Draft Environmental Assessment
Prepared in Accordance with Chapter 343, Hawai‘i Revised Statutes and Title 11, Chapter 200, Hawai‘i Administrative Rules

Hawai‘i Belt Road Rockfall Protection at Maulua, Laupāhoehoe and Ka‘awali‘i Gulches

North Hilo and Hāmākua, Island of Hawai‘i, Hawai‘i
State of Hawai‘i Department of Transportation
Right of Way

June 2009

Department of Transportation, Highways Division
869 Punchbowl Street, Room 513
Honolulu, HI 96813

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1-18831-01

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Prepared by:
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Appendix D – Roadway Assessment Report, Hawaiʻi Belt Road Rockfall Protection at Maulua, Laupāhoehoe and Kaʻawaliʻi Gulches, North Hilo and Hāmākua, Island of Hawaiʻi, Hawaiʻi, R.M. Towill Corporation, 2008.

Appendix E – Traffic Study Report, Hawaiʻi Belt Road Rockfall Protection, Phase 1, at Maulua, Laupāhoehoe and Kaawalii Gulches, North Hilo and Hamakua, Island of Hawaiʻi, HawaiʻI, Federal-Aid Project No. NH-19-2(41), Julian Ng, Incorporated, March 2006.

Queue Estimates for Construction of Hawaiʻi Belt Road Projects, Rockfall Protection at Maulua, Laupāhoehoe and Kaʻawaliʻi Gulches, Hāmākua Coast, Hawaiʻi, Julian Ng, Incorporated, April 23, 2009

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Project Summary

Project:	Hawai'i Belt Road Rockfall Protection at Maulua, Laupahoehoe and Kaʻawaliʻi Gulches
Proposing Agency/Applicant:	Department of Transportation, Highways Division 869 Punchbowl Street, Room 513 Honolulu, HI 96813
Accepting Authority:	State of Hawaii Department of Transportation 869 Punchbowl Street, Room 301 Honolulu, Hawaiʻi 96813 Contact: Ken Tatsuguchi, P.E. Engineering Program Manager Highways Division
TMK:	(3) 3-9-02: 01, (3) 3-6-04: 02, 15, 17, 23, 30, (3) 3-4-02: 03, 04, 05
Location:	North Hilo and Hamakua, Island of Hawaiʻi, Hawaiʻi
Project Area:	Kaʻawaliʻi Gulch – 5.6 acres Laupāhoehoe Gulch – 5.8 acres Maulua – 4.8 acres Total – 16.2 acres
Document Preparers:	R. M. Towill Corporation 2024 North King Street, Suite 200 Honolulu, Hawaii 96819 Contact: Brian Takeda, Planning Project Coordinator
County Zoning:	Road, AG-20, General Agricultural District
State Land Use:	State Land Use boundaries are not applicable. Project is located within the State Department of Transportation Right of Way.
Existing Land Uses:	The proposed area of use, along the Hawaiʻi Belt Road (Route 19), serves as the primary thoroughfare between Hilo and Kailua.
Proposed Action:	Rockfall Mitigation Improvements along the Hawaiʻi Belt Road (Route 19). Includes ROW Acquisition of small portions of the above mentioned properties.
Permits that May be Required:	Construction Plan Review, building and grading permits, NPDES, CZM FED CON, State DOT Approval of Construction Plans & Specifications, Permit to Perform Work upon State Highways, Section 4(f), 7, and 106 Consultations

Section 1
Project Description

1.1. Project Purpose

The proposed project involves the construction of rockfall mitigation and stabilization measures along the Hawai'i Belt Road at specific locations adjacent to Maulua, Laupāhoehoe and Ka'awali'i Gulches. The project proponent is the Hawai'i Department of Transportation, Highways Division (HDOT). The mitigation and stabilization measures proposed by HDOT include the installation of anchored wire mesh panels along the existing steep rock cut cliffs adjacent to the roadway entrances and exits of the three gulches, construction of rockfall impact barriers along the top edge of the wire mesh panels, the creation of interceptor ditches above the cliffs to divert surface-water runoff, and minor improvements to existing drainage. The purpose of these measures is to improve highway safety along the segments fronting the three gulches by improving upon the present unsafe conditions resulting in falling rocks, boulders, and associated sediments.

The Hawai'i Belt Road (State Route 19) is located on the northeastern coastline of the Island of Hawai'i and is the primary thoroughfare between Hilo and Kailua. Loosely following the coastline between Hilo and Honoka'a, the highway crosses Maulua, Laupāhoehoe and Ka'awali'i Gulches and borders accompanying steep and sometimes unstable rock cut cliffs. Daily clearing of fallen debris is required at each of these gulch crossings, and cases of boulders of up to two feet in diameter falling into the roadway after heavy rains have been experienced. Falling debris presents a hindrance and expense to HDOT due to the need for constant cleanup, as well as obvious safety risks to highway travelers.

1.2. Purpose for Preparation of an Environmental Assessment

The purpose of this Draft Environmental Assessment (DEA) is to inform interested parties of the proposed project and to seek public comment on subject areas that should be addressed prior to the acceptance of the Final Environmental Assessment (FEA). The proposed rockfall protection improvements have the potential for beneficial and/or adverse environmental impacts. This EA describes existing conditions at the location of the Maulua, Laupāhoehoe and Ka'awali'i Gulch improvements project area and addresses the potential for adverse primary and secondary environmental impacts associated with the proposed project.

This Environmental Assessment (EA) is prepared pursuant to the requirements of the National Environmental Policy Act (NEPA) and Chapter 343, Hawai'i Revised Statutes (HRS). It assesses the potential for adverse environmental impacts due to construction of the proposed rockfall protection improvements. As appropriate, mitigation measures to address potential for negative environmental impacts are identified. The use of FHWA funds under NEPA, and HDOT lands or funds under Chapter 343, HRS, triggers the requirement for this EA. Specifically, According to HRS, Section 343-5, Applicability and requirements:

> "(a) Except as otherwise provided, an environmental assessment shall be required for actions that: (1) Propose the use of state or county lands or the use of state or county funds, other than funds to be used for feasibility or planning studies for possible future programs or projects that the agency has not approved, adopted, or funded, or funds to be used for the acquisition of unimproved real property; provided that the agency shall consider environmental factors and available alternatives in its feasibility or planning studies; provided further that an environmental assessment for proposed uses under section [205-2(d)(10)] or [205-4.5(a)(13)] shall only be required pursuant to section 205-5(b);"

1.3. Project Description

1.3.1. Project Location and Site Characteristics

The proposed project is located on the Hawai'i Belt Road DOT Right of Way (ROW) along the Hāmākua Coast in the Districts of Hāmākua and North Hilo, along the northeastern coastline of the Island of Hawai'i (See **Figure 1,** Project Location). The Hawai'i Belt Road is located on the Island of Hawai'i and is the primary thoroughfare between Hilo and Kailua. Between Hilo and Honoka'a the highway loosely follows the Hāmākua coast, where the highway crosses the Maulua, Laupāhoehoe and Ka'awali'i gulches.

Maulua Gulch (mile post 21.3 to 22.3) and Laupāhoehoe Gulch (milepost 26 to 27) are located within the North Hilo District; Ka'awali'i Gulch (mile post 28 to 29) is located within the Hāmākua District. Maulua Gulch is located nearest to Hilo, approximately 20 miles away, and Laupāhoehoe and Ka'awali'i Gulches are located approximately 26 and 29 miles from Hilo, respectively. Ka'awali'i Gulch is approximately 15 miles southeast of Honoka'a.

Maulua, Laupāhoehoe and Ka'awali'i Gulches are natural, deeply incised drainage ways which deliver concentrated runoff flow to the ocean from inland areas. The gulches are located in high rainfall areas with dense forest vegetation covering the slopes. The naturally steep volcanic slopes by erosion of Mauna Kea basalt rock have been steepened further during construction of the Hawai'i Belt Road. The roadway cuts range from approximately 0.25 to 0.50 horizontal to 1 vertical (0.25 – 0.50:1) and extend approximately 40 to 130 feet in height above the roadway. Above the cut areas, the natural, undisturbed slope of the valley continues upward to the summit bluff. The roadway elevation at each gulch is highest at the entry and exit of the gulch and lowest at the gulch crossing. The highest roadway elevation within the project limits is approximately 440 feet relative to mean sea level (msl) at the Hilo side (eastern approach) at Laupāhoehoe Gulch. The lowest roadway elevation within the project limits is approximately 130 feet msl at the Maulua Gulch crossing.

Land abutting the State DOT ROW consists of agricultural lots and sparsely dispersed agricultural and rural single family dwellings. The project extents may incorporate small sections of land outside of the existing ROW to accommodate the installation of the wire mesh panels. ROW acquisition will be undertaken by the DOT and will involve a regulatory taking of these small portions of land that abut the steep cliff faces.

Project design shows that ROW acquisition may be required at eight locations, (See **Figure 2.1** through **2.3,** ROW Acquisition). The affected properties are identified by the following TMKs:

Ka'awali'i Gulch		
Location 1 -	(3) 3-9-01: 01 (State of Hawai'i/Island Dairy Inc.)	[0.10 acre]
Laupāhoehoe Gulch		
Location 1 -	(3) 3-6-04: 11 (LHF Lopiwa LLC)	[0.37 acre]
	(3) 3-6-04: 17 (No Listing)	
Location 2 -	(3) 3-6-04: 30 (No Listing)	[0.057 acre]
	(3) 3-6-04: 23 (LHF Lopiwa LLC)	
	(3) 3-6-04: 02 (No Listing)	
	(3) 3-6-04: 17 (No Listing)	
Location 3 -	(3) 3-6-04: 15 (No Listing)	[0.067 acre]
Maulua Gulch		
Location 1 -	(3) 3-4-002: 03 (Hager BC & M)	[0.005 acre]
	(3) 3-4-002: 04 (Maulua Investments LLC)	
	(3) 3-4-002: 05 (Barton MD & L)	
Location 2 -	(3) 3-4-002: 03, 04, and 05	[1.69 acre]
Location 3 -	(3) 3-4-002: 03, 04, and 05	[0.05 acre]
Location 4 -	(3) 3-4-002: 03, 04, and 05	[0.10 acre]
		Total: [~2.4 acres]

Approximately 2.4 acres of land will need to be acquired for additional ROW as a result of this project.

1.3.2. Proposed Construction Activities

The project order of design/construction will begin with Laupāhoehoe Gulch and will be followed by Maulua and Ka'awili'i Gulch. The work is planned to be sequenced and only one gulch will be worked on at a time. Construction activities will involve the clearing of unstable vegetation, such as overhanging large trees, and scaling of large rocks and loose debris, constructing interceptor ditches above the rock cut cliffs, erecting rockfall impact barriers, and installing wire mesh panels anchored above the existing cut slope (See **Figure 3**, Typical Cross-section). Slope scaling is the removal of loose rock material from a slope face by means of manual force and/or mechanical assistance in an effort to reduce the volume of unstable material that has the potential to fall from the slope.

Scaling, including tree removal, and installation of the wire mesh panels pose potential hazards to highway travelers from falling materials and will require road closure during these activities. Because there are no alternate routes that could be used to divert traffic, construction activity will take place intermittently to allow for the safe passage of traffic throughout the day. Traffic control personnel will be present to regulate the flow of traffic through the area when pauses in construction activity occur. Clearing of potentially hazardous leaning trees and loose debris on the slopes is needed prior to the construction of rockfall mitigation improvements to reduce the risk of falling materials and the potential precipitation of a rockfall event. The installation of anchored wire mesh paneling to the rock cut cliff is the major addition to rockfall mitigation on the project site and will prevent material, broken free from the existing cut slope, from reaching the roadway.

Above the anchored wire mesh panels a rockfall impact barrier will be constructed to catch and contain material that falls from the existing natural slope above. The wire mesh panels and impact barrier will be anchored along the top of the existing rock cut slope. Behind the barrier, a shallow concrete lined interceptor ditch (swale) will be added to divert surface runoff from the slopes above and will help reduce the quantity of water percolating into the soils of the existing rock cut cliff. Interceptor ditches will reduce the quantity and velocity of runoff flowing down the gulch slopes. Since most of the runoff flowing down the gulch slopes is generated on the slope itself, a swale located at the top of the gulch would not significantly reduce the amount of surface runoff. A swale would be more useful if it is located along benches on the slope face. These swales will transport

runoff to a nearby stream or gulch for disposal. The construction of the interceptor ditches will require minor grading and excavation to the existing natural slope to allow for a maintained width and to achieve the slope necessary to properly convey surface water.

Improvements to existing swales and drainage basins will be limited to only those necessary to maintain proper function and achieve adequate capacity.

1.3.3. Project Schedule and Cost

Construction is anticipated to begin in the summer of 2010 starting at Laupāhoehoe Gulch. Work at each gulch is estimated to last between 1 to 2 years and will be undertaken in sequence, with a total time of construction of approximately 6 years. The project schedule will allow for breaks between construction activities in the individual gulches. This will address the rainy winter season and possible storms when it may not be practical or safe to maintain construction equipment and personnel at the site.

The projected cost of full project implementation is estimated at approximately $47,300,000. The project will be funded in full by the U.S. Department of Transportation through the Capital Improvement Program.

After fifteen years the rockfall protection measures will be evaluated for sufficiency and site conditions assessed to determine if further improvements are needed.

Section 1 – Figures

Environmental Assessment for Hawai‘i Belt Road
Rockfall Protection at Maulua, Laupāhoehoe and Ka‘awali‘i Gulches
North Hilo and Hāmākua, Island of Hawai‘i, Hawai‘i

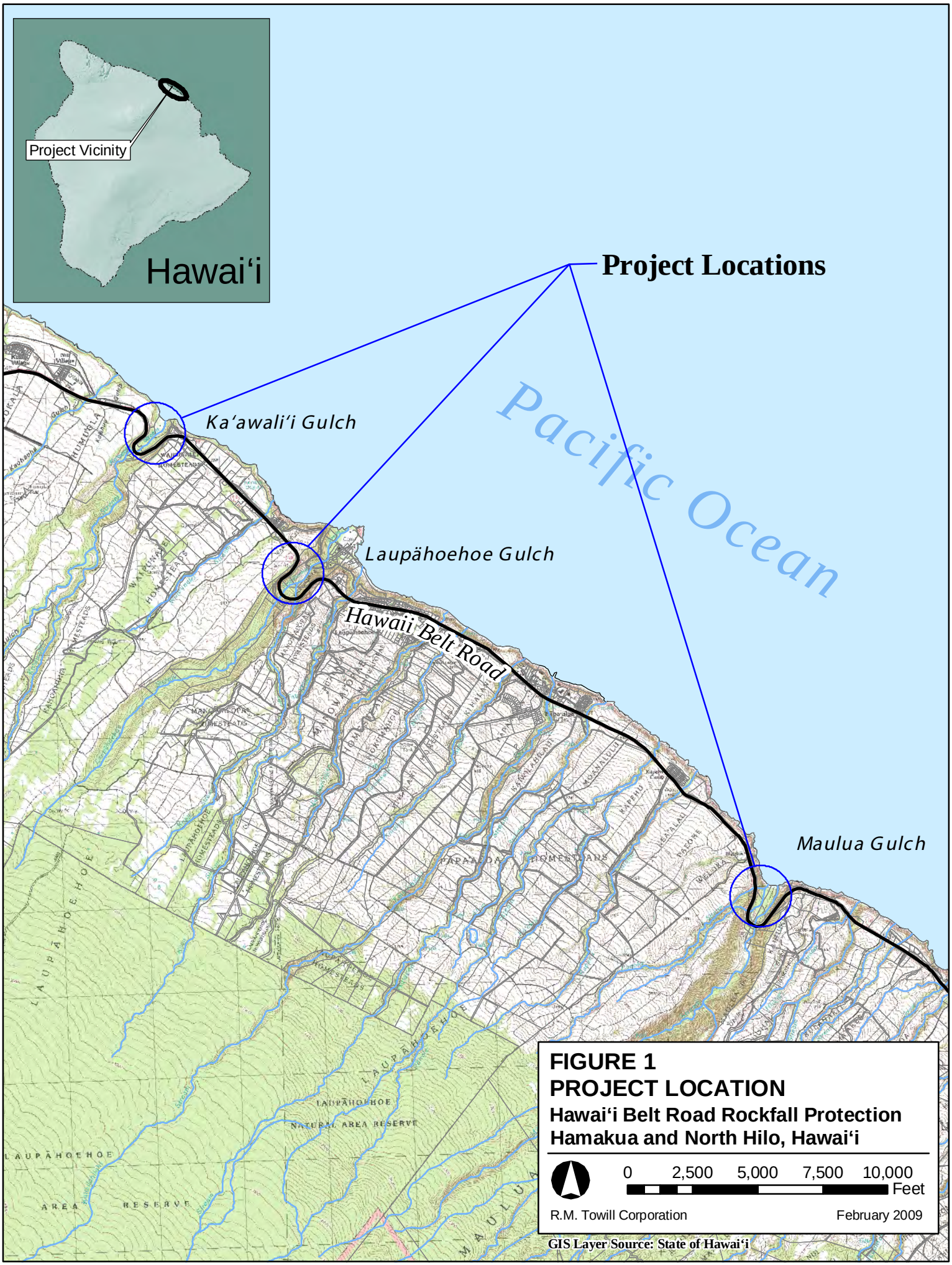
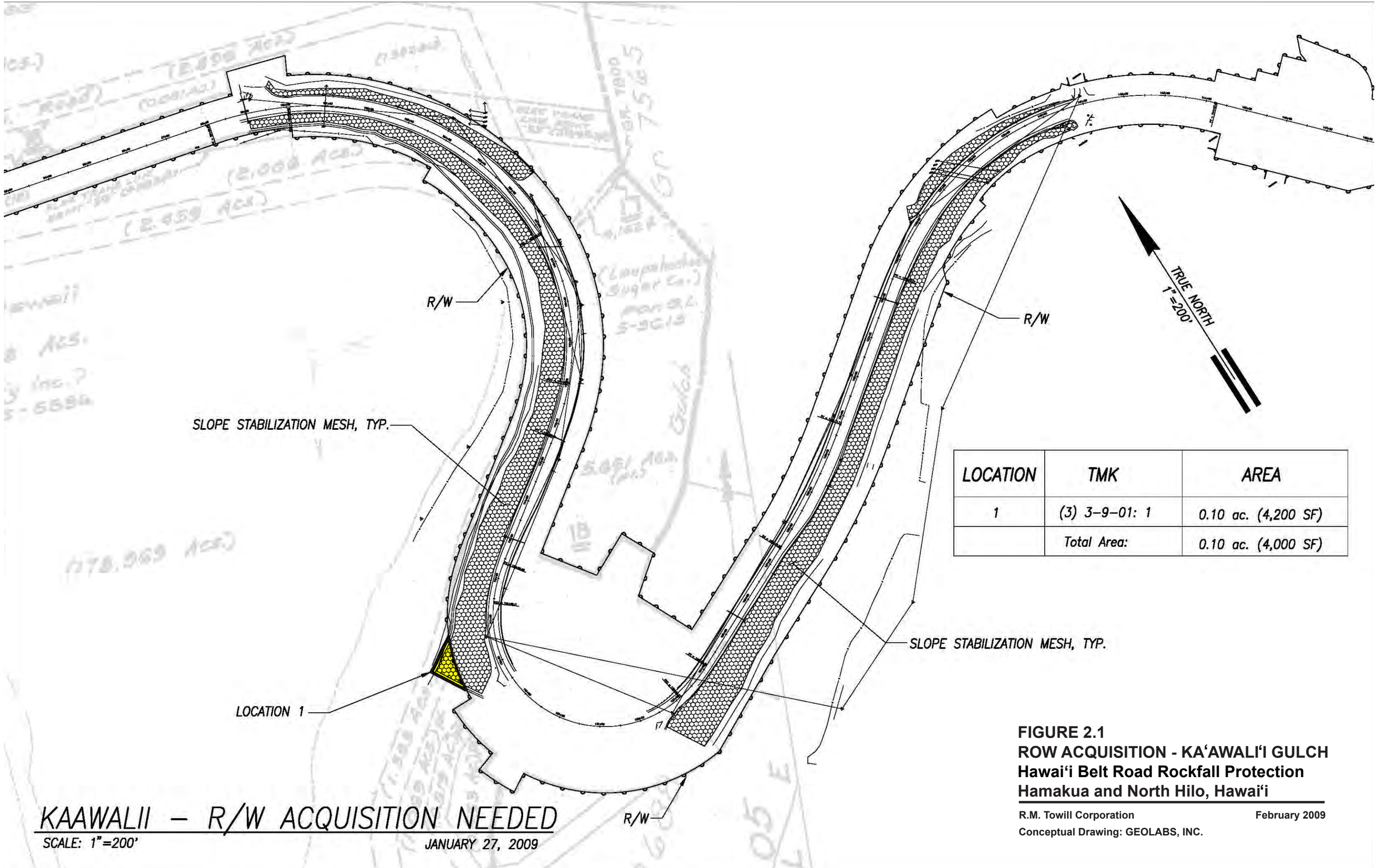


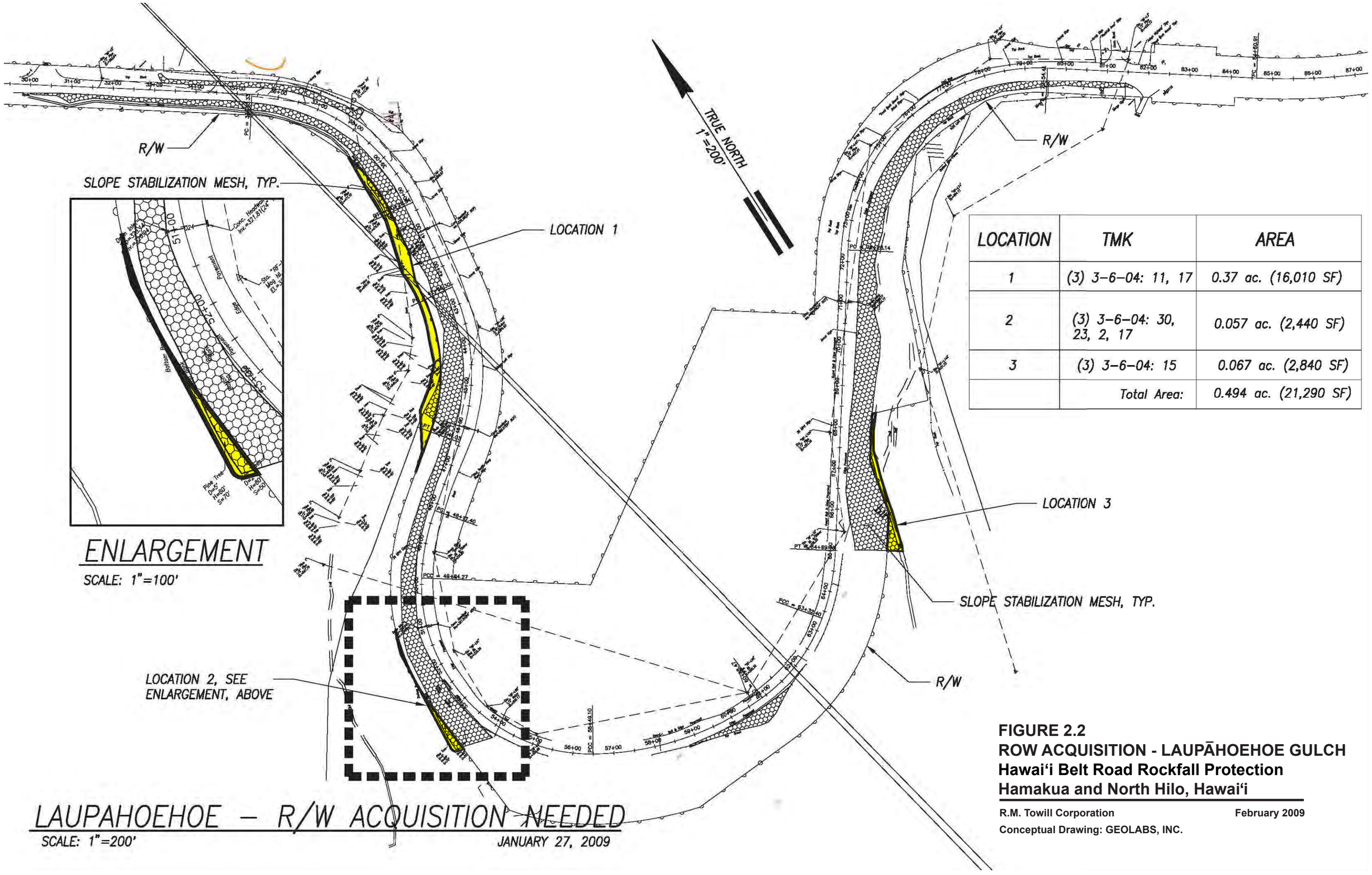
FIGURE 1
PROJECT LOCATION
Hawai'i Belt Road Rockfall Protection
Hamakua and North Hilo, Hawai'i



LOCATION	TMK	AREA
1	(3) 3–9–01: 1	0.10 ac. (4,200 SF)
	Total Area:	0.10 ac. (4,000 SF)

FIGURE 2.1
ROW ACQUISITION - KA'AWALI'I GULCH
Hawai'i Belt Road Rockfall Protection
Hamakua and North Hilo, Hawai'i

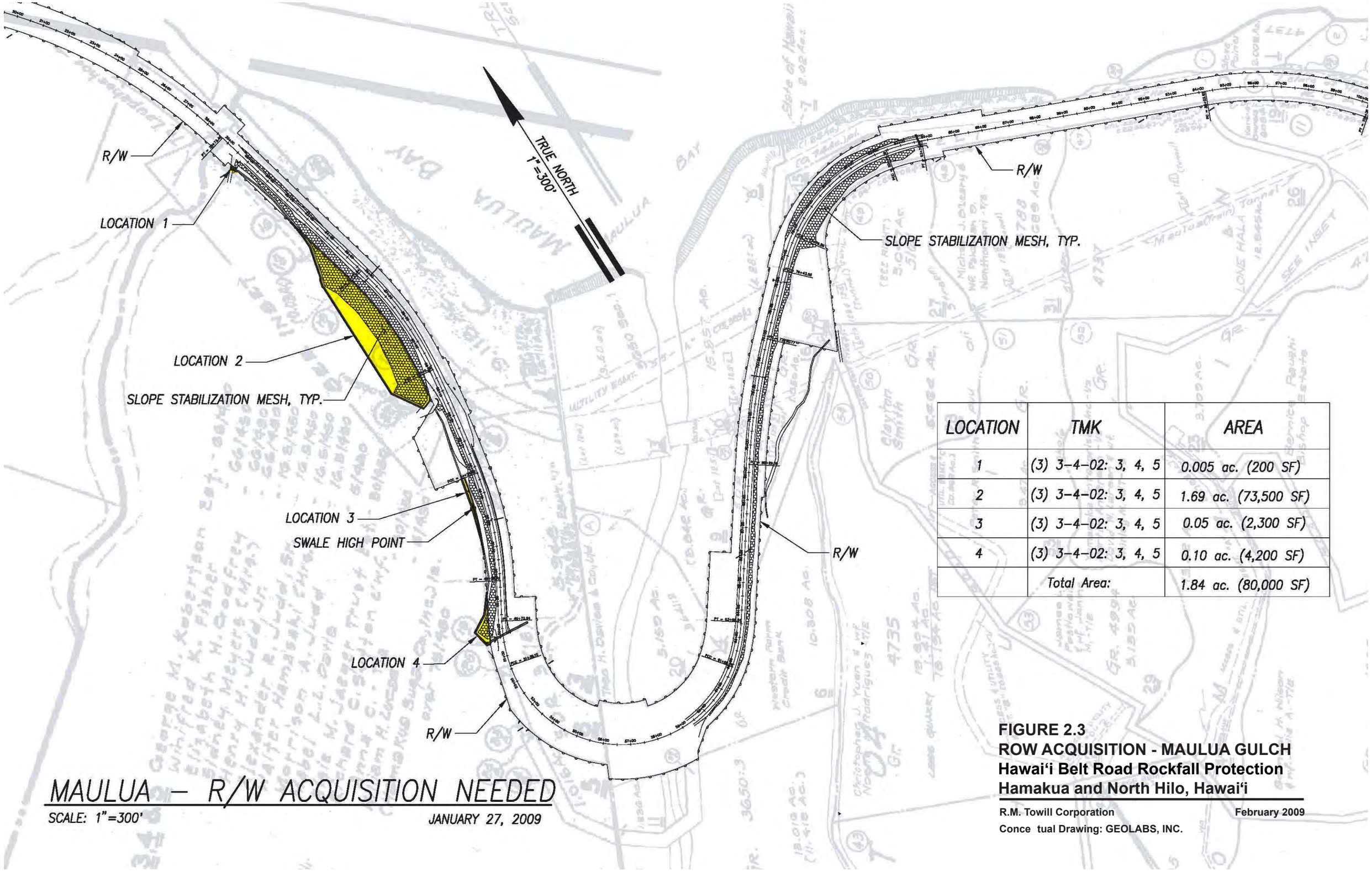
R.M. Towill Corporation February 2009
Conceptual Drawing: GEOLABS, INC.



LOCATION	TMK	AREA
1	(3) 3–6–04: 11, 17	0.37 ac. (16,010 SF)
2	(3) 3–6–04: 30, 23, 2, 17	0.057 ac. (2,440 SF)
3	(3) 3–6–04: 15	0.067 ac. (2,840 SF)
	Total Area:	0.494 ac. (21,290 SF)

FIGURE 2.2
ROW ACQUISITION - LAUPĀHOEHOE GULCH
Hawai'i Belt Road Rockfall Protection
Hamakua and North Hilo, Hawai'i

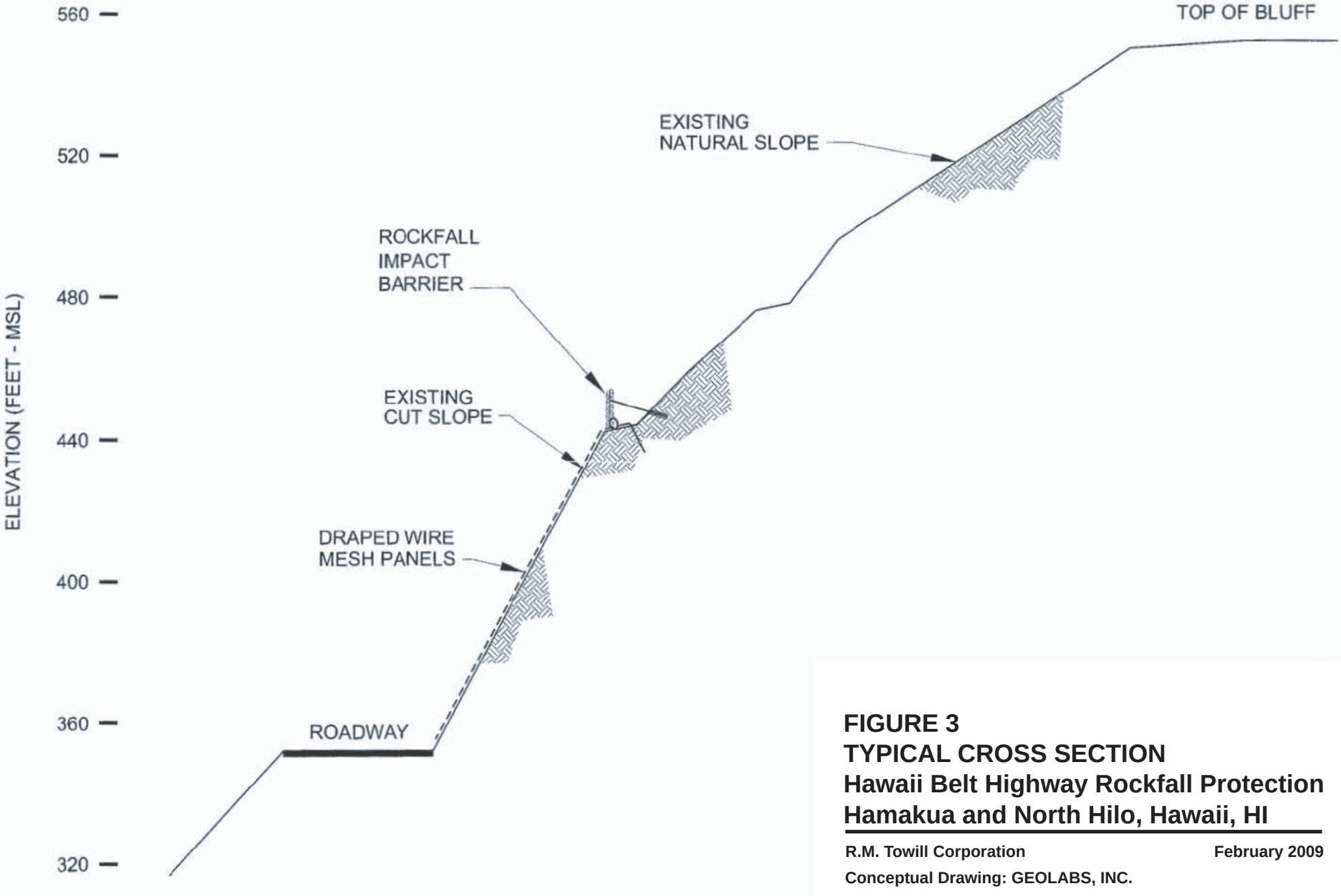
R.M. Towill Corporation February 2009
Conceptual Drawing: GEOLABS, INC.



LOCATION	TMK	AREA
1	(3) 3-4-02: 3, 4, 5	0.005 ac. (200 SF)
2	(3) 3-4-02: 3, 4, 5	1.69 ac. (73,500 SF)
3	(3) 3-4-02: 3, 4, 5	0.05 ac. (2,300 SF)
4	(3) 3-4-02: 3, 4, 5	0.10 ac. (4,200 SF)
	Total Area:	1.84 ac. (80,000 SF)

FIGURE 2.3
ROW ACQUISITION - MAULUA GULCH
Hawai'i Belt Road Rockfall Protection
Hamakua and North Hilo, Hawai'i

R.M. Towill Corporation — February 2009
Conce tual Drawing: GEOLABS, INC.



NOTE:
TYPICAL SLOPE PROFILE ILLUSTRATION IS FROM LAUPAHOEHOE GULCH, STATION 68+00.

FIGURE 3
TYPICAL CROSS SECTION
Hawaii Belt Highway Rockfall Protection
Hamakua and North Hilo, Hawaii, HI

R.M. Towill Corporation **February 2009**

Conceptual Drawing: GEOLABS, INC.

Section 2
Environmental Setting, Potential Impacts and Mitigation Measures

2.1. Physical Environment

2.1.1 Climate

The project site is located along the northeastern shore of the Island of Hawai'i. Temperatures in this region, and statewide, are moderate and equable throughout most of the year. This reflects the small seasonal variation in the energy received from the sun and the tempering effect of the surrounding Pacific Ocean. Being situated in the tropics, there are essentially only two seasons. The summer months, called Kau, extend from May to October with statewide daytime temperatures at sea level averaging 85 degrees Fahrenheit (F). Ho'oilo, or the winter months, are experienced from November to April with an average temperature of 78 degrees F. Nighttime temperatures are approximately 10 degrees F lower.[1] The annual temperatures recorded along the Hāmākua Coast, on the Island of Hawai'i, range from the mid-60s to high 80s F.

Rainfall in this region, (as measured at the Hilo Airport) has averaged approximately 129.85 inches per year over the last 50 years. The highest rainfall in recent years was experienced in 2004 and averaged 15.2 inches per month in the winter months and 7.7 inches monthly through the summer.[2] The highest recorded rainfall in this area for a 24 hour period occurred in November of 2000 totaling 27.36 inches. Winds generally approach the site from the northeast, except during the winter months when storms are usually accompanied by Kona (southerly) winds. Average wind speeds at Hilo Airport measured annual averages of approximately seven (7) mph in 2006 and 2007, with a high of 37 mph accruing in February of 2006.[3]

Potential Impacts and Mitigation Measures

The frequent rain and strong winds of the area can increase the risk of the felling of large shallow rooted trees onto the roadway. The first part of the project will involve the removal of large trees that are deemed hazardous and scaling to remove loose debris from the existing natural slope. Because of the high risk of falling debris during this activity traffic will be stopped temporarily while active removal is taking place. During site preparation and

[1] http://www.bigisland.org/weather/
[2] http://www.co.Hawai'i.hi.us/databook_2006/Table%205/5.17.pdf
[3] http://www.co.Hawai'i.hi.us/databook_2006/Table%205/5.18.pdf

equipment placement, a minimum of one lane of the Hawai'i Belt Road will remain open to allow for traffic flow. The anticipated duration of roadway closures have yet to be determined but will be kept within reasonable limits. Hawai'i County residents will receive notification of scheduled roadway closures in advance of such activity.

The project is planned to begin in Laupāhoehoe Gulch after the rainy winter months and will continue throughout the summer months for as long as possible. If activity is not completed in Laupāhoehoe Gulch in the summer of 2010, the balance of work will be postponed until the summer of 2011. It is anticipated that project implementation will not be significantly impacted by regional climatic conditions. Due to the inaccessibility of the cliff tops the installation of typical storm water mitigation features, such as silt fencing, will not be possible. Storm water mitigation will include the use of waddles and geo-textile woven fabric around drainage ways to minimize sediment transmission. Silt fences will be used in locations where terrain permits its effective use. It is anticipated that the implementation of this project will reduce the frequency of rockfall events in the project areas and prevent rocks and debris from falling directly onto the Hawai'i Belt Highway resulting from heavy rains.

2.1.2. Topography, Geology and Soils

The project site situated on the northeastern slope of Mauna Kea has long been subject to eroding basaltic lava flows and human disturbance. Geologic formations above the highway are characterized by steep rock cut cliffs and natural forested slopes. The lava flows that formed this land mass are classified as the Hāmākua volcanic series. This post shield volcano, created some 237,000 years ago, has not erupted since a series of seven separate vents opened occurring around 4,000 to 6,000 years ago.[4] The Maulua, Laupāhoehoe and Ka'awali'i Gulches are natural, deeply incised drainage ways which deliver concentrated runoff flow to the ocean from inland areas. The gulches are located in high rainfall areas with dense forest vegetation covering the slopes. Frequency and quantity of rainfall in this region causes persistently wet soils, a condition which accelerates chemical weathering of volcanic rock and increases erosion rates. The naturally steep volcanic slopes created by the natural erosion processes were further steepened further when the slopes were cut to construct the Hawai'i Belt Road.

[4] USGS; Hawaiian Volcano Observatory: http://hvo.wr.usgs.gov/volcanoes/maunakea/

The roadway cuts range from approximately 0.25 - 0.50:1 and extend approximately 40 to 130 feet in height above the roadway with continual upward slopes. Roadway elevations at each gulch are highest at the gulch entry and exit and lowest at the gulch crossing. The highest roadway elevation within the project limits is approximately 440 feet msl at the Hilo side (eastern approach) at Laupāhoehoe Gulch. The lowest roadway elevation within the project limits in approximately 130 feet msl at Maulua Gulch. Cliff heights and slopes vary throughout the project area and are most pronounced at Maulua Gulch, (See **Figure 4,** Regional Topography).

Approximate rock cut cliff heights above the Hawai'i Belt Road at each of the gulch crossings are as follow (as measured from the highway grade):

- Ka'awali'i Gulch – 100 feet on west and east faces
- Laupāhoehoe Gulch – 100 feet on west face and 200 on east face
- Maulua Gulch – 200 feet on west and east faces

Above the cut areas, the natural, undisturbed slope of the valley continues upward to the summit bluff. The undisturbed slopes extend up to 330 feet in Maulua Gulch, 240 feet in Laupāhoehoe Gulch and 200 feet in Ka'awali'i Gulch. Soil instability creates the potential for tree instability in these naturally forested areas above the highway.

According to the Soil Survey of Hawai'i, State of Hawai'i, as prepared by the U.S. Department of Agriculture, 1972, the soil classifications found at the project location include: "O'okala silty clay loam"; "rough broken land" (RB), and "mixed alluvial land" (MT) (See **Figure 5,** Soils Map).

O'okala silty clay loam is found on coastal areas of the windward side of Mauna Kea. This soil is characterized by fine sand-size aggregates in which roots can penetrate to a depth of 4 or 5 feet. On the surface it is very strongly acidic with a slightly acid to medium acid subsoil. Permeability with this soil type is moderately rapid; runoff is dependant on slope percentage and is detailed below:

- O'okala silty clay loam, 6 to 12 percent slopes (OoC):
  Runoff is slow, and the erosion hazard is slight
- O'okala silty clay loam, 12 to 20 percent slopes (OoD):

Runoff is medium, and the erosion hazard is moderate

- O'okala silty clay loam, 20 to 35 percent slopes (OoE):
  Runoff is rapid, and the erosion hazard is severe.

The RB soil type is a nondescript land type consisting of precipitous land interwoven by many intermittent drainage channels. This land type occurs primarily in gulches, and the slope is typically 35 to 70 percent. The soil materials can be shallow or deep and stony outcroppings are common. RB is found at elevations ranging from near sea level to 3,000 feet where rainfall averages 50 inches to over 150 inches.

The MT soil type is composed of varied soils transmitted by surface water from the higher elevation of surrounding lands. It is commonly found in valley bases, at the mouths of rivers and in flood prone areas. Included with this designation are areas containing talus material deposited along the bases of the steep valleys. Surface conditions are characterized by a littering of stones and boulders. Mixed alluvial land is encountered at elevations ranging from sea level to 500 feet. The main composition of this classification includes rock debris and soil material.

Potential Impacts and Mitigation Measures

The proposed project will involve scaling and minor grading above the existing rock cut slopes and installation of wire mesh over the cut slopes at the entrances and exits of the three gulches. Any excavated material will be disposed of at an approved waste facility in accordance with State and County of Hawai'i regulations.

Land work will involve removal of loose debris on the existing natural slope above the cut slope. Grubbing will be required to construct the concrete lined interceptor ditch and the rockfall impact barrier. The disturbed areas will be properly handled using stormwater control management and structural practices as required to ensure against loss of sediment during periods of rainfall or inclement weather. These areas will promptly be covered with concrete in the creation of aforementioned features to avoid soil loss in the event of a storm. Management practices will include only excavating the area required to accomplish the interceptor ditch installation possible that day; maintaining open areas with appropriate storm water controls to prevent the commingling of runoff with exposed soils and excavated material; and securing the job site following the end of each work day.

Other measures and practices will be followed as required in accordance with applicable State and County of Hawai'i standards for grading and related construction activities.

2.1.3. Hydrology

The subject gulches were formed by the erosive power of the network of enduring perennial streams replenished by surface runoff and discharging ground waters from higher elevations. The high permeability of the stratified lavas and subterranean conduits such as clinker pockets and lava tubes characteristic of this region allow for rapid absorption of surface water. Groundwater held at higher elevations by confining strata of volcanic ash, clayey soil seams, or other fine-grained low-permeability rock can prevent percolation and create groundwater build up causing areas of high pore water pressure. Localized saturation from these areas can occur through permeable soils and transmit ground water to surrounding soils or to streams at lower elevations. These areas of high pore water pressure can initiate rockfall and landslides in instances of weak and unstable ground conditions. A preliminary assessment of the drainage conditions within the three gulches is provided in the Preliminary Drainage Assessment, presented in **Appendix A** of this report. A summary of the findings is presented in this section.

The scope of the Preliminary Drainage Assessment was to identify existing drainage patterns along the highway alignment within the gulches and provide recommendations for drainage improvements relative to rockfall mitigation. The drainage assessment focused on surface water flow traversing the gulch slopes, which has the potential to erode the slope.

2.1.3.1. Sources of Runoff

The two main sources of water flowing down the gulch slopes are stormwater runoff and groundwater seepage. Stormwater runoff flows down the slopes and is collected in roadside swales and captured in drain inlets. The inlets are connected to culverts under the highway, which outlet into the gulch. Runoff flowing down the gulch slopes may contribute to slope instability.

Groundwater seepage occurs when natural springs daylight onto the slope face. The flow rates of the groundwater seepage ranges from low (moisture wicking) to high (stream flow). Groundwater seepage rates may be affected by drainage from upland areas, which could in turn affect groundwater

levels on the gulch slopes by raising the basal groundwater surfaces and creating localized perched groundwater conditions. The observed locations of groundwater seepage within the gulches are summarized in **Table 1**.

Table 1
Observed Groundwater Seepage Locations

Gulch	Source	Approximate Location
Ka'awali'i	Waterfall	Sta. 127+25
Maulua	Spring	Sta. 34+25
Maulua	Stream	Sta. 50+50
Maulua	Waterfall/Streams	Sta. 71+50 to Sta. 73+50

2.1.3.2. Drainage Areas

The approximate drainage areas for the three gulches are presented in Figures 1 through 3 in the Preliminary Drainage Assessment, (**Appendix A).** The Assessment indicated that most of the drainage areas for the gulch slopes are limited to the area between the top of the slope and the highway. Since the drainage areas do not extend beyond the top of the slopes, the runoff from upstream drainage areas is negligible, and most of the runoff flowing down the gulch slopes is generated on the slope itself.

Contributions of surface runoff and transmitted ground water from higher elevations create the tributary streams associated with these gulches. According to the Hawai'i Stream Assessment there are four main streams in the project limits, (CWRM, 1990). Ka'awali'i Stream is composed of three primary tributaries, Laupāhoehoe Stream has two tributaries, and Maulua Stream comprises four tributaries and shares the north side of Maulua Gulch basin with Paeohe Stream. While these are the only streams that drain through the subject gulches it is important to note that there are many more streams in the area due to frequent heavy rainfall (See **Figure 6**, Perennial Streams).

Erosion caused by soil transmission from these streams has taken place for over 200,000 years contributing to the mixed soil types RB and MT (**Section 2.1.2.** Topography, Geology and Soils)

largely characterizing the surface soil found in the gulches today. The high permeability of these soils allow for rapid saturation and in conditions of frequent rainfall leads to high levels of perched groundwater held by soil layers of low permeability. High pore water pressure resulting from perched water, in combination with the reduced sheer strength due to soil saturation, increase the risk of slope failure. Such geologic and surface and ground water conditions exist in the project vicinity and it is anticipated that perched groundwater is present and a contributing factor to rockfall in the project area. These unstable conditions are exacerbated by the presence, in some areas, of large leaning or leveraging trees anchored with shallow root systems on the slopes above the cut rock cliffs.

Potential Impacts and Mitigation Measures

No adverse impact to perennial or intermittent streams in the vicinity of the project is anticipated. The addition of interceptor ditches will not increase the flow of surface runoff water to the adjacent streams, but will simply alter the point at which such waters enter the stream. Construction activities associated with the rockfall mitigation improvements are not anticipated to infringe on the surface water flow to adjacent streams or obstruct streams in any way which would require mitigation measures to otherwise minimize, reduce, or eliminate the potential for adverse effects.

Although runoff from the project site is not expected to affect the adjacent streams, the contractor will manage all work activities to prevent and reduce erosion from the job site. Construction related fugitive dust, which could affect driver visibility on the Hawai'i Belt Road or be carried by wind blowing toward the streams, will be controlled by regular wetting of the work area as required. Only enough water will be used for dust control to suppress the dust from becoming airborne.

2.1.4. Rockfall and Landslide Conditions

Rockfall and the possibility of landslides are a constant threat and burden to this area. Road crews are sent out daily to clear fallen debris at each of these gulch crossings. There have been cases of boulders up to two feet in diameter falling into the roadway after heavy rain. Constant falling debris presents a hindrance and expense to the County of Hawai'i due to needed cleanup in addition to the obvious safety risks to highway travelers. Mitigation is required to reduce the possibility of more serious and destructive activity such as the collapse of large trees or a large scale landslide.

2.1.4.1. History

The three gulches have a history of rock and debris slides. The following observations were made based on prior rock and debris slides:

- Most of the slide debris appear to originate from the steeper cut slopes
- Most landslides are shallow in depth, involving the outermost layers of more fractured and weathered earth materials
- Some landslides that have occurred in areas of thicker soil deposits exhibit depths of 5 to 10 feet
- The locations of previous slide activity:
    - Appeared to be concentrated in areas underlain by wetter decomposed rock and saprolitic soil materials
    - Occurs more frequently on the steeper cut slopes on both sides of the road
    - Occurs more frequently on the northern and western facing slopes

Discussion with highway maintenance personnel and a review of available highway maintenance logs provided the following information:

- Larger slides of soil and rock tend to occur more frequently during wet weather
- Rockfall consisting of baseball to basketball sized rocks may occur at any time, but is more commonly experienced during wet weather associated with slope runoff
- Rockfall and landslide cleanup is most common in Maulua Gulch, followed by Laupāhoehoe Gulch, and then Ka'awali'i Gulch

Based on discussions with highway maintenance personnel and site reconnaissance, there are four general types of rockfall and landslide activity within the three gulches. A description of these types, in the order of greatest to least frequency is provided in **Table 2**.

Table 2
General Types of Rockfall and Landslide Activity

Description	Frequency	Weather Effect on Frequency	Notes
1. Random fall of smaller rocks & rock fragments (baseball-football sized)	Nearly daily	Increases during wet weather	Typically swept to the road shoulder by manual labor as part of regular maintenance
2. Larger quantities of rock material (typically several cubic yards), usually from locations where the rock is weaker and more fractured	Every several weeks	Increases during wet weather or after extended very dry weather	Generally restricted to lengths of hill slope that have recurring failure problems due to greater slope weathering and open rock fractures
3. Large rock and soil landslides from steeper slopes; typically truckloads of debris which may consist of a mix of soil, rock and vegetation	Once or twice a year	Usually occurs during or following a larger storm event	Highway may be partially or completely blocked by debris such that heavy equipment is required to remove
4. Soil slides and debris flows from the flatter upper hillside above the cut slopes; may involve several to tens of cubic yards of wet debris, consisting of entrained soil and rocks with other debris	Up to several times a year	Occurs during very wet weather	Material from the natural slope could entrain loose material from the cut slope as it falls over the cut slope

Based on information provided by highway maintenance personnel, an area of active rockfall is in Ka'awali'i Gulch in the vicinity of plan station 115+00 to 118+00. Concrete jersey barriers have been installed along the shoulder to contain the rockfall. The rockfall appears to have occurred as individual rock fragments and occasionally as shallow slides of entrained soil and weathered rock.

Based on a review of accident data within the project limits for the period of 1998 through 2000 which was provided by HDOT, Laupāhoehoe Gulch appears to have had the greatest number of recorded traffic accidents involving falling rock, followed by Maulua Gulch and then Ka'awali'i Gulch.

2.1.4.2. Potential Rockfall and Landslide Zones

Based on an evaluation of the existing site conditions described previously, slope segments were identified as having a greater risk for future rockfall and landslide activity. These segments are listed in **Table 3**. The gulches are listed in order of most hazardous to least hazardous; however the

individual slope segments listed within each gulch are not listed according to the level of potential risk and hazard.

Table 3
Potential Rockfall and Landslide Zones

Gulch	Location (Station)	Reason
Maulua	32+00 to 38+00	Past slope instability, adverse geology
	71+00 to 83+00	Adverse geology, canyon cuts
Laupāhoehoe	33+00 to 41+00	Canyon cuts, adverse geology
	50+00 to 54+00	Past slope instability
	68+00 to 82+00	Canyon cuts, adverse geology, past slope instability
Ka'awali'i	100+00 to 105+00	Canyon cuts, adverse geology
	115+00 to 118+00	Old landslide area
	136+00 to 140+00	Canyon cuts, adverse geology

2.1.5. Other Natural Hazards

2.1.5.1. Earthquakes and Volcanoes

Natural hazards in the West Hawai'i region are infrequent and rarely destructive. Most frequent are small earthquakes that usually go unnoticed. The largest earthquake in the recent past occurred in 2006 approximately 6 miles southwest of the island measuring 6.7 on the Richter scale. This event mainly affected the Kona and Kohala Districts and generated a small tsunami measured by the Pacific Tsunami Warning Center to be approximately 4 inches. Major earthquakes of the last 140 years are described in **Table 4**.

Table 4
Destructive Earthquakes in Hawai`i County Since 1868[5]

Date	Epicenter Location	Maximum Intensity	Magnitude	No of Deaths	Damage
03 28 1868	Southern Hawai'i	IX	7.0	0	Extensive-Southern Hawai`i
04 02 1868	Southern Hawai'i	XII	7.9	81>100	Houses destroyed, tsunami
10 05 1929	Hualālai	VIII	6.5	0	Extensive-Kona
08 21 1951	Kona	VIII	6.9	0	Extensive-Kona
04 26 1973	North of Hilo	VIII	6.2	0	Extensive-Hilo, $5.6M
11 29 1975	Kalapana	VIII	7.2	2	Extensive-Hilo, $4.1M
11 16 1983	Ka`oiki	IX	6.7	0	Extensive-S. Hawai'i, >$6M
06 25 1989	Kalapana	VII	6.2	0	Southeast Hawai'i almost $1M
10 15 2006	Kiholo Bay	VIII	6.7, 6.0	0	NW Hawai'i, >$100M

Most earthquakes in Hawai'i are directly related to volcanic activity and are caused by magma moving beneath the earth's surface. These earthquakes tend to be concentrated beneath Kilauea and Mauna Loa, the island's active volcanoes, particularly their south flanks and in the region between them. The northern part of the Big Island is made up of two volcanoes, Mauna Kea and Kohala. Mauna Kea has erupted several times in the last 10,000 years, most recently about 4,500 years ago. This volcano is considered dormant but not extinct.

Kilauea, located on the southeast side of the island has been active since the early 1980s and has since caused destruction to homes and the displacement of people in the District of Puna. Due to its physical location there is no threat of lava flow within the project area. Potential impacts from Kilauea are primarily to air quality caused by volcanic gases.

The U.S. Geological Survey (USGS) has prepared volcanic hazard maps that divide the island into zones that are ranked from 1 through 9 based on the probability of coverage by lava flows. Zone 1

[5] *From USGS Bulletin 2006, Isoseismal Maps, Macroseismic Epicenters, and Estimated Magnitudes of Historical Earthquakes in the Hawaiian Islands by Max Wyss and Robert Koyanagi.*

is the area of greatest hazard, and Zone 9 the area of least hazard. The project site is located in Lava Hazard Zone 8. Most of this area has not been affected by lava flows for the past 10,000 years.

2.1.5.2. Tsunami

A 2006 tsunami generated by an earthquake in West Hawai'i produced a wave measured at 4 inches. Hilo, located in East Hawai'i, experienced destructive tsunami in 1960 and 1946. Tsunamis are an uncommon event in the Hawaiian Islands, but the possibility of such an event does exist. However, because the project site is located approximately 0.75 miles inland and up-gradient from the shoreline the project is not anticipated to be affected by tsunami.

2.1.5.3. Hurricane

Heavy rains and strong winds associated with tropical storms occasionally impact the Hawaiian Islands and can cause flooding and major erosion. Hurricanes occasionally approach the Hawaiian Islands, but rarely reach the islands with hurricane force wind speeds. The most recent hurricane event was Iniki in 1992 and mainly affected the Island of Kaua'i. During this event the Island of Hawai'i experienced wind and rain to the level of a severe tropical storm.

2.1.5.4. Flood Hazard

Maulua Gulch and the southern slope of Laupāhoehoe Gulch are in a region yet unclassified by the Federal Emergency Management Agency (FEMA), Flood Insurance Rate Map (FIRM). Ka'awali'i Gulch and the balance of Laupāhoehoe Gulch are identified as occupying Flood Hazard Zone X, (See **Figure 7,** Flood Map). The potential for inundation by runoff from a 100-year storm in Zone X is estimated to reach an average runoff depth of 0-1 feet.

Potential Impacts and Mitigation Measures

Heavy rainfall associated with tropical storms has the potential to initiate rockfall in the project area. To reduce this threat during construction, all work is planned to take place in the summer months when heavy rainfall is less likely and ground conditions are more stable. Attention will be paid to approaching weather systems and proper stormwater runoff mitigation measures. Silt fencing or other controls will be installed when necessary to prevent the commingling of cliff soils with runoff flowing to the adjacent streams.

Earthquakes pose a threat to unstable slopes, but disruptive seismic events are relatively uncommon in this region. Although the North Hilo and Hāmākua districts have not suffered damage from earthquakes since the 1970s (see **Table 4**), the contractor will exercise caution at the worksite should an advance warning from the State and County civil defense agencies be issued. No further mitigation measures are anticipated to be required.

Tsunami and flooding in the project area are unlikely due to its location in the highway ROW which is equipped with a drainage control system and the presence of steep cliffs. Further diminishing the likelihood of a flood in the project area are factors such as elevation, site location along a mountain slope and the well draining soils in this area. The project is not expected to be adversely affected by flooding and no adverse impacts to the rockfall mitigation improvements are expected. No further mitigation measures are proposed.

2.1.6. Flora/Fauna

2.1.6.1. Introduction

A biological survey of the site was conducted in February 2009 by AECOS Consultants (**Appendix B**). The purpose of the survey was to determine the presence of botanical, avian, or mammalian species currently listed as endangered, threatened, or proposed for listing under either the Federal or the State of Hawai'i's endangered species programs on, or within the immediate vicinity of the site. Federal and State of Hawai'i listed species status follows species identified in documents from the Department of Land and Natural Resources (DLNR) 1998, Federal Register 2005, and U. S. Fish & Wildlife Service (USFWS) 2005, 2008a.

Botanical Survey Methods

The botanical survey was limited to making observations from the highway and identifying plants present on the slopes from a distance. This was due to the very steep slopes and the potential that climbing around or on the cliff faces could cause rockfalls endangering motorists and pedestrians.

All tree species observed were recognizable from the survey distances, but binoculars (Leica Ultravid 8 x 42) were needed to identify the smaller plants. This approach proved serviceable since the vegetation occupied an exposed face and consisted mostly of low growing grasses,

leafy herbs, vines, and shrubs with an open covering of trees. Forest vegetation was present higher on the slopes, generally above the project area. Difficulty was encountered in confirming the identification of some of the ferns, as these require close up inspection of the fronds, and no doubt some small plant species were missed. Plant names follow Hawai'i's Ferns and Fern Allies (Palmer, 2003) for ferns, Manual of the Flowering Plants of Hawai'i (Wagner et al., 1990, 1999) for native and naturalized flowering plants, and A Tropical Garden Flora (Staples and Herbst, 2005) for crop and ornamental plants.

Avian Survey Methods

The three stretches of roadway were walked from the north rim to the south rim and then in reverse. The zoologist covered the same area as the botanist and took approximately one hour to survey each of the gulches. A running tally was kept of all avian and mammalian species detected during the time spent within each gulch. Field observations were made with the aid of Leitz 10 X 42 binoculars and by listening for vocalizations.

The avian phylogenetic order and nomenclature used in the survey followed The American Ornithologists' Union Checklist of North American Birds, 7th Edition (American Ornithologists' Union 1998), and the 42nd through the 49th supplements to Check-list of North American Birds (American Ornithologists' Union 2000; Banks et al. 2002, 2003, 2004, 2005, 2006, 2007, 2008).

Mammal Survey Methods

With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or 'ōpe'ape'a as it is known locally, all terrestrial mammals currently found on the Island of Hawai'i are alien species and most are ubiquitous. The mammal survey was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all vertebrate species observed, heard or detected by other means within each of the three project areas.

2.1.6.2. Survey Results

Botanical Survey Results

The results of the botanical survey are identified in **Table 5** Plant Species Found at Project Site.

Vegetation

The vegetation on the various slopes is dependent upon the friable nature of the slope. Exposure (north vs. south) probably also plays a role. On the more easily eroded slopes, the vegetation is dominated by smaller shrubs and juvenile trees. The typical vegetation on these slopes is some combination of several grasses (Guinea grass, or *Urochloa maxima*, elephant grass or *Pennisetum purpureum*, and molasses grass or *Melinus minutiflora*), several shrubs, such as sourbush (*Pluchea carolinensis*), lantana (*Lantana camara*), and strawberry guava (*Psidium cattleianum*), and scattered trees, typically juvenile or short statured ironwood (*Casuarina equisetifolia*), gunpowder (*Tremma orientalis*), melochia (*Melochia umbellata*), guava (*Psidium guajava*), and Chinese banyan (*Ficus microcarpa*). On the south slopes of Laupāhoehoe and Maulua, the endemic native tree called Neleau (*Rhus sandwicensis*) is very abundant but the growths are small, perhaps mostly root suckers. In places where landslides are infrequent if occurring at all, large trees have developed into a forest.

The south (north-facing) slopes tend to support ferns (particularly *Blechnum appendiculatum*) and leafy herbaceous plants with a notable reduction in cover by grasses as compared with many south-facing slopes. Common trees on these slopes include African tulip (*Spathodea campanulata*), pandanus or hala (*Pandanus tectorius*), guava, mango (*Mangifera indica*), and kukui (*Aleurites moluccana*).

Table 5
Plant Species Found at Project Sites

Species listed by family	*Common name*	*Status*	*Abundance*	*Notes*
Ferns and Fern Allies				
BLECHNACEAE				
Blechnum appendiculatum Willd.	-	Nat	A	
GLEICHENIACEAE				
Dicranopteris linearis (Burm. f.) Underw.	*uluhe*	Ind	U3	(4)
NEPHROLEPIDACEAE				
Nephrolepis multiflora (Roxb.) F.M. Jarrette ex C. V. Morton	-	Nat	O3	(1)
POLYPODIACEAE				
Phymatosorus grossus (Langsd. & Fisch.) Brownlie	*laua'e*	Nat	U2	
PTERIDACEAE				
Adiantum hispidulum Sw.	rough maidenhair fern	Nat	U2	
THELYPTERIDACEAE				
Christella dentata (Forssk.) Brownsey & Jermy	oak fern	Nat	U	(5)
Christella parasitica (L.) Lév	oak fern	Nat	C	(5)
SCHIZAEACEAE				
Lygodium japonicum (Thumb.) Sw.	Japanese climbing fern	Nat	R2	(4)
Flowering Plants (Dicotyledons)				
ACANTHACEAE				
Justicia betonica L.	white shrimp plant	Nat	U2	
Thunbergia fragrans Roxb.	sweet clock vine	Nat	U2	(1)
ANACARDIACEAE				
Mangifera indica L.	mango	Nat	U	
Rhus sandwicensis A. Gray	*neleau*	End	C3	(3, 4)
Schinus terebinthifolius Raddi	Christmas berry	Nat	U	
ARALIACEAE				
Schefflera actinophylla (Endl.) Harms	octopus tree	Nat	O	
ASTERACEAE (COMPOSITAE)				
Ageratum conyzoides L.	*maile hohono*	Nat	U	
Bidens pilosa		Nat	U2	
Conyza sp.	horseweed	Nat	U	(5)
Crassocephalum crepidioides (Benth.) S. Moore	-	Nat	R	
Emilia fosbergii Nicolson	Flora's paintbrush	Nat	U	
Pluchia carolinensis (Jacq.) G. Don	sourbush Nat C	Nat		
Sphagneticola trilobata (L.) Pruski	wedelia	Nat	U	(1)
Youngia japonica (L.) DC	Oriental hawksbeard	Nat	R	
indet.		Nat	U3	(3,5)
BEGONIACEAE				
Begonia hirtella Link	begonia	Nat	U	

Table 5

Plant Species Found at Project Sites, Cont'd

Species listed by family	*Common name*	*Status*	*Abundance*	*Notes*
Flowering Plants (Dicotyledons) Cont'd				
BIGNONIACEAE				
Spathodea campanulata P. Beauv. C	African tulip tree	Nat	C	
BUDDLEJACEAE				
Buddleja asiatica Lour.	dog tail	Nat	U	
CASURINACEAE				
Casuarina equisetifolia L.	ironwood	Nat	C-A	
CONVOLVULACEAE				
Ipomoea indica (J. Burm.) Merr..	*koali "awa*	Ind	U2	
Merremia tuberosa (L.) Rendle	wood rose	Nat	U	(1)
CRASSULACEAE				
Kalanchoë pinnata (Lam.) Pers.		Ind	U2	(3)
EUPHORBIACEAE				
Aleurites moluccana (L.) Willd.	*kukui*	Pol	O	
Chamaesyce hirta (L.) Millsap.	garden spurge	Nat	U	
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	Nat	U	
Chamaesyce prostrata (Aiton) Small	prostrate spurge	Nat	R	(1)
Euphorbia heterophylla L.	*kaliko*	Nat	A	
FABACEAE				
Chamaecrista nictitans (L.) Moench	partridge pea	Nat	U	(1)
Crotalaria sp	rattlepod	Nat	R	(1, 5)
Delonix regia (Bojer ex Hook.) Raf.	royal poinciana	Nat	R	(1)
Desmodium incanum DC	Spanish clover	Nat	U	
Falcataria moluccana (Miq.) Barneby & Grimes	albizia	Nat	R	(1)
Macroptilium lathyroides (L.) Urb.	-	Nat	U	
LAMIACEAE				
Hyptis pectinata (L.) Poit.	comb hyptis	Nat	O	
MALVACEAE				
Hibiscus tiliaceus L.	*hau*	Ind	U3	(4)
Sida acuta N. L. Burm.	-	Nat	R	
MELASTOMATACEAE				
Clidemia hirta (L.) D. Don	Koster's curse	Nat	R	
Melastomia cf. *septemnervium* Lour.	-	Nat	U2	(5)
MORACEAE				
Artocarpus altilis (Parkinson) Fosberg	*'ulu*, breadfruit	Pol	R	(4)
Ficus microcarpa L. fil.	Chinese banyan	Nat	O	
MYRTACEAE				
Eucalyptus ?saligna		Nat	O3	(1)
Metrosideros polymorpha Gaud.	*'ohi'a*	End	R3	(4)
Psidium cattleianum Sabine	strawberry guava	Nat	C3	
Psidium guajava L.	common guava	Nat	C	
Syzygium cumini (L.) Skeels	Java plum	Nat	O	
Syzygium jambos (L.) Alston	Rose apple	Nat	R	(4)
NYCTAGINACEAE				
Bougainvillea cf. *spectabilis* Wildenow	bougainvillea	Orn	R	

Table 5
Plant Species Found at Project Sites, Cont'd

Species listed by family	*Common name*	*Status*	*Abundance*	*Notes*
Flowering Plants (Dicotyledons) Cont'd				
OXALIDACEAE				
Oxalis corniculata L.	yellow wood sorrel	Pol	R	
PASSIFLORACEAE				
Passiflora foetida L.	running pop	Nat	R	
Passiflora moillissima (Kunth) L.H. Bailey	banana poka	Nat	R	
POLYGALACEAE				
Polygala paniculata L.	-	Nat	R	(1)
RUBIACEAE				
Morinda citrifolia L.	Indian mulberry, *noni*	Pol	U	
Paederia foetida L.	*maile pilau*	Nat	R	
STERCULIACEAE				
Melochia umbellata (Houtt.) Stapf	-	Nat	O-C	
ULMACEAE				
Trema orientalis (L.) Blume	gunpowder tree	Nat	C	
VERBENACEAE				
Lantana camara L.	lantana	Nat	O3	
Flowering Plants (Monocotyledons)				
AGAVACEAE				
Cordyline fruticosa (L.) A. Chev..	tī, kī	Pol	O3	
ARACEAE				
Philodendron erubescens K. Koch & Augustin	red - leaf philodendron	Orn	R	(2)
ARECACEAE				
Archontophoenix alaxandrae (F.V. Mueller) Wendl. & Drude	Alexandria palm	Nat	R	(1)
Cocos nucifera L.	coconut	Nat	U	
COMMELINACEAE				
Commelina diffusa N. L. Burm.	day flower	Nat	R	
MUSACEAE				
Musa sp.	banana	Nat	R	
ORCHIDACEAE				
Spathoglottis plicata Blume	Malayan ground orchid	Nat	U2	
PANDANACEAE				
Pandanus tectorius S. Parkinson ex Z	*hala*	Ind	O3	
POACEAE				
Andropogon virginicus L.	broomsedge	Nat	U3	
Chloris barbata (L.) Sw.	swollen fingergrass	Nat	U3	(1)
Eleusine indica (L.) Gaertn.	wire grass	Nat	U	(1)
Melinus minutiflora P. Beauv.	molasses grass	Nat	A	

Table 5
Plant Species Found at Project Sites, Cont'd

Species listed by family	*Common name*	*Status*	*Abundance*	*Notes*
Flowering Plants (Monocotyledons) Cont'd				
POACEAE Cont'd				
Melinis repens (Willd.) Zizka	Natal redtop	Nat	U	(1)
Pennisetum purpureum Schumach.	elephant grass	Nat	AA	
Pennisetum setaceum (Forssk.) Choiv.	fountain grass	Nat	U3	(3)
Saccharum officinarum L.	sugar cane	Orn	R	(3)
Sacciolepis indica (L.) Chase	Glenwood grass	Nat	R	(1)
Urochloa maxima (Jacq.) R. Webster	Guinea grass	Nat	AA	

LEGEND

STATUS = distributional status for the Hawaiian Islands:
- end. = endemic; native to Hawaii and found naturally nowhere else.
- ind. = indigenous; native to Hawaii, but not unique to the Hawaiian Islands.
- nat. = naturalized, exotic, plant introduced to the Hawaiian Islands since the arrival of Cook Expedition in 1778, and well-established outside of cultivation.
- orn. = exotic, ornamental or cultivated; plant not naturalized (not well-established outside of cultivation).
- pol. = Polynesian introduction before 1778.

ABUNDANCE = occurrence ratings for plants in the project area:
- R – Rare - seen in only one or perhaps two locations.
- U - Uncommon - seen at most in several locations
- O - Occasional - seen with some regularity
- C - Common - observed numerous times during the survey
- A - Abundant - found in large numbers;
- AA - Very abundant - abundant and dominant; defining vegetation type in some areas.

NOTES = Numbers following an occurrence rating indicate clusters within the survey area. The ratings above provide an estimate of the likelihood of encountering a species within the specified survey area; numbers modify this if abundance, where encountered, tends to be greater than the occurrence rating:
- 1 – Mostly or entirely observed just beyond the margin of the slopes proposed for rockfall protective structures, but potentially found in a project site.
- 2 – Species only noted in Ka'awali'i Gulch (this survey).
- 3 – Species only noted in Laupāhoehoe Gulch (this survey).
- 4 – Species only noted in Maulua Gulch (this survey).
- 5 – Observed plant lacking fruit or flowers, or too distant to make a certain identification.

A few areas of more distinctive vegetation are present. Fountain grass is common on dense basalt off the rocky faces of the north cut (point at which the highway enters the gulch with cliffs on both sides of the roadway) in Laupāhoehoe gulch. The south cut of Maulua Gulch supports an open 'ohi'a (*Metrosideros polymorpha*) forest with an understory of uluhe (*Dicranopteris linearis*) fern, representing a native plant community. Ki or tī (*Cordyline fruticosa*) and Neleau are present here as well.

Flora

A total of 85 species of ferns and flowering plants were identified. The listing provided in the table includes some species observed along the roadway that are likely to be present in the area of potential impact from the proposed rockfall protection structures. Of the total list, only 6 (or 7%) are native species, with another 5 (5.9%) representing early Polynesian introductions. None of the native plants are considered rare species on the Island of Hawai'i.

Avian Survey Results

Ninety-seven individual birds of nine different species, representing eight separate families were recorded during the course of the survey (**Table 6** Avifaunal Species Found at Project Site). One of the species detected, Hawaiian Hawk (*Buteo solitarius*), is an endemic endangered species currently protected under both Federal and State of Hawai'i endangered species statutes. The remaining eight species recorded are all considered to be alien to the Hawaiian Islands.

Avian diversity and densities were extremely low and consistent with the near vertical nature of the survey sites, and the highly disturbed habitat. Three species; Japanese White-eye (*Zosterops japonicus*), Northern Cardinal (*Cardinalis cardinalis*), and House Finch (*Carpodacus mexicanus*), accounted for slightly more than 76% of the total number of all birds recorded during station counts. The most common avian species recorded was Japanese White-eye, which accounted for slightly more than 37% of the total number of individual birds recorded. An average of 33 individual birds was recorded in each of the three gulches.

Mammal Survey Results

One mammalian species, pig (*Sus s. scrofa*), was detected during the course of this survey. Also found were tracks, scat and sign of pig, in all three gulches. Large rooting areas were seen in the lower reaches of each gulch generally on the makai side of the road.

Table 6
Avifaunal Species Found at Project Sites

Common Name	***Scientific Name***	***ST***	***RA***
	PELECANIFORMES		
	PHAETHONTIDAE – Tropicbirds		
White-tailed Tropicbird	*Phaethon lepturus dorothea*	IB	0.33
	FALCONIFORMES		
	ACCIPITRIDAE - Hawks, Kites, Eagles & Allies		
	Accipitrinae - Kites, Eagles & Hawks		
Hawaiian Hawk	*Buteo solitarius*	EE	1.00
	COLUMBIFORMES		
	COLUMBIDAE - Pigeons & Doves		
Spotted Dove	*Streptopelia chinensis*	A	0.67
Zebra Dove	*Geopelia striata*	A	0.33
	PASSERIFORMES		
	ZOSTEROPIDAE - White-eyes		
Japanese White-eye	*Zosterops japonicus*	A	12.00
	STURNIDAE - Starlings		
Common Myna	*Acridotheres tristis*	A	3.33
	CARDINALIDAE - Cardinals Saltators & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	6.67
	FRINGILLIDAE - Fringilline and Carduline Finches & Allies		
	Carduelinae - Carduline Finches		
House Finch	*Carpodacus mexicanus*	A	6.00
	ESTRILDIDAE - Estrildid Finches		
	Estrildinae - Estrildine Finches		
Nutmeg Mannikin	*Lonchura punctulata*	A	2.00

LEGEND

ST = Status
A = Alien Species
EE = Endangered Endemic Species – native and unique to the Island of Hawai'i and endangered
IB = Indigenous Breeding Species – native to Hawai'i but also found elsewhere naturally
ST = Status
RA = Relative Abundance – number of birds detected divided by the number of bird counts (3)

2.1.6.3. Survey Discussion

Botanical Resources

The slopes of the gulches that may be directly impacted by the proposed rockfall protection measures are primarily covered in alien or non-native and naturalized plants. Native plants are represented within the project area by the extensive amount of Neleau on the north slope of Laupāhoehoe gulch and to a lesser extent on the north slope of Maulua Gulch, and the 'ophi'a/uluhe association at the upper end of the south slope and entry cut of Maulua Gulch.

Avian Resources

Avian diversity and densities were consistent with the quality of habitat present at the sites; the sites are essentially cliff faces that are north and south facing walls of three gulches. The vegetation and substrate along most of the survey corridors is highly disturbed and evidence of previous rock fall is clearly visible. The combination of steep slopes, relatively small trees, and the high volume of vehicular traffic along the roadway do not present particularly attractive habitat for avian species.

The majority of birds heard and seen were from within the dense vegetation below the roadway and along the bottom of the gulches. Of the nine different avian species recorded during this survey, seven are alien species. The other two species, Hawaiian Hawk, and White-tailed Tropicbird (*Phaethon lepturus dorothea*), are endemic, and indigenous species respectively. Three Hawaiian Hawks were observed soaring above and within Ka'awali'i Gulch. Hawaiian Hawks are currently found in nearly all habitats that still have some large tree components on the Island of Hawai'i and are regularly seen foraging in the Hāmākua area. Hawk densities are highest in mature, native species dominated forests, with grassy under-stories. This habitat, with high amounts of forest edge, supports large populations of game birds and the four species of introduced rodents known from the island, all of which are prey items for the hawk. Additionally, this type of habitat also provides numerous perches and nesting sites suitable for this species (Klavitter, 2000). The Hawaiian Hawk is an endemic endangered species currently protected under both Federal and State of Hawai'i endangered species statutes.

One White-tailed Tropicbird was seen soaring well above the cliff face in Laupāhoehoe Gulch. White-tailed Tropicbirds are an indigenous breeding pelagic seabird. On the Island of Hawai'i tropicbirds usually nest on relatively remote cliff faces, usually overlooking the ocean. There are no known nesting sites within any of the three project areas surveyed.

Although not detected during this survey, it is possible that small numbers of the endangered endemic Hawaiian Petrel (*Pterodroma sandwichensis*), or ua'u, and the threatened Newell's Shearwater (*Puffinus auricularis newelli*), or 'a'o, over-fly the project areas between the months of May and November (Banko, 1980a, 1980b; Day et al., 2003a; Harrison, 1990). Newell's Shearwaters were formerly common on the Island of Hawai'i (Wilson and Evans, 1890–1899). This species breeds on Kaua'i, Hawai'i, and Moloka'i in extremely small numbers. The primary cause of mortality in both Hawaiian Petrels and Newell's Shearwaters is thought to be predation by alien mammalian species at the nesting colonies (USFWS, 1983; Simons and Hodges, 1998; Ainley et al., 2001). Collision with man-made structures is considered to be the second most significant cause of mortality of these seabird species in Hawai'i. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall, can become disoriented by exterior lighting. When disoriented, seabirds often collide with manmade structures, and if they are not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals (Hadley, 1961; Telfer, 1979; Sincock, 1981; Reed et al., 1985; Telfer et al., 1987; Cooper and Day, 1998; Podolsky et al., 1998; Ainley et al., 2001). There is no suitable nesting habitat within or close to any of the project sites for either of these pelagic seabird species.

Mammal Resources

The findings of the mammalian survey were consistent with the habitat present at the project sites. Although the Hawaiian hoary bat was not recorded during the survey, bats have been recorded on numerous recent surveys conducted within the general Hāmākua area (Bonaccorso et al., 2005, 2007, 2009). It can be expected that Hawaiian hoary bats forage over sections of one or more of the project sites.

The Hawaiian hoary bat is a typical lasurine bat and primarily leads a solitary existence, described as "over-dispersed". They generally roost cryptically in foliage, which makes them difficult to study (Findley and Tomich, 1983; Jacobs, 1994; Carter et al., 2000). Research into species distribution and life cycle are currently in the relatively early stages of systematic study (Bonaccorso et al., 2005, 2007, 2009). Data gathered as part of a multi-year project to study this species, it distribution, densities and life history is just being prepared for publication. Key findings include the opinion that at least on the Island of Hawai'i, the bat is ubiquitous in areas that still have forest or dense cover. They have

also concluded that the species is a human commensal species and is a generalist, having adapted to roost in, and prey upon both native and alien species (Bonaccorso et al., 2005, 2007, and 2009).

Given the vegetation present within the three project sites it is unlikely that the Hawaiian hoary bat uses any of the vegetation found as roosting sites, as the trees present are too small to likely appeal as a desirable roosting site for this species. Hawaiian hoary bats tend to select roosting trees that are 20 feet (6 meters) tall or higher, with a well-developed crown, and free air space below the canopy for the bats to easily drop out of the vegetation. Typical ornamental trees that bat roosts have been located in include mango (*Mangifera indica*), lychee (*Litchi chinensis*), and avocado (*Persea americana*), trees with thick well-developed canopies and relatively sparse vegetation below the crown.

Potential Impacts and Mitigation Measures

Critical Habitat

There is no federally delineated Critical Habitat within or close to the project site. Clearing, grubbing and construction of rockfall protective measures will not result in any impacts to federally designated Critical Habitat.

Native Hawaiian Plants

The project may require the removal of large trees on the slopes above the cliff and in areas that require cutback to reduce the risk of falling vegetative debris, rocks and sediments. This step, including the installation of the rockfall barriers, will provide safety to workers and highway travelers. Some native plant species that occur in the area may be directly impacted. However, no Federal or State listed threatened or endangered species were found to be present. Losses of the plant species present at the site are anticipated to be minimal based on the proposed scope and scale of the project focusing the construction work within selected portions of the three gulches. The native 'ohi'a area is mostly located above the planned rockfall protection structures, and the open nature of the steel webbing will allow recovery of the Neleau plants. Providing stability to the slopes where the majority of the Neleau occur is expected to contribute to the long term preservation of this species on these slopes.

Hawaiian Petrel and Newell's Shearwater

The principal potential impact of the proposed project to Hawaiian Petrels and Newell's Shearwaters is the increased threat that birds will be downed after becoming disoriented by

exterior lighting that may be required in conjunction with nighttime construction activities, and, or the servicing of construction equipment at night. The proposed project will be constructed during daylight hours with no nightwork planned. No impacts to seabirds are therefore anticipated from nightwork. The installation of exterior lighting that may be required will comply with Hawai'i County Code, Article 9, Outdoor Lighting (Sections 14-50 through 14-55.1) which requires the shielding of all exterior lights to reduce ambient glare.

Other Potential Impacts and Mitigation Measures

Noise will be temporarily generated during construction activities. However, all internal combustion powered equipment will be muffled and work will be limited to daytime hours. No night work will be required. Upon completion of work, the area will return to preconstruction noise levels.

2.1.7. Scenic and Visual Resources

Existing views from the project site are primarily from along the Hawai'i Belt Road and most notably include mauka views of the forested valleys rising from the gulches. Surrounding the gulches are views of the slopes of Mauna Kea, the rock cut cliffs, and intermittent views of the Pacific Ocean. Other views along the highway include small scattered residential areas and agricultural land.

Potential Impacts and Mitigation Measures

The proposed project was selected from among nine (9) alternatives for the implementation of rockfall preventative measures and is considered the alternative with the least impact to existing view planes. While the anchored wire mesh along portions of the three gulches will be visible from vehicles along the Hawai'i Belt Road, adverse impacts to viewplanes toward mauka facing valleys are not expected to be significant, and views toward the ocean will remain unaffected. Vegetative controls that will be used to stabilize open areas of soil to reduce erosion will have some benefit in helping to reduce the potential visual impact of the wire mesh.

Overall, while some views of the rockfall preventative measures may be visible from various points along the Hawai'i Belt Road traversing past the Ka'awali'i, Laupāhoehoe, and Maulua Gulches, these views will be infrequent and temporary as motorists pass each of the gulches. This minor effect may be considered a reasonable and practical result of a project that would

improve public safety from future rockfall events. In this regard, no significant adverse impact to the scenic and visual resources of the area is anticipated.

2.1.8. Historic and Archaeological Resources

An archaeological literature review and field investigation of the site was conducted in early 2009 by Cultural Surveys Hawai'i (CSH) (**Appendix C**). The purpose of the investigation was to undertake the following:

1. Historical research including study of archival sources, historic maps, Land Commission Awards and previous archaeological reports to construct a history of land use and to determine if archaeological sites have been recorded on or near the project area.

2. Limited field inspection of the project area to identify any surface archaeological features and to investigate and assess the potential for impact to such sites. The assessment would identify any sensitive areas that may require further investigation or mitigation before the project proceeds.

3. Preparation of a report to include the results of historical research and the limited fieldwork with an assessment of archaeological potential based on research, with recommendations for further archaeological work, if appropriate. It will also provide mitigation recommendations if there are archaeologically sensitive areas that need to be taken into consideration.

Methodology

The methodology undertaken for the investigation consisted of the following:

Document Review

Background research included: a review of previous archaeological studies on file at State Historic Preservation Division (SHPD); review of documents at Hamilton Library of the University of Hawai'i, the Hawai'i State Archives, the Mission Houses Museum Library, the Hawai'i Public Library, and the Archives of the Bishop Museum; study of historic

photographs at the Hawai'i State Archives and the Archives of the Bishop Museum; and study of historic maps at the Survey Office of the Department of Land and Natural Resources. Historic maps and photographs from the CSH library were also consulted. In addition, Mahele records were examined from the Waihona 'Āina database (<www.waihona.com>).

The research provided the environmental, cultural, historic, and archaeological background for the study area. The sources studied were used to formulate a predictive model regarding the expected types and locations of historic properties in the study area.

Field Methods

The fieldwork component of the archaeological literature review and field inspection was conducted on January 21 and 22, 2009 by CSH archaeologists and required 3 person-days to complete including one day for compilation.

