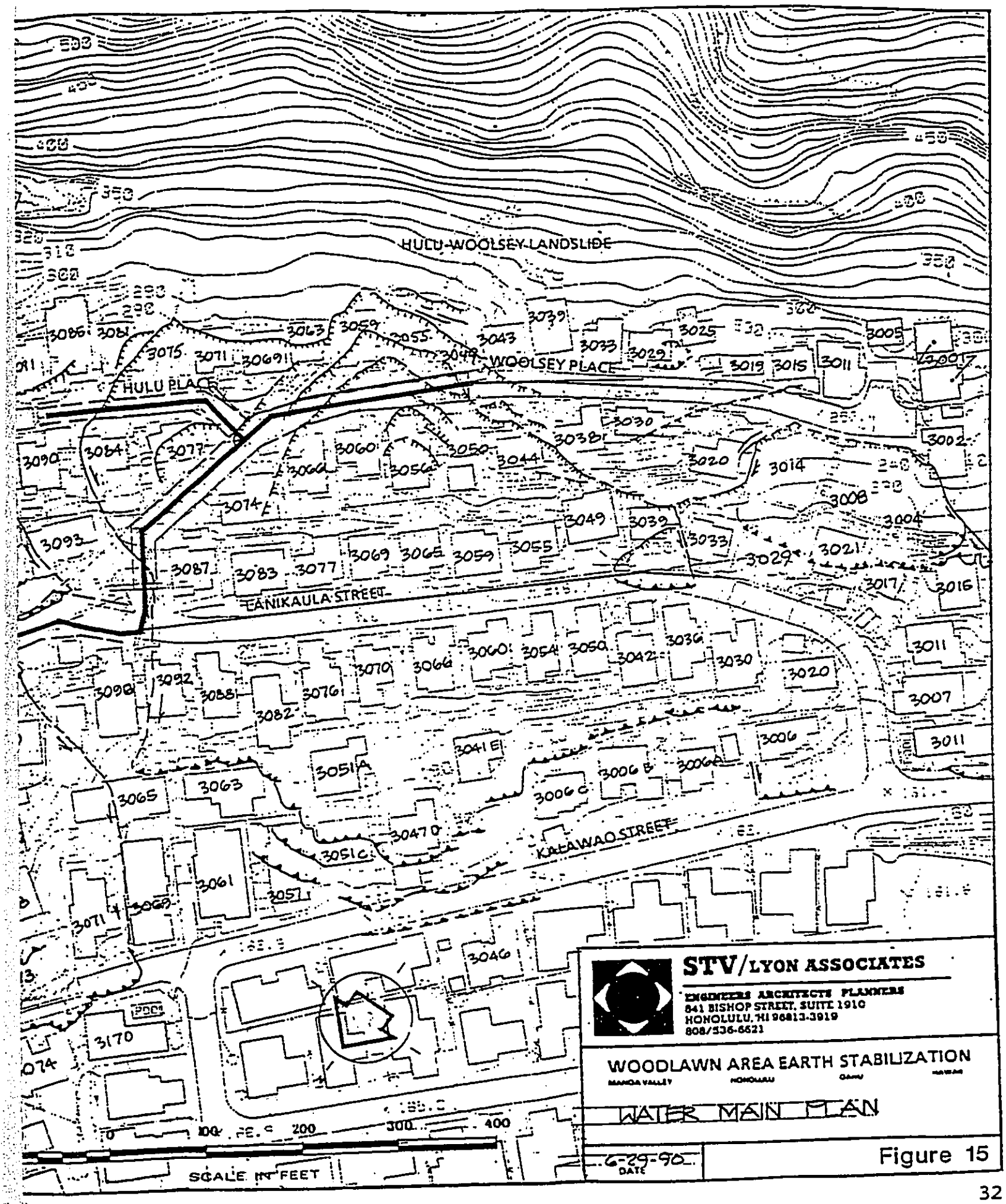
WOODLAWN AREA EARTH STABILIZATION
MANOA VALLEY HONOLULU OAHU HAWAII

SANITARY SEWER MAIN PLAN

6-29-90
DATE

Figure 14


KAHALOA DRIVE
PALY DRIVE
KAHALOA PLACE
LONO PLACE
HULU PLACE
LANIKAULUA STREET
PATY-ALANI LANDSLIDE
LEGEND
TEMPORARY WATER LINE REMOVED
EXISTING WATER LINE REMAIN
PROPOSED WATER MAIN



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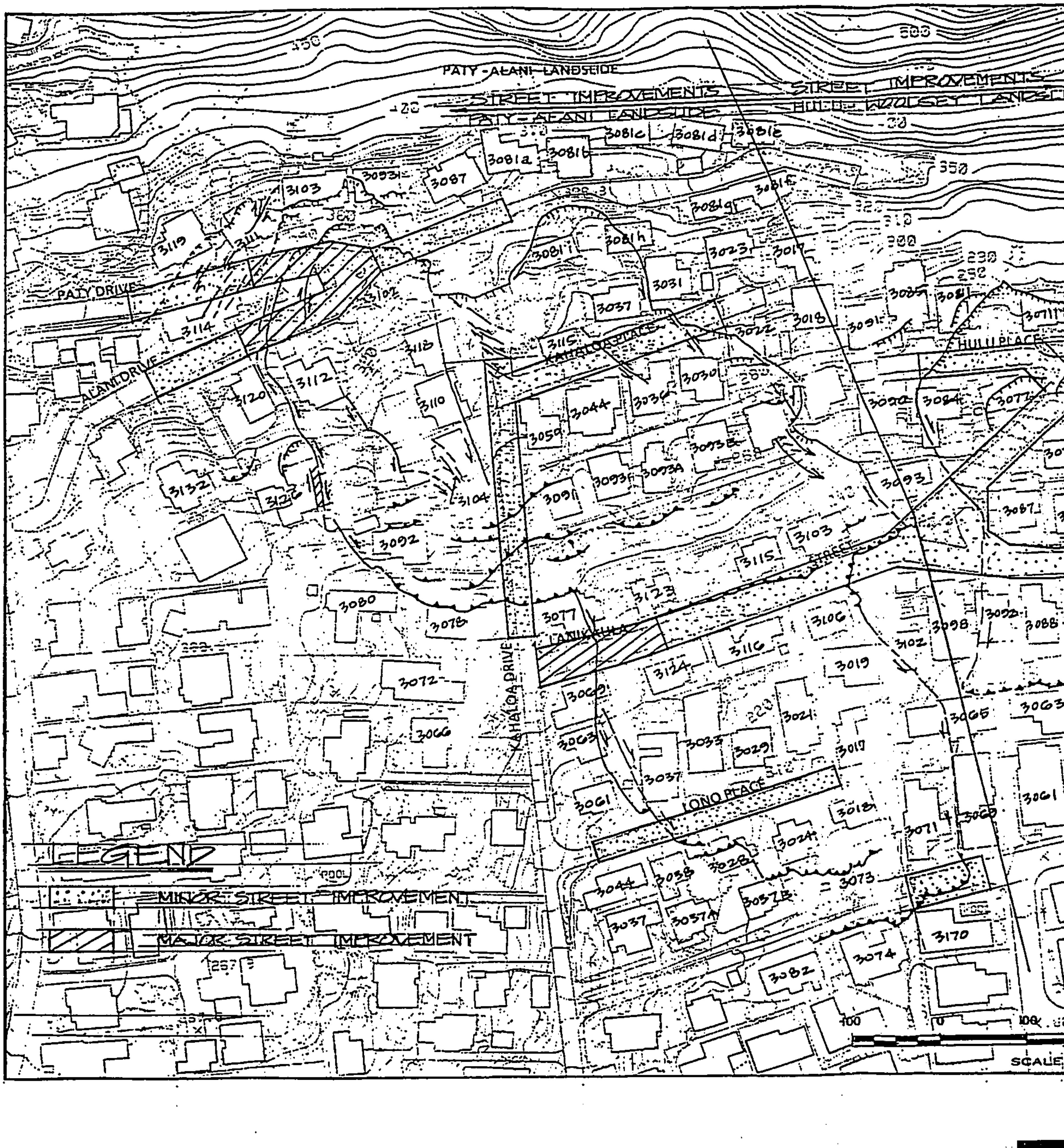
WOODLAWN AREA EARTH STABILIZATION

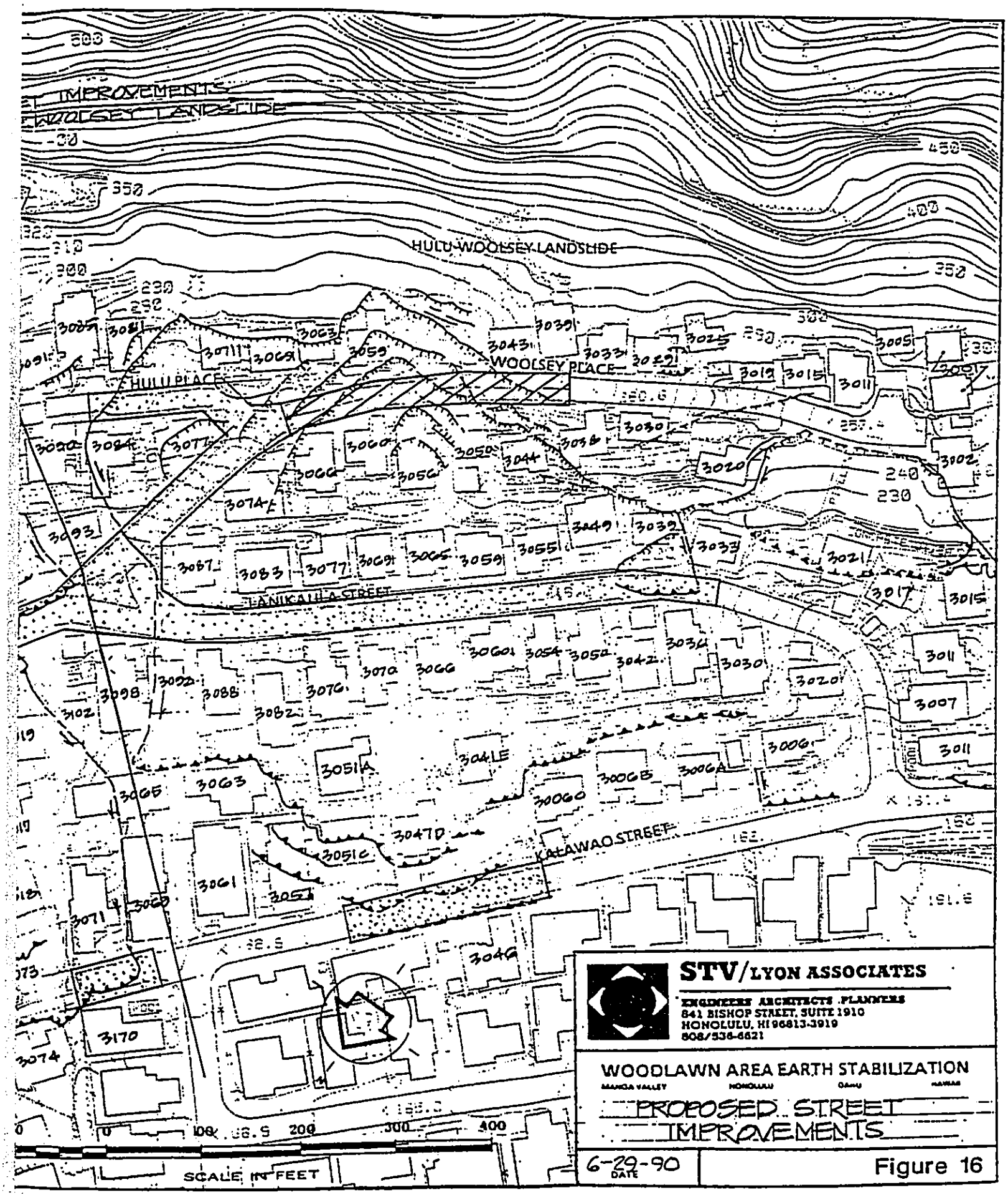
MANOA VALLEY HONOLULU OAHU HAWAII

WATER MAIN PLAN

6-29-90
DATE

Figure 15


PATY-ALANI LANDSLIDE
STREET IMPROVEMENTS
PATY-ALANI LANDSLIDE
STREET IMPROVEMENTS
PATY DRIVE
ALANI DRIVE
KAHALOA PLACE
HULU PLACE
KAHALOA DRIVE
LANIKAULA
STREET
IONO PLACE
POOL
LEGEND
MINOR STREET IMPROVEMENT
MAJOR STREET IMPROVEMENT
SCALE


IMPROVEMENTS
WOOLSEY LANDSLIDE
HULU WOOLSEY LANDSLIDE
HULU PLACE
WOOLSEY PLACE
LANIKAILA STREET
KALAWAO STREET
SCALE IN FEET
STV/LYON ASSOCIATES
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WOODLAWN AREA EARTH STABILIZATION
MANOA VALLEY HONOLULU OAHU HAWAII
PROPOSED STREET IMPROVEMENTS
6-29-90
DATE
Figure 16

4.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT, IDENTIFICATION OF PROBABLE IMPACTS AND PROPOSED MITIGATING MEASURES

4.1 Natural Resources

4.1.1 Flora and Fauna

Existing Conditions

The project area is urban in character predominated by residential activities, structures and streets. Vegetation consists primarily of landscaping associated with residential uses. Within this urban environment, bird species sighted or presumed to frequent the project area are those common to urban Honolulu, including: lace-necked and barred doves, house sparrows, common mynahs, cardinals and Japanese white-eyes (Ref. 1). Other animals found within the project area include domestic pets and strays, mongooses, rats and mice. The steeply sloping State-designated Conservation lands directly mauka of the project area are not known to contain any flora or fauna presently classified as endangered by the U.S. Fish and Wildlife Service. Any activities proposed for Conservation lands will be closely coordinated with the State Department of Land and Natural Resources.

Probable Impacts

Since the vegetation within the project area consists almost entirely of landscaped materials, the impact of the proposed project will primarily consist of removal of some of the existing vegetation and its eventual replacement with new landscaping.

It is expected that during construction, the birds will move to nearby undisturbed areas and will return when disturbances (increased human presence, noise) cease. Similarly, stray domestic animals, mongooses, rats and mice will move to adjoining areas during construction and return when construction is completed.

4.1.2 Air Quality

Existing Conditions

Ambient air quality within the project area is good, consistent with its location within a residential area, well away from major roadways and point sources of pollution.

