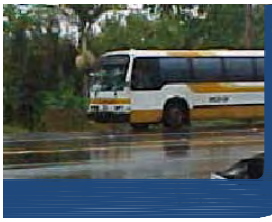


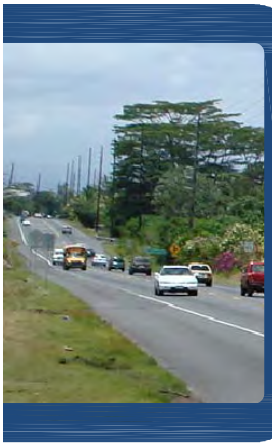
Draft Environmental Assessment

Kea'au - Pāhoa Road Improvements

Kea'au Bypass to Pāhoa - Kapoho Road,
Puna District, Hawai'i Island, Hawai'i
Project No. STP-130(27)

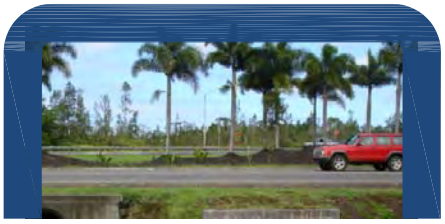
Submitted Pursuant to the National Environmental Policy Act & Chapter 343, Hawai'i Revised Statutes by:

DEPARTMENT OF TRANSPORTATION
STATE OF HAWAII



Prepared by:

SSFM INTERNATIONAL



May 2010

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KEAʻAU-PĀHOA ROAD IMPROVEMENTS

Keaʻau Bypass to Pāhoa-Kapoho Road
Puna District, Hawaiʻi Island, Hawaiʻi

DRAFT ENVIRONMENTAL ASSESSMENT

Submitted Pursuant to the
National Environmental Policy Act, 42 USC 4332 (2) (c)
and
Chapter 343, Hawaiʻi Revised Statutes

US Department of Transportation
Federal Highway Administration
and
State of Hawaiʻi Department of Transportation
Highways Division

_____	_____
Date of Approval	Brennon T. Morioka Director of Transportation State of Hawaiʻi Department of Transportation
_____	_____
Date of Approval	Abraham Wong Division Administrator Federal Highway Administration US Department of Transportation

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This report documents the anticipated impacts of reconstruction of 9.5 miles of Keaʻau-Pāhoa Road (State Route 130), from the terminus of the existing 4-lane Keaʻau Bypass to its intersection with Pāhoa-Kapoho Road. The project purpose is to improve highway safety, increase roadway capacity, and modernize the existing facility, which is heavily congested during its peak hours of operation and has an accident rate much higher than the statewide average. Five alternatives (including No-Build and Transportation Systems Management) are evaluated; none are anticipated to have significant impacts based on criteria specified in Section 11-200-12b of the Hawaiʻi Administrative Rules. However, the Federal Highway Administration will not issue a final determination until comments on the Draft Environmental Assessment are received and addressed.

Comments on this Draft Environmental Assessment are due by July 23, 2010 and should be sent to Mr. Abraham Wong of the Federal Highway Administration and Mr. Brennon Morioka of the State Department of Transportation at the addresses above.