The purpose of the fieldwork was to develop data on the nature, density, and distribution of archaeological sites within the study area, and also to develop information on the degree of difficulty that vegetation and terrain create for future archaeological studies. The field inspection consisted of a visual inspection of the three rockfall remediation areas from the highway with only limited cliff face(s) surveys. The spacing between the archaeologists was generally less than 10 meters. Potential archaeological sites or site areas were documented with brief written descriptions, and photographs, and were located using a GPS unit (accuracy 3-5 meters).

Background Research

Refer to the Archaeological Report (**Appendix C**) and **Section 6**, Cultural Impact Assessment Evaluation, for detailed discussion of the historical background of the project site and region including the following:

Section 6.1.2.1, Review of Historical Documentation:

- Place Name Definitions, Proverbs and Legends
- Early 1800s
- The Mahele

- Alterations to the Hāmākua Coastline (1870s-1940s)
- Sugarcane Cultivation
- Original Belt Highway
- Hilo Railroad

Prior archaeological research in the vicinity of the proposed project area are identified in **Table 7** and shown in **Figure 8** Location of Previous Archaeological Studies in Project Area. Historic properties identified in the vicinity of the project area are shown on **Figure 9** Location of Historic Properties in Vicinity of Project Area.

Table 7
Previous Archaeological Studies in the Vicinity of the Project Area

Reference	Location	Nature of Study	Results
Stokes 1991	Island of Hawai'i	Historic Survey of Native Hawaiian Temple Sites	Documented five heiau in the immediate vicinity of Laupāhoehoe.
Cox 1983	Laupāhoehoe Point, TMK: [3] 3-6-002: 24	Archaeological reconnaissance	Identified a stepped terrace, likely of pre-contact origin, possibly functioning as a large residence, stream diversion, canoe storage, or heiau. No State Inventory of Historic Properties (SIHP) number was assigned.
Rechtman 2000	TMK [3] 3-9-002: 007	Archaeological Survey	No historic properties identified.
Shideler and Hammatt 2003	TMK [3] 3-6-004: 007	Archaeological reconnaissance	Relocated SIHP # 50-10-16-1784, Mamala or Ha'akoa Heiau.

Field Inspection

Pedestrian inspection of the study area was performed and was limited due to safety issues, accessibility, and dense vegetation. Archaeologists initially drove along the Belt Highway between Maulua Gulch and Ka'awali'i Gulch to determine parking and field inspection accessibility. Parking was very limited. In some cases areas where parking was possible, walking along the highway was too dangerous due to narrow or minimal roadside shoulders and sharp turns in the road. Some areas appeared to only be accessible by private property.

Sheer walls completely or partially covered with vegetation were found in the three gulch study areas. Several attempts to inspect these gulch walls from the opposite ridge were unsuccessful due to dense vegetation that appeared to be feral cane or California grass. Archaeologists were able to review the makai side of the northern portion of Laupāhoehoe Gulch from the mauka ridge, and the mauka side of the northern portion of Ka'awali'i Gulch from the makai ridge. However, dense vegetation in both areas again prevented a thorough inspection.

Archaeologists walked along the highway, when possible, to inspect the study area. Areas that could not be walked or viewed from the opposite ridge were inspected by car and photographed. No historic sites were found within or adjacent to the proposed study area.

Figure 10 shows the location of an "abandoned railroad tunnel and portal located below highway". This tunnel was visible while driving on the highway although it was not possible to access the tunnel due to safety issues. Dense vegetation just below the highway and a sheer drop did not allow inspection. It was also not possible to photograph the tunnel while driving or to park to photograph the tunnel.

Summary and Recommendations

The study area consists of three discrete locations at three major Hawai'i Belt Road stream valley crossings (Maulua, Laupāhoehoe, and Ka'awali'i gulches) within the North Hilo District. The three study area locations are all with the Hawai'i Belt Road Right-of-Way and total approximately 2.6 miles.

No historic properties were observed during the field inspection of the study area. The absence of historic properties can be attributed to extensive land modifications associated with historic sugar cultivation and construction associated with the Hāmākua Division of the Hilo Railroad, later known as the Hawai'i Consolidated Railway. The Belt Highway and portions of the current project area follow much of the railway right-of-way. After the demise of the sugar industry, previously cultivated areas became pasture lands, and/or were planted with eucalyptus or ironwood trees. The proposed Hawai'i Belt Road Rockfall Protection Project also involves minimal ground disturbance involving boring for the installation of a new wire mesh drapery over exiting road cuts.

The abandoned railroad tunnel and portal located below the highway was not visible from the highway and it was not possible to access the tunnel due to safety issues and dense vegetation. No work is planned in the vicinity of the abandoned railroad tunnel and therefore no adverse effects are anticipated.

Project plans do not indicate locations of staging areas. If staging areas are not necessary, no further work is recommended for the Hawai'i Belt Road Rockfall Protection Project at Maulua, Laupāhoehoe, and Ka'awali'i gulches. If, however, staging areas involving ground disturbance are planned, additional research / inspection may be required by SHPD in the form of archaeological monitoring during construction.

If in the unlikely event that intact historic properties, including but not limited to human remains or other significant cultural deposits, are encountered during the course of the proposed project activities, all work in the immediate area should stop and the SHPD should be promptly notified.

Potential Impacts and Mitigation Measures

The proposed project is located along the Hawai'i Belt Road and serves as the primary thoroughfare between Hilo and Kailua. Given the extent of land disturbance and the project being located primarily on a sheer eroded cliff face it is highly unlikely that any historically or culturally significant artifacts will be encountered on the project site. If any iwi or other cultural remains are uncovered by earthwork or grading work will be temporarily halted and the SHPD immediately notified at (808) 692-815 for further instructions. Work will only be resumed upon appropriate notification to do so by the SHPD.

As noted, archaeological monitoring may be required during construction as determined by the SHPD to ensure against the potential for adverse effects should any archaeological resources be present.

2.1.8. Noise

Existing sources of noise in the project area are limited to motor vehicles traveling along Hawai'i Belt Road, wind from trees, and avifauna and human associated activities in the area. Most, if not all of these sources of noise are limited and do not ordinarily constitute an acoustic nuisance.

Potential Impacts and Mitigation Measures

Construction activities are anticipated to increased noise in the area immediately surrounding the site from work crews and construction equipment. Construction equipment is expected to include, but not be limited to, the use of hydraulic boom trucks, dump and concrete trucks, powered hand tools and possibly, a helicopter or crane for delivery and installation of the wire mesh panels.

Construction equipment will be operating from the Hawai'i Belt Road. The steep cliff faces and forested slopes above will help to buffer and reduce the sound generated by construction equipment. The project area is located within a rural, country setting and only four houses are located in near proximity to the gulches (within 200 linear feet). The small scope and scale of the work suggests that there is limited potential for construction related noise to adversely affect residences. Mitigative measures to minimize or reduce potential noise impacts will include limiting construction activities to daylight working hours from about 8:00 am to 4:00 pm and inspecting all combustion powered machinery to ensure the equipment is in proper working order and muffled in accordance with law.

2.1.10. Air Quality

No information on air quality was collected. Construction activities are expected to have little or no impact since the project will be of limited duration and where engine exhausts may be a source of potential air pollution, all internal combustion equipment will be governed in accordance with applicable State and County regulations.

Potential Impacts and Mitigation Measures

During construction, fugitive dust may be generated which can constitute a nuisance to traffic along the Hawai'i Belt Road. Residences in the area of the project are not anticipated to be affected. To reduce the incidence of fugitive dust the construction contractor will regularly wet disturbed soil areas or areas that are susceptible to the generation of dust.

During construction activities there may be an increased potential for the generation of fugitive dust. Construction activities will employ fugitive dust emission control measures in compliance with provisions of HRS, Chapter 43-10 and HAR, Chapter 11-60.1, "Air Pollution Control," Section 11-60.1-33 on "Fugitive Dust." Dust control measures such as

frequent watering of areas of exposed soil will be employed. Only a sufficient amount of water will be used to ensure the proper suppression of dust.

2.2. Public Facilities

2.2.1. Access

The proposed project will not affect public shoreline access. It is located along the existing Hawai'i Belt Road and will provide for the implementation of rockfall mitigation measures along the Ka'awali'i, Laupāhoehoe and Maulua Gulches.

During construction there may be periods when it is necessary to temporarily close one or both directions of travel along the Hawai'i Belt Road. This would be during installation of the rockfall preventative hardware when there may be a risk of construction material falling onto the roadway. However, this is expected to be a temporary precaution lasting not more than a few hours, at most, in order to maintain public safety. As required, traffic controls such as safety cones, signage, and/or flag personnel will also be implemented to alert motorists and the public to the presence of construction workers and personnel, and to exercise caution. Once construction is complete all personnel and equipment necessary to the project, including the traffic controls, will be removed.

2.2.2. Traffic and Roadways

2.2.2.1. Description

The existing roadway within the three gulches was constructed in three separate projects between 1951 and 1953, as shown in **Table 8.**

Table 8
Project Listing - Existing Roadway

Gulch	Project No.	Begin Mile Post	End Mile Post	Year
Maulua	SDR 3 (16)	20.7	22.9	1951
Laupāhoehoe	SDR 3 (17)	25.4	27.6	1953
Ka'awali'i	SDR 3 (18)	27.6	29.4	1953

Hawai'i Belt Road is a two-way rural arterial. The roadway through Maulua Gulch consists of two lanes, one lane in each direction. The roadway through Laupāhoehoe and Ka'awali'i Gulches consist of two lanes, one lane in each direction, with a passing lane on each inclined departure leg from the stream crossing. The existing travelway surface is asphalt concrete. The graded shoulder width varies between five and seven feet. Portions of the shoulder area have been paved during previous resurfacing projects. The roadway within the project limits has no traffic signals, sidewalks, curbs, highway lighting or planted landscaping.

Warning signs, posted within Ka'awali'i Gulch, indicate a reduced speed for the approaching curves of 25 miles per hour (MPH). Warning signs are also posted within Laupāhoehoe Gulch and a portion of Maulua Gulch which indicate a reduced speed for the approaching curves of 40 MPH.

Portions of the roadway have retaining walls or guardrails. Roadway drainage and drainage coming from the cut slopes are conveyed across Hawai'i Belt Road through culverts. The drainage eventually discharges into the streams. Existing 69 kilovolt (kV) overhead lines cross the gulches above the cut slopes of Hawai'i Belt Road.

2.2.2.2. Right-of-Way

HDOT has jurisdiction of the Hawai'i Belt Road right-of-way. The right-of-way width within most of Maulua Gulch is 100 feet, with the width extending to almost 310 feet near the stream crossing. Within Laupāhoehoe Gulch, the right-of-way width is variable, ranging from 100 feet on the Honoka'a side of the gulch to approximately 670 feet near the stream crossing. The right-of-way width within Ka'awali'i Gulch varies from 120 feet on the Hilo side of the gulch to 670 feet near the stream crossing.

2.2.2.3. Assessment

An assessment of the existing roadway design was conducted to determine if the roadway design within the three gulches meets current design standards. The Roadway Assessment Report is provided in **Appendix D** of this report and includes a supplemental analysis of vehicular queuing. Existing highway geometric and cross section elements and roadside hazards were compared with AASHTO standards. The geometric analysis focused on horizontal curves and superelevation rates. The cross section analysis focused on the travel lane and shoulder widths.

The findings of this report show that each gulch contains horizontal curves which have inadequate sight distance where the cut slope obstructs the driver's line of sight, because the design speed of the gulch requires a sight distance that cannot be provided within the gulches. The assessment shows that many aspects of the roadway do not meet current design standards and a major construction effort would be required to bring the roadway into conformance. Since improvements of this scale are beyond the scope of the proposed project no improvements to roadway conditions are planned.

2.2.2.4. Traffic Conditions

A Traffic Study Report was prepared to evaluate existing traffic volumes and to determine the number of lanes needed to accommodate the projected traffic volume along the Hawai'i Belt Road. Existing traffic volumes on the highway were based on information reported in the Traffic Summary - Island of Hawai'i 2000. Peak hourly volumes were computed using factors from the Traffic Summary. Historic data from the annual Traffic Summary reports from HDOT were also reviewed. The Traffic Study Report is provided in **Appendix E**.

2.2.2.5. Existing Traffic Volumes

The data provided in the Traffic Summary report shows that the average daily traffic (ADT) for the segment of the Hawai'i Belt Road where the gulches are located (between Akaka Falls Road and Mamane Street) is 6,397 vehicles per day (vpd). Over a typical day, trucks and other heavy vehicles comprise 8.5% of the traffic.

Traffic volume during the AM peak hour is 7.0% of the daily volume, with 55% traveling in the peak direction. Trucks and other heavy vehicles comprise 9.0% of the traffic volume in the AM peak hour. In the PM peak hour, traffic volume is 8.5% of the daily volume with 55% traveling in the peak direction and trucks comprising 4.0% of the traffic.

2.2.2.6. Existing Levels of Service

The roadway was evaluated to determine the "Level of Service" (LOS) according to concepts described in the Highway Capacity Manual. Traffic conditions can be described as LOS A (good conditions) to LOS E (poor conditions). Over-capacity conditions or very long delays are described as LOS F. In rural areas, LOS C or better is considered to be acceptable.

A two-lane highway analysis was used to evaluate the level of service. For two-lane highways, the ability to pass a slow-moving vehicle determines the highway level of service. The portion of heavy vehicles in the traffic stream, the directional split, and other factors is used to determine the average travel speed and the percent time-spent-following; from these results the level of service is determined and a volume-to-capacity ratio is computed. Highway density is another measure of traffic congestion. Large vehicles are converted to equivalent passenger cars.

The existing peak hour levels of service were computed for an average speed of 35 miles per hour. The results of the two-lane highway and the highway density analyses show that the existing peak hour levels of service are "C" or better.

2.2.2.7. Queue Estimate During Construction

A supplemental analysis of vehicular queuing along the Hawai'i Belt Road during construction was performed by Julian Ng, Inc., April 23, 2009, and is included in **Appendix E**. For purposes of the analysis the following were used as assumed conditions:

- The complete closure of the highway was assumed for a period of 5 minutes during the weekday peak hours in the year 2010.
- An approach speed of 45 miles per hour with 23 feet of roadway allowed for each car and 45 feet for each truck.
- The queue would dissipate at a rate of 1,200 vehicles per hour once the roadway is reopened.

The analysis was performed for traffic volumes for the northbound traffic and for the AM Peak Hour as follows:

	AM Peak Hour		PM Peak Hour	
Condition	southbound	northbound	southbound	northbound
2038 volumes (from traffic report)	516	422	590	482
2010 volumes	292	239	334	273
Maximum queue (vehicles)	40	30	48	36
Maximum queue (miles)	0.19	0.14	0.22	0.16
Time required to dissipate queue (minutes)	2.0	1.5	2.4	1.8

A sensitivity analysis was performed to determine the effects of different assumptions on the resulting queue lengths. Changing the approach speed had only a minor effect on the queue; a higher speed resulted in slightly lower queue length (e.g., for 60 miles per hour, the southbound queue in the PM Peak Hour is reduced from 48 vehicles to 47 vehicles.

The length of lane taken up by each queued vehicle had only a minor effect on the number of vehicles queued and a proportionate effect on the queue length. Use of 25 feet for each car and 50 feet for each truck did not affect the number of queued vehicles, but resulted in a proportionate increase in the distances.

A higher rate of queue dissipation would reduce the number of vehicles in the queue and the maximum length of queue. A rate of 1,440 vehicles per hour (2.5-second headway) would result in a decrease of about 10% in the number of vehicles and in the queue distances.

Potential Impacts and Mitigation Measures

The roadway and traffic analysis indicates that future improvements are required to address safety and future traffic flow along the Hawai'i Belt Road. However, while this is beyond the scope and purpose of the proposed project involving the construction of rockfall preventative measures, the existing traffic volumes and roadway limitations will require that traffic control measures be implemented. The project roadway, a two-lane roadway carrying traffic in both the eastbound and westbound directions, will be limited to a single lane during construction and controlled by safety cones, signage and traffic control personnel.

Vehicular queuing is expected to result from the proposed project during temporary periods when complete closure of the Hawai'i Belt Road may be required. This could occur, for example, during the installation of rockfall preventative hardware on cliff faces, or during earthwork when there is the potential for falling debris. These temporary periods are anticipated to be limited and would only be required in order to maintain protection of vehicles and occupants traversing the highway in the immediate area of active construction.

The modeling of a 5 minute period of closure during the PM Peak Hour Period would result in the queuing of from 36 to 48 vehicles, and for the AM Peak Hour Period from 30 to 40 vehicles. The length of the queue would range from approximately 0.14 miles (750 feet) to

0.22 miles (1,150 feet) in length. Should the length of closure be longer than 5 minutes, the increase in queue would be proportionately longer, e.g., a 10 minute closure would produce a queue length of approximately 1,500 feet to 2,300 feet.

While the need for closure of limited sections along the Hawai'i Belt Road may be required during construction, the potential for adverse impacts resulting from vehicular queuing is expected to be of relatively short duration, but necessary in order to maintain the protection of the travelling public. Upon project completion, the proposed improvements will have no negative or cumulative effect on traffic conditions. One positive effect will be improved public safety conditions and a reduction in the frequency of County rockfall cleanup in the area.

Construction activities will comprise approximately 6.2 linear miles of the mauka portion of the Hawai'i Belt Highway around the entrances and exits of the three gulches. Existing turns are abrupt and turning radiuses are below recommended levels. Reduced speeds and signage around construction areas in addition to traffic control measures are anticipated to reduce and minimize potential hazards. During peak hours delayed driving conditions are likely, but impacts to driving conditions are not expected to be significant during other times of the day.

2.2.3. Utility Infrastructure

Drain inlets are located on the mauka side of the roadway to capture stormwater runoff from the slopes and roadway surface. The drain inlets are connected to culverts under the highway, which outlet into the gulches. Approximate locations of the drain inlets and culverts are provided in **Table 9,** below:

Table 9
Drainage Structure Locations

Maulua Gulch	Laupāhoehoe Gulch	Ka'awali'i Gulch
36+00 (24" RCP)	41+00 (24" RCP)	99+00 (24" RCP)
41+20 (Box culvert) *	46+00 (24" RCP)	107+50 (24" RCP)

46+00 (24" RCP)	51+00 (24" RCP)	112+30 (24" RCP)
50+30 (5.2'x5.2' Box culvert) *	71+00 (24" RCP)	115+00 (24" RCP)
66+00 (24" RCP)		125+50 (24" RCP)
72+50 (24" RCP)		134+00 (24" RCP)
76+00 (24" RCP)		
83+70 (4' Box Culvert)		

* Flowing stream

Potential Impacts and Mitigation Measures

Although water lines, sewer lines or street lighting are not present within the right-of-way of the project limits there may be potential for discharges of stormwater associated with construction activity resulting in the potential for release of silt and sediments. Potential for water quality impacts will be minimized by the use of Best Management Practices (BMPs) during construction activities. The construction BMPs will be implemented by the construction contractor and will include management, structural and/or vegetative practices:

Management practices include, but are not limited to:

- Ensuring that all construction machinery is in proper working order. Any machinery found to be leaking shall be removed from the project site and be repaired or replaced. No maintenance of construction machinery with the potential for leakage shall be permitted at the job site.
- All receptacles containing construction materials shall be closed or sealed against the entry of rainwater as much as practicable during working hours and at the end of the work day.
- Stockpile sites used for the storage of excavated or construction materials shall be covered at the end of the work day.

Structural practices include, but are not limited to:

- Silt fencing or the installation of berms around active work areas to prevent commingling with stormwater.

Vegetative practices include, but are not limited to:

- The application of hydromulch or other appropriate vegetation.

2.2.4. Police, Fire and Ambulance Service

The project sites are readily accessible for police, fire and emergency medical service based on its location along the Hawai'i Belt Road. Police services are provided for the area from the Laupāhoehoe Police Station. Fire protection and ambulance services are provided by the Laupāhoehoe Fire Station No. 17, located in Laupāhoehoe. Additional fire fighting service is provided by the Laupāhoehoe Volunteer Fire Department Station No. 17A.

Potential Impacts and Mitigation Measures

The proposed project in itself is not expected to generate any new demand for police, fire or ambulance service. During construction, however, these services may be required as a result of an injury or construction accident. This potential use for such services is not expected to result in the requirement for new personnel or for construction of new police, fire or ambulance facilities. No impacts and no mitigation measures are proposed.

2.3. Additional Information Concerning the Potential for Secondary Impacts Associated with the Hawai'i Belt Road Rockfall Protection Improvements

2.3.1. Socio-Economic Characteristics

Background

Population increase in the Hāmākua district, in contrast to County increases, has been low. From 1980 to 2000 the County of Hawai'i experienced a 61.5% population increase, while statewide population increased by only 25%. The population in the Hāmākua district in this same timeframe rose by approximately 19%, while North Hilo saw very little increase at approximately 2.4%. Resident population in Hāmākua district is projected to be approximately 7,328 by 2020.[6] Future traffic volumes projections show that anticipated ridership on the Hawai'i Belt Road in 2020 will be accommodated by existing roadways.

Economic opportunity in East Hawai'i is limited and employment suffered a loss in 1994, with the closing of the Hāmākua Sugar Company and 700 accompanying jobs. This closure also took approximately 20,000 acres of agricultural land out of production. Job inventory has yet to be

[6] http://www.Hawai'i-county.com/databook_current/Table%201/1.5.pdf; http://www.Hawai'i-county.com/databook_current/Table%201/1.1.pdf

restored, but other agricultural activities continue in the area including ranching and macadamia and diversified agricultural crop production.

Potential Impacts and Mitigation Measures

The proposed project in itself is not expected to adversely affect the socio-economic conditions in the region. The proposed rockfall mitigation improvements, however, are anticipated to improve traffic flow on the Hawai'i Belt Road by reducing the need for periodic rockfall cleanup performed by the County. No adverse impacts to the socio-economic resources of the area or region are expected and no further mitigation is proposed.

2.3.2. On Site Water Requirements

Existing Conditions

There are no existing water lines in the project vicinity and all water required for dust control and construction activity will be delivered to the project site by the contractor.

Potential Impacts and Mitigation Measures

In as much as there are is no on-site water supply available at the project sites, the proposed project will have no effect on water supply. The contractor will be responsible for providing sufficient water for work crews and related personnel, and for work related purposes including dust control.

2.3.3. Wastewater Systems

Existing Conditions

The proposed project will not require the provision of services from a wastewater treatment facility and wastewater mains are not located in the proposed project vicinity.

Potential Impacts and Mitigation Measures

Portable toilets will be provided for use by construction workers and project related personnel. The portable toilets will be maintained by the contractor in accordance with State DOH and County of Hawai'i health regulations. No significant adverse impact to wastewater facilities are anticipated and no mitigation measures are recommended.

2.3.4. Solid Waste

Existing Conditions

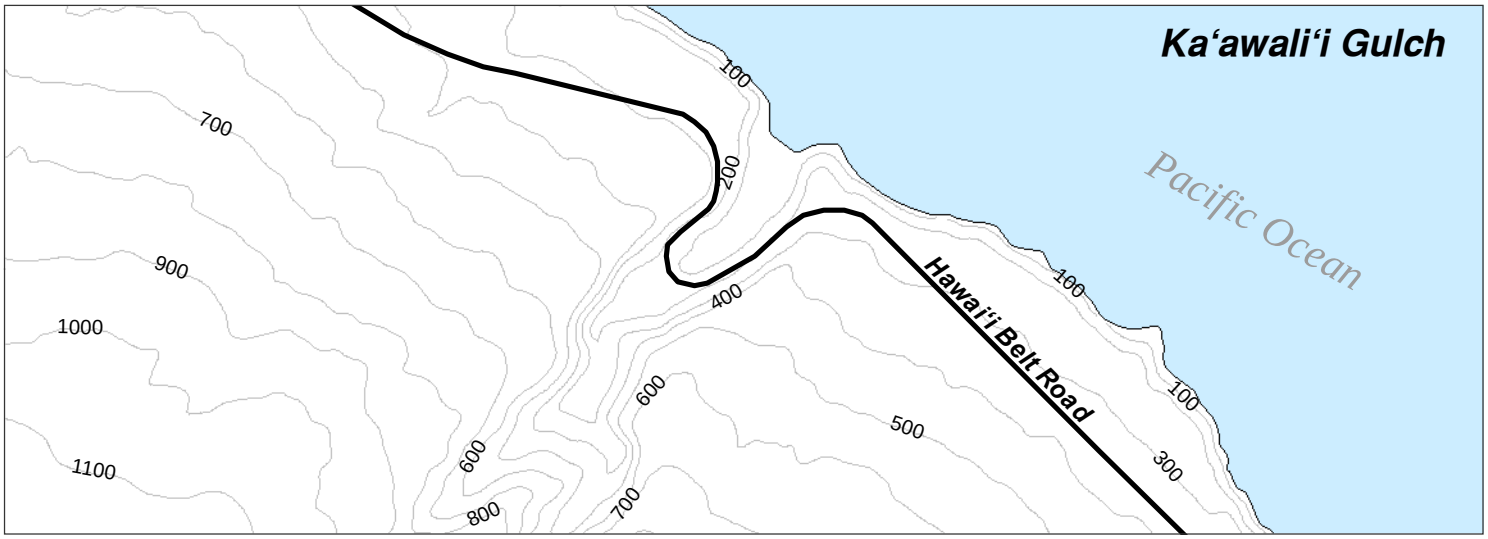
The East Hawai'i landfill is located in South Hilo approximately 23.5 to 18 miles away from the subject gulches. Three solid waste transfer stations operate in the Hāmākua District and are located in the villages of Laupāhoehoe, Paauilo, and Honomu.

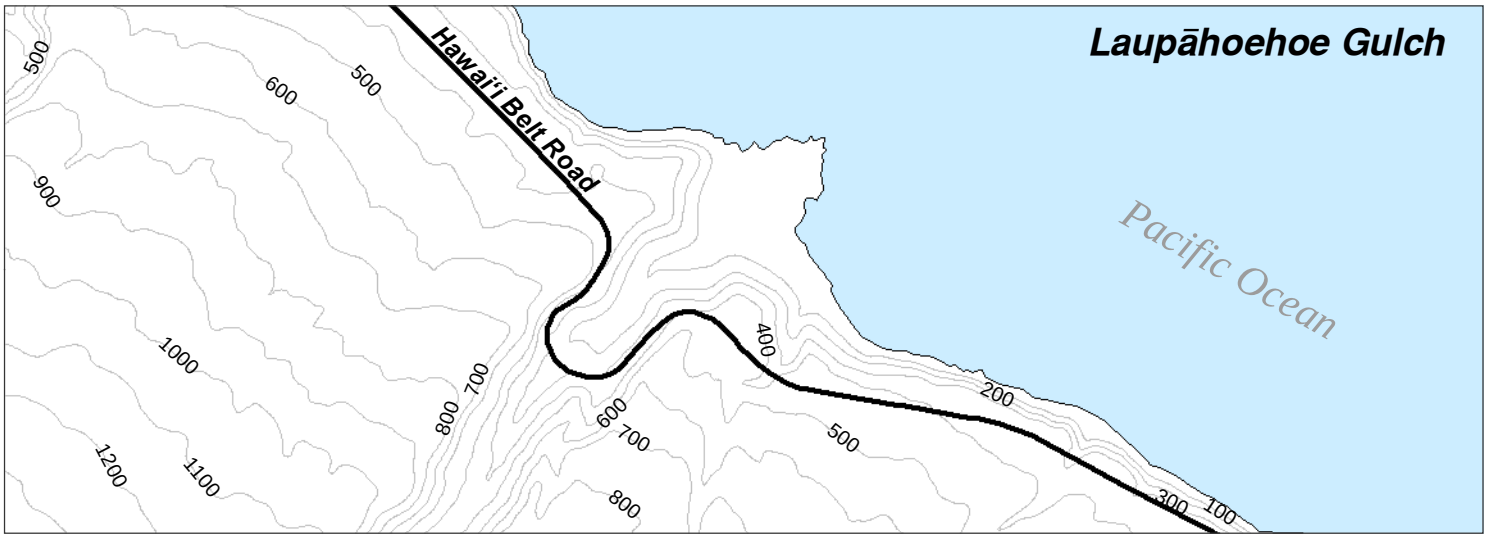
Potential for Secondary Impacts

Because the solid waste transfer stations in the area are not equipped to handle large deliveries of construction related debris all excavated material will be carried off site by truck to the South Hilo landfill. All construction related debris carried off site will be properly secured and/or covered to prevent the inadvertent loss of load or the commingling of rainfall with the construction debris while it is in transit. No adverse impacts are anticipated.

Section 2 – Figures

Environmental Assessment for Hawai‘i Belt Road
Rockfall Protection at Maulua, Laupāhoehoe and Ka‘awali‘i Gulches
North Hilo and Hāmākua, Island of Hawai‘i, Hawai‘i





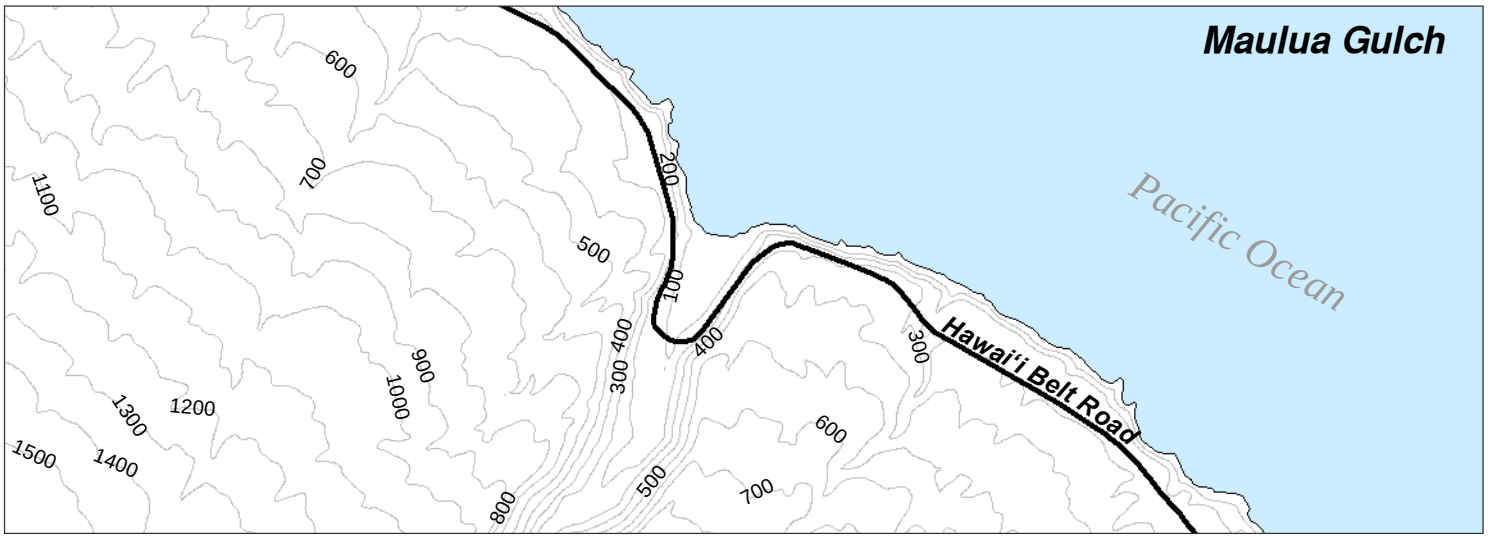
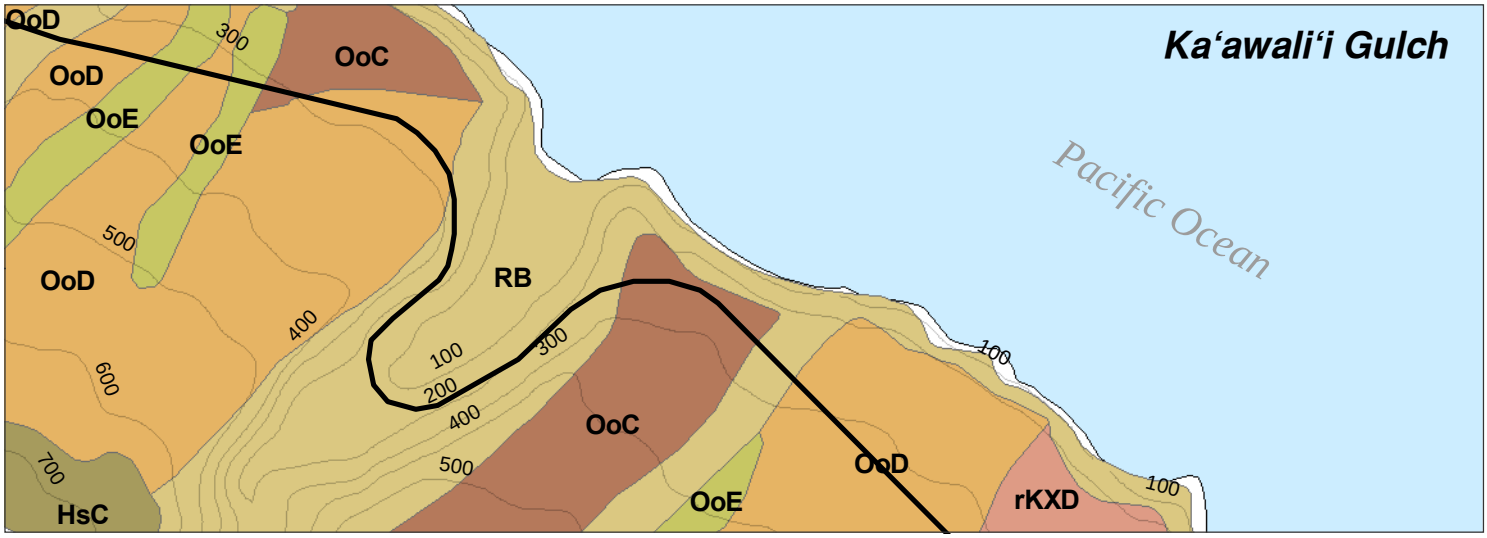


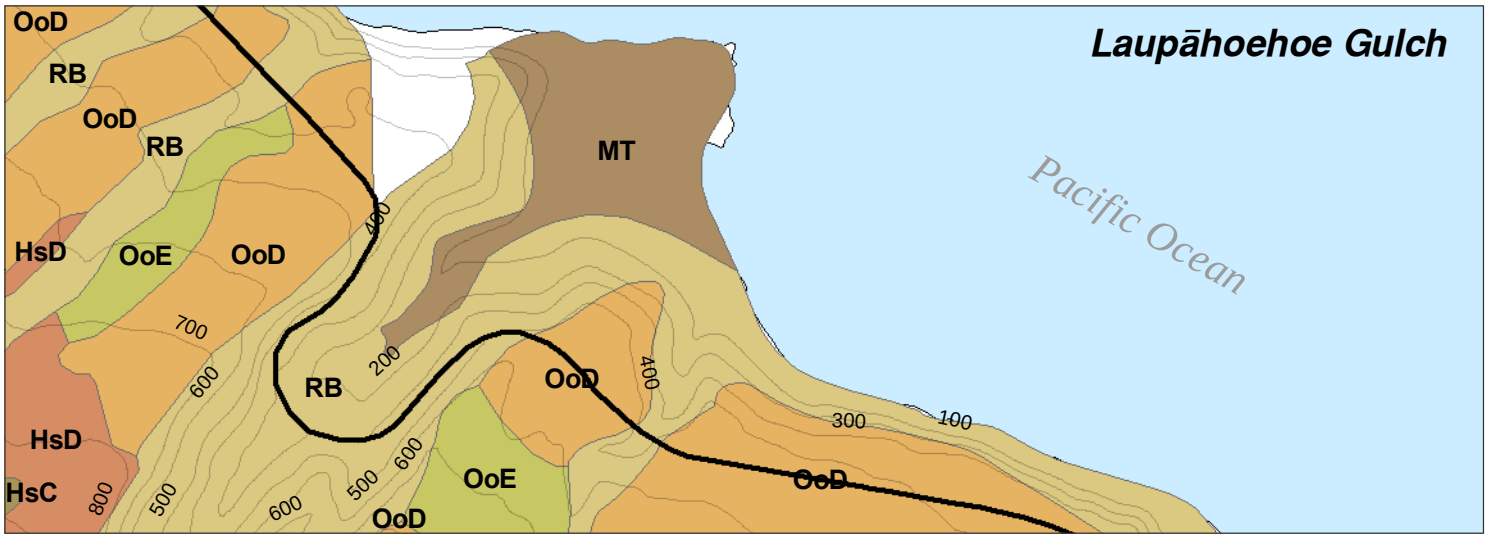
FIGURE 4
REGIONAL TOPOGRAPHY
Hawai‘i Belt Road Rockfall Protection
Hamakua and North Hilo, Hawai‘i

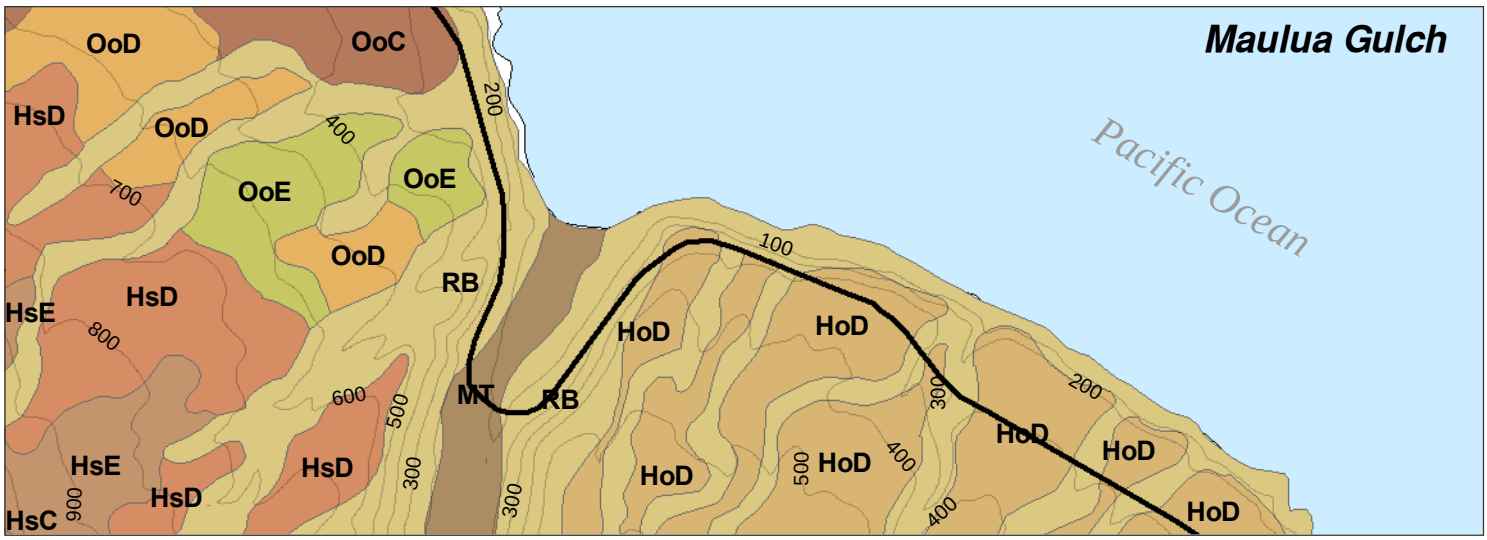
0 1,000 2,000 3,000 4,000 Feet

R.M. Towill Corporation February 2009

GIS Layer Source: State of Hawai‘i







Legend

HoD	OoD
HsC	OoE
MT	RB
OoC	rKXD

FIGURE 5
SOIL CLASSIFICATIONS
Hawai'i Belt Road Rockfall Protection
Hamakua and North Hilo, Hawai'i

0 500 1,000 1,500 2,000 Feet

R.M. Towill Corporation February 2009

GIS Layer Source: State of Hawai'i & USGS

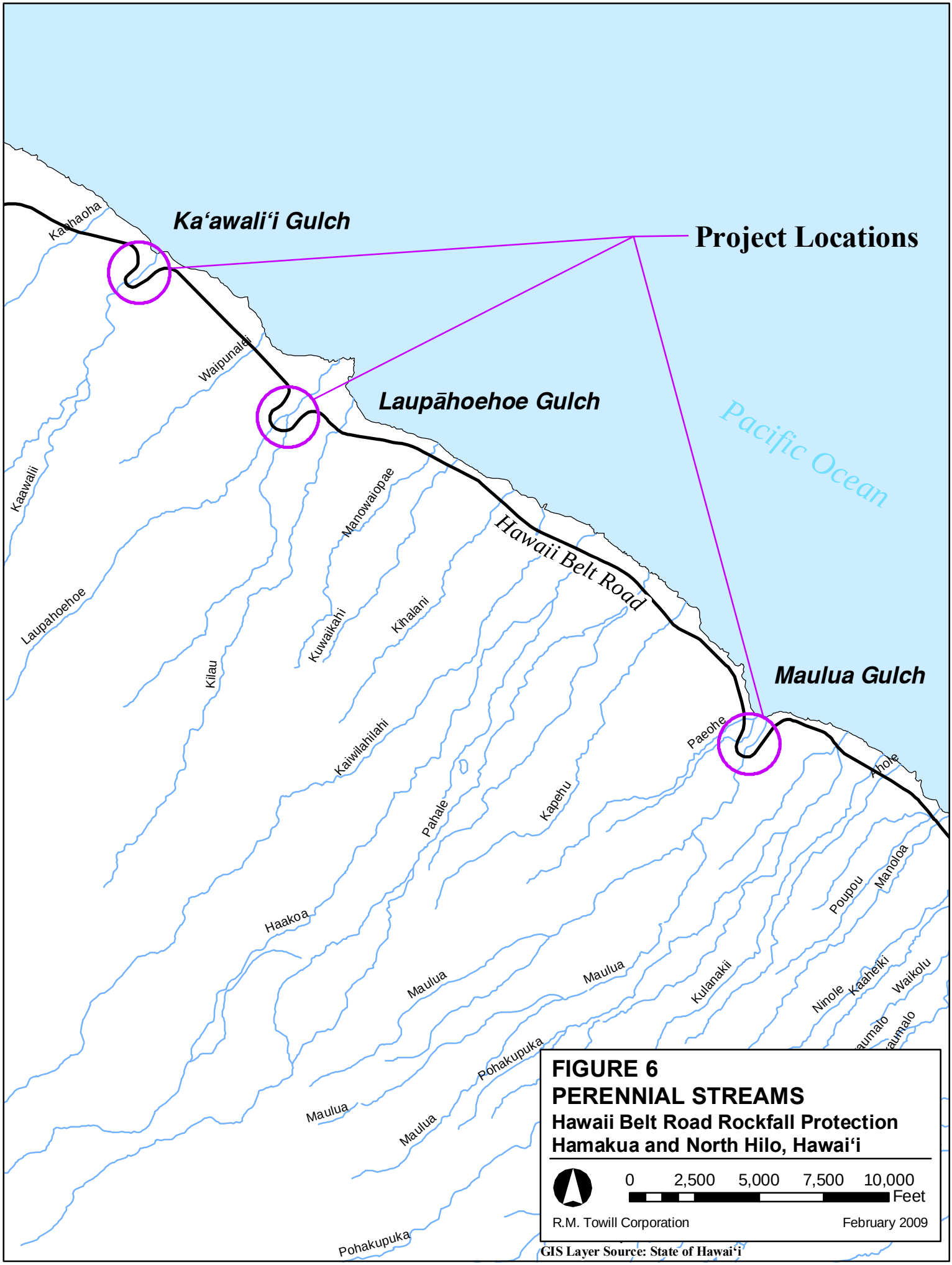


FIGURE 6
PERENNIAL STREAMS
Hawaii Belt Road Rockfall Protection
Hamakua and North Hilo, Hawai'i

0 2,500 5,000 7,500 10,000 Feet

R.M. Towill Corporation February 2009

GIS Layer Source: State of Hawai'i

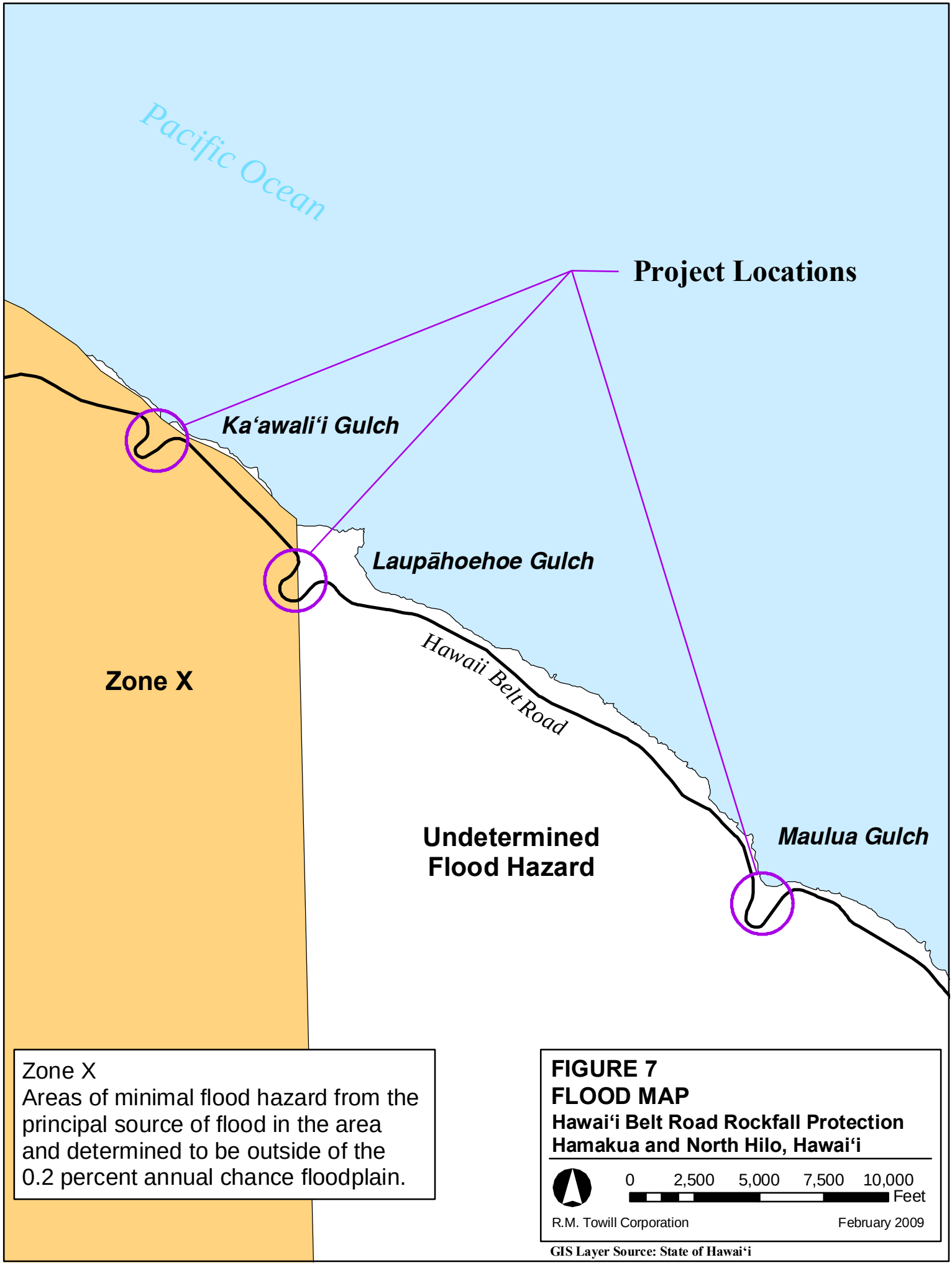


FIGURE 7
FLOOD MAP
Hawai'i Belt Road Rockfall Protection
Hamakua and North Hilo, Hawai'i

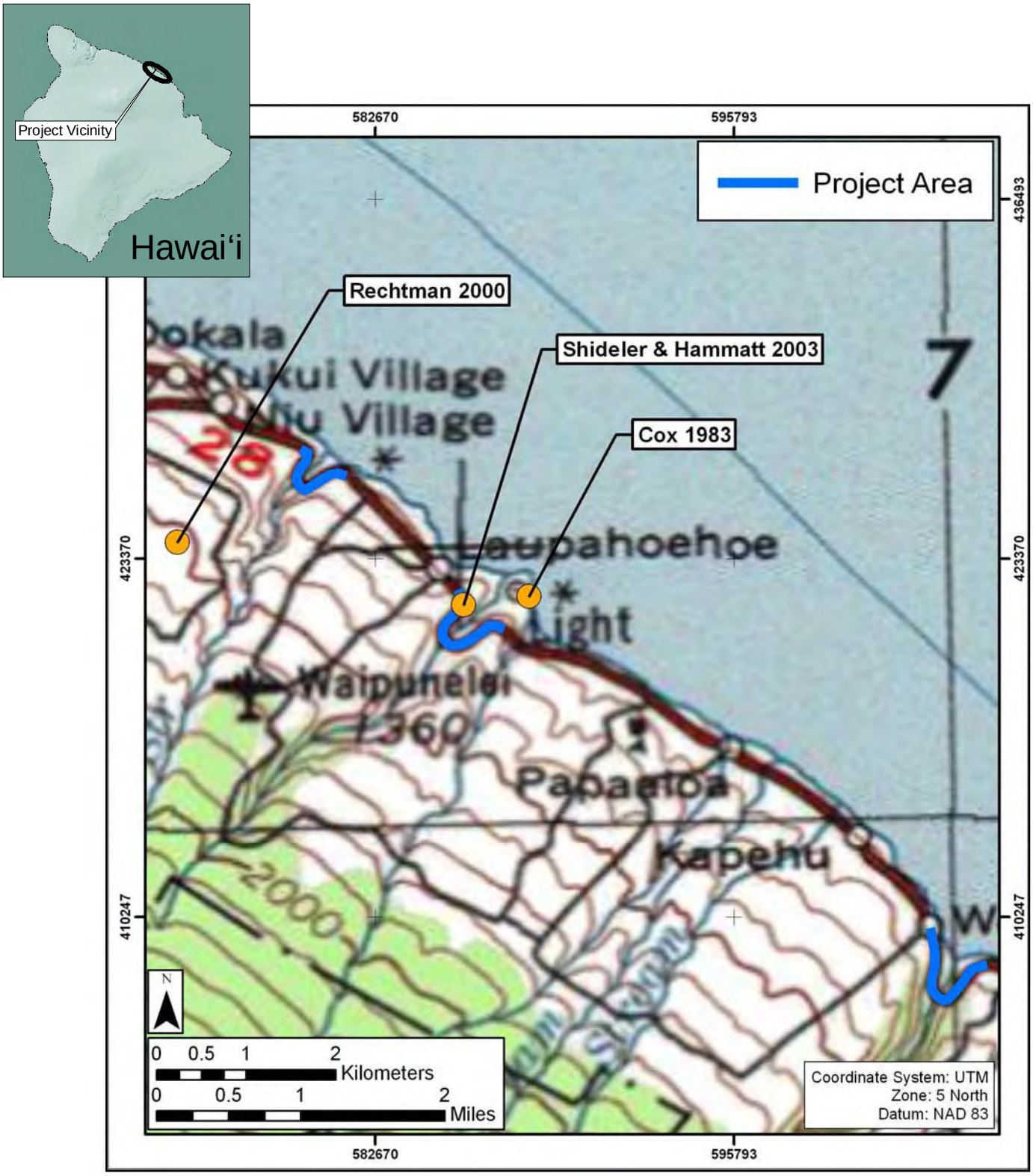


FIGURE 8
Previous Archaological Studies in Project Area
Hawai'i Belt Road Rockfall Protection
Hamakua and North Hilo, Hawai'i

R. M. Towill Corporation February 2009

Source: Cultural Surveys Hawaii, Inc., 2009

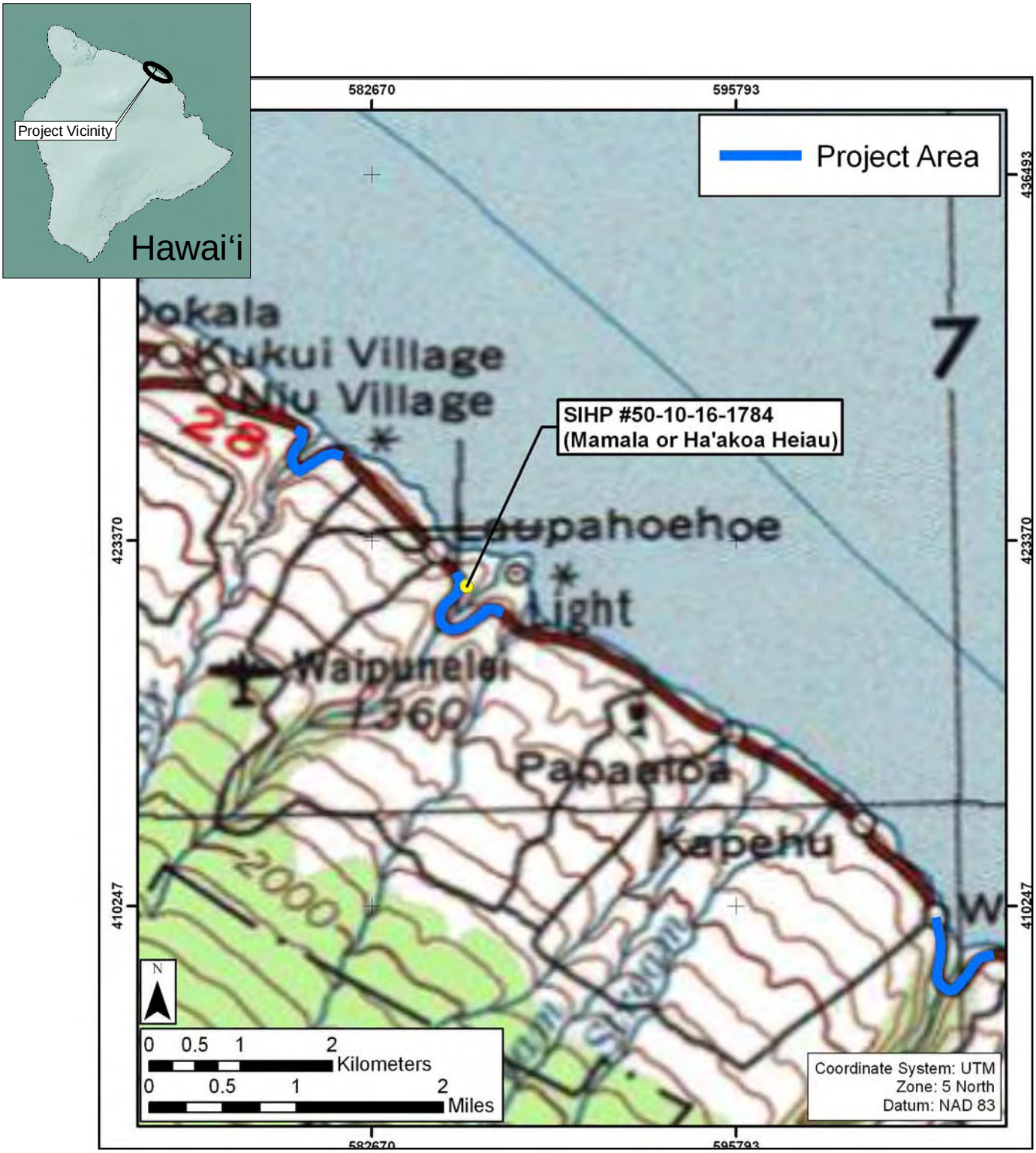


FIGURE 9
Location of Historic Properties in Vicinity of Project Area
Hawai'i Belt Road Rockfall Protection
Hamakua and North Hilo, Hawai'i

R. M. Towill Corporation February 2009

Source: Cultural Surveys Hawaii, Inc., 2009

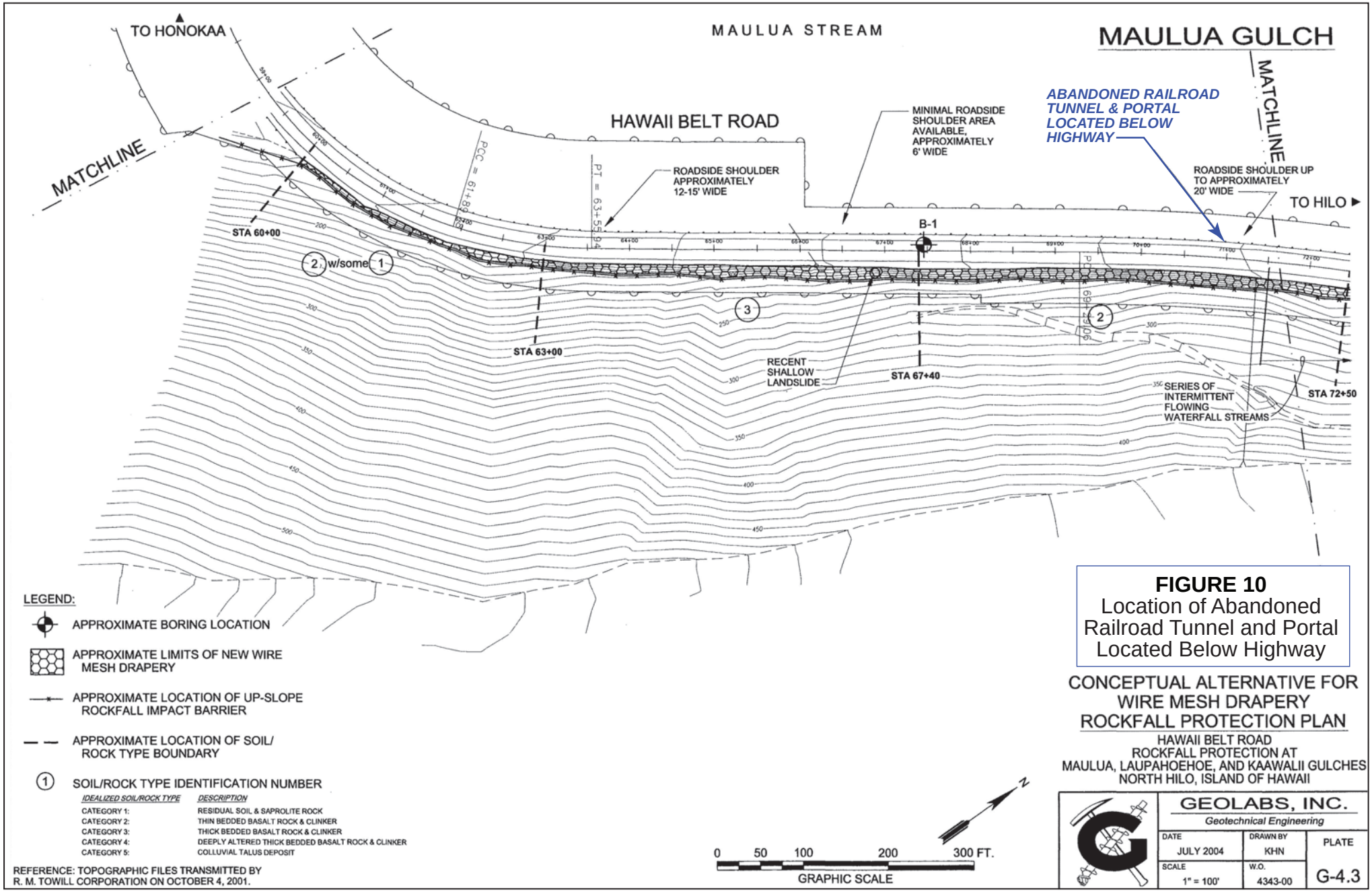


FIGURE 10
Location of Abandoned Railroad Tunnel and Portal Located Below Highway

Note: Reduced size drawing

Section 3
Project Alternatives

3.1. No Action and Delayed Action

The No Action Alternative would involve no further action to develop the project. Inasmuch as the rockfall mitigation improvements would support roadway access and reduce the time and cost to constantly clear the roadway, the proposed project is considered necessary by the County of Hawai'i and the State DOT to maintain safe travel conditions along the Hawai'i Belt Road.

While the No Action Alternative would avoid the expenditure of resources for design and construction it would fail to provide for the required improvements. For this reason, it is not considered a viable option.

The Delayed Action Alternative differs from taking no action in that the proposed project would be undertaken, but at a later point in time. Delayed action to construct the proposed rockfall protection measures would leave motorists and the public susceptible to potential vehicular accidents and injury along the Hawai'i Belt Road. Costs associated with road clearing following rockfall events would also continue to be incurred.

Because the project is intended to protect the Hawai'i Belt Road and its travelers, the delayed action alternative would similarly fail to accomplish the purpose of the project. For this reason, it is also not considered a viable option.

3.2. Rockfall Mitigation Alternatives

A number of rockfall mitigation alternatives were assessed to address the requirements of this project. This section identifies the criteria, the resulting analysis of the criteria, and the recommended preferred alternative (Final Feasibility Report, Hawai'i Belt Road Rockfall Protection at Maulua, Laupāhoehoe and Ka'awali'i Gulches, North Hilo, Island of Hawai'i (R. M. Towill Corporation, 2005).

3.2.1. Formulation of Alternatives

Approach to Problem

The goal of the project is to reduce or otherwise eliminate the potential risk of future soil failure and rockfall incidents along the three identified gulches in the North Hilo region. The objectives toward meeting this goal consist of the following:

- Mitigate the rockfall and landslide hazard within the gulches
- Incorporate corrections to the roadway deficiencies, if practical
- Avoid or minimize road closures during construction, if possible
- Minimize future maintenance requirements of the highway through the gulches

In order to achieve these goals the following preliminary criteria were identified to serve as the basis for selection of appropriate alternatives:

Highway – The design criteria of the Hawai'i Belt Road (highway) include:

- Classification: Rural Arterial
- Posted Speed Limit: 45 – 55 mph
- Design Speed: 50 – 65 mph
- Terrain: Mountainous

The design speed is based on American Association of State Highway Transportation Officials (AASHTO) standards and guidelines where the posted speed is 85% of the design speed.

Traffic – The traffic design criteria are as follows:

- Average Daily Traffic (ADT) (2008) = 7,280 vehicles per day
  ADT (2028) = 13,400 vehicles per day
- Design Hour Volume (DHV) (2028) = 1,070 vehicles per hour
- Directional Distribution (D) = 55/45
- Peak Hour Traffic Volume (T_{24}) = 8.5%
- Level of Service (LOS) = C or better

Right-of-Way Acquisition – The acquisition of additional right-of-way may be required. Compensation and/or relocation cost will vary with each parcel depending on its use and size. The potential impact on existing land uses should also be considered.

Infrastructure – The existing infrastructure consists of electrical (utility poles and overhead power lines) and drainage (inlets and culverts crossing the roadway) infrastructure. Implementation of the rockfall and landslide mitigation method may require modification or relocation of some or all of the existing infrastructure. The utilities should be relocated prior to construction activities such as slope excavation, slope scaling, and other slope stabilization treatments in the vicinity of the power transmission lines to maintain construction safety and protect the existing electrical utility infrastructure.

3.2.2. Development of Rockfall and Landslide Alternatives

The methods identified in the Final Feasibility Report to mitigate rockfall and landslide hazards are summarized in **Table 10** Slope Stability and Rockfall Control Systems. The various mitigation methods were divided into three general groups based on the expected performance and maintenance requirements of the mitigation method.

The alternatives in Group 1 are considered to be permanent, low maintenance systems for complete protection from potential rockfall and landslide hazards.

The alternatives in Group 2 are considered to be long-term performance systems that require periodic inspection and maintenance to retain the desired performance. Future repair and replacement of the system components may be required. The alternatives in Group 2 may be constructed as stand-alone improvements.

The alternatives in Group 3 are considered long-term remedial alternatives that should be constructed in conjunction with other alternatives in Group 2 protection. The alternatives in Group 3 are not considered stand-alone measures because the alternatives offer only complimentary benefits or may not be appropriate for extensive slope coverage settings.

The removal of vegetation and the prevention of tree growth on the cut slopes should be a basic contractual requirement to facilitate the construction of any rockfall protection system at the site. It is recommended that the vegetation and tree clearing effort be performed under a separate contract prior to the construction of the slope improvements. This would permit the construction contractor to visually examine the exposed cut slope conditions to facilitate the planning and construction of the slope improvements.

Table 10
Slope Stability and Rockfall Control Systems

System	Description	Advantages	Disadvantages	Relative Cost	Notes
Group 1 *– Permanent and comprehensive solutions; low maintenance requirements*					
Bridge By-Pass	Construction of a new bridge across the gulch	• Most effective and complete solution • Existing gulch slopes and vegetation would not require modification except at the bridge abutments • Eliminates highway curves & areas with limited sight distances • Bike lanes and wider shoulders can be provided • Disruption to traffic during construction is minimized	• Cost • Aesthetics may be a concern • Significant acquisition of additional right-of-way required • Permitting process will be difficult	**Very High**	Bridge lengths will range from approx. 1100 feet to 1800 feet; the largest existing bridge span along the Hamakua Coast is approx. 800 feet.
Rockfall Shed	Construction of a new structural canopy over the existing highway	• Highly effective solution	• Cost • Long construction time • Significant road closures required during construction • Aesthetics may be a concern	**Very High**	The canopy would divert earth slides over the roadway. The canopy would need to span the entire length of highway adjacent to slopes.
Group 2 *– Long term solutions; periodic inspection and maintenance required*					
Rockfall Impact Barrier	Construction of heavy-duty containment fence to intercept and retain large boulder impacts	• Limited road closures required • Relatively low cost	• Does not provide slope stabilization • Does not capture slide materials	**High**	Life expectancy of 15 to 25 years. Catchment ditch required when installed adjacent to roadway.
Draped Wire Mesh	Installation of wire mesh panels & supporting cables on the slope face	• Controls rockfall & directs towards the base of the slope • Various types of mesh are available based on required strength, corrosion resistance and color	• Short-duration road closures required while mesh is draped by helicopter • Life expectancy may be shortened by coastal corrosion or large vegetation growth on the slope	**High**	Life expectancy of 15 to 20 years. If less than a full-width catchment ditch is provided, draped mesh is recommended for the slope. Intensive scaling required prior to installation.
Anchored Wire Mesh Drapery	Wire mesh fastened to slope with rock nails	• Catchment ditch may not be necessary because anchored mesh system is designed to resist breakout of rock and shallow depth materials • Can provide slope stabilization	• Short-duration road closures required while mesh is lifted into place by helicopter • Life expectancy may be shortened by coastal corrosion or large vegetation growth on the slope • Installation is more labor-intensive than draped mesh	**High**	Life expectancy of 15 to 20 yrs. Erosion control mats may be installed to facilitate greening of the slope and help prevent surface erosion until permanent ground cover is established.
Cable/Ring Net Drapery	Cable or ring net is pinned onto the slope face	• Large blocks of loose rock, rock outcroppings or boulders can be retained against the slope • Less frequent ditch cleaning is required than with draped mesh	• Short-duration road closures required while mesh is lifted into place by helicopter • Installation is more labor-intensive than draped mesh • Periodic road closures likely to be required throughout the day	**High**	Can be used for localized regions or for entire slope face; life expectancy is 15 to 20 years

Table 10
Slope Stability and Rockfall Control Systems, Continued

System	Description	Advantages	Disadvantages	Relative Cost	Notes
Group 2 *– Long term solutions; periodic inspection and maintenance required, Continued*					
Cut Slope Setback for Full-Size Catchment Ditch	Excavate new cut slopes to create space for catchment ditch; some highway realignment req'd	• Potential to improve sight distance • Newly exposed rock face should have fewer sources for rockfall	• Long construction time • Significant road closures required during construction	**High**	The slope of the new cut slope varies (vertical to 1:1) according to the type of exposed rock face
Group 3 *– Local application in conjunction with Group 2 alternatives*					
Cantilevered Highway Widening	Construct new cantilevered highway & realign the highway to create space for catchment ditch	• Long term solution • The inner portion of the roadway could be converted into a catchment area to control fallen debris	• Cost • Partial road closures likely to be required	**High**	The additional highway lanes would be supported by cantilever beams or structural piers.
Limited Widening on Makai Shoulder	Realign the highway onto existing outer shoulder to create space for catchment ditch	• Moderate cost • Disruption to traffic during construction is minimized	• Makai shoulder is not available at all portions of the gulches • Shoulder widening is also recommended, which limits the distance the roadway can be shifted	**Moderate**	The makai shoulder is 3 to 12 feet wide at some locations; 8-foot high retaining wall is also required
Elimination of Existing Passing Lane	Eliminate passing lane and shift roadway makai	• Moderate cost • Disruption to traffic during construction is minimized	• No passing lanes in Maulua Gulch • Traffic will be backed up behind slow-moving vehicles • Passing lane width alone is insufficient to provide a full-width catchment ditch	**Moderate**	Passing lanes could be relocated outside the gulch; a limited-width catchment ditch with 5-foot high jersey barrier could be incorporated within the passing lane width
Soil Nail With Shotcrete Facing	Installation of soil nails and shotcrete facing to stabilize the slope	• Life expectancy is longer than mesh alternatives	• Can only be used where clinker seams and water seepage are limited • High precipitation, porous volcanic materials and deterioration of weep drains could lead to failure of shotcrete • Shotcrete slope may result in significant sheet flow of surface runoff from the slopes onto the highway	**High**	Should be used only where other alternatives are impractical
Rock Slope Scaling	Removal of loose rock material from the slope face - required for any catchment ditch alternative	• Short term reduction of falling rock • Moderate cost	• Periodic road closures likely to be required throughout the day • Potential for rockfall will remain	**Moderate**	Needs to be repeated at 8 to 10 year intervals; vegetation must be removed prior to scaling

Table 10
Slope Stability and Rockfall Control Systems, Continued

System	Description	Advantages	Disadvantages	Relative Cost	Notes
Group 3 *– Local application in conjunction with Group 2 alternatives, Continued*					
Rock Anchor Bolts & Dowels	Tensioned structural anchors	• Secures blocks of potentially unstable rock to the slope	• Not a solution for the entire slope	**Varies**	Used to stabilize localized portions of the slope
Slope Drainage Improvements	Various means to divert runoff from the gulch slopes and minimize groundwater seepage	• Improves slope stability	• Not an independent solution; should be incorporated with the selected mitigation method	**Moderate**	Slope drainage is especially important where there are weak rock masses and ssaprolitic materials.

The rockfall mitigation methods described in **Table 10** were considered separately and in combination to develop nine conceptual alternatives:

Alternative 1 Bridge

Alternative 2 Rockfall shed

Alternative 3 Slope set-back with full size catchment ditch

Alternative 4 Slope set-back with limited size catchment ditch and rockfall impact fence between the roadway and catchment ditch

Alternative 5 Slope set-back with limited size catchment ditch and draped mesh on existing cut slopes

Alternative 6 Extensive cantilevered widening with makai alignment shift, develop limited size catchment ditch, and draped mesh on existing cut slopes

Alternative 7 Makai alignment shift, elimination of passing lanes, develop limited size catchment ditch, and draped mesh on existing cut slopes

Alternative 8 Draped mesh on existing cut slopes, limited makai shift for safety widening only, no catchment ditch

Alternative 9 Anchored wire mesh on existing cut slopes, limited makai shift for safety widening only, no catchment ditch

Alternatives 1 and 2 are considered to be permanent solutions that offer complete protection from rockfall and landslide activity. However, Alternatives 1 and 2 are also anticipated to be the most difficult and costly to construct.

Based on computer rockfall simulation, Alternatives 3 through 9 are considered to be appropriate remedial measures that should protect the highway from most rockfalls (90 to 100 percent) emanating from the cut slope areas. In general, the level of rockfall protection increases with increasing width of the catchment ditch (for unmeshed slopes). Alternatives 3 and 4 offer comparable levels of rockfall protection. Alternatives 5, 6, and 7 offer similar levels of protection as Alternatives 3 and 4; however, the mesh may be subject to damage from rockfall failures involving large intact blocks of rock material.

For Alternatives 3 through 9, removal of woody vegetation and slope scaling are required for the site preparation and reduction of the rockfall hazard potential, as well as to optimize the performance of the slope stabilization treatments, where constructed. Localized slope stabilization treatments may be needed to stabilize portions of the cut slopes that appear to remain in a potentially hazardous condition following examination by experienced slope scalers during the slope scaling effort. The localized slope stabilization treatments may consist of pinned mesh (wire, cable, or ring type), rock bolts and dowels, and shotcrete and soil nail construction.

For Alternatives 3 through 9, a 12-foot high rockfall impact barrier fence along the top of the cut slope is proposed to provide protection from rockfall from the natural slopes above.

3.2.3. Drainage Improvement Considerations

Consideration for proper drainage will require improvements and should be constructed in conjunction with the construction of new cut slopes and other slope stabilization treatments to improve slope stability by diverting surface runoff away from the slope face. Slope drainage is especially important where weak rock masses and saprolitic materials are encountered at the project site.

To reduce the amount of runoff traversing the gulch slopes, three types of drainage improvements were considered in conjunction with the proposed alternatives. These include the use of interceptor ditches, subsurface drains, and vegetative controls.

Interceptor Ditches

Interceptor ditches should be used to reduce the quantity and velocity of runoff flowing down the gulch slopes. Since most of the runoff flowing down the gulch slopes is generated on the slope itself, the interceptor ditches should be located along existing or newly constructed slope benches on the slope face. These interceptor ditches will transport runoff to a nearby stream or gulch for disposal.

Subsurface Drains

Subsurface drains consist of holes drilled into the cut slope. The holes would be lined with perforated pipe and/or sand backfill. The drains can be installed horizontally or vertically and will alleviate some of the groundwater, thereby reducing the potential for springs.

Vegetation

Vegetation can be planted on the slopes used to reduce moisture in the soil. Plants should be selected based on their ability to absorb moisture in the ground without developing an obtrusive root network or large canopy.

The most effective solution should incorporate a combination of all three drainage improvements. Any or all of the improvements should be implemented in conjunction with the proposed slope stability and highway improvements as part of the rockfall project. At a minimum, interceptor ditches should be installed along existing and newly constructed benches on the slopes.

3.2.4. Evaluation of Alternatives

A comparative evaluation of the nine alternatives was performed using the following criteria:

(1) Rockfall and Landslide Hazard Mitigation Effectiveness
(2) Cost Considerations
(3) Traffic and Safety Benefits
(4) Right-of-way Impacts
(5) Construction Requirements and Impacts
(6) Environmental Considerations
(7) Maintenance Requirements
(8) Constructability

(9) Aesthetics and Visual Impact

(1) Rockfall and Landslide Hazard Mitigation Effectiveness

All of the conceptual alternatives will provide some measure of protection from rockfall and landslide activity. The relative effectiveness of each alternative in mitigating the rockfall and landslide hazard is presented in **Table 11**.

Table 11
Relative Effectiveness of Rockfall and Landslide Hazard Mitigation

Complete Protection	High Level of Protection	Medium Level of Protection	Low Level of Protection
Alternative 1 Alternative 2	Alternative 3 Alternative 4 Alternative 9	Alternative 5 Alternative 6 Alternative 7	Alternative 8

Alternatives 1 and 2 are considered to be permanent solutions which offer complete protection from rockfall and landslide activity.

Alternatives 3, 4, 5, 6 and 7 are considered to be appropriate remedial measures that should protect the highway from most rockfall (about 90%) emanating from the cut slope areas. Alternatives 5, 6, and 7 are ranked lower than Alternatives 3 and 4 because the draped mesh may be subject to damage from rockfall failures involving large intact blocks of rock material.

Alternative 8 offers protection to the highway from rockfall by controlling the fall of rock debris. However, because there is no catchment ditch provided in this alternative, the rock debris may roll away from the bottom of the mesh system and encroach upon the paved shoulder and travel lanes of the highway. Therefore, Alternative 8 is considered to have the lowest relative effectiveness in mitigating the rockfall hazard.

In Alternative 9, no catchment ditch is necessary because the anchored mesh system is designed to resist breakout of rock and shallow depth materials. Furthermore, because the wire mesh is tensioned against the slope face with anchors, the anchored mesh system also provides slope

stabilization. For these reasons, Alternative 9 is considered to be comparable in effectiveness to Alternatives 3 and 4.

(2) Cost Considerations

Alternatives 1 and 2 are anticipated to be the most costly and difficult to construct. Alternative 8 is estimated to be the least expensive to construct because there is no slope setback required. After Alternative 8, Alternatives 7 and 9 are estimated to be the least expensive to construct. The estimated construction costs were presented on **Table 12**.

The 75-year life cycle cost for each alternative was estimated based on the following assumptions:

- Complete replacement of the wire mesh (Alternatives 5, 6, 7, 8 and 9) and rockfall impact barriers (Alternatives 3, 4,5,6,7,8 and 9) will be required every 15 years
- The bridges and rockfall sheds are expected to have a useable life of 75 years
- Real discount rate of 3% was used to calculate present value of the cost to replace the wire mesh and estimated annual maintenance cost

As shown in the table, Alternative 8 has the lowest estimated 75-year life cycle cost.

Table 12
Estimated 75-Year Life Cycle Cost (In Millions)

Alternative	Construction Cost	Right-of-Way Cost	Present Value of Replacement Costs	Present Value of Yearly Maint. Cost	Estimated 75-Year Life Cycle Cost (Rounded)
Alt. 1 – Bypass Bridge	$183.3	$1.71	$0	$0	$185
Alt. 2 – Rockfall Shed	$223.4	$0	$0	$0	$223
Alt. 3 – Slope Set-back with Full Size Catchment Ditch Width	$94.9	$0.03	$19.0	$0.3	$114
Alt. 4 – Slope Set-back with Limited Size Catchment Ditch & Rockfall Impact Fence Between Roadway and Catchment Ditch	$89.1	$0	$36.9	$0.3	$126

Alt. 5 – Slope Set-back with Limited Size Catchment Ditch & Draped Mesh	$81.6	$0	$34.0	$0.3	$116
Alt. 6 – Makai Alignment Shift, Cantilevered Widening with Limited Size Catchment Ditch & Draped Wire Mesh	$79.0	$0	$34.0	$0.3	$113
Alt. 7 – Makai Alignment Shift, Elimination of Passing Lanes with Limited Size Catchment Ditch & Drape Wire Mesh	$48.5	$0	$34.0	$0.3	$83
Alt. 8 – Draped Wire Mesh	$39.7	$0	$34.0	$0.7	$74
Alt. 9 – Anchored Wire Mesh	$47.3	$0	$44.3	$0	$92

(3) Traffic and Safety Benefits

Alternative 1 will remove the curves through the Gulch, thereby correcting the existing sight distance and superelevation deficiencies and allowing a higher design speed. The bridge provided in Alternative could also provide wider shoulders as required by AASHTO. The slope setbacks provided in Alternatives 3, 4, 5, and 6 can also correct the sight distance, superelevation and shoulder deficiencies. The slope setback provided in Alternative 3 for the full width catchment ditch will provide greater sight distance than in the other slope setback alternatives.

Similar to Alternatives 3, 4, 5 and 6, the limited road widening in Alternatives 7 and 8 will also correct the shoulder deficiencies. The rockfall shed proposed to be constructed in Alternative 2 will not correct any of the roadway deficiencies, and may possibly further limit the sight distance.

The removal of passing lanes in Alternative 7 will create slower traffic conditions within the gulches. This could be remedied somewhat by providing passing lanes just outside of the gulches away from the cut slope areas. The other alternatives are not anticipated to have any detrimental effect on traffic after construction.

(4) Right-of-way Impacts

Alternative 1 will require a new right-of-way across the gulch and for the realigned highway at the bridge approaches. The slope setbacks for Alternatives 3, 4 and 5 are likely to require additional

right-of-way. The mesh installation on the cut slopes for Alternatives 5, 6, 7, 8 and 9 will require additional right-of-way for maintenance of the mesh.

The rockfall shed proposed for Alternative 2 will not require any additional right-of-way.

(5) Construction Requirements and Impacts

Alternative 1 will require the fewest road closures during construction, since the existing highway can remain in use during most of the construction of the new bridge. Alternative 2 may require lengthy road closures during construction of the rockfall shed.

Vegetation clearing and scaling will require two full lanes for man-lifts. Temporary road closures will be required; where space is available, a possible alternative to road closure is to provide a temporary barrier to allow one lane of traffic.

The slope setback excavation may require controlled blasting. Temporary road closures during the blasting and clearing will be required.

During construction of the cantilevered road widening, one or two lanes of traffic may be able to be provided, depending on the width of the existing shoulder.

Installation of the wire mesh panels will likely be done be by helicopter. FAA requires temporary (10 minutes minimum) closure of the road while helicopters are overhead.

Construction is expected to be lengthiest for Alternatives 1 and 2 and shortest for Alternative 8. The vegetation clearing, scaling and mesh installation in each gulch is estimated to require approximately 6 months.

(6) Environmental Considerations

The construction of the bridge for Alternative 1 will potentially require several permits that are not expected to be required by the other alternatives. These permits include:

- Department of the Army Permit for Activities in Waterways – Army Corps of Engineers, (COE), Honolulu District, Fort Shafter

- Section 401 Water Quality Certification (WQC) Permit - State Department of Health (Delegated by EPA and Section 401, Clean Water Act)
- Stream Channel Alteration Permit - State Department of Land and Natural Resources, Commission on Water Resource Management
- Permit for Work In Shores and Shorewaters - State Department of Transportation, Harbors Division

(7) Maintenance Requirements

Alternatives 1 and 2 will require little maintenance. Alternatives 3 through 8 will require clean-up of soil and rock debris. However, the maintenance requirements for Alternative 8 will be the most labor-intensive since there is no ditch to catch the falling debris or to provide access for clean-up equipment. For Alternative 9, the anchored mesh system is designed to resist breakout of rock and shallow depth materials, so there should be minimal clean-up requirements.

The wire mesh installed under Alternatives 5 through 9 will require periodic inspection to check for breaks or corrosion.

(8) Constructability

Constructability is an estimate of the degree of difficulty and complexity of the construction required which may increase the likelihood of cost increases and delays during construction. Constructability is not intended to be a measure of the effort required or the duration of construction.

Alternatives 1 and 2 are likely to more difficult to construct than the other alternatives. Alternative 8 is anticipated to be the least complex of the remaining alternatives to construct. Of the slope setback alternatives, Alternative 5 may be more difficult to construct than Alternatives 3 and 4 due the narrower slices to be excavated from the existing cut slopes.

(9) Aesthetics and Visual Impact

The bridge in Alternative 1 will be highly visible and could be considered an undesirable addition to the landscape. However, the bridge will offer unique scenic vistas for motorists.

The wire mesh in Alternatives 5 through 9 will have some visual impact to the cut slopes. However, the mesh material can be purchased in a variety of colors and a color can be specified to minimize the visual impact of the wire mesh.

The rockfall impact fence in Alternative 4 will require a height of 8 to 12 feet and will be highly visible, since it will be at eye level with passing motorists.

The soil anchors required to anchor the wire mesh in Alternative 9 may leave a visible pattern.

Evaluation Summary

A summary of the evaluation is presented in **Table 13** to compare the conceptual alternatives to each other.