Probable Impacts

The principal source of air quality impact will be construction activity. Construction vehicle activity will increase vehicular pollutant concentrations along certain roads within the project area, depending on the location of

construction activities. Site preparation and earth moving will create particulate emissions as will building and on-site road construction.

Mitigating Measures
The impact of construction activities will be mitigated by conforming to strict erosion control measures, particularly those specified in the State Department of Health's (DOH) Water Quality Standards, Chapter 37-A, Public Health Regulations, 1968; and the U.S. Soil Conservation Service's Erosion and Sediment Control Guide for Hawaii, 1968. Primary fugitive dust control measures include wetting down loose soil areas, good housekeeping on the job site and the prompt paving or landscaping of bare soil areas.

4.1.3 Noise

Existing Conditions
Ambient noise levels within the project area are typical of lower density residential areas with noise from wind, vegetation and occasional passing vehicles causing the primary noise impacts. Noise data was collected in Manoa during the latter part of 1981 and throughout 1982 (during daylight hours only) (Ref. 32). The noise data collected indicates that ambient noise levels exceeded 51.5 decibels 10 percent of the time, 46.0 decibels 50 percent of the time, and 43.4 decibels 90 percent of the time.

Probable Impacts
The proposed action will generate short-term noise impacts in those areas of Woodlawn where project-related construction activities will be occurring. The primary source of noise during construction can be broken down by activity: (1) clearing, grubbing, grading and other site preparation activities; (2) excavation and embankment; (3) drilling and installation of tiebacks and vertical wells, filling; and (4) paving and landscaping.

Primary sources of noise will be equipment required for construction activities, including heavy vehicles required to excavate and remove spoil material and import construction materials,and the use of other power equipment.

During construction, the residents in the project area will be the most affected by noise generated during construction activities as sound attenuates with distance. The timing and duration of these activities are subject to regulations of the State DOH (Ref. 15). Noelani Elementary School and Manoa Elementary School are approximately 3,000 and 2,000 feet away from the project area, respectively. There are no hospitals or other similar facilities nearby that would be affected by construction noise from the project area.

Mitigating Measures
Construction-period noise impacts will be mitigated through compliance with the provisions of Title 11, Administrative Rules, Chapter 43, Community Noise Control for Oahu, of the State Department of Health (Ref. 15). Construction activities will be limited to daylight hours, and mufflers will be required of all equipment. Traffic noise from heavy vehicles travelling to and from the construction site must be minimized near existing residential areas and schools, and must comply with the provisions of Title 11, Administrative Rules, Chapter 42, Vehicular Noise Control for Oahu (Ref.16).

4.2 Archaeological/Historical Resources

Existing Conditions
According to preliminary consultation with the State Historic Sites Section, the only significant historic site within the project area is the Eyman-Judson residence (3114 Paty Drive; TMK: 2-9-39:1), which is listed on the National and Hawaii Registers of historic places (Site No. 80-14-1370). The Eyman-Judson residence was built in 1926 by C.W. Dickey and was placed on the Registers of Historic Places because it is a significant example of regional-style architecture. No other significant archaeological or historic resources are known to be present within the project area.

Probable Impacts
The proposed action will avoid the Eyman-Judson residence and if the proposed improvements to reduce slippage are successful, the action may result in saving this historic structure from the effects of the Paty-Alani landslide. No impacts to archaeological or historical resources are expected as a result of the project. In the event that any previously unidentified sites or remains are encountered during construction and site work phases, work in the immediate area will cease until the State Historic Preservation Officer has been notified and is able to assess the impact and make further recommendations for mitigative measures.

4.3 Recreational Resources

Existing Conditions
There are no parks within the project area. Recreational activities are generally limited to running, walking and bicycling along Paty Drive, Alani Drive, Kahaloa Drive, Kahaloa Place, Lono Place, Hulu Place, Woolsey Place and Lanikaula Street.

Probable Impacts
The Manoa landslides have badly buckled parts of the above streets and roadway improvements as part of the proposed project will improve paved surface conditions for runners, walkers and bicyclists.

4.4 Socio/Economic Characteristics

The following information is taken from the Census of Population and Housing, 1980, and updated where more current information is available.

4.4.1 Population

Existing Conditions
The project area lies within Census Tracts (CT) 29 and 31.01. CT 29, East Manoa, had a resident population of 1,583 in 1980 (Ref. 29), increasing slightly to 1,598 in 1985 (Ref.11). CT 31.01, Woodlawn, had a population of 3,923 in 1980 (Ref. 29), increasing slightly to 4,020 in 1985 (Ref. 11), indicating a very stable population base. Approximately 130 homes are located within the boundaries of the landslide area identified by the USGS. Assuming an average household size of 3.3 residents (Census Tracts 29 and 31.01 total population divided by total housing units), it is estimated that the landslide is directly affecting about 429 residents.

Probable Impacts
The proposed action is directed at stabilizing hillside movement in the area which is now destroying residential property and consequently forcing impacted households to relocate to other areas of Oahu. Implementation of the proposed action will therefore act to stabilize residential population levels within the area. The proposed action will not affect any State of Hawaii or City and County of Honolulu population policies. There will be no secondary effects on future development, population or public facilities. In fact, the proposed action will, in a limited manner, prevent secondary impacts by averting the relocation of 130 households to other neighborhoods, or to temporary housing with friends or relatives. Also, new residential units would not have to be built or sold to accommodate those who would be forced to relocate, thereby leaving those units available for individuals and families who voluntarily chose to enter the housing market.

4.4.2 Housing Conditions

Existing Conditions
Based on Census data, over half (55 percent) of the homes in the general project area were built prior to 1960. Most of the rest of the existing homes were constructed during the ten-year period between 1960 and 1969 (40

percent). Thus, 95 percent of the homes within the general project area are at least 20 years old (or older).

Probable Impacts
Tangible beneficial impacts of the proposed action include the reduction of damages to private and public property due to continued earth movement. The principal purpose of the proposed action is to mitigate damages to public and private property resulting from hillside movement. The proposed action directly responds to the area residents' concerns about damage to private residences, flooding, and hazardous road conditions. Stabilization of the hillside will therefore reduce the amount of damage to residential uses and generally provide a beneficial effect to private property owners in the project area.

4.5 Infrastructure and Services

4.5.1 Traffic

Existing Conditions
The roads within the project area provide vehicular access to the residential parcels located within and beyond the project area. As discussed below, many of the roadways are in poor repair due to hillside movement causing congestion and sometimes dangerous traffic movements. Construction activities in the area have temporarily increased traffic congestion.

Probable Impacts
Short term impacts will be limited primarily to traffic congestion as roadways are excavated and reconstructed. The primary long term impact of the proposed action will be the reconditioning of all project area roads, resulting in the restoration of safe and efficient vehicle movements.

Mitigating Measures
Construction activities will be phased to limit impact to traffic within the project area. Within the affected roadways, the contractor is required to provide, install, and maintain all necessary signs and other protective facilities, which shall conform with rules adopted by the City and County of Honolulu Department of Transportation Services (DTS) (Ref. 17), and the current U.S. Federal Highway Administration guidelines. Work on any of the streets within the project area will be performed only between the hours of 8:00 a.m. to 3:30 p.m., Monday through Friday, unless otherwise permitted by DTS. During working hours, to the extent possible, the contractor is required to provide a lane for through traffic. During non-working hours, all trenches are required to be covered with a safe, non-skid bridging material and to the extent possible, all lanes are to remain open to traffic. Where pedestrian walkways exist, they are required to be maintained in passable condition or other facilities for

pedestrians are to be provided. Passage between pedestrian walkways at intersections must also be maintained.

4.5.2 Drainage

Existing Conditions

Runoff generated from the area above Kahaloa Place is collected in a drain intake and two catch basins located along Kahaloa Place and is discharged into a new 60-inch drain line within Kahaloa Drive (below Lanikaula Street). A portion of the drain line from Kahaloa Place to Kahaloa Drive is located within a drainage easement.

Runoff from the area above portions of Woolsey Place, Hulu Place and Lanikaula Street is collected by a series of trench drains along Hulu and Woolsey Place, routed through branch drains at the intersection of Lanikaula and Woolsey Place, discharged into the reconstructed drain with pipe sizes from 18-60 inches in diameter along Lanikaula Street and released into an outlet near the intersection of Lanikaula and Kalawao Streets.

Probable Impacts

Short-term impacts will be limited to the construction period. Repair and replacement of drainage lines will require work within roadway rights-of-way and will therefore adversely impact traffic flows during the construction period. The proposed drainage improvements will have positive long-term impacts. Drainage improvements will be designed and constructed to adequately dispose of excess surface water, preventing it from reaching the clay subsoil and, thereby stabilizing the hillside area. Drainage improvements will confine the present excess runoff within the roadways and reduce erosion and siltation, minimizing discharge of silt into Manoa Stream (Ref. 24). No work will be done in the stream itself.

Mitigative Measures

Construction activities will be phased to limit impact to traffic within the project area. Refer to Section 4.5.1 for specific measures to mitigate impacts to traffic during construction.

4.5.3 Domestic Water Supply

Existing Conditions

The Honolulu Board of Water Supply (BWS) provides potable water service to the project area via a series of pipelines buried within the roadways. The water lines consist of: 2-inch lines along Paty Drive, Lanikaula Street, and Woolsey Place; 6-inch lines along Alani Drive and Kahaloa Drive; 6-inch and 4-inch lines along Kahaloa Place; 4-inch lines along Hulu Place; and 2 1/2-inch and 2-inch lines along Lono Place. The embankment slope in the Alani

Drive/Paty Drive/Paty Drive Extension area has experienced continual lateral movements (on the order of several feet) which have resulted in damage to the underground water lines (Ref. 7). Ground movements appear to be particularly severe near the upper end of Kahaloa Drive where numerous utility line breaks have been reported, with less damage occurring downslope (Ref. 7).

Probable Impacts

Short-term impacts will be limited to the construction period. Repair and replacement of water lines will require work within roadway rights-of-way and will therefore adversely impact traffic flows during the construction period. The proposed improvements to the water delivery system will have positive long-term impacts. Stabilization of earth movements within the project area would have a positive impact on BWS' ability to provide uninterrupted potable water service to the residences within the project area. The repair of buried water lines will also eliminate a potential source of subsurface water, thus reducing the potential for hillside slippage.

Mitigative Measures

Construction activities will be phased to limit impact to traffic within the project area. Refer to Section 4.5.1 for specific measures to mitigate impacts to traffic during construction.

4.5.4 Wastewater Collection Facilities

Existing Conditions

DPW provides wastewater collection facilities within the project area consisting of a series of pipelines buried within roadways and easements through various private properties. The sewer lines consist of 8-inch and 12-inch lines along Kahaloa Drive, 8-inch lines along Paty Drive, Alani Drive, Lono Place, Kahaloa Place, Lanikaula Street, Woolsey Place and Hulu Place. As noted earlier, DPW conducted a visual inspection of most of the sewers within the project area in June 1986. The visual inspection revealed that 20 out of 22 lengths (manhole to manhole) of sewer line were completely or partially displaced (Ref. 25). These 20 lengths are considered to be damaged.

Probable Impacts

Short-term impacts will be limited to the construction period. Repair and replacement of sewer lines will require work within roadway rights-of-way and will therefore adversely impact traffic flows during the construction period.

The proposed improvements to the wastewater collection system will have positive long-term impacts. The repair of broken sewer lines will also eliminate a potential source of subsurface water, thus reducing the potential for hillside slippage, and will minimize the potential of untreated wastewater reaching surface or groundwater resources. Stabilization of earth movements within the

project area would have a positive impact on DPW's ability to provide wastewater collection service to the residences within the project area.

Mitigative Measures
Construction activities will be phased to limit impact to traffic within the project area. Refer to Section 4.5.1 for specific measures to mitigate impacts to traffic during construction.

4.5.5 Electricity

Existing Conditions
Hawaiian Electric Company, Inc. provides residential electrical service to the project area via a system of overhead 4 KV powerlines (except on Kahaloa Drive, where it is 46 KV) located within the roadway right-of-ways. In some places within the project area, earth movements have caused overhead powerline poles to lean over (Appendix A, Photo 1).

Probable Impacts
Short-term impacts will be limited to the construction period. Repair and replacement of electrical lines and poles will require work within roadway rights-of-way and will therefore adversely impact traffic flows during the construction period. The proposed improvements to the electrical lines and poles will have positive long-term impacts. Stabilization of earth movements within the project area would have a positive impact on Hawaiian Electric Company, Inc.'s ability to provide electrical service to the residences within the project area.

Mitigative Measures
Construction activities will be phased to limit impact to traffic within the project area. Refer to Section 4.5.1 for specific measures to mitigate impacts to traffic during construction.

4.5.5 Telephone

Existing Conditions
GTE Hawaiian Tel provides telephone service to the project area via a system of overhead lines located within the roadway right-of-ways. Appendix A, Photo 1 shows a severe example of the effect of earth movements on poles carrying overhead telephone lines.

Probable Impacts
Short-term impacts will be limited to the construction period. Repair and replacement of telephone lines and poles will require work within roadway rights-of-way and will therefore adversely impact traffic flows during the construction period.

The proposed improvements to the telephone lines and poles will have positive long-term impacts. Stabilization of earth movements within the project area would have a positive impact on GTE Hawaiian Tel's ability to provide telephone service to the residences within the project area.

Mitigative Measures
Construction activities will be phased to limit impact to traffic within the project area. Refer to Section 4.5.1 for specific measures to mitigate impacts to traffic during construction.

4.5.6 Gas

Existing Conditions
The Gas Company, Inc. (Gasco Inc.) maintains 2-inch underground gas lines along Kahaloa Drive, Lono Place, Lanikaula Street, and Woolsey Place, a 5/8-inch line at Hulu Place, and a 3/4-inch line at Kahaloa Place up to Paty Drive Extension via an easement. Due to landslide conditions in the project area, residential gas service was discontinued along Lono Place, Lanikaula Street, Woolsey Place and Hulu Place. Gasco Inc. still provides service via gas lines along Kahaloa Drive and Kahaloa Place and by filling tanks at various residences. Gas service via underground lines was never available along Paty Drive and Alani Drive.

Probable Impacts
Short-term impacts will be limited to the construction period. Repair and replacement of gas lines will require work within roadway rights-of-way and will therefore adversely impact traffic flows during the construction period.

The proposed improvements to the gas lines will have positive long-term impacts. If the proposed action is successful in stabilizing earth movements within the project area, Gasco Inc. will reconnect discontinued gas lines if there is sufficient demand for gas service.