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Project Summary

Project Name:	Kea‘au-Pāhoa Road Improvements
Location:	Between Kea‘au and Pāhoa Villages, Hawai‘i
District:	Puna
Project Site Tax Map Key:	(3)-1-5-various through (3)-1-6-various
Project Study Area:	Approximately 230 acres (a 200-foot wide corridor was considered over a distance of approximately 9.5 miles)
Project Site Existing Use:	Existing two-lane highway corridor. Areas of right-of-way acquisition that abut corridor include open space, residential, commercial, institutional and other uses.
Project Site Existing Land Use Designations:	Generally within state highway right-of-way. Areas that abut project, which may require acquisition for right-of-way purposes are classified as follows: <u>State Land Use:</u> All agricultural with the exception of one localized urban zone near Pāhoa <u>Hawai‘i County General Plan’s Land Use Pattern Allocation Guide (LUPAG):</u> Generally Rural, Extensive Agriculture, and Urban Expansion. Small pockets of Low Density Urban and Medium Density Urban <u>Hawai‘i County Zoning:</u> Primarily agricultural of varying density levels
Proposed Action:	The Hawai‘i Department of Transportation (HDOT) has proposed improvements along approximately 9.5 miles of Kea‘au-Pāhoa Road (State Route 130), from the terminus of the existing four-lane Kea‘au Bypass to its intersection with Pāhoa-Kapoho Road. Five alternatives are under consideration in this Draft EA, and a preferred alternative has not been selected at this time, but will be disclosed in the Final EA. Alternatives under consideration include: • A “No-Build” alternative (Alternative 1), which only includes currently programmed actions • A Transportation Systems Management (TSM) alternative (Alternative 2), which would make lower-cost improvements along the corridor, including signalizing intersections/roundabouts, access management, and transit improvements but not entail major construction • Alternative 3, which would incorporate the TSM improvements above, plus widen Kea‘au-Pāhoa Road to four lanes between Kea‘au Bypass and Ainaloa Boulevard, and retain the two lane cross-section between Ainaloa Boulevard and Pāhoa-Kapoho Road. This alternative includes a shoulder/bikeway, bus pull-outs, improved shoulders, and median treatments.

	• Alternative 4, which would incorporate the TSM improvements above, plus widen Keaʻau-Pāhoa Road to four lanes between Keaʻau Bypass and Pāhoa-Kapoho Road. This alternative includes a shoulder/bikeway , bus pull-outs, improved shoulders, and median treatments. • Alternative 5, which would incorporate the TSM improvements above, plus widen Keaʻau-Pāhoa Road to six lanes between Keaʻau Bypass and Paradise Drive, four lanes between Paradise Drive and Kahakai Boulevard, and retain the two lane cross-section between Kahakai Boulevard and Pāhoa-Kapoho Road. This alternative includes a shoulder/bikeway , bus pull-outs, improved shoulders, and median treatments. The purpose of the project is to improve safety, provide mobility/relieve congestion, improve travel for alternative modes (transit, bicycles, pedestrians), address future traffic increases, support future land use objectives, and enable civil defense/emergency travel/evacuations.
Anticipated Impacts	A variety of impacts are anticipated under all five alternatives, but none are expected to be significant after mitigation. They include: • Right-of-Way takings • Relocations (only if optional access modifications convert three "T" intersections to four-way intersections) • Traffic Impacts (generally beneficial) and improved safety • Access changes • Future growth (directed by Puna Community Development Plan) • Air Quality • Noise • Removal of vegetation • Modification of waterways • Impacts on historic properties and cultural practices • Utility relocations • Construction-phase impacts on air, water, noise levels, sedimentation, vegetation, etc.
HRS Chapter 343 Proposing Agency and Accepting Authority:	State of Hawaiʻi Department of Transportation 869 Punchbowl Street Honolulu, HI Brennon Morioka, Director of Transportation (808) 587-2150
Anticipated Determination:	Finding of No Significant Impact (FONSI)
Project Site Permits/Approvals Required (not an exhaustive list, refer to Section 4.17 for more information)	• National Pollutant Discharge Elimination System (NPDES) • State of Hawaiʻi DBEDT - Coastal Zone Management Federal Consistency • State of Hawaiʻi DLNR/SHPD - Archaeological Inventory Survey, Archaeological Mitigation Plan, Cultural Impact Assessment approvals

	• State of Hawaiʻi DOH - Noise Permit/Variance • State of Hawaiʻi DOH - Underground Injection Control • County of Hawaiʻi Grubbing, Grading, Excavation and Stockpile Permits
EA Preparer	SSFM International 99 Aupuni Street, Suite 202 Hilo, HI 96720 (808) 933-2727 Contact: Douglas Zang, AICP
Individuals, Community Groups and Agencies Consulted	See **Chapter 7: PUBLIC INVOLVEMENT** for list

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CHAPTER 1: PURPOSE AND NEED FOR PROJECT