Table 13
Evaluation Matrix of Conceptual Alternatives

		Alt 1		**Alt 2**		**Alt 3**		**Alt 4**		**Alt 5**		**Alt 6**		**Alt 7**		**Alt 8**		**Alt 9**	
Description	Wt	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S
Rockfall & Landslide Hazard Mitigation Effectiveness	10	5	50	5	50	4	40	4	40	3	30	3	30	3	30	0	0	4	40
75-Year Life Cycle Cost	8	0	0	0	0	3	24	2	16	3	24	3	24	4	32	5	40	4	32
Construction Requirements & Impacts	6	5	30	0	0	1	6	1	6	1	6	2	12	2	12	4	24	4	24
Constructability	6	0	0	0	0	2	12	2	12	1	6	2	12	2	12	5	30	4	24
Traffic & Safety Benefits	6	5	30	0	0	4	24	3	18	3	18	3	18	0	0	1	6	1	6
Maintenance Requirements	6	5	30	5	30	4	24	3	18	3	18	3	18	2	12	0	0	4	24
Aesthetics / Visual Impact	4	1	4	0	0	5	20	2	8	3	12	3	12	3	12	3	12	2	8
Right-of-Way Impacts	2	0	0	5	10	1	2	2	4	2	4	3	6	3	6	3	6	3	6
Environmental Considerations	2	0	0	2	4	0	0	0	0	0	0	0	0	4	8	5	10	5	10
Total Scores			**144**		**94**		**152**		**122**		**118**		**132**		**124**		**128**		**174**

Wt=Weight R=Rating S=Score

The above table identifies the nine criteria representing different aspects of each of the alternatives. The criteria were weighted according to their relative importance to the overall evaluation. For each

criterion, each alternative was assigned a rating of 0 to 5. The ratings for the alternatives are relative, with 0 assigned to the alternative(s) which were evaluated to be the worst for the criterion, and 5 assigned to the alternative(s) which were considered to be the best for the criterion.

Intermediate ratings of 1 to 4 were assigned to the remaining alternatives. The criterion score for each alternative in each of the seven criteria is the product of the criterion weight and the rating. The total score is the sum of the seven criterion scores. The highest possible score in the matrix is 250.

3.2.5. Preferred Alternative

Alternative 9 is the recommended alternative and offers the best combination of a high level of rockfall protection from the cut slopes with a relatively low life-cycle cost and minimal future maintenance requirements. The factors considered important in the selection of this alternative included:

(1) The anchored wire mesh panels topped with an impact barrier will provide a high level of rockfall protection from cut slope (comparable to Alternatives 3 and 4).

(2) The slope stabilization provided by this alternative, through the tension from the wire mesh panel anchors and by reducing the quantity of water percolating into the soil by diverting surface water through use of interceptor ditches, is far greater then that achieved by Alternative 8.

(3) The proposed rockfall protection will be effective for controlling rockfall and breakout of loose materials and will remove the need for a rockfall catchment ditch beside the Hawai'i Belt Road.

(4) The preferred alternative will have a lower impact on traffic during construction because project duration is shorter and it does not involve alterations to the existing roadway or utility features as do Alternatives 1-7.

(5) The cost of the chosen alternative is relatively low compared to Alternatives 1-7.

(6) While the up-front cost of Alternative 8 are lower the debris clean-up requirements of the anchored system proposed in Alternative 9 are less than for draped mesh and will save the County time and money in the long term.

After Alternative 9, Alternative 3 is the next highest recommended alternative. Alternative 3 provides rockfall protection from the natural slopes above the cut slopes without the need for

construction and periodic maintenance or replacement of a rockfall impact fence at the top of the cut slopes. Most of the widening for the development of full size catchment ditches and wider shoulders would be accomplished by the set-back of the cut slopes, which would also serve to improve vehicle sight distances. Furthermore, the slope stabilization treatments would be limited to localized problem areas, thereby reducing the potential visual impact of the mesh and the need for future maintenance or replacement of the mesh materials.

Section 4
Relationship to State and City & County Land Use Plans and Policies

4.1. Hawai'i State Plan and Functional Plans

4.1.1. Hawai'i State Plan

The Hawai'i State Plan, Chapter 226, Hawai'i Revised Statutes (HRS), serves as a written guide for the future long range development of the State. The Plan identifies statewide goals, objectives, policies, and priorities.

The proposed project is consistent with the following provisions of the State Plan:

> Section 226-8 Objective and policies for the economy-visitor industry.
> (b) To achieve the visitor industry objective, it shall be the policy of this State to:
> (1) Support and assist in the promotion of Hawai'i's visitor attractions and facilities; [and,]
> (3) Improve the quality of existing visitor destination areas.

The proposed project involves the installation of rockfall protection on the Hawai'i Belt Road along the Hāmākua Coast. This region is one of scenic value for the natural beauty of the mountain slopes, valleys and expansive views of the Pacific Ocean. While the Hawai'i Belt Road is an important thoroughfare for Hawai'i Island residents it is also an area heavily visited by tourists. Safe and relatively unobstructed driving conditions are important factors to the experience of these visitors. Rockfall protection in the Ka'awali'i, Laupāhoehoe and Maulua Gulches will contribute to the quality of this experience while maintaining public and visitor safety.

> Section 226-17 Objectives and policies for facility systems-transportation.
> a) Planning for the State's facility systems with regard to transportation shall be directed towards the achievement of the following objectives:
> (1) An integrated multi-modal transportation system that services statewide needs and promotes the efficient, economical, safe, and convenient movement of people and goods.
> (b) To achieve the transportation objectives, it shall be the policy of this State to:
> (5) Promote a reasonable level and variety of mass transportation services that adequately meet statewide and community needs;

The proposed project offers a reasonable solution to improving safety and roadway conditions in the Hāmākua region and will reduce the time and public expense of maintaining the Hawai'i Belt Road following rockfall and landslide events. The proposed project will address the State Plan objective of maintaining an important land transportation facility that is used for public and private purposes in the efficient and safe movement of people and goods.

4.1.2. State Functional Plans

The State Functional Plans are designed to implement the broader goals, objectives, and policies of the State Plan through specific actions identified as Implementing Actions (IA). While the proposed project is not specifically identified as an IA, the project maintains consistency with the Transportation Functional Plans through the following:

> State Transportation Functional Plan
> Objective I.F: Improving and enhancing transportation safety

The proposed project involves the design and construction of rockfall protection improvements along the cliff faces of Ka'awali'i, Laupāhoehoe, and Maulua Gulches to protect visitors and the general public traversing the Hawai'i Belt Road. The project will comply with State and County of Hawai'i design and construction requirements and address the need for safety along the roadway.

4.1.3. State Land Use District

The project site is located primarily in the State DOT ROW with small encroachments to surrounding lands designated for use within the State Agricultural District (**Figure 11**, State Land Use Districts). According to Section 205-4.5, the proposed project can be considered as a permissible use:

> §205-4.5 Permissible uses within the agricultural districts. (a) Within the agricultural district, all lands with soil classified by the land study bureau's detailed land classification as overall (master) productivity rating class A or B shall be restricted to the following permitted uses:
> (7) Public, private, and quasi-public utility lines and roadways, transformer stations, communications equipment buildings, solid waste transfer stations, major water storage tanks, and appurtenant small buildings such as booster pumping stations, but not including

offices or yards for equipment, material, vehicle storage, repair or maintenance, treatment plants, corporation yards, or other similar structures;

The installation of rockfall protection measures to the cut rock cliffs of the subject gulches is an accessory action necessary for the maintenance of a public roadway.

4.2. County of Hawai'i

4.2.1. General Plan

The current edition of the General Plan for the County of Hawai'i was adopted in 1971, revised in 1978 and 1989, and last updated in February 2005. The General Plan is a comprehensive statement of objectives and policies for the future development of the Island of Hawai'i. The proposed project is consistent with the following objectives and policies of the General Plan:

Transportation

The objectives and policies for transportation related improvements are stated in Section 13.2, Transportation – Roadways:

Objective A: Provide a system of roadways for the safe, efficient and comfortable movement of people and goods.

Policy D: Support the development of programs to identify and improve hazardous and substandard sections of roadway and drainage problems.

The proposed project will improve roadway and safety conditions along the Hawai'i Belt Road. These improvements will be in accordance with the requirements of the County of Hawai'i and State DOT, to promote safe and efficient transportation facilities for residents and visitors.

4.2.2. North Hilo and Hāmākua District Courses of Action

There are no Community Development Plans established for the North Hilo or Hāmākua districts. The Courses of Action regarding transportation for these areas are identified by district in the Hawai'i County General Plan in the following:

Courses of Action – Hāmākua:

(d) Improve County maintained roads and encourage the improvement of non-County owned roads by the State of Hawai'i or private landowner.

The proposed project will be funded by the U. S. Department of Transportation Capital Improvements Program and State DOT and will provide important and necessary safety improvements to the Hawai'i Belt Road in the Ka'awali'i, Laupāhoehoe and Maulua Gulch areas.

4.2.3. County of Hawai'i Zoning

The project site is located principally in the State DOT ROW with small portions of the project crossing into adjacent private property zoned A-20a, Agricultural Zoning (minimum size of 20 acres) (**Figure 12,** Zoning). According to the Hawai'i County Code:

> Section 25-5-70. Purpose and applicability.
> The A (agricultural) district provides for agricultural and very low density agriculturally-based residential use, encompassing rural areas of good to marginal agricultural and grazing land, forest land, game habitats, and areas where urbanization is not found to be appropriate.
> Section 25-5-71. Designation of A districts.
> Each A (agricultural) district shall be designated on the zoning map by the symbol "A" followed by a number together with the lower case letter "a" which indicates the required or minimum number of acres for each building site…
> Section 25-5-72. Permitted uses.
> (a) The following uses shall be permitted in the A district:
> (17) Public uses and structures which are necessary for agricultural practices.

The proposed rockfall mitigation improvements will address the County of Hawai'i and State DOT requirements for roadway safety that will support transportation associated with agricultural activities, and use of the roadway by the general public. The proposed improvements are also anticipated to reduce the erosion rate of the rock cut cliffs which will help to preserve the condition of the adjacent agricultural lands. In this regard, the proposed project will help to maintain existing agricultural land uses of the area consistent with the A-20a zoning of the site.

4.2.4. Special Management Area

The County of Hawai'i has designated the shoreline and certain inland areas of the Island of Hawai'i within the Special Management Area (SMA). SMA areas are designated sensitive environments that

should be protected in accordance with the State's Coastal Zone Management policies, as set forth in Section 205A, Coastal Zone Management, HRS. As noted in Section 205A-21, HRS:

> The legislature finds that, special controls on developments within an area along the shoreline are necessary to avoid permanent losses of valuable resources and the foreclosure of management options, and to ensure that adequate access, by dedication or other means, to public owned or used beaches, recreation areas, and natural reserves is provided. The legislature finds and declares that it is the state policy to preserve, protect, and where possible, to restore the natural resources of the coastal zone of Hawai'i.

The designation of the boundary of the SMA is through the County of Hawai'i as promulgated through Section 205A-23, County special management area boundaries. The proposed project site is located on the mauka side of the Hawai'i Belt Road and may be considered as outside of the designated SMA zone as shown in **Figure 13**, SMA Map.

According to the Rules of Practice and Procedure, Rule 9-Special Management Area, Planning Commission, County of Hawai'i, the proposed project may also be considered as exempt from the requirements a SMA permit application. As noted in Section 9-4 – Definitions:

> (10) "Development" means any of the following uses, activities, or operations on land or in or under water within the Special Management Area:
> B. "Development" does not include the following uses, activities or operations:
> (ii) Repair or maintenance of roads and highways within existing rights-of-way;

The proposed project will be located within the existing Hawai'i Belt Road ROW and would not be considered as a "development" subject to the requirement for regulatory review of the project according to the rules of the County's Planning Commission.

4.3. Coastal Zone Management, HRS 205(A)

The State of Hawai'i designates the Coastal Zone Management Program (CZMP) to manage the intent, purpose and provisions of HRS, Chapter 205(A)-2, as amended, for the areas from the shoreline to the seaward limit of the State's jurisdiction, and any other area which a lead agency may designate for the purpose of administering the CZMP.

The following is an assessment of the project with respect to the CZMP objectives and policies set forth in Section 205(A)-2.

1. Recreational resources
Objective: Provide coastal recreational opportunities accessible to the public.
Policies:
A) Improve coordination and funding of coastal recreational planning and management; and
B) Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by:
(i) Protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas;
(ii) Requiring replacement of coastal resources having significant recreational value including, but not limited to, surfing sites, fishponds, and sand beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the State for recreation when replacement is not feasible or desirable;
(iii) Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;
(iv) Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;
(v) Ensuring public recreational uses of county, state, and federally owned or controlled shoreline lands and waters having recreational value consistent with public safety standards and conservation of natural resources;
(vi) Adopting water quality standards and regulating point and nonpoint sources of pollution to protect, and where feasible, restore the recreational value of coastal waters;
(vii) Developing new shoreline recreational opportunities, where appropriate, such as artificial lagoons, artificial beaches, and artificial reefs for surfing and fishing; and
(viii) Encouraging reasonable dedication of shoreline areas with recreational value for public use as part of discretionary approvals or permits by the land use commission, board of land and natural resources, and county authorities; and crediting such dedication against the requirements of section 46-6.

Discussion:

Recreational and shoreline facilities, and public access to the shoreline will not be adversely affected by the project. Although the proposed project area is located along the Hawai'i Belt Road, portions of which may be used to access portions of the shoreline, the proposed project would constitute an effort to correct an existing condition involving rockfall and landslide events that can disrupt such access. In this regard the project constitutes a corrective action that will improve the maintenance of long term shoreline access.

2. Historic resources
Objective: Protect, preserve, and, where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.
Policies:
(A) Identify and analyze significant archaeological resources;
(B) Maximize information retention through preservation of remains and artifacts or salvage operations; and
(C) Support state goals for protection, restoration, interpretation, and display of historic resources.

No adverse impacts to archaeological or historic resources associated with construction of the proposed project are anticipated. As required by the SHPD, archaeological monitoring during construction will be performed.

In the event that unidentified archaeological remains or deposits are uncovered during construction, work will cease in the immediate area and the State Historic Preservation Office will be contacted. As appropriate, corrective actions will be proposed and coordinated with the SHPD, Department of Land and Natural Resources, prior to the resumption of work.

The potential for adverse impacts to cultural practices or resources are not expected. The immediate project site has been subject to development and use as a major thoroughfare, and is not readily used for present day traditional or cultural gathering practices.

3. Scenic and open space resources
Objective: Protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources.
Policies:
(A) Identify valued scenic resources in the coastal zone management area;
(B) Ensure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of natural land forms and existing public views to and along the shoreline;
(C) Preserve, maintain, and, where desirable, improve and restore shoreline open space and scenic resources; and
(D) Encourage those developments that are not coastal dependent to locate in inland areas.

Discussion:

The proposed project will involve the installation of wire mesh panels, a rockfall impact barrier, and a shallow concrete lined drainage interceptor ditch. These project requirements are based on vehicular safety considerations and, while visible to roadway travelers, are not expected to adversely affect scenic and open space resources.

4. Coastal ecosystems
Objective: Protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.
Policies:
(A) Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources;
(B) Improve the technical basis for natural resource management;
(C) Preserve valuable coastal ecosystems, including reefs, of significant biological or economic importance;
(D) Minimize disruption or degradation of coastal water ecosystems by effective regulation of stream diversions, channelization, and similar land and water uses, recognizing competing water needs; and
(E) Promote water quantity and quality planning and management practices that reflect the tolerance of fresh water and marine ecosystems and maintain and enhance water quality through the development and implementation of point and nonpoint source water pollution control measures.

Discussion:

The proposed project is not expected to have any adverse effect on coastal ecosystems or resources. The project location is in an area that is not subject to coastal processes and will be undertaken in a manner that will minimize or otherwise avert the potential for environmental impacts.

5. Economic uses
Objective: Provide public or private facilities and improvements important to the State's economy in suitable locations.
Policies:
(A) Concentrate coastal dependent development in appropriate areas;
(B) Ensure that coastal dependent development such as harbors and ports, and coastal related development such as visitor industry facilities and energy generating facilities, are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area; and
(C) Direct the location and expansion of coastal dependent developments to areas presently designated and used for such developments and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:
(i) Use of presently designated locations is not feasible;
(ii) Adverse environmental effects are minimized; and
(iii) The development is important to the State's economy.

Discussion:

The proposed project has been assessed for potential social, visual, and environmental impacts. With the implementation of the mitigation measures identified in this document, no adverse impacts are expected to result.

The County zoning designation for the project site is for a road and is within the A-20a, Agricultural zoning district. The proposed rockfall mitigation improvement project will be in compliance with the requirements for this zoning district.

6. Coastal hazards
Objective: Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution.
Policies:
(A) Develop and communicate adequate information about storm wave, tsunami, flood, erosion, subsidence, and point and nonpoint source pollution hazards;
(B) Control development in areas subject to storm wave, tsunami, flood, erosion, hurricane, wind, subsidence, and point and nonpoint source pollution hazards;
(C) Ensure that developments comply with requirements of the Federal Flood Insurance Program; and
(D) Prevent coastal flooding from inland projects.

Discussion:

The subject property is located along the Hawai'i Belt Road in the North Hilo and Hāmākua Districts of the Island of Hawai'i. Ka'awali'i Gulch and a portion of Laupāhoehoe Gulch are designated within Flood Zone X. The balance of Laupāhoehoe Gulch and Maulua Gulch occupy areas unclassified by the FEMA Flood Insurance Rate Maps (**Figure 7,** Flood Map).

The development of the project will be in compliance with the requirements of the Federal Flood Insurance Program and the County of Hawai'i Drainage, Grading and Development standards for Flood Hazard Districts.

7. Managing development
Objective: Improve the development review process, communication, and public participation in the management of coastal resources and hazards.
Policies:
(A) Use, implement, and enforce existing law effectively to the maximum extent possible in managing present and future coastal zone development;
(B) Facilitate timely processing of applications for development permits and resolve overlapping or conflicting permit requirements; and
(C) Communicate the potential short and long-term impacts of proposed significant coastal developments early in their life cycle and in terms understandable to the public to facilitate public participation in the planning and review process.

Discussion:

All improvement activities will be conducted in compliance with State and County environmental rules and regulations. This EA document is prepared to identify and, where necessary, propose mitigation measures to address the potential for impacts anticipated from the construction and operation of the project. This document will be published for public review in compliance with procedures set forth by the Office of Environmental Quality Control (OEQC), Chapter 343, HRS, and Chapter 11-200, Hawai'i Administrative Rules (HAR).

8. Public participation;
Objective: Stimulate public awareness, education, and participation in coastal management.
Policies:
(A) Promote public involvement in coastal zone management processes;
(B) Disseminate information on coastal management issues by means of educational materials, published reports, staff contact, and public workshops for persons and organizations concerned with coastal issues, developments, and government activities; and
(C) Organize workshops, policy dialogues, and site-specific mitigation to respond to coastal issues and conflicts.

Discussion:

Public involvement in the project will consist of public notice of the proposed action in the State Office of Environmental Quality Control (OEQC) Bulletin. See **Section 7**, Agencies, Organizations, and Individuals Consulted for a list of the agencies, organizations and individuals that have been or will be consulted for this project. All written public comments will be provided with a written response. Where appropriate, mitigation measures will be developed to address issues and concerns raised during public review of the project.

9. Beach protection;
Objective: Protect beaches for public use and recreation.
Policies:
(A) Locate new structures inland from the shoreline setback to conserve open space, minimize interference with natural shoreline processes, and minimize loss of improvements due to erosion;
(B) Prohibit construction of private erosion-protection structures seaward of the shoreline, except when they result in improved aesthetic and engineering solutions to erosion at the sites and do not interfere with existing recreational and waterline activities; and
(C) Minimize the construction of public erosion-protection structures seaward of the shoreline.

Discussion:

The proposed project is not located in proximity to the beach and will have no effect on beach or shoreline processes. Scaling activities and wire mesh panel installation may cause temporary delays in traffic flow to beach areas, but access will not be otherwise obstructed. BMPs will be used during scaling and grubbing activity and any excavated material will be transported off site to prevent discharges of sediments to adjacent streams.

10. Marine resources
Objective: Promote the protection, use, and development of marine and coastal resources to assure their sustainability.
Policies:
(A) Ensure that the use and development of marine and coastal resources are ecologically and environmentally sound and economically beneficial;
(B) Coordinate the management of marine and coastal resources and activities to improve effectiveness and efficiency;

(C) Assert and articulate the interests of the State as a partner with federal agencies in the sound management of ocean resources within the United States exclusive economic zone;
(D) Promote research, study, and understanding of ocean processes, marine life, and other ocean resources in order to acquire and inventory information necessary to understand how ocean development activities relate to and impact upon ocean and coastal resources; and
(E) Encourage research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources.

Discussion:

The proposed project will have no effect on marine resources. The scope and scale of the project will be limited to the installment of wire mesh paneling, rockfall impact barriers, and shallow concrete lined drainage interceptor ditches. These rockfall mitigation improvements are being constructed to improve roadway safety.

4.4. Federal

Federal regulatory controls are identified in Chapter 1, Introduction. The following additional Federal regulatory policies and laws apply to this project.

4.4.1. Environmental Justice

This new aspect of environmental activism and regulation broadens the scope of the traditional Environmental Movement, in general, and redefines the term "environment" to include places where people live, work, pray, play, and go to school. A significant Federal response to ongoing advocacy and organizing efforts is Executive Order (EO) 12898, issued in 1994. The intent of the EO is to prevent environmental racism under Title VI of the 1964 Civil Rights Act. Title VI prohibits discrimination on the basis of race, color or national origin. It also prohibits the use of Federal funds, including the actions of Federal and State agencies, from discriminatory acts.

The Federal Environmental Protection Agency (EPA) states that environmental justice means "fair treatment." As defined by the EPA, "Fair treatment means that no groups of people, including racial, ethnic or socioeconomic groups, should bear a disproportionate share of negative environmental consequences from industrial, municipal, and commercial operations, or the execution of federal, state, local, and tribal programs and policies."

The proposed project will improve a regional transportation facility and will benefit a large segment of the population regardless of race, ethnicity or socioeconomic status. The decision to undertake

this project was not biased by race or income, but by an objective evaluation that indicated that rockfall protection is required at the locations specified in this document.

4.4.2. Section 4(f)

The purpose of Section 4(f) of the Department of Transportation Act (49 U.S.C. 303 and 23 U.S.C. 138) is to preserve parkland, recreation areas, wildlife refuges, and historic sites by limiting the circumstances under which such land can be used for transportation programs or projects. Section 4(f) permits the use of land for a transportation project from a significant publicly owned park, recreation lands, wildlife or waterfowl refuge, or any significant historic site only when FHWA and the Urban Mass Transportation Administration has determined that (1) there is no feasible and prudent alternative to such use, and (2) the project includes all possible planning to minimize harm to the property resulting from such use.

The proposed project has been evaluated in relation to the provisions of Section 4(f). The project sites involve an existing roadway ROW and portions of land immediately adjacent to the project. The affected adjacent lands are undeveloped areas that are not designated as recreational areas or wildlife refuges. The affected areas do not contain historic or archaeological properties.

4.4.3. Section 6(f)

Section 6(f) of the Land and Water Conservation Fund Act (LWCFA) concerns transportation projects that propose actions which will result in impacts to outdoor recreation properties acquired or developed with LWCFA grant assistance. Passed by Congress in 1965, the act established the Land and Water Conservation Fund (LWCF), a matching assistance program that provides grants which pay half the acquisition and development cost of outdoor recreation sites and/or facilities. Section 6(f) of the act prohibits the conversion of property acquired or developed with these grants to a non-recreational purpose without the approval of the Department of Interior's National Park Service (NPS).

The proposed project will not impact any outdoor recreational properties developed with LWCF assistance. The nearest LWCF property is the Laupāhoehoe Beach Park located approximately 2,000 feet to the northwest of the Laupāhoehoe Gulch project site.

4.4.4. Farmland Protection and Policy Act

The implementing regulations of the Farmland Protection and Policy Act, 7 CFR Volume 6, Part 658 applies to Federal or federally-assisted projects that "may directly or indirectly and irretrievably convert farmland that is defined as: 1) prime, 2) unique, 3) other than prime or unique that is of statewide importance, or 4) other than prime or unique that is of local importance, to nonagricultural use".

The proposed project incorporates small portions of agricultural lands identified in **Section 1.3.1** Project Location and Site Characteristics. Even though these lands will be acquired for the Hawai'i Belt Road ROW, it is anticipated that this project will reduce the erosion rates of the affected cliff faces which could in turn slow the loss of this land, in addition to providing improved safety to the roadway.

Section 4 – Figures

Environmental Assessment for Hawaiʻi Belt Road
Rockfall Protection at Maulua, Laupāhoehoe and Kaʻawaliʻi Gulches
North Hilo and Hāmākua, Island of Hawaiʻi, Hawaiʻi

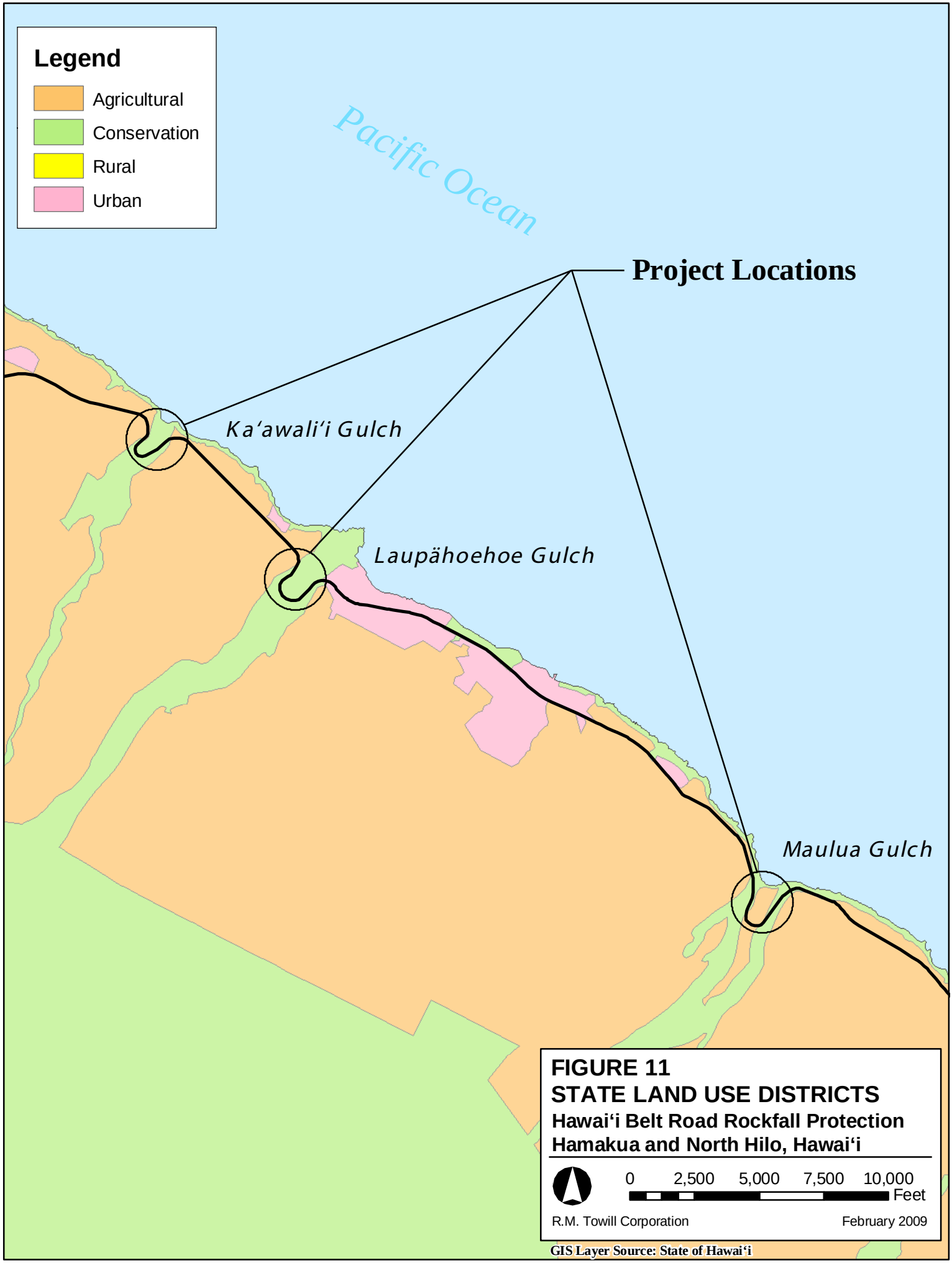


FIGURE 11
STATE LAND USE DISTRICTS
Hawai'i Belt Road Rockfall Protection
Hamakua and North Hilo, Hawai'i

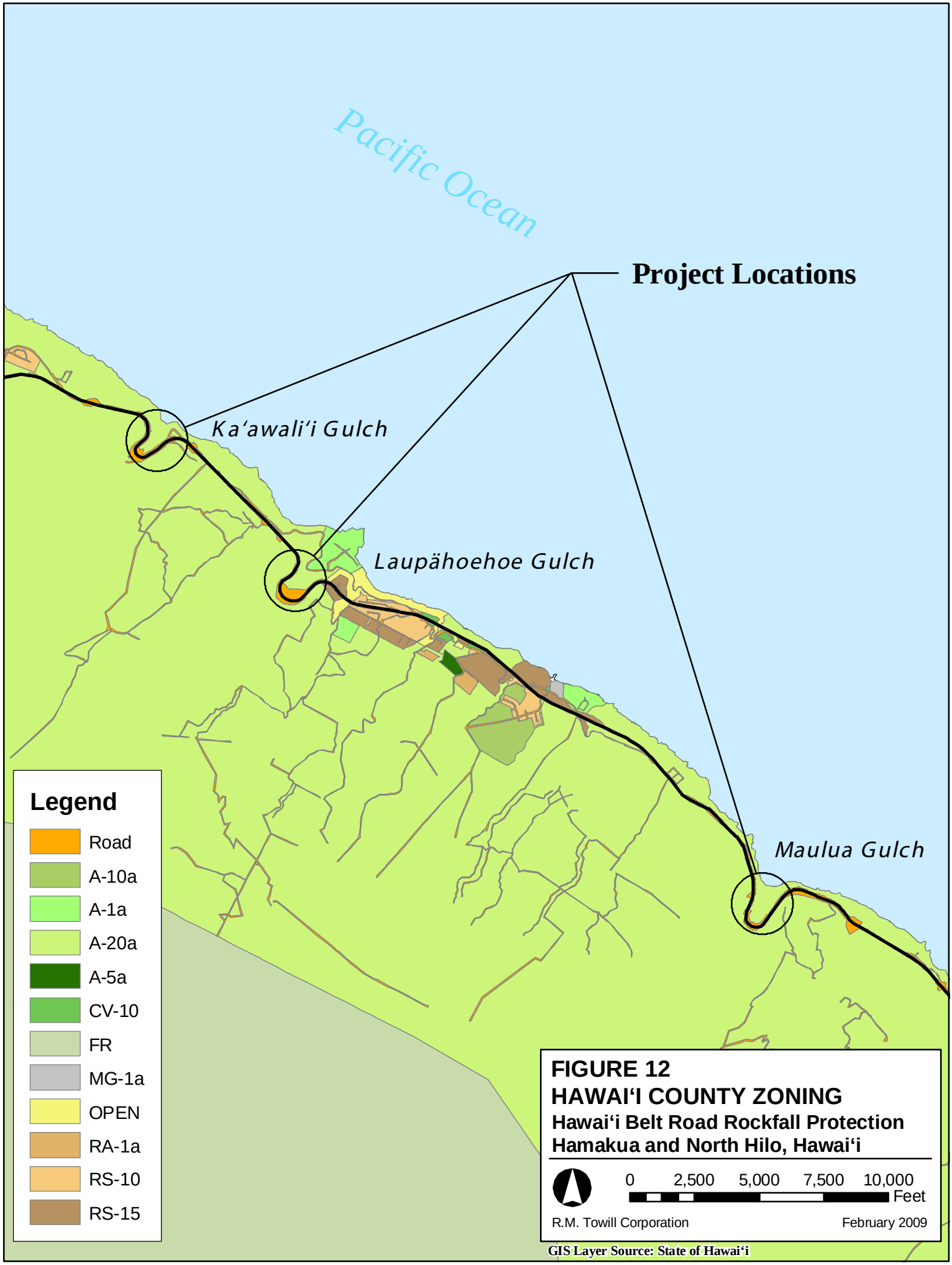


FIGURE 12
HAWAI'I COUNTY ZONING
Hawai'i Belt Road Rockfall Protection
Hamakua and North Hilo, Hawai'i

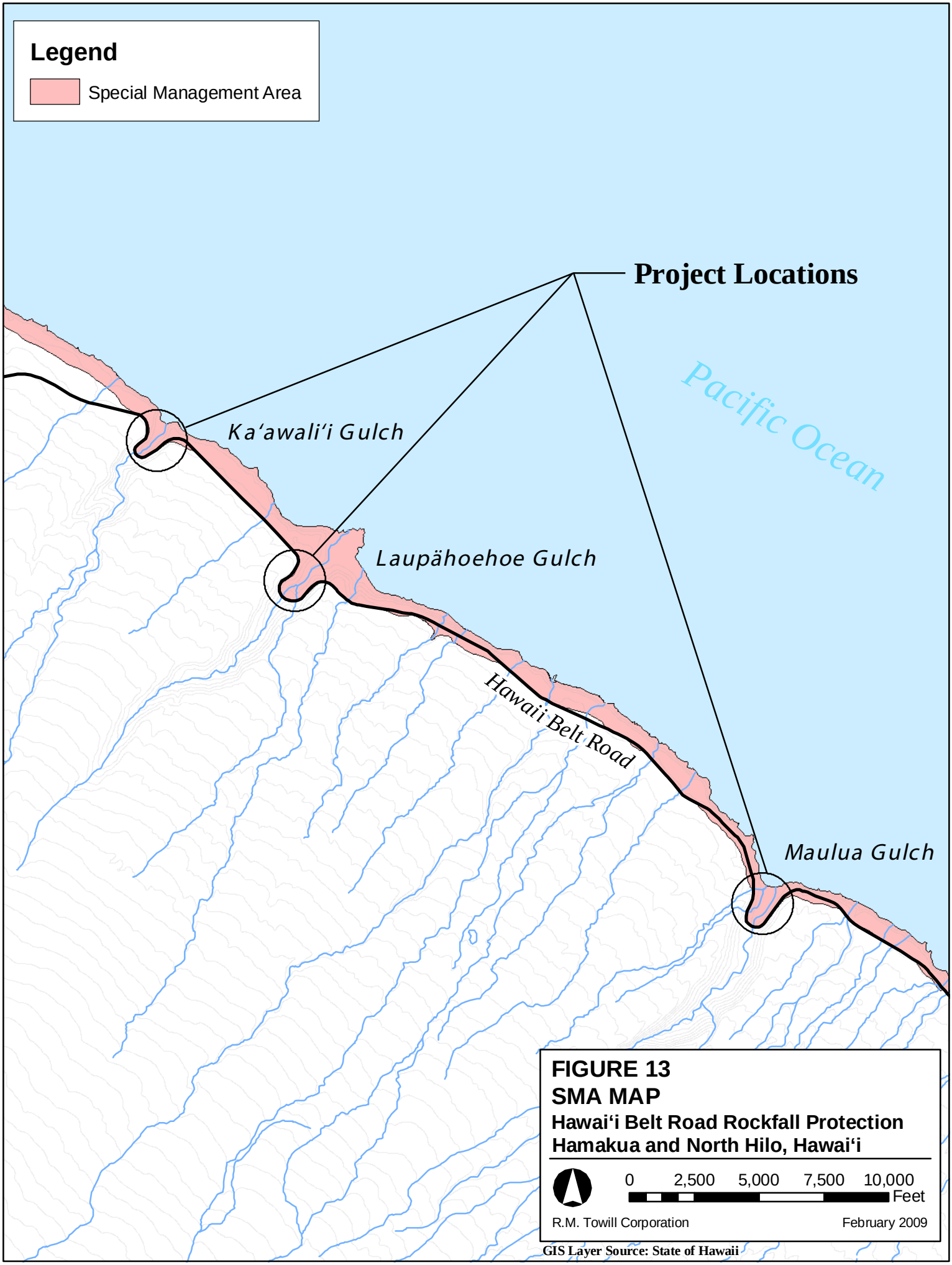


FIGURE 13
SMA MAP
Hawai'i Belt Road Rockfall Protection
Hamakua and North Hilo, Hawai'i

Section 5
Permits and Approvals that May be Required

5.1. County of Hawai'i

Planning Department

- Construction Plan Review
- Grading Permit
- Building Permit

5.2. State of Hawai'i

Department of Health (DOH)

National Pollution Discharge Elimination System (NPDES) Permit

- Notice of Intent Form C, Construction Stormwater Permit Application

Department of Land and Natural Resources (DLNR)

- State Historic Preservation Division Review

Department of Business, Economic Development & Tourism - Office of Planning

- Coastal Zone Management Federal Consistency Review

Department of Transportation

- Approval of Construction Plans & Specifications
- Permit to Perform Work upon State Highways

5.3. Federal

Section 106, National Historic Preservation Act (NHPA), Consultation

Section 4(f) Consultation

Section 7, Endangered Species Act Consultation

Coastal Zone Management Federal Consistency Review

Section 6
Cultural Impact Assessment Evaluation

6.1. Impacts to Traditional/Cultural Resources

A Cultural Impact Assessment (CIA), including document research and cultural consultation, is being undertaken for the project Area of Potential Effect (APE), by Cultural Surveys Hawai'i (**Appendix F**). The APE includes approximately 2.434 total acres and encompasses all or portions of Tax Map parcels: (3) 3-4-002: 03, 04 & 05; (3) 3-6-004: 02, 11, 15, 17, 23 & 30; and (3) 3-9-001: 01. The CIA study area included the APE and entire ahupua'a of Maulua Nui, Laupāhoehoe, and Humu'ula.

The CIA supports the project's historic preservation review under Section 106, NHPA; HRS Chapter 6E-42; HAR Chapter 13-284; and the Office of Environmental Quality Control's Guidelines for Assessing Cultural Impacts.

The following is a summary of the preliminary findings in accordance with provisions of Section 106 of the National Historic Preservation Act (NHPA) and the State of Hawai'i environmental review process as promulgated in HRS Chapter 13-343, requiring the consideration of a potential project's effect on traditional cultural practices.

6.1.1 Scope of Work

The following CIA scope of work tasks were coordinated with the SHPD:

1. Examination of cultural and historical documents, such as Land Commission Awards (LCAs) and previous research reports and historic maps, to identify traditional Hawaiian activities, including gathering of plant, animal, and other resources in the historic record.

2. A review of the previous archaeological work conducted at or near the subject parcels, relevant to reconstructions of traditional land use activities, and identification and description of cultural resources, practices, and beliefs.

3. Conduct oral interviews with persons knowledgeable about the historic and traditional practices in the project area and region.

4. Preparation of a report on items 1-3 summarizing the information gathered. The report assesses the impact of the proposed action on the cultural practices and features identified.

6.1.2 Findings

6.1.2.1 Review of Historical Documentation

Place Name Definitions, Proverbs and Legends

Hāmākua is one of six original *moku* (districts) on the island and is described as *kihi loa,* long corner, illustrating its southwestward extension to the summit of Mauna Loa (Pukui et al. 1974:39). This potion of the project area falls within the Hāmākua *moku*. Laupāhoehoe literally translates to smooth lava flat (Pukui et al. 1974:130) or leaf-shaped smooth lava (Clark 1985:4). Pukui et al (1974:130) report that Laupāhoehoe was an "ancient surfing area." Maulua translates to "always depressed" (Pukui et al 1974: 148), and Ka'awali'i means "the small 'awa" (Ulukau 2003).

Cultural Surveys Hawaii (CSH) (Tulchin et al., 2009) revealed four passages that make mention of Hāmākua in Mary Pukui's *'Oleto No 'eau: Hawaiian Proverbs* & *Poetical Sayings* (1983). The rugged landscape, exceptional length, and strong winds were reflected in passages from Pukui (1983).

The abundant rainfall and flourishing agriculture gave particular importance to the Hawaiian God Lono in the rituals and legends of Hāmākua. Images of Lono, being associated with abundant growth and dark, rain-laden clouds, were invoked by both rulers and commoners. The Hāmākua coast was also said to be claimed by Lono's animal form, Kamapua'a (pig child), as his domain.

The "Tradition of Kamapua'a" tells of how Kamapua'a fought Pele, the volcano goddess, for many days at Halema'uma'u, the crater at Kīlauea Volcano. Their dispute was settled by splitting the island between the two. Pele took stony Puna, Ka'u and Kona and Kamapua'a took Kohala, Hāmākua and Hilo (Fornander 1916:342).

The legend of "Pele and the Snow-goddess", recorded by Westervelt, detailed a battle between Pele and Poli'ahu, one of the snow maidens who dwell atop Mauna Kea. Pele's fire-fountains and lava were cast against Poli'ahu's mantle of snow causing clouds to gather over the summit of Mauna Kea.

The last legend of significance to this area is the story of the ruling chief 'Umi's (‚Umi-a-Uloa's) sacrifice of Pai'ea, a chief of Laupāhoehoe, as captured by Samuel M. Kamakau in the Hawaiian language newspaper *Ke Au 'Oko 'a* dated November 17, 1870.

Early 1800s

In 1819, Liholiho, heir to Kamehameha, abolished the *kapu* (tabu) system. In 1823, Reverend William Ellis spent two-months circumnavigating the entire island of Hawai'i, using the primary coastal route.

T. Stell Newman (2000) conducted an ethnohistorical study which combined Ellis' observations and modern environmental data in an effort to define indigenous Hawaiian land use patterns circa 1823. Using Ellis' journal writings, Newman reconstructed Ellis' route around the island, plotted this route onto a map and indicated Ellis' references to indigenous Hawaiian agriculture, population density, soil type, water resources, and botany. This mapping allowed Newman to establish four agricultural zones: Irrigation, Dryland Farming, Scattered Farms, and Field Systems (See Figure 7 of Appendix F). A review of the work performed by Newman indicates that the current project area falls in the Scattered Farms agricultural zone. This zone is defined as having low population density, dispersed settlement with few fishing villages at the coast, and scattered fields and gardens with no major field systems (Newman 2000).

The Mahele

The Organic Acts of 1845 and 1846 initiated the process of the Mahele - the division of Hawaiian lands, which introduced private property into Hawaiian society. In 1848, the crown and the *ali'i* (royalty) received their land titles. Kuleana awards for individual parcels within the ahupua'a were later granted to commoners *(maka'iinana)* in 1850. LCA records generated during the Mahele serve as the first specific documentation of land ownership in Hawai'i. Although an incomplete record of residency at that time, the LCAs can provide insight into patterns of residence and agriculture, including the intensity and nature of Hawaiian activity in that area.

No *kuleana* LCAs were awarded to commoners in the vicinity of the project area. Tulchin et al note that this suggests that indigenous Hawaiian land use within the project area may have been limited.

Alterations to the Hāmākua Coastline (1870s-1940s)

Prior to sugar cultivation in the area in the 1870s, the Hāmākua coastline may not have undergone much alteration. The coastal trail, as traversed by Ellis followed the natural contours of the local topography and provided mobility to indigenous inhabitants. Once sugar began a roadway and eventually a railroad were required to support the business that may influence the archaeological

findings of today. These land altering uses included sugarcane cultivation, construction of the Hawai'i Belt Highway, and construction of the Hilo Railroad.

Sugarcane Cultivation

Widespread sugar cultivation in the project vicinity began in the 1870s with the opening of Laupāhoehoe Sugar Company (later Hamakua Sugar Company) (Dorrance and Morgan 2000). This 900 acre plantation fronted the Hāmākua coast for approximately 10 miles with fields that extended *mauka* for 2 to 3 miles (Conde and Best 1973).

Handy and Handy (1972:538) reported taro terraces "in and below" Laupāhoehoe and Maulua *awāwa* in the late 1800s. Some sweet potatoes were grown in all three *awāwa* and in the vicinity of Ka'awali'i, sweet potatoes "used to rival taro as a staple." Handy (1940:164) noted "former taro lands along the lower slopes ... are now covered by sugar cane."

Original Belt Highway

The 1898 annual report by the Hawai'i Minister of the Interior details the completion of the road "…from Kiilau bridge through Laupāhoehoe to Ka'awali'i gulch, making one of the finest sections of road on the Island." The section was completed between November 1896 and October 1897 (Hawai'i Minister of the Interior 1898:190). A road through Maulua *awāwa* was also completed in 1897 (Hawai'i Minister of the Interior 1898:42). At that time, the Belt Highway ran in and out of each gulch.

Hilo Railroad

The original Hilo Railroad, later known as the Hawai'i Consolidated Railway, was constructed in the late 1800s by B.F. Dillingham, and traversed from Hilo to 'Ola'a Sugar Mill in Kea'au. The Hāmākua extension, called the Hāmākua *moku*, was constructed between 1909 and 1913. The line extended 35 miles and contained more than 3,100 feet of tunnels and 13 trestles to cross the valleys and streams along the coast.

The April 1, 1946 tsunami destroyed the railway. Because Consolidated Railway did not want to rebuild the Hawai'i Consolidated Railway right-of-way and remaining bridges, tunnels and trestles were offered to the Hawai'i Territory highway division. The highway division was not interested in the purchase and the railway was sold to the Gilmore Steel and Supply Company. The highway

division later purchased the rights from Gilmore after realizing the importance of the property. The current highway and portions of the current project area follow much of the railroad right-of-way. Several highway bridges are also converted railroad trestles (Laupāhoehoe Train Museum 2009).

6.1.2.2 Archaeological Research

Previous archaeological studies conducted in the area and reviewed for the CIA are identified in **Table 7**, Section 2.1.8. Historic and Archaeological Resources, above.

A summary of the studies is provided below:

> John F. O. Stokes (1919) of the Bishop Museum compiled the findings of fieldwork conducted primarily in 1906 and 1907 into a manuscript entitled *"Heiau of the Island of Hawaii: a Historic Survey of Native Hawaiian Temple Sites"* (1991). Five *heiau* in the immediate vicinity of Laupāhoehoe was documented (See Figure 15 of Appendix F). Four of the five *heiau* (Lonopuha, Kama'o, Papauleki'i, and Moeapuhi) were already destroyed by the time of Stokes's site visit to the Laupāhoehoe area, with Mamala or Ha'akoa Heiau being the only surviving structure (See Figure 16 of Appendix F).
>
> The Army Corps of Engineers (1983) undertook archaeological reconnaissance at Laupāhoehoe Point for the Laupāhoehoe Navigation Improvements Project (Cox 1983). One archaeological feature located along the north bank of Laupāhoehoe Stream was identified and consisted of a double-walled stepped terrace. This feature may have functioned as a large residence, stream diversion, canoe storage, or *heiau*. No State Inventory of Historic Properties (SIHP) number was assigned.
>
> Rechtman Consulting (2000) conducted an archaeological survey of a 2,900 square foot area above 'O'okala, in the *ahupua'a* of Humu'ula for the placement of a cell tower (Rechtman 2000). No historic properties were identified within the project area.
>
> CSH (2003) conducted a brief site inspection of the proposed Nextel Waipunalei (Laupāhoehoe) project site (Shideler and Hammatt 2003). No historic properties were identified within the project area. However, heavy damage to Mamala or Ha'akoa Heiau, originally identified by Stokes (Stokes 1991), was observed.
>
> CSH (2009) conducted a field inspection in which no historic properties were observed within the approximately 2.434 mile study area (Tulchin et al, 2009). The absence of historic properties is attributed to extensive land modifications associated with historic sugar cultivation and construction associated with the Hamakua Division of the Hilo Railroad and the Belt Highway.

6.1.2.3 Consultation with Community Contacts

Community consultation was undertaken by CSH with Hawaiian organizations, agencies and community members to seek out individuals with cultural expertise and/or knowledge of the project area and the vicinity. This effort was made by use of letters, e-mails, telephone, and in-person contact. In the majority of cases, letters along with a map of the project area were mailed with the following text:

> *At the request of R.M. Towill Corporation, Cultural Surveys Hawai'i Inc., is conducting the Cultural Impact Assessment (CIA) for the Rockfall Remediation of Hawai'i Belt Road in Maulua, Laupahoehoe, and Ka'awali'i Gulches, Maulua Nui, Laupahoehoe, and Humu'ula, Ahupua'a, North Hilo and Hamakua Districts, Hawai'i Island (TMK: [3] 3-4-002: 03, 04 & 05; [3] 3-6-04: 02, 11, 15, 17,23, & 30; [3] 3-9-01: 01). Please see the enclosed maps.*
>
> *The proposed project involves the construction of rockfall mitigation and stabilization measures along the Hawai'i Belt Road (Route 19) at specific locations adjacent to Maulua, Laupahoehoe, and Ka'awali'i Gulches. The mitigation and stabilization proposed by the Hawai'i Department of Transportation (HDOT), Highways Division include the installation of anchored wire mesh panels along the existing steep rock cut cliffs adjacent to the roadway entrances and exits of the three gulches, the creation of interceptor ditches above the cliffs to divert surface-water runoff, and minor improvements to existing drainage. The purpose of these measures is to improve highway safety along the segments fronting the three gulches by improving upon the present unsafe conditions resulting in falling rocks, boulders and associated sediments.*
>
> *Construction is anticipated to begin in the summer of 2010 starting at Laupahoehoe Gulch. Work at each gulch is estimated to last between one to two years and will be undertaken in sequence, with a total time of construction of approximately six years.*
>
> *The purpose of this cultural study is to assess potential impacts to cultural practices as a result of the proposed development in Maulua, Laupahoehoe, and Ka'awali'i Gulches. We are seeking your k6kua and input on any of the following aspects of this study:*
>
> *General history and present and past land use of the project area.*
>
> *Knowledge of cultural sites for example, historic sites, archaeological sites, and burials.*
>
> *Knowledge of traditional gathering practices in the project area, both past and ongoing.*
>
> *Cultural associations of the project area, such as legends and traditional uses.*
>
> *Referrals of kupuna and kama'aina who might be willing to share their cultural knowledge of the project area and the surrounding ahupua'a lands.*
>
> *Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the project area.*

The individuals, organizations, and agencies contacted by CSH, and the results of any consultation are presented in **Table 14.**

Table 14
Summary of Ongoing Community Consultation

Aila, William	Hui Malama I Na Kupuna 'O Hawai'i Nei	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 13, 2009. CSH emailed a copy of community outreach letter with maps on Feb. 13, Feb. 23 and March 11, 2009. CSH received a response email on March 11, 2009 which stated to consult with Aunty Pua or anyone she recommends.
Ayau, Halealoha	Hui Malama I Na Kupuna 'O Hawai'i Nei	CSH emailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 13, Feb. 23, March 11 and March 18, 2009.
Barton, Lisa	Laupahoehoe Train Museum, Coordinator	Judi Steinman referred Lisa Barton to CSH. CSH received a response email on March 21 and 31, 2009. See Appendix F for full statement.
Cayan, Phyllis "Coochie"	History & Culture Branch Chief, State Historic Preservation Division (SHPD)	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 13, 2009. CSH emailed a copy of community outreach letter with maps on Feb. 13, Feb. 23, March 11 and March 18, 2009.
Chung, Lucille	Queen Liliuokalani Children's Center (QLCC) - Hilo	CSH emailed a copy of community outreach letter with maps on March 20, 2009.
Donham, Theresa	Hawai'i Archaeologist, State Historic Preservation Division (SHPD)	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 13, 2009. CSH emailed a copy of community outreach letter with maps on Feb. 13, Feb. 23, March 11 and March 18, 2009.
Josephides, Analu	Cultural Historian, State Historic Preservation Division (SHPD)	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 13, 2009. CSH emailed a copy of community outreach letter with maps on Feb. 13, Feb. 23, March 11 and March 18, 2009.
Ka'apuni, Aunty Pili	*Kama'aina*	CSH emailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on March 11 and March 18, 2009. CSH received a response email March 19, 2009. See Appendix F for full statement.
Kahakalau, Kū	Big Island Burial Council (BIBC), Hāmākua	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 13, 2009. CSH emailed a copy of community outreach letter with maps on Feb. 13 and Feb. 23, 2009. CSH received a response email on March 6, 2009 which stated she is not knowledgeable about this area. Referred CSH to Aunty Pili Ka'apuni who may have some

		information.
Kahiapo, John	Education Specialist, Department of Land and Natural Resources, Division of Aquatic Resources (DLNR-DAR)	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 13, Feb. 24, March 11, and March 18, 2009.
Kane, Micah	Chairman, Hawaiian Homes Commission; Director, Department of Hawaiian Home Lands (DHHL)	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 13 and 24, 2009. CSH received a reply on Feb. 24, 2009 which stated that DHHL has no comment at this time. See Appendix F for full letter.
Keli'ikoa-Sherlock, Ululani	Vice-Chair, Big Island Burial Council (BIBC)	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 13, 2009. CSH emailed a copy of community outreach letter with maps on Feb. 13, Feb. 23, March 11 and March 18, 2009.
Laupahoehoe Library	Laupāhoehoe Library	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 13, Feb. 24, March 11 and March 18, 2009.
Lindsey, Keola	Lead Advocate-Culture, Office of Hawaiian Affairs (OHA)	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 13 and March 18, 2009. CSH emailed a copy of community outreach letter with maps on Feb. 13, Feb. 23, March 11 and March 18, 2009.
McShane, Marsue	Resided in Laupahoehoe from 1945 to 1952. Survivor of the April 1, 1946 tsunami.	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 24,2009. CSH interviewed Mrs. McShane on March 3, 2009. See Appendix F for statement.
Nahale-A, 'Alapaki	East Hawai' i Homes Commission, Department of Hawaiian Home Lands (DHHL)	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 13, Feb. 24, March 11 and March 18, 2009.
Namu'o, Clyde	Administrator, Office of Hawaiian Affairs (OHA)	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 13, 2009. CSH emailed a copy of community outreach letter with maps on Feb. 13, Feb. 23, 2009 and March 11,2009. CSH received a reply on March 11, 2009 which stated that OHA has no comment at this time. See Appendix C for letter.
Nishimoto, Dr. Robert T.	Program Manager, Department of Land and Natural Resources, Division of Aquatic Resources (DLNR-DAR)	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 13, Feb. 24, March 11 and March 18, 2009.
Office of Hawaiian Affairs	East Hawai'i – Hilo	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on March 13 and March 18, 2009.
Steinman Ph.D., Judi	Recording Secretary, North Hilo Community Council	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 13, Feb. 24, March 11 and March 18, 2009.
Young, Charles Kui Hin	Chair, Big Island Burial Council (BIBC)	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on Feb. 13, Feb. 24, March 11 and March 18, 2009.

6.1.2.4 Cultural Landscape

The traditional cultural practices of the Hawaiians of old were based on an awareness of the relationship between man and the natural resources. The cultural practices that grew from this relationship often were depended upon for survival and many exist to this day.

Traditional cultural practices and resources pertaining to the project area were assessed within the entire *ahupua'a* of Maulua Nui, Laupāhoehoe, and Humu'ula which contains the Maulua, Laupahoehoe and Ka'awali'i *awāwa*. Different types of traditional practices and cultural resources including discussions of specific aspects of traditional Hawaiian culture in relation to the project area are summarized below.

Marine and Freshwater Resources

The Hawaiians recognized the sea as a rich resource and were traditionally expert fishermen. Fish of all types have always supplied the Hawaiian diet and Hawaiian women traditionally practiced the gathering of *limu* (seaweeds) and *pa 'akai* (salt).

Intermittent *kahawai* (stream) and tributaries formed the Maulua, Laupahoehoe, and Ka'awali'i *awāwa*. These intermittent streams flowed from inland towards the ocean and emptied into the *muliwai* (river mouth).

Gathering of Plant Resources

Upland and forest resources were used for many purposes and provided food, clothing, and materials for tools, weapons, canoe building, house construction, dyes, adornments, hula, medicinal and religious purposes. Maulua, Laupahoehoe and Ka'awali'i *awawa* were noted by a community participant as being used historically and to the present day.

Traditional Hawaiian Sites

During the CSH field inspection no historic properties were observed in the study area. No burial sites or Hawaiian trails of historic or cultural significance were found within the proposed project area. Community participants have indicated that the lands surrounding the project area may be used for hunting pigs or goats in the mountains. The project area is associated with general *mo'olelo* (stories, legends), which are detailed in Section 6.1.2.1 of this Environmental Assessment.

Summary of Findings

Background research into the traditional and historic importance of the project area included the findings of previous archaeological studies, consultation with community members and organizations, and a field inspection. A total of twenty-one people were contacted, seven of which have responded to date. Research has shown that the area is termed a 'Scattered Farms' agricultural zone and is considered to be an area with a historically low population density, dispersed settlement with few fishing villages at the coast, and scattered fields and gardens with no major field systems (Newman 2000).

No historic properties were observed within the approximately 2.4 mile study area. The absence of historic properties is attributed to extensive land modification associated with sugar cultivation and construction of the Hamakua Division of the Hilo Railroad and the Belt Highway. No *kuleana* LCAs were awarded to commoners in the vicinity of the project further supporting other indications that indigenous Hawaiian land use may have been limited.

The project vicinity is associated with specific *mo'olelo*, but places areas of cultural importance outside of the affected project area. The use of the site for traditional or cultural practices is not expected based on the location of the project encompassing the existing rock cut cliffs beside the Hawai'i Belt Road. The modified condition of the project area includes the presence of introduced plant species not normally associated with cultural gathering or use. Plants present at the site include ironwood, eucalyptus and other introduced tree species, grasses contained within the adjacent agricultural lands located beside the Hawai'i Belt Road, and various other low lying weed and grass species along the roadway.

The developed and paved condition of the ROW area and the presence of steep cliffs are also not conducive to the gathering of important native species that may include tī, flowering plants, or other species bearing fruit. See also Section 2.1.6. – Flora/Fauna.

Potential Impacts and Mitigation

The potential for adverse impacts to traditional and cultural practices are not anticipated based on the location and existing use of the site as a State DOT roadway facility. Above and across the Hawai'i Belt Road the use of agricultural lands may be affected by the

temporary generation of noise. However, all work practices will be in accordance with the noise regulations of the State and County of Hawai'i.

As noted in **Section 2.1.8** Historic and Archaeological Resources, should iwi or other cultural remains be uncovered by earthwork or grading activities all work will be temporarily halted and the SHPD immediately notified for further instructions. Work will only be allowed to be resumed upon appropriate notification to do so by the SHPD.

Section 7
Agencies, Organizations and Individuals Consulted

The following agencies, organizations, and individuals were/will be contacted during the preparation of the EA for this project.

7.1. County of Hawai'i

Planning Department

Department of Environmental Management

Department of Public Works

Fire Department

Police Department

7.2. State of Hawai'i

Department of Health

Department of Land and Natural Resources

- Land Division
- State Historic Preservation Division

Department of Transportation - Highways Division

7.3. Federal Government

U.S. Fish and Wildlife Service

National Marine Fisheries Service

7.4 Elected Officials, Organizations and Individuals

The Hilo Hāmākua Community Development Corporation (HHCDC)

Mark M. Nakashima, State Representative - 1st Representative District

Dwight Y. Takamine, Senator - 1st Senatorial District

Council Member Dominic Yagong - District 1

Hawai'i County Council

Section 8
Summary of Impacts and Significance Determination

8.1. Short Term Impacts

Short term impacts are expected to be limited and will last for only the duration of construction. The construction contractor will access the project site via the Hawai'i Belt Road and noise will be generated from construction and related mobilization of equipment.

Construction equipment is expected to include a crane and boom, dump, and concrete trucks, and powered hand tools. All equipment will be muffled in accordance with standard engine operating practices. The work is anticipated to occur during weekday daylight hours, but weekend construction activity may be required to avoid impacts to weekday commuter traffic. Engine exhausts will be governed in accordance with applicable State and County regulations. Upon construction completion, noise levels will return to ambient levels.

Dust and associated nuisance problems are expected to be slight to insignificant due to the limited scope and scale of the project. Fugitive dust will be controlled with the use of dust screens and/or regular wetting of the soil by the contractor.

Construction activity will temporarily disturb soils. To minimize soil erosion, silt fences, berms and other applicable erosion control devices will be utilized to prevent construction-related soil and silt from leaving the active work area and mixing with storm water.

All necessary environmental permit applications and building permit approvals will be secured prior to initiation of construction activities.

8.2. Long Term Impacts

Long term benefits derived from this project include improved rockfall protection to and a reduced need for rockfall clean in the area of the three subject gulches fronting the Hawai'i Belt Road. These improvements will be constructed in compliance with State and County standards. No long term adverse impacts are anticipated. Upon completion, all construction equipment used on-site will be demobilized and all debris and waste materials will be disposed of at an approved refuse facility.

8.3. Significance Criteria

In accordance with the content requirements of Chapter 343, Hawai'i Revised Statutes (HRS), and the significance criteria set forth in Section 11-200 of Title 11, Chapter 200, Hawai'i Administrative Rules (HAR), it is anticipated that this project will have no significant negative environmental impacts. All anticipated potential impacts will be addressed through the use of mitigation measures and practices as set forth in this Environmental Assessment. The recommended preliminary determination for the proposed project is a Finding of No Significant Impact (FONSI). The findings and reasons supporting this determination are summarized as follows:

1. *Involves an irrevocable commitment to loss or destruction of any natural or cultural resource*

   The proposed project is not anticipated to result in the adverse loss of natural or cultural resources. There are no known threatened or endangered species of plants or wildlife that inhabit the immediate area of the project site. Given the transportation related use of the site, historic or archaeological sites are not known to be present which would be subject to adverse effects.

   In the unlikely event of a discovery of significant historic or archaeological resources, the SHPD will be immediately notified for appropriate action and treatment. All activities will comply with the required provisions of Chapter 106, NHPA, and Chapter 6E, HRS, as well as other provisions of law governing natural of cultural preservation and protection to prevent the irrevocable loss of natural or cultural resources.

2. *Curtails the range of beneficial uses of the environment*

   The subject property is utilized for transportation related purposes and within the State DOT ROW. Acquisition of small portions of adjacent agricultural land may be required, but it is anticipated that this acquisition will benefit the adjacent properties by slowing the erosion rate of the cliff. The proposed action does not curtail beneficial uses of the environment.

3. *Conflicts with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 343, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders*

The proposed project is consistent with the environmental policies, goals and guidelines expressed in HRS, Chapter 343. Potential sources of adverse impacts have been identified and appropriate measures have been developed to either mitigate or minimize potential impacts to negligible levels.

4. *Substantially affects the economic and social welfare of the community or state*

The proposed project will not affect the economic and social welfare of the community or State. The proposed improvements will promote the safety of motorists transiting the Hawai'i Belt Road in the project vicinity. The construction of the improvements will be regulated in accordance with County of Hawai'i and State regulations.

5. *Substantially affects public health*

Factors affecting public health, including air quality, water quality, and noise levels, are expected to be only minimally affected, or unaffected. The proposed project does not pose a direct threat to public health and safety. Potential impacts will be mitigated in accordance with regulations.

6. *Involves substantial secondary impact, such as population changes or effects on public facilities*

The proposed activity is expected to have little to no secondary or indirect impacts such as population changes or effects on public facilities based on the limited scope and scale of the project.

7. *Involves a substantial degradation of environmental quality*

Impacts to air and water quality, noise levels, natural resources, and land use associated with the planned improvements are anticipated to be minimal. Mitigation measures will be employed as practicable to further minimize potentially detrimental effects to the environment. The proposed project does not involve substantial degradation of environmental quality.

8. *Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions*

The proposed rockfall protection improvements are individually limited and do not involve a commitment to larger actions. Replacement may be required in the future and will need to be inspected in approximately 15 to 20 years. However, appropriate future improvements to this section of the Hawai'i Belt Highway will require a new assessment of the area at that time.

9. *Substantially affects a rare, threatened or endangered species*

The proposed project is not anticipated to impact rare, threatened or endangered species or habitats.

10. *Detrimentally affects air or water quality or ambient noise levels*

On a short-term basis, ambient air and noise conditions may be affected by construction of the proposed improvements, but these are short-term and can be controlled by the mitigation measures as described in this EA. Once the project is completed, air and noise in the project vicinity will be allowed to return to preconstruction conditions.

11. *Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters*

It is the goal of the proposed project to provide rockfall protection to an erosion-prone area. While safety measures are required during the construction phases, the proposed additions will not negatively impact or be negatively impacted by erosion conditions. Conversely, these additions will improve safety and maintenance conditions in the project area. The proposed action is not expected to have a significant impact on flood plain, tsunami zone, estuary, fresh water, or coastal waters.

12. *Substantially affects scenic vistas and viewplanes identified in county or state plans or studies*

Minimal impacts to scenic vistas and viewplanes are expected. The project will involve the installation of wire mesh paneling across the rock cut slopes of Ka'awali'i, Laupāhoehoe and Maulua Gulches. While these additions will be visible, they are not anticipated to negatively affect mauka or makai views

13. Requires substantial energy consumption

Construction and daily activities associated with the proposed site improvements will require the consumption of energy. The use of energy during construction will be unavoidable and irretrievable. However, the rockfall mitigation improvements will greatly reduce the amount of energy spent on daily highway clearing. The energy required for this project, given the long term benefits is not considered substantial.

Section 9
Findings

In accordance with the provisions set forth in HRS, Chapter 343, and the significance criteria in HAR, Section 11-200-12 of Title 11, Chapter 200, it is anticipated that the proposed project will have no significant adverse impacts, including secondary or cumulative impacts, to water quality, air quality, existing utilities, noise levels, social welfare, archaeological sites, or wildlife habitat. All anticipated impacts are expected to be temporary in duration and will not adversely impact the environmental quality of the area. It is expected that an Environmental Impact Statement (EIS) will not be required, and that a Finding of No Significant Impact (FONSI) will be issued for this project.

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http://www.ctahr.hawaii.edu/soilsurvey/soils.htm

U.S. Geological Survey (USGS): Hawaiian Volcano Observatory;
http://hvo.wr.usgs.gov/volcanoes/maunakea/ , http://hvo.wr.usgs.gov/earthquakes/

Lava Flow Hazard Zone Maps, Hawai'i Island; http://pubs.usgs.gov/gip/hazards/maps.html

Appendix A

Preliminary Drainage Assessment
Hawai‘i Belt Road Rockfall Protection
at Maulua, Laupāhoehoe and Ka‘awali‘i Gulches
North Hilo and Hāmākua, Island of Hawai‘i, Hawai‘i

PRELIMINARY DRAINAGE ASSESSMENT

PURPOSE

The purpose of this assessment is to identify existing drainage patterns within the three gulches and evaluate potential drainage improvements.

REFERENCES

1. USGS maps, 1982.
2. Geolabs report, July 2002.
3. "Design Criteria for Highway Drainage", State of Hawaii, Department of Transportation, Highways Division, December 5, 1985.

SCOPE OF WORK

Identify existing drainage patterns along the highway alignment within the gulches and provide recommendations for drainage improvements. The limits of work for this assessment are shown below:

Gulch	Baseline Stations
Kaawalii	99+00 to 118+00
	122+00 to 140+50
Laupahoehoe	30+00 to 54+00
	58+50 to 61+00
	65+00 to 82+00
Maulua	30+00 to 50+00
	60+00 to 83+00

For this assessment, defined drainage ways crossing the gulch slopes will not be included since the existing highway takes these features into account. Existing culverts or bridges at these crossings accommodate the runoff in the drainage ways. Rockfall within the streams does not affect the motorists on the highway because it is contained within the limits of the stream. Therefore, this assessment will focus on surface water flow traversing the gulch slopes, which has the potential to erode the slope.

EXISTING WATERSHED CHARACTERISTICS

Terrain

Steep cut slopes are adjacent to the highway within the gulches. The slopes are typically covered with vegetation consisting of trees, grass and brush. Exposed rocks and boulders are also visible on the slopes. Typical slopes for each gulch are shown below (vertical:horizontal):

Side	Kaawalii	Laupahoehoe	Maulua
North	2.5V:1H	1.5V:1H	1.1V:1H
South	2V:1H	1.8V:1H	1.1V:1H

The slope heights vary between 190 feet and 360 feet.

Sources of Runoff

There are two main sources of water flowing down the gulch slopes, runoff and groundwater. Stormwater runoff flows down the slopes where it is collected in roadside swales and captured in drain inlets. The inlets are connected to culverts under the highway, which outlet into the gulch. Runoff flowing down the slope creates potential hazards along the highway by exposing rocks and boulders.

Another source of water flowing down the gulch slopes is groundwater seepage. Natural springs daylight onto the slope face at various locations throughout the gulches. The flow rates of springs range from moisture wicking (low) to stream flow (high).

The locations of observed water sources are summarized below:

Gulch	Source	Approx. Location
Kaawalii	waterfall	Sta. 127+25
Maulua	spring	Sta. 34+25
Maulua	stream	Sta. 50+50
Maulua	waterfall/streams	Sta. 71+50 to Sta. 73+50

Drainage Areas

Approximate drainage areas are shown in Figures 1 to 3. Other than streams, most of the drainage areas along the gulch slopes are limited to the area between the top of slope and the highway. Since the drainage areas do not extend beyond the top of the slopes, the runoff contribution from upstream drainage areas is negligible. Therefore, most of the runoff flowing down the slopes is generated on the slope itself.

Hydrologic Analysis

A hydrologic analysis should be conducted to quantify the amount of runoff generated on the gulch slopes. The following criteria should be used for this analysis:

- Design Storm - 25 year (arterial)
- Methodology - Rational Method (drainage area < 200 acres)

PROPOSED DRAINAGE IMPROVEMENTS

To reduce the amount of runoff traversing the gulch slopes, three types of drainage improvements should be considered:

- Interceptor ditches
- Subsurface drains
- Vegetation

Interceptor Ditch

Interceptor ditches should be used to reduce the quantity and velocity of runoff flowing down the gulch slopes. Since drainage areas above the gulches do not contribute runoff to the gulch slopes, a swale located at the top of the gulch would not reduce the amount of surface runoff. A swale would be more useful if it is located along benches on the slope face. These swales will transport runoff to a nearby stream or gulch for disposal. The swales should be lined to prevent infiltration into the cut slopes.

Subsurface Drains

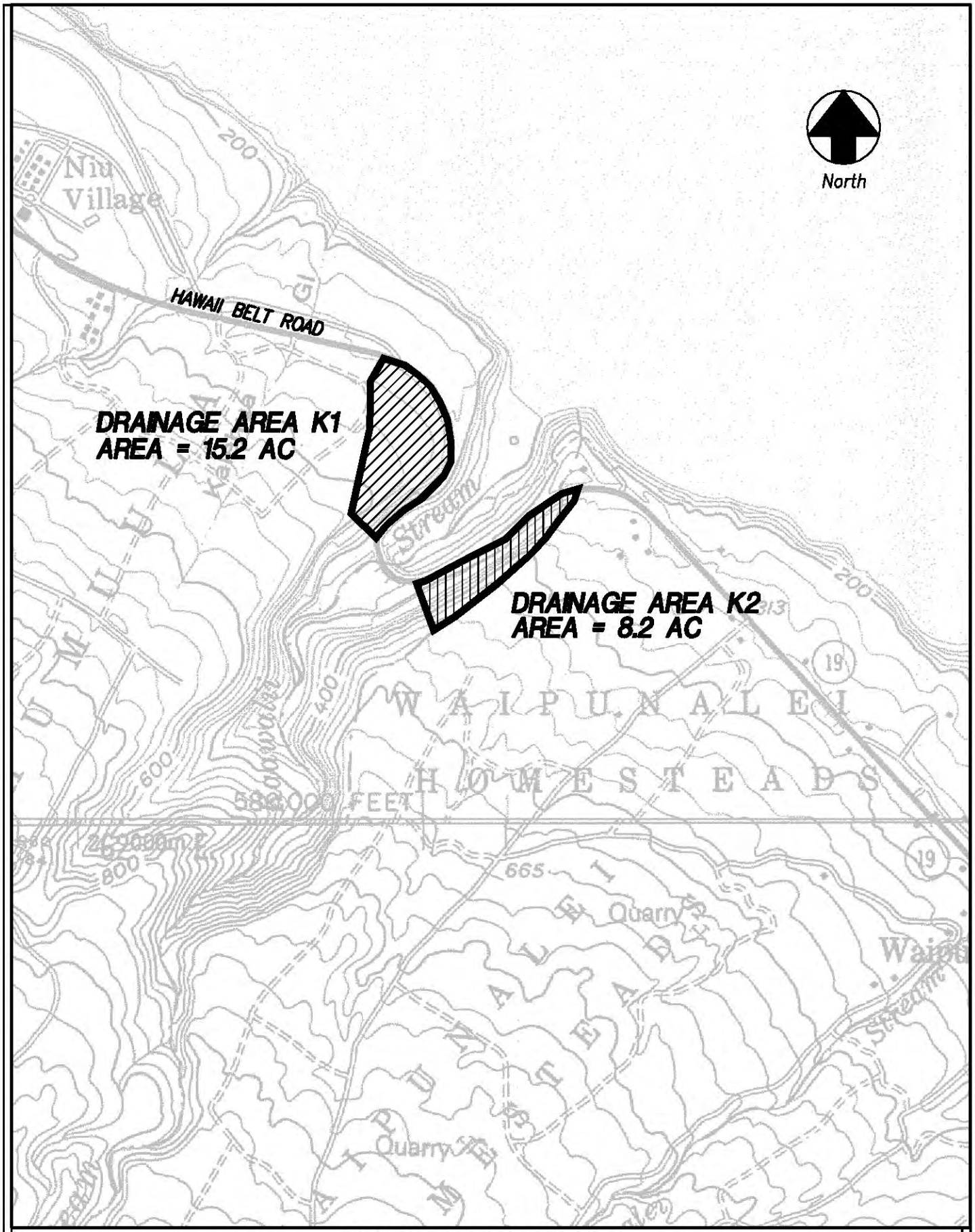
Subsurface drains would consist of holes drilled into the cut slope. The holes would be lined with perforated pipe and/or sand backfill. The drains can be installed horizontally or vertically. These drains will alleviate some of the groundwater, thereby reducing the potential for springs.

Vegetation

Vegetation can be planted on the slopes used to reduce moisture in the soil. Plants should be selected based on their ability to absorb moisture in the ground without developing an obtrusive root network or large canopy.

Conclusion

The most effective solution should incorporate a combination of all three of the drainage improvements listed above. Any or all of these improvements should be implemented in conjunction with the proposed slope stability and highway improvements as part of the rockfall project. At a minimum, interceptor ditches should be installed along benches on the slopes.

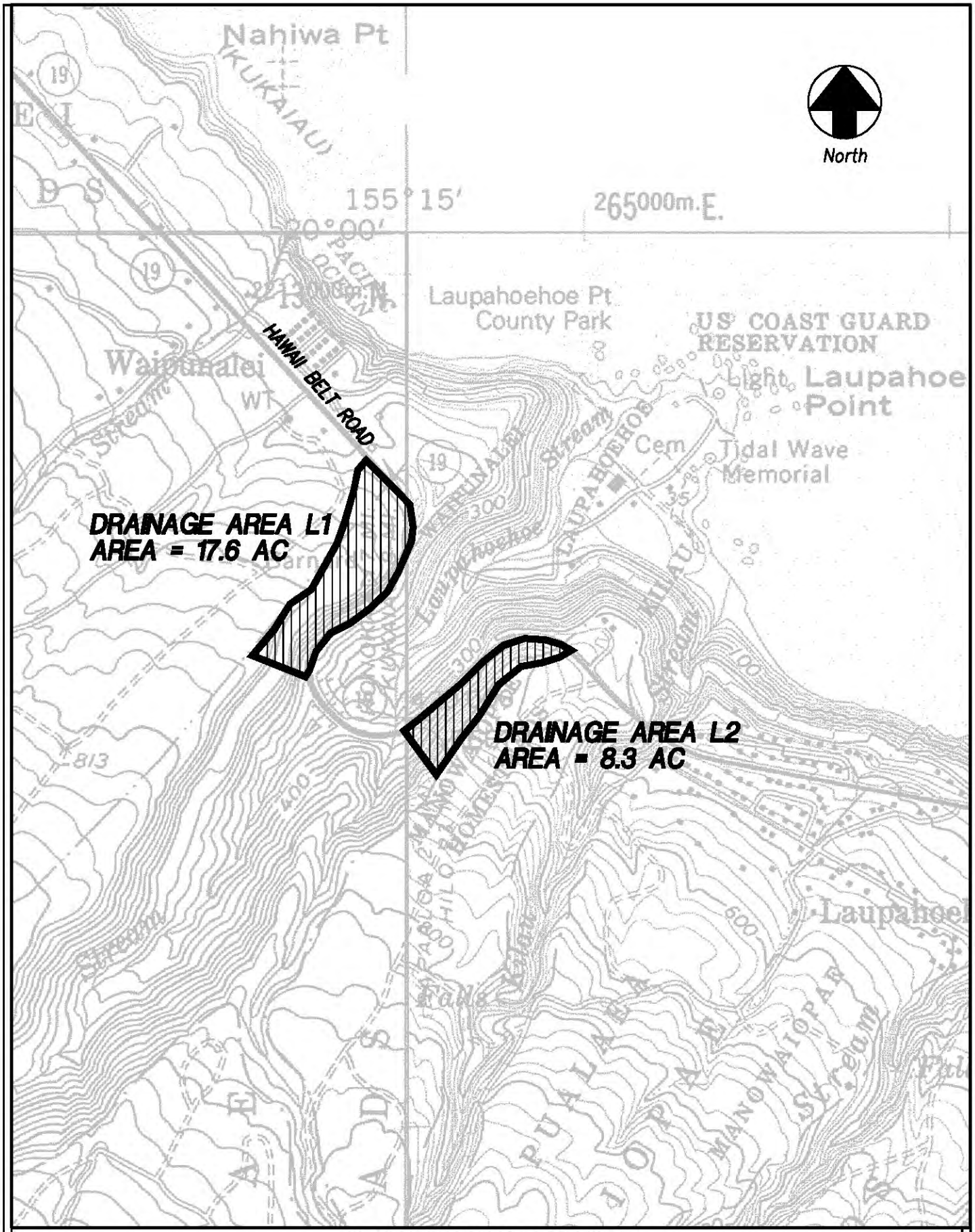


PRELIMINARY DRAINAGE ASSESSMENT

Planning – Engineering – Environmental Services – Photogrammetry – Surveying – Construction Management
R. M. TOWILL CORPORATION
808 329 4494 73-5574 Malau Street Suite 11 Kailua-Kona Hawaii 96740

KAAWALII GULCH
DRAINAGE AREAS
SCALE: 1" = 1000'

Figure
1

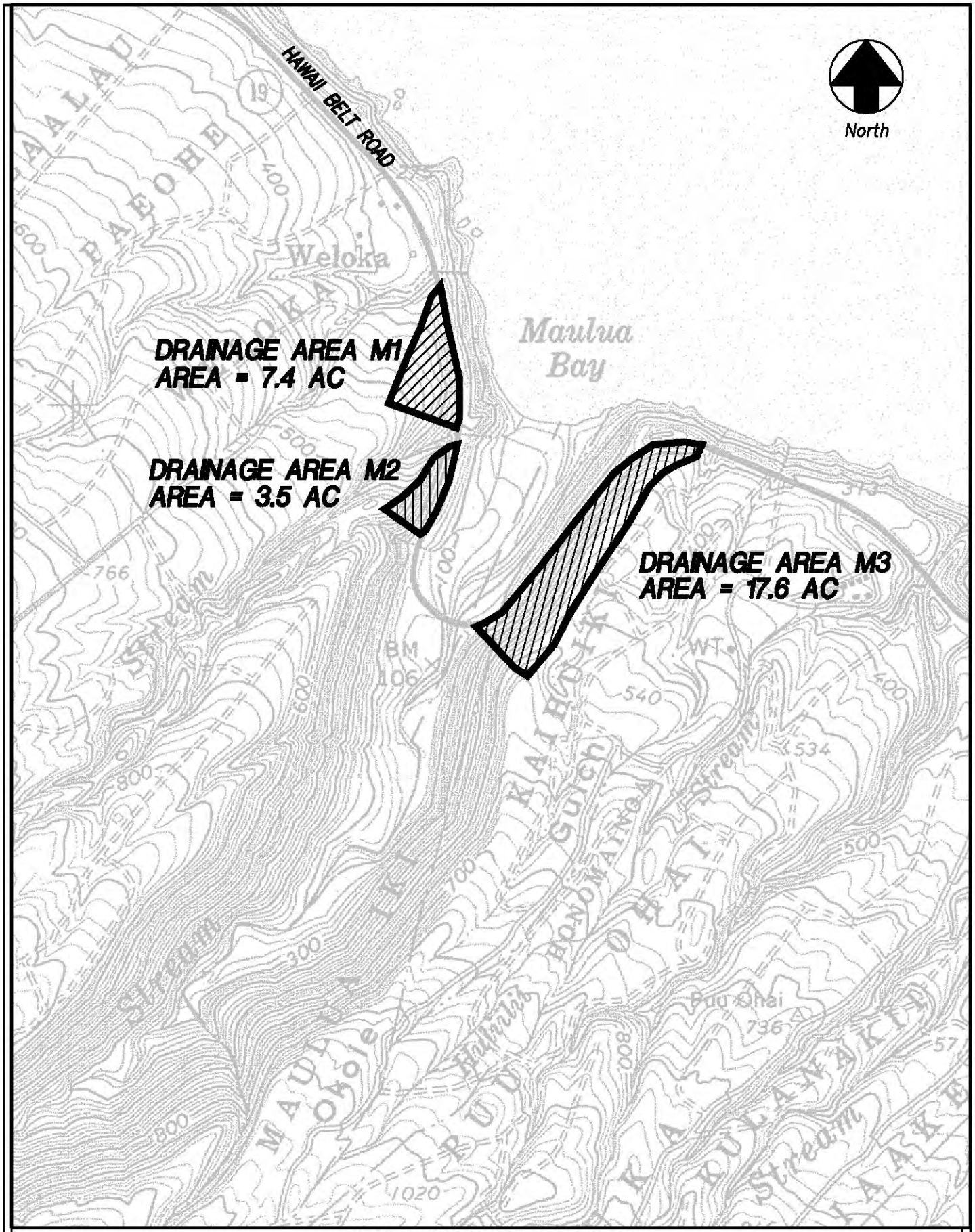


PRELIMINARY DRAINAGE ASSESSMENT

Planning – Engineering – Environmental Services – Photogrammetry – Surveying – Construction Management
R. M. TOWILL CORPORATION
808 329 4494 73-5574 Maiau Street Suite 11 Kailua-Kona Hawaii 96740

LAUPAHOEHOE GULCH
DRAINAGE AREAS
SCALE: 1" = 1000'

Figure
2



PRELIMINARY DRAINAGE ASSESSMENT

Planning – Engineering – Environmental Services – Photogrammetry – Surveying – Construction Management
R. M. TOWILL CORPORATION
808 329 4494 73-5574 Maiau Street Suite 11 Kailua-Kona Hawaii 96740

MAULUA GULCH
DRAINAGE AREAS
SCALE: 1" = 1000'

Figure 3

Appendix B

Biological Surveys in Maulua, Laupāhoehoe and Ka‘awali‘i Gulches for a Highway Rockfall Protection Project North Hilo, Island of Hawai‘i, Hawai‘i

Rept. No. AC082

Biological surveys in Maulua, Laupāhoehoe, and Ka‘awali‘i gulches for a highway rockfall protection project, North Hilo, Island of Hawai‘i

March 9, 2009

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INTRODUCTION

State Rte. 19 between Honoka‘a and Hilo crosses the windward slope of Mauna Kea. A number of gulches cut into the ancient shield volcano, the largest of these being Ka‘awali‘i (Kawāili), Laupāhoehoe, and Maulua (Fig. 1), which approach 1000 ft (300 m) in depth near the coast. The highway crosses on bridges the numerous other smaller gulches along the Hāmākua Coast, but these three were too large to be spanned and required that the highway traverse the side walls to a lower elevation bridge over each stream. To accomplish this feat required extensive cuts in the basalt formations of the steep gulch margins (see Fig, 2). State Highways Division (State DOT) is planning to undertake rockfall protection efforts (the "project") involving selected slopes above the roadway within the three gulches (R.M. Towill, 2005).

This report summarizes the findings of biological/natural resources surveys conducted within the project sites. The primary purpose of the surveys was to determine if there were any botanical, avian, or mammalian species currently listed as endangered, threatened, or proposed for listing under either the federal or the State of Hawai‘i's endangered species programs on, or within in the immediate vicinity of the site. Federal and State of Hawai‘i listed species status follows species identified in the following referenced documents (Division of Land and Natural Resources (DLNR) 1998, Federal Register 2005, U. S. Fish & Wildlife Service (USFWS) 2005, 2008a). Fieldwork was conducted in February 2009.