Mitigative Measures
Construction activities will be phased to limit impact to traffic within the project area. Refer to Section 4.5.1 for specific measures to mitigate impacts to traffic during construction.

4.5.7 Roads

Existing Conditions

DPW maintains nearly all of the public roadways within the project area (Alani Drive, Paty Drive, Paty Drive Extension, the upper portion of Kahaloa Drive down to Kahaloa Place, Kahaloa Place, Lono Place, Lanikaula Street, Woolsey Place and Hulu Place). The area in the vicinity of the intersection of Alani and Paty Drives has experienced large lateral movements, as evidenced by severe cracking and undulations of the road pavements (Ref. 7). The boundary between the portions of the roads which have experienced large movements and portions which have been relatively stable is readily visible by the pavement cracking pattern (Ref. 7). The embankment slope in the Paty Drive Extension area has experienced continual lateral movements and has resulted in damage to the road pavement (Ref. 7). Evidence of ground movements on Kahaloa Drive are visible as cracks and undulations in the pavements. The movements appear to be particularly severe near the upper end of Kahaloa Drive and lessen downslope. The northern portion of Kahaloa Place have experienced significant lateral movements downslope (Ref. 7). Portions of Lanikaula Street roadway surface shows undulations and cracking. Undulations are especially severe near the mid-point of Woolsey Place.

Probable Impacts

Short term impacts will be limited primarily to traffic congestion as roadways are dug up and reconstructed. In sections where 15 feet or more of the clay is encountered, parts of the above roadways would be excavated, resulting in a blockage of traffic flow. The primary long term impact of the proposed action will be the reconditioning of all project area roads, resulting in the restoration of safe and efficient vehicle movements.

Mitigating Measures

Construction activities will be phased to limit impact to traffic within the project area. Refer to Section 4.5.1 for specific measures to mitigate impacts to traffic during construction.

5.0 ALTERNATIVES

The main objective of the proposed action is the stabilization of the Woodlawn area. A number of alternatives that may meet the objective of stabilizing earth in the project area have been considered, but were rejected due to the greater cost, these included: shallow buttress fills, H-pile walls, large diameter caissons, soil nails, and mini-pile walls.

Other alternatives which have been raised, but would not attain the stated objective include:

- o No Action;
- o Acquisition of affected properties;
  - Remove homes and develop into park areas;
  - Remove homes and develop multi-level residential structures

5.1 Alternatives Which Would Meet the Objectives of the Proposed Action

5.1.1 Shallow Buttress Fills

Shallow buttress fills are deemed not appropriate given subsequent measurements of depths of movement which has determined that slides are deeper than originally thought. This alternative would not be less expensive than the proposed method of earth stabilization.

5.1.2 H-Pile Wall

Given the slope of the slide (8 to 10 degrees) and the translational nature for much of its length of 800 feet, the slides require restraint at a number of locations down the slope. With the slope, density of housing and depth of slide of 50 feet (or even 30 feet) excavation for installation of any wall, whether buttress, reinforced earth, or concrete is unfeasible. Excavation of difficult soil with cobbles and boulders to depths of 60 feet, below the water table, and transporting the soil for disposal or temporary retention, and the required shoring would be very costly and impractical.

The only practical solutions involve construction from the top, or surface, down. An H-pile wall would be constructed down to a depth of 25 to 30 feet to intersect the shallower slide surface and with tiebacks anchored well below the deeper slide depth. Stress from the wall would apply sufficient tangential and normal forces to the deeper sliding surface to stabilize it. This alternative was determined to be unfeasible because of the difficulties in construction and its higher costs. Specifically, the H-pile wall system requires pre-drilling for all soldier piles; the expense of temporarily removing excavated soil and later

replacing it; working width of 30 feet to temporarily shore the downslope cut; and greater disruption of residents.

5.1.3 Large Diameter Caissons

Large diameter caissons were considered and rejected due to the greater construction costs. The caissons would require penetration to 75 feet, or more, and very close spacing with frequent tiebacks.

5.1.4 Soil Nails

Soil nails were considered and rejected because of the existing soil conditions. Pre-drilling would be required at close spacing. In as much as most of the costs for the nails and ties (and mini-piles) is in the drilling, it is more effective and economical to install anchors. Many more nails would be required as these are only passive elements.

5.1.5 Mini-Pile Wall

A mini-pile wall system involves minor excavation and the pre-drilling of a large number of small diameter piles at close spacing so the enclosed soil and piles act as a gravity retaining structure. Only 5 walls of this type have been completed in the U.S. in the past 12 years. The lack of experience with this wall type and the lack of a definitive design procedure would require greater conservatism and cost in the final design.

5.2 Alternatives Which Would Not Meet the Objectives of the Proposed Action

5.2.1 No Action

If the proposed action is not implemented, then landslides in the project area will continue. Structural damage within the present boundaries (as well as within expanded boundaries) will continue to intensify. The slide zone will progressively respond to smaller and smaller storm events. Conceivably, all 130 residential units presently affected by the landslides could be so severely affected that they would be rendered uninhabitable and residents would face eventual displacement. Landslides could continue to grow in all directions to an ultimate size 2.3 to 2.5 times its present area with progressive damage to more homes in the area. In addition, all public improvements within the project area, including roads, sidewalks, sewer lines, storm drains and utilities, could become unusable, requiring significant replacement. While this alternative may appear economically attractive in the short-term, it could mean more significant public expenditures in the long-term if it becomes necessary to

acquire the affected properties or remedial work is pursued at a future date. There will also be decreasing land valuation and reduced tax revenues.

Finally, the course of "no-action" is contrary to the present objectives of public policy as demonstrated by City Council and the Department of Public Works (DPW). DPW has contracted with STV/Lyon Associates to design stabilization remedies for the project area, which is a clear indication that remedial work is the preferred goal of the Administration of the City and County of Honolulu.

5.2.2 Acquisition of Affected Properties

The alternative to acquire affected properties to remove existing homes to develop either into open areas (as was done in Palolo and Aina Haina) or into multi-level structures, would result in the displacement of residents, which would result in a similar eventual outcome as the "no action" alternative.

The acquisition of all residential properties within the slide area (approximately 130 homes) would require an unprecedented capital outlay of public funds (assuming an average purchase price of $200,000 per site, the total outlay could amount to as much as $25 million) to acquire the properties and another outlay of possibly the same magnitude to demolish/stabilize the hillside area. In any event, the acquisition alternative would still necessitate the stabilization of the slide areas in order to prevent possible additional damage further downslope. In addition, there would be costs incurred in developing the park for grading, drainage and landscaping.

It has been suggested that an acquisition alternative could include the development of a multi-family, multi-level structure within the project area once the remedial stabilization has been completed. Because more stable soil can be found at depths underlying the unstable soils, it would probably be necessary to install supporting beams (piles, posts, etc) to this depth. However, large-scale multi-family structures such as these would significantly alter the single-family, low-rise residential character of Manoa Valley and, accordingly, would likely be strongly opposed by area residents. This would also contravene existing land use policies for the area, which currently is for single-family residential use rather than multi-family residential use.

5.3 Conclusion

The proposed action is the most sensible and logical choice of the alternatives for the following reasons:

- It is the most economical of the earth stabilization methods studied.

- Most or all affected households can retain present locations, thereby negating the need for large-scale resident relocation.
- Factors which have accelerated natural soil slide properties will be corrected or mitigated.
- The need for future expenditures for remedial or ad-hoc repair work will be greatly reduced.
- Present land use policies for the project area will be maintained.

6.0 AGENCIES CONSULTED DURING THE PREPARATION OF THE ENVIRONMENTAL ASSESSMENT

Copies of the draft environmental assessment were distributed to the following agencies for review and comment. Appendix C presents all relevant correspondence relating to this consultation process.

Federal
Department of the Army, U.S. Army Engineer District
Department of the Interior, Fish and Wildlife Service
Department of the Interior, USGS Water Resources Division

State of Hawaii
Department of Health
Department of Land and Natural Resources
University of Hawaii Environmental Center

City & County of Honolulu
Board of Water Supply
Department of General Planning
Department of Land Utilization
Department of Parks and Recreation
Department of Transportation Services
Building Department

Other Agencies and Organizations
Manoa Association of Sliding Hillside Homeowners
Manoa Neighborhood Board No. 7
The Honorable Brian T. Taniguchi
The Honorable Andy Mirikitani
The Honorable Ann Kobayashi

Utilities
The Gas Company
Hawaiian Electric Company
Hawaiian Telephone Company
Oceanic Cablevision

7.0 DETERMINATION

After completing an assessment of the potential environmental effects of the proposed project and consulting formally with other governmental agencies, it has been determined that an Environmental Impact Statement is not required. Therefore, this document constitutes a notice of Negative Declaration.

8.0 FINDINGS AND REASONS SUPPORTING THE DETERMINATION

Findings and reasons supporting the Negative Declaration determination are as follows, using the criteria, policies, guidelines and provisions of Title 11, Chapter 200, Environmental Impact Statement Rules and Chapter 343, HRS. The proposed project will not:

A. Involve an irrevocable commitment to loss or destruction of any natural or cultural resource;

B. Curtail the range of beneficial uses of the environment;

C. Conflict with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 344,. Hawaii Revised Statutes, and any revisions thereof and amendments thereto, court decisions or executive orders;

D. Substantially adversely affect the economic or social welfare of the community or State (the proposed action will alleviate the earth movement problems and reduce the risk of injury and property damage);

E. Substantially adversely affect public health;

F. Involve substantial secondary impacts, such as population changes or effects on public facilities;

G. Involve a substantial degradation of environmental quality;

H. Substantially affect a rare, threatened or endangered species, or its habitat;

I. Detrimentally affect air or water quality or ambient noise levels; or

J. Affect an environmentally sensitive area such as a flood plain, tsunami zone, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters.

9.0 REFERENCES

1. Belt Collins & Associates. Draft Environmental Impact Statement for the Waahila 180 and Waahila 405 Reservoirs. Prepared for City and County of Honolulu Department of Public Works. 20 April 1989.

2. Evans, John R. and Paul L. Hummel. Review of Proposed Improvements to the area near Woolsey Place, Manoa Valley, Oahu, Hawaii. Prepared for the Honolulu City Council. 29 July 1986.

3. Fujita & Associates, Inc. Drainage Improvements in the Vicinity of Paty Drive, Kahaloa Place, Hulu Place, Woolsey Place and Lanikaula Street. Prepared for City and County of Honolulu Department of Public Works. December 1985.

4. Geolabs-Hawaii. Soil Engineering Investigation Report, For the Study of Earth Movement Areas in the Vicinity of Kahaloa Drive, Kahaloa Place, Hulu Place, Woolsey Place, and Lanikaula Street, Manoa Valley, Honolulu, Oahu, Hawaii. Prepared for the City and County of Honolulu Department of Public Works. April 1984.

5. Geolabs-Hawaii. Geotechnical Engineering Investigation, Remedial Work for Earth Movement Areas Vicinity of Hulu and Woolsey Place, Manoa Valley, Oahu, Hawaii. Prepared for Fujita and Associates, Inc. September 1985.

6. Geolabs-Hawaii. Progress Report No. 1, Earth Movements in the Vicinity of the End of Woolsey Place, Honolulu, Oahu, Hawaii. Prepared for the City and County of Honolulu Department of Public Works. 11 February 1988.

7. Geolabs-Hawaii. Progress Report No. 2, Earth Movements in the Vicinity of Alani and Paty Drives, Paty Extension, Hale Manoa, Kahaloa Drive and Kahaloa Place, Manoa Valley, Honolulu, Oahu, Hawaii. Prepared for the City and County of Honolulu Department of Public Works. 8 March 1988.

8. Geolabs-Hawaii. Progress Report No. 3, Additional Study of Earth Movements in the Vicinity of the End of Woolsey Place, Honolulu, Oahu, Hawaii. Prepared for the City and County of Honolulu Department of Public Works. 11 March 1988.

9. Geolabs-Hawaii. Progress Report No. 4, Earth Movements in the Vicinity of Alani Drive, Paty Drive and Paty Extension, Manoa Valley, Honolulu, Oahu, Hawaii. Prepared for the City and County of Honolulu Department of Public Works. 13 December 1988.

10. Harding Lawson Associates. Final Monitoring Report, Drainage Improvements in the Vicinity of Hulu Place, Woolsey Place and Lanikaula Street. Oahu, Hawaii. Prepared for the City and County of Honolulu Department of Public Works. December 1988.

11. Hawaii, State of, Department of Business and Economic Development. State of Hawaii Data Book. 1988.

12. Hawaii, State of, Department of Health. "Title 11, Administrative Rules, Chapter 59, Ambient Air Quality Standards". (n.d.).

13. _____. "Title 11, Administrative Rules, Chapter 200, Environmental Impact Statement Rules." December 1985.

14. _____. "Title 11, Administrative Rules, Chapter 60, Air Pollution Control". (n.d.).

15. _____. "Title 11, Administrative Rules, Chapter 43, Community Noise Control for Oahu". November 6, 1981.

16. _____. "Title 11, Administrative Rules, Chapter 42, Vehicular Noise Control for Oahu". October 27, 1981.

17. Hawaii State of, Department of Transportation. "Title 19, Administrative Rules, Chapter 129. Rules Governing the Use of Traffic Control Devices at Work Sites on or Adjacent to Public Streets and Highways." August 1982

18. Honolulu, City and County of, City Council. Resolution 88-472, CD-1

19. _____. Resolution 89-138, CD-1.

20. _____. Revised Ordinances of Honolulu, No. 89-150

21. . Honolulu, City and County of, Department of Public Works, Thiede, Alfred J., Director and Chief Engineer. Letter to Letitia N. Uyehara, Director, State of .Hawaii Office of Environmental Quality Control regarding Notice of Negative Declaration for the Kahaloa Drive Drainage Improvements Project, Manoa, Honolulu, Oahu, Hawaii. 12 February 1987.

22. Honolulu, City and County of, Department of Public Works, Thiede, Alfred J., Director and Chief Engineer. Letter to Marvin T. Miura, Director, State of Hawaii Office of Environmental Quality Control regarding notice of Negative Declaration for the Proposed Land Acquisition for the Woodlawn Earth Movement Area, Honolulu, Oahu, Hawaii. 19 May 1988.

23. Honolulu, City and County of, Department of Public Works, Division of Engineering. Environmental Assessment for Land Acquisition of Improved Residential House Lots Within the Woodlawn Earth Movement Area of Manoa, Hawaii, Oahu, Hawaii. 17 May 1988.