The Federal Highway Administration (FHWA) in cooperation with the State of Hawaiʻi Department of Transportation (HDOT) is proposing to improve approximately 9.5 miles of Keaʻau-Pāhoa Road (State Route 130). The project corridor includes existing Keaʻau-Pāhoa Road, currently a two-lane roadway, from the terminus of the existing four-lane Keaʻau Bypass (approximately milepost 2.0) to its intersection with Pāhoa-Kapoho Road (approximately milepost 11.5), as shown in **Figure 1-1: Project Study Area**. Five alternatives have been considered in this document to improve Keaʻau-Pāhoa Road, and are outlined in **Chapter 2: Alternatives.**

This Draft EA has been prepared to comply with the National Environmental Policy Act (NEPA) of 1969; Chapter 343 of the Hawaii Revised Statutes (HRS); Title 11, Chapter 200 of the Hawaiʻi Administrative Rules (HAR); and FHWA and Federal Transit Administration Joint Regulations, Environmental Impact and Related Procedures [23 Code of Federal Regulations 771]. Compliance with federal laws is required because of the use of federal funds for construction.

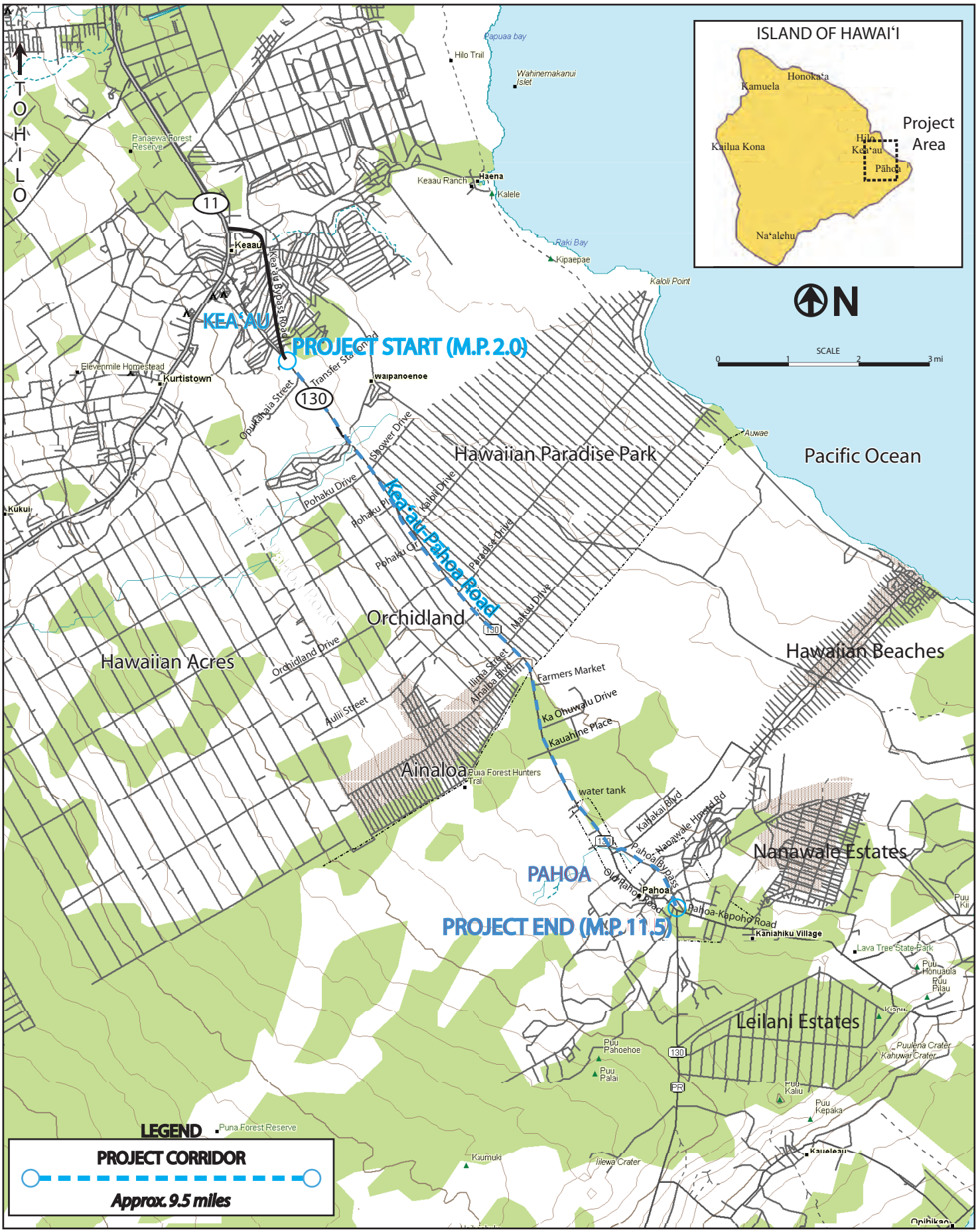
The Keaʻau-Pāhoa Road Improvements, Project # STP-0130(27), will be placed within the federally-required State Transportation Improvement Program (STIP).