[1] Rana Productions Ltd., Kailua-Kona

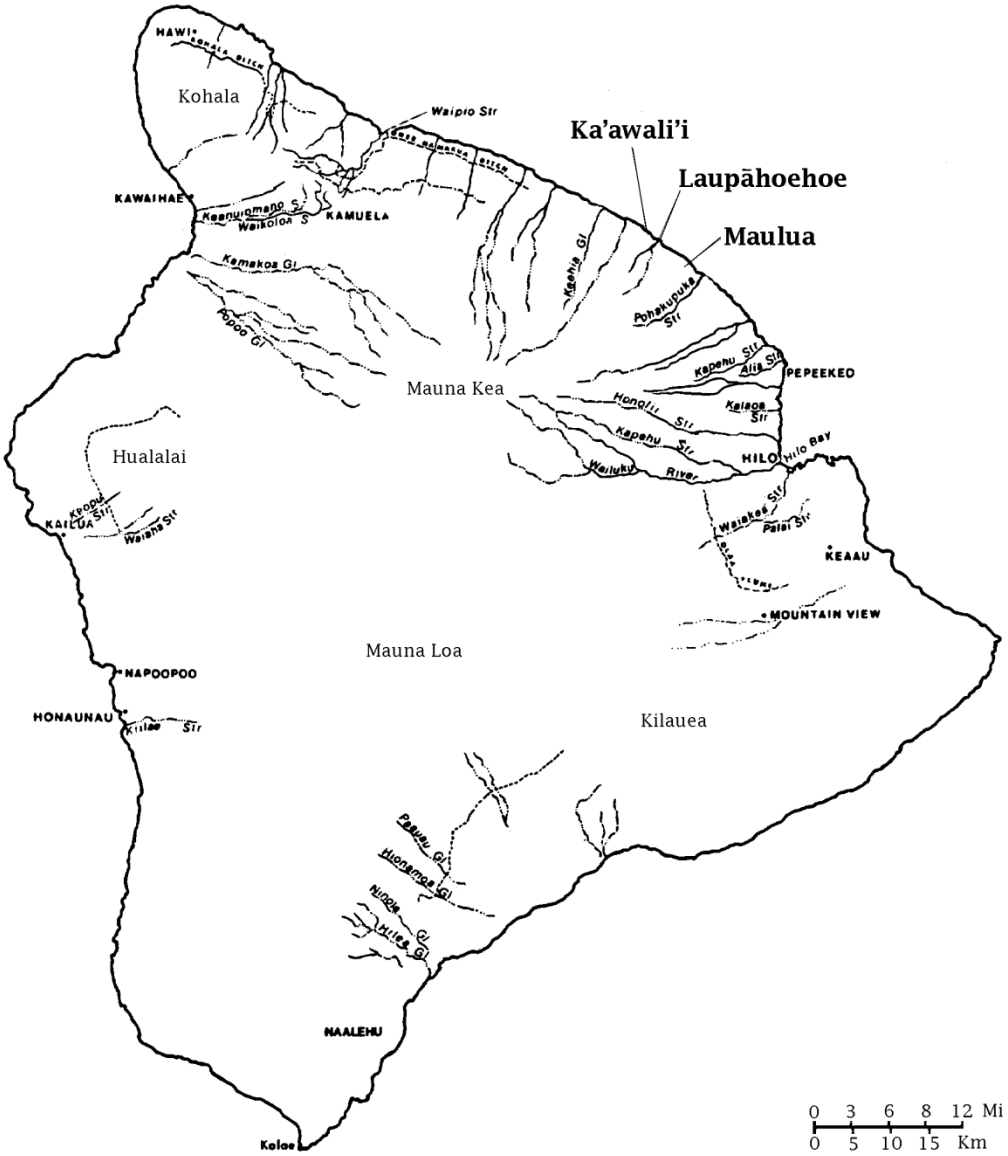

Figure 1. Approximate locations of the project gulches on the northeast coast of the Island of Hawai'i.

METHODS

Place names follow *Place Names of Hawaii* (Pukui et al. 1974).

Botanical Survey Methods

Because of very steep slopes and the potential that climbing around on the cliff faces could cause rockfalls endangering motorists, the botanical survey was limited to making observations from the highway itself and identifying plants present on the slopes from a distance. All tree species observed were recognizable from these distances, but binoculars (Leica Ultravid 8 x 42) were needed to identify the smaller plants. This approach proved serviceable since the vegetation occupied an exposed face and consisted mostly of low growing grasses, leafy herbs, vines, and shrubs with an open covering of trees. Forest vegetation was present higher on the slopes, generally above the project area. Difficulty was encountered in confirming the identification of some of the ferns, as these require close up inspection of the fronds, and no doubt some small plant species were missed. Plant names follow *Hawai'i's Ferns and Fern Allies* (Palmer, 2003) for ferns, *Manual of the Flowering Plants of Hawai'i* (Wagner et al., 1990, 1999) for native and naturalized flowering plants, and *A Tropical Garden Flora* (Staples and Herbst, 2005) for crop and ornamental plants.

Avian Survey Methods

The three stretches of roadway were walked from the north rim to the south rim and then in reverse. The zoologist covered the same area as the botanist and walked the routes at the botanist's pace. It took approximately one hour to survey each of the gulches. A running tally was kept of all avian and mammalian species detected during the time spent within each gulch. Field observations were made with the aid of Leitz 10 X 42 binoculars and by listening for vocalizations.

The avian phylogenetic order and nomenclature used in this report follows *The American Ornithologists' Union Checklist of North American Birds 7th Edition* (American Ornithologists' Union 1998), and the 42nd through the 49th supplements to *Check-list of North American Birds* (American Ornithologists' Union 2000; Banks et al. 2002, 2003, 2004, 2005, 2006, 2007, 2008).

Mammalian Survey Methods

With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *'ōpe'ape'a* as it is known locally, all terrestrial mammals currently found on the Island of Hawai'i are alien species. Most are ubiquitous. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other

animal sign. A running tally was kept of all vertebrate species observed, heard or detected by other means within each of the three project areas.

Figure 2. South-facing slope on Belt Highway at Laupāhoehoe Gulch. Eroding face here limits plant growth; densely forested (*Casuarina equisetifolia*) slopes are mostly above the project site.

RESULTS

Botanical Survey

The results of the botanical survey include a brief description of the vegetation in the project area and a list of plant species (flora; Table 1) identified during the February 2009 survey.

VEGETATION — The nature of the vegetation on the various slopes varies dependent upon the friable nature of the slope. Exposure (north vs. south) probably also plays a role. On the more easily eroded slopes, the vegetation is dominated by smaller shrubs and juvenile trees. The typical vegetation of these slopes is some combination of several

grasses (Guinea grass, or *Urochloa maxima*, elephant grass or *Pennisetum purpureum,* and molasses grass or *Melinus minutiflora*), several shrubs, such as sourbush (*Pluchea carolinensis*), lantana (*Lantana camara*), and strawberry guava (*Psidium cattleianum*), and scattered trees, typically juvenile or short statured ironwood (*Casuarina equisetifolia*), gunpowder (*Tremma orientalis*), melochia (*Melochia umbellata*), guava (*Psidium guajava*), and Chinese banyan (*Ficus microcarpa*). On the south slopes of Laupāhoehoe and Maulua, the endemic native tree called *neleau* (*Rhus sandwicensis*) is very abundant. The growths are small, presumably root suckers as this species is known to form dense thickets in this manner (Wagner, et al., 1990). In places where landslides are infrequent if occurring at all, large trees have developed into a forest.

Table 1. Flora listing for the Hāmākua Rockfall Protection Project: Maulua, Laupāhoehoe, and Ka'awali'i gulch side slopes, Island of Hawai'i.

Species listed by family	*Common name*	*Status*	*Abundance*	*Notes*
	FERNS AND FERN ALLIES			
BLECHNACEAE				
Blechnum appendiculatum Willd.	---	Nat	A	
GLEICHENIACEAE				
Dicranopteris linearis (Burm. f.) Underw.	*uluhe*	**Ind**	U3	[4]
NEPHROLEPIDACEAE				
Nephrolepis multiflora (Roxb.) F.M. Jarrette ex C. V. Morton	---	Nat	O3	[1]
POLYPODIACEAE				
Phymatosorus grossus (Langsd. & Fisch.) Brownlie	*laua'e*	Nat	U2	
PTERIDACEAE				
Adiantum hispidulum Sw.	rough maidenhair fern	Nat	U2	
THELYPTERIDACEAE				
Christella dentata (Forssk.) Brownsey & Jermy	oak fern	Nat	U	[5]
Christella parasitica (L.) Lév	oak fern	Nat	C	[5]
SCHIZAEACEAE				
Lygodium japonicum (Thumb.) Sw.	Japanese climbing fern	Nat	R2	[4]
	FLOWERING PLANTS			
	Dicotyledons			
ACANTHACEAE				
Justicia betonica L.	white shrimp plant	Nat	U2	
Thunbergia fragrans Roxb.	sweet clock vine	Nat	U	[1]

Table 1 (continued).

Species listed by family	*Common name*	*Status*	*Abundance*	*Notes*
ANACARDIACEAE				
Mangifera indica L.	mango	Nat	U	
Rhus sandwicensis A. Gray	*neleau*	**End**	C3	[3,4]
Schinus terebinthifolius Raddi	Christmas berry	Nat	U	
ARALIACEAE				
Schefflera actinophylla (Endl.) Harms	octopus tree	Nat	O	
ASTERACEAE (COMPOSITAE)				
Ageratina riparia (Regel) R. King & H. Robinson	Hāmākua *pāmakani*	Nat	U3	[3]
Ageratum conyzoides L.	*maile hohono*	Nat	U	
Bidens pilosa L.		Nat	U2	
Conyza sp.	horseweed	Nat	U	[5]
Crassocephalum crepidioides (Benth.) S. Moore	---	Nat	R	
ASTERACEAE (continued)				
Emilia fosbergii Nicolson	Flora's paintbrush	Nat	U	
Pluchia carolinensis (Jacq.) G. Don	sourbush	Nat	C	
Sphagneticola trilobata (L.) Pruski	wedelia	Nat	U	[1]
Youngia japonica (L.) DC	Oriental hawksbeard	Nat	R	
BEGONIACEAE				
Begonia hirtella Link	begonia	Nat	U	
BIGNONIACEAE				
Spathodea campanulata P. Beauv.	African tulip tree	Nat	C	
BUDDLEJACEAE				
Buddleja asiatica Lour.	dog tail	Nat	U	
CASURINACEAE				
Casuarina equisetifolia L.	ironwood	Nat	C-A	
CONVOLVULACEAE				
Ipomoea indica (J. Burm.) Merr.	*koali 'awa*	**Ind**	U2	
Merremia tuberosa (L.) Rendle	wood rose	Nat	U	[1]
CRASSULACEAE				
Kalanchoë pinnata (Lam.) Pers.		Nat	U2	[3]
EUPHORBIACEAE				
Aleurites moluccana (L.) Willd.	*kukui*	**Pol**	O	
Chamaesyce hirta (L.) Millsap.	garden spurge	Nat	U	
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	Nat	U	
Chamaesyce prostrata (Aiton) Small	prostrate spurge	Nat	R	[1]
Euphorbia heterophylla L.	*kaliko*	Nat	A	

Table 1 (continued).

Species listed by family	*Common name*	*Status*	*Abundance*	*Notes*
FABACEAE				
Chamaecrista nictitans (L.) Moench	partridge pea	Nat	U	[1]
Crotalaria sp	rattlepod	Nat	R	[1,5]
Delonix regia (Bojer ex Hook.) Raf.	royal poinciana	Nat	R	[1]
Desmodium incanum DC	Spanish clover	Nat	U	
Falcataria moluccana (Miq.) Barneby & Grimes	albizia	Nat	R	[1]
Macroptilium lathyroides (L.) Urb.	---	Nat	U	
LAMIACEAE				
Hyptis pectinata (L.) Poit.	comb hyptis	Nat	O	
MALVACEAE				
Hibiscus tiliaceus L.	*hau*	**Ind**	U3	[4]
Sida acuta N. L. Burm.	---	Nat	R	
MELASTOMATACEAE				
Clidemia hirta (L.) D. Don	Koster's curse	Nat	R	
Melastomia cf. *septemnervium* Lour.	---	Nat	U2	[5]
MORACEAE				
Artocarpus altilis (Parkinson) Fosberg	*'ulu,* breadfruit	**Pol**	R	[4]
Ficus microcarpa L. fil.	Chinese banyan	Nat	O	
MYRTACEAE				
Eucalyptus sp.	forest plantings	Nat	O3	[1]
Metrosideros polymorpha Gaud.	*'ohi'a*	**End**	R3	[4]
Psidium cattleianum Sabine	strawberry guava	Nat	C3	
Psidium guajava L.	common guava	Nat	C	
Syzygium cumini (L.) Skeels	Java plum	Nat	O	
Syzygium jambos (L.) Alston	Rose apple	Nat	R	[4]
NYCTAGINACEAE				
Bougainvillea cf. *spectabilis* Wildenow	bougainvillea	Orn	R	
OXALIDACEAE				
Oxalis corniculata L.	yellow wood sorrel	**Pol**	R	
PASSIFLORACEAE				
Passiflora foetida L.	running pop	Nat	R	
Passiflora moillissima (Kunth) L.H. Bailey	banana poka	Nat.	R	
POLYGALACEAE				
Polygala paniculata L.	---	Nat	R	[1]
RUBIACEAE				
Morinda citrifolia L.	Indian mulberry, *noni*	**Pol**	U	
Paederia foetida L.	*maile pilau*	Nat	R	
STERCULIACEAE				
Melochia umbellata (Houtt.) Stapf	---	Nat	O-C	

Table 1 (continued).

Species listed by family	*Common name*	*Status*	*Abundance*	*Notes*
ULMACEAE				
Trema orientalis (L.) Blume	gunpowder tree	Nat	C	
VERBENACEAE				
Lantana camara L.	lantana	Nat	O3	
FLOWERING PLANTS				
Monocotyledons				
AGAVACEAE				
Cordyline fruticosa (L.) A. Chev..	ti, *ki*	**Pol**	O3	
ARACEAE				
Philodendron erubescens K. Koch & Augustin	red-leaf philodendron	Orn	R	[2]
ARECACEAE				
Archontophoenix alaxandrae (F. v. Mueller) Wendl. & Drude	Alexandria palm	Nat	R	[1]
Cocos nucifera L.	coconut	Nat	U	
Livistona chenensis (N. Jacq.) Martius	Chinese fan palm	Nat	U2	[1,4]
COMMELINACEAE				
Commelina diffusa N. L. Burm.	day flower	Nat	R	
MUSACEAE				
Musa sp.	banana	Nat	R	
ORCHIDACEAE				
Spathoglottis plicata Blume	Malayan ground orchid	Nat	U2	
PANDANACEAE				
Pandanus tectorius S. Parkinson ex Z	*hala*	**Ind**	O3	
POACEAE				
Andropogon virginicus L.	broomsedge	Nat	U3	
Chloris barbata (L.) Sw.	swollen fingergrass	Nat	U3	[1]
Eleusine indica (L.) Gaertn.	wire grass	Nat	U	[1]
Melinus minutiflora P. Beauv.	molasses grass	Nat	A	
Melinis repens (Willd.) Zizka	Natal redtop	Nat	U	[1]
Pennisetum purpureum Schumach.	elephant grass	Nat	AA	
Pennisetum setaceum (Forssk.) Choiv.	fountain grass	Nat	U3	[3]
Saccharum officinarum L.	sugar cane	Orn	R	[3]
Sacciolepis indica (L.) Chase	Glenwood grass	Nat	R	[1]
Urochloa maxima (Jacq.) R. Webster	Guinea grass	Nat	AA	

Table 1 Legend:

STATUS = distributional status for the Hawaiian Islands:

end. = endemic; native to Hawaii and found naturally nowhere else.

ind. = indigenous; native to Hawaii, but not unique to the Hawaiian Islands.

Table 1 (continued). Legend:

nat. = naturalized, exotic, plant introduced to the Hawaiian Islands since the arrival of Cook Expedition in 1778, and well-established outside of cultivation.able 1 (continued).

orn. = exotic, ornamental or cultivated; plant not naturalized (not well-established outside of cultivation).

pol. = Polynesian introduction before 1778.

ABUNDANCE = occurrence ratings for plants in the project area:

R – Rare seen in only one or perhaps two locations.
U - Uncommon- seen at most in several locations
O - Occasional seen with some regularity
C - Common observed numerous times during the survey
A - Abundant found in large numbers;
AA - Very abundant abundant and dominant; defining vegetation type in some areas.

Numbers following an occurrence rating indicate clusters within the survey area. The ratings above provide an estimate of the likelihood of encountering a species within the specified survey area; numbers modify this if abundance, where encountered, tends to be greater than the occurrence rating:

1 – several plants present
2 - many plants present
3 – abundant over a localized area

NOTES:

[1] – Mostly or entirely observed just beyond the margin of the slopes proposed for rockfall protective structures, but potentially found in a project site.
[2] – Species only noted in Ka'awali'i Gulch (this survey).
[3] – Species only noted in Laupāhoehoe Gulch (this survey).
[4] – Species only noted in Maulua Gulch (this survey).
[5] – Observed plant lacking fruit or flowers, or too distant to make a certain identification.

The south (north-facing) slopes tend to support ferns (particularly *Blechnum appendiculatum*) and leafy herbaceous plants with a notable reduction in cover by grasses as compared with many south-facing slopes. Common trees on these slopes include African tulip (*Spathodea campanulata*), pandanus or *hala* (*Pandanus tectorius*), guava, mango (*Mangifera indica*), and *kukui* (*Aleurites moluccana*).

A few areas of more distinctive vegetation are present. Fountain grass is common on dense basalt off the rocky faces of the north cut (point at which the highway enters the gulch with cliffs on both sides of the roadway) in Laupāhoehoe gulch. The south cut of Maulua Gulch supports an open *'ohi'a (Metrosideros polymorpha)* forest with an understory of *uluhe* (*Dicranopteris linearis*) fern, representing a native plant community. *Ki* or ti (*Cordyline fruticosa*) and *neleau* are present here as well.

FLORA — The flora (plant species that are present in an area) is provided in Table 1 (above). A total of 85 species of ferns and flowering plants were identified from the area. This listing includes some species observed along the roadway that are likely to be present in the area of impact from the proposed rockfall protection structures. Of this total, only 6 (or 7%) are native species, with another 5 (5.9%) representing early Polynesian introductions. None of the native plants are considered rare species on the Island of Hawai'i.

Figure 3. Portion of the north-facing wall in Laupāhoehoe Gulch showing a relatively recent rockfall scar.

Avian Survey Results

Ninety-seven individual birds of nine different species, representing eight separate families were recorded during the course of the February 2009 survey (Table 2). One of the species detected, Hawaiian Hawk (*Buteo solitarius*), is an endemic endangered species currently protected under both federal and state of Hawai'i endangered species statutes. The remaining eight species recorded are all considered to be alien to the Hawaiian Islands.

Avian diversity and densities extremely low, though in keeping with the near vertical nature of the survey sites, and the highly disturbed habitat present. Three species; Japanese White-eye (*Zosterops japonicus*), Northern Cardinal (*Cardinalis cardinalis*), and

House Finch (*Carpodacus mexicanus*), accounted for slightly more than 76% of the total number of all birds recorded during station counts. The most common avian species recorded was Japanese White-eye, which accounted for slightly more than 37% of the total number of individual birds recorded. An average of 33 individual birds were recorded in each of the three gulches.

Table 2. Avian Species Detected along Hawaii Belt Highway in Maulua, Laupāhoehoe, and Ka‘awali‘i gulches.

Common Name	***Scientific Name***	***ST***	***RA***
	PELECANIFORMES		
	PHAETHONTIDAE – Tropicbirds		
White-tailed Tropicbird	*Phaethon lepturus dorothea*	IB	0.33
	FALCONIFORMES		
	ACCIPITRIDAE - Hawks, Kites, Eagles & Allies		
	Accipitrinae - Kites, Eagles & Hawks		
Hawaiian Hawk	*Buteo solitarius*	**EE**	1.00
	COLUMBIFORMES		
	COLUMBIDAE - Pigeons & Doves		
Spotted Dove	*Streptopelia chinensis*	A	0.67
Zebra Dove	*Geopelia striata*	A	0.33
	PASSERIFORMES		
	ZOSTEROPIDAE - White-eyes		
Japanese White-eye	*Zosterops japonicus*	A	12.00
	STURNIDAE - Starlings		
Common Myna	*Acridotheres tristis*	A	3.33
	CARDINALIDAE - Cardinals Saltators & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	6.67
	FRINGILLIDAE - Fringilline and Carduline Finches & Allies		
	Carduelinae - Carduline Finches		
House Finch	*Carpodacus mexicanus*	A	6.00
	ESTRILDIDAE - Estrildid Finches		
	Estrildinae - Estrildine Finches		
Nutmeg Mannikin	*Lonchura punctulata*	A	2.00

Key To Table 2.

ST Status
A Alien Species
EE Endangered Endemic Species – native and unique to the Island of Hawai‘i and endangered
IB Indigenous Breeding Species – native to Hawai‘i but also found elsewhere naturally
ST Status
RA Relative Abundance – number of birds detected divided by the number of bird counts (3)

Mammalian Survey Results

One mammalian species was detected during the course of this survey. We encountered tracks, scat and sign of pig (*Sus s. scrofa*), in all three gulches. Large rooting areas were seen in the lower reaches of each gulch generally on the *makai* side of the road.

DISCUSSION

Botanical Resources

For the most part, the slopes of the gulches to be directly impacted by the proposed rockfall protection measures are covered in alien or non-native and naturalized plants. Native plants are represented within the project area by the extensive amount of *neleau* on the north slope of Laupahoehoe gulch (and to a lesser extent on the north slope of Maulua Gulch) and the *'ophi'a/uluhe* association at the upper end of the south slope and entry cut of Maulua Gulch.

Avian Resources

Avian diversity and densities were in keeping with the habitat present within the three project areas. It should be noted that the survey sites are essentially cliff faces that are the north and south facing walls of the three respective gulches. There is almost no verge between the rock face and the travel-way at any of the survey locations. Observations of all resources were made from the opposite side of the road, looking up at the cliff faces. The vegetation and substrate along most of the survey corridors is highly disturbed and ample evidence of previous rock fall is clearly visible. The combination of steep slopes, relatively small trees, and the high volume of vehicular traffic along the roadway do not present particularly attractive habitat for avian species. The majority of birds heard and seen were from within the dense vegetation below the roadway and along the bottom of the gulches.

Of the nine different avian species recorded during this survey, seven are alien species. The other two species, Hawaiian Hawk, and White-tailed Tropicbird (*Phaethon lepturus dorothea*), are endemic, and indigenous species respectively. We saw three Hawaiian Hawks soaring above and within Ka'awali'i Gulch. One of these birds was a dark phase bird, likely a female, considering it's size; the other two were light phase birds and both appeared to be males based on a comparison of their size and the significantly large dark phase bird. The dark phase bird briefly alighted on a small stature African tulip tree on the south side of the gulch within the a portion of the proposed action area.

Hawaiian Hawks are currently found in nearly all habitats that still have some large tree components on the Island of Hawai'i. They are regularly seen foraging in the Hāmākua area. Hawk densities are highest in mature, native species dominated forests, with grassy under-stories. This habitat, with high amounts of forest edge, supports large populations of game birds and the four species of introduced rodents known from the island, all of which are prey items for the hawk. Additionally, this type of habitat also provides numerous perches and nesting sites suitable for this species (Klavitter, 2000).

As previously mentioned the Hawaiian Hawk is an endemic endangered species currently protected under both federal and state of Hawai'i endangered species statutes. This species was first listed as endangered in 1967 (Federal Register, 1967), proposed for down listing from endangered to threatened in 1993 (Federal Register, 1993), and has recently been proposed for delisting all together (Federal Register, 2008).

One White-tailed Tropicbird was seen soaring well above the cliff face in Laupāhoehoe Gulch. White-tailed Tropicbirds are an indigenous breeding pelagic seabird. On the Island of Hawai'i tropicbirds usually nest on relatively remote cliff faces, usually overlooking the ocean. There are no known nesting sites within any of the three project areas surveyed.
Although not detected during this survey, it is possible that small numbers of the endangered endemic Hawaiian Petrel (*Pterodroma sandwichensis*), or *ua'u*, and the threatened Newell's Shearwater (*Puffinus auricularis newelli*), or *'a'o*, over-fly the project areas between the months of May and November (Banko, 1980a, 1980b; Day et al., 2003a; Harrison, 1990).

Hawaiian Petrels were formerly common on the Island of Hawai'i (Wilson and Evans, 1890–1899). This pelagic seabird reportedly nested in large numbers on the slopes of Mauna Loa and in the saddle area between Mauna Loa and Mauna Kea (Henshaw, 1902), as well as at the mid-to-high elevations of Mount Hualālai. Within recent historic times, Hawaiian petrels have been reduced to relict breeding colonies located at high elevations on Mauna Loa, and possibly, Mount Hualālai (Banko, 1980a; Banko et al., 2001; Cooper and David, 1995; Cooper et al., 1995; Day et al., 2003a; Harrison, 1990; Hue et al., 2001; Simons and Hodges, 1998).

Newell's Shearwaters were formerly common on the Island of Hawai'i (Wilson and Evans, 1890–1899). This species breeds on Kaua'i, Hawai'i, and Moloka'i in extremely small numbers. Newell's Shearwater populations have dropped precipitously since the 1880s (Banko, 1980b; Day et al., 2003b). This pelagic species nests high in the mountains in burrows excavated under thick vegetation, especially *uluhe* (*Dicranopteris linearis*) fern.

The primary cause of mortality in both Hawaiian Petrels and Newell's Shearwaters is thought to be predation by alien mammalian species at the nesting colonies (USFWS,

1983; Simons and Hodges, 1998; Ainley et al., 2001). Collision with man-made structures is considered to be the second most significant cause of mortality of these seabird species in Hawai'i. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall, can become disoriented by exterior lighting. When disoriented, seabirds often collide with manmade structures, and if they are not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals (Hadley, 1961; Telfer, 1979; Sincock, 1981; Reed et al., 1985; Telfer et al., 1987; Cooper and Day, 1998; Podolsky et al., 1998; Ainley et al., 2001). There is no suitable nesting habitat within or close to any of the three the project sites for either of these pelagic seabird species.

Mammalian Resources

The findings of the mammalian survey are in keeping with the habitat present and the general nature of the three project sites. Although, Hawaiian hoary bats were not recorded during this survey, bats have been recorded on numerous recent surveys conducted within the general Hāmākua area (Bonaccorso et al., 2005, 2007, 2009). It can be expected that Hawaiian hoary bats forage over sections of one or more of the project sites.

The Hawaiian hoary bat is a typical lasurine bat, and as such, they primarily lead a solitary existence, described as "over-dispersed". They generally roost cryptically in foliage, which makes them difficult to study (Findley and Tomich, 1983; Jacobs, 1994; Carter et al., 2000). Fundamental research into this species distribution and life cycle are currently in the relatively early stages of systematic study (Bonaccorso et al., 2005, 2007, 2009). Data gathered as part of a multi-year project to study this species, it distribution, densities and life history is just being prepared for publication. Key findings include the opinion that at least on the Island of Hawai'i, the bat is ubiquitous in areas that still have forest or dense cover. They have also concluded that the species is a human commensal species and is a generalist, having adapted to roost in, and prey upon both native and alien species (Bonaccorso et al., 2005, 2007, 2009).

Given the vegetation present within the three project sites it is unlikely that bats use any of vegetation as roosting sites, as the trees present are way to small to likely appeal as a desirable roosting site for this species of bat. Hawaiian hoary bats tend to select roosting trees that are 20 ft (6 m) tall or higher, with a well-developed crown, and free air space below the canopy for the bats to be easily drop out of the vegetation. Typical ornamental trees that bat roosts have been located in include mango (*Mangifera indica*), lychee (*Litchi chinensis*), and avocado (*Persea americana*), trees with thick well-developed canopies and relatively sparse vegetation below the crown.

Impacts Assessment: Protected and/or Valuable Species

NATIVE HAWAIIAN PLANTS — Although several native plants occur in areas anticipated to be directly impacted by the erection of rockfall protective structures, no listed species are present, and losses of others would be minimal. The native *'ōhi'a* area is mostly above the proposed structures, and the open nature of the steel webbing will allow recovery of the *neleau* plants. Providing stability to the slopes where the majority of the *neleau* occur could contribute to the preservation of this species on these slopes.

HAWAIIAN PETREL AND NEWELL'S SHEARWEATER — The principal potential impact that the proposed action poses to Hawaiian Petrels and Newell's Shearwaters is the increased threat that birds will be downed after becoming disoriented by exterior lighting that may be required in conjunction with nighttime construction activities, and, or the servicing of construction equipment at night.

To reduce the potential for interactions between nocturnally flying Hawaiian Petrels and Newell's Shearwaters with external lights and man-made structures, it is recommended that any external lighting planned to be used during construction be shielded (Reed et al. 1985, Telfer et al. 1987). This mitigation would serve the dual purpose of minimizing the threat of disorientation and downing of Hawaiian Petrels and Newell's Shearwaters, while at the same time complying with the Hawaii County Code § 14 – 50 *et seq.* which requires the shielding of exterior lights so as to lower the ambient glare caused by unshielded lighting to the astronomical observatories located on Mauna Kea.

CRITICAL HABITAT — There is no federally delineated Critical Habitat within or close to the project site. Clearing, grubbing and construction of rockfall protective measures will not result in any impacts to federally designated Critical Habitat.

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Appendix C

Archaeological Assessment Report
Hawai‘i Belt Road Rockfall Protection
at Maulua, Laupāhoehoe and Ka‘awali‘i Gulches
North Hilo and Hāmākua, Island of Hawai‘i, Hawai‘i

Archaeological Literature Review and Field Inspection for Hawai‘i Belt Road Rockfall Protection at Maulua, Laupāhoehoe, and Ka‘awali‘i Gulches, Maulua Nui, Laupāhoehoe, and Humu‘ula, Ahupua‘a, North Hilo District, Hawai‘i Island

TMK: [3] 3-4-002: 03, 04 & 05; [3] 3-6-04: 02, 11, 15, 17, 23 & 30; [3] 3-9-01:01

Prepared for

R.M. Towill Corporation

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Cultural Surveys Hawai‘i, Inc.

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Management Summary

Reference	Archaeological Literature Review and Field Inspection for Hawai‘i Belt Road Rockfall Protection at Maulua, Laupāhoehoe, and Ka‘awali‘i Gulches, Maulua Nui, Laupāhoehoe, and Humu‘ula, Ahupua‘a, North Hilo District, Hawai‘i Island, TMK: [3] 3-4-002: 03, 04 & 05; [3] 3-6-04: 02, 11, 15, 17, 23 & 30; [3] 3-9-01:01 (Tulchin et al. 2009)
Date	April 2009
Project Number	Cultural Surveys Hawai‘i Inc. (CSH) Job Code: KAAWALII 1
Investigation Permit Number	The fieldwork component of the archaeological literature review and field inspection study was carried out under CSH’s annual archaeological permit # 09-20 issued by the Hawai‘i State Historic Preservation Division/Department of Land and Natural Resources (SHPD/DLNR), per Hawai‘i Administrative Rules (HAR) Chapter 13-282.
Project Location	The study area consists of three discrete locations at three major Hawai‘i Belt Road stream valley crossings (Ka‘awali‘i, Laupāhoehoe, and Maulua) within the North Hilo District. This area is depicted on the 1980 1:100,000 USGS Map of Hawai‘i County, Hawai‘i, Sheet 2 of 3.
Project Funding and Land Jurisdiction	State of Hawai‘i
Project Area Acreage	Approximately 4.2 kilometers (2.6 miles) by an average width of approximately 10 m for approximately 42,000 m^2 or 10.4 acres.
Project Description	The proposed project consists of rockfall remediation at three major Hawai‘i Belt Road stream valley crossings (Ka‘awali‘i, Laupāhoehoe, and Maulua). This will involve the installation of a new wire mesh drapery over exiting road cuts that are prone to rockfall.
Agencies	State Historic Preservation Division of the Department of Land and Natural Resources (SHPD/DLNR)
Historic Preservation Regulatory Context and Document Purpose	The proposed project is subject to Hawai‘i State environmental and historic preservation review legislation [Hawai‘i Revised Statutes (HRS) Chapter 343 and HRS Chapter 6E-8 and HAR Chapter 13-275]. This investigation does not fulfill the requirements of an archaeological inventory survey investigation per the rules and regulations of the SHPD/DLNR (per HAR Chapter 13-276). However, the level of work is sufficient to determine if there are any major archaeological concerns within the project area and to develop data on the general nature, density and distribution of archaeological resources, as well as to provide recommendations of any additional cultural resource management work that might be needed prior to land alteration within the project area. This document was prepared to support the project’s historic preservation and environmental review.

Fieldwork Effort	The fieldwork component of the archaeological literature review and field inspection study was accomplished on January 21 and 22, by two CSH archaeologists, Randy Groza, M.A., and Sarah Wilkinson, B.A., under the general supervision of Hallett H. Hammatt, Ph.D. (principal investigator). The fieldwork required approximately 3 person-days to complete.
Results Summary	No historic properties were observed during the field inspection of the project area. The absence of historic properties can be attributed to extensive land modifications associated with historic sugar cultivation and construction associated with the Hāmākua Division of the Hilo Railroad, later known as the Hawai‘i Consolidated Railway. The Belt Highway and portions of the current project area follow much of the railway right-of-way. Following the demise of the sugar industry, previously cultivated areas became pasture lands, and/or were planted with eucalyptus or ironwood trees.
Recommendations	Based on the results of this investigation, no additional cultural resource management work is recommended for the project. This is based on the results of the field inspection, in which no historic properties were observed, as well as the background research, which suggests prior extensive land modifications. The proposed Hawai‘i Belt Road Rockfall Protection Project also involves minimal ground disturbance involving 10 boring holes for the installation of a new wire mesh drapery over exiting road cuts.

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Section 1 Introduction

1.1 Project Background

At the request of R.M. Towill Corporation, Cultural Surveys Hawai‘i, Inc. (CSH) completed this archaeological literature review and field inspection study for Hawai‘i Belt Road Rockfall Protection at Maulua, Laupāhoehoe, and Ka‘awali‘i gulches, Maulua Nui, Laupāhoehoe, and Humu‘ula, Ahupua‘a, North Hilo District, Hawai‘i Island, TMK: [3] 3-4-002: 03, 04 & 05; [3] 3-6-04: 02, 11, 15, 17, 23 & 30; [3] 3-9-01:01. The project area consists of three discrete locations at three major Hawai‘i Belt Road stream valley crossings (Maulua, Laupāhoehoe, and Ka‘awali‘i gulches) within the North Hilo District. The three project area locations are all within the Hawai‘i Belt Road Right-of-Way and total approximately 4.2 kilometers (2.6 miles). These areas are depicted on the 1980 1:100,000 USGS Map of Hawaii County (Figure 1), the 1982 Kūka‘iau and Pāpa‘aloa U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles (Figure 2, Figure 3, & Figure 4), and the Tax Map Key (TMK) Zone [3] 3 map (Figure 5).

The project area is under the land jurisdiction of the State of Hawai‘i and is proposed for rockfall protection within the Hawai‘i Belt Road Right-of-Way at Maulua Gulch, Laupāhoehoe Gulch, and Ka‘awali‘i Gulch (see Appendix A). The proposed project consists of rockfall remediation at three major Hawai‘i Belt Road stream valley crossings (Ka‘awali‘i, Laupāhoehoe, and Maulua). This will involve the installation of a new wire mesh drapery over exiting road cuts that are prone to rockfalls.

The proposed project is subject to Hawai’i State environmental and historic preservation review legislation [Hawai’i Revised Statutes (HRS) Chapter 343 and HRS Chapter 6E-8 and Hawaii Administrative Rules (HAR) Chapter 13-275]. This investigation does not fulfill the requirements of an archaeological inventory survey investigation per the rules and regulations of the State Historic Preservation Division/Department of Land and Natural Resources (SHPD) (per HAR Chapter 13-276). However, the level of work is sufficient to determine if there are any major archaeological concerns within the project area and to develop data on the general nature, density, and distribution of archaeological resources, as well as to provide recommendations of any additional cultural resource management work that might be needed prior to land alteration within the project area. This document was prepared to support the project’s historic preservation and environmental review.

1.2 Scope of Work

The agreed upon scope of work for this archaeological literature review and field inspection was as follows:

1. Historical research including study of archival sources, historic maps, Land Commission Awards and previous archaeological reports to construct a history of land use and to determine if archaeological sites have been recorded on or near the project area.

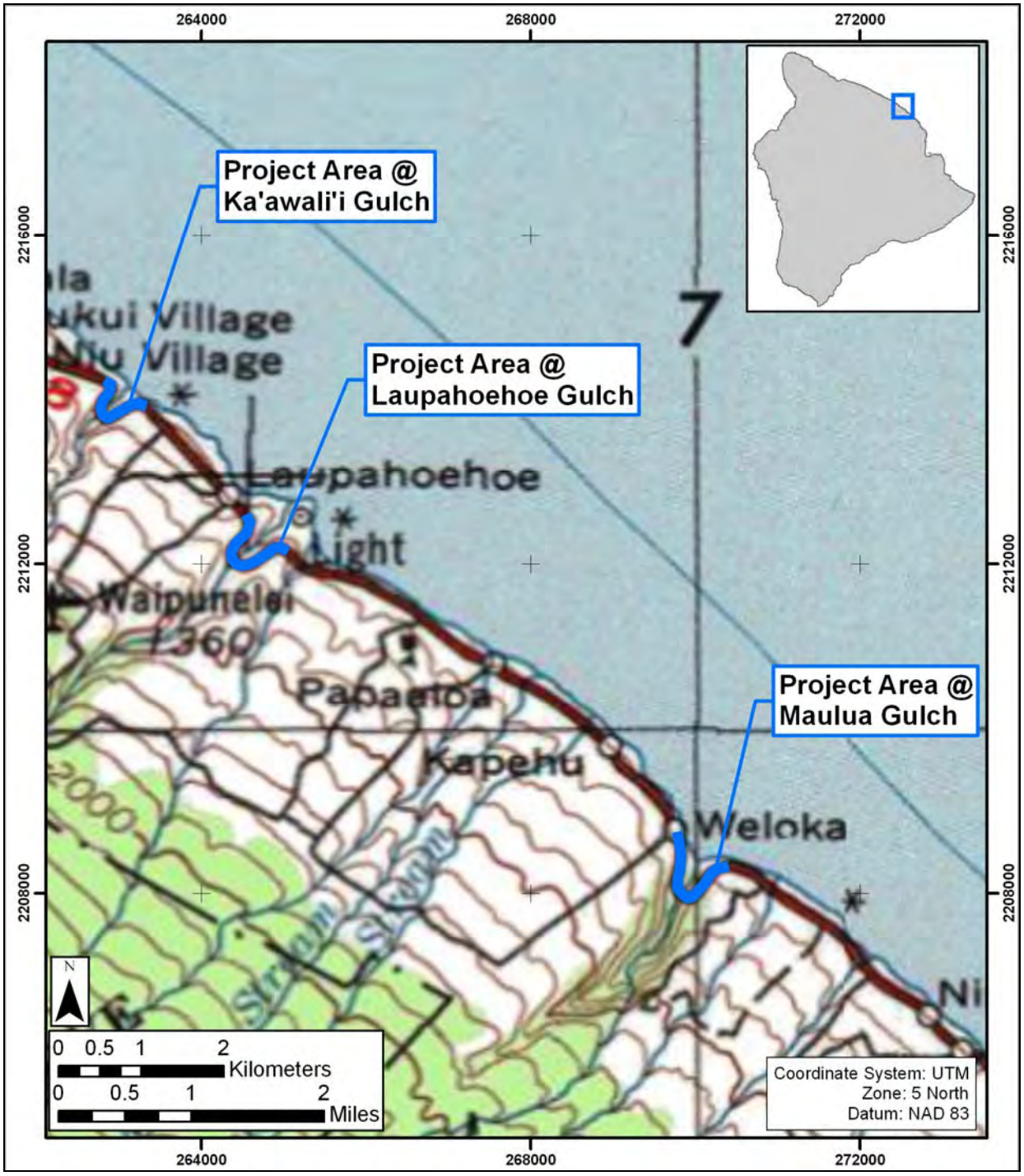


Figure 1. Portion of 1980 1:100,000 USGS Map of Hawaii County, Hawai‘i, Sheet 2 of 3, showing the location of the project area

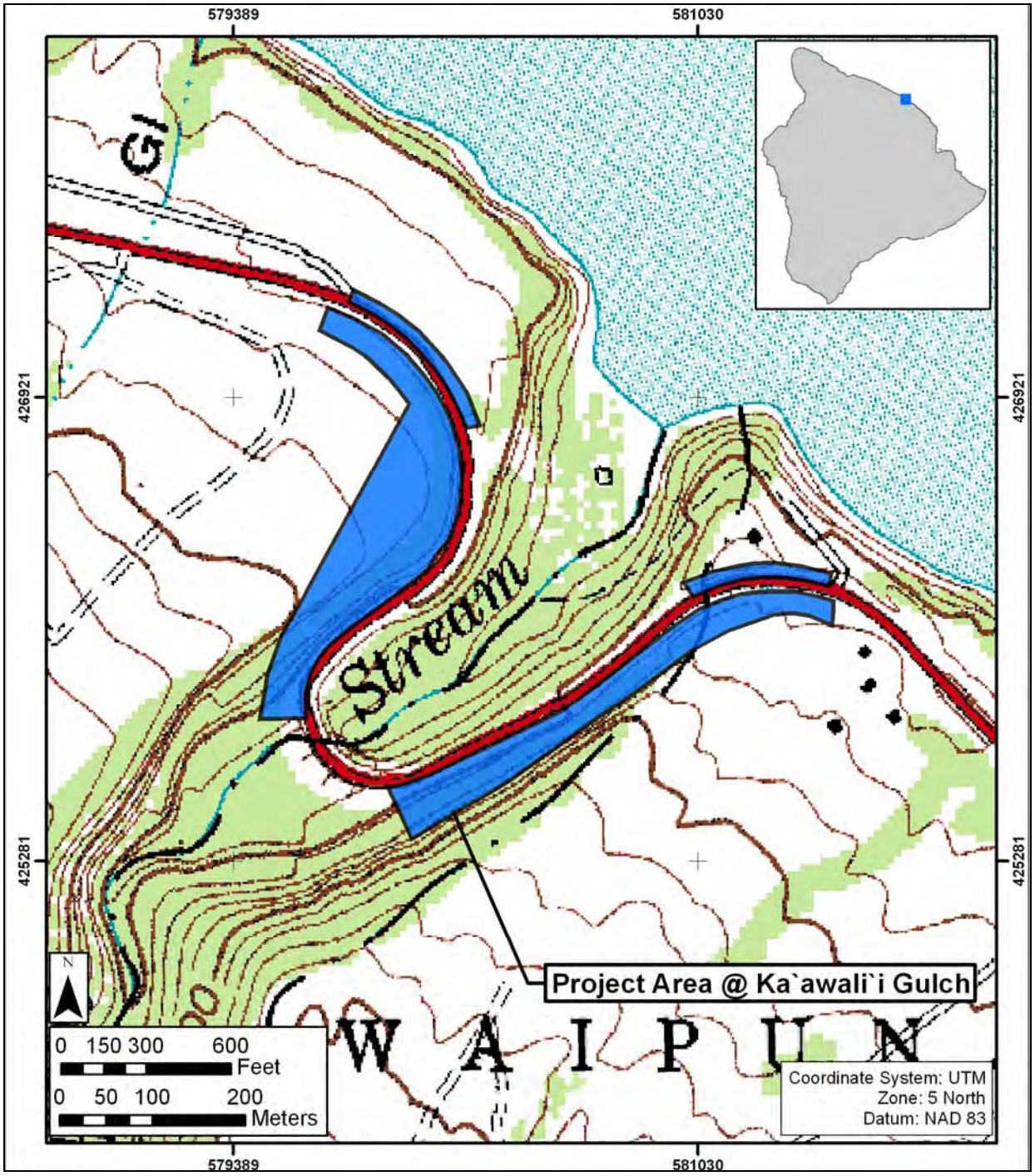


Figure 2. USGS 7.5 Minute Series Topographic Map, Kūka‘iau Quadrangle (1982), showing the location of the Ka‘awali‘i Gulch portion of the project area

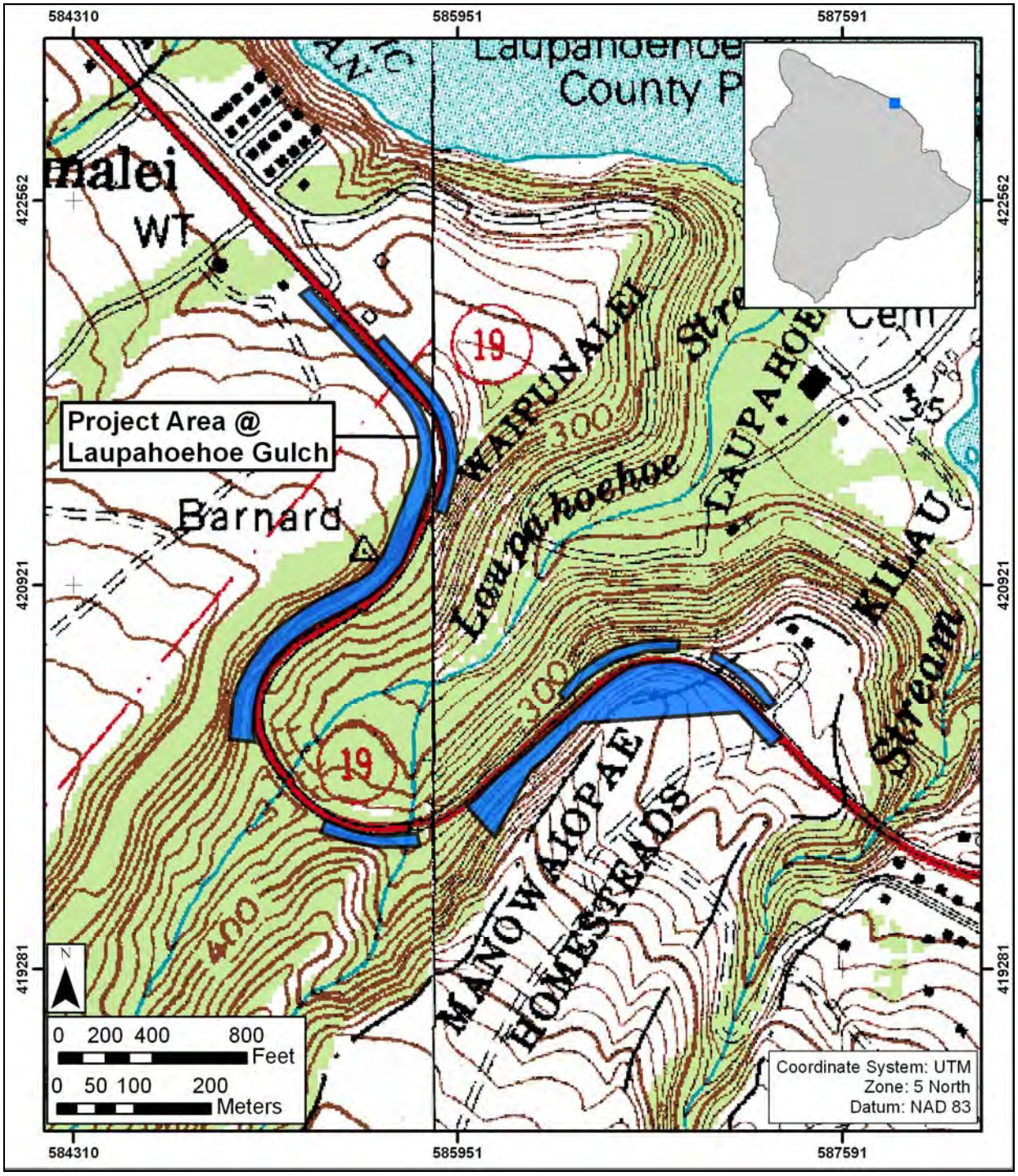


Figure 3. USGS 7.5 Minute Series Topographic Map, Pāpa‘aloa Quadrangle (1982), showing the location of the Laupāhoehoe Gulch portion of the project area

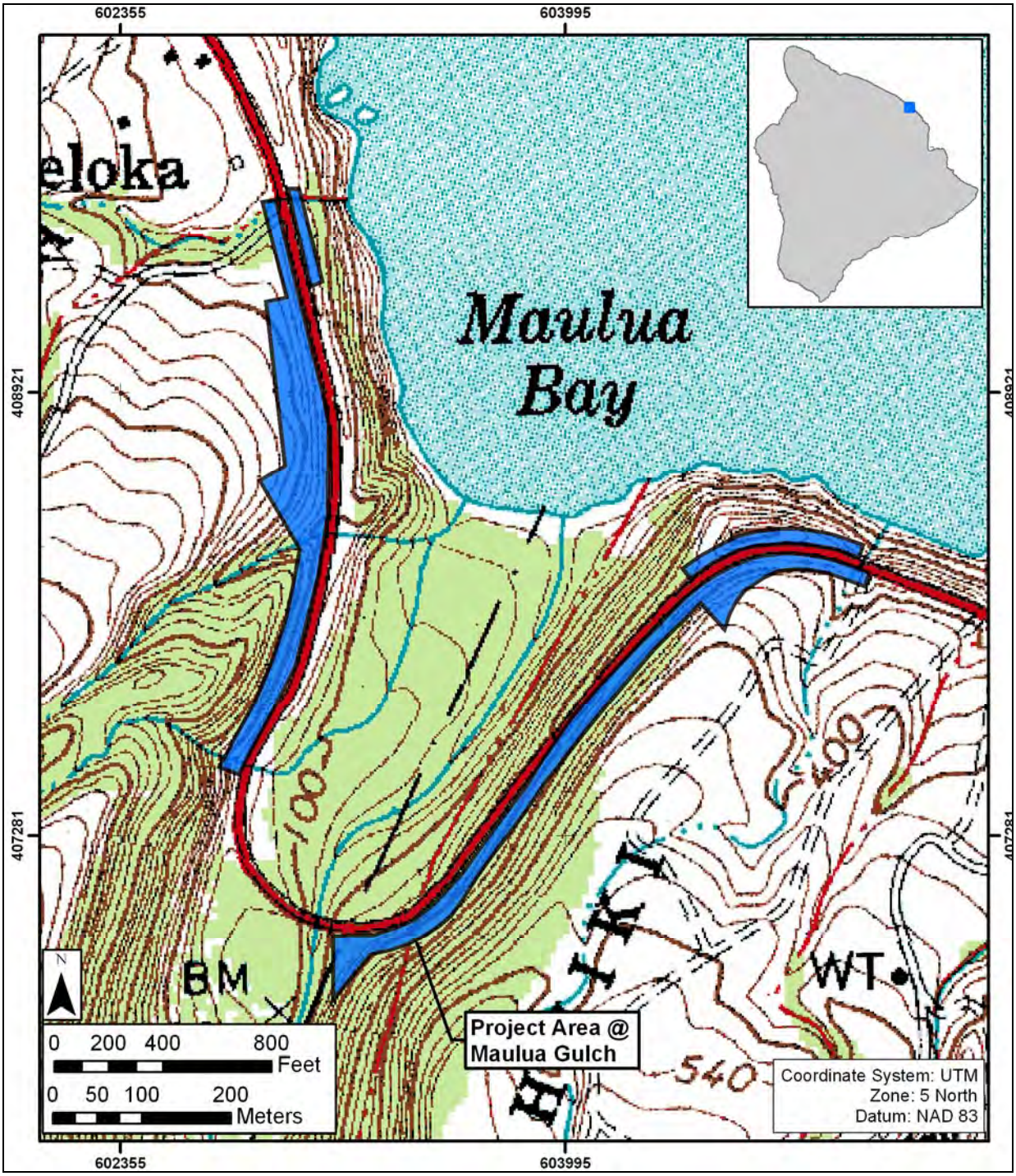


Figure 4. USGS 7.5 Minute Series Topographic Map, Pāpa‘aloa Quadrangle (1982), showing the location of the Maulua Gulch portion of the project area

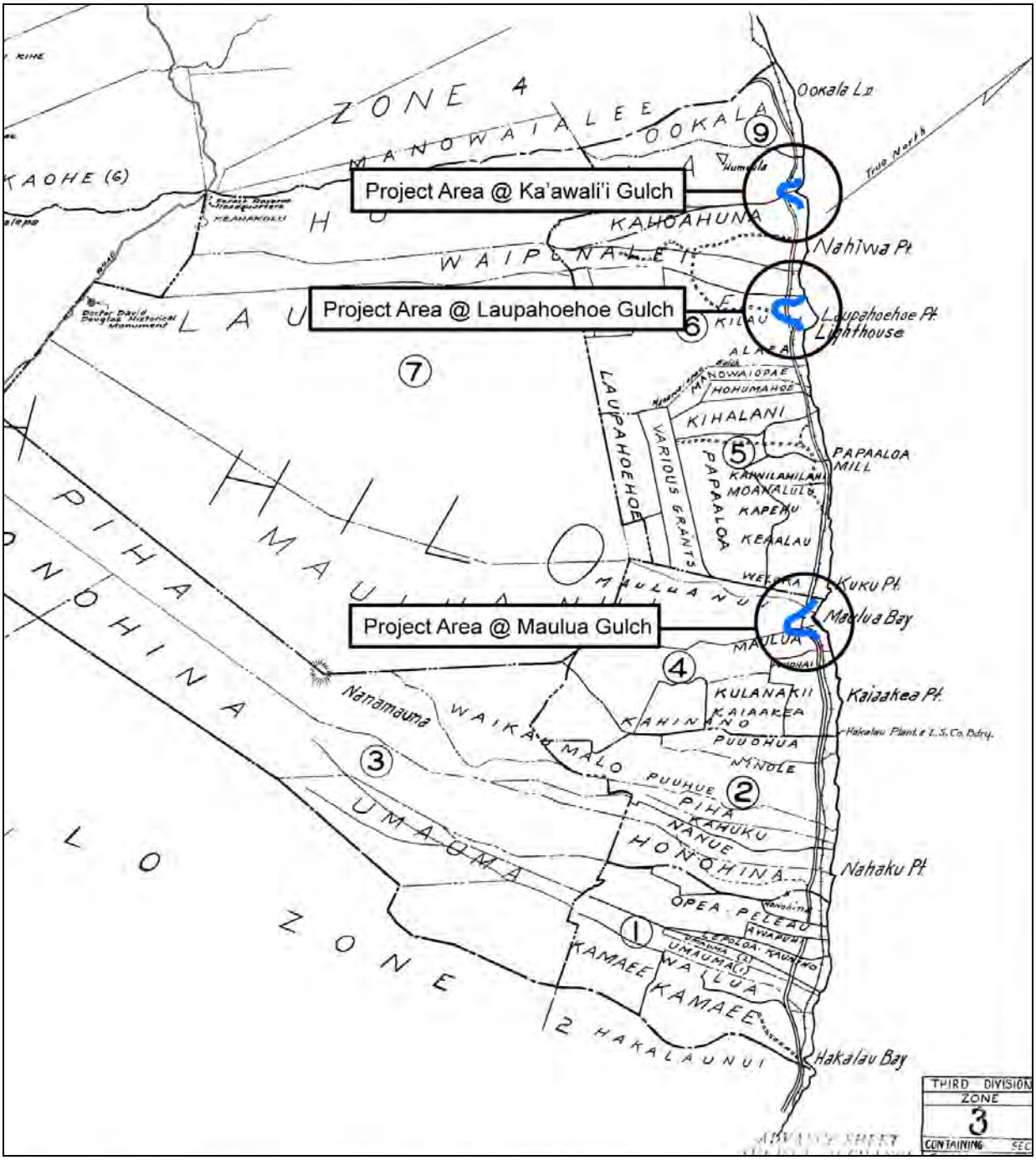


Figure 5. Portion of TMK: [3] 3 showing project area location

2. Limited field inspection of the project area to identify any surface archaeological features and to investigate and assess the potential for impact to such sites. This assessment will identify any sensitive areas that may require further investigation or mitigation before the project proceeds.

3. Preparation of a report to include the results of historical research and the limited fieldwork with an assessment of archaeological potential based on that research, with recommendations for further archaeological work, if appropriate. It will also provide mitigation recommendations if there are archaeologically sensitive areas that need to be taken into consideration

1.3 Environmental Setting

1.3.1 Natural Environment

The project area is located along the northeastern coast of the island of Hawai‘i. The topography within the project area is fairly rugged with elevations ranging from approximately 30-120 m (100-400 ft) AMSL (Above Mean Sea Level). The average annual rainfall in the vicinity of the project area is very high at approximately 3000-4000 mm (118-157 inches) (Giambelluca et al. 1986). Vegetation in the project area consists of native and introduced trees and grasses. Maulua Gulch contained *kukui*, *‘ōhi‘a*, *hau*, *hibiscus*, and *pūhala* trees. The *mauka* ridge of Maulua Gulch was fenced pasture lands with non-native trees. Laupāhoehoe Gulch contained some *kukui* and *hau* trees and many non-native trees including eucalyptus and ironwoods. Ka‘awali‘i Gulch contained areas of dense feral cane or California grass, and ironwood trees.

Soils within the project area consist primarily of Rough Broken Land (RB) (Figure 6). Rough broken land is described as “a miscellaneous land type that consists of very steep, precipitous land broken by many intermittent drainage channels...primarily in gulches” (Foote et al. 1972).

1.3.2 Built Environment

The entire project area is situated within the Hawai‘i Belt Road right-of-way and is within asphalt paved roadways and/or bulldozed road cuts.

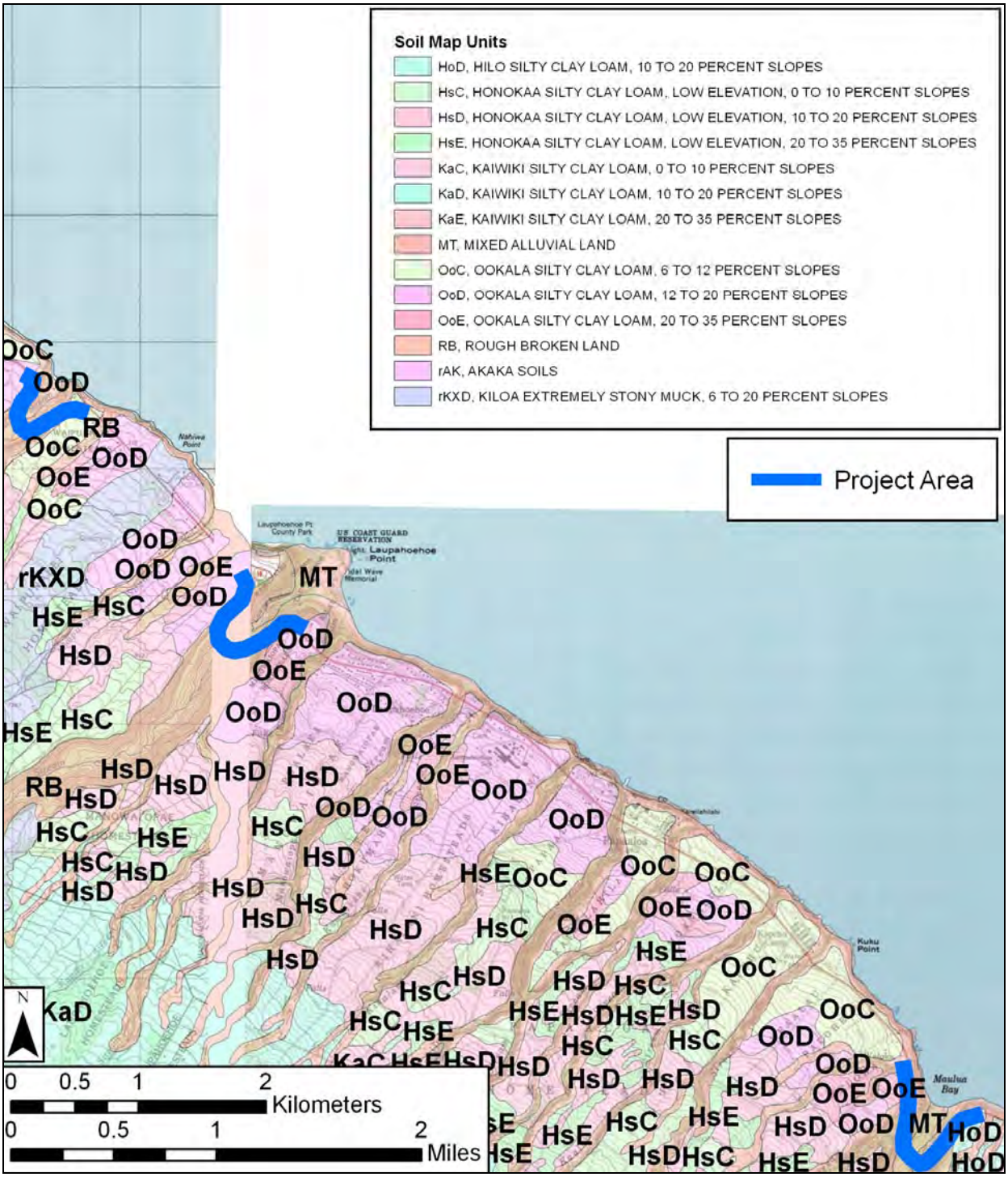


Figure 6. Overlay of Soil Survey of the State of Hawai‘i (Foote et al. 1972), indicating sediment types within the project area

Section 2 Methods

2.1 Document Review

Background research included: a review of previous archaeological studies on file at SHPD; review of documents at Hamilton Library of the University of Hawai‘i, the Hawai‘i State Archives, the Mission Houses Museum Library, the Hawai‘i Public Library, and the Archives of the Bishop Museum; study of historic photographs at the Hawai‘i State Archives and the Archives of the Bishop Museum; and study of historic maps at the Survey Office of the Department of Land and Natural Resources. Historic maps and photographs from the CSH library were also consulted. In addition, Mahele records were examined from the Waihona ‘Aina database (<www.waihona.com>).

This research provided the environmental, cultural, historic, and archaeological background for the study area. The sources studied were used to formulate a predictive model regarding the expected types and locations of historic properties in the study area.

2.2 Field Methods

The fieldwork component of the archaeological literature review and field inspection was conducted on January 21 and 22, by two CSH archaeologists, Randy Groza, M.A., and Sarah Wilkinson, B.A., under the general supervision of Hallett H. Hammatt, Ph.D. (principal investigator). The fieldwork required 3 person-days to complete.

In general, the purpose of the field inspection was to develop data on the nature, density, and distribution of archaeological sites within the study area, and also to develop information on the degree of difficulty that vegetation and terrain create for future archaeological studies. The field inspection consisted of a visual inspection of the three rockfall remediation areas from the highway with only limited cliff face(s) survey. The spacing between the archaeologists was generally less than 10 m. Potential archaeological sites or site areas were documented with brief written descriptions, and photographs, and were located with Garmin GPS survey technology (accuracy 3-5 m). A track log of the area covered by the field inspection was also generated (see section 4).

Section 3 Background Research

3.1 Traditional and Historical Background

Laupāhoehoe literally means smooth lava flat (Pukui et al. 1974:130) or leaf shaped smooth lava (Clark 1985:4). Pukui et al. (1974:130) relate that Laupāhoehoe was an “ancient surfing area” and once had a *heiau* called Ule-ki‘i, that was built by a man from Kahiki (the ancestral Hawaiian southern homeland). Maulua literally means “always depressed” (Pukui et al. 1974:148), and Ka‘awali‘i means “the small harbor” (Elbert and Pukui 2001:636).

3.1.1 Myths and Legends

The story of the ruling chief ‘Umi’s (‘Umi-a-Līloa’s) sacrifice of Pai‘ea, a chief of Laupāhoehoe is related by Samuel M. Kamakau in an article in the “Hawaiian language newspaper *Ke Au ‘Oko‘a* on November 17, 1870 and is translated as follows:

> ‘Umi and his wives went sea bathing, surfing (*he‘e nalu*), riding on the surf (*kaha nalu*), and a certain chief of Laupāhoehoe noticed ‘Umi’s skill in surf-riding. His name was Pai‘ea, and he knew all the surfs and the best one to side. It was the one directly in front of Laupāhoehoe, facing Hilo. It was a huge one which none dared to ride except Pai‘ea, who was noted for his skill. Gambling on surfing was practiced in that locality. All of the inhabitants from Waipunalei to Ka‘ula placed their wager on ‘Umi, and those of Laupāhoehoe on Pai‘ea. The two rode the surf, and while surfing, Pai‘ea noticed that ‘Umi was winning. As they drew near a rock, Pai‘ea crowded him against it, skinning his side. ‘Umi was strong and pressed his foot against Pai‘ea’s chest and then landed ashore. ‘Umi won against Pai‘ea, and because he crowded ‘Umi against the rock with the intention of killing him, Pai‘ea was roasted in an *imu* (Kamakau 1961).

Fornander (1917) offers a virtually identical account:

> ‘Umi was very skilful in riding the surf, and he showed this while living in humble life in Laupāhoehoe. One day while out surf riding he had a race with Pai‘ea, a man famous in Laupāhoehoe as the best surf rider of that place. In this race Pai‘ea crowded ‘Umi up against the rocks, thus bruising his shoulder. Therefore, years after this it was remembered against Pai‘ea, and he was killed by ‘Umi when Hawai‘i came under his rule.

3.1.2 Early 1800s

In 1823 Reverend William Ellis conducted a two month journey around the entire island of Hawai‘i, utilizing a route primarily along the coast. During his journey Ellis made observations of indigenous Hawaiian agriculture and population densities. The following is his account of the coastal inhabitants of the North Hilo and Hāmākua districts:

> ...the inhabitants, excepting at Waiakea, did not appear better supplied with the necessaries of life than those of Kona, or the more barren parts of Hawaii. They

> had better houses, plenty of vegetables, some dogs, and few hogs, but hardly any fish, a principle article of food with the natives in general (Ellis 1963: 252)

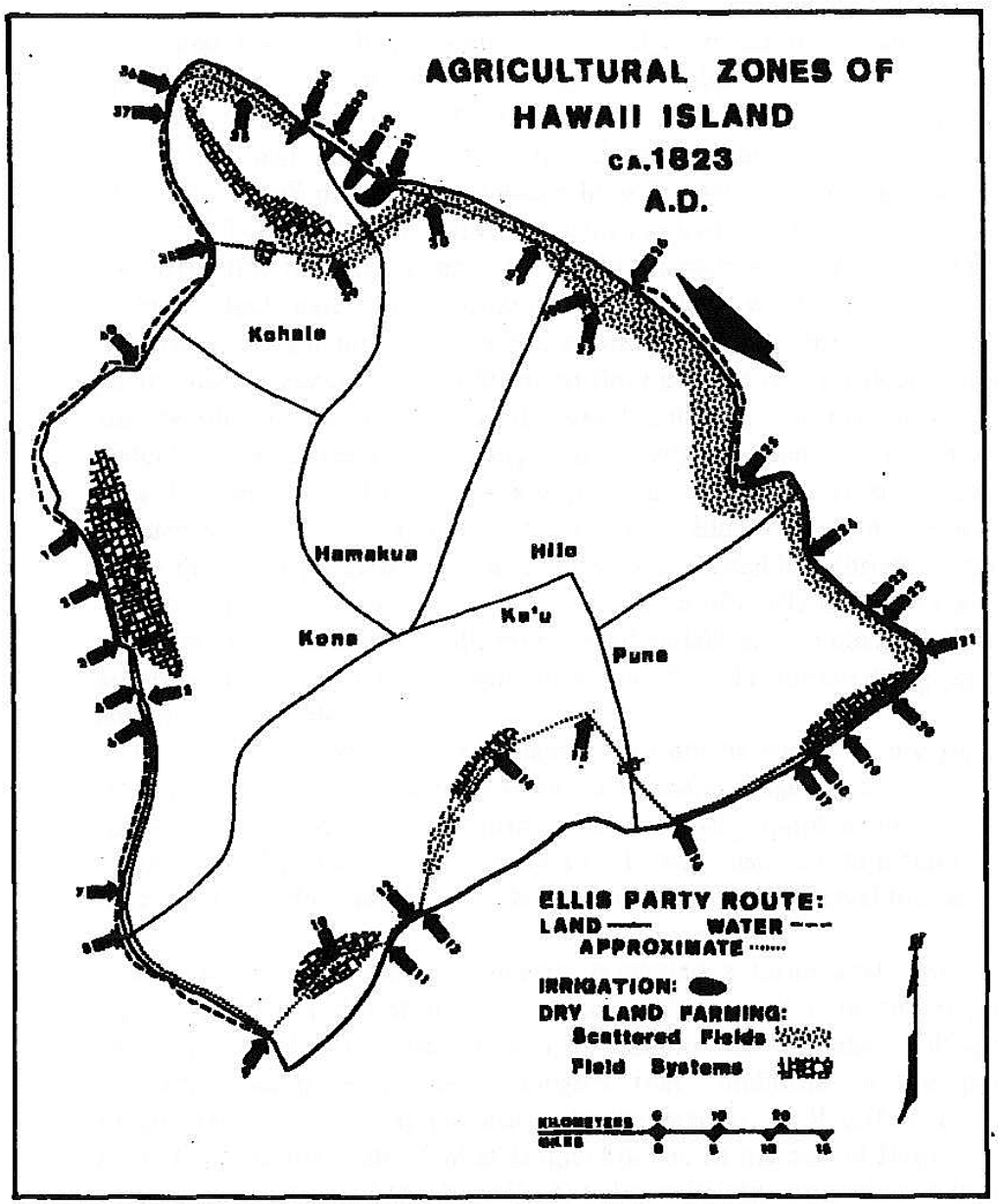
Ellis also provides a brief description of indigenous Hawaiian land use observed along his route from Humu‘ula Ahupua‘a to Kaula Valley:

> The high land over which we passed was generally woody, though the trees were not large. The places that were free from wood were covered with long grass and luxuriant ferns. The houses mostly stood singly and were scattered over the face of the country.
>
> A rich field of potatoes or taro, five to six acres in extant, or large plantations of sugar-cane and bananas, occasionally bordered our path. But though the soil was excellent, it was only partially cultivated. The population also appeared less than what we had seen inhabiting some of the most desolate parts of the island (Ellis 1963: 249-250).

Ellis describes the land as:

> Bold and steep, and intersected by numerous valleys or ravines, apparently formed by the streams from the mountains, which flow through them into the sea….The habitations of the natives generally appear in clusters at the opening of the valleys, or scattered over the face of the high land. The soil is fertile, and herbage abundant. (Ellis 1963:326)

T. Stell Newman (2000) conducted an ethnohistorical study utilizing the observations of Ellis in conjunction with modern environmental data in an attempt to define indigenous Hawaiian land use patterns circa 1823. Through an analysis of Ellis’s journal writings Newman was able to reconstruct Ellis’s route around the island. Ellis’s route was then plotted onto a map and all references by Ellis about indigenous Hawaiian agriculture, population density, soil type, water resources, and botany were matched to the route allowing Newman (2000) to establish four agricultural zones: Irrigation, Dryland Farming, Scattered Farms, and Field Systems (Figure 7). Based on a review of Newman’s map it appears that the current project area falls into the Scattered Farms agricultural zone, which is defined as having a low population density, dispersed settlement with few fishing villages at the coast, and scattered fields and gardens with no major field systems (Newman 2000). Crops that would have been cultivated consisted of dryland taro, sweet potato, bananas, yams, breadfruit, sugarcane, and paper mulberry. A late 19th Century photograph of Laupāhoehoe Point provides an example of an indigenous Hawaiian settlement within Newman’s Scattered Farms agricultural zone (Figure 8).



1. Kailua; 2. Keauhou; 3. Kaawaloa; 4. Honaunau; 5. Keokea; 6. Kalahiki; 7. Kapua; 8. Kaulanamauna; 9. Kailiki; 10. Waiohinu; 11. Honuapo; 12. Hilea; 13. Punaluu; 14. Kapapala; 15. Kilauea Volcano; 16. Keaiakomo; 17. Kalapana; 18. Kaimu; 19. Kamaili; 20. Keahialaka; 21. Kapoho; 22. Kahuwai; 23. Honolulu; 24. Keaau; 25. Waiakea (present city of Hilo); 26. Laupahoehoe; 27. Humuula; 28. Kaula Valley; 29. Manienie; 30. Kapulena; 31. Waipio Valley; 32. Waimanu Valley; 33. Honokane Valley; 34. Poluhu Valley; 35. Halawa; 36. Awalua; 37. Mahukona; 38. Kawaihae; 39. Waimea (also called Kamuela) 40. Kiholo.

Figure 7. Map of Hawai‘i Island showing the route of Reverend William Ellis and the agricultural zones delineated by Newman (source: Newman 2000)

Figure 8. Late 19th Century photograph of an indigenous Hawaiian settlement at Laupāhoehoe Point (source: Okimoto 2002)

3.1.3 The Māhele

The Organic Acts of 1845 and 1846 initiated the process of the Māhele, the division of Hawaiian lands, which introduced private property into Hawaiian society. In 1848, the crown and the *ali‘i* received their land titles. The common people (*maka‘āinana*) received their *kuleana* awards (individual land parcels) in 1850. It is through records for Land Commission Awards (LCAs) generated during the Māhele that the first specific documentation of life in Hawai‘i, as it had evolved up to the mid-nineteenth century come to light. Although many Hawaiians did not submit or follow through on claims for their lands, the distribution of LCAs can provide insight into patterns of residence and agriculture. Many of these patterns of residence and agriculture probably had existed for centuries past. By examining the patterns of *kuleana* (commoner) LCA parcels in the vicinity of the project area, insight can be gained to the likely intensity and nature of Hawaiian activity in the area.

No *kuleana* LCAs were awarded to commoners in the vicinity of the project area suggesting that indigenous Hawaiian land use within the project area may have been limited. The three gulches under study were within or adjacent to several Land Grants including:

Land Grant 3641 surrounds the southern half of Maulua Gulch and was granted to Laupahoehoe Sugar Co.

Land Grant 3650 just borders Maulua Gulch and was granted to J.H. Boyd, a colonel and member of Queen Lili‘uokalani’s staff

Land Grant 5528 surrounds the southern portion of Ka‘awali‘i Gulch and was granted to Anehila Holokahi; there are no grants to the north.

Land Grant 1960 borders the southern portion of Laupāhoehoe Gulch and was granted to Maele.

Land Grant 1066:1 borders the northeastern portion of Laupāhoehoe Gulch and was granted to Mohaiula and Moku.

Land Grant 1064 borders the northwestern portion of Laupāhoehoe Gulch and was granted to Kahoapiliwale.

No other information was found (Waihona ‘Aina 2000) regarding the lands grants.

3.1.4 Laupāhoehoe Sugar Company

Laupāhoehoe Sugar Company was begun in the 1870’s by William Lidgate and Thomas Campbell, with Lidgate managing cane cultivation and Campbell constructing the Laupāhoehoe Sugar Mill (Dorrance and Morgan 2000). By 1880 the Laupāhoehoe Sugar Mill produced 600 tons of sugar from the 900 acres under cultivation (Dorrance and Morgan 2000).

The plantation fronted the coast for approximately 10 miles with fields that extended *mauka* for 2 to 3 miles from the 300-ft elevation to an elevation of 1850 feet (Condé and Best 1973). An interesting note is that the plantation never supported a railroad as it was located within rugged terrain with fields cutting through deep gulches (Figure 9), an environment that prevented rail construction (Condé and Best 1973). As a result the primary method of transporting cane from the fields to the mill was by fluming (Figure 10). However, due to the deep ravines at Maulua

Figure 9. 1920 photograph of Laupāhoehoe Gulch showing the deep gulches that prevented the Laupāhoehoe Sugar Company from constructing a rail system (source: Okimoto 2002)

Figure 10. Sugar cane irrigation flume on Hāmākua Coast, ca. 1930-1950 (source: UH Hawaiian Photo Album 2007)

Gulch, which separated fields from the mill, the plantation was forced to develop an unusual method of cane transport utilizing a steam hoist and cable lift system.

This unique transport system is described in Gilmore’s *Hawaii Sugar Manual*:

> The call on engineering talent by the Company got the needed answer, through the unique plan of fluming cane from the uplands to the south, down to the base of the gulch near the public road, at a point lower level than the factory; then
>
> loading this flumed cane into cars then by steam hoist are lifted up an incline of 38 degrees, a lift of 1100 feet by cable.
>
> Then when at the top of the gulch the cane is transferred again to flumes and washed down to the mill a mile or more away. The cars are loaded with 3 tons of cane each, and have wide flarebacks to keep the cane from falling out as hoisted skyward (Gilmore 1931 in Condé and Best 1973: 150).

In 1979 the Laupāhoehoe Sugar Company ceased to exist when it was subsumed by the Hāmākua Sugar Company, which was in operation until 1994 (Dorrance and Morgan 2000).

3.1.5 Other Agricultural Development

Handy and Handy (1972:538) relate that there were taro terraces “in and below” Laupāhoehoe and Maulua gulches in the late 1800s. By the 1930s, “there were a number of terraces which are now unused” in Laupāhoehoe (Handy and Handy 1972:538). Some sweet potatoes were also grown in all three gulches and in the vicinity of Ka‘awali‘i, sweet potatoes “used to rival taro as a staple”. Handy (1940:164) notes “former taro lands along the lower slopes … are now covered by sugar cane.”

3.1.6 Original Belt Highway

The 1898 annual report by the Hawai‘i Minister of the Interior details the completion of the road “from Kiilau bridge through Laupahoehoe to Kaawalii gulch, making one of the finest sections of road on the Island”. The section was completed between November 1896 and October 1897 by a “gang of day laborers” (Hawai‘i Minister of the Interior 1898:190). A road through Maulua Gulch was also completed in 1897 (Hawai‘i Minister of the Interior 1898:42). At that time, the Belt Highway ran in and out of each gulch.

An 1895 Hawaiian Islands tourist guide describes the portion of the road between Laupāhoehoe and Maulua gulches:

> Then follows a very broken country, every flat covered with cane until the Maulua Gulch is reached. This is the deepest ravine in the whole route, the sides being 406 feet high…The spot is extremely picturesque with its fern and tree clad sides and its frowning precipices (Whitney 1895:91).

This same tourist guide states the entire district of Hilo is “devoted to cane cultivation” (Whitney 1895:90).

3.1.7 Hilo Railroad

Despite the difficulty of constructing rail within North Hilo and along the Hāmākua coast, the Hilo Railroad was extended north between 1909 and 1913. The original portion of the Hilo Railroad was constructed in the late 1800s by B.F. Dillingham from Hilo to his ‘Ōla‘a Sugar Mill in Kea‘au. Dillingham, who also developed railroads on O‘ahu, extended the rail line to carry lumber and later tourists to Kīlauea Volcano (Laupāhoehoe Train Museum 2009).

The Hāmākua Division as the rail line was called was constructed to support the sugar mills north of Hilo and extended 35 miles. The line contained more than 3,100 feet of tunnels and 13 trestles to cross the valleys and streams along the coast. The Maulua Tunnel was more than 800 meters long.

Construction costs related to Hāmākua Division extension caused the Hilo Railroad to go into receivership in 1914. Bondholders reorganized the railroad as the Hawai‘i Consolidated Railway in 1916. Cane transport continued and special tours called the “Scenic Express” encouraged visitors to tour the coastline (Figure 11). Local passengers including students and business commuters also used the railway. Although the Great Depression adversely affected business in the 1930s, by the 1940s visiting military troops increased the number of riders. Passengers also increased due to gas rationing during World War II (Laupahoehoe Train Museum 2009).

Figure 11. 1923 photograph of Maulua Bridge showing view of coastline from train (Hawaii Historical Images 2008)

The April 1, 1946 tsunami destroyed the railway – some trestles and bridges were completely washed away. The Hawai‘i Consolidated Railway right-of-way and remaining bridges, tunnels, and trestles were offered to the Hawai‘i Territory highway division. Consolidated Railway did not want to attempt a costly rebuild. The highway division was not interested in the purchase, which was then sold to the Gilmore Steel and Supply Company for $81,000. The highway division purchased the rights back from the Gilmore Steel and Supply Company for more than $300,000 shortly after the initial transaction after realizing the importance of the property. The current highway and portions of the current project area follow much of the railway right-of-way. Several highway bridges are also converted railroad trestles (Laupāhoehoe Train Museum 2009).

3.1.8 Laupāhoehoe School

Laupāhoehoe School was originally founded in 1883 at Laupāhoehoe Point (Figure 12). The 1946 tsunami destroyed the first Laupāhoehoe School; twenty-three school children and four teachers were killed by three large waves. The school and coastal residences were then rebuilt inland at the top of a ridge.

Figure 12. Photograph of Old Laupāhoehoe School before the tsunami of 1946 (source: Okimoto 2002). The original highway is visible *mauka* of the peninsula

3.2 Previous Archaeological Research

Previous archaeological studies in the vicinity of the current project area are presented in Table 1 and shown in Figure 13. Historic properties identified in the vicinity of the project area are shown on Figure 14. The following is a summary of these archaeological studies.

In 1919, John F. G. Stokes of the Bernice Pauahi Bishop Museum produced a manuscript entitled "*Heiau of the Island of Hawaii: A Historic Survey of Native Hawaiian Temple Sites*" (1991) based on fieldwork conducted primarily in 1906-1907. In the course of his working in the Hilo District he documented five *heiau* in the immediate vicinity of Laupāhoehoe (Figure 15). Four of the five *heiau* (Lonopūhā, Kama‘o, Papauleki‘i, and Moeapuhi) were already destroyed during Stokes's site visit to the Laupāhoehoe area, with Mamala or Ha‘akoa Heiau being the only surviving structure (Figure 16).

Stokes' description of Mamala Heiau or Ha‘akoa Heiau (SIHP #50-10-16-1784) is as follows:

> Heiau of Mamala of Ha‘akoa, Land of Ha‘akoa and adjoining Waipunalei, Hilo. Located near the edge of the bluff overlooking Laupāhoehoe Village. Laupāhoehoe New benchmark is located just outside of southeast wall.
>
> This is a walled heiau that has served in modern times as a cattle and slaughtering pen. The walls at present average 4.5 feet in height; the southern wall is 6 feet wide, while the opposite wall is only 5 feet wide. The present floor is earth, well trampled, but there are so many smooth beach pebbles in the soil that it seems probable that the floor was paved with them. The remains of a stone platform are to be found in the north corner. No native local history was obtainable. It was probably this *heiau* at which the chief Paiea was sacrificed by ‘Umi (Stokes 1991:157).

In 1983, the Army Corps of Engineers conducted an archaeological reconnaissance at Laupāhoehoe Point for the Laupāhoehoe Navigation Improvements Project (Cox 1983). One archaeological feature consisting of a double-walled stepped terrace located along the north bank of Laupāhoehoe Stream was identified. It was believed that the archaeological feature possibly functioned as a large residence, stream diversion, canoe storage, or *heiau*. No State Inventory of Historic Properties (SIHP) number was assigned.

In 2000, Rechtman Consulting conducted an archaeological survey of a 2,900 square foot area above ‘O‘ōkala, in the *ahupua‘a* of Humu‘ula for the placement of a cell tower (Rechtman 2000). No historic properties were identified within the project area.