24. Honolulu, City and County of, Department of Public Works, Division of Engineering, Drainage Section. "Environmental Assessment for the Kahaloa Drive Drainage Improvements, Manoa, Honolulu, Oahu, Hawaii". February 1987.

25. Honolulu, City and County of, Department of Public Works, Division of Engineering, Drainage Section, Takakura, Melvin, Project Manager. Memorandum regarding Review of Exempted Project According to Departmental EIS Procedures for the Drain and Sewer Reconstruction in the Vicinity of Woolsey Place, Hulu Place, Lanikaula Street and Kalawao Street, Manoa, Honolulu, Hawaii. 10 July 1987.

26. STV/Lyon Associates, Inc. Hydrologic Analysis for the Waahila Ridge Adjacent to the Woodlawn Area of Oahu, Hawaii. Honolulu, Hawaii. Prepared for the City and County of Honolulu Department of Public Works. June 1989.

27. STV/Lyon Associates, Inc. Woodlawn Area Earth Stabilization Landslides and Facilities Draft Evaluation Report, Volume I. Honolulu, Hawaii. Prepared for the City and County of Honolulu Department of Public Works. June 29, 1990.

28. Stearns, Harold T. and Knute N. Vaksik. Geology and Ground Water Resources of the Island of Oahu, Hawaii. Terr. Dir. Hydrography Bull. 1. 1935.

29. U.S. Census Bureau. Census of Population and Housing, 1980--Summary Tape File 3A.

30. U.S. Department of the Interior, U.S. Geological Survey. Maps Showing Landslide Features and Related Ground Deformation in the Woodlawn Area of the Manoa Valley, City and County of Honolulu. Open-File Report 89-290. 1989.

31. _____. Longitudinal Forces in Landslides--A Comparison Between Field Observations and a One-Dimensional Model. September 1989.

32. Wilson Okamoto & Associates, Inc.. Final Environmental Impact Statement for Sewer Tunnel Relief. Prepared for City and County of Honolulu Department of Public Works. 9 September 1985.

APPENDIX A

PHOTO ANALYSIS

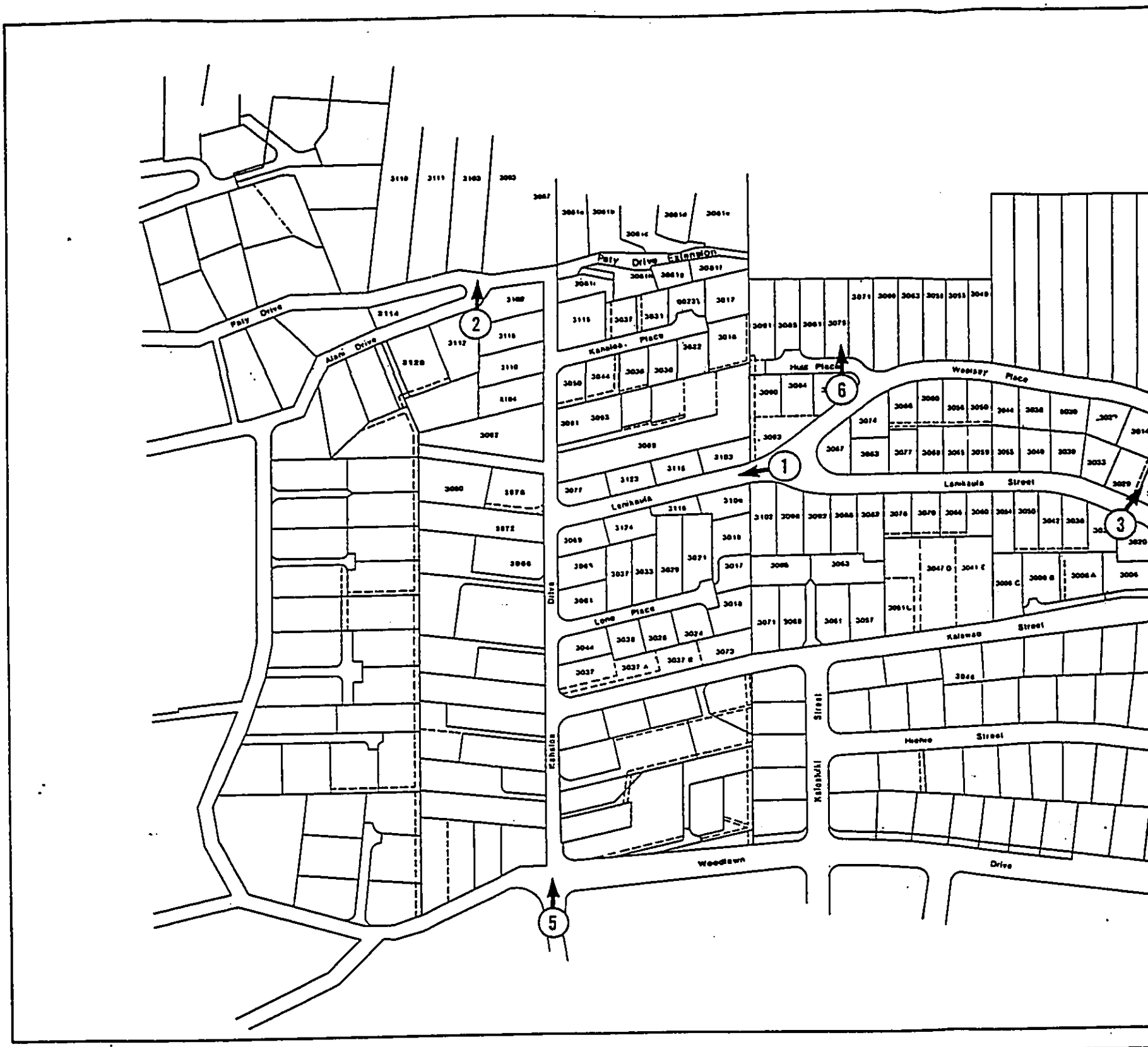


Photo Analysis Key Map

Woodlawn Area Earth Stabilization Project

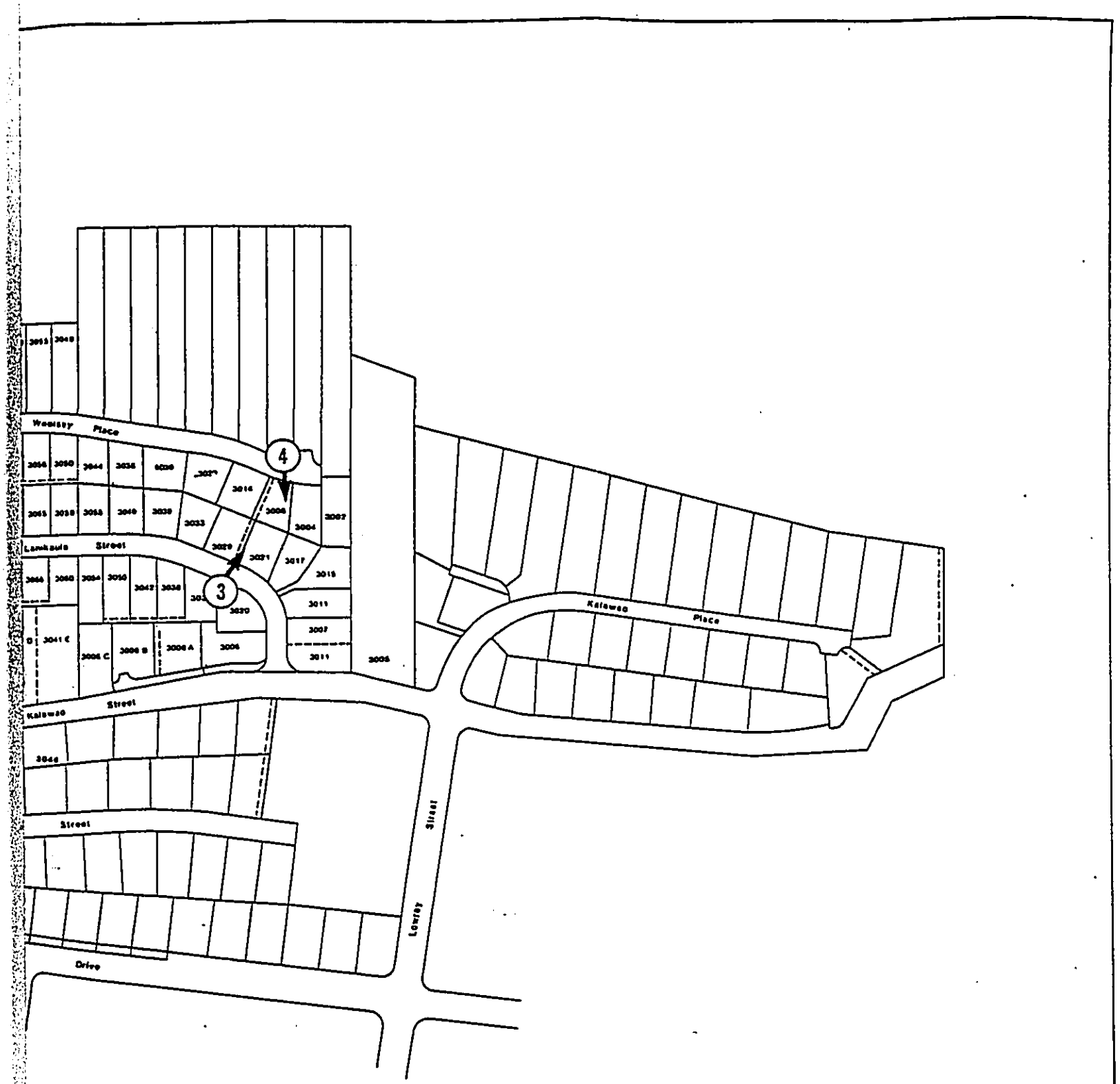
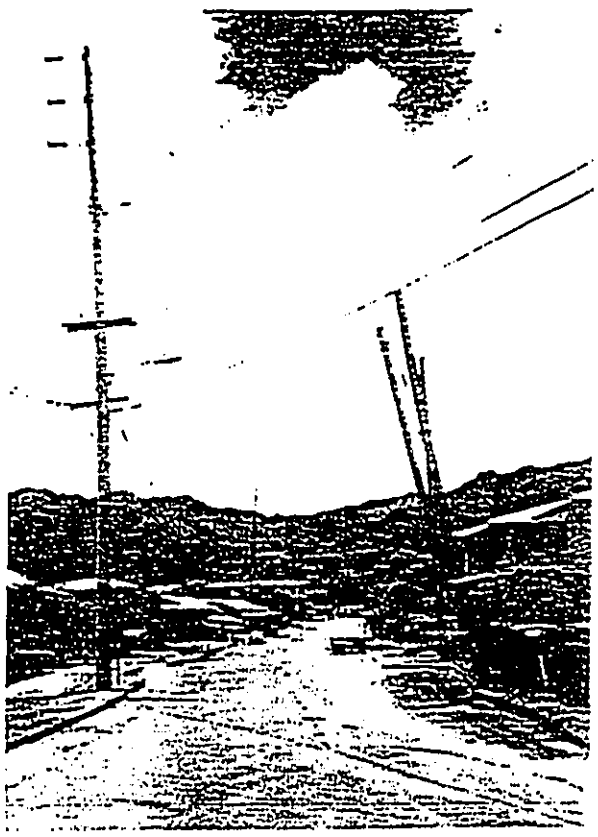


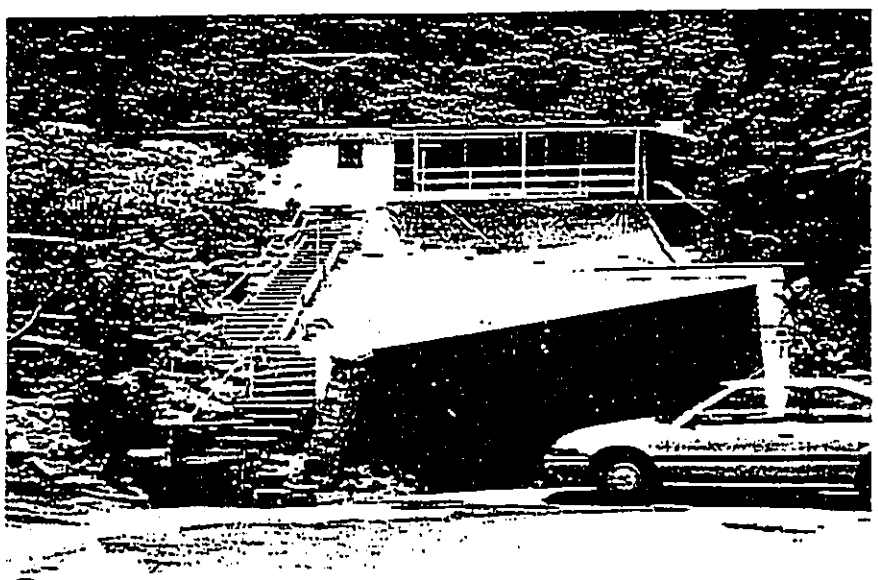
Figure **A-1**

FEET
0 250 500

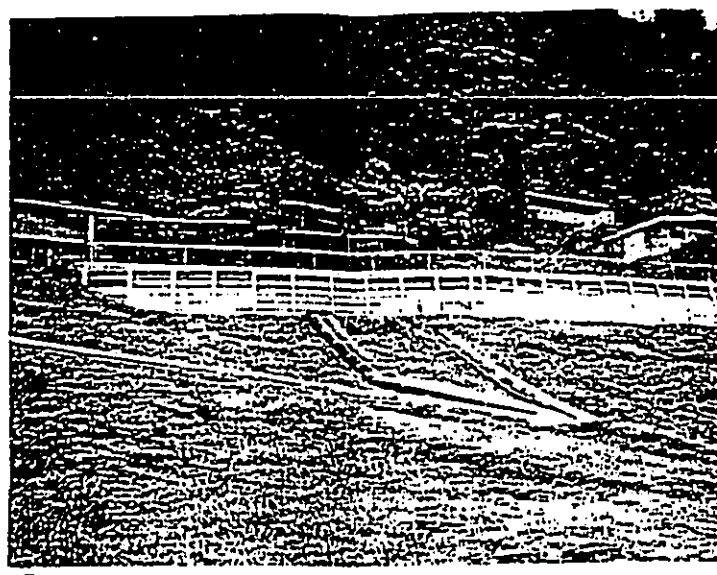
STV/LYON ASSOCIATES
ENGINEERS
841 Bishop Street, Suite 1910
Honolulu, HI 96813-3919
808/536-6621, Fax 808/523-1738