HDOT is anticipating federal funding for the following phases of the project: design, right-of-way, and construction. The Federal and State governments will provide 80 percent and 20 percent, respectively, of the actual funding. Currently, the first phase of design is programmed in the Hawaii Department of Transportation, Statewide Transportation Improvement Program (STIP) for Federal Fiscal Year 2012 (October 1, 2011 – September 30, 2012).

Prior to the EA process, HDOT worked extensively with the affected communities to implement a Context Sensitive Solutions (CSS) process. The goal of the CSS effort was to provide an opportunity for community involvement at the earliest stages of the project. The Keaʻau-Pāhoa Advisory Group (KPAG) was convened from a diverse group of local stakeholders. As part of the CSS process, the KPAG identified a full range of alternatives, addressed community concerns with those alternatives, and built consensus for the project. The KPAG is described in greater detail in **Section 1.3: Community Participation in Determination of Project Purpose and Need**. The Purpose and Need statement that follows demonstrates the importance of this project and is largely based on the Purpose and Need statement produced by the KPAG.

1.1 Purpose and Need for Action

Keaʻau-Pāhoa Road (SR 130) is a rural highway functionally classified as a minor arterial. The Federal classification system is a management tool used to assign jurisdictional responsibility, allocate funds, and establish appropriate design standards. This minor arterial is designated as an important highway in a large district, where typical trip lengths are several miles long, and the corridor connects multiple rural, agricultural and urban land uses. The highway is owned by the State of Hawaiʻi and is on the Federal Aid Highway system. Local roads, mostly serving residential subdivisions, intersect this highway at over 23 locations.



PROJECT LOCATION MAP

Kea'au-Pāhoa Road Improvements, Kea'au to Pāhoa, Project No. STP-0130(27)

State of Hawai'i, Department of Transportation

Figure 1-1

Source:
DeLorme 3-D TopoQuads

Keaʻau-Pāhoa Road serves the Puna District on the Island of Hawaiʻi. Puna is predominantly rural in character, but it was also platted many years ago for residential development and traffic continues to grow. The area is not fully built out, and it is expected that over the next twenty years, the population will likely more than double, which will further exacerbate the existing traffic congestion. Many trips that begin or end in Puna go to Hilo, which is the primary center for employment and shopping in the region at the present time.

The Puna Regional Circulation Plan (PRCP) of 2005 and the Puna Community Development Plan of 2008 (PCDP) identify the need for safety and capacity improvements on this road. The PCDP also calls for a land use scenario known as the "Village Center Concept," which would bring more neighborhood oriented retail and employment into the area, thus relieving the need for some travel out of the district. The PCDP also calls for increased ridesharing and mass transit service, and for an alternate route (known as the Puna Makai Alternate Route, or PMAR) to address both capacity needs and emergency evacuation. Improvements along SR 130 should consider and complement these strategies.

SR 130 is used primarily by residents for commuting to schools, shopping centers, and businesses which may be located outside of Puna. Most residents use some section of the highway on a daily basis and they are acutely aware when congestion occurs and where the greatest highway dangers lie. A few residents use the highway shoulder for biking, running and walking. The Hawaii County bus system, Hele-On, uses the highway to transport its passengers to and from various locations in the Keaʻau to Pāhoa area.