In 2003, CSH conducted a brief site inspection of the proposed Nextel Waipunalei (Laupāhoehoe) project site (Shideler and Hammatt 2003). No historic properties were identified within the project area. However, of particular interest was Mamala or Ha‘akoa Heiau which was originally identified by Stokes (Stokes 1991). The *heiau* was relocated atop a *pu‘u* or hill overlooking the mouth of Laupāhopehoe Valley, approximately140 feet northeast of the proposed Nextel Waipunalei (Laupāhoehoe) project site. A significant development impacting Mamala Ha‘akoa Heiau after Stokes surveyed the area c. 1906 was the excavation of a near vertical, approximately 30 foot deep, fifty foot wide (at the top) cut through the ridge understood

Table 1. Previous Archaeological Studies in the Vicinity of the Project Area

Reference	Location	Nature of Study	Results
Stokes 1991	Island of Hawai‘i	Historic Survey of Native Hawaiian Temple Sites	Documented five *heiau* in the immediate vicinity of Laupāhoehoe.
Cox 1983	Laupāhoehoe Point, TMK: [3] 3-6-002: 024	Archaeological reconnaissance	Identified a stepped terrace, likely of pre-contact origin, possibly functioning as a large residence, stream diversion, canoe storage, or *heiau*. No State Inventory of Historic Properties (SIHP) number was assigned.
Rechtman 2000	TMK [3] 3-9-002: 007	Archaeological Survey	No historic properties identified.
Shideler and Hammatt 2003	TMK [3] 3-6-004: 007	Archaeological reconnaissance	Relocated SIHP # 50-10-16-1784, Mamala or Ha‘akoa Heiau.

Figure 13. Portion of 1980 1:100,000 USGS Map of Hawaii County, Hawai‘i, Sheet 2 of 3, showing the location of previous archaeological studies in the vicinity of the project area

Figure 14. Portion of 1980 1:100,000 USGS Map of Hawaii County, Hawai‘i, Sheet 2 of 3, showing the location of historic properties in the vicinity of the project area

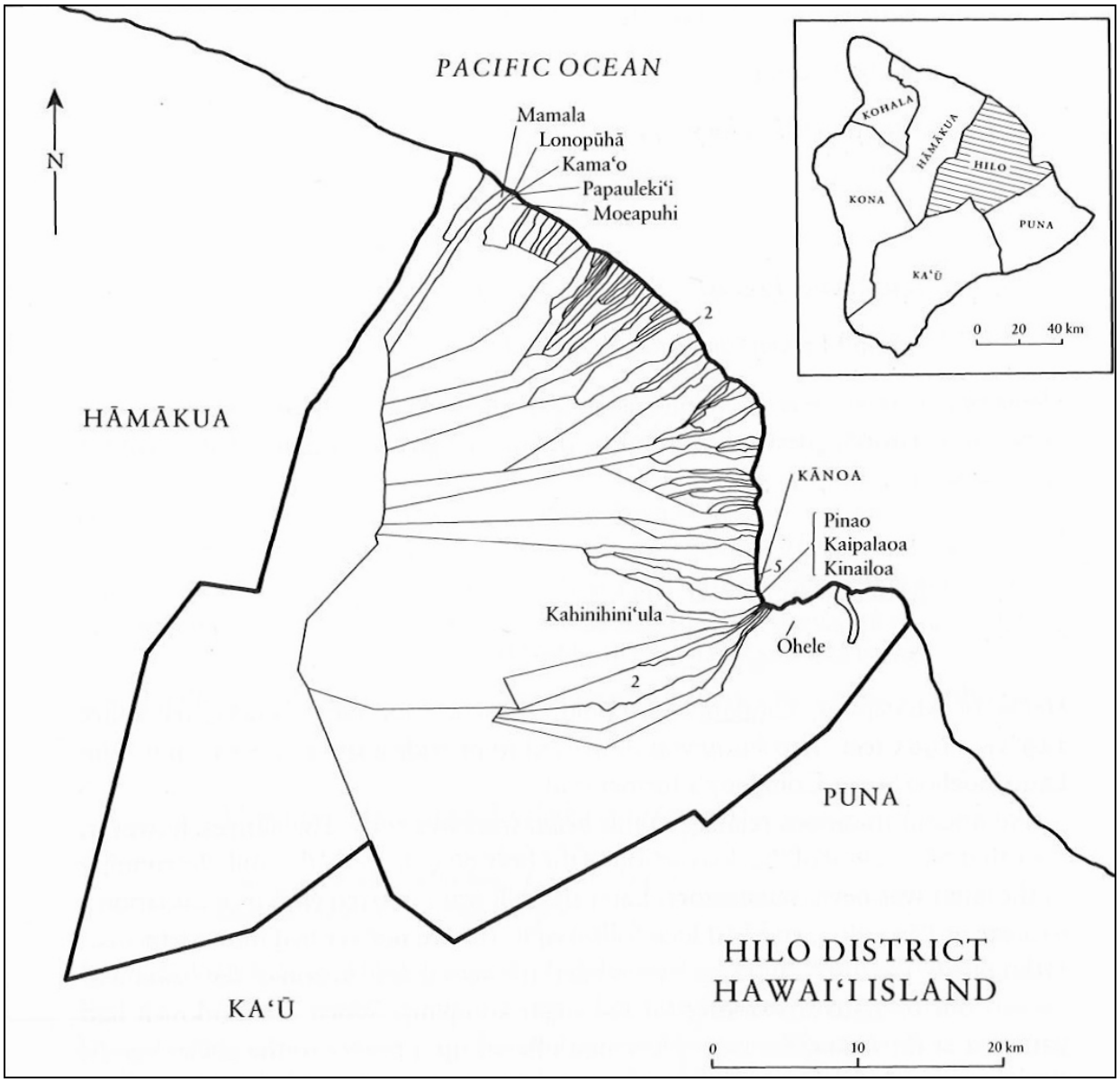


Figure 15. Locations of *heiau* documented by John F. G. Stokes in the Hilo District (source: Stokes 1991)

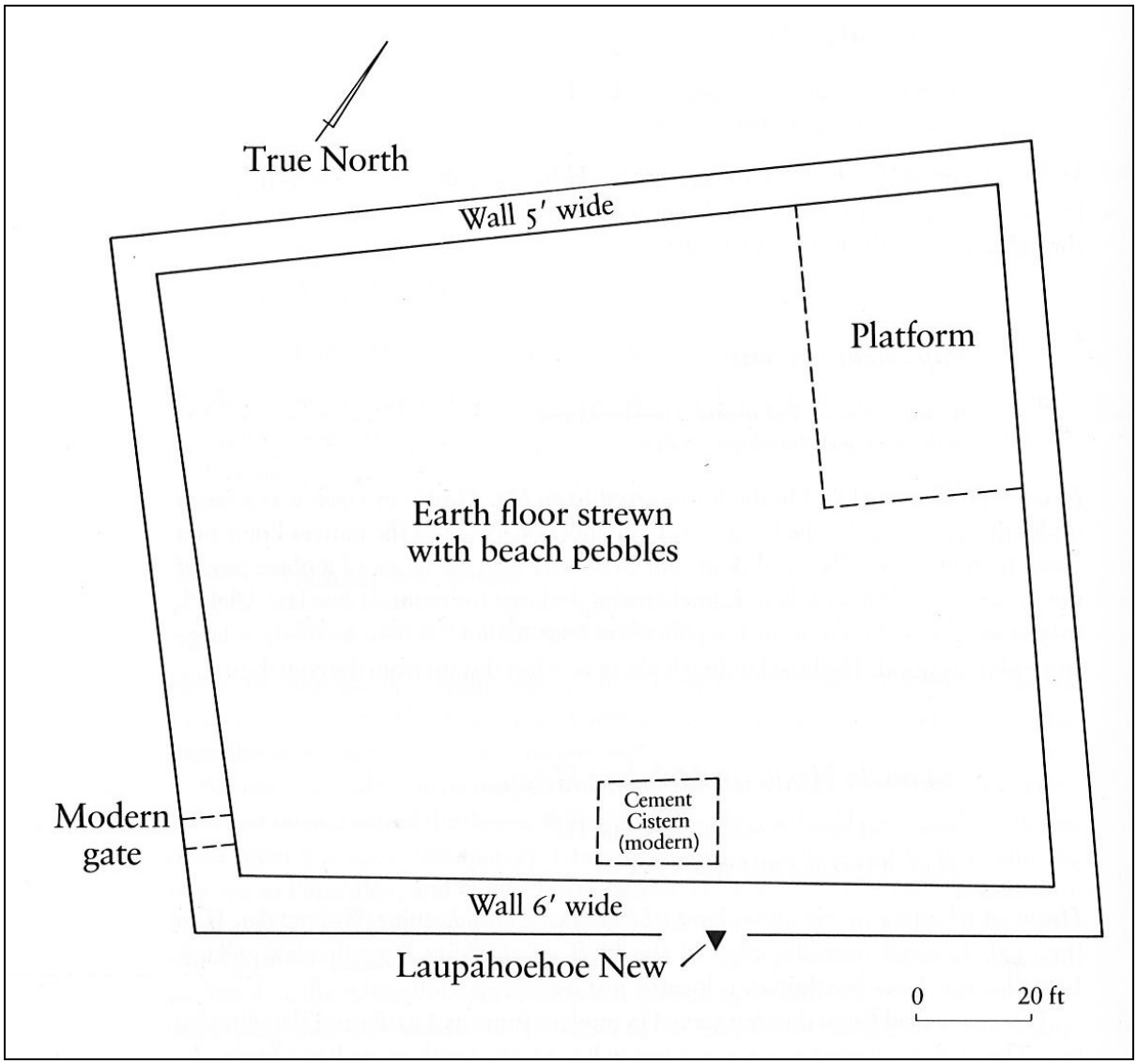


Figure 16. Plan view map of Mamala or Ha‘akoa Heiau, drawn by John F. G. Stokes (source: Stokes 1991)

as excavated for sugar cane transport. This cut destroyed the *mauka* (southwest) wall of the *heiau* and perhaps 15% of the southwestern side of the *heiau* structure. Otherwise the *heiau* is much as Stokes describes it. The interior is heavily overgrown with ironwood and guava. Remnants of the cistern may be noted in the middle of the southeast side. A low platform/pavement of water-rounded cobbles is present in the east side of the north corner and was probably the focus of ritual activities.

3.3 Background Summary and Predictive Model

T. Stell Newman’s ethnohistorical study defining indigenous Hawaiian land use patterns has indicated that the current project area falls into what is termed the Scattered Farms agricultural zone with a low population density, dispersed settlement with few fishing villages at the coast, and scattered fields and gardens with no major field systems (Newman 2000). Crops that would have been cultivated consisted of dry land taro, sweet potato, bananas, yams, breadfruit, sugarcane, and paper mulberry.

The fact that no LCAs have been identified within or in the immediate vicinity of the project area suggests that indigenous Hawaiian land use within the project area may have been limited. This appears to support Newman’s placement of the project area within a zone of low population density and scattered gardens with no major field systems.

Deviating from the settlement pattern outlined above is the portion of the project area situated at the mouth of Laupāhoehoe Gulch, just *mauka* of Laupāhoehoe Point. Previous archaeological research has documented a number of *heiau* in the vicinity of this portion of the project area (Stokes 1991; Shideler and Hammatt 2003). Cox notes that “the concentration of religious structures in this relatively small, but strategic, valley mouth is indicative of both the area’s importance and its sizable pre-contact period population” (Cox 1983:3).

Following pre-contact Hawaiian settlement, the project area was utilized by Laupahoehoe Sugar Company. Sugar may have been grown within the rugged topography that defines the project area, and the three gulch crossings that make up the project area were utilized to transport harvested cane from the fields to the sugar mill. The Laupāhoehoe Sugar Company was unique in that it did not utilize a railroad to transport cane, but instead used flumes and a steam hoist and cable lift system due to the steep gulches and deep ravines that characterize the area.

Portions of the Hilo Railroad, later known as the Hawai‘i Consolidated Railway, ran through the project area from the early 1900s until it was destroyed by the April 1, 1946 tsunami. Portions of the railway including trestles, bridges, and tunnels were maintained and incorporated into today’s Hawai‘i Belt Road.

Based on background research, expected finds during the field inspection of the project area could include both pre-contact and post-contact archaeological sites. Pre-contact archaeological sites may include: dry land agricultural sites, including planting mounds and terraces in the vicinity of drainage gulches; habitation sites, including enclosures and platforms; trail markers (*ahu)*; and religious sites including enclosures, terraces, platforms, and/or upright stones located on prominent hills or other significant locations. Post-contact archaeological sites may include: sugar agriculture related structures including walls, irrigation and cane transport flumes, and steam hoist and cable lift infrastructure utilized by the Laupāhoehoe Sugar Company to transport

sugarcane from Maulua Gulch to the sugar mill; and remnants of the Hawai‘i Consolidated Railway.

Regarding human burials, pre-contact and early post-contact Hawaiian populations typically utilized coastal areas with Jaucas sand deposits for human interment where available. A review of the USDA soil survey of the area has indicated that the narrow strip of coastline located in the immediate vicinity of the current project area does not contain any Jaucas sand deposits increasing the likelihood that the rocky outcrops *mauka* of Hawai‘i Belt Road may contain overhangs and caves that might have served as an alternative interment location for pre-contact and early post-contact Hawaiian populations in the area.

Section 4 Results of Field Inspection

Pedestrian inspection of the study area was limited due to safety issues, accessibility, and dense vegetation. Archaeologists initially drove along the Belt Highway between Maulua Gulch and Ka‘awali‘i Gulch to determine parking and field inspection accessibility. Parking was very limited. In some cases areas where parking was possible, walking along the highway was too dangerous due to narrow or minimal roadside shoulders and sharp turns in the road. Some areas appeared to only be accessible by private property.

Sheer walls completely or partially covered with vegetation were found in the three gulch study areas (Figure 17 - Figure 19). Several attempts to inspect these gulch walls from the opposite ridge were unsuccessful due to dense vegetation that appeared to be feral cane or California grass (Figure 20). Archaeologists were able to review the *makai* side of the northern portion of Laupāhoehoe Gulch from the *mauka* ridge (Figure 21 & Figure 22), and the *mauka* side of the northern portion of Ka‘awali‘i Gulch from the *makai* ridge (see Figure 17). However, dense vegetation in both areas again prevented a thorough inspection.

Archaeologists walked along the highway, when possible, to inspect the study area (Figure 25). Areas that could not be walked or viewed from the opposite ridge were inspected by car and photographed. No historic sites were found within or adjacent to the proposed study area. The actual route traveled by the archaeologists on foot and in the car is shown in Figure 25 - Figure 27.

Figure 17. Northern portion of Ka‘awali‘i Gulch study area showing sheer, steep walls, view to southwest

Figure 18. Northern portion of Laupāhoehoe Gulch study area, view to south

Figure 19. Southern most portion of Maulua Gulch study area, view to north

Figure 20. Dense feral cane or California grass, approximately 2 meters tall and dense, view to south

Figure 21. Laupāhoehoe Gulch showing dense vegetation extending below Belt Highway, view to southeast

Figure 22. Laupāhoehoe Gulch in foreground, showing dense vegetation extending above and below Belt Highway, view to south

Figure 23. Southern portion of Ka‘awali‘i Gulch, showing iron wood trees at higher elevations and dense vegetation at lower elevations, view to northwest

Figure 24. Laupāhoehoe Gulch showing dense forest of trees at highest elevations and dense vegetation below, view to west-northwest

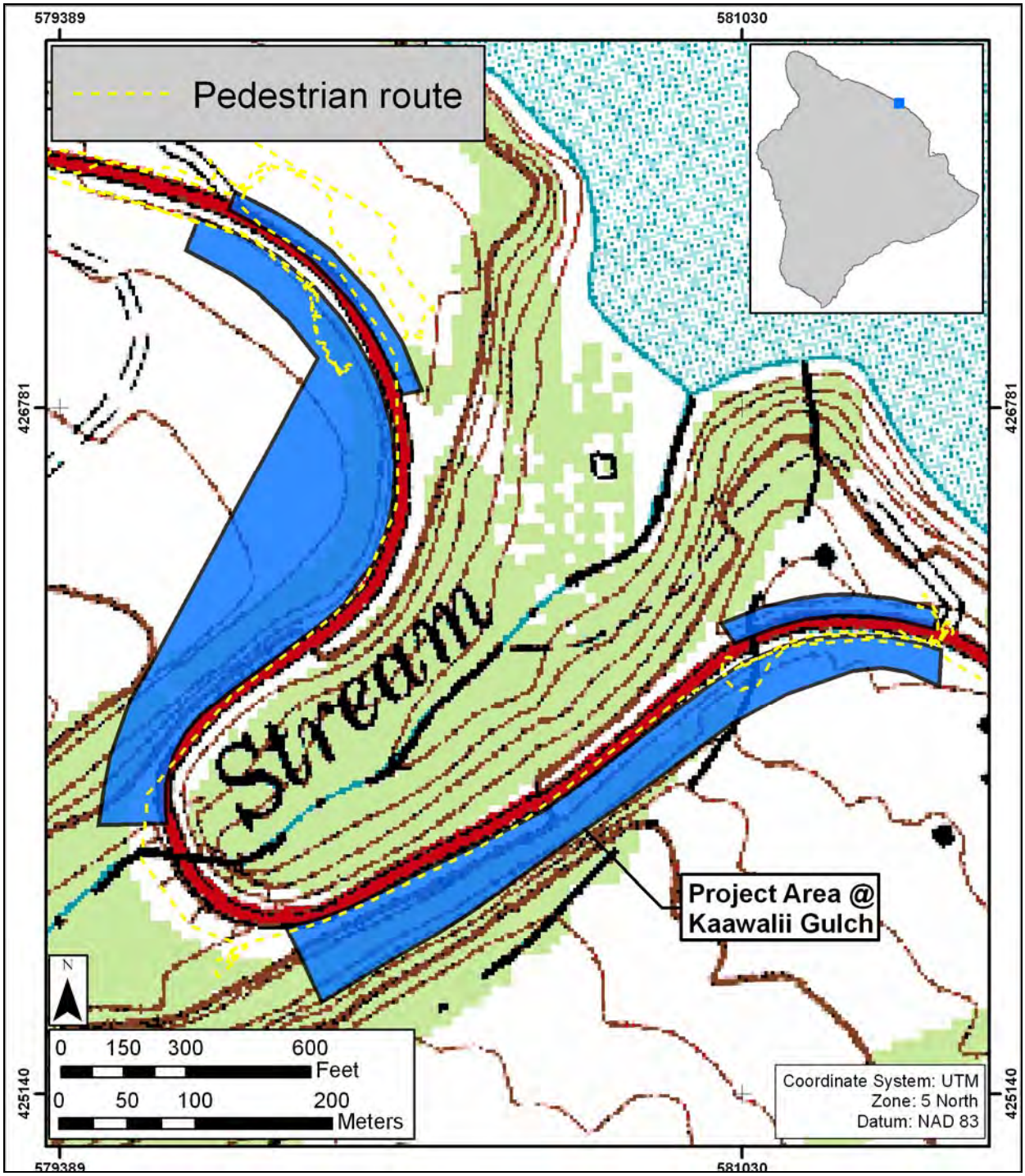


Figure 25. USGS 7.5 Minute Series Topographic Map, Kūka‘iau Quadrangle (1982), showing the route traveled by archaeologists on foot and in the car in the Ka‘awali‘i Gulch portion of the study area

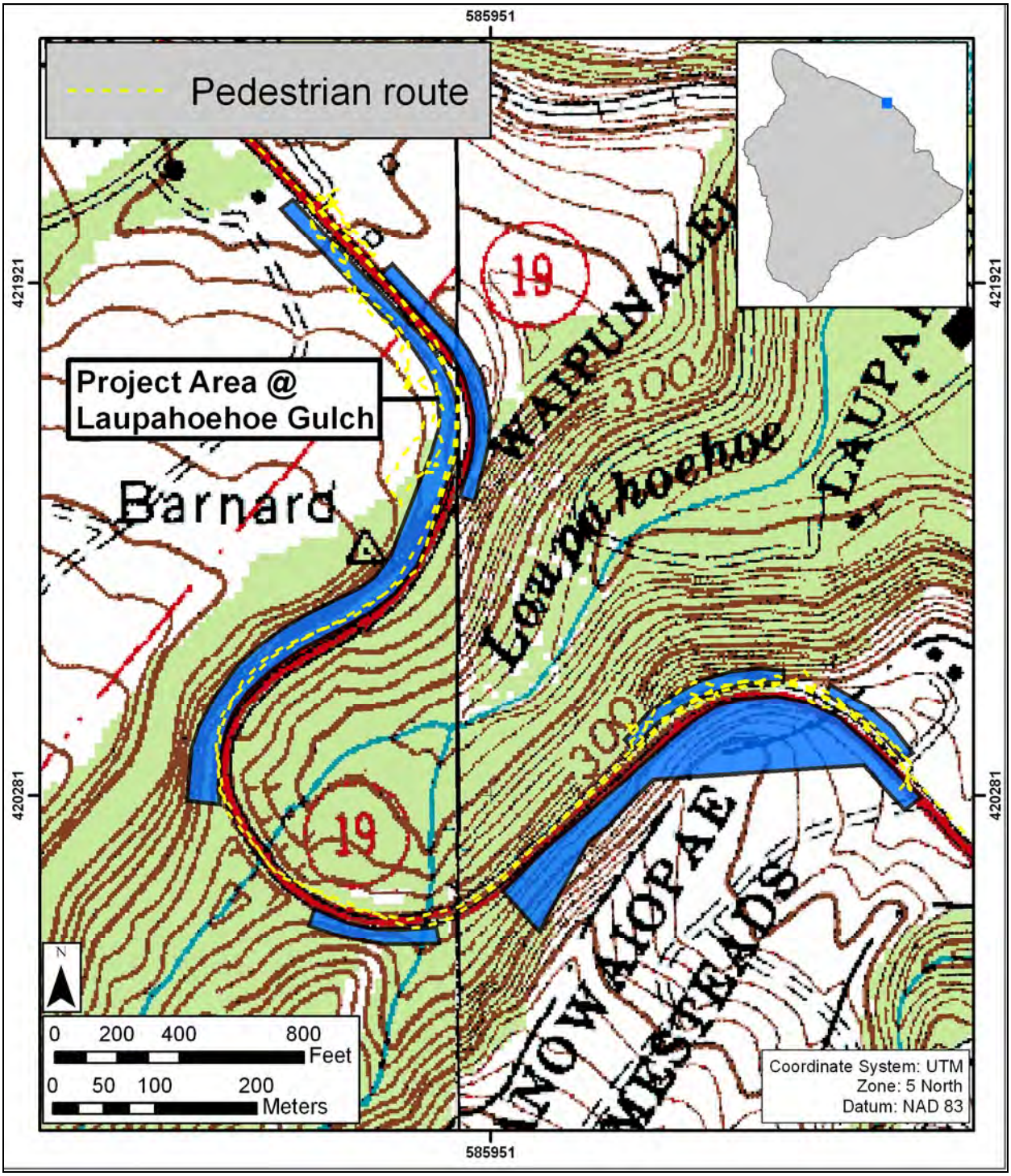


Figure 26. USGS 7.5 Minute Series Topographic Map, Pāpa‘aloa Quadrangle (1982), showing the route traveled by archaeologists on foot and in the car in the Laupāhoehoe Gulch portion of the study area

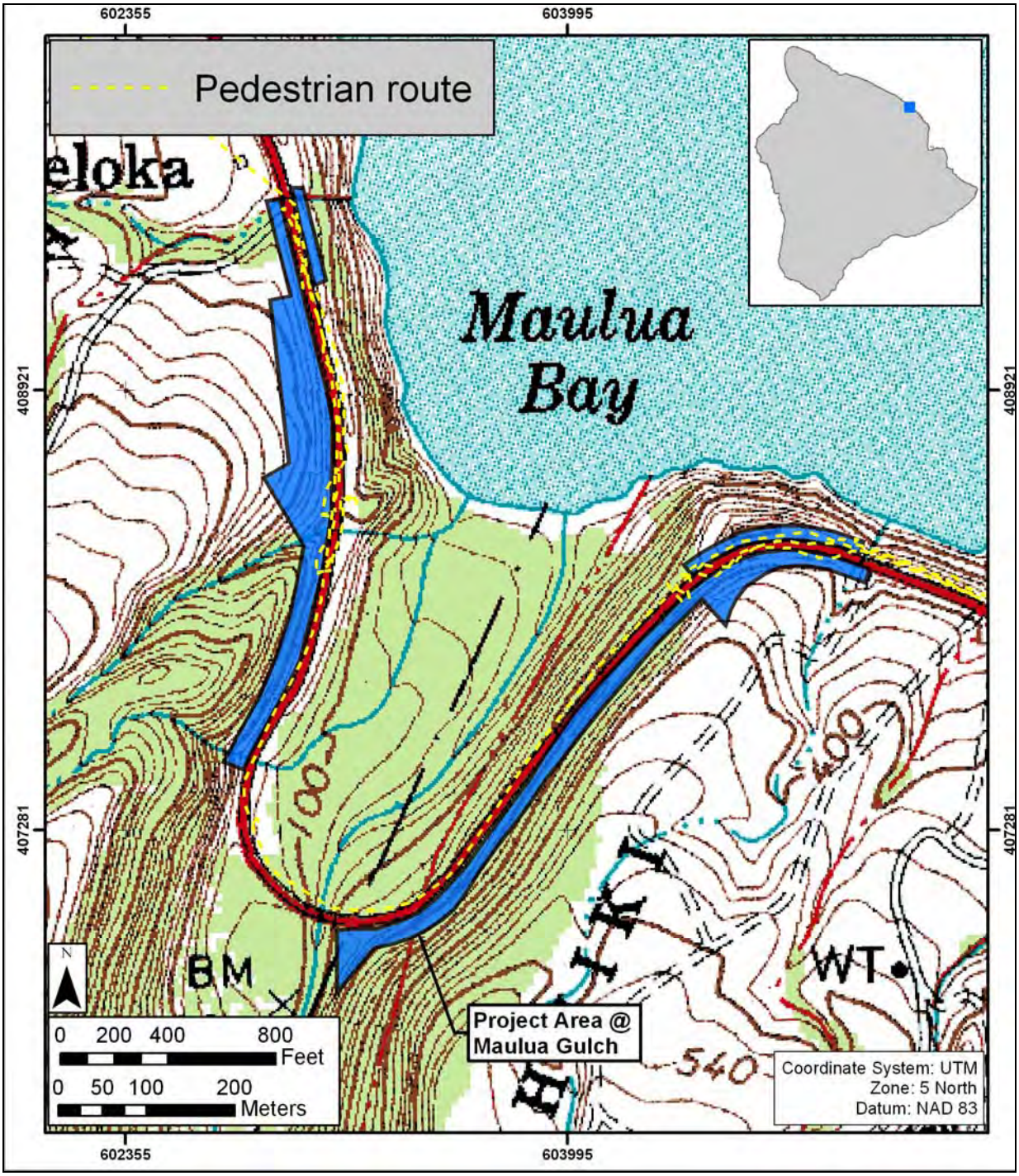


Figure 27. USGS 7.5 Minute Series Topographic Map, Pāpa‘aloa Quadrangle (1982), showing the route traveled by archaeologists on foot and in the car in the Maulua Gulch portion of the study area

Plate G-4.3 on page A-4 in Appendix A shows an “abandoned railroad tunnel and portal located below highway”. This tunnel was visible while driving on the highway although it was not possible to access the tunnel due to safety issues. Dense vegetation just below the highway and a sheer drop did not allow inspection (Figure 28). It was also not possible to photograph the tunnel while driving and or park to photograph the tunnel.

Figure 28. Maulua Gulch, abandoned railroad tunnel would be below the area shown in the foreground, view to north

Section 5 Summary and Recommendations

The study area consists of three discrete locations at three major Hawai‘i Belt Road stream valley crossings (Maulua, Laupāhoehoe, and Ka‘awali‘i gulches) within the North Hilo District. The three study area locations are all with the Hawai‘i Belt Road Right-of-Way and total approximately 4.2 kilometers (2.6 miles).

No historic properties were observed during the field inspection of the approximately 2.6 mile study area. The absence of historic properties can be attributed to extensive land modifications associated with historic sugar cultivation and construction associated with the Hāmākua Division of the Hilo Railroad, later known as the Hawai‘i Consolidated Railway. The Belt Highway and portions of the current project area follow much of the railway right-of-way. After the demise of the sugar industry, previously cultivated areas became pasture lands, and/or were planted with eucalyptus or ironwood trees. The proposed Hawai‘i Belt Road Rockfall Protection Project also involves minimal ground disturbance involving 10 boring holes for the installation of a new wire mesh drapery over exiting road cuts.

Plate G-4.3 on page 4 in Appendix A shows an “abandoned railroad tunnel and portal located below highway”. This tunnel was not visible from the highway and it was not possible to access the tunnel due to safety issues and dense vegetation. No work is planned in the vicinity of the abandoned railroad tunnel and therefore the project will not affect the tunnel.

Project plans do not indicate locations of staging areas. If staging areas are not necessary, no further work is recommended for the Hawai‘i Belt Road Rockfall Protection Project at Maulua, Laupāhoehoe, and Ka‘awali‘i gulches. If, however, staging areas involving ground disturbance are planned, additional research / inspection may be necessary.

If in the unlikely event that intact historic properties, including but not limited to human remains or other significant cultural deposits, are encountered during the course of the proposed project activities, all work in the immediate area should stop and the State Historic Preservation Division should be promptly notified.

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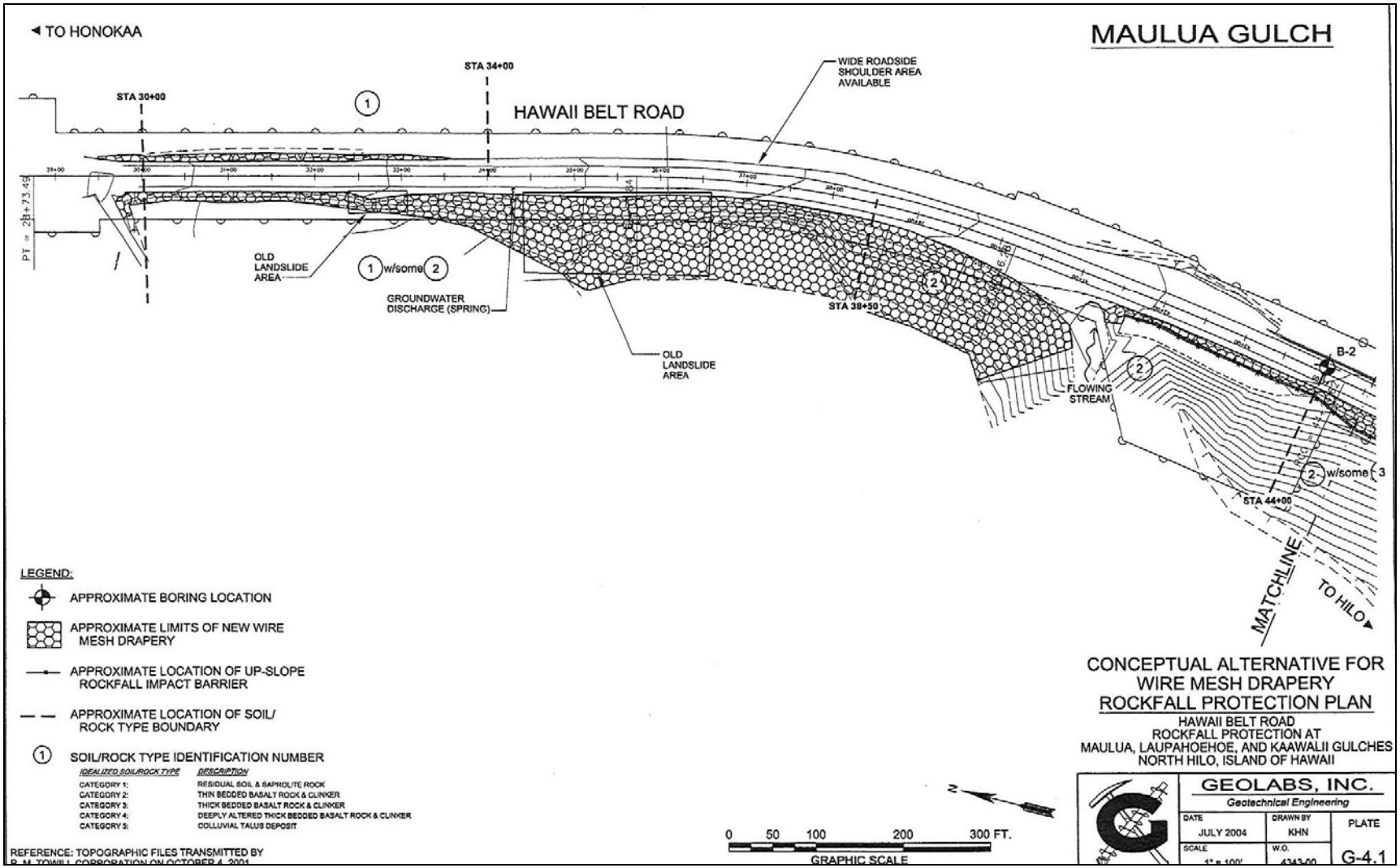
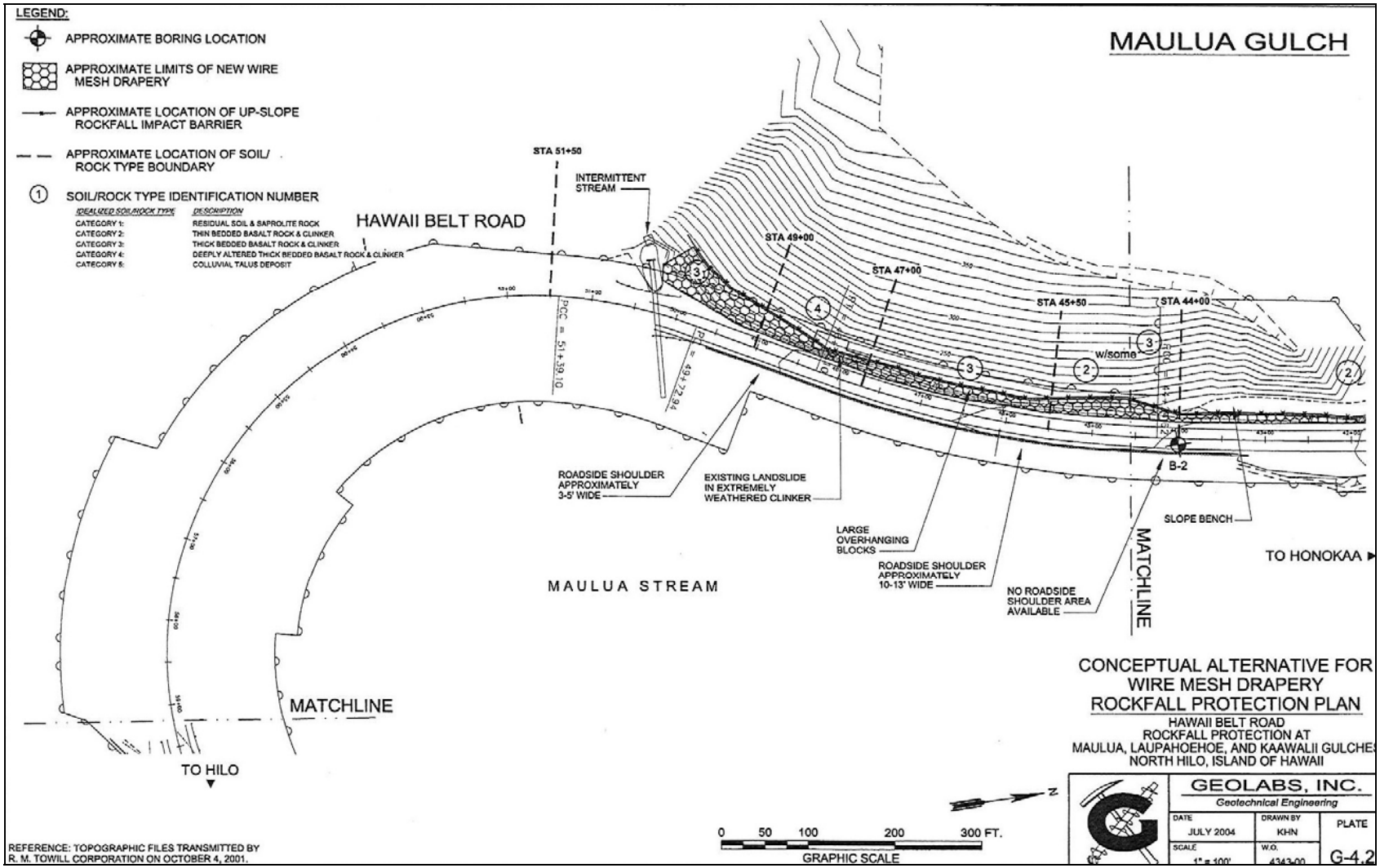
1982 Pāpa‘aloa Quadrangle, 7.5 Minute Series, U. S. Geological Survey.

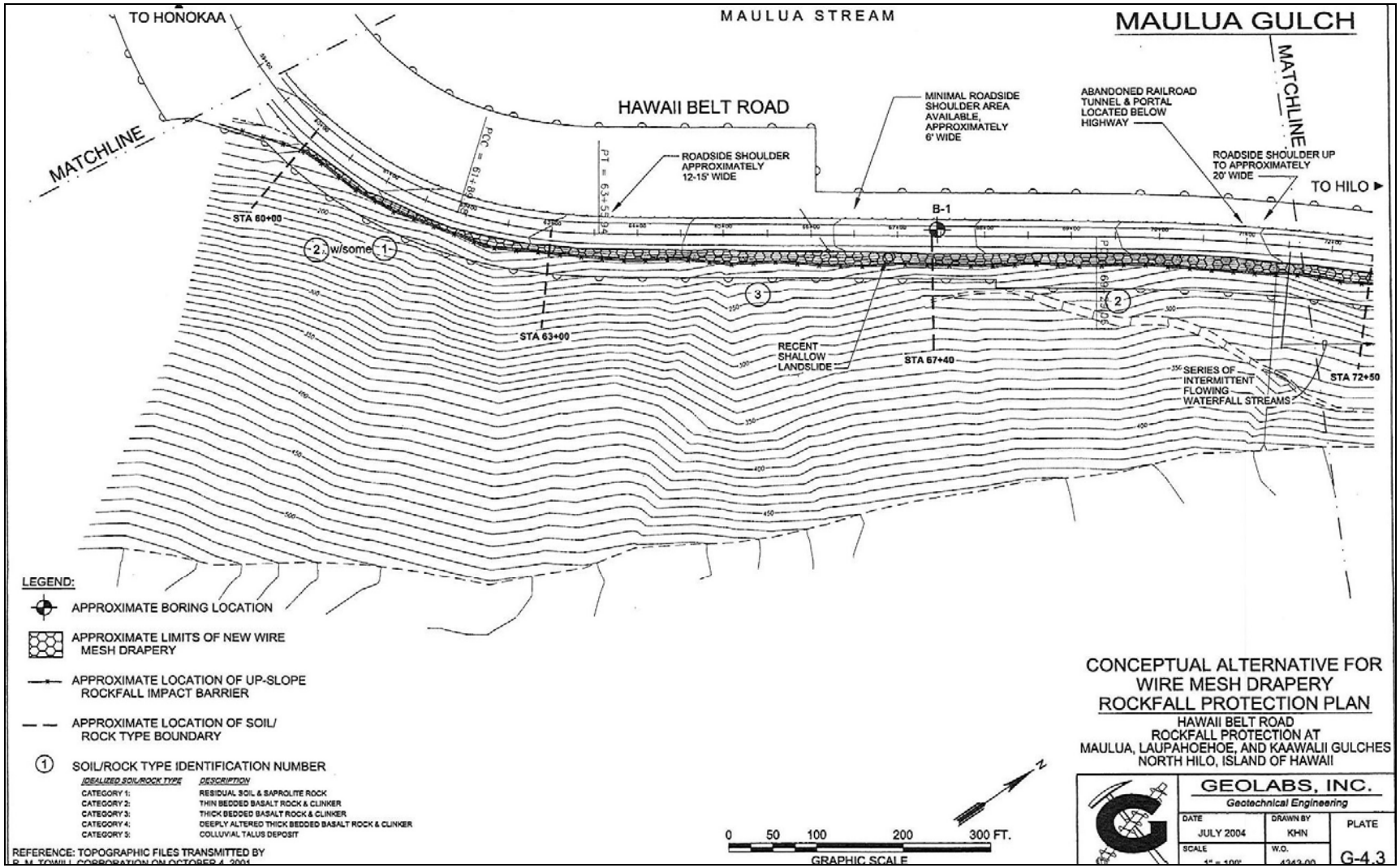
Appendix A Site Plans for Hawai‘i Belt Road Rockfall Protection



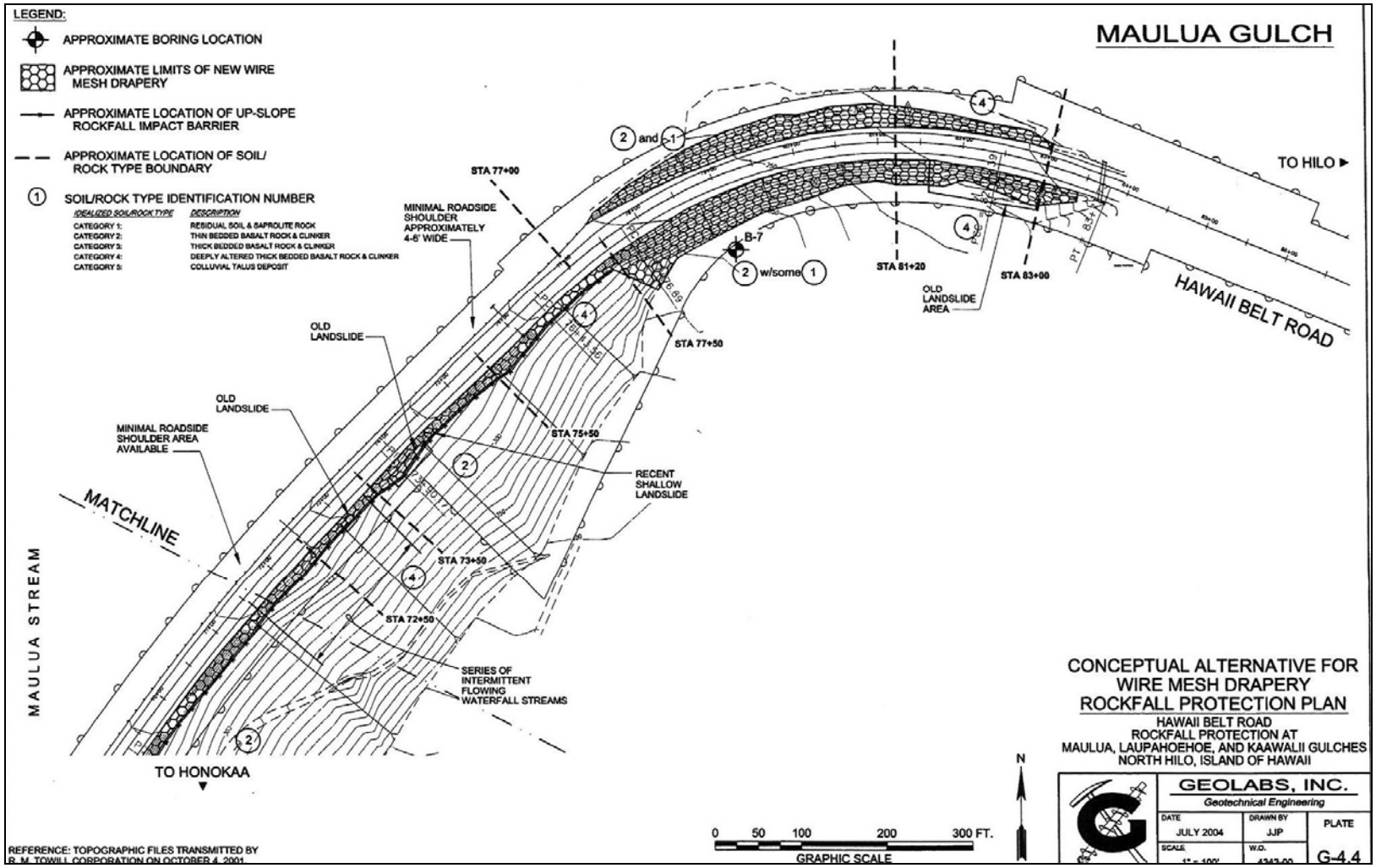
Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Maulua Gulch, Plate G-4.1 (source: Geolabs, Inc.2004)



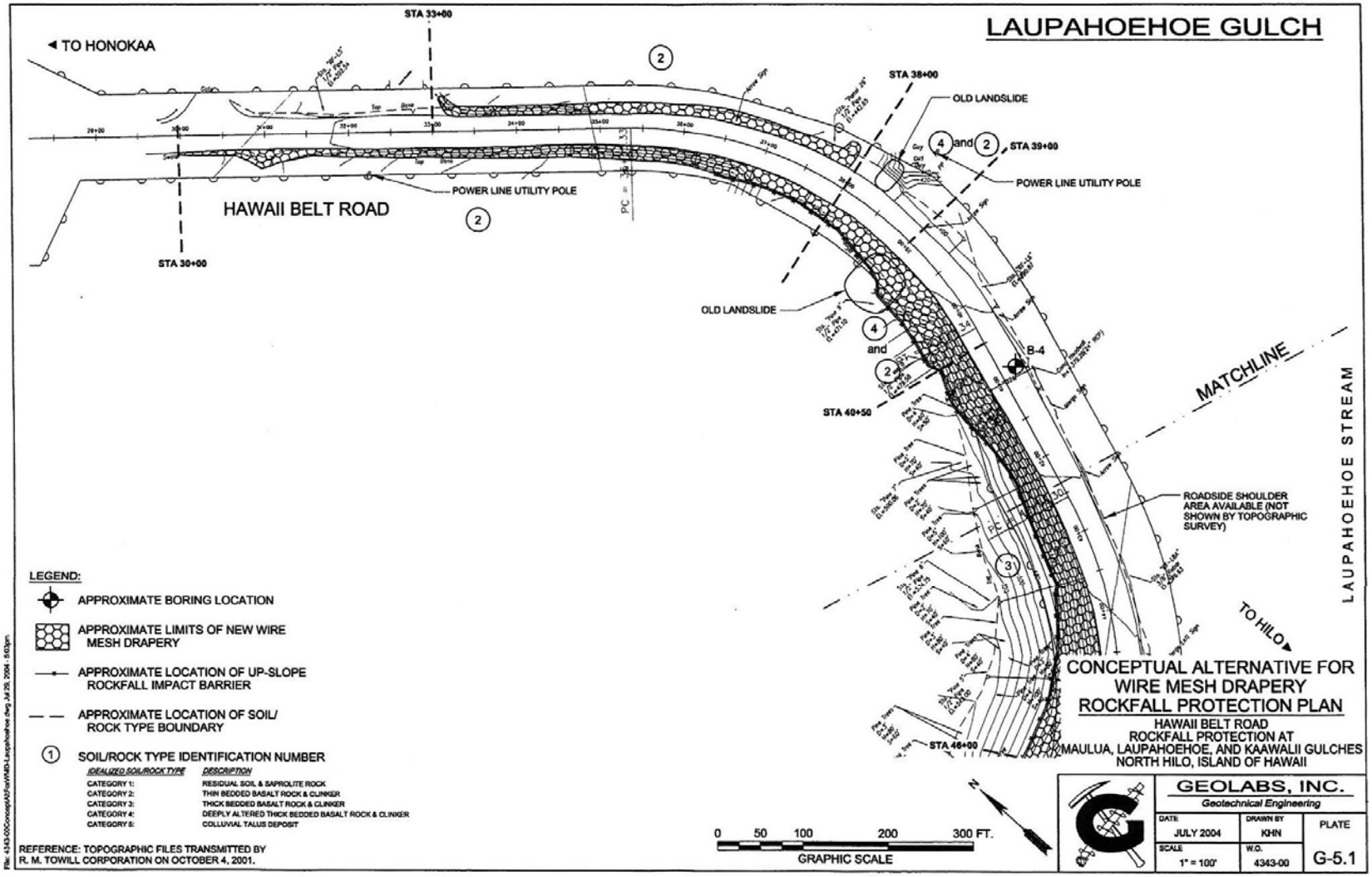
Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Maulua Gulch, Plate G-4.2 (source: Geolabs, Inc.2004)



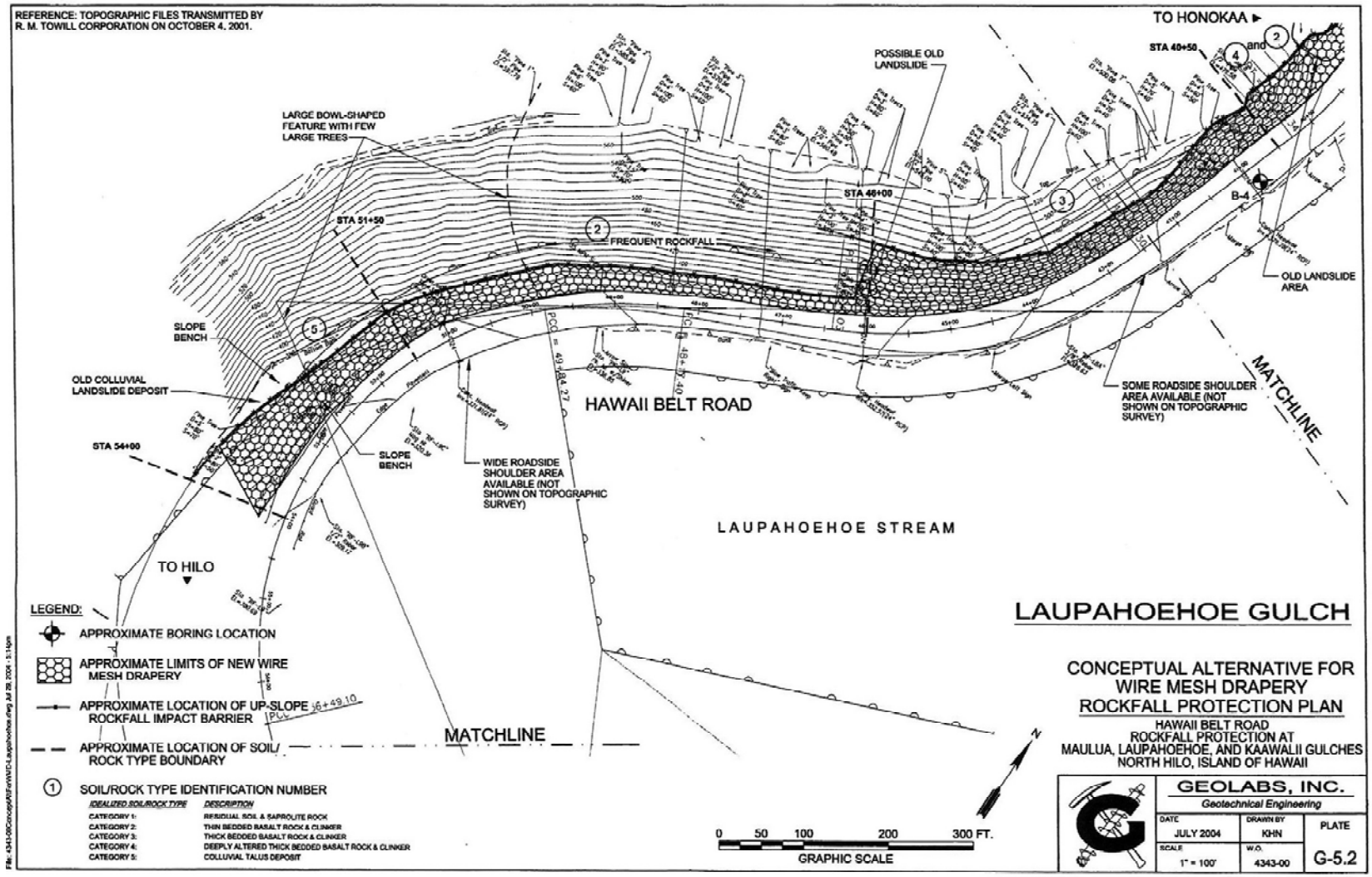
Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Maulua Gulch, Plate G-4.3 (source: Geolabs, Inc.2004)



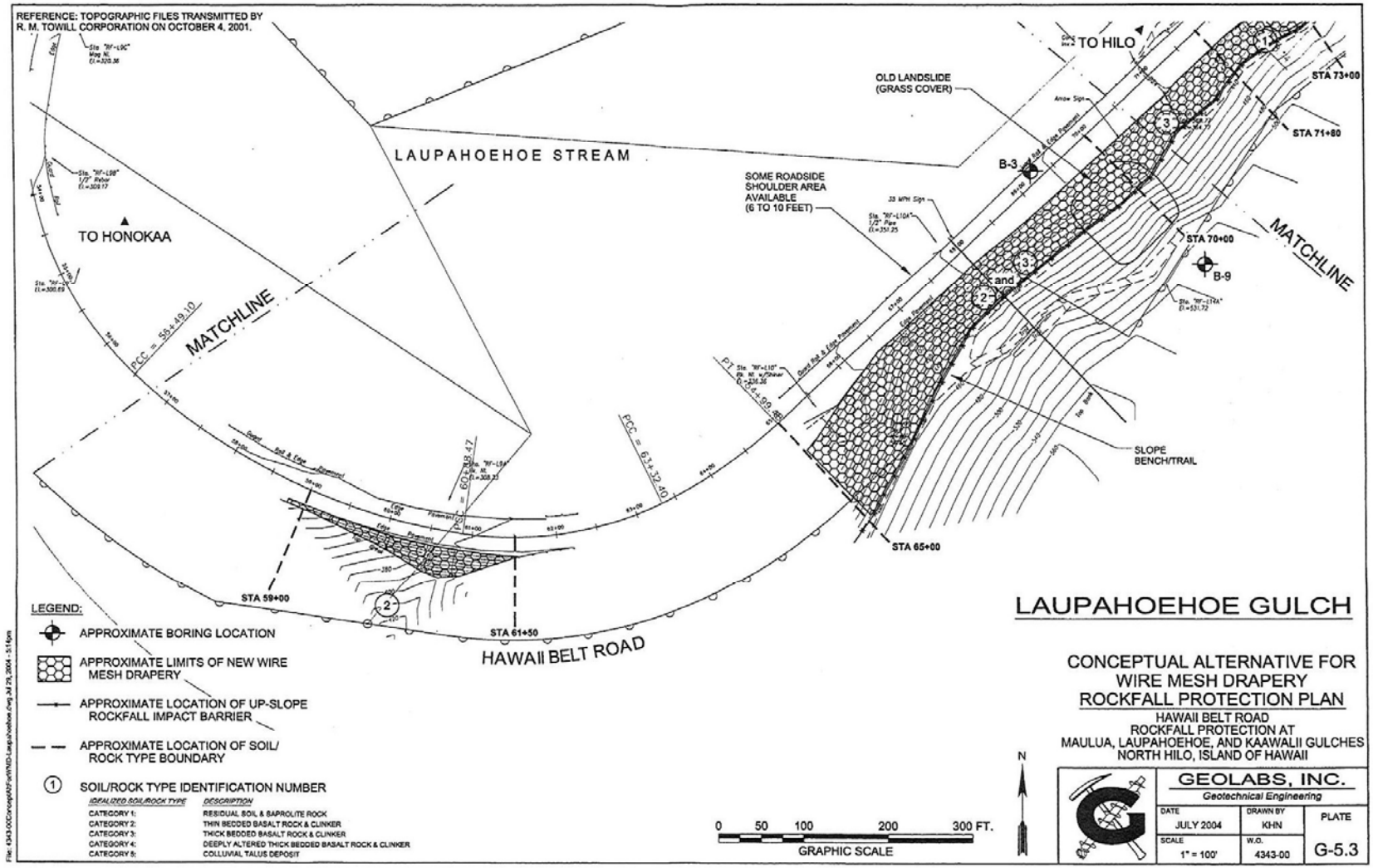
Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Maulua Gulch, Plate G-4.4 (source: Geolabs, Inc.2004)



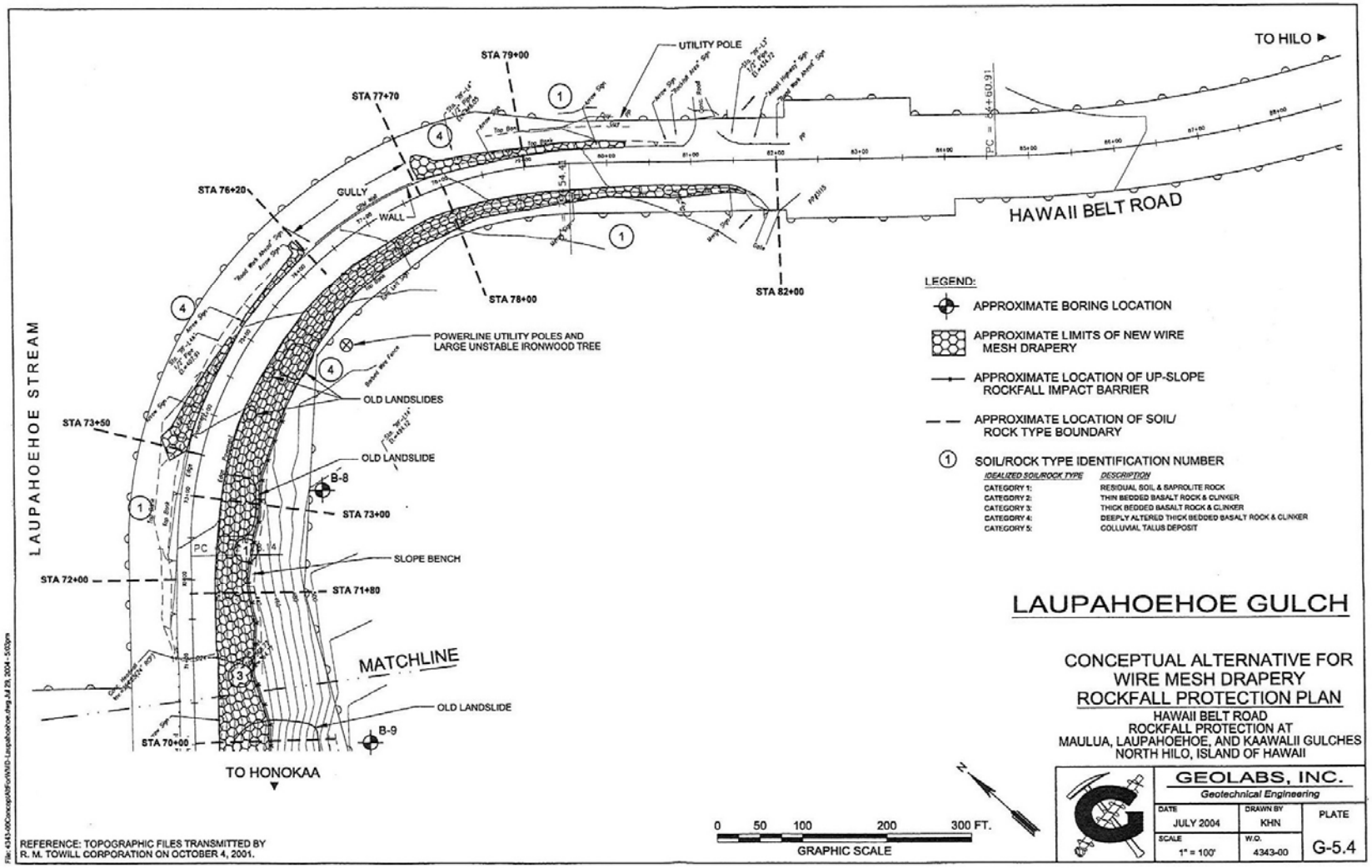
Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Laupāhoehoe Gulch, Plate G-5.1 (source: Geolabs, Inc.2004)



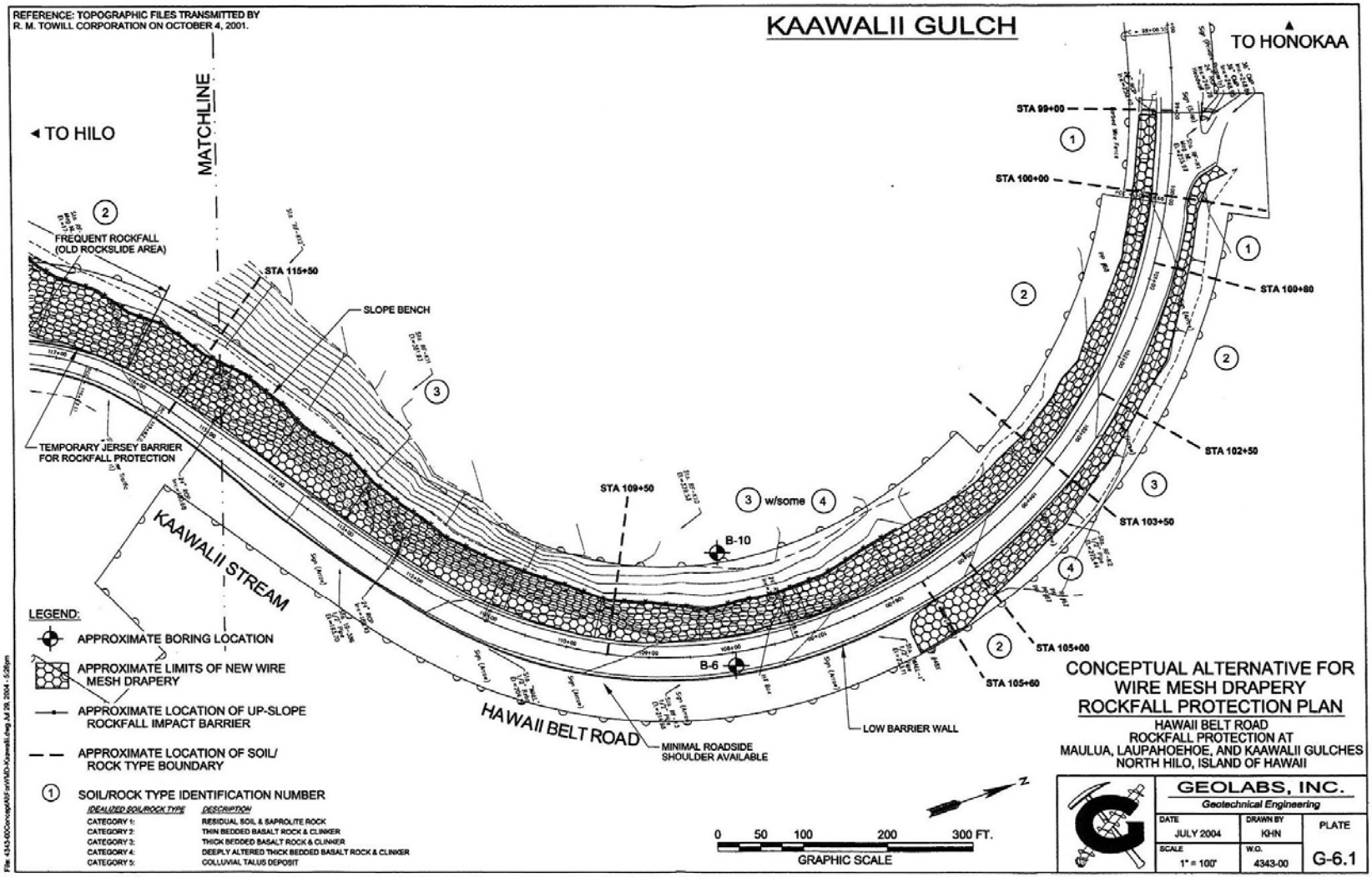
Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Laupāhoehoe Gulch, Plate G-5.2 (source: Geolabs, Inc.2004)



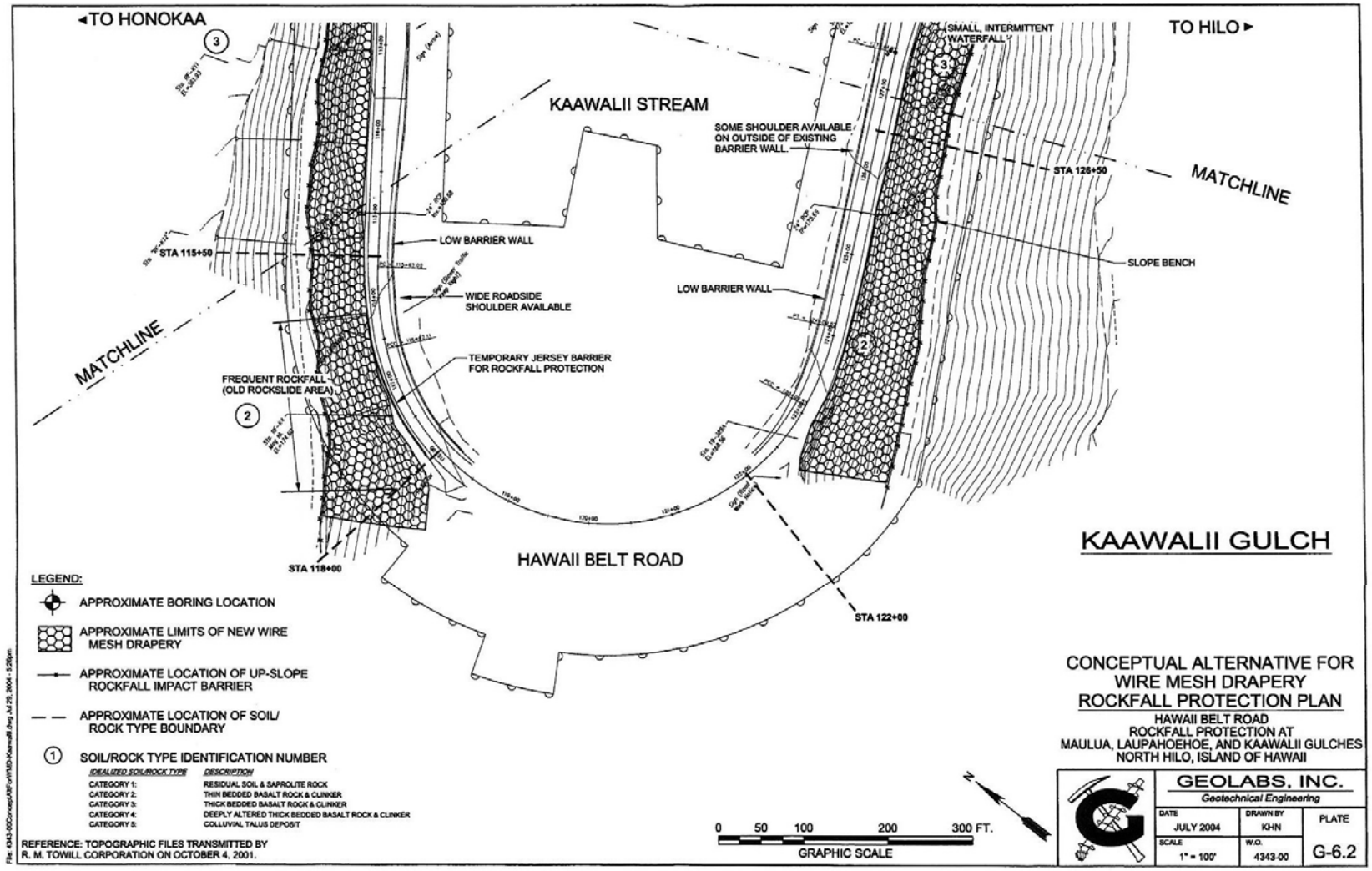
Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Laupāhoehoe Gulch, Plate G-5.3 (source: Geolabs, Inc.2004)



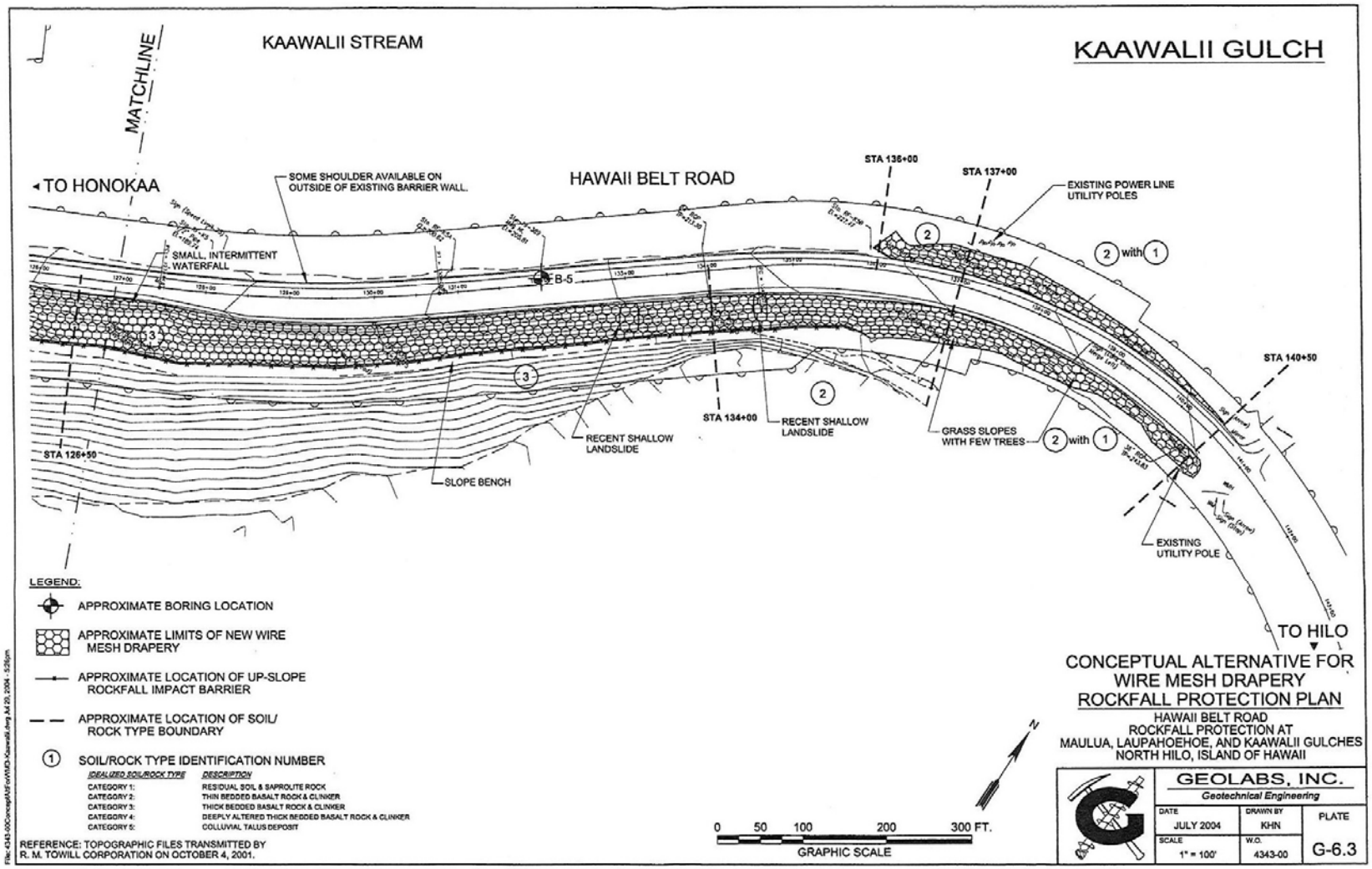
Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Laupāhoehoe Gulch, Plate G-5.4 (source: Geolabs, Inc.2004)



Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Ka‘awali‘i Gulch, Plate G-6.1 (source: Geolabs, Inc.2004)



Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Ka‘awali‘i Gulch, Plate G-6.2 (source: Geolabs, Inc.2004)



Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Ka‘awali‘i Gulch, Plate G-6.3 (source: Geolabs, Inc.2004)

Appendix D

Roadway Assessment Report
Hawai‘i Belt Road Rockfall Protection
at Maulua, Laupāhoehoe and Ka‘awali‘i Gulches
North Hilo and Hāmākua, Island of Hawai‘i, Hawai‘i

PURPOSE

The purpose of this report is to determine if the roadways within the three gulches meet AASHTO standards.

REFERENCES

1. "A Policy on Geometric Design of Highways and Streets", 5th Edition, AASHTO, 2004.
2. "Roadside Design Guide", AASHTO, January 2002.
3. "Traffic Study Report, Hawaii Belt Road Rockfall Protection at Maulua Gulch, Laupahoehoe Gulch, Kaawalii Gulch", Julian Ng Inc., March 2006

SCOPE OF WORK

Existing highway geometric and cross section elements and roadside hazards will be compared with AASHTO standards. A geometric analysis will focus on horizontal curves and superelevation rates. A cross section analysis will focus on the travel lane and shoulder widths. A roadside hazard analysis will focus on guardrails and obstacles. The limits of work for the three gulches are shown below:

Gulch	Baseline Stations
Kaawalii	99+00 to 118+00
	122+00 to 140+50
Laupahoehoe	30+00 to 54+00
	58+50 to 61+00
	65+00 to 82+00
Maulua	30+00 to 50+00
	60+00 to 83+00

ROADWAY CHARACTERISTICS

Existing Conditions

- Classification: Rural Arterial
- Posted Speed Limit: 45 - 55 mph
- ADT (2008): 7,280
- Level of Service: C
- Terrain: Mountainous

Design Criteria

- Design Speed: 50 - 65 mph
- ADT (2038): 13,400
- Level of Service: C or better

The design speed for this analysis is based on the posted speed limit. According to AASHTO, the posted speed is 85% of the design speed. A posted speed of 55 mph results in a design speed of 65 mph. A posted speed of 45 mph results in a design speed of 50 mph. Warning signs posted within the gulches indicate a reduced speed for the approaching curves.

GEOMETRIC ANALYSES

The roadway geometrics analyses are based AASHTO requirements for the selected design speed.

Sight Distance

Three types of sight distance analyses can be applied to a highway: passing, decision and stopping. Decision sight distance includes sufficient length to accommodate the additional driver reaction time needed to avoid an unexpected obstacle in the roadway. Passing sight distance requires even longer lengths to successfully pass another vehicle. Due to the highway alignment through the gulches, the sight distance analysis will be limited to stopping sight distance.

Each curve in the gulches was analyzed for adequate stopping sight distance. The assumption was made that the driver's eye is 3.5' above the ground and the object ahead is 2' above the ground. Sight distance around curves is typically obstructed by trees, buildings or cut slope.

A. Kaawalii Gulch (Figures 1-3): The posted speed limit for this gulch is 55 mph. Therefore, the design speed is 65 mph, which results in a stopping sight distance of 645 ft. This gulch contains five horizontal curves, four of which are part of a compound curve. The horizontal sight distance for three of the five curves is inadequate because the sight line is obstructed by the cut slope. The available sight distance ranges from 230 ft to 260 ft.

B. Laupahoehoe Gulch (Figures 4-5): The posted speed limit for this gulch is 45 mph. Therefore, the design speed is 50 mph, which results in a stopping sight distance of 425 ft. This gulch contains four horizontal curves. The sight distance is adequate for Curve 3. The remaining curves do not provide adequate sight distance because the cut slope interferes with the driver's line of sight. The available sight distance for the curves in this gulch ranges from 200 ft to 250 ft.

C. Maulua Gulch (Figures 7-9): The posted speed limit for this gulch is 55 mph. Therefore, the design speed is 65 mph, which results in a stopping sight distance of 645 ft. This gulch contains four horizontal curves. Although this gulch contains the largest radii curves, none of the curves provide adequate sight distance because the cut slope obstructs the driver's line of sight. The available sight distance ranges from 240 ft to 530 ft.

Conclusion

None of the horizontal curves provides adequate sight distance. For all the curves, the cut slope obstructs the driver's line of sight. The design speed requires a sight distance that cannot be provided within the gulches. The following highway improvements should be considered to provide adequate sight distance within the gulches:

- Reduce the posted speed limit and therefore the design speed.
- Increase the shoulder width.
- Adjust the roadway geometrics by increasing the curve radii and widening the shoulders.

Based on the available sight distance, the existing highway will be able to accommodate the following design speeds in accordance with AASHTO standards:

- Kaawalii - 30 mph (posted 25 mph)
- Laupahoehoe - 30 mph (posted 25 mph)
- Maulua - 30 mph (posted 25 mph)

Superelevation

The superelevation rate for each of the curves in the gulches was analyzed by comparing the existing superelevation rates with those recommended by AASHTO. The maximum superelevation rate selected for this analysis was 8%.

A. Kaawalii Gulch: The minimum curve radius for a design speed of 65 mph is 1,485 ft. All the curves in this gulch have smaller radii than 1,485 ft. Therefore, an analysis of the existing superelevation rate is not possible.

B. Laupahoehoe Gulch: The minimum curve radius for a design speed of 50 mph is 750 ft. All of the curves in this gulch have smaller radii than 750 ft. Therefore, an superelevation analysis of the curves within this gulch is not possible.

C. Maulua Gulch: The minimum curve radius for a design speed of 65 mph is 1,485 ft. Three of the four curves in this gulch have radii smaller than 1,485 feet. Curve 3 has adequate radius, however, the superelevation rate provided should be increased.

Conclusion

Only one of the curves in all three gulches meets the minimum radius requirement for superelevation. The following roadway improvements should be considered to comply with AASHTO standards:

- Reduce the posted speed limit.
- Realign the horizontal curves to provide larger radii.

If the posted speed limit is lowered on the existing highway, the following design speeds can be accommodated:

- Kaawalii - 40 mph (posted 35 mph)
- Laupahoehoe - 35 mph (posted 30 mph)
- Maulua - 40 mph (posted 35 mph)

ROADSIDE HAZARDS

Obstacles along the roadway can create hazards for motorists. The clear zone and shy line distances are determined by AASHTO and are based on the ADT, design speed, and road cross section. The clear zone is defined as the area along the roadway available for safe use by errant vehicles. The shy line is the distance from the edge of traveled way to a roadside object that will not cause a driver to change the vehicle's direction or speed. Existing obstacles along the gulch roads include signs, utility poles, culvert headwalls and walls. An inventory of existing obstacles is shown in Table 1. If an obstacle is located within the clear zone and is not protected by a barrier, an analysis should be performed to determine whether a barrier is warranted or not.

A. Kaawalii Gulch: The clear zone is 34.4 feet on the fill side and 29.5 feet on the cut side. The shy line is 9.2 feet. Roadside obstacles consist of single post signs and walls. All of the signs and walls are located within the shy line and clear zone.

B. Laupahoehoe Gulch: The clear zone is 21.3 feet on both sides. The shy line is 6.6 feet. Roadside obstacles consist of single post warning signs, walls and culvert headwalls. All of the obstacles are located within the clear zone and a handful are also located within the shy line.

C. Maulua Gulch: The clear zone is 34.4 feet on the fill side and 29.5 feet on the cut side. The shy line is 9.2 feet. Roadside obstacles consist of single post warning signs, walls and culvert headwalls. All of the obstacles are located within the clear zone and most of the them are also within the shy line.

Conclusion

Most of the obstacles within the gulches are located within both the shy line and clear zone. However, before any of the obstacles are relocated, accident data along the gulch roads should be analyzed. If the accident data indicates a significant number of vehicular accidents with an obstacle located within the shy line, relocation of the obstacle should be considered. If accident data indicates a significant number of vehicular accidents with obstacles within the clear zone, beyond the shy line, the installation of guardrail should be considered. To determine if guardrail installation is warranted at a specific location, a cost/benefit analysis of the proposed barrier location should be performed using the methods specified in the Roadside Design Guide.

ROAD CROSS SECTION ELEMENTS

Typical road cross sections are shown in Figures 10-15. These road cross sections indicate the existing roadway deficiencies and the improvements necessary for the existing highway to comply with AASHTO standards. The proposed cross section improvements should be coordinated with slope protection and traffic analysis recommendations for this project. The proposed improvements are:

- Replace old or substandard guardrail and end-treatments
- Widen existing shoulders to 8 ft

Guardrail

A. Kaawalii Gulch: Existing guardrail is generally in good condition and end treatments appear to comply with current HDOT standards. No improvements are necessary.

B. Laupahoehoe Gulch: Existing guardrail is generally in good condition and end treatments appear to comply with current HDOT standards. No improvements are necessary.

C. Maulua Gulch: Guardrail posts and W-beams are rusting and should be replaced. End treatments should also be replaced to comply with current HDOT standards. Therefore, all guardrail segments in this gulch should be replaced.

Conclusion

At a minimum, the guardrail improvements should be implemented. These improvements could be constructed with minimal impact to the existing roadway.

Shoulders

Existing shoulder widths vary from 3 ft to 6 ft. Based on the ADT for this highway, AASHTO recommends 8-foot wide shoulders along this highway.

A. Kaawalii Gulch: Existing shoulder widths in this gulch are 3 to 4 feet on the left side and 4 to 5 feet on the right side. Therefore, the shoulders should be widened on both sides of the highway.

B. Laupahoehoe Gulch: Existing shoulder widths in this gulch are 3 to 6 feet on the left side and 4 to 5 feet on the right side. Therefore, the shoulders on both sides of the highway should be widened.

C. Maulua Gulch: Existing shoulder widths in this gulch are 5 to 6 feet wide on the left side and 5 feet wide on the right side. Therefore, the shoulders on both sides of the highway should be widened.

Conclusion

In order for the roadway to comply with AASHTO standards, an 8-foot wide shoulder should be constructed. A major construction effort will be required to widen all shoulders within the gulches. On the left side of the highway, shoulder improvements may require demolition of walls and removal of guardrail. New guardrail or walls should be installed beyond the shoulder extension to replace the portions that were removed. Beyond the guardrail, embankment will be needed to daylight the fill slope or a retaining wall should be constructed. Existing culvert headwalls may need to be extended to accommodate the new fill slope toe. Retaining walls may need to be constructed at cut sections along the left side of the highway. For the most part, the right side of the highway is in a cut condition. Therefore, the cut slope must be excavated to accommodate the shoulder widening and a roadside swale. Existing drainage structures should be relocated to align with the new roadside swale.

CONCLUSION

The analyses of the existing highway elements indicate that the highway does not comply with AASHTO requirements for the following categories:

- Stopping sight distance
- Superelevation
- Shoulder width

To avoid major reconstruction along the highway, lowering the posted speed limit should be considered. Lowering the posted speed limit will have the smallest impact on the existing highway with respect to construction delays. However, a traffic analysis should be performed using the proposed speeds to determine the level of service available. For a rural arterial, AASHTO recommends a design speed between 40 and 70 mph. At the lowest recommended design speed, 40 mph, some portions of the gulches still will not comply with AASHTO standards. For the gulches

to meet AASHTO standards for stopping sight distance and superelevation, the following speed limits should be posted:

- Kaawalii Gulch - 25 mph
- Laupahoehoe Gulch - 25 mph
- Maulua Gulch - 25 mph

If these speed limits are unacceptable because they are too low, another alternative is to realigne the highway with larger radius curves, which will increase the available stopping sight distance. Since highway realignment will require major construction, consideration should be given to shifting the baseline towards the left side of the road. Enough room should be provided to allow for new road cross section elements such as wider shoulders. Shifting the baseline away from the right side of the road would reduce the amount of excavation on the cut side and confine the work zone to one side of the road, thereby minimizing the effect of construction on traffic.

If the existing highway alignment is maintained and the shoulders are widened, the available sight distance will not increase enough to meet AASHTO standards for the existing posted speed limits.