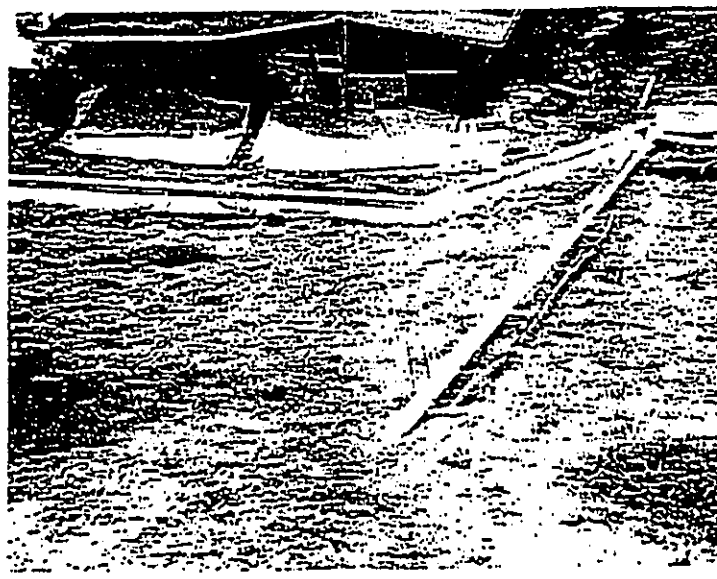
(1) Lanikaula Street near Woolsey Place



(2) Collapsed Garage at 3103 Paty Drive



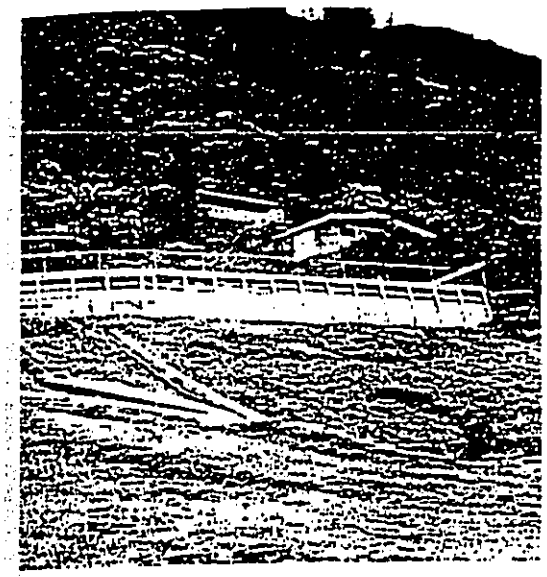
(3) Crib Wall and Trench Drain at Woolsey Place



(4) Drain Lines at Woolsey Place

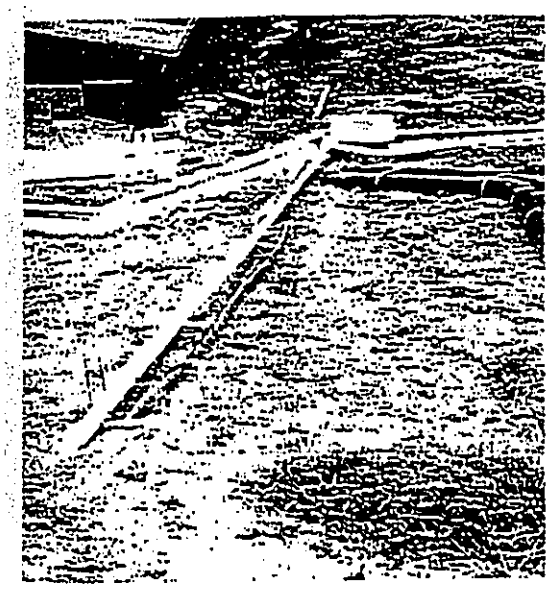
Photo Analysis

Woodlawn Area Earth Stabilization Project

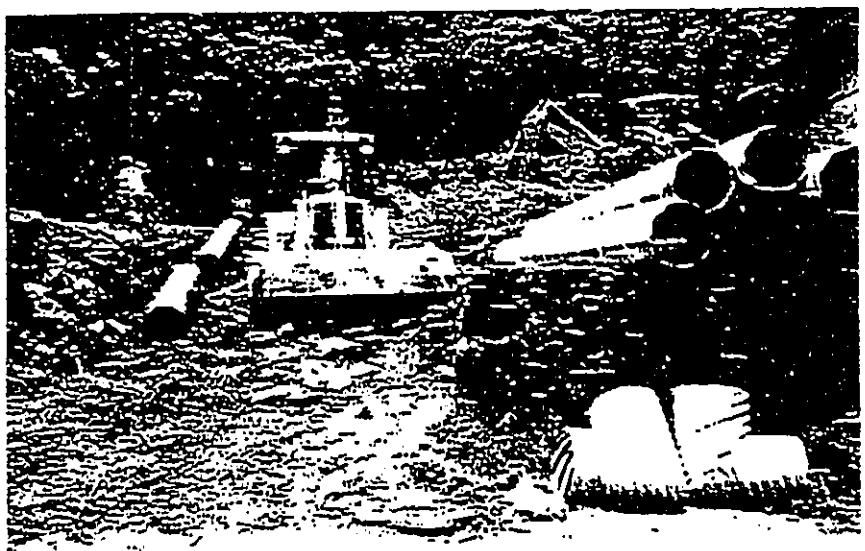


ı Drain at Woolsey Place

(5) Drainage and Roadway Improvements at Kanaloa Drive



lsey Place



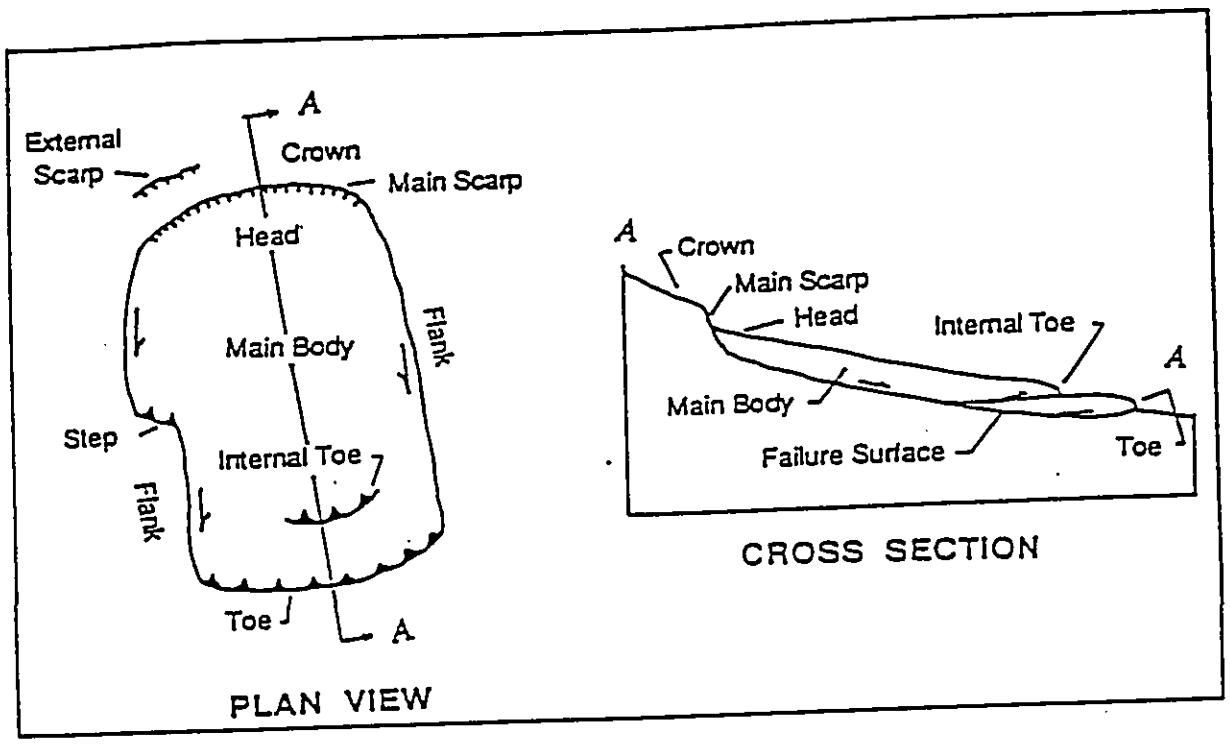
(6) Drainage Improvements at 3075 Hulu Place

Figure **A-2**

STV/LYON ASSOCIATES
ENGINEERS
841 Bishop Street, Suite 1910
Honolulu, HI 96813-3919
Phone 808/523-1721, Fax 808/523-1738

APPENDIX B

LANDSLIDE NOMENCLATURE



NOMENCLATURE

Main Scarp--A steep surface on the undisturbed ground around the upper periphery of the slide caused by the movement of slide material away from the undisturbed ground. The projection of the scarp surface under the displaced material becomes the failure surface.

Crown--The material that is still in place or practically undisplaced and adjacent to the highest parts of the main scarp.

Failure Surface--The surface or surfaces on which movement occurs.

Head--The upper parts of the slide material immediately adjacent to the main scarp. Deformation is by stretching and sagging.

Main Body--That part of the landslide that overlies the failure surface between the main scarp and the toe.

Toe--The margin of displaced material most distant from the main scarp. Deformation is by shortening or compression.

Flank--The side of the landslide. Deformation is principally by shearing.

Step--Offset of a landslide boundary, usually along a flank.

Plan view and cross section of a hypothetical landslide showing nomenclature of parts of a landslide. Modified after Varnes, D.J., 1978, Slope movement types and processes, Chapter 2 *in* Schuster, R.L., and Krizek, R.J. (editors). *Landslides--Analysis and Control*: Transportation Research Board Special Report 176, National Academy of Sciences, Washington, DC, p. 11-33.

Source: Ref. 17

APPENDIX C

COMMENTS FROM AND RESPONSES TO AGENCY CONSULTATION PROCESS

APPENDIX C

COMMENTS FROM AND RESPONSES TO AGENCY CONSULTATION PROCESS

Copies of the Draft EA were distributed to the following agencies for review and comment. Copies of comments/responses to the EA are provided on the following pages. Agency comments warranting a response are identified by an asterisk (*). The appropriate DPW response letter follows each agency comment letter identified by an asterisk.

Federal
Department of the Army, U.S. Army Engineer District
Department of the Interior, Fish and Wildlife Service
*Department of the Interior, USGS Water Resources Division

State of Hawaii
Department of Health
*Department of Land and Natural Resources
University of Hawaii Environmental Center

City & County of Honolulu
Board of Water Supply
Department of General Planning
Department of Land Utilization
Department of Parks and Recreation
Department of Transportation Services
Building Department

Other Agencies and Organizations
*Manoa Association of Sliding Hillside Homeowners
Manoa Neighborhood Board No. 7
*The Honorable Brian T. Taniguchi
The Honorable Andy Mirikitani
The Honorable Ann Kobayashi

Utilities
The Gas Company
Hawaiian Electric Company
Hawaiian Telephone Company
Oceanic Cablevision

DEPARTMENT OF THE ARMY

RECEIVED ENGINEERING 1 52 PM '91

U. S. ARMY ENGINEER DISTRICT, HONOLULU
BUILDING 230
FT. SHAFTER, HAWAII 96858-5440

RECEIVED DEPT OF PUB. WORKS SEP 3 10 19 AM '91

91-3455

REPLY TO ATTENTION OF:

August 30, 1991

TO _____

Planning Division

Mr. Sam Callejo
Director and Chief Engineer
Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Callejo:

Thank you for the opportunity to review and comment on the environmental assessment (EA) for the proposed Woodlawn Area Earth Stabilization Project, Manoa, Oahu, Hawaii (TMK 4-5-25, 39,50,57,58). 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 proposed project will not require a Department of the Army Permit from the Corps.

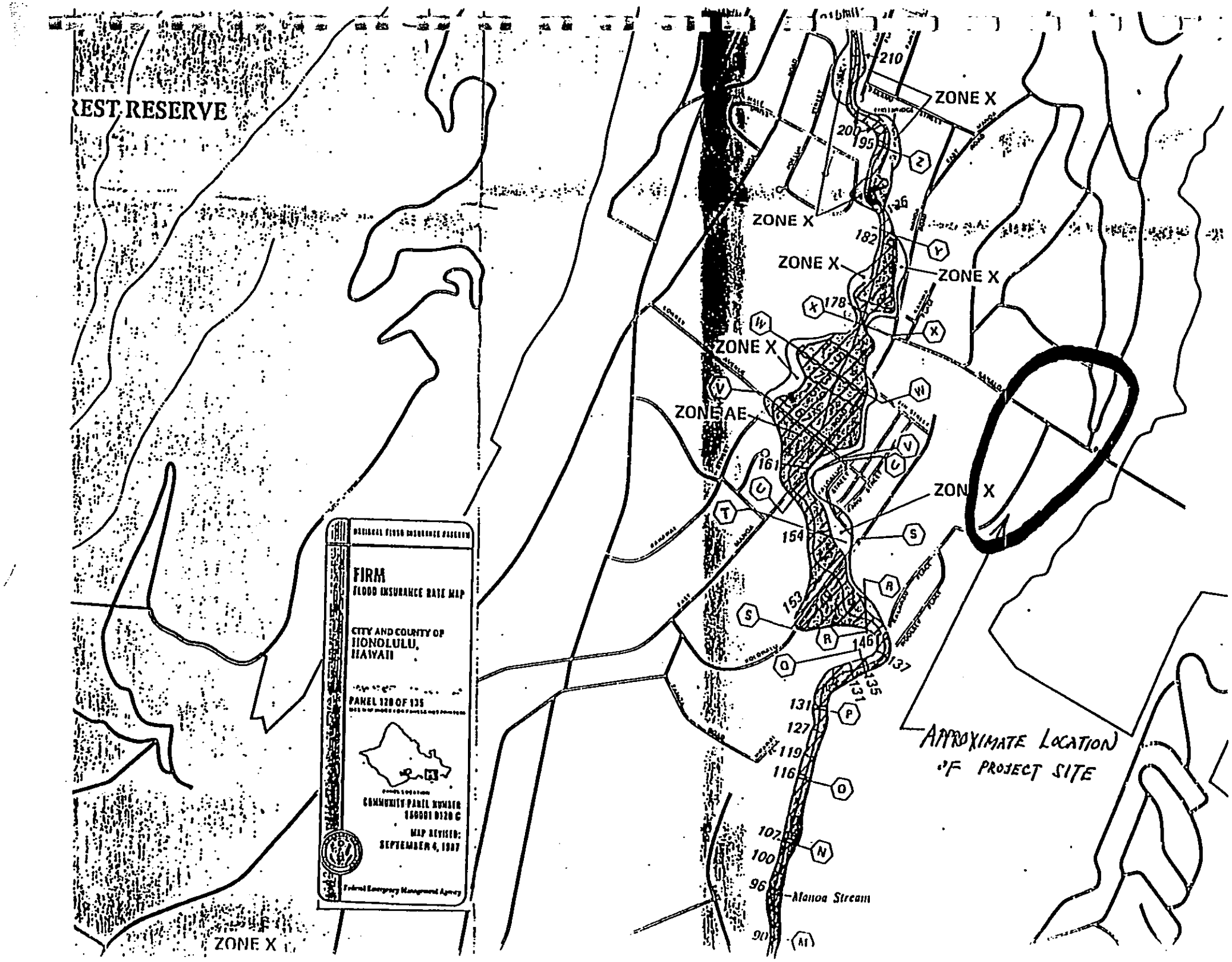
b. According to the Federal Emergency Management Agency's Flood Insurance Rate Map, Panel 150001-0120-C dated September 4, 1987, the proposed site is located in Zone X - unshaded (areas determined to be outside the 500-year flood plain).

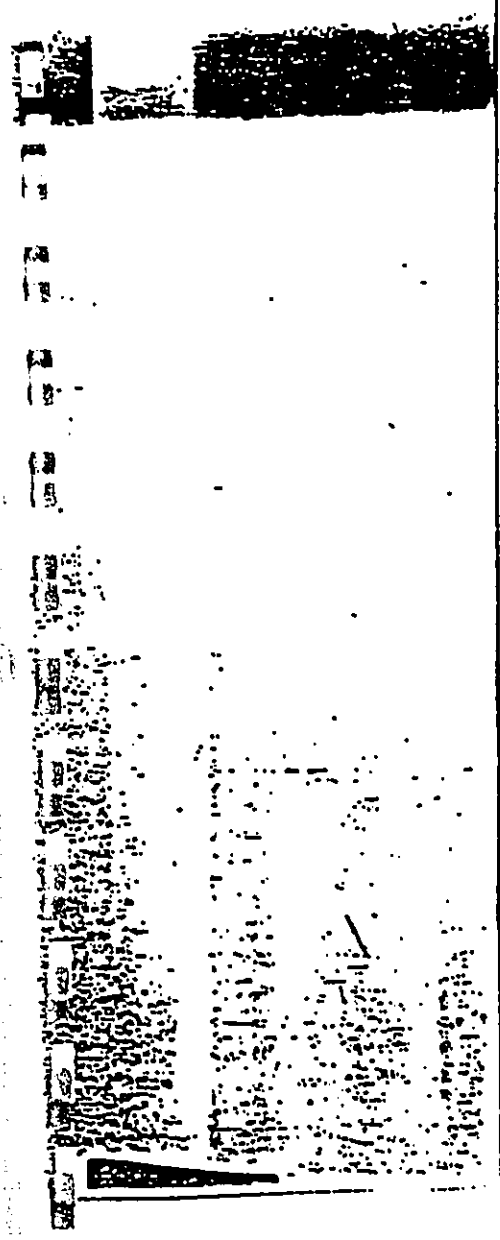
Sincerely,

Jaime A. Kaloa

Kisuk Cheung for
Director of Engineering

Enclosure


REST RESERVE
FIRM
FLOOD INSURANCE RATE MAP
CITY AND COUNTY OF HONOLULU, HAWAII
PANEL 320 OF 135
COMMUNITY PANEL NUMBER
150001 0320 C
MAP REVISED:
SEPTEMBER 4, 1987
ZONE X
ZONE X
ZONE X
ZONE X
ZONE X
ZONE AE
ZONE X
ZONE X
210
200
195
182
178
161
154
153
146
137
135
131
131
127
119
116
107
100
96
90
Manoa Stream
APPROXIMATE LOCATION OF PROJECT SITE



SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A No base flood elevations determined.

ZONE AE Base flood elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE A99 To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.

ZONE V Coastal flood with velocity hazard (wave action); no base flood elevations determined.

ZONE VE Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

ZONE N Areas determined to be outside 500-year flood plain.

ZONE D Areas in which flood hazards are undetermined.

Flood Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 Base Flood Elevation Line; Elevation in Feet*

D D Cross Section Line

(EL 987) Base Flood Elevation in Feet Where Uniform Within Zone*

RM7X Elevation Reference Mark

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for flood insurance and flood plain management purposes; it does not necessarily show all areas subject to flooding in the community or all planimetric features outside Special Flood Hazard Areas.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Floodway widths are provided in the Flood Insurance Study Report.

Coastal base flood elevations apply only landward of the shoreline.

Elevation reference marks are described in the Flood Insurance Study Report.

For adjoining map panels see separately printed Map Index.

MAP REPOSITORY

Department of Land Utilization, Information Center, Honolulu Municipal Building, 1st Floor, 650 South King Street, Honolulu, Hawaii 96813 (Map available for reference only, not for distribution)

INITIAL IDENTIFICATION:
JUNE 8, 1970

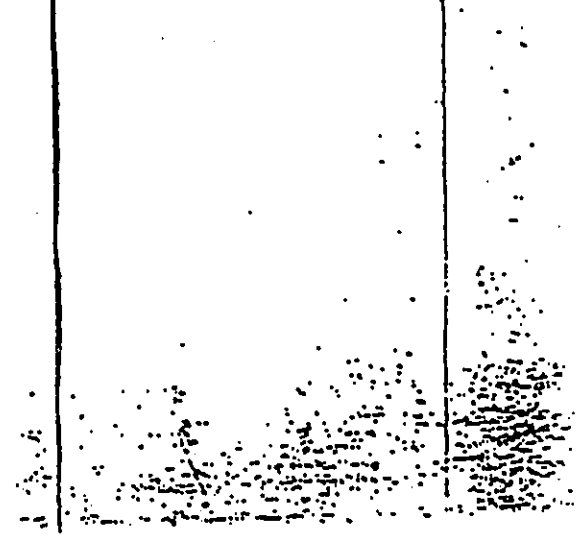
FLOOD HAZARD BOUNDARY MAP REVISIONS:
JUNE 4, 1971

FLOOD INSURANCE RATE MAP EFFECTIVE:
SEPTEMBER 3, 1980

FLOOD INSURANCE RATE MAP REVISIONS:

Map revised January 6, 1983 to change flood plain boundaries, zone designations, base flood elevations, corporate limits, scale, cultural features, or map format.

Map revised September 4, 1987 to change flood plain boundaries, zone designations, base flood elevations, corporate limits, scale, cultural features, or map format.



United States Department of the Interior

GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
677 Ala Moana Boulevard, Suite 415
Honolulu, Hawaii 96813

RECEIVED
DEPT OF PUBLIC WORKS
SEP 24 2 53 PM '91

RECEIVED
DIV. OF ENGINEERING
SEP 25 1 53 PM '91

TAKE PRIDE IN AMERICA

TO

September 20, 1991

09/25 DIK/DEP/ALS

Mr. Sam Callejo
Director and Chief Engineer
Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Callejo:

This letter is in response to your letter of August 19, 1991 in which you ask for our comments on the report, Environmental Assessment for the Woodlawn Area Earth Stabilization Project, Manoa, Oahu, Hawaii.

We have reviewed the report and believe that one aspect of the proposed work may have the potential to create destabilizing conditions in the slope. Vertical drains slotted to a depth of 60 feet would allow water from the saturated zone within the slide mass to drain into unsaturated materials at the 60 foot depth, even with pumps operating in the drain. Based on STV/Lyon data, materials are unsaturated or have low water pressures at a depth of 45-60 feet over about 3/4 of the landslide area. Allowing these materials to saturate and build up high positive pore-water pressures could be potentially destabilizing. This possibility has not been adequately addressed in the Environmental Assessment.

During the past year of data collection, we have learned that infiltration of surface water in the upslope portion of the landslide appears to be important. The control of surface water upslope of the landslide, before it infiltrates, is inadequately discussed in the Environmental Assessment report also.

Finally, the report does not address the control of surface water runoff that may flow into open excavations in the slide during construction of the remedial measures. Such additional water added during rainstorms directly into the slide may increase water pressures there and potentially initiate further movement of the slide.

The assessment of the other geologic and hydrologic aspects of the environmental impacts appears reasonable. We concur with the Environmental Assessment that stabilization of the hillslope sliding would result in a significant improvement of the local environmental conditions.

Sincerely,

William Meyer

William Meyer
District Chief

#212

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

SAM CALLEJO
DIRECTOR AND CHIEF ENGINEER

IN REPLY REFER TO:
91-12-0519

November 4, 1991

Mr. William Meyer
Water Resources Division
U.S. Geological Survey
677 Ala Moana Boulevard, Suite 415
Honolulu, Hawaii 96813

Dear Mr. Meyer:

Subject: Your Letter of September 20, 1991, Relating to the Environmental Assessment for the Woodlawn Area Stabilization Project

Thank you for your review and comments to the subject environmental assessment. The following is provided in response to your concerns:

I. Paragraph 2. Raises a question regarding the possible creation of "destabilizing conditions" by water seepage from the vertical drains into possible unsaturated strata beneath the landslide.

(1) Unsaturated conditions were found in only two hydrologically isolated zones underneath the landslide; and even at these points, the existing data indicate pressures only marginally below saturation. All of our other piezometers consistently recorded sustained positive pressures far in excess of saturation. None of the U.S.G.S. casagrande piezometers indicate any pore water pressures significantly lower than saturation.

(2) Due to the specific design features and planned operation of the vertical drains, the annular zone of coarse drain rock which will be placed against the native colluvium (with a layer of intervening filter fabric) will be kept fully drained at all times, insuring the creation of a permanent free drainage face against the colluvium and imposing a reorientation of seepage paths from the surrounding colluvial strata toward the central axis of the drain. This reorientation of ground water flow toward the drains will exist for both unsaturated flow at marginally negative pore pressures (unsaturated flow) as well as for saturated flow at any pressures.

(3) All positive soil moisture pressures retained in colluvial strata penetrated by and adjacent to vertical drains will be gradually reduced to values, only marginally above and below zero.

(4) Even if all the available piezometric data are ignored and the specific design features incorporated in the vertical drains fail to prevent some seepage into confined, discontinuous unsaturated strata (as hypothesized in the U.S.G.S. letter, paragraph 2), the effectiveness of the vertical drains would not be significantly reduced and the overall slope stability would not be significantly effected.

The conservative, adverse ground water hydrological assumptions in which the stability analysis have been made indicate a significant factor of safety after construction even at full saturation of all strata below the basal landslide surface.

II. Paragraph 3. The statement: "infiltration of surface water in the upslope portion of the landslide appears to be important" is vague. The planned system of horizontal drains located in three groups all systematically penetrate the peripheral zone surrounding the upslope margins of the landslides, and are intended to intercept and draw down ground water pore pressures derived from infiltration within these zones. In particular, they will repeatedly penetrate and drain crown zone tension cracks surrounding the upper limits of the present landslides.

The concern expressed in Paragraph 4 regarding the possible destabilizing effects arising from surface runoff flowing into open tiebacks during construction and thereby raising pore water pressures within the landslide is unwarranted.

(1) All construction of trenches and excavations will be accomplished only during the "dry" season, minimizing the runoff volumes which must be handled.

(2) All of the trenches will be immediately backfilled with coarse drain rock over filter fabric and finally by perforated sub-drain pipe at the low point of the trench section to drain the trenches. At all construction stages, these trenches will be kept dewatered, by temporary pumping if necessary. Water, whether derived from surface runoff or seepage directly into the excavations will be disposed of by means of functioning storm drains. Therefore, the trenches will have a significant, stabilizing hydrological effect during all stages of construction and operation.

Very truly yours,

C. Michael Hogan

SAM CALLEJO
Director and Chief Engineer

cc: STV/Lyon Associates

91-3788

JOHN WAIHEE
GOVERNOR OF HAWAII

RECEIVED
DEPT. OF PUBLIC WORKS
SEP 24 11 05 AM '91
TO _____

RECEIVED
DIV. OF ENGINEERING
SEP 25 1 54 PM '91

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
KEITH W. AHUE
MANABU TAGOMORI
Dan T. Kochi

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

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

REF:OCEA:SKK

FILE NO.: 92-129
DOC. NO.: 1677E

SEP 23 1991

cc 9/25 DLR/DOF NSK 9/25 Engr

The Honorable Sam Callejo
Director and Chief Engineer
Department of Public works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Callejo:

Subject: Environmental Assessment for the Woodlawn Area Earth Stabilization Project
Location: Manoa, Oahu, Hawaii
TMK: 2-9-25,39,50,57 and 58

Thank you for giving our Department the opportunity to comment on this matter. We have reviewed the materials you submitted and have the following comments.

HISTORIC PRESERVATION DIVISION CONCERNS:

The environmental assessment correctly notes that there is a single known historic site, 50-80-14-1370, at the project plats. It is unlikely that undiscovered historic sites remain at these plats due to the extensive grading that preceded development there. The project is designed to slow the movement of land in the area and, if successful, will have a "beneficial effect" on site 50-80-14-1370 by retarding damage caused by shifting foundations. Thus, we believe that the project will have "no adverse effect" on the site.

OFFICE OF CONSERVATION AND ENVIRONMENTAL AFFAIRS COMMENTS:

While this project may benefit the community by reducing the potential for landslides and destruction of property, it will certainly be a significant inconvenience to residents in and outside the project area. As such, the Department of Public Works should work with members of the community to help invent a more exhaustive list of mitigative solutions in addition to those mandated by the state.]?

Thank you for your cooperation in this matter. please feel free to call me or Sam Lemmo at our Office of Conservation and Environmental Affairs, at 548-7837, should you have any questions.

Very truly yours,

WILLIAM W. PATY

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

SAM CALLEJO
DIRECTOR AND CHIEF ENGINEER

IN REPLY REFER TO:
91-12-0518

November 6, 1991

Mr. William Paty, Chairperson
Board of Land and Natural Resources
State of Hawaii
P. O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Paty:

Subject: Your Letter of September 23, 1991 (File No. 92-129, Doc. No. 1677E) Relating to the Environmental Assessment for the Woodlawn Area Earth Stabilization Project

Thank you for your review and comments to the subject environmental assessment.

The concerns of the Office of Conservation and Environmental Affairs will be addressed as requirements in the construction contract to have the contractor institute a system of notice and advise the community of his ongoing activities. In addition, the Department of Public Works will schedule meetings as required to hear and respond to the residents' concerns.