TABLE 1

INVENTORY OF ROADSIDE OBSTACLES

KAAWALII GULCH - SOUTH BOUND

BL STA.	CLEAR ZONE	SHY LINE	OBSTACLE
112+73	X	X	SIGN
116+45	X	X	SIGN
126+85	X	X	SIGN
129+31	X	X	SIGN
136+36	X	X	SIGN
138+61	X	X	SIGN

KAAWALII GULCH - NORTH BOUND

BL STA.	CLEAR ZONE	SHY LINE	OBSTACLE
101+10	X	X	SIGN
102+63	X	X	SIGN
103+93	X	X	SIGN
105+47	X	X	SIGN
106+00 TO 118+20	X	X	WALL & SIGNS
122+00 TO 135+90	X	X	WALL & SIGNS
136+15	X	X	SIGN
137+13	X	X	SIGN
138+11	X	X	SIGN
139+35	X	X	SIGN
140+33	X	X	SIGN

LAUPAHOEHOE GULCH - SOUTH BOUND

BL STA.	CLEAR ZONE	SHY LINE	OBSTACLE
40+93	X		SIGN
46+03	X		SIGN
49+15	X	X	SIGN
51+02	X		SIGN
70+29	X		SIGN
71+03	X		SIGN
77+21	X		SIGN

LAUPAHOEHOE GULCH - NORTH BOUND

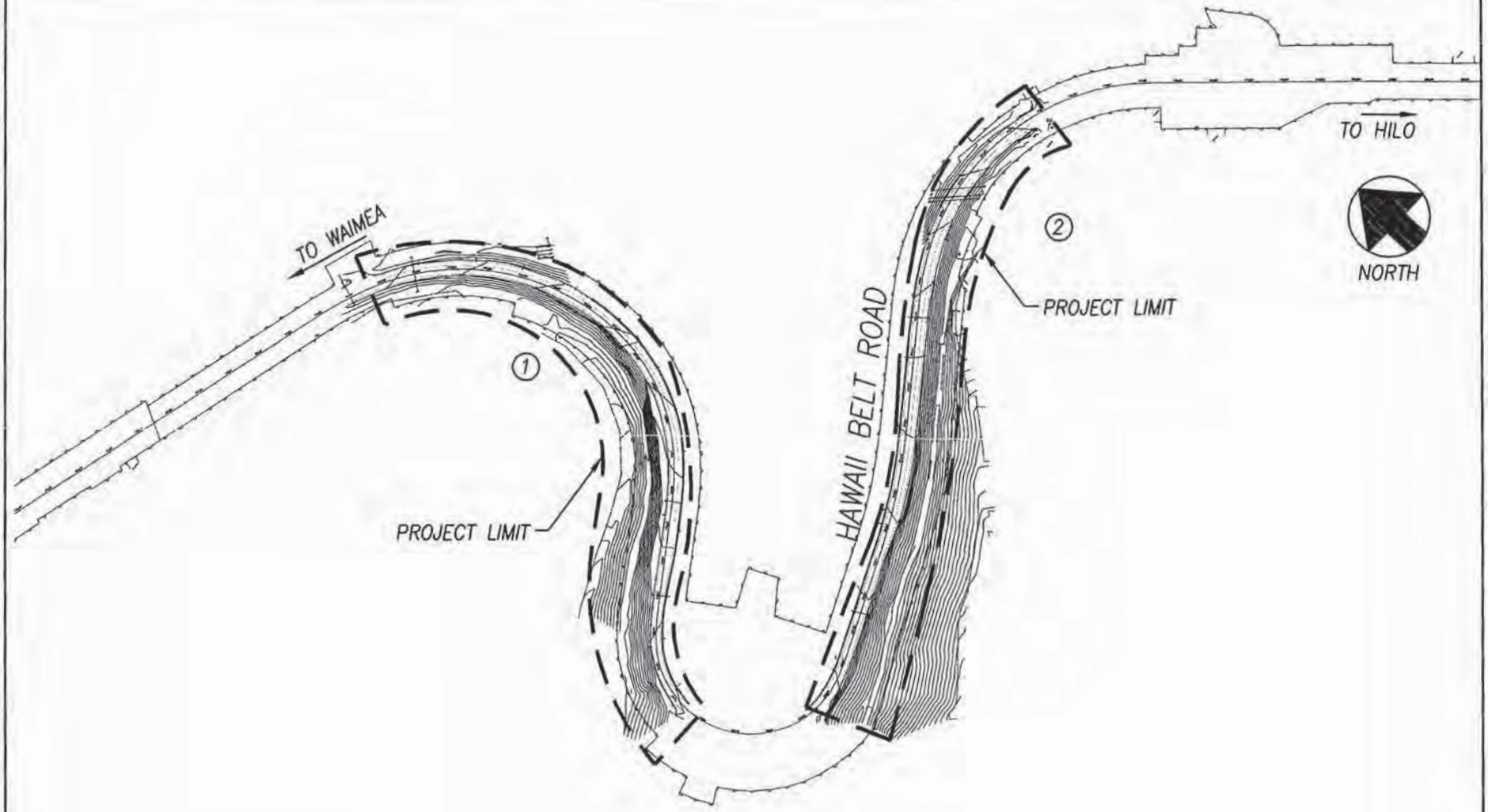
BL STA.	CLEAR ZONE	SHY LINE	OBSTACLE
36+56	X		SIGN
39+00	X	X	SIGN
40+27	X	X	SIGN
41+02	X		HEADWALL
41+48	X		SIGN
42+38	X		SIGN
44+54	X		SIGN
46+03	X		HEADWALL
71+03	X		HEADWALL
74+01	X	X	SIGN
75+13	X	X	SIGN
76+19	X	X	SIGN
76+32	X		SIGN
76+36 TO 77+69	X		WALL
77+87	X	X	SIGN
78+64	X	X	SIGN
79+88	X	X	SIGN
80+69	X		SIGN
80+82	X		SIGN

MAULUA GULCH - SOUTH BOUND

BL STA.	CLEAR ZONE	SHY LINE	OBSTACLE
33+08	X	X	SIGN
42+53	X		SIGN
47+50	X	X	SIGN
60+86	X	X	SIGN
61+86	X	X	SIGN
66+12	X	X	SIGN
72+88	X		SIGN
83+74	X		HEADWALL

MAULUA GULCH - NORTH BOUND

BL STA.	CLEAR ZONE	SHY LINE	OBSTACLE
40+89	X		SIGN
43+20 TO 49+55	X	X	WALL
49+58	X	X	SIGN
78+65	X	X	SIGN
79+80	X	X	SIGN
80+93	X	X	SIGN
82+02	X	X	SIGN
83+16	X		SIGN



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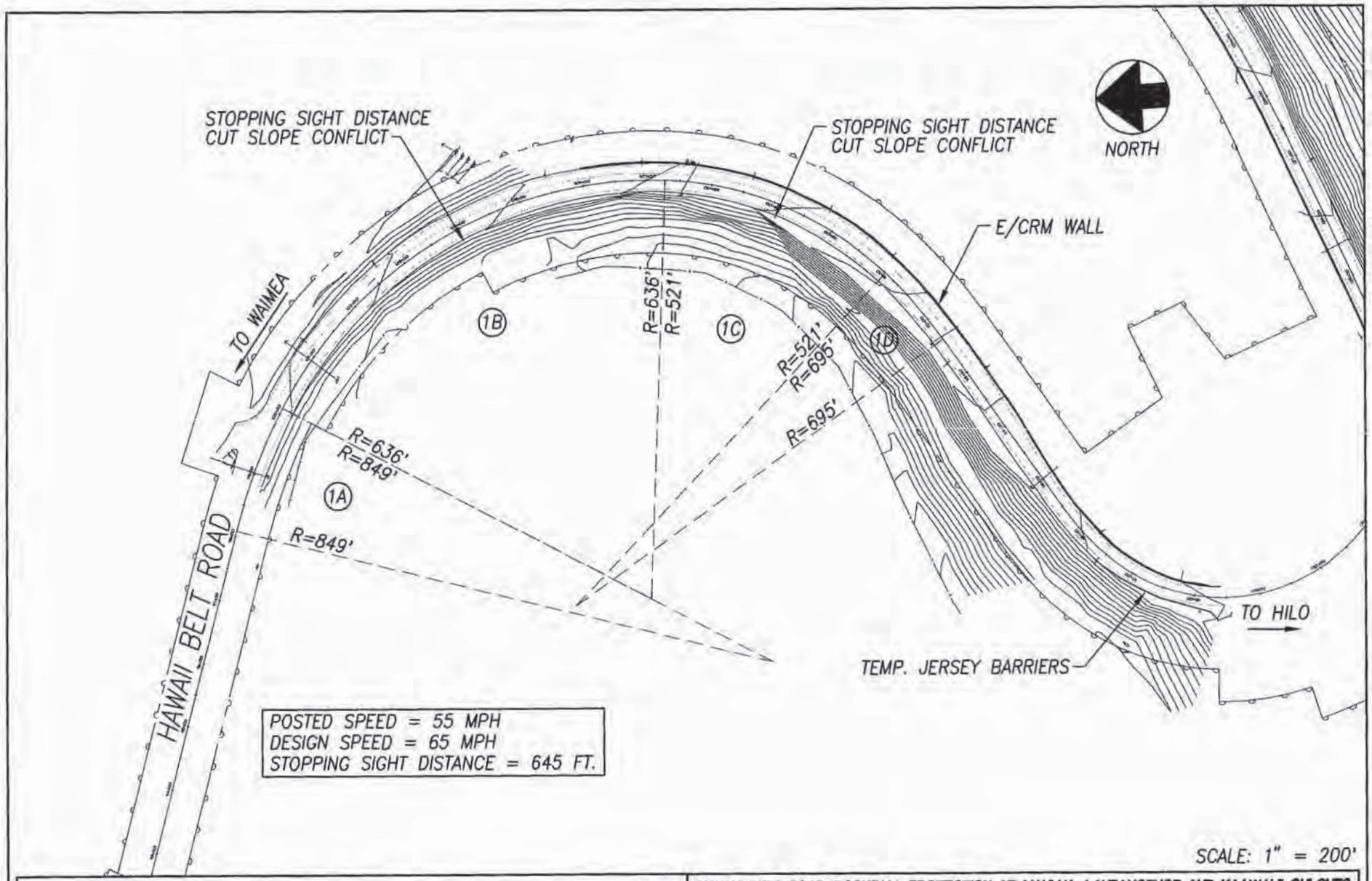
HAWAII BELT ROAD, ROCKFALL PROTECTION AT MAULUA, LAUPAHOEHOE AND KAAWALII GULCHES

ROADWAY ANALYSIS OF DEFICIENCIES
KAAWALII GULCH
OVERALL PLAN

Figure
1



SCALE: 1" = 200'

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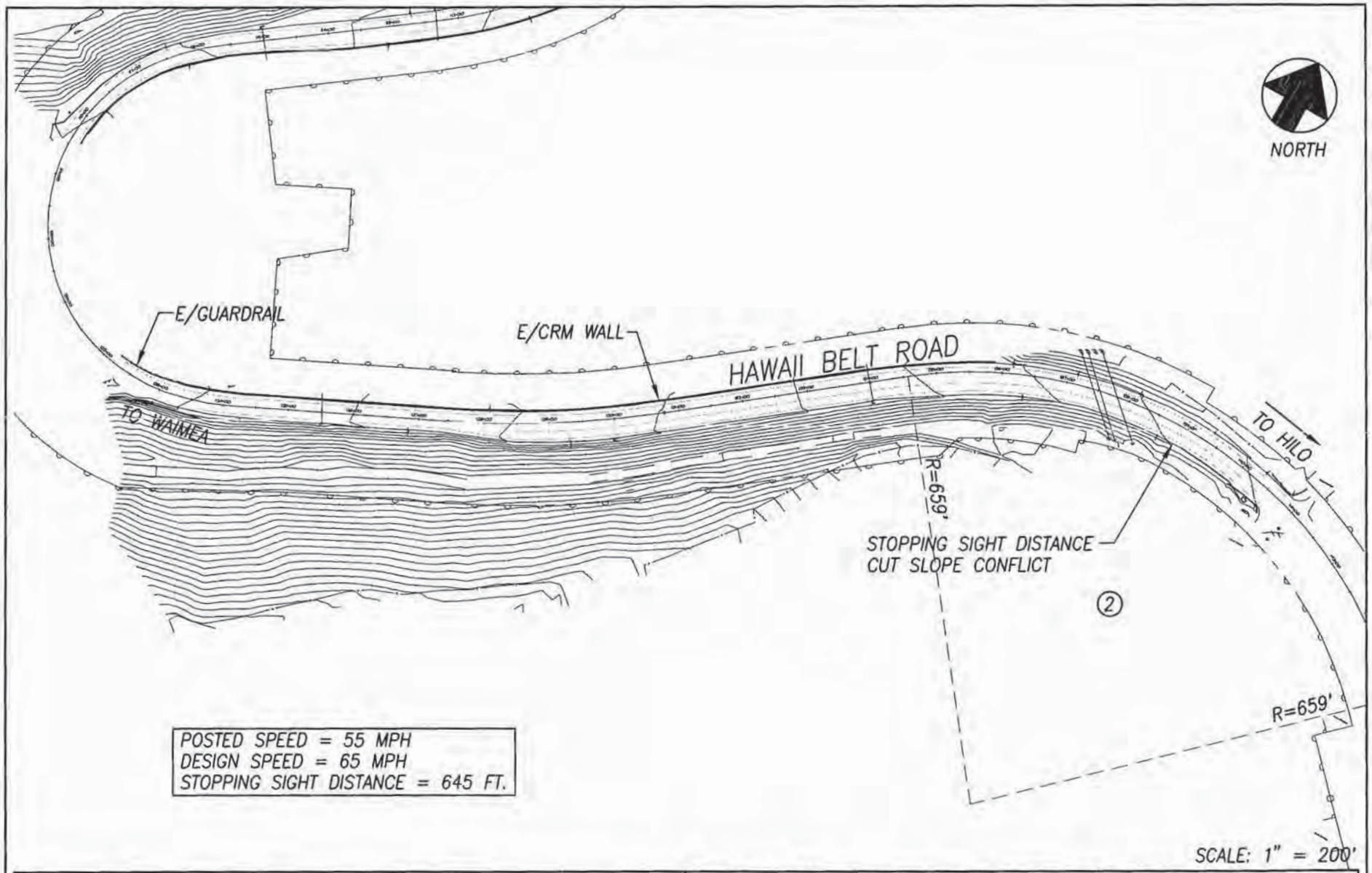
ROADWAY ANALYSIS OF DEFICIENCIES
KAAWALII GULCH - NORTH SIDE
BARRIER AND GEOMETRIC DEFICIENCIES

Figure 2



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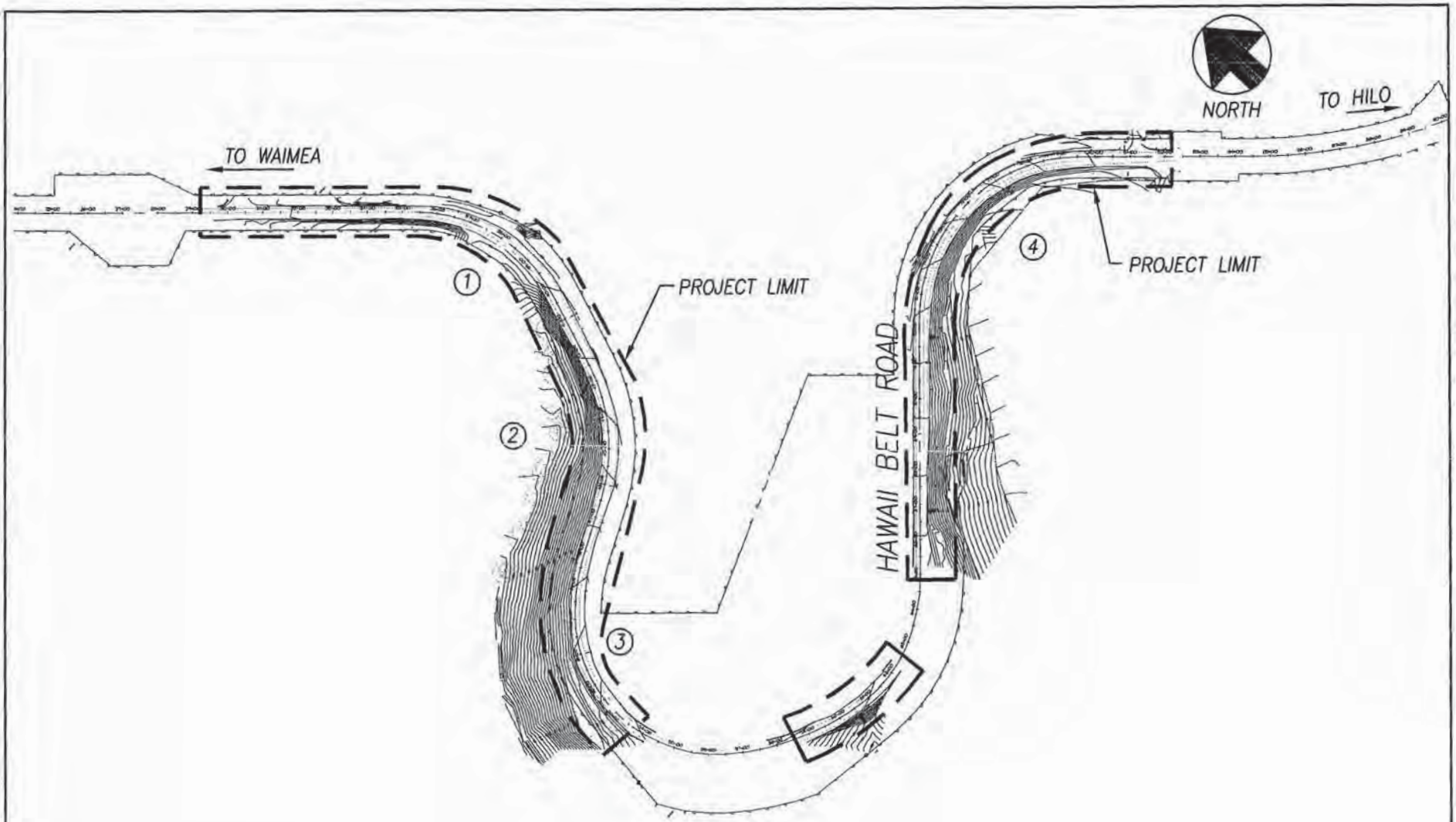
ROADWAY ANALYSIS OF DEFICIENCIES
KAAWALII GULCH - SOUTH SIDE
BARRIER AND GEOMETRIC DEFICIENCIES

Figure 3



SCALE: 1" = 400'

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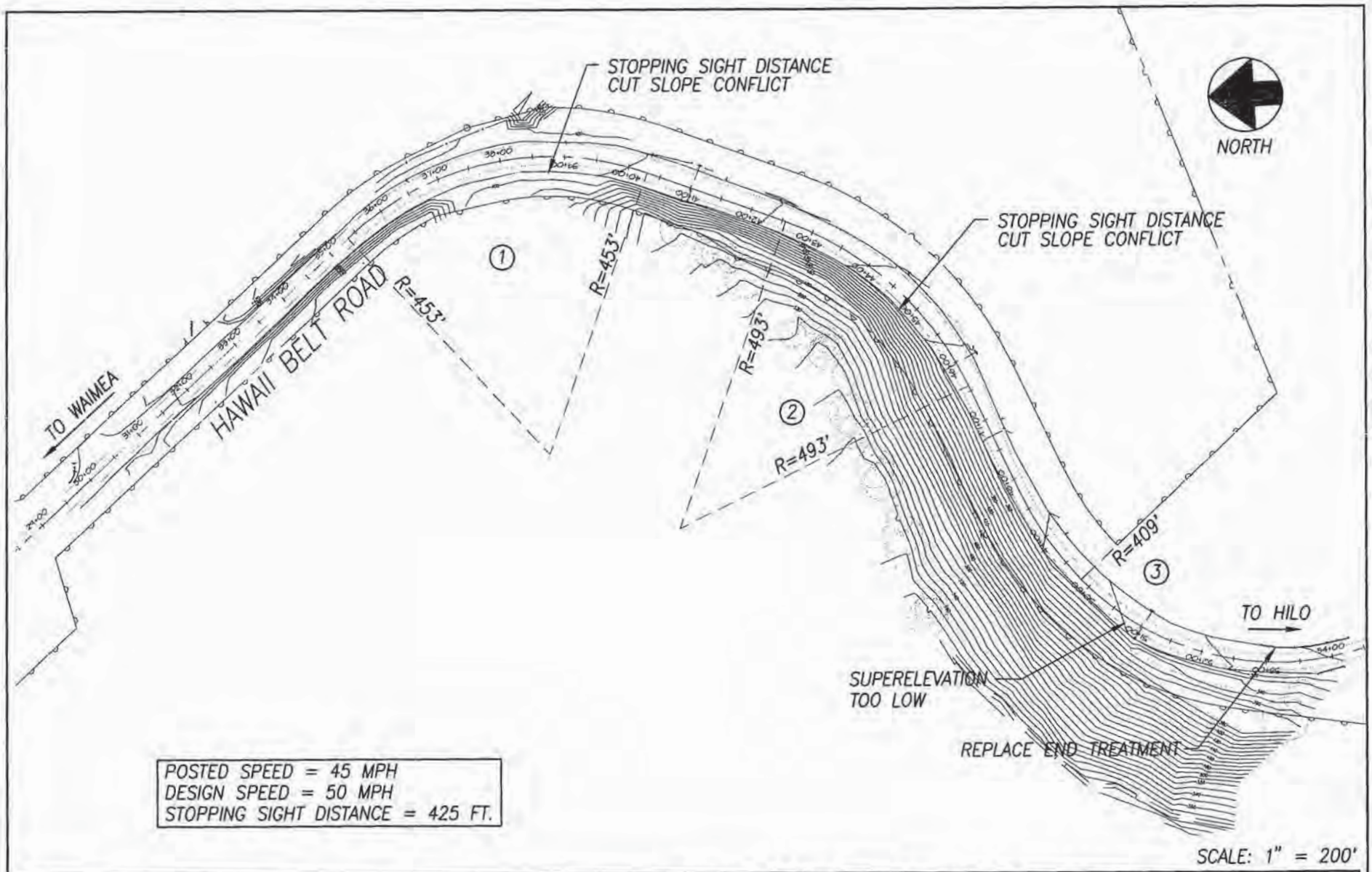
ROADWAY ANALYSIS OF DEFICIENCIES
LAUPAHOEHOE GULCH
OVERALL PLAN

Figure 4



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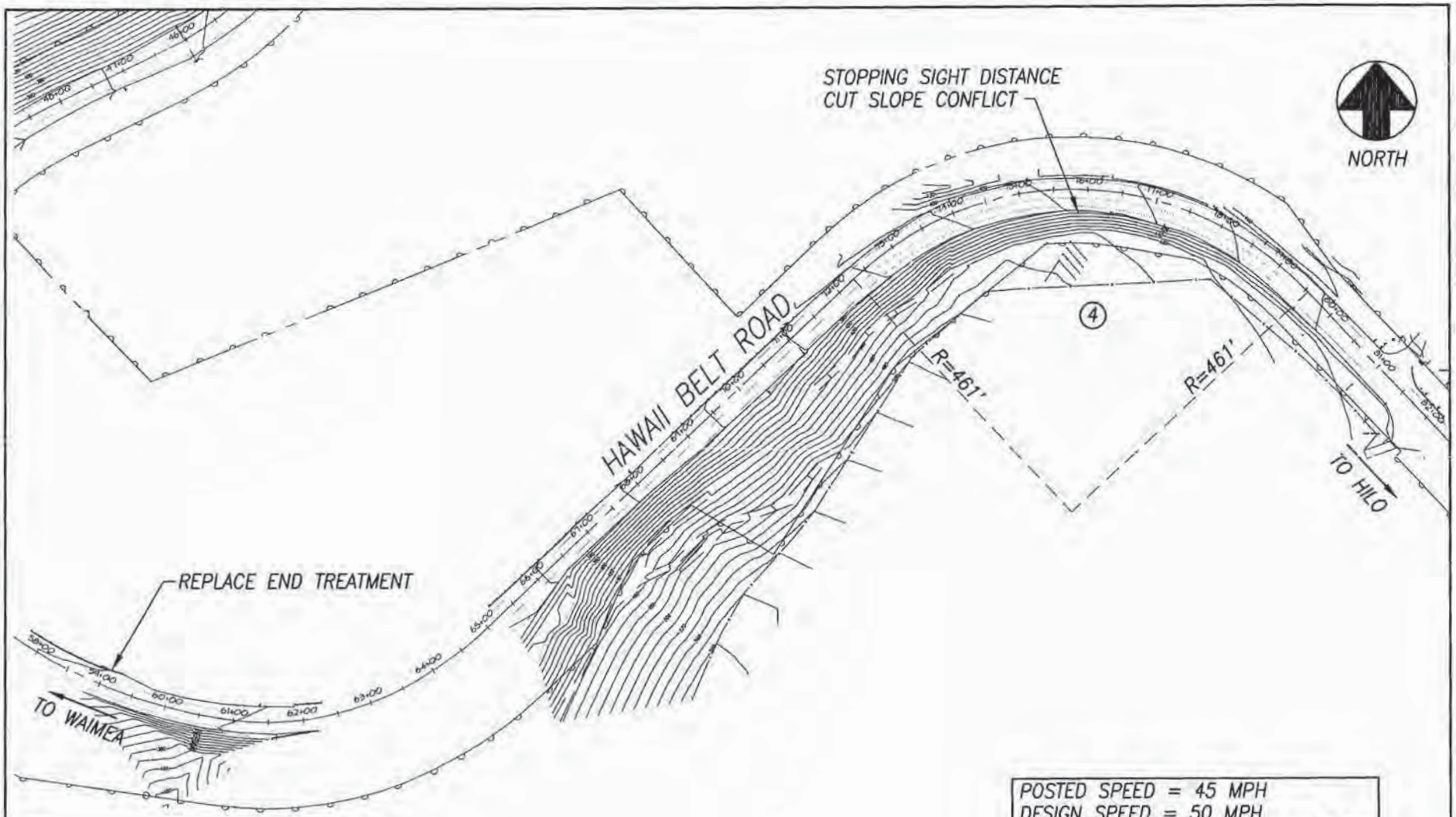
ROADWAY ANALYSIS OF DEFICIENCIES
LAUPAHOEHOE GULCH - NORTH SIDE
BARRIER AND GEOMETRIC DEFICIENCIES

Figure
5



SCALE: 1" = 200'

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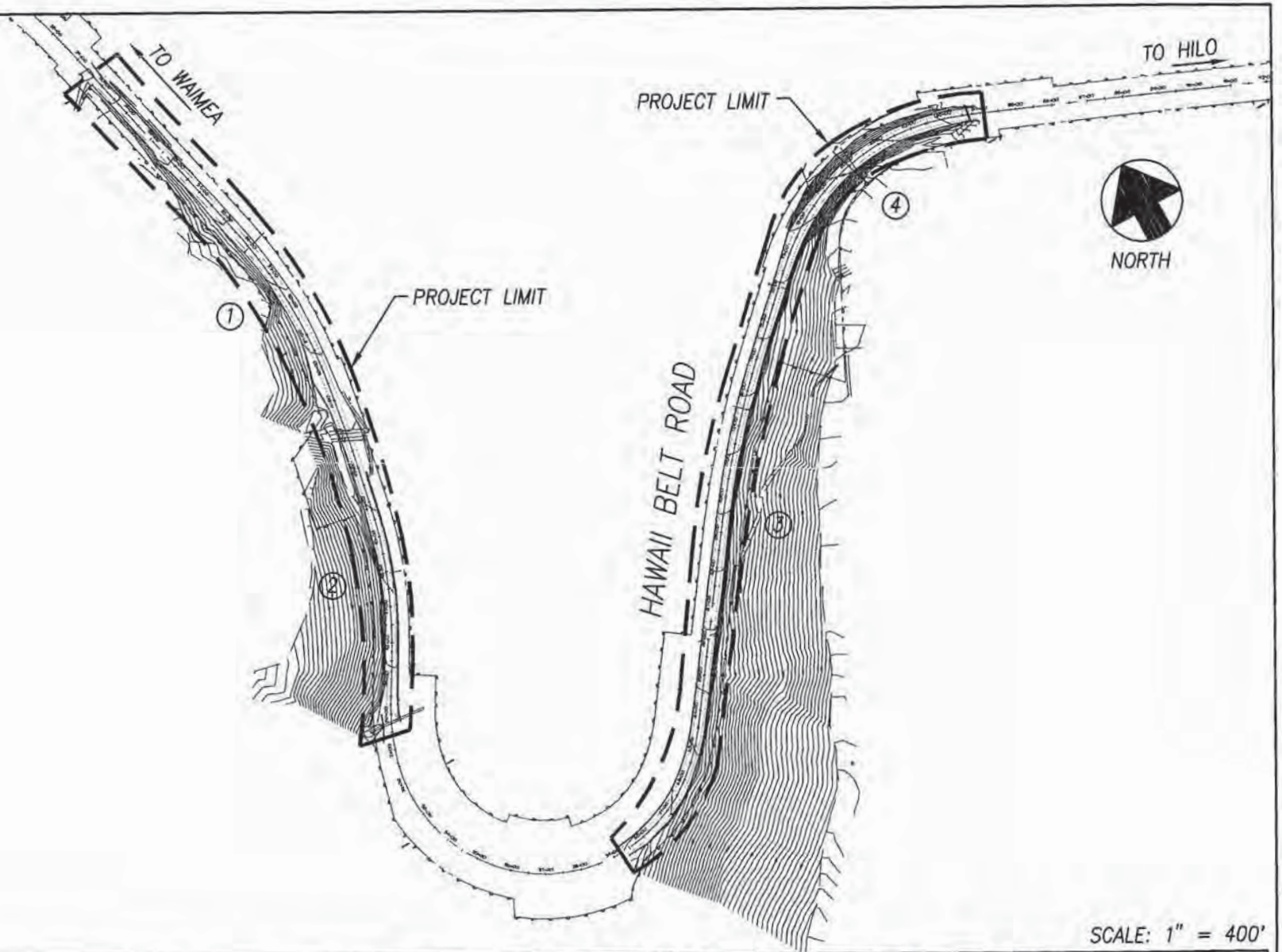
ROADWAY ANALYSIS OF DEFICIENCIES
LAUPAHOEHOE GULCH - SOUTH SIDE
BARRIER AND GEOMETRIC DEFICIENCIES

Figure
6



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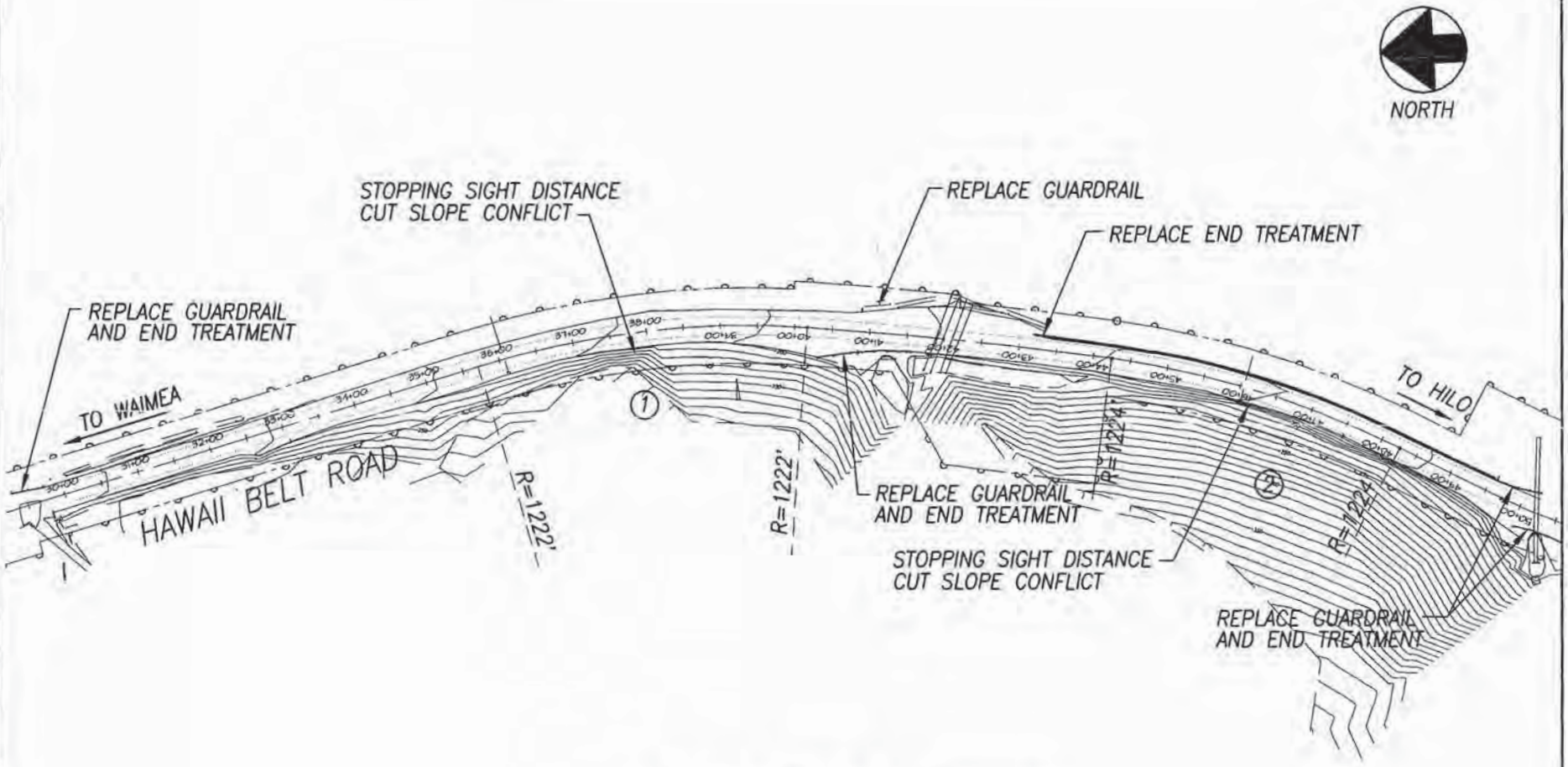
ROADWAY ANALYSIS OF DEFICIENCIES
MAULUA GULCH
OVERALL PLAN

Figure
7



POSTED SPEED = 55 MPH
DESIGN SPEED = 65 MPH
STOPPING SIGHT DISTANCE = 645 FT.

SCALE: 1" = 200'

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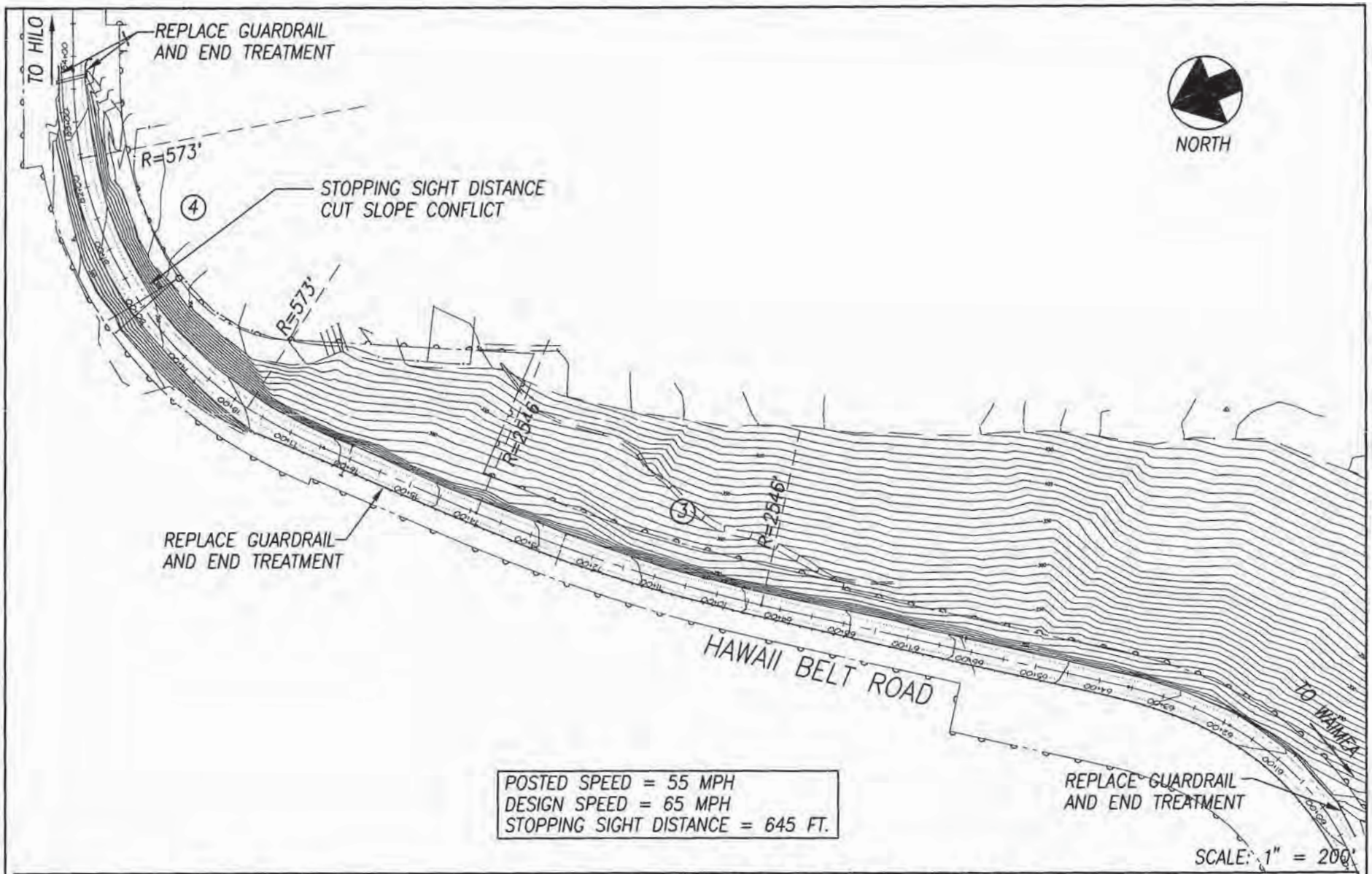
HAWAII BELT ROAD, ROCKFALL PROTECTION AT MAULUA, LAUPAHOEHOE AND KAAWALII GULCHES

ROADWAY ANALYSIS OF DEFICIENCIES
MAULUA GULCH - NORTH SIDE
BARRIER AND GEOMETRIC DEFICIENCIES

Figure
8



POSTED SPEED = 55 MPH
DESIGN SPEED = 65 MPH
STOPPING SIGHT DISTANCE = 645 FT.

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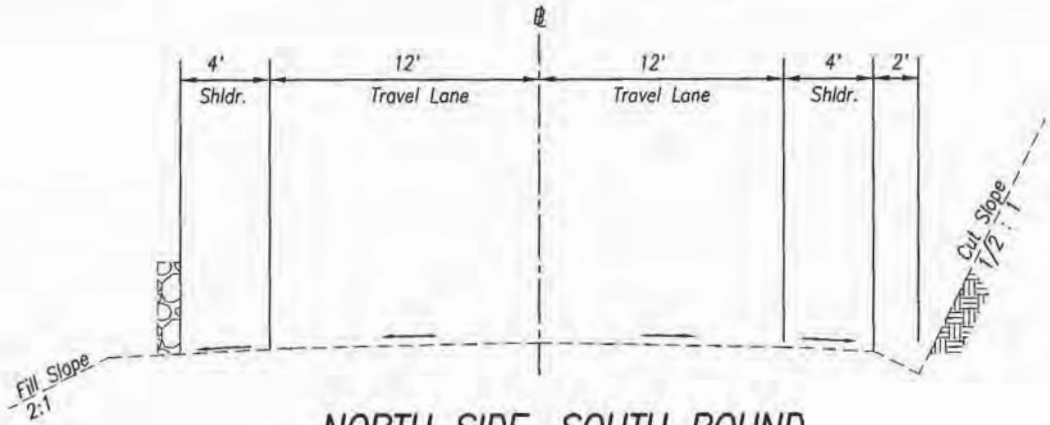
HAWAII BELT ROAD, ROCKFALL PROTECTION AT MAULUA, LAUPAHOEHOE AND KAAWALII GULCHES

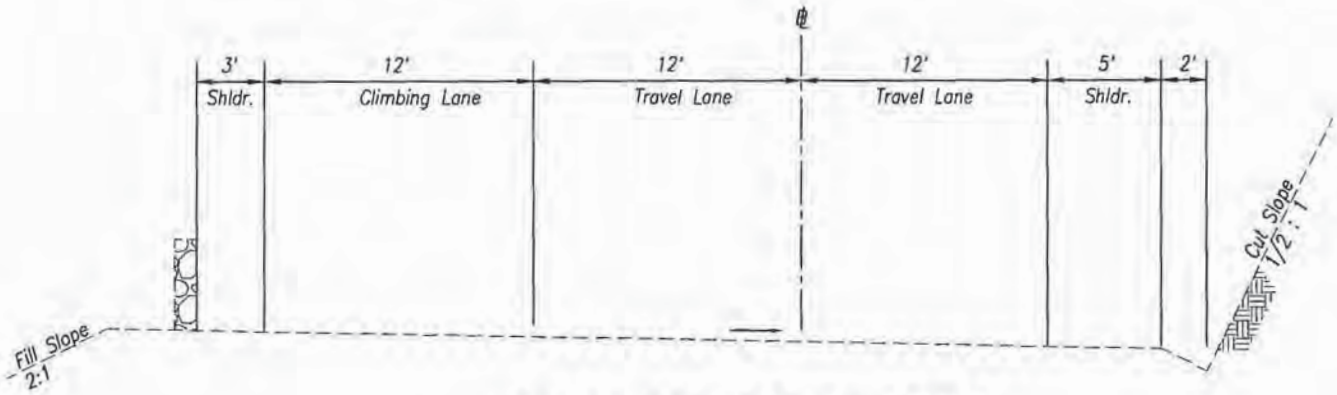
ROADWAY ANALYSIS OF DEFICIENCIES
MAULUA GULCH - SOUTH SIDE
BARRIER AND GEOMETRIC DEFICIENCIES

Figure
9



NORTH SIDE, SOUTH BOUND
TYPICAL TANGENT SECTION

Scale: 1/8" = 1'-0"



NORTH SIDE, SOUTH BOUND
TYPICAL SUPERELEVATED SECTION

Scale: 1/8" = 1'-0"

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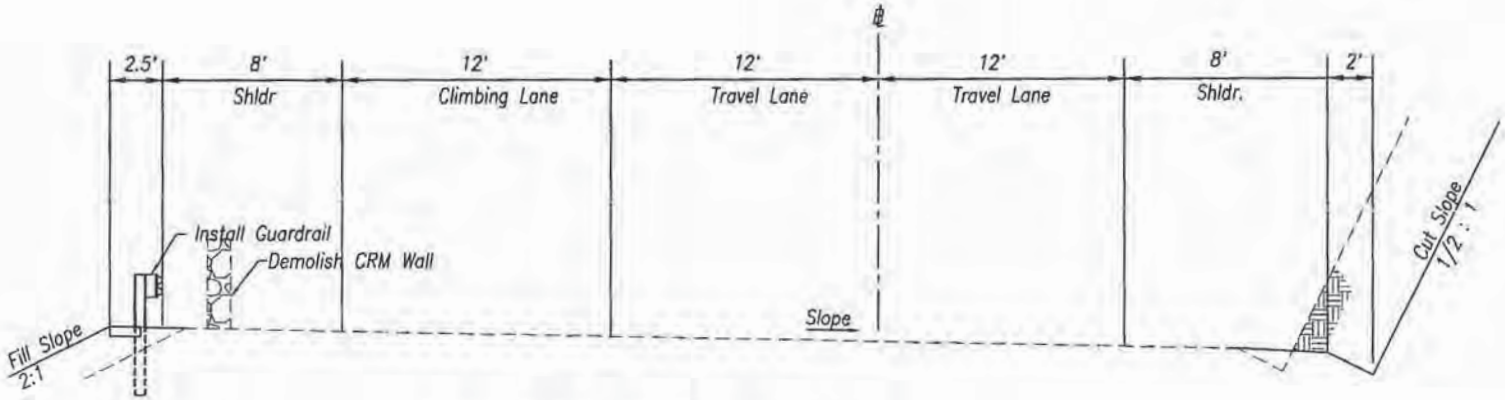
ROADWAY ANALYSIS OF DEFICIENCIES
KAAWALII GULCH
TYP. ROAD SECTIONS - EXIST. CONDITIONS

Figure 10



NORTH SIDE, SOUTH BOUND
TYPICAL SUPERELEVATED SECTION

Scale: 1/8" = 1'-0"

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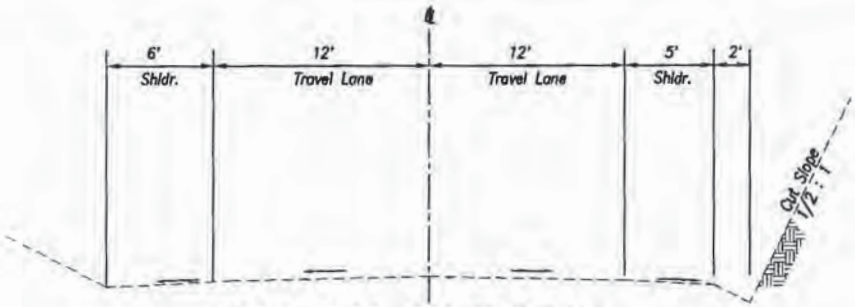
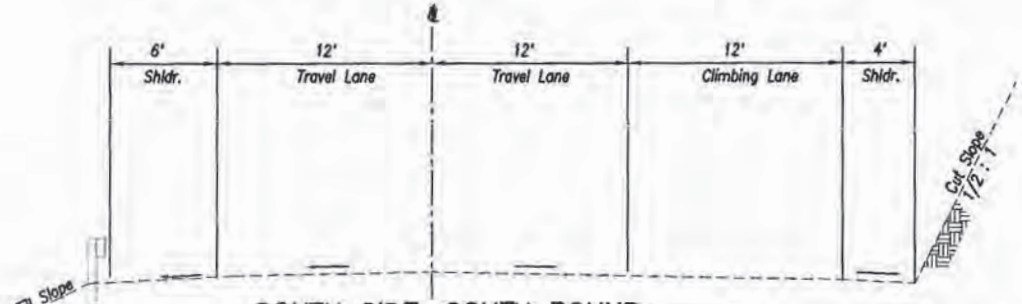
HAWAII BELT ROAD, ROCKFALL PROTECTION AT MAULUA, LAUPAHOEHOE AND KAAWALII GULCHES

ROADWAY ANALYSIS OF DEFICIENCIES
KAAWALII GULCH
TYP. ROAD SECTIONS - PROPOSED IMPROVEMENTS

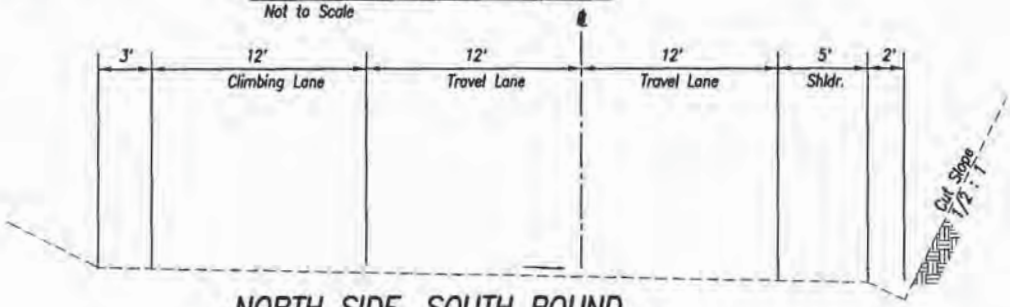
Figure 11



NORTH SIDE, SOUTH BOUND
TYPICAL TANGENT SECTION
Not to Scale



SOUTH SIDE, SOUTH BOUND
TYPICAL TANGENT SECTION
Not to Scale



NORTH SIDE, SOUTH BOUND
TYPICAL SUPERELEVATED SECTION
Not to Scale

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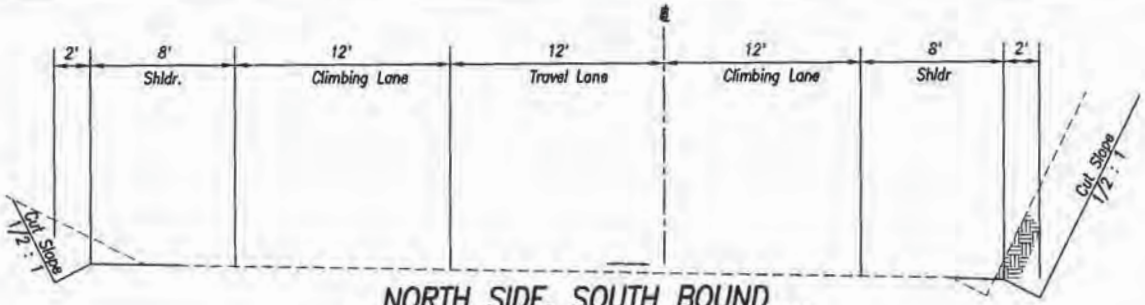
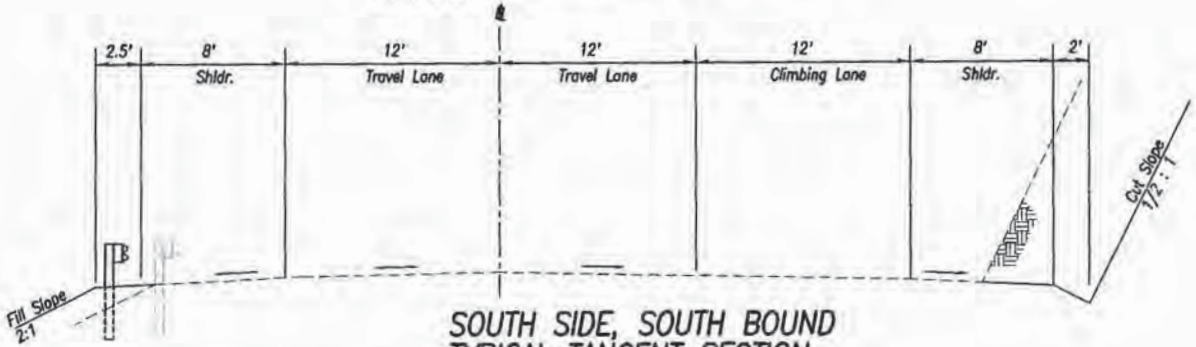
HAWAII BELT ROAD, ROCKFALL PROTECTION AT MAULUA, LAUPAHOEHOE AND KAAWALII GULCHES

ROADWAY ANALYSIS OF DEFICIENCIES
LAUPAHOEHOE GULCH
TYP. ROAD SECTIONS - EXIST. CONDITIONS

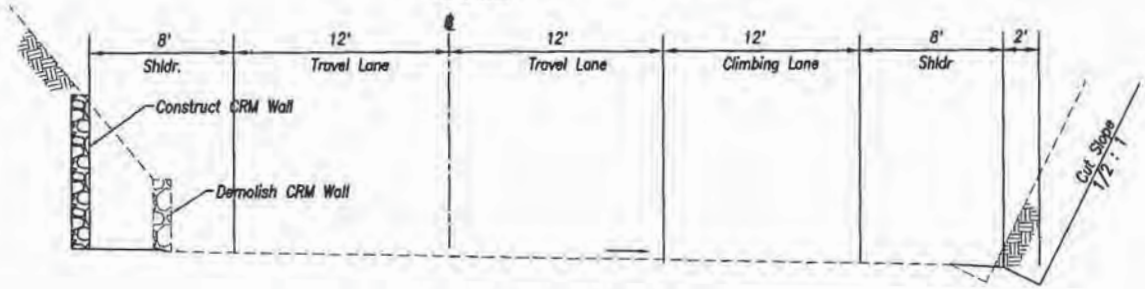
Figure
12



NORTH SIDE, SOUTH BOUND
TYPICAL SUPERELEVATED SECTION
Not to Scale



SOUTH SIDE, SOUTH BOUND
TYPICAL TANGENT SECTION
Not to Scale



SOUTH SIDE, SOUTH BOUND
TYPICAL SUPERELEVATED SECTION
Not to Scale

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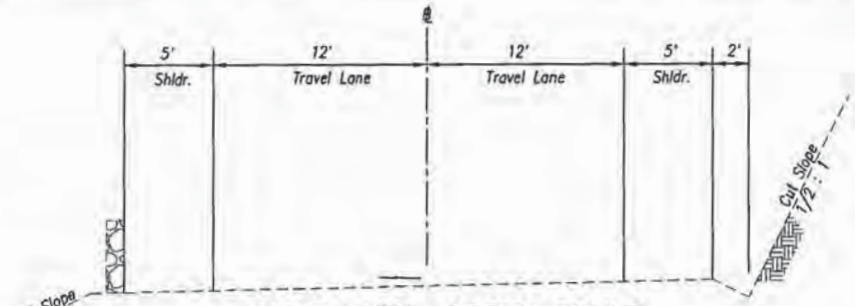
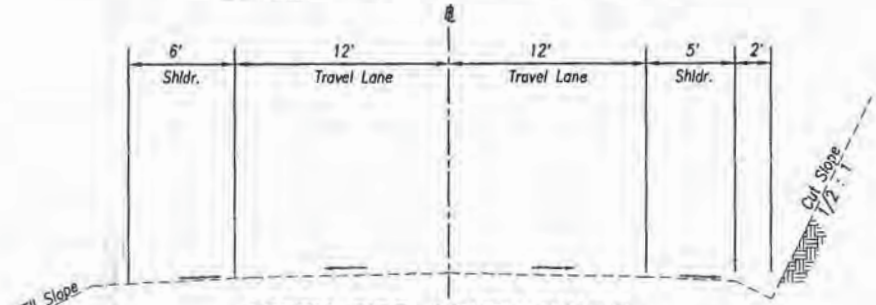
HAWAII BELT ROAD, ROCKFALL PROTECTION AT MAULUA, LAUPAHOEHOE AND KAAWALII GULCHES

ROADWAY ANALYSIS OF DEFICIENCIES
LAUPAHOEHOE GULCH
TYP. ROAD SECTIONS - PROPOSED IMPROVEMENTS

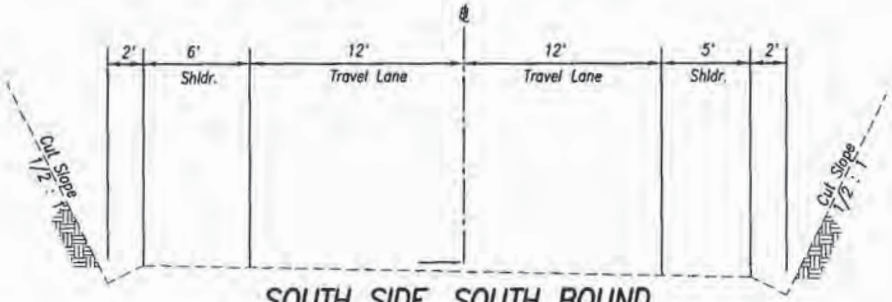
Figure
13



NORTH SIDE, NORTH BOUND
TYPICAL SUPERELEVATED SECTION
Not to Scale



SOUTH SIDE, SOUTH BOUND
TYPICAL TANGENT SECTION
Not to Scale



SOUTH SIDE, SOUTH BOUND
TYPICAL SUPERELEVATED SECTION
Not to Scale

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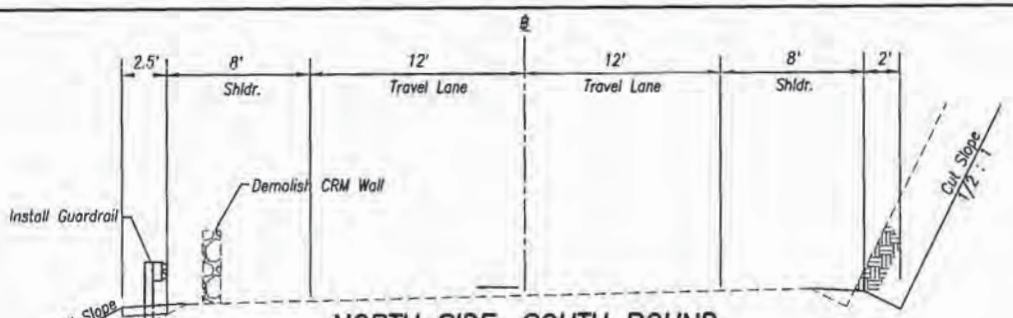
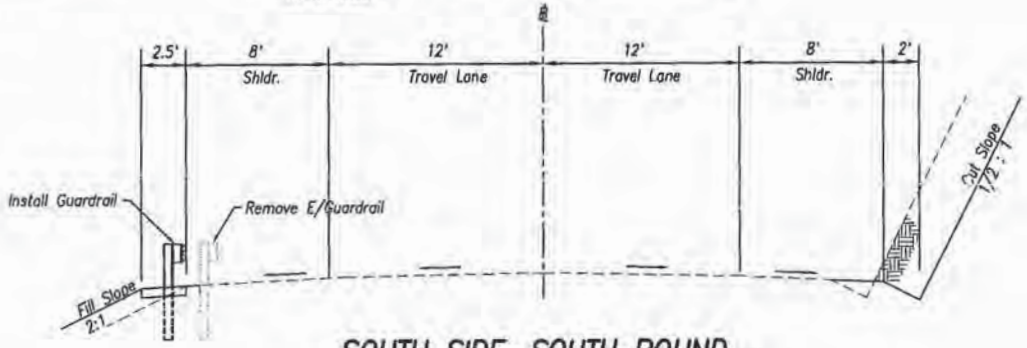
HAWAII BELT ROAD, ROCKFALL PROTECTION AT MAULUA, LAUPAHOEHOE AND KAAWALII GULCHES

ROADWAY ANALYSIS OF DEFICIENCIES
MAULUA GULCH
TYP. ROAD SECTIONS - EXISTING CONDITIONS

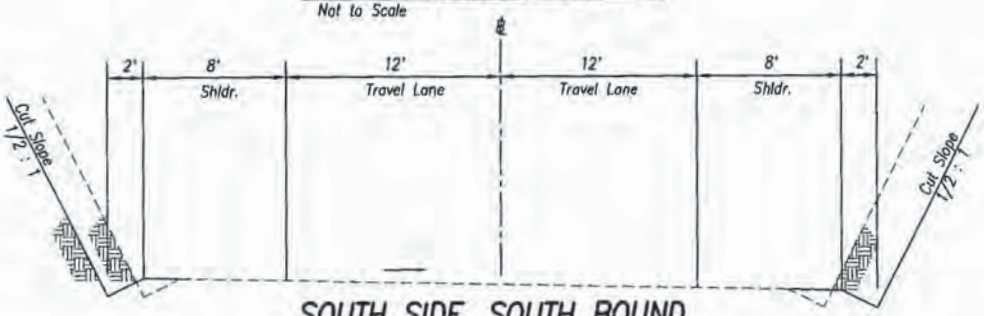
Figure
14



NORTH SIDE, SOUTH BOUND
TYPICAL SUPERELEVATED SECTION
Not to Scale



SOUTH SIDE, SOUTH BOUND
TYPICAL TANGENT SECTION
Not to Scale



SOUTH SIDE, SOUTH BOUND
TYPICAL SUPERELEVATED SECTION
Not to Scale

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HAWAII BELT ROAD, ROCKFALL PROTECTION AT MAULUA, LAUPAHOEHOE AND KAAWALII GULCHES

ROADWAY ANALYSIS OF DEFICIENCIES
MAULUA GULCH
TYP. ROAD SECTIONS - PROPOSED IMPROVEMENTS

Figure
15

R. M. TOWILL CORPORATION

Project Title:	Rockfall Protection	Job No.	118831-0E	Page 1	of 1
Location:	Hamakua Coast, Hawaii	Prepared By:	GR	Date:	4/25/2006
Item:	AASHTO design guidelines	Checked By:	WC	Date:	4/25/2006

PURPOSE: Determine current AASHTO requirements for horizontal and vertical alignments

ROADWAY CLASSIFICATION
Rural Arterial

TERRAIN
Mountainous

DESIGN SPEED

Range:	40 mph to 50 mph for mountainous terrain
Posted:	55 mph, 45 mph (Laupahoehoe)
Design:	65 mph, 50 mph (Laupahoehoe)

TRAFFIC VOLUME, ADT

2008	7280
2038	13400

LEVEL OF SERVICE

Desired	C
2008	C or better
2038	D or better

SIGHT DISTANCE (Exhibit 7-1)

SSD	645 ft (65 mph)
	425 ft (50 mph)

GRADES (Exhibit 7-2)

Mountainous	5%

ROAD WIDTH (Exhibit 7-3)

Travel Way	24 ft
Shoulder	8 ft.

CLEAR ZONE (Table 3.1)

	Cut Slope	Fill Slope
50 mph	21.3 ft	21.3 ft
65 mph	29.5 ft	34.4 ft

SHY LINE (Table 5.4)

50 mph	6.6 ft
65 mph	9.2 ft

R. M. TOWILL CORPORATION

Project Title:	Rockfall Protection	Job No.	118831-0E	Page 1	of 3
Location:	Hamakua Cost, Hilo, HI	Prepared By:	GR	Date:	4/25/2006
Item:	Inventory of Hwy. Deficiencies	Checked By:	WC	Date:	4/25/2006

PURPOSE: Inventory design deficiencies of existing highway based on AASHTO standards.

REFERENCES

AASHTO Green Book, 4th ed., 2001
AASHTO Roadside Design Guide, 1996

ROADWAY CLASSIFICATION

Rural Arterial

SUPERELEVATION

determine minimum radius, Exhibit 3-14
determine superelevation rate, e Exhibit 3-23

Kaawalii

Design Speed 65
Emax 8% Rmin=1485'

Curve #	Radius	Exist. E	Req'd E	Conclusion
1A	849	4.30%		Radius too small
1B	636	7.80%	7.45%	Radius too small
1C	521	8.50%		Radius too small
1D	695	3.90%		Radius too small
2	659	7.90%	7.37%	Radius too small

Laupahoehoe

Design Speed 50
Emax 8% Rmin=750'

Curve #	Radius	Exist. E	Req'd E	Conclusion
1	453	9.10%	N/A	Radius too small
2	493	9.80%	8.00%	Radius too small
3	409	8.80%	N/A	Radius too small
4	461	8.20%	N/A	Radius too small

Maulua

Design Speed 65
Emax 8% Rmin=1485'

Curve #	Radius	Exist. E	Req'd E	Conclusion
1	1222	8.17%	8.00%	Radius too small
2	1224	6.33%	8.00%	Radius too small
3	2546	3.70%	6.30%	Increase superelevation
4	573	9.54%	N/A	Radius too small

R. M. TOWILL CORPORATION

Project Title:	Rockfall Protection	Job No.	118831-0E	Page	2 of 3
Location:	Hamakua Cost, Hilo, HI	Prepared By:	GR	Date:	4/25/2006
Item:	Inventory of Hwy. Deficiencies	Checked By:	WC	Date:	4/25/2006

STOPPING SIGHT DISTANCE

Distances will vary depending on design speed and road grade

Gulch	Posted Speed	Design Speed	SSD
Kaawalii	55	65	645
Laupahoehoe	45	50	425
Maulua	55	65	645

DECISION SIGHT DISTANCE

Case A = Stop of rural road. Case C = Speed/Path/ Direction change on rural road.

Exhibit 3-3

This is required for motorists to have ample time to drive around rocks that may have fallen onto the roadway.

Gulch	Design Speed	Case A	Case C
Kaawalii	65	695	1050
Laupahoehoe	50	465	750
Maulua	65	695	1050

R. M. TOWILL CORPORATION

Project Title:	Rockfall Protection	Job No.	118831-0E	Page 3 of 3	
Location:	Hamakua Cost, Hilo, HI	Prepared By:	GR	Date:	4/25/2006
Item:	Inventory of Hwy. Deficiencies	Checked By:	WC	Date:	4/25/2006

HORIZONTAL CURVE SIGHT DISTANCE

Determine middle ordinate, M
Exhibit 3-57
Sight distance is measured along CL of inside lane
Driver's eye height = 3.5'
Object height = 2'

Kaawalii

Design Speed 65 mph

Curve #	Radius	M (DSD)	M (SSD)	SSD Avail	Conclusion
1A	849	70.14	60.53		OK
1B	636	92.61	80.04	260	Insufficient SSD
1C	521	111.67	96.68	230	Insufficient SSD
1D	695	85.09	73.50		OK
2	659	89.53	77.36	250	Insufficient SSD

Laupahoehoe

Design Speed 50 mph

Curve #	Radius	M (DSD)	M (SSD)	SSD Avail	Conclusion
1	453	58.37	48.94	250	Insufficient SSD
2	493	53.82	45.10	220	Insufficient SSD
3	409	64.33	53.98		OK
4	461	57.41	48.12	200	Insufficient SSD

Maulua

Design Speed 65 mph

Curve #	Radius	M (DSD)	M (SSD)	SSD Avail	Conclusion
1	1222	49.08	42.32	365	Insufficient SSD
2	1224	49.01	42.25	360	Insufficient SSD
3	2546	23.68	20.40	530	Insufficient SSD
4	573	102.20	88.40	240	Insufficient SSD

Appendix E

Traffic Study Report
Hawai‘i Belt Road Rockfall Protection
at Maulua, Laupāhoehoe and Ka‘awali‘i Gulches
North Hilo and Hāmākua, Island of Hawai‘i, Hawai‘i

and

Queue Estimates for Construction of Hawai‘i Belt Road Projects
Rockfall Protection at Maulua, Laupāhoehoe and Ka‘awali‘i Gulches
Hāmākua Coast, Hawai‘i

TRAFFIC STUDY REPORT

Hawaii Belt Road Rockfall Protection, Phase 1

Maulua, Laupahoehoe and Kaawalii Gulches

FEDERAL-AID PROJECT NO. NH-019-2(41)

March 2006

Prepared for:

R. M. Towill Corporation

and

State of Hawaii
Department of Transportation
Highways Division

Prepared by:

Julian Ng, Incorporated
P. O. Box 816
Kaneohe, Hawaii

Table of Contents

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Existing Conditions	2
Table 1 – Historic Daily Volumes	3
Table 2 - Results of Two-Lane Highway Analysis, Existing (2002) Volumes	3
Table 3 - Existing (2002) Traffic Densities	4
Future Traffic	4
Table 4 – Long-Range Forecasts	4
Table 5 – Future Daily Volumes	5
Table 6 – Results of Two-Lane Highway Analysis, Future (2038) Volumes	5
Table 7 – Future (2038) Traffic Densities	5
Conclusions and Recommendations	6

Traffic Study Report

Hawaii Belt Road Rockfall Protection, Phase 1

Maulua, Laupahoehoe and Kaawalii Gulches

Federal-Aid Project No. NH-019-2(41)
District of North Hilo, Hawaii

March 2006

INTRODUCTION

The State of Hawaii, Department of Transportation, Highways Division will be implementing rockfall protection measures along the Hawaii Belt Road at three gulches in North Hilo, island of Hawaii. The project will require that portions of the existing roadbed be used to provide buffer areas or to support guardrails, fences, or other devices for the protection of traffic from falling rock.

A traffic study was done to evaluate the traffic volumes on the highway. Existing traffic volumes on the highway are from the *Traffic Summary - Island of Hawaii 2002* report. Peak hourly volumes were computed using "K" and "D" factors from the *Traffic Summary* report. Future daily volumes were projected using a growth rate based on the estimates of average daily traffic for recent years, as reported in the State Highways Division's annual *Traffic Summary* reports. Future peak hour volumes were computed with the latest "K" and "D" factors for the roadway segment.

Traffic analyses were based on the concepts from the *Highway Capacity Manual*[1]. Traffic conditions are described by a "Level of Service" (LOS), which range from LOS A (good conditions) to LOS E (poor conditions). Level of Service F describes over capacity conditions or very long delays. In rural areas, LOS C of better is considered acceptable.

Peak hour levels of service on a two-lane highway were determined to assess the overall condition on the highway. The concept of highway density was also used to evaluate shorter

[1] Transportation Research Board Special Report 209, *Highway Capacity Manual - 2000.*

segments of highway, such as may occur as the highway passes across Maulua Gulch, Laupahoehoe Gulch, and Kaawalii Gulch.

For two-lane highways, the ability to pass a slow-moving vehicle determines the highway level of service. The portion of heavy vehicles in the traffic stream, the directional split, and other factors are used to determine average travel speed and the percent time-spent-following; from the average speed and percent time-spent following results, a level of service is determined and a volume-to-capacity ratio is computed.

Highway density is another measure of traffic congestion. While typically used for multi-lane highways, application to a two-lane highway provides an additional rating for short segments of the highway. The number of vehicles, expressed as passenger cars per mile per lane, is compared with the guidelines used for multi-lane highways. Large vehicles in the traffic stream are converted to equivalent passenger cars, and the density is computed for an average speed on the highway. Maximum densities for each levels of service are as follows:

Level of Service A	11 passenger cars per mile per lane
Level of Service B	18 passenger cars per mile per lane
Level of Service C	26 passenger cars per mile per lane
Level of Service D	35 passenger cars per mile per lane
Level of Service E	45 passenger cars per mile per lane

Level of Service F describes any cases in which density exceeds 45 passenger cars per mile per lane.

EXISTING CONDITIONS

The Hawaii Belt Road is generally a two-lane highway providing the only through route along the northeastern (Hamakua) coast of Hawaii and linking Hilo with Honokaa. The highway passes through several smaller communities along the Hamakua Coast. In certain areas, hill climbing lanes (a second lane in one direction, usually on an uphill grade) have been provided to allow faster vehicles to pass slow moving vehicles.

The *Traffic Summary - Island of Hawaii 2002* report shows an average daily traffic (ADT) of 6,634 vehicles per day (vpd) in 2002 for the segment of Route 19 (Hawaii Belt Road) between Akaka Falls Road and Mamane Street. The three gulches are all located within this segment of roadway. Over a typical day, trucks and other heavy vehicles comprise 8.5% of the traffic. Table 1 shows recent daily volumes.

Table 1
Historic Daily Volumes
Hawaii Belt Road, Akaka Falls Road to Mamane Street

1992 Average Daily Traffic	5,413 vehicles per day
1994 Average Daily Traffic	5,659 vehicles per day
1996 Average Daily Traffic	5,425 vehicles per day
1998 Average Daily Traffic	5,575 vehicles per day
2000 Average Daily Traffic	6,397 vehicles per day
2002 Average Daily Traffic	6,634 vehicles per day

Source: *Traffic Summary, Island of Hawaii 2002.*

Trucks and other heavy vehicles comprised 8.5% of the traffic volume over a 24-hour period in 2002. In the AM peak hour, traffic volume was 7.0% of daily volume with 55% traveling in the peak direction and trucks were 9.0% of the traffic. In the PM peak hour, traffic volume was 8.0% of daily volume with 55% traveling in the peak direction and trucks were 4.0% of the traffic.

Table 2 shows 2002 peak hour volumes and levels of service for a two-lane highway and Table 3 shows the results of the density analysis, with traffic densities computed for an average speed of 35 miles per hour. .

Table 2
Results of Two-Lane Highway Analysis, Existing (2002) Volumes
Hawaii Belt Road, Akaka Falls Road to Mamane Street

	Peak Hour Volume	volume-to-capacity ratio	Level of Service
AM Peak Hour	465	0.18	C
PM Peak Hour	531	0.20	C

Table 3
Existing (2002) Traffic Densities
Hawaii Belt Road, Akaka Falls Road to Mamane Street

	Southbound	Northbound
AM Peak Hour volume	256	209
density	12.65	10.32
level of service	B	A
PM Peak Hour volume	292	239
density	11.05	9.04
level of service	B	A

FUTURE TRAFFIC

The most recently completed (1998) Long Range Transportation Plan for the island of Hawaii had forecasted that traffic volumes on the Hawaii Belt Highway along the Hamakua Coast of the island of Hawaii will increase at a rate of approximately 3% per year. Table 4 shows the base year (1992) volumes and future year (2020) forecasts at two locations on the highway. The Long Range Transportation Plan will be updated in the near future.

Table 4
Long-Range Forecasts

Location	1992 Average Daily Traffic*	2020 forecast*	annual growth
East of Mamane Street	5,000	13,800	+3.7%
North of Akaka Falls Road	6,600	13,100	+2.5%

* source: Frederic R. Harris, Inc.

Historically, traffic volumes on the highway have increased at an average annual rate of 2.05% per year, based on a linear regression of the average daily traffic (ADT) on the highway segment between Akaka Falls and Mamane Street from 1992 to 2002. At this rate of growth, daily traffic volume would be more than two times existing (2002) volumes by 2038. The projections of future daily volumes are shown in Table 5.

Table 5
Future Daily Volumes
Hawaii Belt Road, Akaka Falls Road to Mamane Street

2008 Average Daily Traffic	7,290 vehicles per day
2018 Average Daily Traffic	8,930 vehicles per day
2028 Average Daily Traffic	10,940 vehicles per day
2038 Average Daily Traffic	13,410 vehicles per day
2048 Average Daily Traffic	16,430 vehicles per day

The project will be designed for traffic volumes projected to the year 2038 (30 years after completion). Peak hour conditions were estimated for the "K"-factors (hourly volume divided by daily volume), "D" factors (directional distribution), and the percentage of heavy vehicles in the traffic stream for year 2002. The results of the two-lane highway analysis are shown in Table 6. Peak hour directional volumes, densities, and levels of service for year 2038 are shown in Table 7.

Table 6
Results of Two-Lane Highway Analysis, Future (2038) Volumes
Hawaii Belt Road, Akaka Falls Road to Mamane Street

	Peak Hour Volume	volume-to-capacity ratio	Level of Service
AM Peak Hour	938	0.37	D
PM Peak Hour	1,072	0.38	D

Table 7
Future (2038) Traffic Densities
Hawaii Belt Road, Akaka Falls Road to Mamane Street

	Southbound	Northbound
AM Peak Hour volume	516	422
density	25.5	20.9
level of service	C	C
PM Peak Hour volume	590	482
density	22.3	18.2
level of service	C	C

The results indicate that a two-lane highway would not meet the desired level of service (LOS C or better) for a rural highway with the projected volumes for 2038 peak hours. Traffic volumes, however, will remain well below capacity. Other improvements, such as the provision of passing lanes, would improve conditions on the two-lane highway and permit the passing of slow-moving vehicles without undue delay. The density calculation indicates that traffic conditions over short segments of the two-lane highway, such as through the gulches, would be within an acceptable range.

Passing lanes or other measures placed on the highway segments immediately before and immediately after the gulches could reduce the queues that may form behind any slow moving vehicles. These improvements could be provided on relatively level ground, at a lower cost than any widening within the gulch areas where side slopes present design challenges.

CONCLUSIONS AND RECOMMENDATIONS

Peak hour volumes on a two-lane highway along the Hamakua Coast in year 2038 would be about 40% of capacity. While delays could occur due to slow-moving vehicles, as indicated by Level of Service D findings in the two-lane highway analyses, passing lanes or other improvements to dissipate queues could be included at strategic locations to mitigate these concerns. If these improvements can not reasonably be provided within the major gulches, they should be provided on the approach and departure to these areas to minimize queues in the traffic streams that cross the gulches.

The following parameters should be used for design:

2008 ADT (Average Daily Traffic) = **7,280** vehicles per day

2038 ADT (Average Daily Traffic) = **13,400** vehicles per day

2038 DHV (Design Hourly Volume) = **1,070** vehicles per hour

D (directional distribution) = **55/45**

$\mathbf{T_{24}}$ (Heavy vehicles in 24-hour period) = **8.5%**

* * *

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April 23, 2009

Mr. Walter Chong, P.E.
R. M. Towill Corporation
2024 North King Street, Suite 200
Honolulu, Hawaii 96819

Subject: Queue Estimates for Construction of Hawaii Belt Road Projects
Rockfall Protection at Maulua, Laupahoehoe and Kaawalii Gulches
Hamakua Coast, Hawaii

Dear Walter:

In response to a question regarding the estimated length of queue on the Hawaii Belt Road during construction of the rockfall protection measures, we have computed queue lengths ranging from 750 feet (0.14 mile) to 1,150 feet (0.22 mile). The estimates are for complete closure of the highway for a period of 5 minutes during weekday peak hours in the year 2010. A proportionate change in the queue lengths can be expected if the duration of the highway closure changes; i.e., a 10-minute closure would produce queue lengths of 1,500 to 2,300 feet.

Traffic Estimates

Traffic estimates are based on the traffic volumes shown in the March 2006 *Traffic Study Report* that we had prepared for the subject project. Table 7 of that report shows the projected traffic volumes, by direction, during morning (AM) and afternoon (PM) peak hours in year 2038. Trucks would be 9% of the volumes in the AM Peak Hour and 4% of the volumes in the PM Peak Hour. The highest volume (590 vehicles per hour in 2038) was projected for southbound traffic in the PM Peak Hour.

The future traffic volumes were based on existing volumes and trends, with traffic increasing at an average rate of 2.05% per year. Table 5 of the report shows Average Daily Traffic (ADT) volumes of 7,290 vehicles per day in 2008, 8,930 vehicles per day in 2018, and 13,410 vehicles per day in 2038. Based on the ADT volumes, the southbound traffic volume in the PM Peak Hour is computed to be 334 vehicles per hour in 2010.

Queue Calculation

The number of vehicles that would be affected by a complete closure of the highway would depend on the approach volume and the length of the closure. Accounting for

variations in the traffic volume within the peak hour, the change in the location where vehicles would stop as the queue builds, and the time required to clear the queue once traffic starts moving again, a queue of 48 vehicles is computed for a 5-minute closure for the southbound traffic in the 2010 PM Peak Hour.

Other assumptions that were made in the calculation are a) approach speed of 45 miles per hour, b) 23 feet of roadway was allowed for each car and 45 feet for each truck, and c) the queue dissipates at a rate of 1,200 vehicles per hour (3-second headways) once the roadway is reopened.

Similar calculations were done for the northbound traffic and for the AM Peak Hour with the results shown in the table below.

Traffic Volumes and Queue Estimates for 5-minute Closure

	AM Peak Hour		PM Peak Hour	
	southbound	northbound	southbound	northbound
2038 volumes (from traffic report)	516	422	590	482
2010 volumes	292	239	334	273
Maximum queue (vehicles)	40	30	48	36
Maximum queue (miles)	0.19	0.14	0.22	0.16
Time required to dissipate queue (minutes)	2.0	1.5	2.4	1.8

Sensitivity Analysis

The analysis included a sensitivity analysis to determine the effects of different assumptions on the resulting queue lengths. Changing the approach speed had only a minor effect on the queue; a higher speed resulted in slightly lower queue length (e.g, for 60 miles per hour, the southbound queue in the PM Peak Hour is reduced from 48 vehicles to 47 vehicles.

The length of lane taken up by each queued vehicle had only a minor effect on the number of vehicles queued and a proportionate effect on the queue length. Use of 25 feet for each car and 50 feet for each truck did not affect the number of queued vehicles, but resulted in a proportionate increase in the distances.

A higher rate of queue dissipation would reduce the number of vehicles in the queue and the maximum length of queue. A rate of 1,440 vehicles per hour (2.5-second headway) would result in a decrease of about 10% in the number of vehicles and in the queue distances.

Conclusions

Peak hour traffic volumes on Hawaii Belt Road during construction were computed from the traffic projections in the traffic study report for the project. Based on these volumes and several assumptions about traffic operations, a maximum queue length resulting from a closure of 5-minute duration in the PM Peak Hour of 0.22 mile was computed.

Should there be any questions, please contact me as noted on the first page.

JULIAN NG, INCORPORATED

Julian Ng, P.E., P.T.O.E.
President

P.T.O.E. is the Professional Traffic Operations Engineer certification from Transportation Professional Certification Board, Inc.
For more information, please see http://www.tpcb.org/ptoe/default.asp

Appendix F

Cultural Impact Assessment Report
Hawai‘i Belt Road Rockfall Protection
at Maulua, Laupāhoehoe and Ka‘awali‘i Gulches
North Hilo and Hāmākua, Island of Hawai‘i, Hawai‘i

A Cultural Impact Assessment for Hawai'i Belt Road Rockfall Protection at Maulua, Laupāhoehoe, and Ka'awali'i Gulches; Maulua Nui, Laupāhoehoe, and Humu'ula Ahupua'a; North Hilo and Hāmākua Districts, Hawai'i Island TMK: [3] 3-4-002: 03, 04 & 05; [3] 3-6-04: 02, 11, 15, 17, 23 & 30; [3] 3-9-01:01

Prepared for

R.M. Towill Corporation

Prepared by

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(Job Code: KAAWALII 2)

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Management Summary

Reference	A Cultural Impact Assessment (CIA) for Hawai'i Belt Road Rockfall Protection at Maulua, Laupāhoehoe, and Ka'awali'i Gulches; Maulua Nui, Laupāhoehoe, and Humu'ula Ahupua'a; North Hilo and Hāmākua Districts, Hawai'i Island; TMK: [3] 3-4-002: 03, 04 & 05; [3] 3-6-04: 02, 11, 15, 17, 23, & 30; [3] 3-9-01: 01 (Wheeler, Tulchin and Hammatt 2009)
Date	May 2009
Project Number (s)	Cultural Surveys Hawai'i (CSH) Job Code: KAAWALII 2
Project Location	The project area consists of three discrete locations at three major Hawai'i Belt Road (Route 19) stream valley crossings (Ka'awali'i, Laupāhoehoe, and Maulua Gulches) within the North Hilo and Hāmākua Districts.
Land Jurisdiction	State of Hawai'i
Agencies	State Historic Preservation Division of the Department of Land and Natural Resources (SHPD/DLNR).
Project Description	The proposed project involves the construction of rockfall mitigation and stabilization measures along the Hawai'i Belt Road (Route 19) at specific locations adjacent to Maulua, Laupāhoehoe, and Ka'awali'i Gulch. The project proponent is the Hawai'i Department of Transportation (HDOT), Highways Division. The mitigation and stabilization measures proposed by HDOT include the installation of anchored wire mesh panels along the existing steep rock cut cliffs adjacent to the roadway entrances and exits of the three *awāwa* (gulch), the creation of interceptor ditches (swale) above the cliffs to divert surface-water runoff, and minor improvements to existing drainage. The purpose of these measures is to improve highway safety along the segments fronting the three *awāwa* by improving upon the present unsafe conditions resulting in falling rocks, boulders, and associated sediments. The project construction is anticipated to begin in the summer of 2010 starting at Laupāhoehoe Gulch. Only one *awāwa* will be worked on at a time. Work at each *awāwa* is estimated to last between one to two years and will be undertaken in sequence, with a total time of construction of approximately six years.
Project Acreage	Approximately 2.434 total acres.
Area of Potential Effect (APE) and Survey Acreage	For the purposes of this CIA, the Area of Potential Effect (APE) includes approximately 2.434 total acres and encompasses all or portions of the following Tax Map parcel: [3] 3-4-002: 03, 04 & 05; [3] 3-6-04: 02, 11, 15, 17, 23 & 30; [3] 3-9-01:01. While this investigation focused on the project APE, for the purposes of this CIA, the study area includes the entire *ahupua'a* (land division extending from the mountains to the sea) of Maulua Nui, Laupāhoehoe, and Humu'ula.