The inconvenience to residents in and around the project area is unavoidable. However, restrictions will be placed on the hours of operation and strict compliance to all applicable noise and dust standards will be enforced to minimize the effects of the construction activities.

Very truly yours,

SAM CALLEJO
Director and Chief Engineer

cc: STV/Lyon Associates

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TO

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DIV. OF ENGINEERING
11 14 AM '91

91-3674

Eng 9/18

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

September 12, 1991
RN: 0292

Mr. Sam Callejo
Director and Chief Engineer
Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Callejo:

Environmental Assessment
Woodlawn Area Earth Stabilization Project
Manoa, Oahu

The above referenced document proposes stabilizing two landslides in the Woodlawn region of Manoa by implementing subsurface drainage improvements (by installing horizontal and vertical drain wells), surface drainage improvements, and construction of a tieback system (a mechanical restraint system). The construction of the tieback system in the Paty-Alani slide will require acquisition of five residential lots and easements from virtually all owners along Alani Drive, Paty Drive, and Paty Drive Extension. Reconstruction of utilities including storm drains, sewer systems, and water mains, and streets damaged by slide movement also will be required. Coordination, minor relocation, and protection during construction of other utilities, including electric, telephone, cable TV, and gas also will be included in this project. Total estimated cost will be 25.1 million in 1991 dollars. Completion of the proposed project is expected to take 2 years for each landslide area (4 years total).

The Environmental Center has completed a review of the above referenced environmental assessment with the assistance of Paul Ekern, Professor Emeritus/Water Resources Research Center; Richard Green, Agronomy and Soil Science; and Jennifer Crummer, the Environmental Center.

Landslide Soil Composition

The slide area corresponds almost exactly to the Kaena soil area mapped on sheet 62 of the USDA SCS Soil Survey of Islands of Kauai, Oahu, Maui,

Molokai, and Lanai, State of Hawaii (Foote, et. al., 1972.). Soils in this area are designated on the soil survey maps as "Kan E" - Kaena very stoney clay 10-35 percent slopes. This soil is characterized by "medium to rapid" runoff, "moderate to severe" erosional hazard, and difficult workability as soil is "stony, steep, and very sticky and very plastic." The soil engineering qualities are characterized by low permeability (0.06-0.63 inches per hour) and high shrink-swell potential.

The high montmorillonitic content and dark color makes the Kaena soils one of the Black soils of the Red and Black complex reported by Uehara and Sherman (Hawaii Agricultural Experiment Station Technical Bulletin 32. University of Hawaii, December 1952). Their description of this type of soil points out the role of lateral seepage of base-rich perched ground waters in the generation of this soil body. This soil development has been attributed to moisture movement along genetic seepage planes rather than entry of on site surface waters. Therefore, the slide movement seems highly dependent on the water seepage from adjacent uplands. Unless remedial measures include blanket wall structures that will intercept the internal seepage, percolation and lateral seepage from adjacent uplands will continue to precipitate catastrophic failure throughout the area. The proposed measures do not adequately address this basic problem.

The EA's section on soils should be expanded to include detailed discussion on the engineering properties of the slide materials. This should include specific evaluation of plasticity as a function of water content (Atterburg limits) and the montmorin clay nature effects. Additionally, several studies have been conducted on Hawaii's montmorillonitic soils, and numerous examples of urban development on unstable material exist. Comparisons between this slide and slides in Palolo, Aina Haina, and other Manoa areas would be beneficial.

Mechanical Restraint System

Although structurally distinct, the proposed tieback system is functionally equivalent to the caisson system previously proposed, both in intended action and in location (i.e., along existing roadways). We note that in their 1986 review of proposed improvements in this area, Professors Evans and Hummel of the Engineering faculty specifically recommended against such measures:

> ✓ The use of caissons, retaining walls, gravel buttress zones, etc. (mechanical restraint) [is] very cost ineffective and should not be used as the general solution to the area, nor for stabilizing the roadways and utilities.

Their rationale is as follows:

> It is possible to stop a triangular block of soil...provided the structure is designed to resist the passive soil pressure. This forces the uphill soil to ride up on the wedge created by the rigid structure and may cause the soil to overlap the wall and/or caissons with no apparent effect on overall movement of the soil

mass... The soil below the caisson may also slide if the length of the lower slope is sufficient for continuing movement.

Drainage Improvements

There is broad consensus that engineering properties of the soils in the slide areas will be improved by lowering the soil water content. However, we note that Kaena very stony clays have a low permeability. Thus, as pointed out by Evans and Hummel, the decrease in soil water content, assuming new input water is effectively intercepted, will be gradual. Since the high montmorillonitic content suggests persistent lateral seepage of base-rich perched groundwater, the efficacy of discrete wells in intercepting seepage along genetic flow plans is questionable. Furthermore, it is highly probable that the proposed drainage improvements will be subject to overloading during low frequency catastrophic events.

Rainfall Data

The climate section should include detailed location data and identification information on the rainfall stations, as well as the sources of the data. State identification indices should be given, as should the Weather Bureau ID numbers, so the data can be checked against Circ. C88, DLNR Median Rainfall of State of Hawaii, 1982, and Report R76, Rainfall Atlas of Hawaii, DLNR 1986.

Terminology

The terms, "taro patch clay" page 10, from Stearns 1935, and "adobe" page 11, are antiquated terms that should be updated.

Historical Land Use

Any information on the pre-Hawaiian landscape, the Hawaiian alteration, the effect of cattle grazing, and the effects of cut and fill during urbanization would be useful. It would be particularly helpful if information regarding the disposition of the fill is included. Was the brush removed prior to fill or was it instrumental to failure as in the upper Woodlawn Terrace land failures?

Alternatives

This section should be expanded upon. Given the nature of the problem, and the similarities between this area and others on O'ahu, this section is possibly the most important in the EA. Solutions to previous urbanized slide areas should be discussed. The to-date cost of the Woodlawn slides may be helpful as well.

Affected Environment

Much of this section is weak on the description of the duration and degree to which residents will have to live with the noise, air quality, traffic, disrupted services, etc. of this 4 year project. How many

weeks/months can a typical resident of the area expect to have each of these disruptions occurring? Ambient noise data are given, but there is no comparison with the anticipated construction noise levels or their duration.

Summary

Our reviewers have expressed serious concerns with the proposed remedial actions discussed in this EA. These concerns may be summarized as follows:

1. Regional landform instability is a natural consequence of weathering processes and evolution of soil types which may be exacerbated by surface landform alterations.

2. Given the questionable efficacy of the proposed mechanical restraints, such a costly measure may not be prudent.

3. The proposed drainage improvements are unlikely to be fully effective in intercepting seepage into the slide areas.

In light of the cost and the potential impacts to the residents of the project area and as there is some question as to the adequacy of the engineering techniques involved, we feel that a complete EIS should be done for this project to expand the public comment time and scope and to be sure that this is the most viable solution to the problem.

Thank you very much for the opportunity to comment on this document.

Yours truly,

John T. Harrison

John T. Harrison, Ph.D.
Environmental Coordinator

cc: OEQC
Roger Fujioka
Paul Ekern
Richard Green
Jennifer Crummer

91-4258

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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

TO DIR/DEP Engr

October 17, 1991

Mr. Sam Callejo
Director and Chief Engineer
Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Callejo:

Environmental Assessment
Woodlawn Area Earth Stabilization Project
Manoa, Oahu

The Environmental Center previously reviewed the referenced document (Ref.: RN: 0292; September 12, 1991). In response to concerns raised in our review, a meeting was convened on September 27th, where representatives of SIV/Lyon Associates, along with Mr. Herb Kido and Mr. Mel Takekura of your office discussed the project with Dr. Paul Ekern and myself. In the interim since that meeting, I have conveyed additional information provided by Dr. Kojan on geo-hydrological and engineering aspects of the proposed work to other reviewers who contributed to our critique. On the basis of their responses, and with their concurrence, I am pleased to confirm that our concerns voiced in my previous letter have been satisfactorily addressed. Consequently, we concur that the proposed methods to address the Woodlawn landform instability constitute the most appropriate course of action available.

I have been particularly gratified by the constructive cooperation among participants in this instance. Too often, the Environmental Assessment process is addressed in an adversarial context which obscures the advisory intent of public review. Thank you for the opportunity to contribute to the review process, and please feel free to call me if you have further questions on this or other matters.

Sincerely,

John T. Harrison, Ph.D.
Environmental Coordinator

cc: Paul Ekern
Roger Fujioka

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HAWAII 96843

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Ck Dir/Dep Mtr 10/2/91
Engr 10/4

KAZU HAYASHIDA
Manager and Chief Engineer

9/30/91

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September 30, 1991

TO: SAM CALLEJO, DIRECTOR AND CHIEF ENGINEER
DEPARTMENT OF PUBLIC WORKS

FROM: KAZU HAYASHIDA, MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

K.H.

SUBJECT: YOUR MEMORANDUM OF AUGUST 19, 1991 RELATING TO THE ENVIRONMENTAL ASSESSMENT FOR THE WOODLAWN AREA EARTH STABILIZATION PROJECT, MANOA, TMK: 2-9-25, 39, 50, 57 & 58

Thank you for the opportunity to review and comment on the proposed Woodlawn Area Earth Stabilization Project. We have the following comments on the environmental assessment:

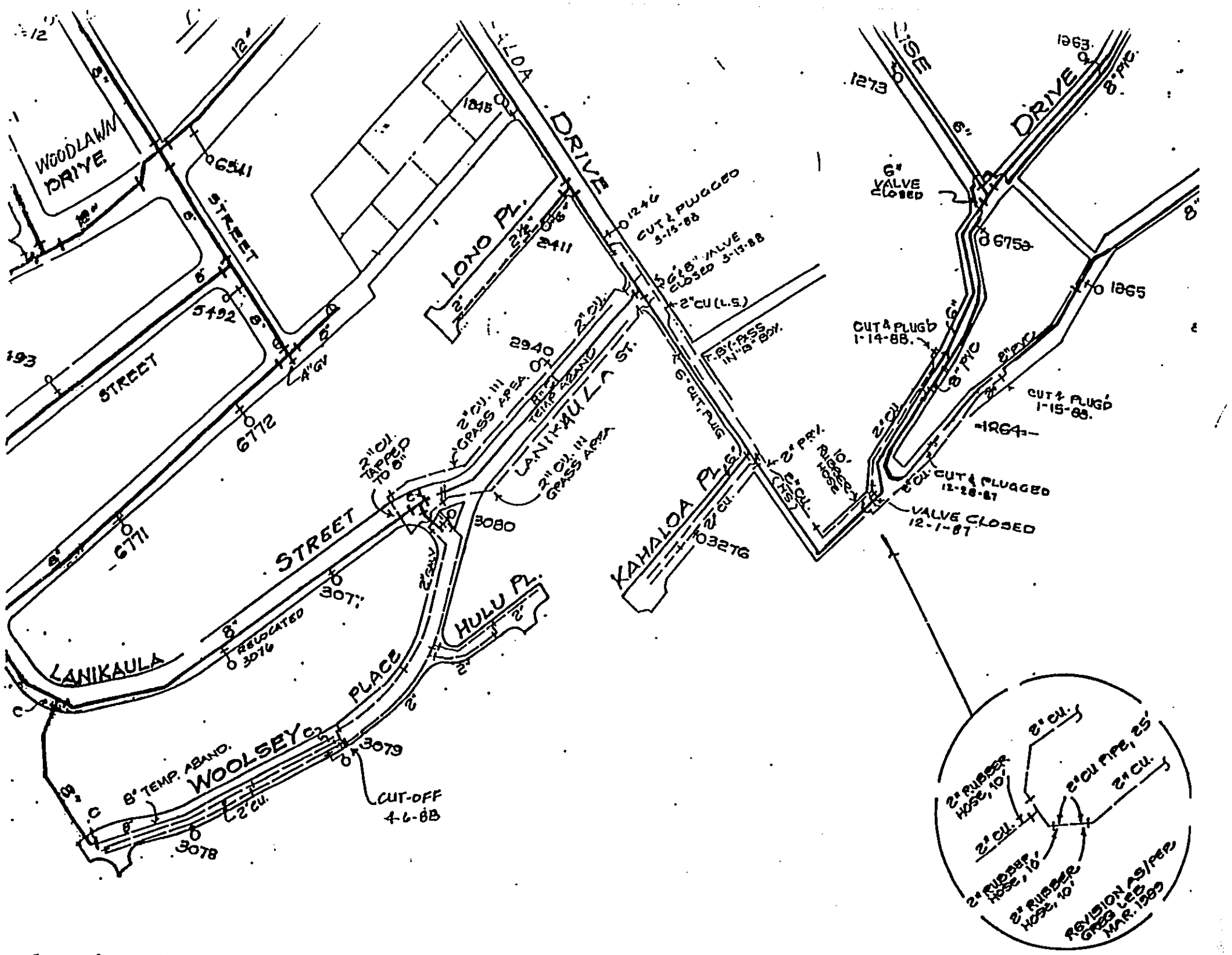
1. We have no objections to the proposed project. There are existing water meters currently within the area. We will conduct a detailed research of all affected water services when the construction plans for the earth stabilization are submitted for our review and approval. The construction plans should indicate all affected water meter boxes and meter numbers.

2. The assessment does not address water line improvements; however, if the system is to be upgraded for fire protection, the design should include the use of flex joint pipes and fittings.

We return excerpted portions of the assessment with our comments and a schematic water distribution map showing the affected area.

If you have any questions, please contact Bert Kuioka at 527-5235.

Attachment


WOODLAWN DRIVE
STREET
LONO PL.
KAHALOA DRIVE
LANIKAULA ST.
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LANIKAULA PLACE
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RISE
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6" VALVE CLOSED
CUT & PLUGD 1-14-88.
CUT & PLUGD 1-15-88.
VALVE CLOSED 12-1-87
CUT-OFF 4-6-88
REVISION AS/PER GREG LEE MAR. 1989
2" RUBBER HOSE, 10'
2" CU PIPE, 25'

DEPARTMENT OF GENERAL PLANNING

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

91-3663

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TO _____

FRANK F. FASI
MAYOR

BENJAMIN B. LEE
CHIEF PLANNING OFFICER

ROLAND D. LIBBY, JR.
DEPUTY CHIEF PLANNING OFFICER

VW 8/91-2752

September 13, 1991

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MEMORANDUM

TO: SAM CALLEJO, DIRECTOR AND CHIEF ENGINEER
DEPARTMENT OF PUBLIC WORKS

FROM: BENJAMIN B. LEE, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

SUBJECT: ENVIRONMENTAL ASSESSMENT (EA) FOR THE WOODLAWN AREA EARTH STABILIZATION PROJECT, MANOA, OAHU, HAWAII, TMK: 2-9-25, 39, 50, 57 AND 58

In response to your memo of August 19, 1991, we have reviewed the subject EA. We have no objections to the project.

Should you have any questions, please contact Verne Winquist of our staff at 527-6044.

BENJAMIN B. LEE
Chief Planning Officer

BBL:js

DEPARTMENT OF LAND UTILIZATION

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813 • (808) 523-4432

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91-3690

FRANK F. FASI
MAYOR

DONALD A. CLEGG
DIRECTOR

LORETTA K.C. CHEE
DEPUTY DIRECTOR

September 16, 1991

MEMORANDUM

TO: SAM CALLEJO, DIRECTOR AND CHIEF ENGINEER
DEPARTMENT OF PUBLIC WORKS

FROM: LORETTA CHEE, ACTING DIRECTOR
DEPARTMENT OF LAND UTILIZATION

SUBJECT: DPW REFERENCE NO. 91-12-0371
ENVIRONMENTAL ASSESSMENT FOR THE WOODLAWN AREA
EARTH STABILIZATION PROJECT, MANOA, OAHU, HAWAII
TAX MAP KEY: 2-9-25, 39, 50, 57 AND 58

We have no comments on the above environmental assessment. Thank you for providing us the opportunity to do so.

Loretta Chee

LORETTA CHEE
Acting Director of Land Utilization

LC:ea

DEPARTMENT OF PARKS AND RECREATION

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

91-4192

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TO _____

Engr

FRANK F. FASI
MAYOR

WALTER M OZAWA
DIRECTOR

CALVIN K.C AU
DEPUTY DIRECTOR

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October 18, 1991

TO: SAM CALLEJO, DIRECTOR AND CHIEF ENGINEER
DEPARTMENT OF PUBLIC WORKS

FROM: WALTER M. OZAWA, DIRECTOR

SUBJECT: ENVIRONMENTAL ASSESSMENT FOR THE WOODLAWN AREA
EARTH STABILIZATION PROJECT
TAX MAP KEY 2-9-25, 39, 50, 57 & 58

We have reviewed the above environmental assessment and find it to be innovative and well done.

The Department of Parks and Recreation does not have any nearby park land and its participation has been limited to tree planting in open areas affected by the slide.

For WALTER M. OZAWA, Director

WMO:ei

Attachment

DEPARTMENT OF TRANSPORTATION SERVICES

CITY AND COUNTY OF HONOLULU

HONOLULU MUNICIPAL BUILDING
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

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FRANK F. FASI
MAYOR

JOSEPH M. MAGALDI, JR
DIRECTOR

AMAR SAPPAL
DEPUTY DIRECTOR

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September 11, 1991

MEMORANDUM

TO: [redacted] VALLEJO, DIRECTOR AND CHIEF ENGINEER
DEPARTMENT OF PUBLIC WORKS

FROM: JOSEPH M. MAGALDI, JR., DIRECTOR

SUBJECT: WOODLAWN AREA EARTH STABILIZATION PROJECT
ENVIRONMENTAL ASSESSMENT
TMK: 2-9-25, 39, 50, 57 AND 58

This is in response to your memorandum of August 19, 1991 requesting our comments on the subject project.

Based on our review, we have no objections to the proposed stabilization project at this time. However, construction plans for all work within the City's right-of-way should be submitted to our department for review. A traffic control plan showing temporary detours for pedestrians and vehicles should be included in these plans.

Should you have any questions, please contact Lance Watanabe of my staff at local 4199.

JOSEPH M. MAGALDI, JR.

91-357E

Engr

BUILDING DEPARTMENT

CITY AND COUNTY OF HONOLULU

HONOLULU MUNICIPAL BUILDING
650 SOUTH KING STREET
HONOLULU, HAWAII

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FRANK F. FASI
MAYOR

HERBERT K. MURAOKA
DIRECTOR AND BUILDING SUPERINTENDENT

B91-825

September 9, 1991

MEMO TO: SAM CALLEJO, DIRECTOR AND CHIEF ENGINEER
DEPARTMENT OF PUBLIC WORKS

FROM: HERBERT K. MURAOKA
DIRECTOR AND BUILDING SUPERINTENDENT

SUBJECT: ENVIRONMENTAL ASSESSMENT FOR THE WOODLAWN AREA
EARTH STABILIZATION PROJECT, MANOA, OAHU, HAWAII
TAX MAP KEY: 2-9-25: 39, 50, 57 AND 58

This is in reply to your memorandum dated August 19, 1991 requesting our review and comments on the above-subject matter.

We have no comments at this time on the environmental assessment report.

Should you have any questions, please contact Mr. Charles Yee at local 6027.

FOR HERBERT K. MURAOKA
Director and
Building Superintendent

91-3573

MANOA ASSOCIATION OF SLIDING HILLSIDE HOMEOWNERS (MASHH)

September 8, 1991 cc 9/11 Dir/DEP WSt 9/11/91 Engr

Sam Callejo
Director and Chief Engineer
Department of Public Works
650 South King Street
Honolulu, Hi 96813

Subject: Your letter dated August 19, 1991 (91-12-0371) Subj: Environmental Assessment for the Woodlawn Area Earth Stabilization Project, Manoa Oahu, Hawaii, Tax Map Key: 2-9-25, 39, 50, 57 and 58

Thank you for the subject letter.

The report has been thoroughly reviewed. In addition, the identification of probable impacts and proposed mitigating measures have been extracted from the report and furnished to several MASHH representatives for comments and feedback.

My only concern at this time is uncontrolled runoff and or soil saturation by continuous use of water for extended periods of drilling.

Since STV/Lyon Associated will be installing tiebacks for test purposes in the emply lot 3102 Alani Drive beginning September 10, 1991, it is requested that an extension for a reply by October 1, 1991.be granted.

Your approval will be greatly appreciated.

Sincerely,

Mary M. Gonsalves

Mary M. Gonsalves
3118 Kahaloa Drive
Honolulu, Hawaii 96822

91-3929

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MANOA ASSOCIATION OF SLIDING HILLSIDE HOMEOWNERS (MASHH)

Tel 988-9883987

October 3, 1991

DrP Ltr
Engr file

Sam Callejo
Director and Chief Engineer
Department of Public Works
650 South King Street
Honolulu, Hi 96813

Subject: Comments on the Woodlawn Area Earth Stabilization Project

Ref: (1) Your letter dated August 19, 1991 (91-12-0271) with enclosure
(2) My letter dated September 8, 1991

Please accept my apology for not submitting my comments by October 1, 1991.

I contacted Mel Takakura on October 2, 1991 and explained the emergency reasons for my delayed response. This letter will confirm a part of my comments to Mel during the course of our telephone conversation.

Parking of vehicles from 3120, 3112 to 3102 Alani Drive is a problem because there are homes that have transient rentals and inadequate parking spaces on property. Recommend that contractors notify residents by a form letter that a specific area is under construction and that the area is needed for movement of construction equipment and heavy vehicles for a specified period time. This condition does not exist on Kahaloa Drive, Kahaloa Pl, Lanikaula St, and Lono Pl.

Excavation for the installation of tiebacks and vertical walls will involve removal of boulders from public and anticipated private properties. Breaking the boulders with a backhoe or tractor arm will cause excessive vibrations to homes abutting area of activity. Breaking huge boulders with drilling equipment will eliminate this process.

The following is listed for your review and consideration.

1. Will the area be monitored periodically for cracks and subsidence on roads and private properties while construction is ongoing?
2. Will there be a staging area for all equipment during construction or will limited equipment be kept at the specified project cite?
3. Will the residents near the specific construction site be notified of impending repairs to water lines, electricity, telephone and roads, etc? Notice should include time frame, restricted traffic flow and ortime of road closing as applicable. This situation will apply to residents located on the upper portion of Kahaloa Dr, Kahaloa Pl and Lono Pl.
4. In the event unforseen weather conditions exist, will precautions be taken to prevent uncontrolled water runoff from the area of construction?

Sincerely

Mary M. Gonsalves

Mary M. Gonsalves
MASHH, 3118 Kahaloa Dr
Honolulu, Hi 96822

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

SAM CALLEJO
DIRECTOR AND CHIEF ENGINEER

IN REPLY REFER TO:
91-12-0517

November 4, 1991

Mrs. Mary M. Gonsalves
Manoa Association of Sliding
Hillside Homeowners
3118 Kahaloa Drive
Honolulu, Hawaii 96822

Dear Mrs. Gonsalves:

Subject: Your Letter of October 3, 1991, Relating to the Environmental Assessment for the Woodlawn Area Earth Stabilization Project

Thank you for your review and comments to the subject environmental assessment. The following is provided in response to your concerns:

I. Paragraph 3. Parking of vehicles is certainly a problem during construction. We will require the contractor to continually keep adjacent residents advised of operations in advance.

II. Paragraph 4. Boulders and all other excavated material will be removed from the site. It is not anticipated that boulders will be broken as indicated to cause excessive vibrations.

III. Paragraph 5.

1. The area will be monitored for cracks as well as horizontal and vertical movement.

2. Basically we will require the Contractor to utilize City owned lots for staging areas and also to require that he keep a minimum of equipment in the area that is not directly involved in the task(s) being performed.

3. The Contractor working with the several utilities involved will be required to keep the residents advised of any interruption of services or access. However, it must be realized that automobile access will not always be available to each resident's home.

4. The Contractor will be required to control all water during construction so as to not cause damage to area residents or the stability of the soil.

Very truly yours,

E. Michael Sweet

FOR SAM CALLEJO
Director and Chief Engineer

cc: STV/Lyon Associates

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cc 9/12 DIR/DEP Mgr & Plus Engr

TO HOUSE OF REPRESENTATIVES

STATE OF HAWAII
STATE CAPITOL
HONOLULU, HAWAII 96813

September 9, 1991

Mr. Sam Callejo, Director and Chief Engineer
Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, HI 96813

Dear Mr. Callejo:

Thank you for the opportunity to comment on the Environmental Assessment for the Woodlawn Area Earth Stabilization Project 91-12-0371, Tax Map Key: 2-9-25,39,50,57 and 58.

After reviewing the document, I have a few concerns on whether noise and air quality impacts can truly be mitigated during the construction of the retaining structures. I am certain that most residents will not mind the noise or dust generated by the project knowing that the final outcome will provide stability to the area, however, I feel it is important that the contractors and subcontractors maintain strict adherence to time constraints and refrain from working on the project during the times that area residents are most likely to be at home, ie. early morning, late evening and on weekends.

Again, I thank you for the opportunity to comment. If you have any questions, please feel free to call me at 586-6460.

Sincerely,

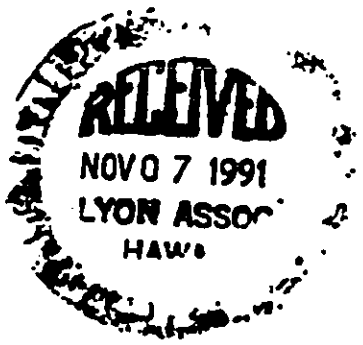
Brian T. Taniguchi
Majority Leader

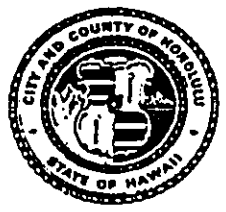
DEPARTMENT OF PUBLIC WORKS

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR





November 4, 1991

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SAM CALLEJO
DIRECTOR AND CHIEF ENGINEER

IN REPLY REFER TO:
91-12-0520

cy 11/7/91

The Honorable Brian T. Taniguchi
State Representative, 27th District
House of Representatives
State Capitol
State of Hawaii
Honolulu, Hawaii 96813

Dear Representative Taniguchi:

Subject: Your Letter of September 9, 1991 Relating to the Environmental Assessment for the Woodlawn Area Stabilization Project

Thank you for you review and comments to the subject environmental assessment.

The concerns of noise generated by construction activities will be mitigated by requiring the contractor to comply with the provisions of Chapter 44-B, Community Noise Control for Oahu, of the State Public Health Regulations. In addition, the following restraints will be placed on construction activities:

A. Construction activities shall not create "excessive noise" when measured at or beyond the property line of the construction site for the hours before 7:00 a.m. and after 6:00 p.m. of the same day.

B. Construction activities which emit noise in excess of 95 dBA at or beyond the property line of the construction site shall be restricted to the hours between 9:00 a.m. and 5:30 p.m. of the same day.

C. Construction activities which will exceed 95 dBA at or beyond the property line of the construction site shall be prohibited on Saturdays.

D. Construction activities which exceed the "allowable noise levels" at or beyond the property line of the construction site shall be prohibited on Sunday and on the following holidays: New Year's Day, President's Day, Memorial Day, Kamehameha Day, Independence Day, Labor Day, Discoverer's Day, Veteran's Day, Thanksgiving Day and Christmas Day.

We do not anticipate any significant impacts to the air quality that will result from the construction activities.

Very truly yours,

E. Michael Street

For SAM CALLEJO
Director and Chief Engineer

cc: STV/Lyon Associates

515 Kamakee Street
PO. Box 3379 Honolulu, Hawaii 96842
Telephone (808) 547-3333
Telex 7430292
Fax (808) 547-3030 547-3561

91 3553

BHP Petroleum

September 4, 1991

City and County of Honolulu
Department of Public Works
650 South King Street
Honolulu, Hawaii 96813

Attention: Mr. Sam Callejo
Director and Chief Engineer

Gentlemen:

Subject: **Environmental Assessment for the Woodlawn Area Earth Stabilization Project**

Please be advised that The Gas Company maintains an underground gas utility system in the project vicinity. We would appreciate the consideration of your consultants during the design phase to provide the necessary coordination during construction and to minimize any potential conflicts with the proposed improvements.

Should there be any questions, or if additional information is desired, please call me at 547-3574.

Very truly yours,

Edwin N. Sawa, P.E.
Manager, Engineering

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91-3536

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DEP WWK 9 Fbd
Engr 9/9

William A. Bonnet
Manager
Environmental Department

September 5, 1991

Mr. Sam Callejo
Director and Chief Engineer
City & County of Honolulu
Department of Public Works
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Callejo:

Subject: Environmental Assessment for the Woodlawn Area Earth Stabilization Project, Manoa, Oahu, Hawaii
Tax May Key: 2-9-25, 39, 50, 57, and 58

We have reviewed the above subject environmental assessment for the Woodlawn area and have no comments at this time.

Sincerely,