Document Purpose	The project requires compliance with the State of Hawai'i environmental review process [Hawai'i Revised Status (HRS) Chapter 343], which requires consideration of proposed project's effect on cultural practices and resources. CSH is undertaking this CIA at the request of R.M. Towill Corporation. Through document research and (ongoing) cultural consultation efforts, this report provides preliminary information pertinent to the assessment of the proposed project's impacts to cultural practices (per the OEQC's *Guidelines for Assessing Cultural Impacts).* The document is intended to support the project's environmental review and may also serve to support the project's historic preservation review under HRS Chapter 6E-42 and Hawai'i Administrative Rules Chapter 13-284.
Consultation Effort	Hawaiian organizations, agencies and community members were contacted in order to identify potentially knowledgeable individuals with cultural expertise and/or knowledge of the project area and the vicinity. The organizations consulted included the State Historic Preservation Division (SHPD), the Office of Hawaiian Affairs (OHA), the Hawai'i Island Burial Council (HIBC), and community and cultural organizations within the Hilo – Hāmākua *moku* (district).
Results of Background Research	Background research shows: 1. T. Stell Newman's ethnohistorical study defining indigenous Hawaiian land use patterns has indicated that the current project area falls into what is termed the Scattered Farms agricultural zone, with a low population density, dispersed settlement with few fishing villages at the coast, and scattered fields and gardens with no major field systems (Newman 2000). Crops that would have been cultivated consisted of dryland taro, sweet potato, bananas, yams, breadfruit, sugarcane, and paper mulberry. 2. Deviating from the settlement pattern outlined above is the portion of the project area situated at the mouth of Laupāhoehoe Gulch, just *ma uka* (inland) of Laupāhoehoe Point. Previous archaeological research has documented a number of *heiau* (temple) in the vicinity of this portion of the project area (Stokes 1991; Shideler and Hammatt 2003). Cox notes that "the concentration of religious structures in this relatively small, but strategic, valley mouth is indicative of both the area's importance and its sizable pre-contact period population" (Cox 1983:3). 3. No historic properties were observed within the approximately 2.434 mile study area during a field inspection conducted by CSH (Tulchin et al. 2009). The absence of historic properties can be attributed to extensive land modifications associated with historic sugar cultivation and construction associated with

	the Hāmākua Division of the Hilo Railroad, later known as the Hawai'i Consolidated Railway. The Belt Highway and portions of the current project area follow much of the railway right-of-way. After the demise of the sugar industry, previously cultivated areas became pasture lands, and/or were planted with eucalyptus or ironwood trees. 4. No *kuleana* (land parcels awarded to commoners) LCAs were awarded to commoners in the vicinity of the project area suggesting that indigenous Hawaiian land use within the project area may have been limited. 5. The project area is associated with specific *mo'olelo* (stories, legends) about: the abundant rainfall and flourishing of agriculture in the *moku* of Hāmākua which encompasses the project area; Lono's, one of the four major Hawaiian gods, importance in rituals and legends of Hāmākua; Lono's animal form of Kamapua'a (pig child) and his claim over the Hāmākua coast as his domain on Hawai'i Island; the surfing (*he'e nalu*) competition between 'Umi and a chief of Laupāhoehoe named Pai'ea, who crowded 'Umi against a rock but was defeated and later roasted by 'Umi in an *imu* (underground oven) (Kamakau 1961). The rugged landscape of the project area also is featured prominently in several *'ōlelo no'eau* (proverbs), which mention Hāmākua's tall cliffs "(*Hāmākua 'āina pali loa)*," steep slopes and long reach of its southwestward extension to the summit of Mauna Loa (Pukui et al. 1974:39); Laupāhoehoe which means smooth lava flat and its significance as an "ancient surfing area" (Pukui et al. 1974:130) and how it once had a *heiau* called Ule-ki'i built by a man from Kahiki; Maulua which means "always depressed" (Pukui et al. 1974:148), and Ka'awali'i which means "the small *'awa*" (Ulukau 2003).
Results of Preliminary Community Consultation	A total of twenty-one people were contacted for the purposes of this CIA; nine people have responded as of this writing. Community consultation for this project yielded the following results: 1. Although not specifically related to direct cultural impacts, community contact Mrs. Marsue McShane stated her objection to the proposed project, saying that it is "unnecessary and a waste of taxpayer's money." She recommends the empty sugarcane fields be used for raising vegetables and the money intended for the rockfall to be put toward helping land-owners become self-sufficient, "instead of directing all these things for [rockfall] mitigation." 2. *Kama'āina* Aunty Pili Ka'apuni, is overjoyed about this

	project finally happening and stated, "I have traveled from Honomu to Waimea every school day for the last 8 years and have come across a lot of dangerous situations on those three horseshoes in that time." 3. According to community contact Mrs. Lisa Barton, the project area has a long history of cultural use as a hunting, fishing and gathering area. During the plantation era, *kama'āina* groups continued to harvest fodder for animals and firewood for cooling and bathing for plantation camps. The nearby shoreline which has been featured prominently in *mo'olelo* continues to be used by *kama'āina* for *he'e nalu* as well as fishing and other recreational practices.
Cultural Impact Assessment Recommendations	A good faith effort to address the following recommendations may help mitigate potential adverse effects of the proposed project on Hawaiian cultural practices and resources in and near the project area. 1. If in the unlikely event that intact historic properties, including but not limited to human remains or other significant cultural deposits, are encountered during the course of the proposed project activities, all work in the immediate area should stop and the State Historic Preservation Division should be promptly notified. 2. It is recommended that ongoing cultural practices of gathering, hunting, and fishing be recognized and safeguarded.

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Section 1 Introduction

1.1 Project Background

At the request of R.M. Towill Corporation, CSH prepared this CIA for Hawai'i Belt Road Rockfall Protection at Maulua, Laupāhoehoe, and Ka'awali'i Gulches; Maulua Nui, Laupāhoehoe, and Humu'ula Ahupua'a; North Hilo and Hāmākua Districts, Hawai'i Island, TMK: [3] 3-4-002: 03, 04 & 05; [3] 3-6-04: 02, 11, 15, 17, 23 & 30; [3] 3-9-01: 01. The project area consists of three discrete locations at three major Hawai'i Belt Road (Route 19) stream valley crossings (Maulua, Laupāhoehoe, and Ka'awali'i Gulches) within the North Hilo and Hāmākua Districts. The three project area locations are all within the Hawai'i Belt Road Right-of-Way and total approximately 2.434 acres. This area is depicted on the 1980 1:100,000 USGS Map of Hawai'i County (Figure 1), the 1982 Kūka'iau & Pāpa'aloa U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles (Figure 2, Figure 3, Figure 4), and Tax Map Key (TMK) [3] 3 (Figure 5).

The project area is under the land jurisdiction of the State of Hawai'i and is proposed for rockfall protection within the Hawai'i Belt Road Right-of-Way at Maulua Gulch, Laupāhoehoe Gulch, and Ka'awali'i Gulch (see Appendix A). The project proponent is the Hawai'i Department of Transportation (HDOT), Highways Division. The mitigation and stabilization measures involve the installation of anchored wire mesh panels along the existing steep rock-cut cliffs adjacent to the roadway entrances and exits of the three gulches, the creation of interceptor ditches (swale) above the cliffs to divert surface-water runoff, and minor improvements to existing drainage. The purpose of these measures is to improve highway safety along the segments fronting the three gulches by improving upon the present unsafe conditions that are prone to falling rocks, boulders, and associated sediments.

The proposed project is to begin construction in the summer of 2010 starting at Laupāhoehoe Gulch. Only one gulch will be worked on at a time. Work at each gulch is estimated to last between one to two years and will be undertaken in sequence. The total time of construction will be approximately 6 years.

1.2 Document Purpose

The project requires compliance with the State of Hawai'i environmental review process [Hawai'i Revised Statutes (HRS) Chapter 343], which requires consideration of a proposed project's effect on cultural practices and resources. At the request of R.M. Towill Corporation, CSH undertook this CIA. Through document research and cultural consultation efforts, this report document provides information pertinent to the assessment of the proposed project's impacts to cultural practices (per the OEQC's *Guidelines for Assessing Cultural Impacts*). The document is intended to support the project's environmental review and may also serve to support the project's historic preservation review under HRS Chapter 6E-42 and Hawai'i Administrative Rules Chapter 13-284.

1.3 Scope of Work

The agreed upon scope of work for the CIA is as follows:

1. Examination of cultural and historical resources, including Land Commission documents, historic maps, and previous research reports, with the specific purpose of identifying traditional Hawaiian activities including gathering of plant, animal, and other resources or agricultural pursuits as may be indicated in the historic record.
2. Review of previous archaeological work at and near the subject parcel that may be relevant to reconstructions of traditional land use activities; and to the identification and description of cultural resources, practices, and beliefs associated with the parcel.
3. Consultation with knowledgeable parties regarding traditional cultural practices at or near the parcel; present uses of the parcel; and/or other (non-Hawaiian) practices, uses, or traditions associated with the parcel.
4. Preparation of a report summarizing the results of these research activities.

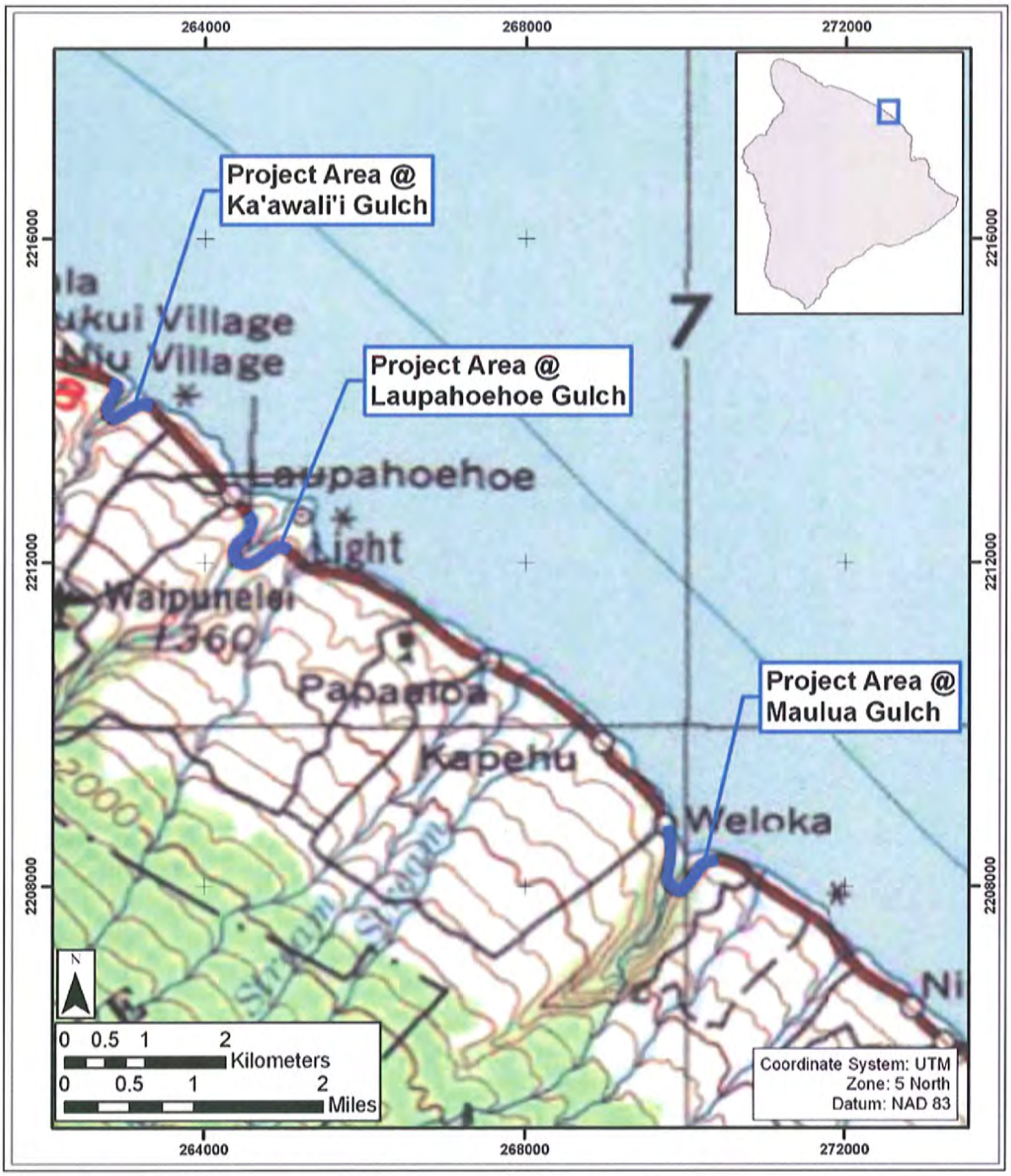


Figure 1. Portion of 1980 1:100,000 USGS Map of Hawai'i County, Hawai'i, Sheet 2 of 3, showing the location of the project area

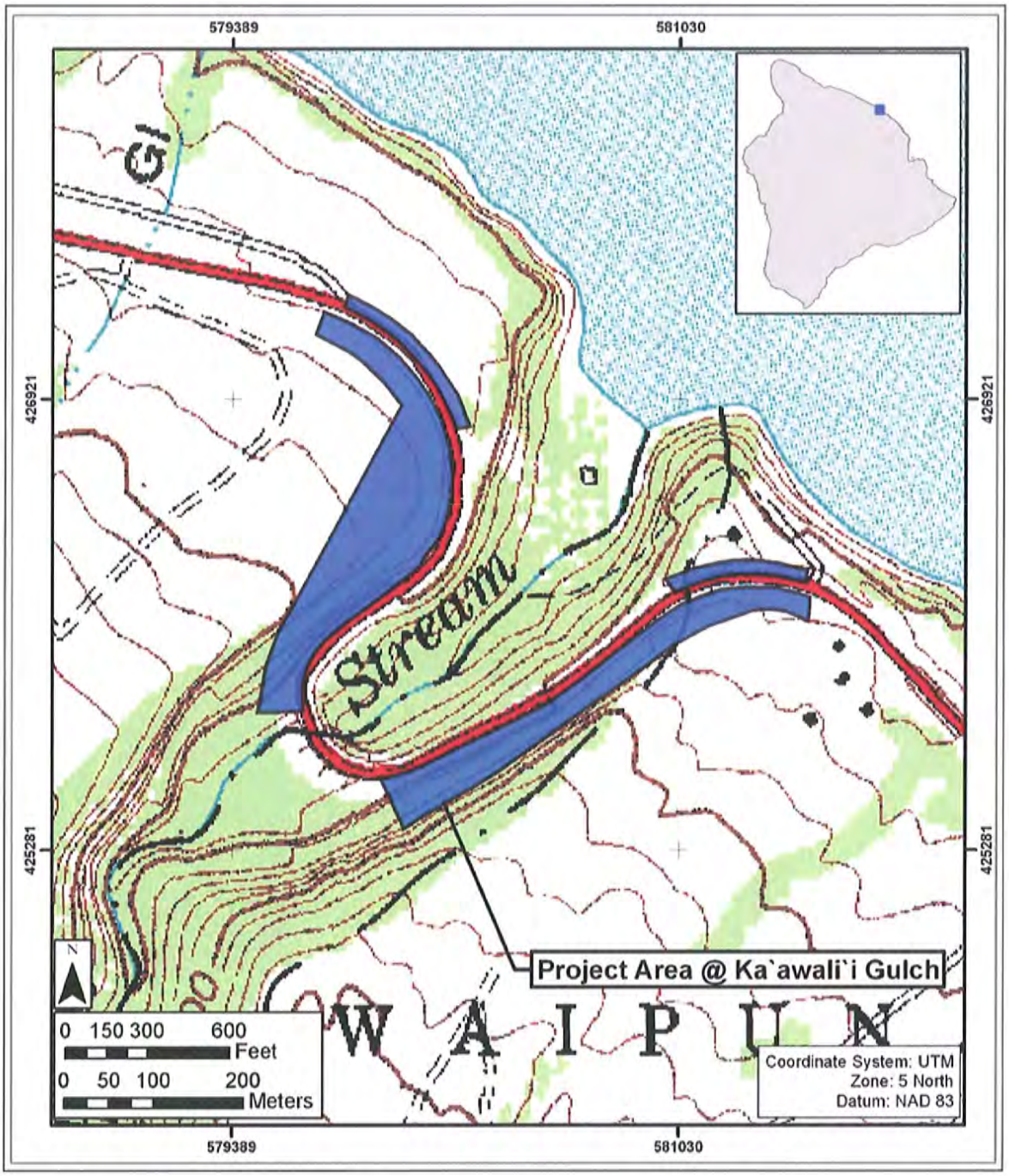


Figure 2. USGS 7.5 Minute Series Topographic Map, Kūka'iau Quadrangle (1982), showing the location of the Ka'awali'i Gulch portion of the project area

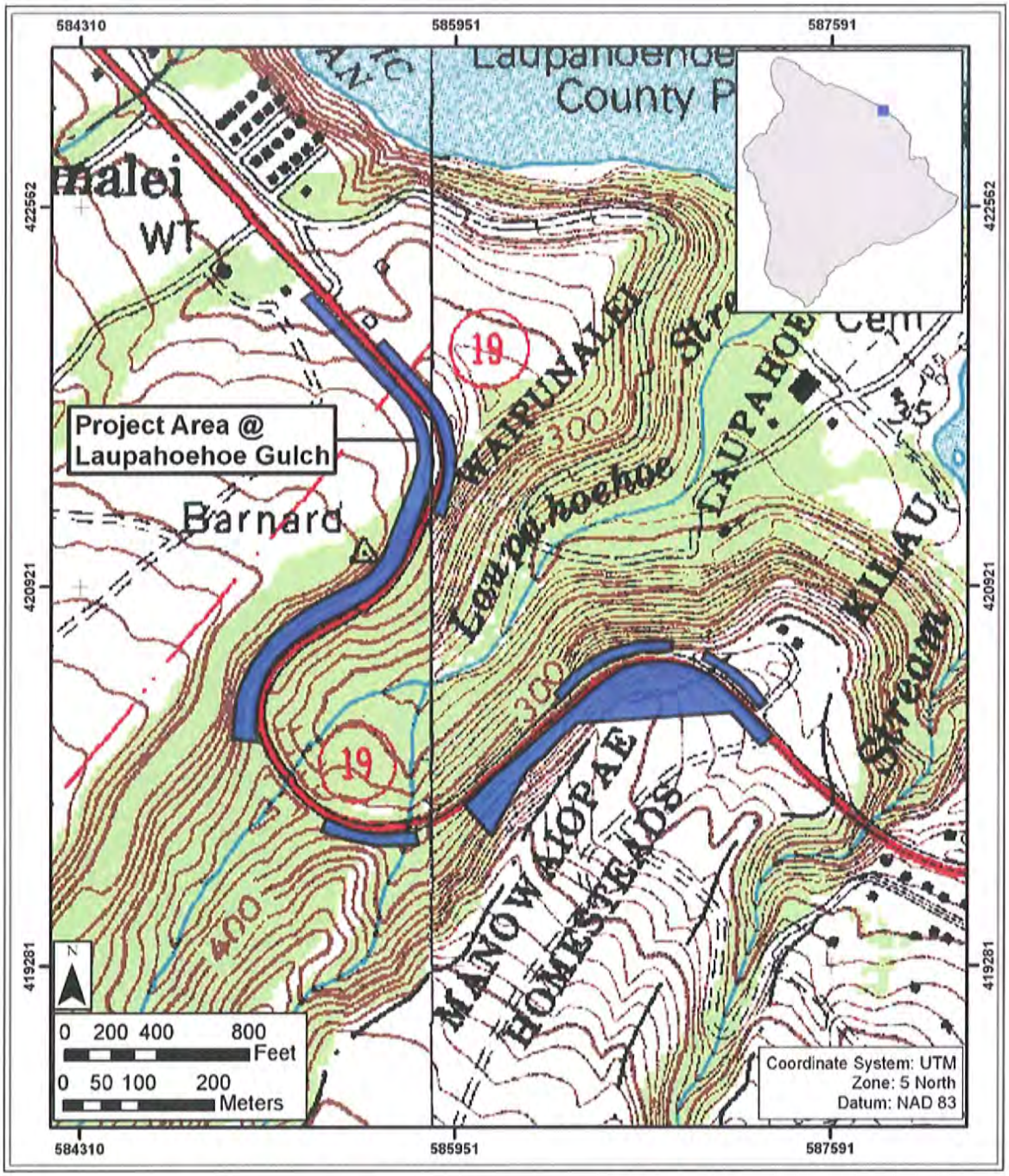


Figure 3. USGS 7.5 Minute Series Topographic Map, Pāpa'aloa Quadrangle (1982), showing the location of the Laupāhoehoe Gulch portion of the project area

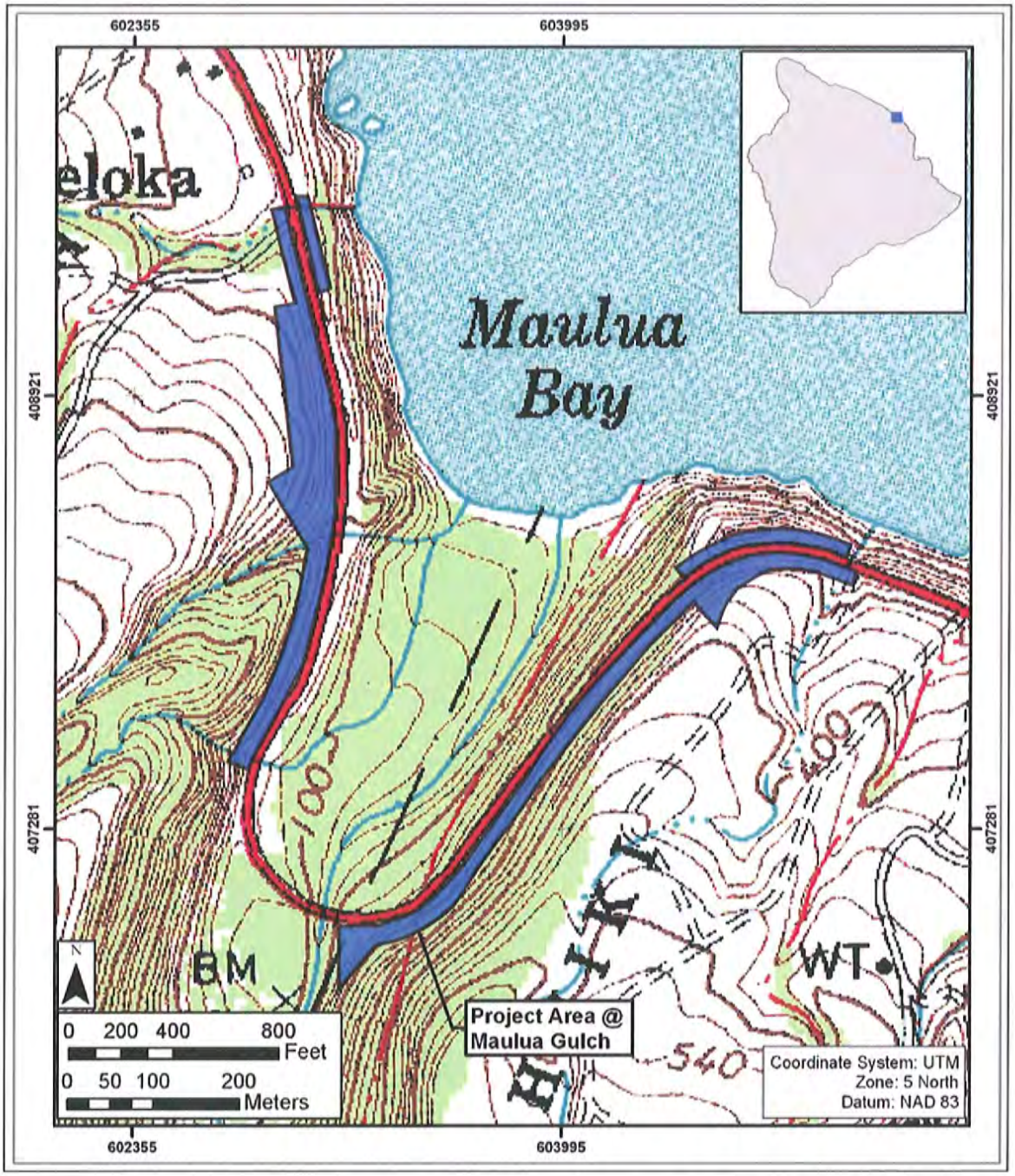


Figure 4. USGS 7.5 Minute Series Topographic Map, Pāpa'aloa Quadrangle (1982), showing the location of the Maulua Gulch portion of the project area

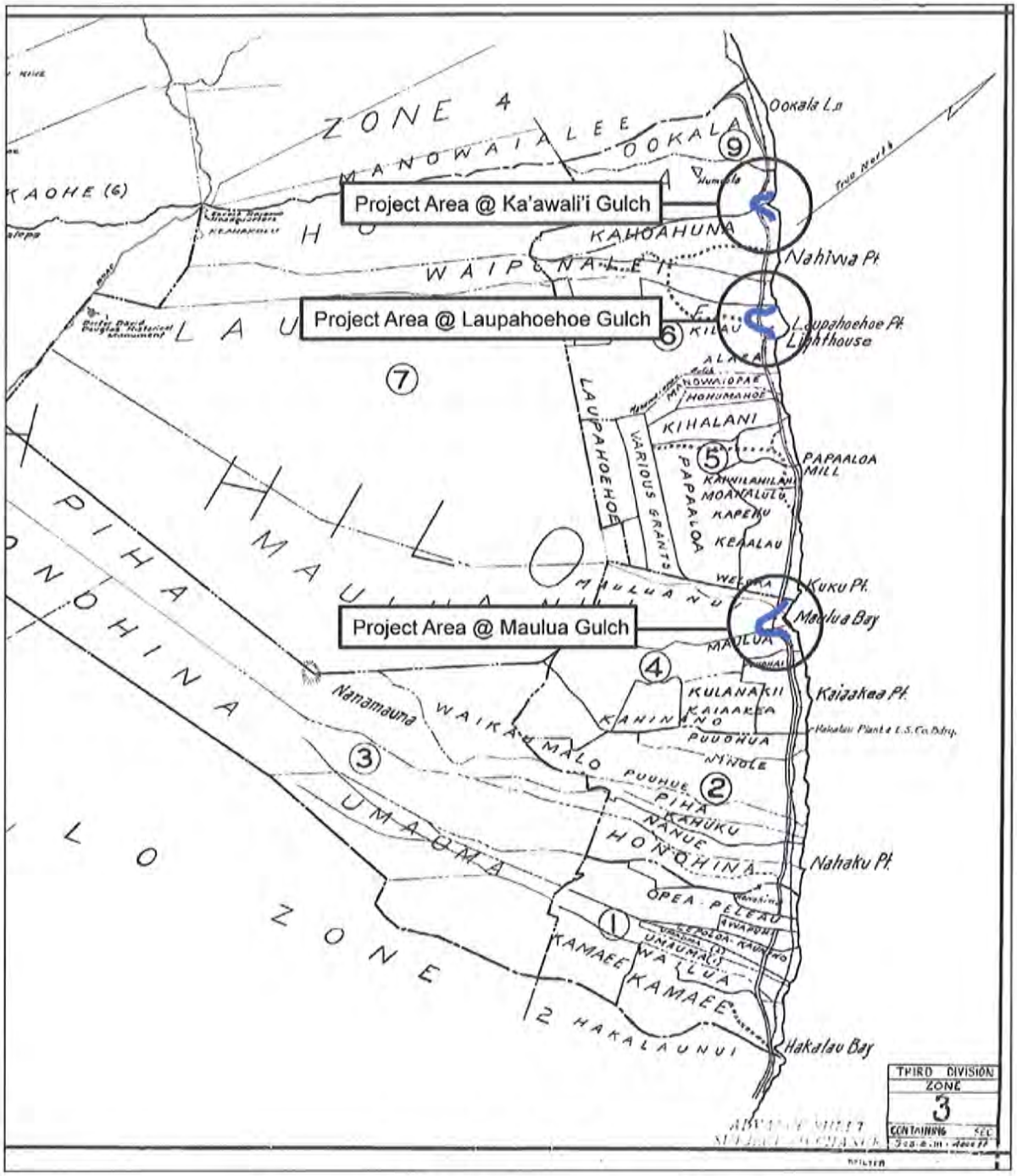


Figure 5. Portion of TMK: [3] 3 showing project area location

1.4 Environmental Setting

1.4.1 Natural Environment

The project area is located along the northeastern coast of the island of Hawai'i. The topography within the project area is moderate with elevations ranging from approximately 30-120 m (100-400 ft) AMSL (Above Mean Sea Level). The average annual rainfall in the vicinity of the project area is approximately 3000-4000 mm (182-244 in) (Giambelluca et al. 1986). Vegetation in the project area consists of native and introduced trees and grasses. Maulua Gulch contains *kukui (Aleurites moluccana)*, *'ōhi'a (Metrosideros macropus)*, *hau (Hibiscus tiliaceus)*, *kī (Cordyline terminalis)* and *pūhala* (*Pandanus odoratissimus)* trees. The *mauka* (inland) ridge of Maulua Gulch consisted of fenced pasture lands with non-native trees. Laupāhoehoe Gulch contained some *kukui (Aleurites moluccana), kī (Cordyline terminalis), hau (Hibiscus tiliaceus)* trees and many non-native trees, including eucalyptus and ironwoods. The *ma uka* ridges of Laupāhoehoe Gulch are fenced pasture lands with non-native trees. Ka'awali'i Gulch contained areas of dense feral cane or California grass, and ironwood trees. The *ma uka* ridges of Ka'awali'i Gulch are fenced pasture lands.

Soils within the project area consist primarily of Rough Broken Land (RB) (Figure 6). Rough broken land is described as "a miscellaneous land type that consists of very steep, precipitous land broken by many intermittent drainage channels...primarily in gulches" (Foote et al. 1972).

1.4.2 Built Environment

The entire project area is situated within the Hawai'i Belt Road Right-of-Way and is within asphalt paved roadways and/or bulldozed road cuts.

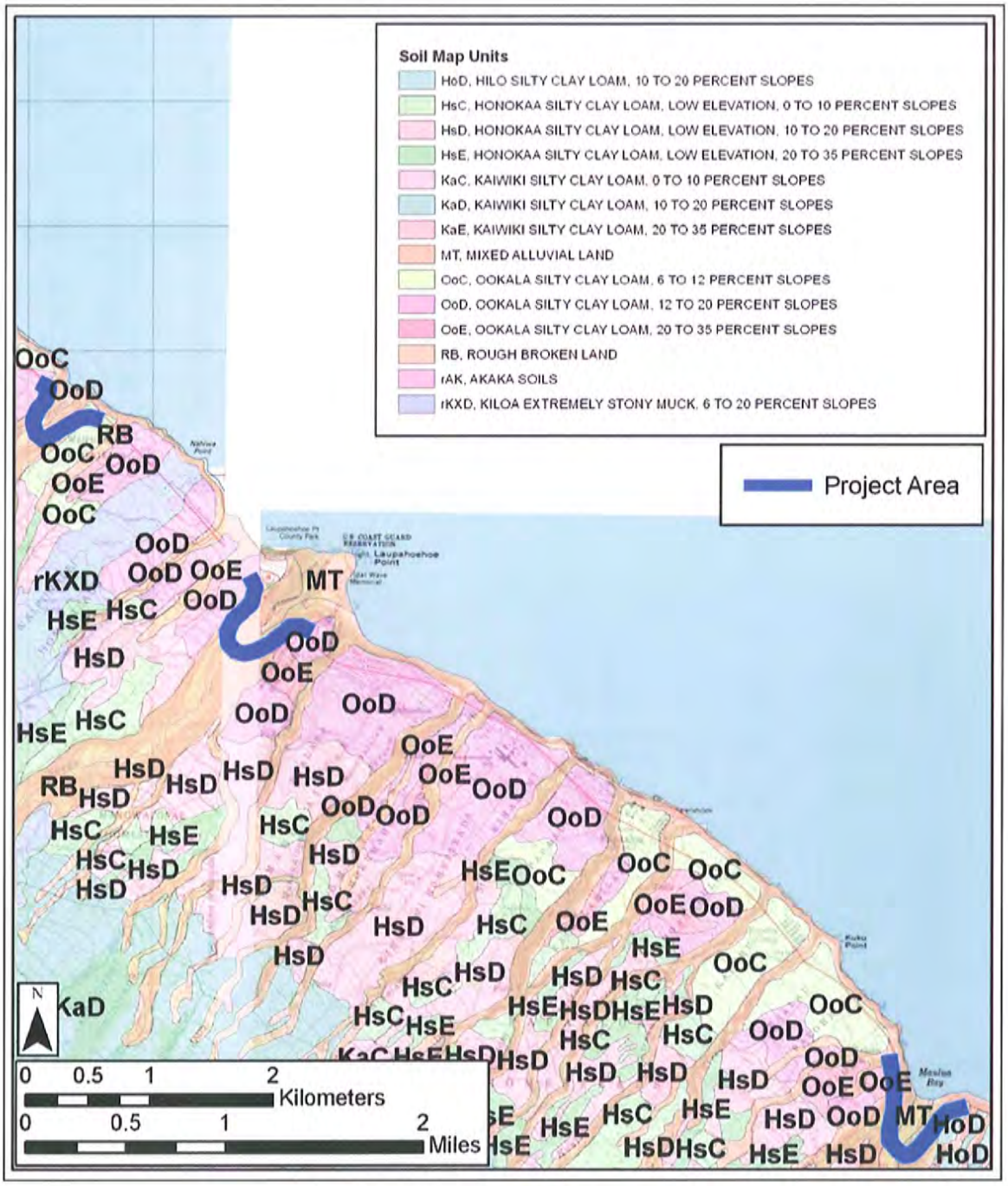


Figure 6. Overlay of Soil Survey of the State of Hawai'i (Foote et al. 1972), indicating sediment types within the project area

Section 2 Methods

2.1 Document Review

Historical documents, maps and existing archaeological information pertaining to historic properties in the vicinity of this project were researched at the CSH Library, Hamilton Library of the University of Hawai'i, the Hawai'i State Archives, the Mission Houses Museum Library, the Hawai'i Public Library, and the Archives of the Bishop Museum. Information on Land Commission Awards was accessed through Waihona 'Āina Corporation's Mahele Data Base (www.waihona.com). The State Historic Preservation Division (SHPD), the Office of Hawaiian Affairs (OHA), the Hawai'i Island Burial Council (HIBC), and community and cultural organizations in Maulua Nui, Laupāhoehoe, and Humu'ula Ahupua'a were contacted in order to identify potentially knowledgeable individuals with cultural expertise and/or knowledge of the project area and the surrounding vicinity. The names for potential community contacts were also provided by colleagues at CSH and from the authors' familiarity with people who live in or around the project area. The cultural specialist conducting research on this assessment employed snowball sampling methods, an informed consent process and semi-structured interviews according to standard ethnographic methods (as suggested by Bernard 2005). Some of the prospective community contacts were not available to be interviewed as part of this project. A discussion of the consultation process can be found in Section 6 on Community Consultation. Please refer to Table 2, Section 6 for a complete list of individuals and organizations contacted.

Section 3 Traditional Background

3.1 Place Names

Hāmākua is one of the six original *moku* (district) on the island of Hawai'i. It is described poetically as *kihi loa*, long corner, perhaps in reference to its southwestward extension to the summit of Mauna Loa (Pukui et al. 1974:39). The present project area falls within the Hāmākua *moku*. Laupāhoehoe literally means smooth lava flat (Pukui et al. 1974:130) or leaf-shaped smooth lava (Clark 1985:4). Pukui et al. (1974:130) relate that Laupāhoehoe was an "ancient surfing area" and once had a *heiau* (shrine) called Ule-ki'i, that was built by a man from Kahiki. Maulua literally means "always depressed" (Pukui et al. 1974:148), and Ka'awali'i means "the small '*awa*" (Ulukau 2003).

3.2 Poetical Sayings

Four passages mention Hāmākua in Mary Kawena Pukui's *'Ōlelo No'eau: Hawaiian Proverbs & Poetical Sayings* (1983). The rugged landscape is reflected in three proverbs, while the fourth emphasizes the great expanse of Hāmākua's uplands.

Passage 438 refers to the sea-cliffs and valley walls of the moku, "Hāmākua, land of tall cliffs (*Hāmākua 'āina pali loa)*." Passage 439 refers to the broken nature of the *moku*, with its steep slopes and many gulches: "Irregular and rough Hāmākua (*Hāmākua i ka wakawaka*)." Passage 440 reflects the effect of the *moku* steep cliffs and broken terrain: "Hāmākua of the steep trails (*Hāmākua i ke ala 'ulili*)."

The last proverb, passage 441, refers to the long arm of Hāmākua that extends up into the center of the island to encompass Mauna Kea and reaches all the way to the summit crater of Mauna Loa. Because Hāmākua touches every other *moku* of Hawai'i, except Puna, the *moku* is known as: "Hāmākua with a long corner (*Hāmākua kihi loa*)."

Passage 1004 refers to the extent of the Hilo *moku* from Mawae on the Puna side to Maulua on the Hāmākua side: "Hilo, from Mawae to the cliff of Maulua (*Hilo, mai Mawae e ka pali o Maulua*)."

Passage 1469 refers to Laupāhoehoe: "The coconut-leaf-lifting wind of Laupāhoehoe (*Ka makani wehe lau niu o Laupāhoehoe*)."

3.3 Myths and Legends

Because of the abundant rainfall and consequent flourishing of agriculture in the Hāmākua *moku*, Lono, one of the four major Hawaiian gods, was particularly important in rituals and legends of Hāmākua. Lono's attributes of abundant growth and dark, rain-laden clouds were invoked by rulers and commoners alike. Lono's animal form of Kamapua'a (pig child) claimed the Hāmākua coast as his domain on Hawai'i Island:

> Where dark clouds at the beginning (November – December) and at the culmination (January – February) of the season of rains pile up against forelands and rocky summits, where thunder rumbles and echoes, there is Kamapua'a. On Hawai'i his domain was the verdant rainy Hamakua coast, where, when southerly

> winds sweep around the eastern flank of Mauna Kea, the storm clouds pile up in rolling masses like giant swine rutting in the uplands. After the thunder, the voice of Lono (=Kamapua'a), the clouds let down their rain in deluges. The verdant forest reaches to the very brink of the crater of Kilauea. (Handy and Handy 1972:341)

The "Tradition of Kamapuaa" relates how Kamapua'a fought the volcano goddess Pele for several days at Halema'uma'u, the crater at Kīlauea Volcano; the settlement of their dispute split the island between the two. Pele took stony Puna, Ka'ū and Kona while Kamapua'a took Kohala, Hāmākua and Hilo, which were the district free of lava rocks (Fornander 1916:342).

Westervelt recorded the legend "Pele and the Snow-goddess" in which Pele battled Poli'ahu, one of the snow maidens who dwell atop Mauna Kea. Pele's fire-fountains and lava were thrown against Poli'ahu's mantle of snow and the clouds that gathered over the summit of Mauna Kea at her call. According to the legend:

> Poliahu in legendary battles has met Pele many times. She has kept the upper part of the mountain desolate under her mantle of snow and ice, but down toward the sea most fertile and luxuriant valleys and hillside sloes attest the gifts of the goddess to the beauty of the island and the welfare of men.
>
> Out of Mauna Loa, Pele has stepped forth again and again, and has hurled eruptions of mighty force and great extent against the maiden of the snow-mantle, but the native say that in this battle Pele has been and always will be defeated. Pele's kingdom has been limited to the southern half of the island, Hawaii, while the snow-maidens rule the territory to the north. (Westervelt 1916:62)

The story of the ruling chief 'Umi's ('Umi-a-Līloa's) sacrifice of Pai'ea, a chief of Laupāhoehoe, is related by Samuel M. Kamakau in an article in the "Hawaiian Language Newspaper *Ke Au 'Oko'a* on November 17, 1870 and is translated as follows:

> 'Umi and his wives went sea bathing, surfing (*he'e nalu*), riding on the surf (*kaha nalu*), and a certain chief of Laupāhoehoe noticed 'Umi's skill in surf-riding. His name was Pai'ea, and he knew all the surfs and the best one to side. It was the one directly in front of Laupāhoehoe, facing Hilo. It was a huge one which none dared to ride except Pai'ea, who was noted for his skill. Gambling on surfing was practiced in that locality. All of the inhabitants from Waipunalei to Ka'ula placed their wager on 'Umi, and those of Laupāhoehoe on Pai'ea. The two rode the surf, and while surfing, Pai'ea noticed that 'Umi was winning. As they drew near a rock, Pai'ea crowded him against it, skinning his side. 'Umi was strong and pressed his foot against Pai'ea's chest and then landed ashore. 'Umi won against Pai'ea, and because he crowded 'Umi against the rock with the intention of killing him, Pai'ea was roasted in an *imu*. (Kamakau 1961)

Fornander (1919) offers a virtually identical account:

> 'Umi was very skillful in riding the surf, and he showed this while living in humble life in Laupāhoehoe. One day while out surf riding he had a race with

Pai'ea, a man famous in Laupāhoehoe as the best surf rider of that place. In this race Pai'ea crowded 'Umi up against the rocks, thus bruising his shoulder. Therefore, years after this it was remembered against Pai'ea, and he was killed by 'Umi when Hawai'i came under his rule.

Section 4 Historical Background

4.1 Early 1800s

In 1819, after the death of Kamehameha, his heir Liholiho abolished the *kapu* (tabu) system. His cousin Kekuaokalani (to whom Kamehameha had bequeathed his war god Kūka'ilimoku and responsibility for the care of the gods, their temples, and the support of their worship), led a revolt against Liholiho and the abolition of the *kapu* system. A rebellion broke out at the same time in Hāmākua. After the king's forces defeated Kekuaokalani's army at Kuamo'o in the Kona *moku*, the Hāmākua rebellion was easily put down (Kuykendall 1938:65-69).

In 1823, Reverend William Ellis conducted a two-month journey around the entire island of Hawai'i, utilizing a route primarily along the coast. During his journey, Ellis made observations of indigenous Hawaiian agriculture and population densities. The following is his account of the coastal inhabitants of the North Hilo and Hāmākua *moku*:

> ...the inhabitants, excepting at Waiakea, did not appear better supplied with the necessaries of life than those of Kona, or the more barren parts of Hawaii. They had better houses, plenty of vegetables, some dogs, and few hogs, but hardly any fish, a principle article of food with the natives in general. (Ellis 1963: 252)

Ellis also provides a brief description of indigenous Hawaiian land use observed along his route from Humu'ula Ahupua'a to Kaula Valley:

> The high land over which we passed was generally woody, though the trees were not large. The places that were free from wood were covered with long grass and luxuriant ferns. The houses mostly stood singly and were scattered over the face of the country.
>
> A rich field of potatoes or taro, five to six acres in extant, or large plantations of sugar-cane and bananas, occasionally bordered our path. But though the soil was excellent, it was only partially cultivated. The population also appeared less than what we had seen inhabiting some of the most desolate parts of the island. (Ellis 1963: 249-250)

Ellis describes the land as:

> Bold and steep, and intersected by numerous valleys or ravines, apparently formed by the streams from the mountains, which flow through them into the sea....The habitations of the natives generally appear in clusters at the opening of the valleys, or scattered over the face of the high land. The soil is fertile, and herbage abundant. (Ellis 1963:326)

T. Stell Newman (2000) conducted an ethnohistorical study utilizing the observations of Ellis in conjunction with modern environmental data in an attempt to define indigenous Hawaiian land use patterns circa 1823. Through an analysis of Ellis' journal writings Newman was able to reconstruct Ellis' route around the island. Ellis' route was then plotted onto a map and all

references by Ellis about indigenous Hawaiian agriculture, population density, soil type, water resources, and botany were matched to the route allowing Newman to establish four agricultural zones: Irrigation, Dryland Farming, Scattered Farms, and Field Systems (Figure 7). Based on a review of Newman's map it appears that the current project area falls into the Scattered Farms agricultural zone, which is defined as having a low population density, dispersed settlement with few fishing villages at the coast, and scattered fields and gardens with no major field systems (Newman 2000). Crops that would have been cultivated consisted of dryland taro, sweet potato, bananas, yams, breadfruit, sugarcane, and paper mulberry. A late 19th -century photograph of Laupāhoehoe Point provides an example of an indigenous Hawaiian settlement within Newman's Scattered Farms agricultural zone (Figure 8).

4.2 The Mahele

The Organic Acts of 1845 and 1846 initiated the process of the Mahele, the division of Hawaiian lands, which introduced private property into Hawaiian society. In 1848, the crown and the *ali'i* (chief) received their land titles. The *maka'āinana* (common people) received their *kuleana* awards (land parcels awarded to commoners) in 1850. It is through records for Land Commission Awards (LCAs) generated during the Mahele that the first specific documentation of life in Hawai'i, as it had evolved up to the mid-nineteenth century, come to light. Although many Hawaiians did not submit or follow through on claims for their lands, the distribution of LCAs can provide insight into patterns of residence and agriculture. Many of these patterns of residence and agriculture probably had existed for centuries past. By examining the patterns of *kuleana* LCA parcels in the vicinity of a project area, insight can be gained to the likely intensity and nature of Hawaiian activity in that area.

No *kuleana* LCAs were awarded to commoners in the vicinity of the project area suggesting that indigenous Hawaiian land use within the project area may have been limited. The three *awāwa* under study were within or adjacent to several Land Grants including:

Land Grant 3641 surrounds the southern half of Maulua Gulch and was granted to Laupāhoehoe Sugar Co.

Land Grant 3650 just borders Maulua Gulch and was granted to J.H.Boyd.

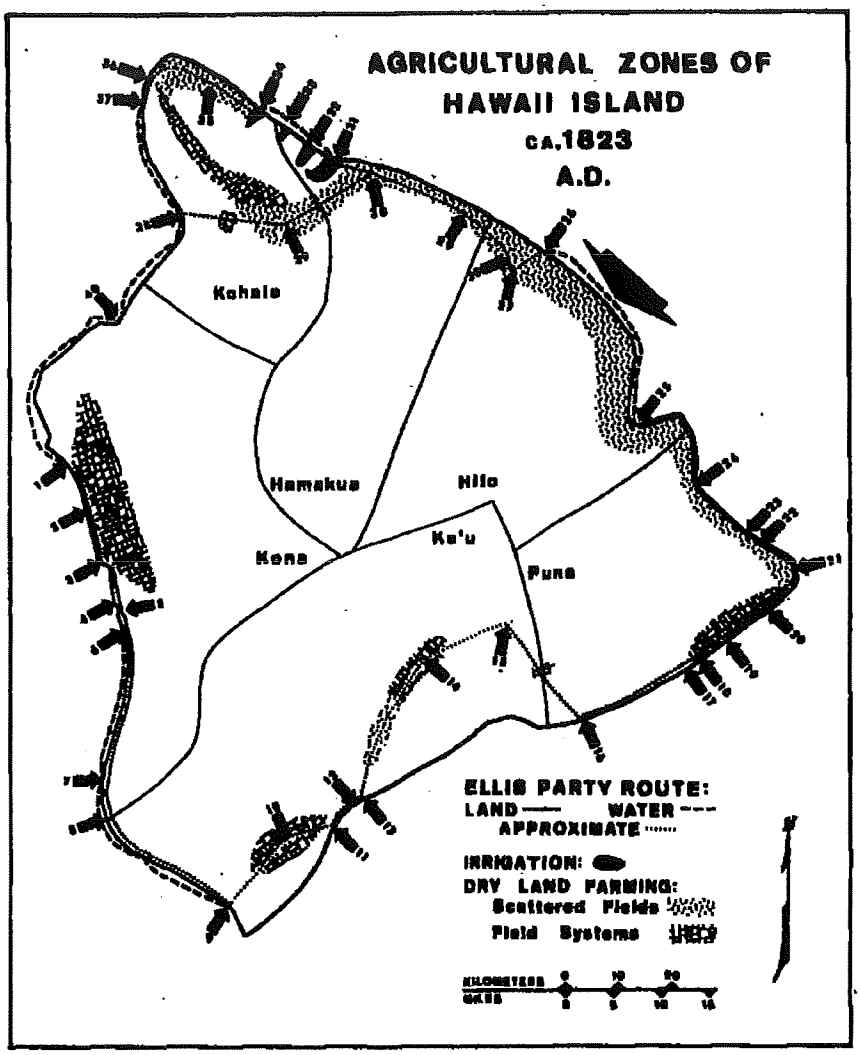
Land Grant 5528 surrounds the southern portion of Ka'awali'i Gulch and was grant to Anehila Holokahi; there are no grants to the north.

Land Grant 1960 borders the southern portion of Laupāhoehoe Gulch and was granted to Maele.

Land Grant 1066:1 borders the northeastern portion of Laupāhoehoe Gulch and was granted to Mohaiula and Moku.

Land Grant 1064 borders the northwestern portion of Laupāhoehoe Gulch and was granted to Kahoapiliwale.

No other information was found (Waihona 'Āina 2000) regarding the lands grants.



1. Kailua; 2. Keauhou; 3. Kaawaloa; 4. Honaunau; 5. Keokea; 6. Kaiahiki; 7. Kapua; 8. Kauiamamauna; 9. Kailiki; 10. Waiohinu; 11. Honuapo; 12. Hilea; 13. Punaluu; 14. Kapapala; 15. Kilauea Volcano; 16. Keaiakomo; 17. Kalapana; 18. Kaimu; 19. Kamaili; 20. Keahialaka; 21. Kapoho; 22. Kahuwai; 23. Honolulu; 24. Keaau; 25. Waiakea (present city of Hilo); 26. Laupahoehoe; 27. Humuula; 28. Kaula Valley; 29. Manienie; 30. Kapulena; 31. Waipio Valley; 32. Waimanu Valley; 33. Honokane Valley; 34. Pokulu Valley; 35. Halawa; 36. Awalua; 37. Mahukona; 38. Kawaihae; 39. Waimea (also called Kamuela) 40. Kiholo.

Figure 7. Map of Hawai'i Island showing the route of Reverend William Ellis and the agricultural zones delineated by Newman (Source: Newman 2000)

Figure 8. Late 19th Century photograph of an indigenous Hawaiian settlement at Laupāhoehoe Point (Source: Okimoto 2002)

4.3 Laupāhoehoe Sugar Company

Laupāhoehoe Sugar Company began in the 1870s by William Lidgate and Thomas Campbell, with Lidgate managing cane cultivation and Campbell constructing the Laupāhoehoe Sugar Mill (Dorrance and Morgan 2000). By 1880, the Laupāhoehoe Sugar Mill produced 600 tons of sugar from 900 acres under cultivation (Dorrance and Morgan 2000).

The plantation fronted the coast for approximately 10 miles with fields that extended *ma uka* for 2 to 3 miles from the 300-ft elevation to an elevation of 1850 feet (Condé and Best 1973). An interesting note is that the plantation never supported a railroad as it was located within rugged terrain with fields cutting through deep *awāwa* (Figure 9), an environment which would have made rail building impossible (Condé and Best 1973). As a result the primary method of transporting cane from the fields to the mill was by fluming (Figure 10). However, due to the deep ravines at Maulua gulch, which separated fields from the mill, the plantation was forced to develop an unusual method of cane transport utilizing a steam hoist and cable lift system.

This unique transport system is described in Gilmore's *Hawaii Sugar Manual*:

> The call on engineering talent by the Company got the needed answer, through the unique plan of fluming cane from the uplands to the south, down to the base of the gulch near the public road, at a point lower level than the factory; then loading this flumed cane into cars then by steam hoist are lifted up an incline of 38 degrees, a lift of 1100 feet by cable.
>
> Then when at the top of the gulch the cane is transferred again to flumes and washed down to the mill a mile or more away. The cars are loaded with 3 tons of cane each, and have wide flarebacks to keep the cane from falling out as hoisted skyward. (Gilmore 1931 in Condé & Best 1973: 150)

In 1979, the Laupāhoehoe Sugar Company ceased to exist when it was subsumed by the Hāmākua Sugar Company, which was in operation until 1994 (Dorrance and Morgan 2000).

4.4 Other Agricultural Development

Handy and Handy (1972:538) relate that there were taro terraces "in and below" Laupāhoehoe and Maulua Gulches in the late 1800s. By the 1930s, "there were a number of terraces which are now unused" in Laupāhoehoe (Handy and Handy 1972:538). Some sweet potatoes were also grown in all three *awāwa* and in the vicinity of Ka'awali'i, sweet potatoes "used to rival taro as a staple." Handy (1940:164) notes "former taro lands along the lower slopes ... are now covered by sugar cane."

4.5 Original Belt Highway

The 1898 annual report by the Hawai'i Minister of the Interior details the completion of the road "from Kiilau bridge through Laupahoehoe to Kaawalii Gulch, making one of the finest sections of road on the Island". The section was completed between November 1896 and October 1897 by a "gang of day laborers" (Hawai'i Minister of the Interior 1898:190). A road through Maulua Gulch was also completed in 1897 (Hawai'i Minister of the Interior 1898:42). At that time, the Belt Highway ran in and out of each *awāwa*.

An 1895 Hawaiian Islands tourist guide describes the portion of the road between Laupāhoehoe and Maulua Gulches:

> Then follows a very broken country, every flat covered with cane until the Maulua Gulch is reached. This is the deepest ravine in the whole route, the sides being 406 feet high...The spot is extremely picturesque with its fern and tree clad sides and its frowning precipices. (Whitney 1895:91)

This same tourist guide states the entire district of Hilo is "devoted to cane cultivation" (Whitney 1895:90).

Figure 9. 1920 photograph of Laupāhoehoe Gulch showing the deep gulches that prevented the Laupāhoehoe Sugar Company from constructing rail (Source: Okimoto 2002)

Figure 10. Sugar cane irrigation flume on Hāmākua Coast, ca. 1930-1950 (Source: UH Hawaiian Photo Album 2007)

4.6 Hilo Railroad

Despite the difficulty of constructing rail within North Hilo and along the Hāmākua Coast, the Hilo Railroad was extended north between 1909 and 1913. The original portion of the Hilo Railroad was constructed in the late 1800s by B.F. Dillingham from Hilo to his 'Ōla'a Sugar Mill in Kea'au. Dillingham, who also developed railroads on O'ahu, extended the rail line to carry lumber and later tourists to Kīlauea Volcano (Laupāhoehoe Train Museum 2009).

The Hāmākua *moku,* as it was called, was constructed to support the sugar mills north of Hilo and extended 35 miles. The line contained more than 3,100 feet of tunnels and 13 trestles to cross the valleys and streams along the coast. The Maulua Tunnel was more than 800 meters long.

Construction costs related to Hāmākua *moku* extension caused the Hilo Railroad to go into receivership in 1914. Bondholders reorganized the railroad as the Hawai'i Consolidated Railway in 1916. Cane transport continued and special tours called "Scenic Express" encouraged visitors to tour the coastline (Figure 11). Local passengers including students and business commuters also used the railway. Although the Great Depression adversely affected business in the 1930s, by the 1940s, visiting military troops increased the number or riders. Passengers also increased due to gas rationing during World War II (Laupāhoehoe Train Museum 2009).

The April 1, 1946 tsunami destroyed the railway – some trestles and bridges were completely washed away. The Hawai'i Consolidated Railway right-of-way and remaining bridges, tunnels, and trestles were offered to the Hawai'i Territory highway division. Consolidated Railway did not want to attempt a costly rebuild. The highway division was not interested in the purchase, and the railway was then sold to the Gilmore Steel and Supply Company for $81,000. The highway division purchased the rights back from the Gilmore Steel and Supply Company for more than $300,000 shortly after the initial transaction after realizing the importance of the property. The current highway and portions of the current project area follow much of the railway right-of-way. Several highway bridges are also converted railroad trestles (Laupāhoehoe Train Museum 2009).

4.7 Laupāhoehoe School

Laupāhoehoe School was originally founded in 1883 at Laupāhoehoe Point (Figure 12). The 1946 tsunami destroyed the first Laupāhoehoe School; twenty-three school children and four teachers were killed by three large waves. The school and coastal residences were then rebuilt inland at the top of Laupāhoehoe ridge.

Figure 11. 1923 photograph of Maulua Bridge showing view of coastline from train (source: Hawai'i Historical Images 2008)

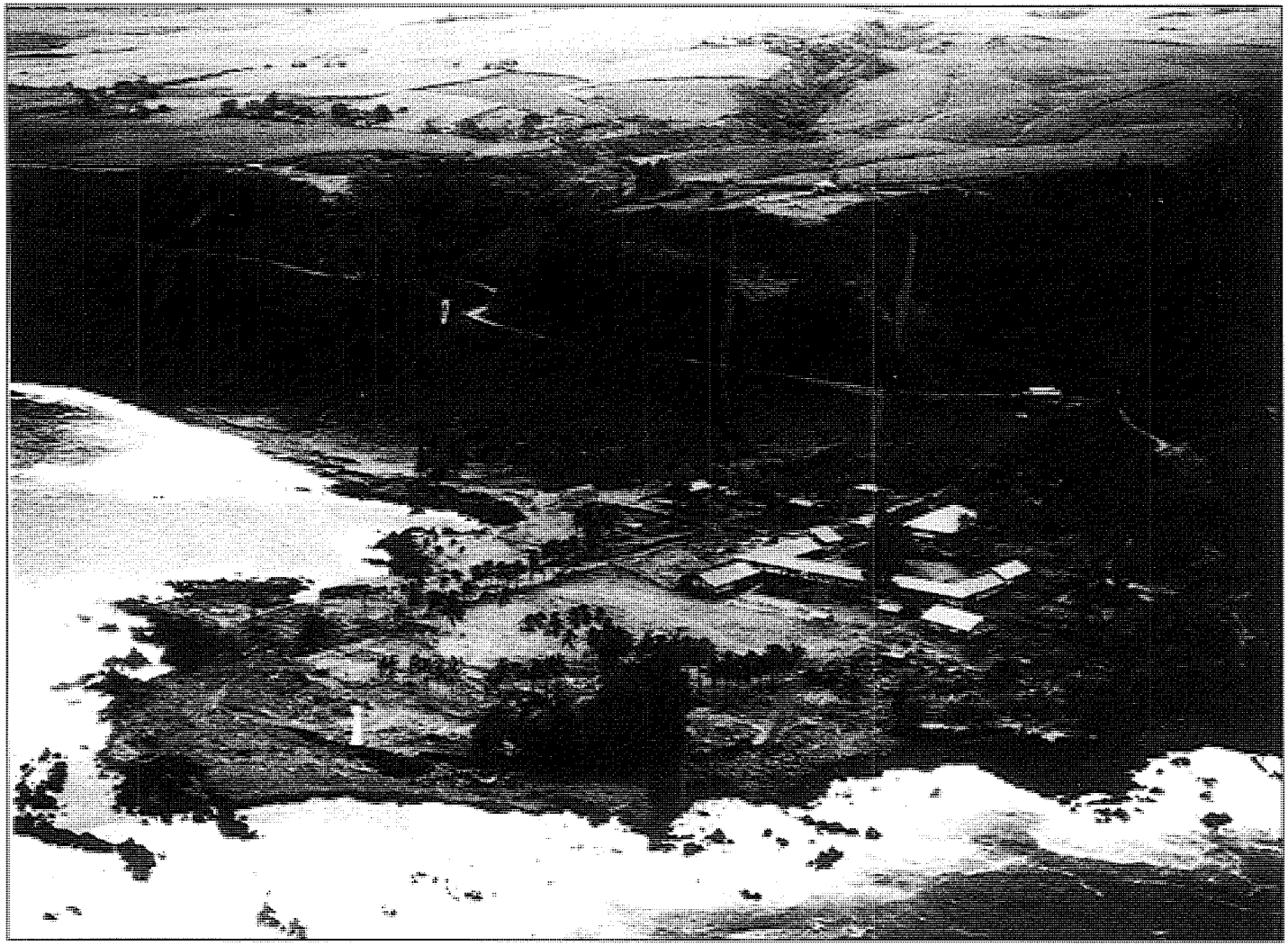


Figure 12. Photograph of Old Laupāhoehoe School before the tsunami of 1946 (Source: Okimoto 2002)

Section 5 Archaeological Research

5.1 Overview

Archaeological studies in the vicinity of the current project area are presented in Table 11 and shown in Figure 13. Historic properties identified in the vicinity of the project area are shown on Figure 14. The following is a summary of these archaeological studies.

5.2 Archaeological Findings at the Vicinity of Project Area

In 1919, John F. G. Stokes of the Bernice Pauahi Bishop Museum produced a manuscript entitled "*Heiau of the Island of Hawaii: a Historic Survey of Native Hawaiian Temple Sites*" (1991) based on fieldwork conducted primarily in 1906-1907. In the course of his working in the Hilo District, he documented five *heiau* in the immediate vicinity of Laupāhoehoe (Figure 15). Four of the five *heiau* (Lonopūhā, Kama'o, Papauleki'i, and Moeapuhi) were already destroyed by the time of Stokes's site visit to the Laupāhoehoe area, with Mamala or Ha'akoa Heiau being the only surviving structure (Figure 16).

Stokes' description of Mamala Heiau or Ha'akoa Heiau (SIHP #50-10-16-1784) is as follows:

> Heiau of Mamala of Ha'akoa, Land of Ha'akoa and adjoining Waipunalei, Hilo. Located near the edge of the bluff overlooking Laupāhoehoe Village. Laupāhoehoe New benchmark is located just outside of southeast wall. This is a walled heiau that has served in modern times as a cattle and slaughtering pen. The walls at present average 4.5 feet in height; the southern wall is 6 feet wide, while the opposite wall is only 5 feet wide. The present floor is earth, well trampled, but there are so many smooth beach pebbles in the soil that it seems probable that the floor was paved with them. The remains of a stone platform are to be found in the north corner. No native local history was obtainable. It was probably this heiau at which the chief Pai'ea was sacrificed by 'Umi. (Stokes 1991:157)

In 1983, the Army Corps of Engineers conducted an archaeological reconnaissance at Laupāhoehoe Point for the Laupāhoehoe Navigation Improvements Project (Cox 1983). One archaeological feature consisting of a double-walled stepped terrace located along the north bank of Laupāhoehoe Stream was identified. It was believed that the archaeological feature possibly functioned as a large residence, stream diversion, canoe storage, or *heiau*. No State Inventory of Historic Properties (SIHP) number was assigned.

In 2000, Rechtman Consulting conducted an archaeological survey of a 2,900 square foot area above 'O'ōkala, in the *ahupua'a* of Humu'ula for the placement of a cell tower (Rechtman 2000). No historic properties were identified within the project area.

Table 1. Archaeological Studies in the Vicinity of the Project Area

Reference	Location	Nature of Study	Results
Cox 1983	Laupāhoehoe Point, TMK: [3] 3-6-002: 024	Archaeological reconnaissance	Identified a stepped terrace, likely of pre-contact origin, possibly functioning as a large residence, stream diversion, canoe storage, or *heiau*. No State Inventory of Historic Properties (SIHP) number was assigned.
Stokes 1991	Island of Hawai'i	Historic Survey of Native Hawaiian Temple Sites	Documented five *heiau* in the immediate vicinity of Laupāhoehoe.
Rechtman 2000	TMK [3] 3-9-002: 007	Archaeological Survey	No historic properties identified.
Shideler and Hammatt 2003	TMK [3] 3-6-004: 007	Archaeological reconnaissance	Relocated SIHP # 50-10-16-1784, Mamala or Ha'akoa Heiau.

Figure 13. Portion of 1980 1:100,000 USGS Map of Hawai'i County, Hawai'i, Sheet 2 of 3, showing the location of previous archaeological studies in the vicinity of the project area

Figure 14. Portion of 1980 1:100,000 USGS Map of Hawai'i County, Hawai'i, Sheet 2 of 3, showing the location of historic properties in the vicinity of the project area

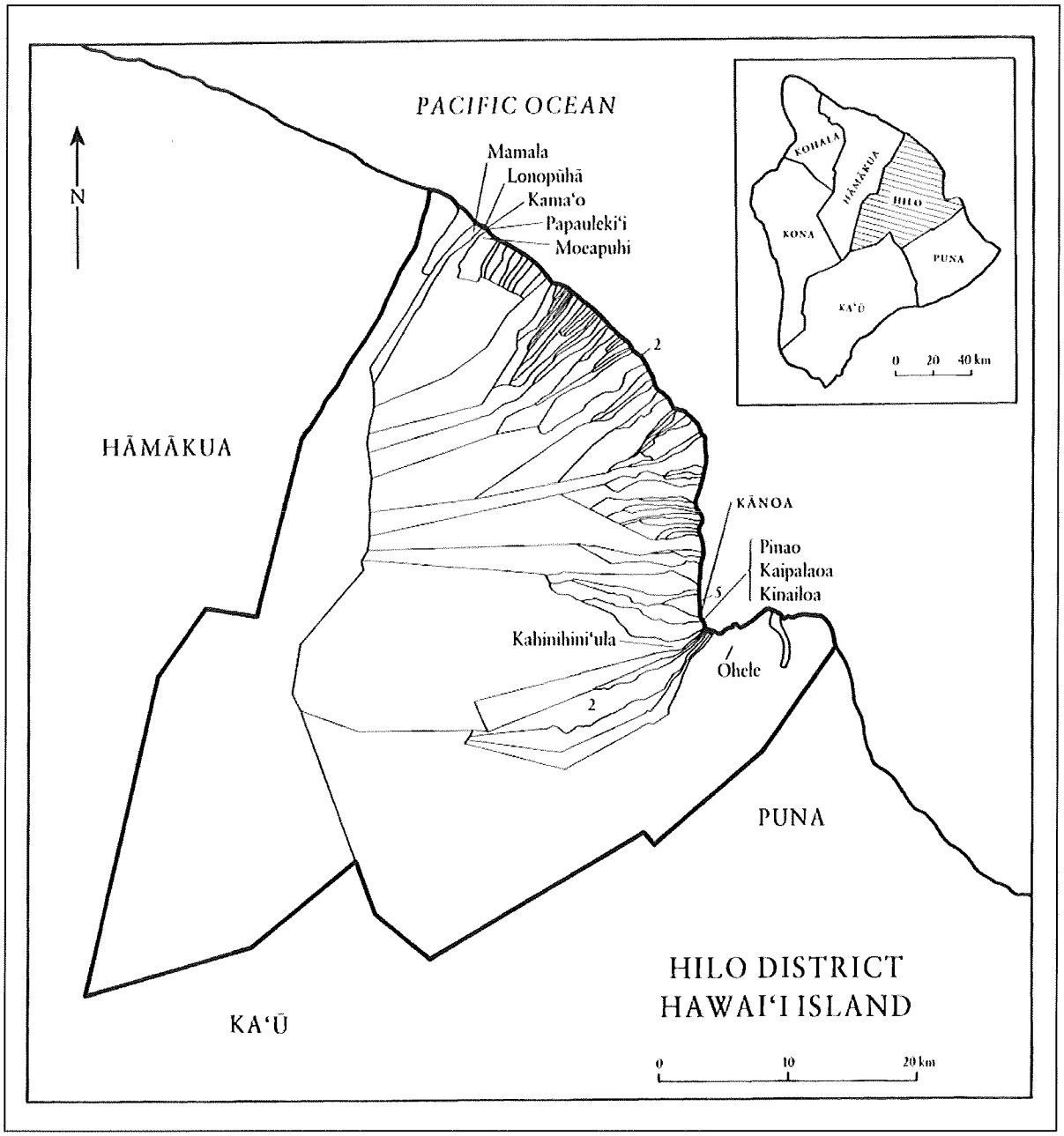


Figure 15. Locations of *heiau* documented by John F. G. Stokes in the Hilo District (Source: Stokes 1991)

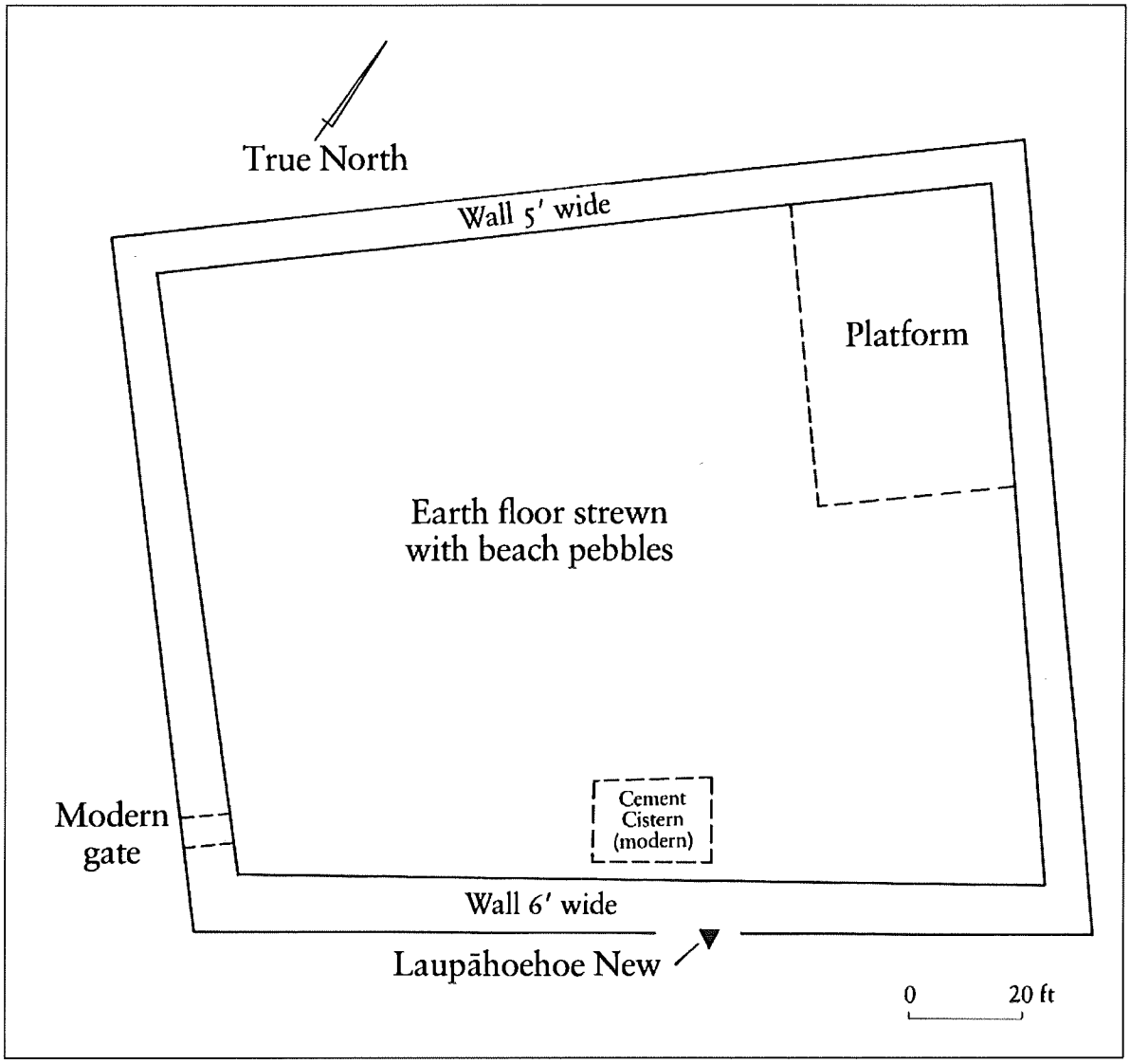


Figure 16. Plan view map of Mamala or Ha'akoa Heiau, drawn by John F. G. Stokes (Source: Stokes 1991)

In 2003, CSH conducted a brief site inspection of the proposed Nextel Waipunalei (Laupāhoehoe) project site (Shideler and Hammatt 2003). No historic properties were identified within the project area. However, of particular interest was Mamala or Ha'akoa Heiau which had been originally identified by Stokes (Stokes 1991). The *heiau* was relocated atop a *pu'u* (hill) overlooking the mouth of Laupāhoehoe Valley, approximately 140 feet northeast of the of the proposed Nextel Waipunalei (Laupāhoehoe) project site. A significant development impacting Mamala or Ha'akoa Heiau since Stokes was there c. 1906 was the excavation of a near vertical, approximately 30 foot deep, fifty foot wide (at the top) cut through the ridge understood as excavated for sugar cane transport. This cut has wiped out the *ma uka* (southwest) wall of the *heiau* and perhaps 15% of the southwestern side of the *heiau* structure. Otherwise the *heiau* is much as Stokes describes it. The interior is heavily overgrown with ironwood and guava. Remnants of the cistern may be noted in the middle of the southeast side. A low platform/pavement of water-rounded cobbles is present in the east side of the north corner and was probably the focus of ritual activities.

5.3 Cultural Surveys Hawai'i Field Inspection

No historic properties were observed within the approximately 2.434 mile study area during a field inspection conducted by CSH (Tulchin et al. 2009). The absence of historic properties can be attributed to extensive land modifications associated with historic sugar cultivation and construction associated with the Hāmākua Division of the Hilo Railroad, later known as the Hawai'i Consolidated Railway. The Belt Highway and portions of the current project area follow much of the railway right-of-way. After the demise of the sugar industry, previously cultivated areas became pasture lands, and/or were planted with eucalyptus or ironwood trees.

Section 6 Community Consultation

Throughout the course of this CIA, an effort was made to contact and consult with Hawaiian cultural organizations, government agencies, and individuals who might have knowledge of and/or concerns about cultural resources and practices specifically related to the project area. This effort was made by letter, e-mail, telephone and in person contact.

CSH sent out a letter, map and aerial photograph dated February 13, 2009, describing the proposed project for the Rockfall Remediation of Hawai`i Belt Road in Maulua, Laupāhoehoe, and Ka`awali`i Gulches, Maulua Nui, Laupāhoehoe, and Humu`ula, Ahupua`a, North Hilo and Hāmākua Districts, Hawai`i Island. Letters along with a map and an aerial photograph of the proposed project area were mailed with the following text:

> At the request of R.M. Towill Corporation, Cultural Surveys Hawai'i Inc., is conducting the Cultural Impact Assessment (CIA) for the Rockfall Remediation of Hawai'i Belt Road in Maulua, Laupāhoehoe, and Ka'awali'i Gulches, Maulua Nui, Laupāhoehoe, and Humu'ula, Ahupua'a, North Hilo and Hāmākua Districts, Hawai'i Island (TMK: [3] 3-4-002: 03, 04 & 05; [3] 3-6-04: 02, 11, 15, 17, 23, & 30; [3] 3-9-01: 01). Please see the enclosed maps.
>
> The proposed project involves the construction of rockfall mitigation and stabilization measures along the Hawai'i Belt Road (Route 19) at specific locations adjacent to Maulua, Laupāhoehoe, and Ka'awali'i Gulches. The mitigation and stabilization proposed by the Hawai'i Department of Transportation (HDOT), Highways Division include the installation of anchored wire mesh panels along the existing steep rock cut cliffs adjacent to the roadway entrances and exits of the three gulches, the creation of interceptor ditches above the cliffs to divert surface-water runoff, and minor improvements to existing drainage. The purpose of these measures is to improve highway safety along the segments fronting the three gulches by improving upon the present unsafe conditions resulting in falling rocks, boulders and associated sediments.
>
> Construction is anticipated to begin in the summer of 2010 starting at Laupāhoehoe Gulch. Work at each gulch is estimated to last between one to two years and will be undertaken in sequence, with a total time of construction of approximately six years.
>
> The purpose of this cultural study is to assess potential impacts to cultural practices as a result of the proposed development in Maulua, Laupāhoehoe, and Ka'awali'i Gulches. We are seeking your *kōkua* and input on any of the following aspects of this study:
>
> **General history and present and past land use of the project area.**
>
> **Knowledge of cultural sites for example, historic sites, archaeological sites, and burials.**

Knowledge of traditional gathering practices in the project area, both past and ongoing.

Cultural associations of the project area, such as legends and traditional uses.

Referrals of *kūpuna* and *kama'āina* who might be willing to share their cultural knowledge of the project area and the surrounding *ahupua'a* lands.

Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the project area.

A number of attempts (2-4) were made to contact individuals, organizations, and agencies apposite to the subject CIA. The results of the community consultation are presented in Table 2.

Responses provided by William Ailā (Hui Mālama I Nā Kūpuna 'O Hawai'i Nei), Lisa Barton (Laupāhoehoe Train Museum Coordinator), Phyllis "Coochie" Cayan (History & Culture Branch Chief, State Historic Preservation Division), Aunty Pili Ka'apuni (*Kama'āina*), Kū Kahakalau (Big Island Burial Council – Hāmākua), Micah Kane (Chairman, Hawaiian Homes Commission; Director, Department of Hawaiian Home Lands), Clyde Nāmu'o (Administrator, Office Of Hawaiian Affairs) and Ululani Keli'ikoa-Sherlock (Vice-Chair, Big Island Burial Council) are presented in and below Table 2. CSH interviewed Marsue McShane which is presented fully in Section 7.

Table 2. Summary of Community Consultation

Name	Background, Affiliation	Comments
Ailā, William	Hui Mālama I Nā Kūpuna O Hawai`i Nei	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February 13, 2009. CSH emailed a copy of community outreach letter with maps on February 13, February 23 and March 11, 2009. CSH received a response email on March 11, 2009 which stated to consult with Aunty Pua Kanaka'ole or anyone she recommends.
Ayau, Halealoha	Hui Mālama I Nā Kūpuna 'O Hawai'i Nei	CSH emailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February 13, February 23, March 11 and March18, 2009.

Name	Background, Affiliation	Comments
Barton, Lisa	Laupāhoehoe Train Museum, Coordinator	Judi Steinman referred Lisa Barton to CSH. CSH received a response email on March 21 and 31, 2009. See below for full statement.
Cayan, Phyllis "Coochie"	History & Culture Branch Chief, State Historic Preservation Division	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February 13, 2009. CSH emailed a copy of community outreach letter with maps on February 13, February 23, March 11 and March 18, 2009. CSH received a letter response on May 4, 2009. SHPD response is provided below this table. See Appendix D for full letter.
Chung, Lucille	Queen Liliuokalani Children's Center (QLCC) – Hilo	CSH emailed a copy of community outreach letter with maps on March 20, 2009.
Donham, Theresa	Hawai'i Archaeologist, State Historic Preservation Division	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February 13, 2009. CSH emailed a copy of community outreach letter with maps on February 13, February 23, March 11 and March 18, 2009.
Josephides, Analu	Cultural Historian, State Historic Preservation Division	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February 13, 2009. CSH emailed a copy of community outreach letter with maps on February 13, February 23, March 11 and March 18, 2009.
Ka'apuni, Aunty Pili	*Kama'āina*	CSH emailed a copy of community outreach letter,

Name	Background, Affiliation	Comments
		USGS map, aerial photograph and site plan map on March 11 and March 18, 2009. CSH received a response email March 19, 2009. See below for full statement.
Kahakalau, Kū	Big Island Burial Council, Hāmākua	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February 13, 2009. CSH emailed a copy of community outreach letter with maps on February 13 and February 23, 2009. CSH received a response email on March 6, 2009 which stated she is not knowledgeable about this area. Referred CSH to Aunty Pili Ka'apuni who may have some information.
Kahiapo, John	Education Specialist, Department of Land and Natural Resources, Division of Aquatic Resources	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February 13, February 24, March 11, and March 18, 2009.
Kane, Micah	Chairman, Hawaiian Homes Commission; Director, Department of Hawaiian Home Lands	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February 13 and February 24, 2009. CSH received a letter response on February 24, 2009 which stated that DHHL has no comment at this time. See Appendix B for full letter.
Keli'ikoa-Sherlock, Ululani	Vice-Chair, Big Island Burial Council	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February 13, 2009. CSH emailed a copy of community outreach letter

Name	Background, Affiliation	Comments
		with maps on February 13, February 23, March 11 and March 18, 2009. CSH received a response email on May 2, 2009 in which Ms. Keli'ikoa-Sherlock stated, "The Rockfall remediation of the Hawai'i Belt Road in Maulau and Ka'awali'i Ahupua'a, again I have no specific knowledge of any burials which does not preclude the fact that others may have more or further knowledge."
Laupāhoehoe Library	Laupāhoehoe Library	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February 13, February 24, March 11 and March 18, 2009.
Lindsey, Keola	Lead Advocate-Culture, Office of Hawaiian Affairs	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February 13 and March 18, 2009. CSH emailed a copy of community outreach letter with maps on February 13, February 23, March 11 and March 18, 2009.
McShane, Marsue	Resided in Laupāhoehoe from 1945 to 1952. Survivor of the April 1, 1946 tsunami.	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February 24, 2009. CSH interviewed Mrs. McShane on March 3, 2009. See below for statement.
Nahale-A, 'Alapaki	East Hawai'i Homes Commission, Department of Hawaiian Home Lands	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February

Name	Background, Affiliation	Comments
		13, February 24, March 11 and March 18, 2009.
Nāmu'o, Clyde	Administrator, Office Of Hawaiian Affairs	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February 13, 2009. CSH emailed a copy of community outreach letter with maps on February 13, February 23 and March 11, 2009. CSH received a letter response on March 11, 2009 which stated that OHA has no comment at this time. See Appendix C for full letter.
Nishimoto, Dr. Robert T.	Program Manager, Department of Land and Natural Resources, Division of Aquatic Resources	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February 13, February 24, March 11 and March 18, 2009.
Office of Hawaiian Affairs	East Hawai'i - Hilo	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on March 13 and March 18, 2009.
Steinman Ph.D., Judi	Recording Secretary, North Hilo Community Council	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February 13, February 24, March 11 and March 18, 2009.
Young, Charles Kui Hin	Chair, Big Island Burial Council	CSH mailed a copy of community outreach letter, USGS map, aerial photograph and site plan map on February 13, February 24, March 11 and March 18, 2009.

6.1 Other Statements and Brief Responses from Community Consultations

6.1.1 State Historic Preservation Division (SHPD) Response Letter

CSH received a response letter from Ms. Phyllis "Coochie" Cayan of the SHPD on May 4, 2009. A copy of the complete letter is located in Appendix D. The contents of the letter are as follows:

> This memo is in response to your request to help assess potential impacts to cultural practices as a result of the proposed project which involves the construction of rockfall mitigation and stabilization measures along the Hawaii Belt Road (route 19) at specific locations adjacent to Maulua, Laupahoehoe, and Kaawalii Gulches.
>
> State Historic Preservation Division (SHPD) reminds CSH that any ground disturbance could disturb burials or burial sites although the likelihood on the slopes are a low risk as the project will be addressing previously developed or disturbed land.
>
> Other resource folks you may find helpful as you begin this planning process is:
>
> 1. Kepa Maly, Executive Director, Lanai Culture & History Center Phone: 808-565-7177. He has done extensive ethnographic cultural work on Hawaii Island for many years.
>
> 2. Charlie Young, current chairman of the Hawaii Island Burials Council. He has a diverse background and may be of help. His contact number is 966-8691 or via email at youngc042@hawaii.rr.com
>
> 3. Kimo Lee, a member of the HIBC with construction/projects background. His contact number is 966-9325 or via email at klee@whshipman.com
>
> 4. University of Hawaii at Hilo – engineering or similar departments.
>
> 5. Hawaii Community College – Ms. Pua Kanahele who may know of the Hawaiian legends and other cultural practices of that area.
>
> We apologize for the delay in responding to this CIA and hope the following suggestions will be of help in your research.

6.1.2 Aunty Pili Ka'apuni, *Kama'āina*

CSH received a response email from Aunty Pili Ka'apuni on March 19, 2009:

> Sorry I haven't replied sooner than today. In regards to the work that will soon take place in that area...yippee! I have traveled from Honomu to Waimea every school day for the last 8 years and have come across a lot of dangerous situations on those three horseshoes in that time. As far as any cultural significance...I was once a Kupuna in the State of Hawaii DOE while Pua Case (from Waimea) and Bobbilyn Akoi (from Keaukaha) were our district resource teachers. I recall that the two of them visited a place located at one of the 3 curves where there was either a heiau or an ahu. I am waiting for my office to send me Pua's email and I will forward it to you. Sorry I couldn't be of more help to you. A family you might contact is the Maikui Ohana from Ookala or you could contact Lucille Chung, originally from Laupahoehoe and a noted community leader who works for Queen Liliuokalani Children's Center (QLCC) in Hilo. Lucille would know more than anyone I am acquainted with the cultural significance in that area.

6.1.3 Lisa Barton, Laupāhoehoe Train Museum Coordinator

CSH received a response email from Lisa Barton on March 22 and 31, 2009:

> Kaawalii Gulch
>
> This area has been used for more years than anyone can remember as a hunting, fishing, and gathering area. In recent years people use two accesses mauka and makai. At the bottom of the gulch behind the guardrails people park walk up the gulch or under the culvert to the ocean. Just passed the gulch nearer mm 29 is the Ookala Community Forest and that is another makai access to the beach area. During the years of the railroad 1912 – 1946 the trains ran on trestles situated just mauka of the current curved highway embankment. All during the plantation days cattle were raised in the gulch, before that it was said that grasses and trees were harvested for animal fodder and firewood for cooking and bathing. There are still remnant remains of what was the old pump house for the plantation that took water gathered in an also still present in the gulch. One story was told to me of a man named Mr. Sylvester who lost his life in the pond of the pump house in an unexplained accident. Delbert Costa and his family were the last to raise cattle in the gulch. Other resource individuals in the area: as supervisor for the plantation was Kenneth Kaniho or Bobby Gonsalves who worked for the plantation in roads construction and Tom Poy long time resident of Laupahoehoe Gulch/Valley.
>
> Maulua
>
> As in all the gulches this area has been used historically for more years than anyone can remember as a hunting, fishing, and gathering area. Plantation grew cane in much of the bottom of the gulch; a camp was located in the front of the valley near the bamboo clump nearer to the power poles just past the explosives shed. All during the early plantation days it was said that grasses and trees were

harvested for animal fodder for animals helping harvesting work in the field and firewood for cooking and bathing for plantation camps. Also during plantation times and before okolehao was made near a small stone foundation left up beyond the mauka bamboo near the river's edge. Large Ti stumps were harvested from the hillside for this purpose.

In this gulch a flume for the plantation ran from halfway down the mauka Hilo side to the bottom of the gulch where gravity could no longer feed it uphill as the Honokaa bank was steeper than the Hilo side, a donkey engine was used. The building housing the engine was referred to as a Pump house; its remains are located on the makai side of hwy 19 south of the gate on the Honokaa side of the curve.

The train ran through the gulch on a 1000' trestle coming out of a half mile long tunnel. The tunnel portal is very overgrown but visible just below the highway roadbed near where the power poles descend into the valley on the makai Hilo side of the highway. This tunnel was a straight shot under the current roadway through to the small gulch near Pohakupuka Church on the Hilo side of the gulch. For the stability of the road and safety this tunnel was backfilled by the state and a retaining wall was poured in place 100' in on the Hilo side of the tunnel and possibly on the gulch end as well, there is room at the opening to stand under the portal.

Since plantation gave up raising cane in the gulches many years ago the lands were available to the Nahakuelu (Hiroko) family for a dairy and vegetable farm. After the Kubo (Kiyoshi) and Ignacio (Richard) family raised cattle and after them then Texiera (Tony) family raised cattle there until 1988. State owns 78 acres from the waterfall on the Hilo side of the valley towards the 14 acre piece presently owned by the Barton's. The Robinson (Robbie) Estate had all the lands from mauka to makai on the Honokaa side of the gulch but for the previously mentioned pieces. Walter Otomo, grew up on homestead and is a farmer at the top of the gulch Honokaa mauka side. He was a teacher and is still farming the land there.

It is said that there are burial caves in this valley. It was also said this gulch and the others as well were where alii brought down koa trees for carving by the water. This is a seasonal stream now but reported to be year round until the 1974 quake. This was also the Kahikina family homestead ahupua'a. Mayta Draeger knows her oral family history and is a good contact person for this area.

Michael and Lisa Barton purchased 14 acres in 1988, their driveway is the original old Mamalahoa Highway, and bridge bases are located in the river bed at the end of the drive. Several road projects have happened in recent years; Bridge retrofit, FEMA work from '06 quake, and Rock Scaling to name a few, during which times permission was granted to park equipment close to work site within Barton property. Contact people for this area: Sakae Tanaka and sister Masako

Okamura lived in the Maulua plantation camp, Yoso Ishizu worked for the plantation and Frank DeCaires worked county roads for 30+ years knows the area well.

Laupahoehoe Gulch

This area also has been historically used for more years than anyone can remember as hunting, fishing and gathering area. People access the mauka area via the highway parking in the pullover areas and walking across the highway to upper elevations. This gulch is the only gulch with multiple land owners farming and ranching the length of the valley from makai to mauka. During the plantation days cattle and sugar were raised in the gulch. Before 1896 there was a mill located at shoreline near Kilau gulch, just one gulch south of Laupahoehoe.

During the years of the railroad 1912 – 1946 the trains ran on trestles situated just mauka of the current curved highway. There was also a tunnel 288' long bored into the pali near the waterfall. In trying to find the entrance we only found the postal cement this tunnel was reportedly backfilled and caved onto itself. The railroad and flume elevations are obvious when the hills are cleared of vegetation. Grasses and trees were harvested for animal fodder and firewood for cooking and bathing as in the other gulches.

The center of the town of Laupahoehoe was located down in the valley from early memory to the late 1930's; commerce areas were located from makai of the highway to mauka of the current county road down in the valley. Many businesses were located there supporting a town of 2000 residents until the railroad impacted businesses to move to upper elevations. A rock crushing facility run by Laupahoehoe Sugar Co. was located at the curve near the bridge on county road to the Point the cement foundation still visible. This river is now seasonal but many remember it being year round in the past. In 1942 there was a huge flood which redirected the river and road permanently. School was located down in the valley until 1952 even though the Tsunami struck 1946. It took six years to acquire land and build buildings etc…It is said that this area was used by King Umi as his recreational area surfing here as the local boys do now. Legend has it that Laupahoehoe – 'the leaf of lava' – was formed when Poliahu and Pele were riding the snow of Mauna Kea and Poliahu received more attention than Pele could handle, so she sent lava down the valley to send Poliahu back up the mountain. Poliahu retaliated by sending snow to freeze the lava in its place thus creating what we have. Many legends and stories abound about Laupahoehoe.

On the top of the valley wall makai of the highway on the Waipunalei side of the valley is the Broda property. This used to be the old seed treatment plant for the plantation; there are two cell towers located there and an agricultural heiau as well. This is also where the railroad continued on from the cut that are clearly obvious when the vegetation is cleared. The old road to the Point went from the Hilo side that had been covered by rock fall for thirty years was cleared. In 2006

an earthquake covered several places it was cleared by FEMA money and subsequent rock fall has not been cleared it is still used by residents for a hiking biking trail.

Resource individuals Richard Mortemore on the heiau, Tom and Kawaihona Poy and Mona Malani all long time residents of Laupahoehoe Gulch/Valley, Frank De Caires 30+ county road worker, Kenneth Kaniho supervisor for the plantation, Bobby Gonslaves who worked for the plantation in roads construction.

Section 7 *Kama'āina* "Talk Story" Interviews

Kama'āina and *kūpuna* with knowledge of Maulua Nui, Laupāhoehoe, and Humu'ula Ahupua'a and the proposed project area were contacted for participation in this assessment. The approach of CSH to cultural impact studies affords these community contacts an opportunity to review transcriptions and/or interview notes and to make any corrections, deletions or additions to the substance of their testimony.

Presented below are brief backgrounds of each participant, followed by their comments and concerns about the proposed project area.

7.1 Mrs. Marsue McShane

CSH interviewed Mrs. Marsue McShane on March 3, 2009 at her home in Lanikai, O'ahu. Mrs. McShane granted CSH permission to use an earlier interview she had with Dr. Warren Nishimoto in 2002. Some of the information she shared overlaps with the previous interview, and excerpts from that interview are incorporated into this summary.

Mrs. McShane moved from her native Ohio to Laupāhoehoe in 1945 to teach art and physical education at Laupāhoehoe School. She met her husband, Dr. Leabert Fernandez in Laupāhoehoe. Dr. Fernandez provided care for three sugar cane plantations in the area: Pāpaloa, Onomea and Honoka'a. He is the son of E.K. Fernandez, a famous Hawai'i promoter and entrepreneur. She resided in Laupāhoehoe for seven years before she and Dr. Fernandez moved to O'ahu in 1952.

In Laupāhoehoe, Mrs. McShane lived with three fellow teachers: Helen Kingseed, Dorothy Duke and Fay Johnson. They shared an out-of-town teachers' cottage near the tip of the peninsula. This is how she described the cottage and the surrounding area:

> From our cottage, we'd look out across the big athletic field and see the school with the big banyan tree in the courtyard and everything. Above that was a huge gulch. And framed in the gulch was Mauna Kea. And of course, in December, it was covered with snow. So there I was with the ocean crashing behind me and looking up and seeing Mauna Kea covered with snow. It was just absolutely amazing. I thought it was the most gorgeous spot in the whole world. And it probably is.
>
> [Whenever] I looked out my room at Laupāhoehoe School, there was a red hibiscus hedge and then a little bit beyond that was the cemetery. In this cemetery was a white horse tethered there to eat the grass and keep the grass down around the graves. Beyond the cemetery was a road and then there was a curve, then the ocean, and the sheer cliffs, and the road coming down, and usually waterfalls coming over that. It was the most unusual and gorgeous sight. It was really something, and I'd look out the window and that's what I'd see... (Nishimoto 62)
>
> The teachers' cottage was right on the ocean. It was rocky, no sand. Down at the end, there were a couple of ironwood trees around this empty cottage in front. But no trees in front. There was kind of a little palm tree that was struggling over by the garage. And of course, there was the road and the wall, the great Hawaiian lava rock wall. I don't know when it was put up there, probably when the school

> was built. Great big tall palm trees edged the athletic field and all around there. Up above the Malani's house were several houses- the Hawaiian people's homes. (Nishimoto 67)

Mrs. McShane is a survivor of the April 1, 1946 tsunami that killed twenty-four people. On that fateful morning, she and her fellow teachers were getting dressed for school when a neighbor, Danny Akiona, alerted them to look at the unusual activity in the ocean. The following are Mrs. McShane's words from her 2002 interview with Warren Nishimoto:

> We looked down and saw the ocean sucked out [i.e. receded] like a bathtub emptying. Then it came back in and it came up a little bit above the high-water mark. (Nishimoto 70)

She said the following about realizing the tsunami was more serious than they thought:

> Famous last words, I said, "Well, it's doing it again and I hope this is one of the bigger ones so I can get a..." But it came and it just kept coming, and it got bigger and bigger. It didn't crash, it kept coming, and got bigger and bigger. I noticed that Fred Kruse and his science students were out there on the rocks looking at the uncovered seafloor, and he was standing out there. This wave just got bigger and bigger. That was the first time that anybody around us, anybody thought to be afraid. Here we were, landlubbers, and it never occurred to anyone to be afraid. (Nishimoto 72)

She then described running for safety and the events that followed:

> Well, I dropped the camera, came in the front door, Fay and I, and went to go out the back, down the steps and run away to higher land. But we got as far as the doorway, the jamb of the doorway. I remember looking back [toward the front door] and the water was just fighting at the windows. It broke the glass, and the cottage went whoomf! All four of us were there at the [back] door, ready to go out the door. I remember grabbing Helen Kingseed by the arm, but she was just sucked right away... (Nishimoto 72)
>
> Well, it was coming this way [towards land], not out. And she was sucked down. We were in the water and hanging on to the roof. The roof went down and Fay and I crawled up to the comb of the roof. And it was going like this, like this [i.e. rocking] and washing up. Just the roof was left...
>
> (Nishimoto 72)
>
> [The cottage had] completely collapsed. There was no basement. It was built on stilts, high. All the cottages. So there we were, hanging on to the roof. I climbed up and sat down on the comb. The coconut trees were- you know how strong they are- were just smashed down. And we went up and by god, it started sucking out again! (Nishimoto 73)
>
> I remember seeing Mr. Ferdun's car, no more garage, just turning end over end, sucking out, end over end like a tootsie toy. I mean, just like nothing. So we were sucked out again and pretty soon- there are big jagged rocks down there [at the tip

> of the peninsula, near the original site of the cottage]. This roof went clunk on these rocks and didn't go any further, the ocean went out further (Nishimoto 73).
>
> So we thought, it's going to tidal-wave all day and each one's going to get bigger and bigger. Our only hope was, while it's sucked out, to climb off the roof and [run inland] because the next one is just going to smash the roof and everything.
>
> So we climbed off the roof, onto the rocks and we were making our way over the [rocks and] seaweed. We got as far as that chair (about twenty feet) and it tidal-waved again... (Nishimoto 73)
>
> Now, when the roof was sucking out, we saw Dorothy hanging onto the corner of the roof. That's the last we saw of her. I never did see Helen again. I [last] saw Helen when she was by the door. (Nishimoto 73)
>
> So we got that far and it tidal-waved again. That's when I knew I was gone because I knew the rocks were there. I could feel myself being clunked and turned around and bubbled. But I was a good swimmer, so I took a breath before going down. Why did I do that? These are the thoughts- it just prolongs the agony. I could feel myself being [dashed] on the rocks. I don't know if you've ever been caught the wrong way in a wave and pounded down at Sandy Beach in the sand. I thought, my lungs are going to burst. But just before I did that, bubbles and everything, I kind of came up. I took another breath and went down again. And why did I do that? All these thoughts going through my head. I knew I was going to die... (Nishimoto 74)

In the interview with Mr. Nishimoto, she shared that at that time she knew there was no God. She said:

> And here I was, faced with death; I knew I was going to die. And I still knew there was no God. And I couldn't tell anybody. That was really one of my main thoughts. I couldn't tell anybody. But then I did come up a third time, and I was right by the top of the lighthouse there. And all around me was wreckage of these cottages, just trees and boards and everything. So I grabbed hold of a piece of house, and I thought, every bone in my body must be broken. But I could tread water and my arms moved. Well nothing's broken, I'm bruised but not broken. And I kind of clung on to this. My one thought, before it tidal-waves again, I got to get out and away from the cliffs. I'm going to be slammed against the cliffs and the rocks again. So I kind of paddled my way and tried to get out. As it turned out, I did get out, sort of into a stream that was going down this way with all this rubbish and everything. (Nishimoto 75)

She recalled taking stock of her situation and realized her jeans, socks and shoes were gone. She was left wearing her bra, panties and a large wool shirt.

> So I was out there with this rubbish and I looked around and took stock that I was movable, everything worked. I looked up and high on the cliff
>
> (Nishimoto 75), Ninole, you know where that is? (footnote: The people she saw probably were standing on the roadside of the Hawai'i Belt Road, located on the

cliffs overlooking Laupāhoehoe peninsula). There were people sort of standing. And I thought, I'm the only one who survived this. I'm the only one out here with all the wreckage. They don't know I'm here. I kind of waved. I knew then that I don't care what happens, I'm going to survive this thing. I knew there was a sugar mill about, what, ten miles down the road that came down. The cliffs ended and there was this sugar mill. If I can make it down there, maybe I can make it into shore, provided it stopped tidal-waving. Might be tidal-waving forever, for all I knew. So I paddled around there and…

I'm hanging on the wreckage. And then I exchanged the original boards that were nailed together for something a bit sturdier. I finally got a hold of a door that wasn't rough and was kind of big, so I clung to that and kind of raised myself up. I got seasick and it rained. I thought about sharks and octopuses and things like that. Here I was. Then I thought, with all this rubbish here, they're [rescuers] not going to be able to swim through that. So I didn't worry about that anymore. Then of course, this was 1946, the war wasn't even over a year. What about all the hundreds of PT boats? What (Nishimoto 76) about all the cruisers and the airplanes and everything in Honolulu, Pearl Harbor? There would be a million boats out here if they only knew I was here.

So I kept waving and you'd think they come right away. But an hour went by, two hours went by, no help, no indication anybody knew I was out there. It was very frustrating. While I was out there, I was kind of on a stream going this way and then there was a sort of current going. And I saw, the waves would go down, you couldn't see anything, and then you'd come up- I saw what looked like two or three boys on a door or raft or something, and their faces were all white, like their skin was peeling off, I couldn't see very well. I kind of yelled to them, and I don't even remember whether they responded, they were way far away. But that turned out to be the three boys that later washed up at Kohala and were saved…I was out there and hours went by. There are those three and there's me. They have to come and rescue us or something. Finally, one or two or three o'clock or something, I saw somebody else. It was one boy hanging on to- I forget what he was hanging on to. But when we'd go up on the crest- we even could exchange words. And we looked out and way out there was a ship. You know a regular interisland ship. And he said he's going to swim to that ship. (Nishimoto 77)

I said, "It's too far. You can't get out there…" Well, he lost his life, I never heard from him again. He's one of the ones who lost his life. Now, why didn't they send help from Pearl Harbor? They never did send boats, they never did. Hilo didn't have a boat floating. Everything was destroyed in Hilo.

Meanwhile, finally, there was an airplane, one airplane. And he was going around like this. And I kept going like this- waving. But he didn't buzz his motor, he didn't dip down, he didn't do anything for, it seemed to me like forever. Finally, he dropped a rubber raft, I guess it was. But it was so far away I couldn't get to it. But that was the first indication that anybody had ever seen me. Then he circled around and I guess he noticed I couldn't get to it and he dropped another one. So I

> maneuvered around, I wasn't going to let go of my door until I was sure. And I can remember seeing this rubber floating raft thing. It had a handle on it and it said "pull." So I pulled and it got up [i.e. inflated] into a rubber raft. So when that happened, I climbed into this rubber raft and relaxed because that was the first time I could. (Nishimoto 78)

She was rescued by her future husband, Dr. Fernandez, Masaru Himoto, who was a good diver and Francis Malani, who knew the ocean well and where the rocks were. Before they had rescued her, they saved two boys she saw earlier. By the time they reached Laupāhoehoe it was about 7:00 P.M. She had no serious injuries, but had swallowed a lot of salt water and nursed a huge bruise on her hip.

Since she moved to O'ahu, Mrs. McShane has made several trips back to the Laupāhoehoe, stating that it is still her favorite island. She noted that instead of the cottages that were formerly there, there are now big ironwood trees she wishes were there during the '46 tidal wave. The location of the school is now a park.

> One of the roadways down has been closed now for many, many years. The other one you have to go past it on the Belt Highway and you turn right and go down the other side to get to the park. There are still Hawaiians living down there. And a few people. And I say, it's a gorgeous, gorgeous spot.

Before her move to O'ahu, Mrs. McShane rode horses at Umikoa Ranch, which was formerly Kukaiao Ranch. The name was changed from Kukaiao, which means "waste," to "Umikoa," which means "bearded koa trees." Her husband served as the doctor to the ranchers, so she was able to ride horses there. She remembers seeing her first silversword plant in that area.

CSH asked Mrs. McShane to share her memories of Laupāhoehoe in regards to traditional or cultural practices.

> Laupāhoehoe used to be, before they built the Hilo Breakwater, people used to land at Laupāhoehoe. It was quite a large village. When I was there, it was one reason why so many people lost their lives. It was a community of full-blooded Hawaiians that fished there, that lived there and they said to come down and watch it." She could not recall what types of fish were caught there.

She also stated that she did not know of any *iwi kūpuna* buried in the area. She did mention that there is a cemetery down near the peninsula, but it probably will not be affected by the proposed project. To her knowledge, no one grew taro there, as the terrain was too rocky. She also added that the Umikoa ranchers may have hunted pigs or goats in the mountains.

CSH asked her if she recalled anyone surfing out in Laupāhoehoe. Mrs. McShane said no, because the shoreline was too rocky. She did recall swimming.

> We used to swim there. There was a sort of a U-shaped swimming pool in front of Laupāhoehoe. And you had to climb over the rocks and then you could swim. Little coves. And of course the sugar mills were located down near the ocean because they had their bagasse [crushed sugar cane refuse from sugar] making stuff in the ocean.

Regarding trails, Mrs. McShane stated:

> Yes, I remember one when I was a teacher there. Of course, I was from Ohio and never been to Hawai'i. And they said, "Do you want to go swimming? It's not so good in the ocean." Each gulch had its waterfalls. But there was one place that had the unromantic name of Cowboy Pond. It was near Pāpaloa. You drive along the road, there was sugarcane and everything. And then you park your car and walk in. I was very grateful there were no snakes in Hawai'i because it was all jungley and everything. And you came in, there were sugarcane fields on either side. This gorgeous waterfall called Cowboy Pond, actually it was several ponds, and it had a waterfall and a place to swim, and another waterfall. I thought when sugarcane went out and all these billionaires would buy and build a big mansion or a hotel, because it's such a beautiful place... But I guess it's still undiscovered. You'll have to ask an old-timer "Where is Cowboy Pond?" My two stepsons learned to swim in something called Charlie's Gulch which was right near the police station and right by the doctor's house, where the little stream came down and there was a little waterfall and the road would go around it. And they'd go down there and that's where they learned to swim. It's called Charlie's Gulch. Again, you'd have to ask an old-timer where Charlie's Gulch is.

When asked what she remembered about the railroad, Mrs. McShane recalled that her roommates would take the train to Hilo.

> I can remember sections we would walk, there were mountain apples and guavas, it was beautiful, a lot of rain. And the gulches- would take you awhile to go around them. But as I say, before they built the highway, we would drive or walk along the gulches and we didn't have trouble with burial grounds or rocks or anything. I don't understand why they're trying to do this, unless the sides are caving in. It's been a couple of years since I've been back there.

She also added that there are streams there which formed the gulches. They are part of the drainage system. When asked if she recalls anything from the two other gulches, Mrs. McShane could not remember anything special. The two gulches, especially Ka'awali'i Gulch, are very small. She did mention the presence of a huge gulch before Hilo.

Mrs. McShane stated her objection to the proposed project, saying that it is unnecessary and a waste of taxpayers' money:

> Okay, this mitigation where there's going to put up these screens to keep rocks from falling. In my mind, it's very unnecessary and very costly. In all my seven years there, going around the gulches, there were very seldom any rockfalls. And the railroad cuts are slanted and very clear on the straightaway parts of the highway. And I don't see spending... It must be quite a big amount of money on this very long project. It just seems like a very unnecessary spending of the taxpayers' money. I prefer they spend the money on potholes on O'ahu. I live in Lanikai. They said they were going to put in a new water main starting May 2007 and they were planned to be finished in December of 2007. It is now March 2009 and they're not nearly finished and they haven't paved it, and it's just full of potholes and dirt. You'll see when you're going out- it's like a Third World country. Also on O'ahu, Enchanted Lakes has been torn up for 3 years. And they

haven't repaired that. And to build this on the Big Island to keep a few rocks off the road is a very large waste of money.

I've looked at the pictures at what they plan to do and I think it's not necessary as long as these other things that we need to look at are a lot more pressing. I think the Big Island when the sugar went, it left a lot of people stranded. All these fields with nothing in them. They should be trying to raise vegetables and things to keep them self-sufficient. Maybe put the money in tractors, or something, so they can farm all that land. Not for sugarcane, but for food. Instead of directing all these things for [rockfall] mitigation.

Figure 17. Photo of Mrs. Marsue McShane, March 3, 2009.

Section 8 Cultural Landscape of the Project Area

Traditional cultural practices are based on a profound awareness concerning harmony between man and our natural resources. The Hawaiians of old depended on these cultural practices for survival. Based on their familiarity with specific places and through much trial and error, Hawaiian communities were able to devise systems that fostered sustainable use of nature's resources. Many of these cultural practices have been passed down from generation to generation and are still practiced in some of Hawai'i's communities today.

This project seeks to assess traditional cultural practices as well as resources pertaining to the project area within the entire *ahupua'a* of Maulua Nui, Laupāhoehoe, and Humu'ula where Maulua, Laupāhoehoe and Ka'awali'i Gulches are located. This section will assess the different types of traditional practices, cultural resources associated within the vicinity.

Discussion of specific aspects of traditional Hawaiian culture as they may relate to the project area and Maulua, Laupāhoehoe and Ka'awali'i Gulches are presented below.

8.1 Marine and Freshwater Resources

The sea is a rich resource and the Hawaiian people were traditionally expert *lawai'a* (fishermen). Fish of all types supplied the Hawaiian diet with a rich source of protein. Hawaiian women practiced the gathering of *limu* (seaweeds) and *pa'akai* (salt). Intermittent *kahawai* (stream) and tributaries formed the Maulua, Laupāhoehoe, and Ka'awali'i Gulches (Figure 2, Figure 3, and Figure 4). These intermittent *kahawai* flow *mauka* to *makai* and empty into the *muliwai* (river mouth). This *kumuwai* (source of a stream, spring) comes from Mauna Kea.

Community participant, Mrs. Marsue McShane, mentioned Hawaiians fishing *makai* of the project area during her time in Laupāhoehoe. Mrs. McShane also discussed the *wailele* located in each gulch. One *wailele* near Pāpa'aloa (Pāpaloa) was popularly called "Cowboy Pond," made up of several ponds, *wailele* and a place to swim. Another place was called "Charlie's Gulch."

Community participant, Mrs. Lisa Barton, mentions that Maulua *kahawai* was a perennial stream until the 1974 quake. Now this *kahawai* is intermittent. Many remember Laupāhoehoe *kahawai* being perennial but it too is now intermittent. In 1942 there was a huge flood which redirected this *kahawai* and road permanently. Mrs. Barton also mentions that Maulua, Laupāhoehoe and Ka'awali'i Gulches has been used historically for more years than anyone can remember as a fishing area. In addition, she noted that King 'Umi used Laupāhoehoe valley as his recreational area for surfing and that local boys continue the practice.

8.2 Gathering of Plant Resources

Hawaiians utilized upland resources for a multitude of purposes. Forest resources were gathered, not only for the basic needs of food and clothing, but for tools, weapons, canoe building, house construction, dyes, adornments, hula, medicinal and religious purposes.

Community participant, Mrs. Lisa Barton, mentions that Maulua, Laupāhoehoe and Ka'awali'i Gulches has been used historically for more years than anyone can remember as a gathering area. She added during the early plantation days it was said that grasses and trees were

harvested for animal fodder for animals helping harvesting work in the field and firewood for cooking and bathing for plantation camps.

8.3 Traditional Hawaiian Sites

No historic properties were observed during the field inspection of the approximately 2.6 mile study area. None of the individuals attempted to be contacted for this assessment identified any traditional Hawaiian sites within the present project area.

8.4 Burials

No burial sites were found within the proposed project area. None of the individuals attempted to be contacted for this assessment identified any burial sites within the present project area. One participant, Mrs. Marsue McShane, mentioned a cemetery near the peninsula, but to her knowledge was not aware of any *iwi kūpuna* (ancestors bones) buried in the area. Another participant, Lisa Barton, stated that there are burial caves in the valley.

8.5 Hawaiian Trails

During this assessment, there were no Hawaiian trails identified within the present project area. None of the individuals attempted to be contacted for this assessment identified any Hawaiian trails within the present project area. Community participants Mrs. Marsue McShane and Lisa Barton did describe several trails that led to *wailele* and places to swim.

8.6 Hunting

Community participant Mrs. Marsue McShane noted that Umikoa ranchers may have hunted pigs or goats in the mountains. Another community participant, Lisa Barton, mentions that Maulua, Laupāhoehoe and Ka'awali'i Gulches has been used historically for more years than anyone can remember as a hunting area.

8.7 Wahi Pana (Legendary Places)

The project area is associated with general *mo'olelo*, including the story of the ruling chief 'Umi ('Umi-a-Līloa) and his surfing contest against Pai'ea, a chief of Laupāhoehoe. Because Pai'ea crowded 'Umi against a rock during the competition, he was later killed by 'Umi.

In more recent times, Laupāhoehoe has become associated with narratives about the devastating tsunami of April 1, 1946, which community participant Mrs. McShane survived.

As told by one community contact, Mrs. Lisa Barton, legend has it that Laupāhoehoe – 'the leaf of lava' – was formed when Poli`ahu and Pele were riding the snow of Mauna Kea and Poli`ahu received more attention than Pele cold handle, so she sent lava down the valley to send Poli`ahu back up the mountain. Poli`ahu retaliated by sending snow to freeze the lava in its place thus creating Laupāhoehoe.

Mrs. Barton also mentions there is an agriculture heiau on the top of Laupāhoehoe valley wall *ma kai* of the highway on the Waipunalei side of the valley.

Section 9 Summary and Recommendations

9.1 Summary of Traditional and Historical Background Research

Hāmākua is one of the six original *moku* on the island of Hawai'i. It is described poetically as *kihi loa* (long corner), perhaps in reference to its southwestward extension to the summit of Mauna Loa (Pukui et al. 1974:39). The present project area falls within the Hāmākua *moku*. Laupāhoehoe literally means smooth lava flat (Pukui et al. 1974:130) or leaf-shaped smooth lava (Clark 1985:4). Pukui et al. (1974:130) relate that Laupāhoehoe was an "ancient surfing area" and once had a *heiau* called Ule-ki'i, that was built by a man from Kahiki. Maulua literally means "always depressed" (Pukui et al. 1974:148), and Ka'awali'i means "the small 'awa" (Ulukau 2003).

Because of the abundant rainfall and consequent flourishing of agriculture in the *moku*, Lono was particularly important in rituals and legends of Hāmākua. Lono's attributes of abundant growth and dark, rain-laden clouds were invoked by rulers and commoners alike. Lono's animal form of Kamapua'a claimed the Hāmākua coast as his domain on Hawai'i Island. (Handy and Handy 1972:341)

The current project area falls into the Scattered Farms agricultural zone, which is defined as having a low population density, dispersed settlement with few fishing villages at the coast, and scattered fields and gardens with no major field systems (Newman 2000). Crops that would have been cultivated consisted of dryland taro, sweet potato, bananas, yams, breadfruit, sugarcane, and paper mulberry. A late 19th -century photograph of Laupāhoehoe Point provides an example of an indigenous Hawaiian settlement within Newman's Scattered Farms agricultural zone (Figure 8).

In 1819, after the death of Kamehameha, his heir Liholiho abolished the *kapu* (tabu) system. His cousin Kekuaokalani (to whom Kamehameha had bequeathed his war god Kūka'ilimoku and responsibility for the care of the gods, their temples, and the support of their worship), led a revolt against Liholiho and the abolition of the *kapu* system. A rebellion broke out at the same time in Hāmākua. After the king's forces defeated Kekuaokalani's army at Kuamo'o in the Kona *moku*, the Hāmākua rebellion was easily put down (Kuykendall 1938:65-69).

Laupāhoehoe Sugar Company was begun in the 1870s by William Lidgate and Thomas Campbell, with Lidgate managing cane cultivation and Campbell constructing the Laupāhoehoe Sugar Mill (Dorrance and Morgan 2000). By 1880, the Laupāhoehoe Sugar Mill produced 600 tons of sugar from 900 acres under cultivation (Dorrance and Morgan 2000).

Handy and Handy (1972:538) relate that there were taro terraces "in and below" Laupāhoehoe and Maulua Gulches in the late 1800s. By the 1930s, "There were a number of terraces which are now unused" in Laupāhoehoe (Handy and Handy 1972:538). Some sweet potatoes were also grown in all three *awāwa* and in the vicinity of Ka'awali'i, sweet potatoes "Used to rival taro as a staple." Handy (1940:164) notes "Former taro lands along the lower slopes ... are now covered by sugar cane."

Construction costs related to Hāmākua *moku* extension caused the Hilo Railroad to go into receivership in 1914. Bondholders reorganized the railroad as the Hawai'i Consolidated Railway

in 1916. Cane transport continued and special tours called "Scenic Express" encouraged visitors to tour the coastline (Figure 11). Local passengers including students and business commuters also used the railway. Although the Great Depression adversely affected business in the 1930s, by the 1940s, visiting military troops increased the number or riders. Passengers also increased due to gas rationing during World War II (Laupāhoehoe Train Museum 2009).

9.2 Summary of Proposed Project and CIA Study

At the request of R.M. Towill Corporation, CSH prepared this CIA for Hawai'i Belt Road Rockfall Protection at Maulua, Laupāhoehoe, and Ka'awali'i Gulches; Maulua Nui, Laupāhoehoe, and Humu'ula Ahupua'a; North Hilo and Hāmākua Districts, Hawai'i Island, TMK: [3] 3-4-002: 03, 04 & 05; [3] 3-6-04: 02, 11, 15, 17, 23 & 30; [3] 3-9-01: 01(Figure 1, Figure 2, Figure 3, Figure 4, and Figure 5). The project area consists of three discrete locations at three major Hawai'i Belt Road (Route 19) stream valley crossings (Maulua, Laupāhoehoe, and Ka'awali'i Gulches) within the North Hilo and Hāmākua Districts. The three project area locations are all within the Hawai'i Belt Road Right-of-Way and total approximately 2.434 acres.

The project proponent is the Hawai'i Department of Transportation (HDOT), Highways Division. The mitigation and stabilization measures involve the installation of anchored wire mesh panels along the existing steep rock-cut cliffs adjacent to the roadway entrances and exits of the three *awāwa*, the creation of interceptor ditches (swale) above the cliffs to divert surface-water runoff, and minor improvements to existing drainage. The purpose of these measures is to improve highway safety along the segments fronting the three *awāwa* by improving upon the present unsafe conditions that are prone to falling rocks, boulders, and associated sediments.

The proposed project is to begin construction in the summer of 2010 starting at Laupāhoehoe Gulch. Only one *awāwa* will be worked on at a time. Work at each *awāwa* is estimated to last between one to two years and will be undertaken in sequence. The total time of construction will be approximately 6 years.

9.2.1 Background Research Findings

Background research shows:

1. T. Stell Newman's ethnohistorical study defining indigenous Hawaiian land use patterns has indicated that the current project area falls into what is termed the Scattered Farms agricultural zone, with a low population density, dispersed settlement with few fishing villages at the coast, and scattered fields and gardens with no major field systems (Newman 2000). Crops that would have been cultivated consisted of dryland taro, sweet potato, bananas, yams, breadfruit, sugarcane, and paper mulberry.
2. Deviating from the settlement pattern outlined above is the portion of the project area situated at the mouth of Laupāhoehoe Gulch, just *ma uka* of Laupāhoehoe Point. Previous archaeological research has documented a number of *heiau* in the vicinity of this portion of the project area (Stokes 1991; Shideler and Hammatt 2003). Cox notes that "the concentration of religious structures in this relatively small, but strategic, valley mouth is indicative of both the area's importance and its sizable pre-contact period population" (Cox 1983:3).

3. No historic properties were observed within the approximately 2.434 mile study area during a field inspection conducted by CSH (Tulchin et al. 2009). The absence of historic properties can be attributed to extensive land modifications associated with historic sugar cultivation and construction associated with the Hāmākua Division of the Hilo Railroad, later known as the Hawai'i Consolidated Railway. The Belt Highway and portions of the current project area follow much of the railway right-of-way. After the demise of the sugar industry, previously cultivated areas became pasture lands, and/or were planted with eucalyptus or ironwood trees.
4. No *kuleana* (land parcels awarded to commoners) LCAs were awarded to commoners in the vicinity of the project area suggesting that indigenous Hawaiian land use within the project area may have been limited.
5. The project area is associated with specific *mo'olelo* about: the abundant rainfall and flourishing of agriculture in the *moku* of Hāmākua which encompasses the project area; Lono's, one of the four major Hawaiian gods, importance in rituals and legends of Hāmākua; Lono's animal form of Kamapua'a and his claim over the Hāmākua coast as his domain on Hawai'i Island; the surfing (*he'e nalu*) competition between 'Umi and a chief of Laupāhoehoe named Pai'ea, who crowded 'Umi against a rock but was defeated and later roasted by 'Umi in an *imu* (Kamakau 1961). The rugged landscape of the project area also is featured prominently in several *'ōlelo no'eau,* which mention Hāmākua's tall cliffs "*(Hāmākua 'āina pali loa)*," steep slopes and long reach of its southwestward extension to the summit of Mauna Loa (Pukui et al. 1974:39); Laupāhoehoe which means smooth lava flat and its significance as an "ancient surfing area" (Pukui et al. 1974:130) and how it once had a *heiau* called Ule-ki'i built by a man from Kahiki; Maulua which means "always depressed" (Pukui et al. 1974:148), and Ka'awali'i which means "the small *'awa*" (Ulukau 2003).

9.2.2 Community Consultation Results

A total of twenty-one people were contacted for the purposes of this CIA; nine people have responded as of this writing. Community consultation for this project yielded the following results:

1. Although not specifically related to direct cultural impacts, community contact Mrs. Marsue McShane stated her objection to the proposed project, saying that it is "unnecessary and a waste of taxpayer's money." She recommends the empty sugarcane fields be used for raising vegetables and the money intended for the rockfall to be put toward helping land-owners become self-sufficient, "instead of directing all these things for [rockfall] mitigation."
2. *Kama'āina* Aunty Pili Ka'apuni, is overjoyed about this project finally happening and stated, "I have traveled from Honomu to Waimea every school day for the last 8 years and have come across a lot of dangerous situations on those three horseshoes in that time."
3. According to community contact Mrs. Lisa Barton, the project area has a long history of cultural use as a hunting, fishing and gathering area. During the plantation era, kama'āina groups continued to harvest fodder for animals and firewood for cooling and

bathing for plantation camps. The nearby shoreline which has been featured prominently in *mo'olelo* continues to be used by kama'āina for *he'e nalu* as well as fishing and other recreational practices

9.2.3 Cultural Impact Assessment Recommendations

A good faith effort to address the following recommendations may help mitigate potential adverse effects of the proposed project on Hawaiian cultural practices and resources in and near the project area.

1. If in the unlikely event that intact historic properties, including but not limited to human remains or other significant cultural deposits, are encountered during the course of the proposed project activities, all work in the immediate area should stop and the State Historic Preservation Division should be promptly notified.
2. It is recommended that ongoing cultural practices of gathering, hunting, and fishing be recognized and safeguarded.

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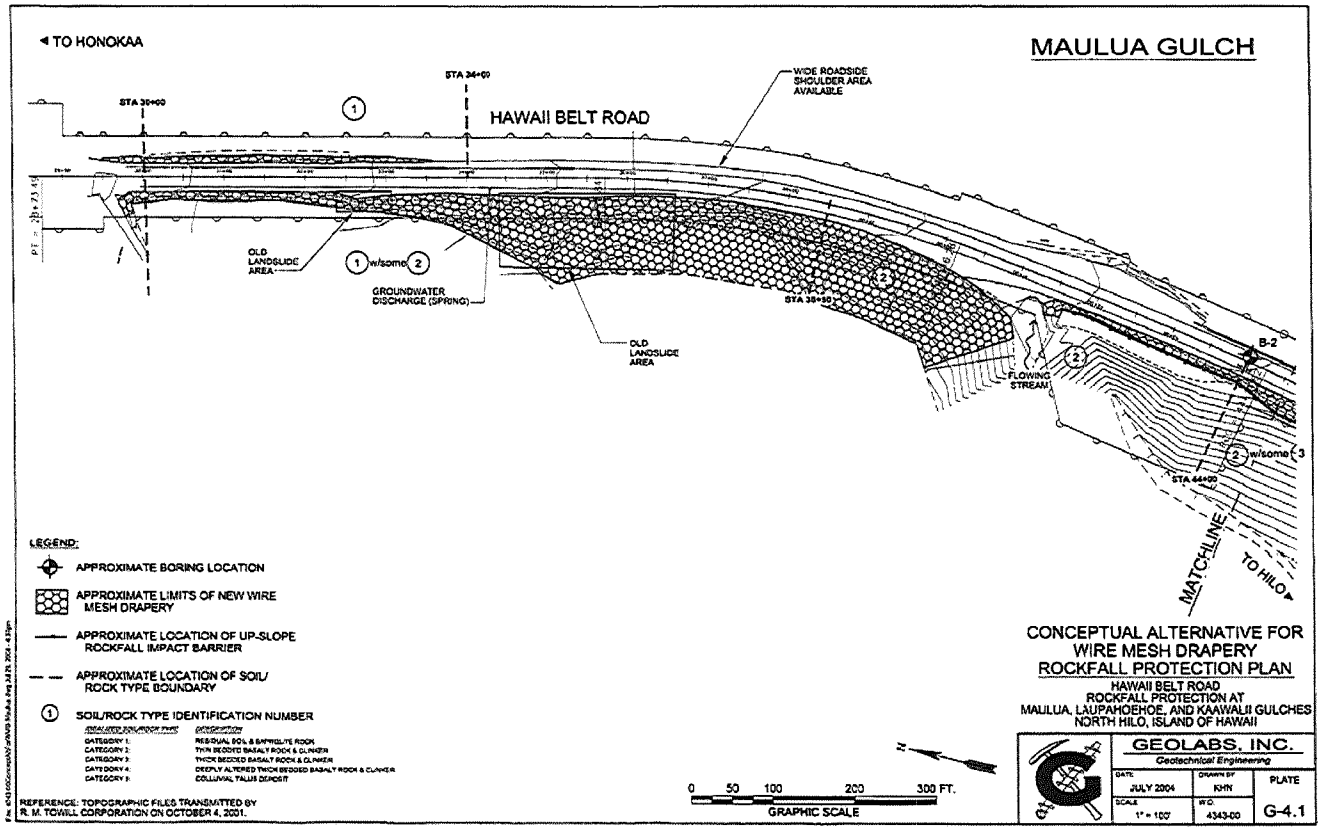
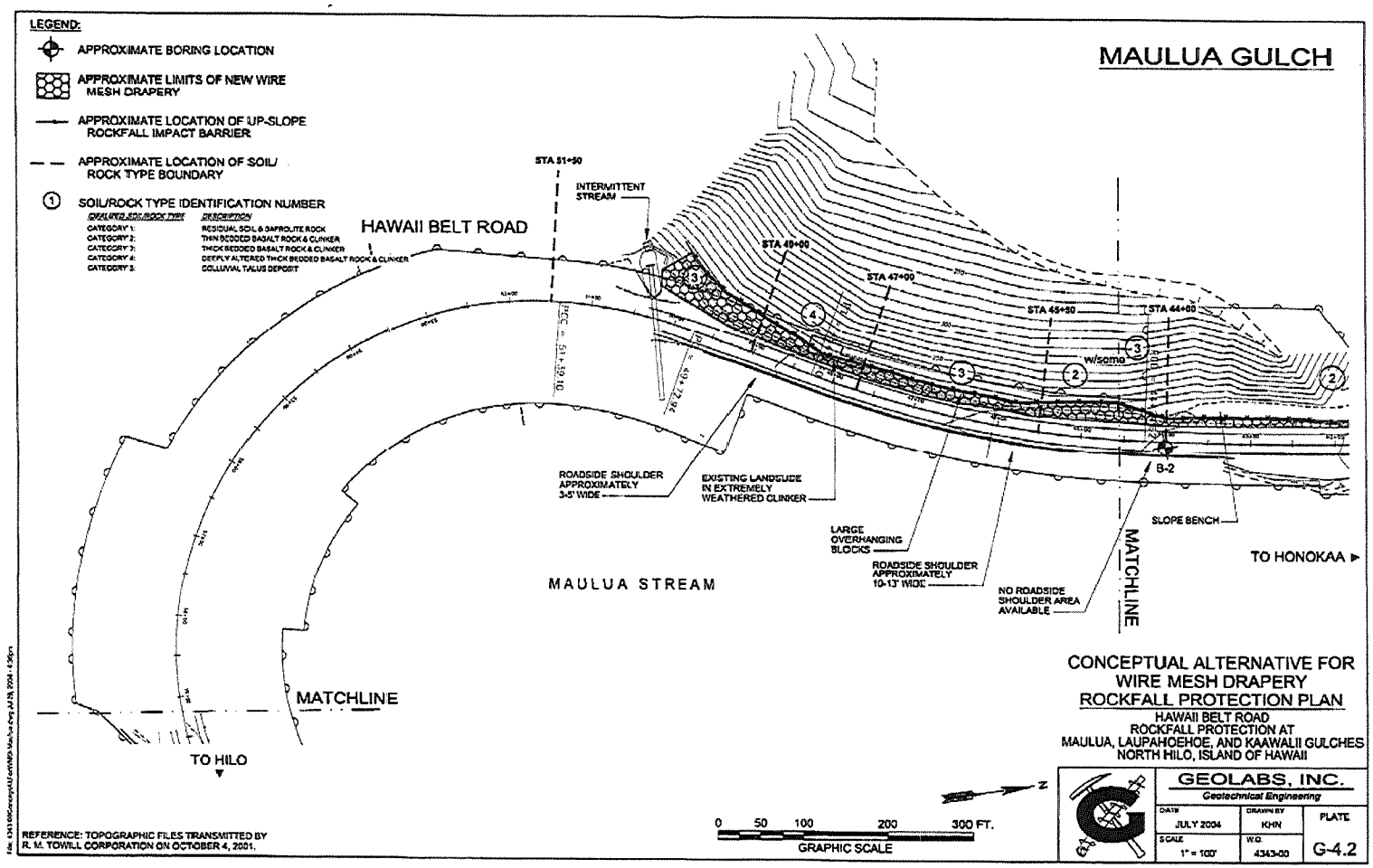
Appendix A Site Plans for Hawai'i Belt Road Rockfall Protection



Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Maulua Gulch, Plate G-4.1 (Source: Geolabs, Inc. 2004)



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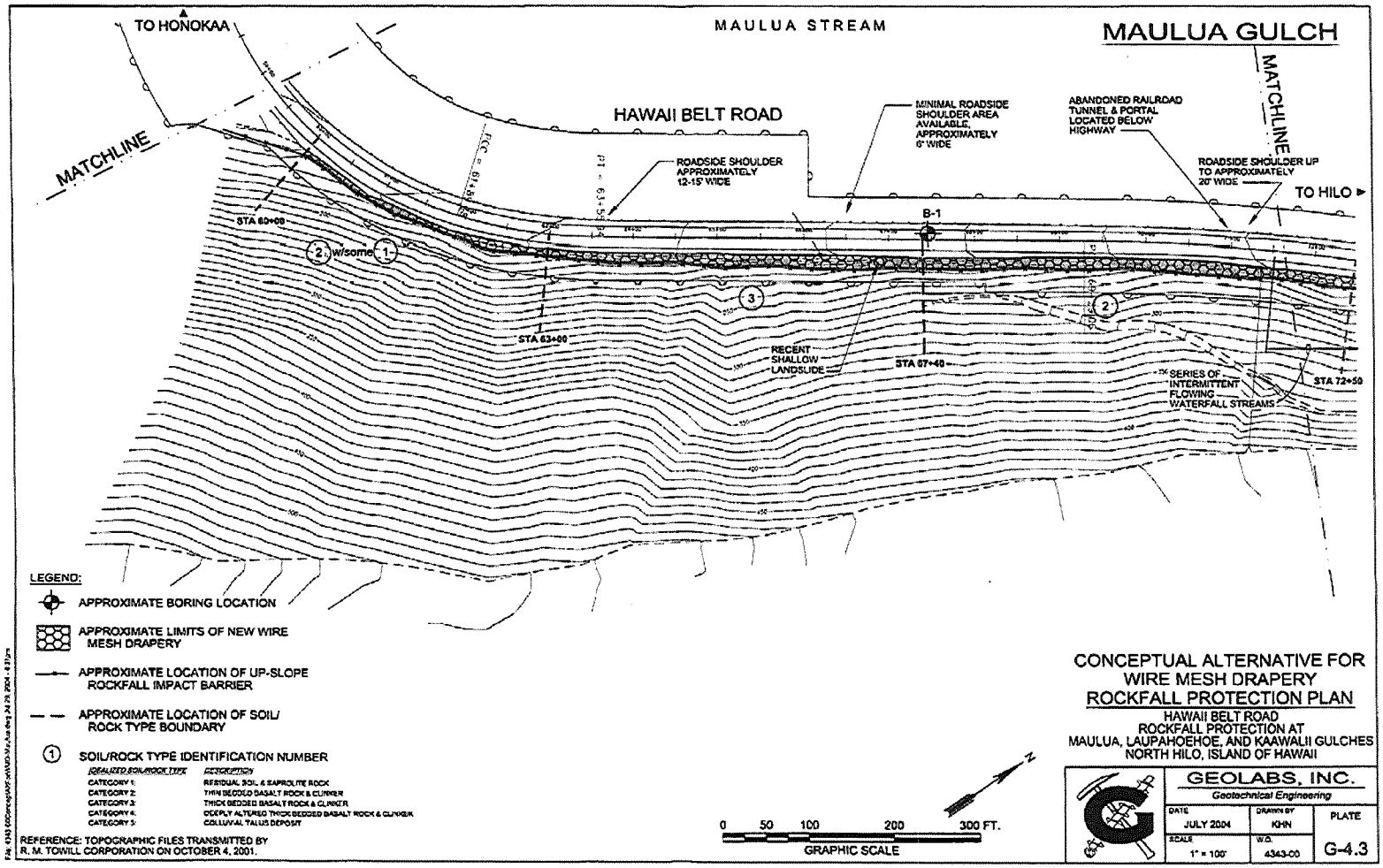

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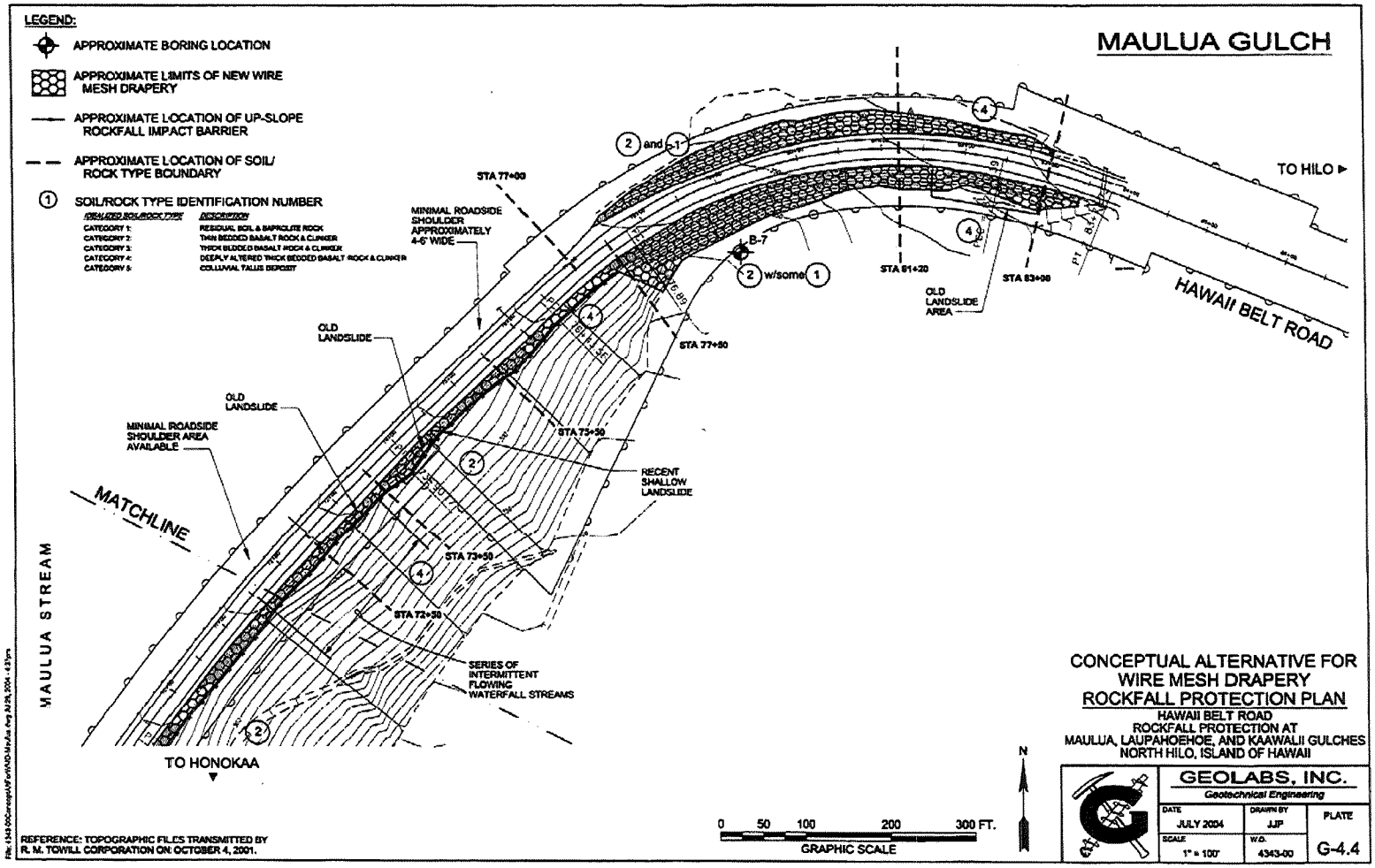

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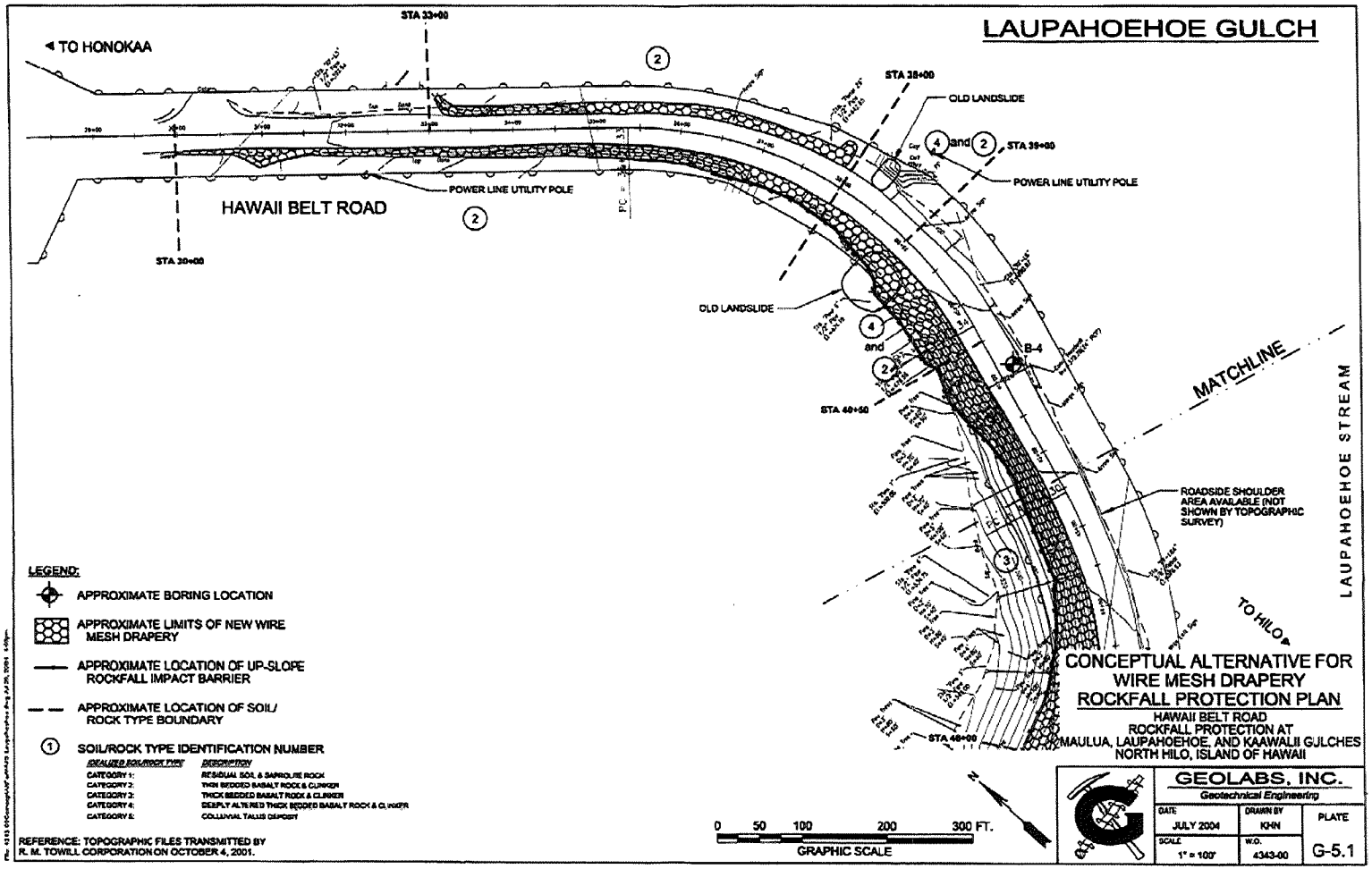
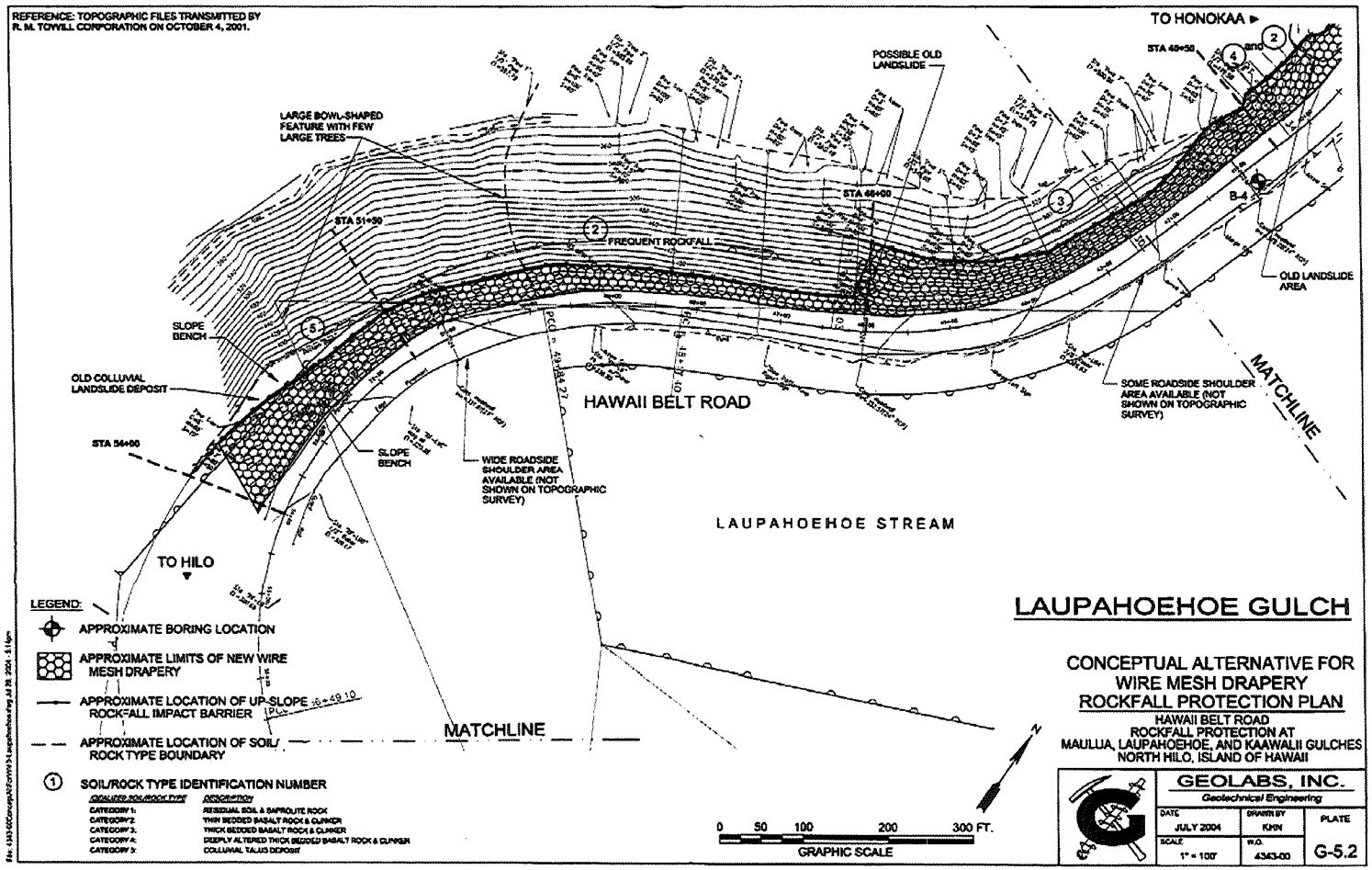
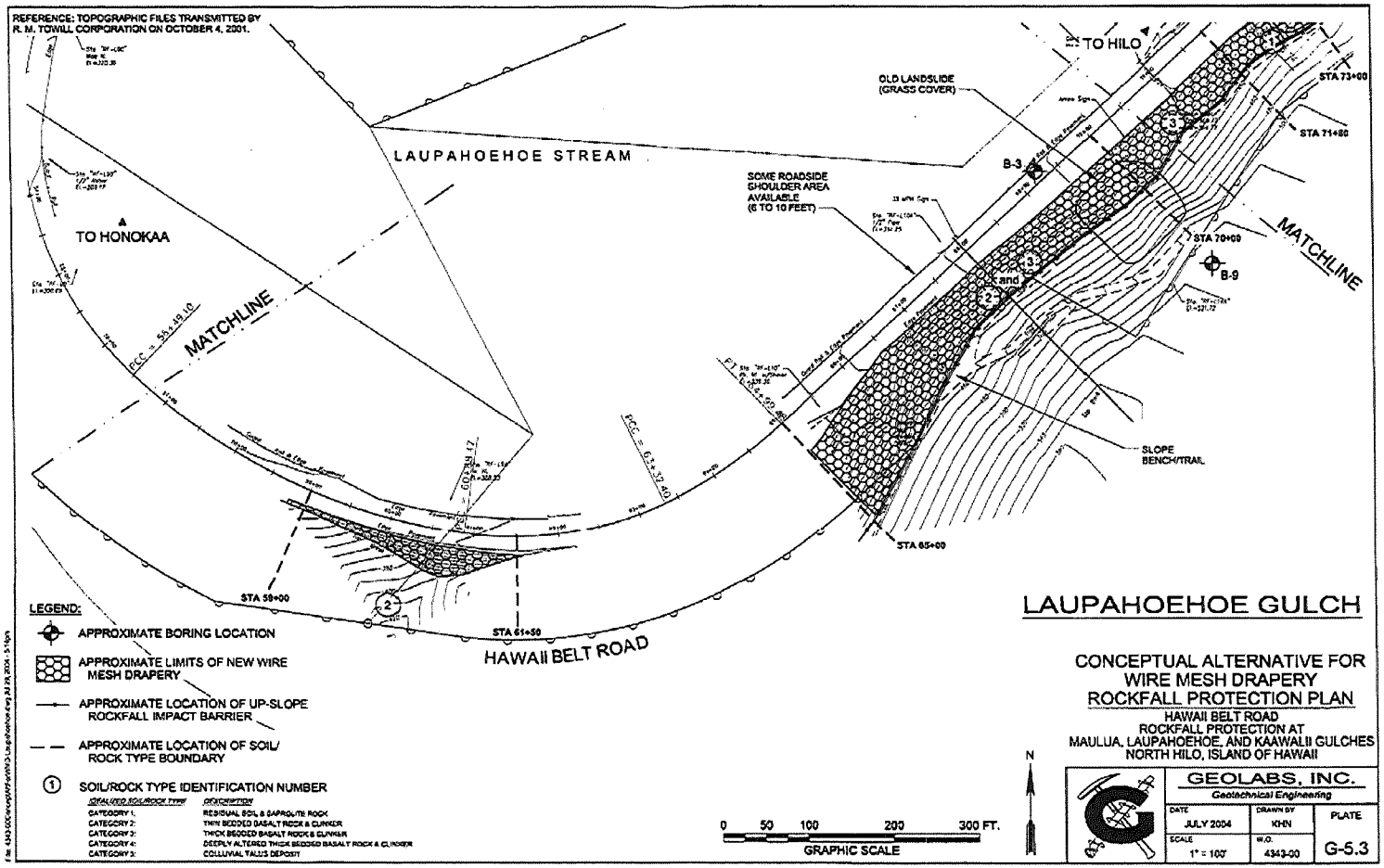


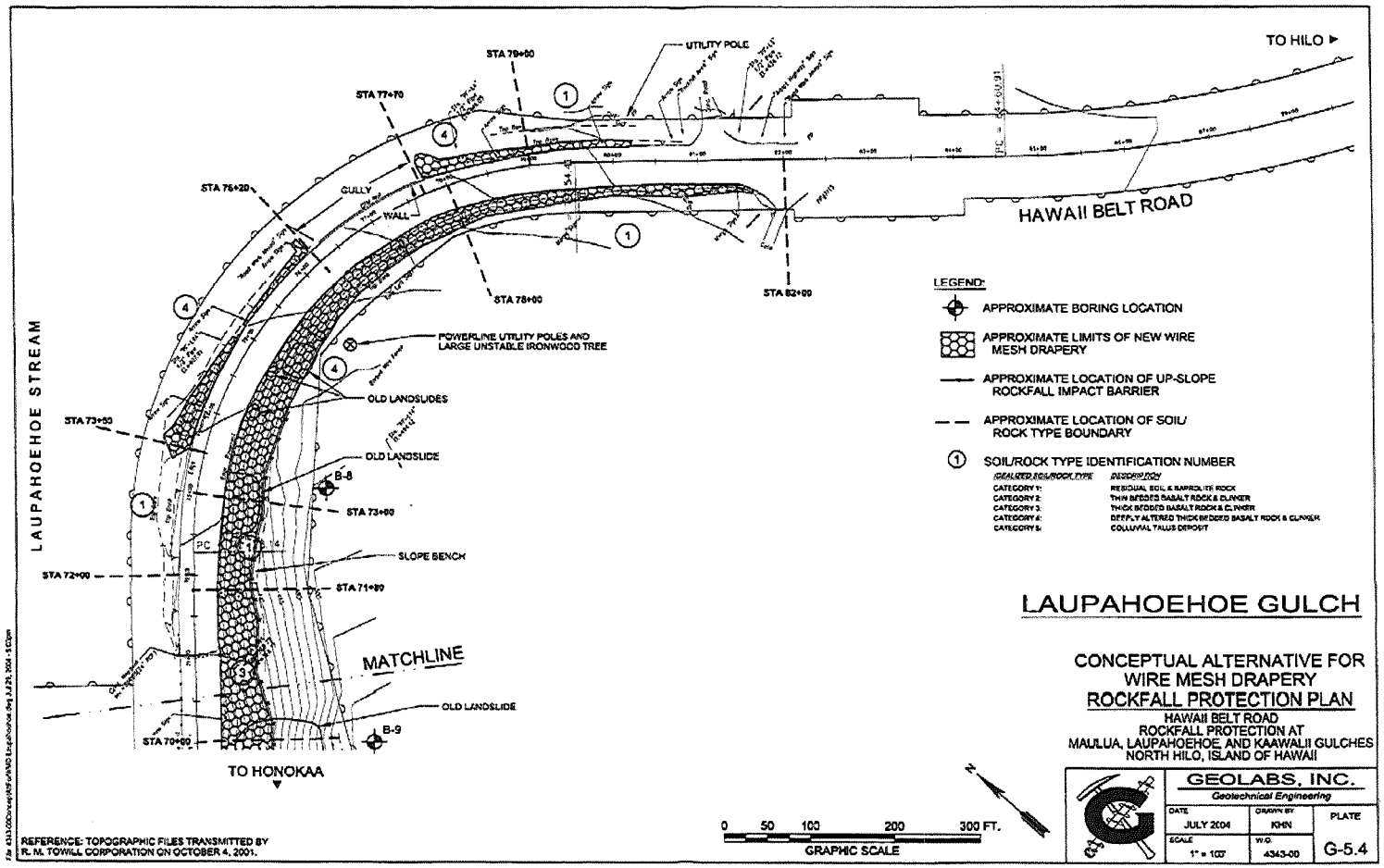
Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Laupāhoehoe Gulch, Plate G-5.1 (Source: Geolabs, Inc. 2004)



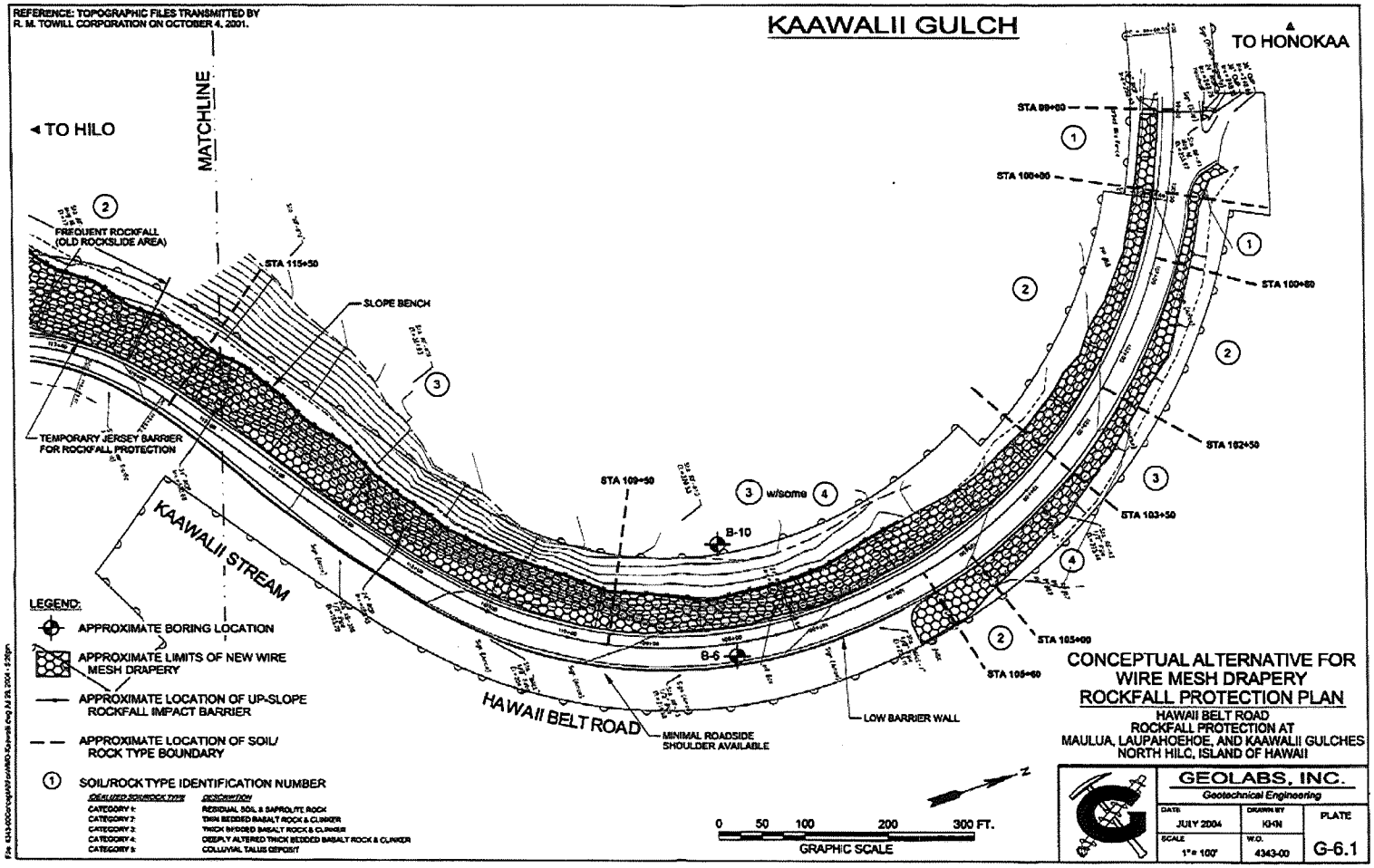
Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Laupāhoehoe Gulch, Plate G-5.2 (Source: Geolabs, Inc. 2004)



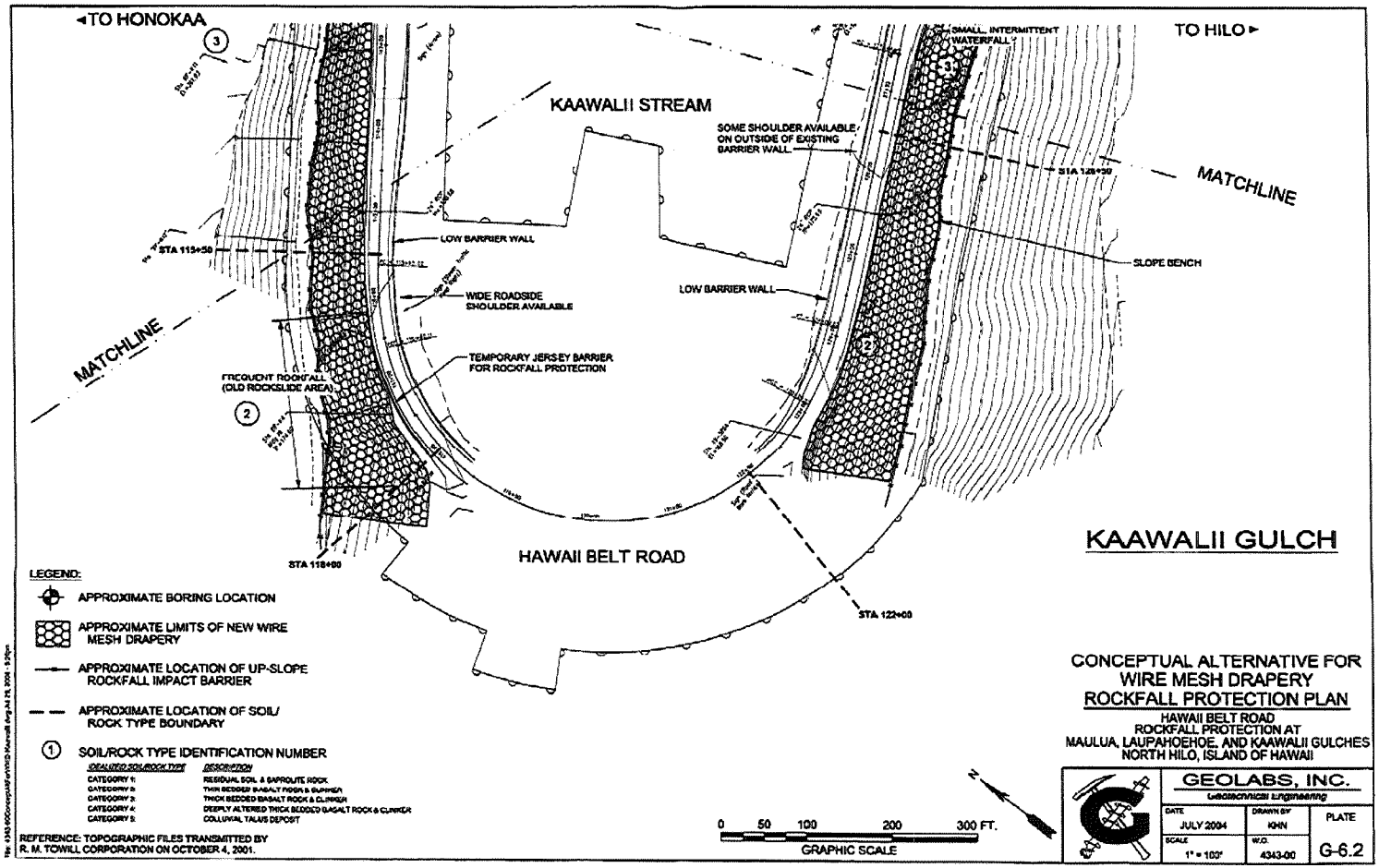
Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Laupāhoehoe Gulch, Plate G-5.3 (Source: Geolabs, Inc. 2004)



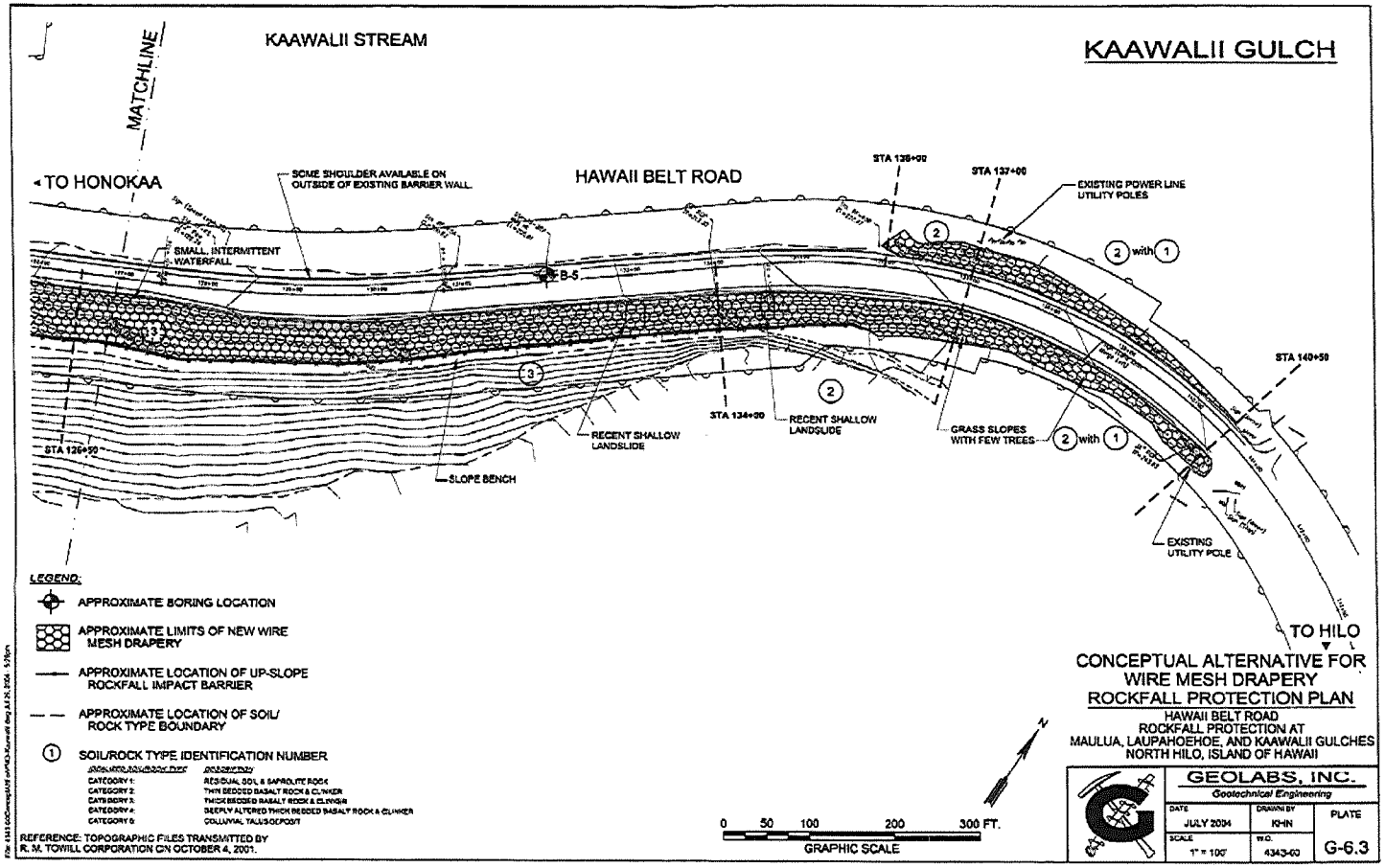
Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Laupāhoehoe Gulch, Plate G-5.4 (Source: Geolabs, Inc. 2004)



Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Ka'awali'i Gulch, Plate G-6.1 (Source: Geolabs, Inc. 2004)



Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Ka'awali'i Gulch, Plate G-6.2 (Source: Geolabs, Inc. 2004)



Conceptual Alternative for Wire Mesh Drapery Rockfall Protection Plan at Ka'awali'i Gulch, Plate G-6.3 (Source: Geolabs, Inc. 2004)

Appendix B Department of Hawaiian Home Lands Response Letter

LINDA LINGLE
GOVERNOR
STATE OF HAWAII

MICAH A. KANE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

KAULANA H. PARK
DEPUTY TO THE CHAIRMAN

ROBERT J. HALL
EXECUTIVE ASSISTANT

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

February 23, 2009

Cultural Surveys Hawai'i, Inc.
Archaeological and Cultural Impact Studies
Ms. Momi Wheeler, Cultural Specialist
15-3011 Mako Way
Pahoa, Hawaii 96778

Dear Ms. Wheeler:

Subject: Cultural Impact Assessment (CIA) for the Rockfall Remediation of Hawai'i Belt Road in Maulua, Laupahoehoe, and Ka'awali'i Ahupua'a, northeast Hilo District, Hawai'i Island (TMK:[3] 3-4-002:03, 04 & 05;[3] 3-6-04:02, 11, 15,17, 23 & 30; [3] 3-9-01: 01).

Thank you for the opportunity to review the subject proposal. The Department of Hawaii Home Lands has no comment to offer at this time. If you have any questions, please contact our Planning Office at 620-9480.

Aloha and Mahalo,

Micah A. Kane, Chairman
Hawaiian Homes Commission

Appendix C Office of Hawaiian Affairs Response Letter

PHONE (808) 594-1888

FAX (808) 594-1865

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPI'OLANI BOULEVARD, SUITE 500
HONOLULU, HAWAII 96813

HRD09/4162

March 5, 2009

Momi Wheeler, Cultural Specialist
Cultural Surveys Hawai'i
15-3011 Mako Way
Pāhoa, Hawai'i 96778

RE: Cultural Impact Assessment consultation
Hawai'i Belt Road rockfall remediation
Maulua, Laupāhoehoe and Ka'awali'i Ahupua'a, North Hilo District
Island of Hawai'i

Aloha e Momi Wheeler,

The Office of Hawaiian Affairs (OHA) is in receipt of your February 13, 2009 letter initiating consultation and seeking comments ahead of a cultural impact assessment (assessment) for the proposed construction of rockfall mitigation and stabilization measures along the Hawai'i Belt Road at specific locations adjacent to Maulua, Laupāhoehoe and Ka'awali'i Gulches.

OHA acknowledges that the purpose of this proposed undertaking is to improve highway safety along the segments fronting the three gulches which are subject to falling rocks and occasional landslides and we have no comments on the assessment at this time. Thank you for initiating consultation at this early stage and we look forward to the opportunity to review the draft assessment and provide additional comments. Should you have any questions, please contact Keola Lindsey, Lead Advocate-Culture at (808) 594-1904 or keolal@oha.org.

'O wau iho nō me ka 'oia'i'o,

Clyde W. Nāmu'o
Administrator

C: OHA East Hawai'i CRC office

Appendix D State Historic Preservation Division Response Letter

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

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DEPUTY DIRECTOR - WATER

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BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

April 21, 2009

LOG NO: 2009.1747
DOC. NO: 0904PC007

MEMORANDUM

TO: Momi Wheeler, Cultural Specialist
Cultural Surveys Hawai'i, 15-3011 Mako Way, Pahoa, Hawaii 96778

FROM: Phyllis Coochie Cayan, History and Culture Branch Chief

Subject: KAAWALII 2: Cultural Impact Assessment (CIA) for the Rockfall Remediation of Hawaii Belt Road in Malua, Laupahoehoe, and Kaawalii Ahupua'a, Northeast Hilo District, Island of Hawai'i. TMK: [3] 3-4-002: 03,04 & 05; [3] 3-6-04: 02, 11,15,17,223, & 30: [3]3 3-9-01:01.

This memo is in response to your request to help assess potential impacts to cultural practices as a result of the proposed project which involves the construction of rockfall mitigation and stabilization measures along the Hawaii Belt Road (route 19) at specific locations adjacent to Maulua, Laupahoehoe, and Kaawalii Gulches.

State Historic Preservation Division (SHPD) reminds CSH that any ground disturbance could disturb burials or burial sites although the likelihood on the slopes are a low risk as the project will be addressing previously developed or disturbed land.

Other resource folks you may find helpful as you begin this planning process are:

1. Kepa Maly, Executive Director, Lanai Culture & History Center Phone: 808-565-7177
   He has done extensive ethnographic cultural work on Hawaii Island for many years.

2. Charlie Young, current chairman of the Hawaii Island Burials Council. He has a diverse background and may be of help. His contact number is 966-8691 or via email at youngc042@hawaii.rr.com
3. Kimo Lee, a member of the HIBC with construction/projects background. His contact number is 966-9325 or via email at klee@whshipman.com
4. University of Hawaii at Hilo – engineering or similar departments
5. Hawaii Community College – Ms. Pua Kanahele who may know of the Hawaiian legends and other cultural practices of that area.

We apologize for the delay in responding to this CIA and hope the following suggestions will be of help in your research.

Any questions, please call me at 808-692-8015 or via email Phyllis.L.Cayan@hawaii.gov

c: Pua Aiu, SHPD Administrator
Nancy McMahon, Deputy SHPO