SR 130 is also used by agriculture vehicles, school buses and delivery trucks. Non-residents using the highway include truck drivers making deliveries, ʻohana visiting relatives or graveyards, and those who come to the area for recreation and to shop at the Makuʻu Farmer's Market and other commercial areas. Visitors using the highway also include tourists who are sightseeing and/or visiting the volcano area at Kalapana to see where the lava flows into the sea.

1.1.1 Community Needs

The KPAG recognized a number of community needs:

- The population base and rate of growth in Puna has been increasing rapidly.
- People take pride in living in Puna, for which a common response is "Malāma Puna." Residents prefer to keep the rural and unique features of the area which they describe as "paradise." The community has many shared values regarding its lifestyle and freedom of movement.
- Any changes should not result in a "this could be anywhere" look; care needs to be taken to not over-design the highway so that it interferes with its rural character and sense of place.

- Improvements on SR 130, whether for safety or capacity or both, need to remain within state-owned right-of-way as much as possible and avoid encroaching onto adjacent property.

- One of the greatest needs of the Puna region is to create a new alternate road. An alternate road provides emergency evacuation, and a different roadway for travel within the district and to Hilo. Improvements for SR 130 are not a substitute for the alternate road, and planning should include connections to a potential alternate road that could be built within the twenty year time horizon.

- Driver behavior is important. Proper driving etiquette includes: a) allowing others to merge; b) providing proper signals; c) making lane changes safely; and, d) driving at a safe speed. As commonly stated, "Drive with aloha." Signage and the design of highway improvements should assist drivers to practice good driving habits.

- Enforcement should be part of the safety program.

1.1.2 Project Purpose

To address the regional and community needs cited above, KPAG identified the most important purposes of the Keaʻau-Pāhoa Road Improvements. These have been described as:

- Improve Safety. The foremost purpose of the proposed action is to increase safety for all travelers between Keaʻau and Pāhoa. The design of the project from a geometric and traffic safety standpoint should address vehicle conflict points along the highway, including intersections and turning points. See **Section 1.1.2.1: Safety** below.

- Provide Mobility and Relieve Congestion. Another primary purpose of this project involves improving regional mobility, local mobility and access, and reducing traffic congestion within the Puna District. See **Section 1.1.2.2: Mobility and Congestion** below.

- Improve Travel for Alternative Modes. An important purpose of this project is to accommodate the transit system, bicyclists and pedestrians, to provide a more balanced transportation system. See **Section 1.1.2.3: Alternative Modes** below.

- Address Future Traffic Increases. Improvements that increase accessibility, mobility and safety for local and regional traffic, including vehicular and non-vehicular modes of travel should be adequate for the next 20 to 30 years. See **Section 1.1.2.4: Future Traffic Increases** below.

In addition to the needs identified by KPAG, there are several other secondary needs that the project proposes to address. Section 6002 of the Safe, Accountable, Flexible Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) of 2005 (23 USC 139) outlines additional purposes that are relevant to this project:

- Support Future Land Use Objectives. The PCDP, adopted in 2008, and the PCRP, adopted in 2005, both envision a future land use concept concentrating future development into village and town centers to serve the local Puna community and address past sprawl and Hilo-centric patterns of travel.
- Enable Civil Defense, Emergency Travel, and Evacuations. Until an alternate parallel route to Keaʻau-Pāhoa Road can be constructed, for now, it provides the only route into and out of Lower Puna. This means that it would serve as the primary evacuation route for Civil Defense needs and it also is the primary route first responders use to reach local subdivisions and transport people to Hilo Medical Center, the region's only hospital. See **Section 1.1.2.6: Civil Defense, Emergency Travel, and Evacuations.**

The following discussion elaborates on these purposes further:

1.1.2.1 Safety

The Keaʻau-Pāhoa Road Corridor has very high crash rates, much higher than the state average. The need to improve safety and reduce the numbers and rates of crashes is a compelling one that has driven much of the public concern for improvements in this corridor. Many residents and visitors perceive Keaʻau-Pāhoa Road as a dangerous facility and in many cases, travelers will travel additional distances to avoid making certain traffic movements like left turns because of the perceived danger.

A major safety issue on Keaʻau-Pāhoa Road stems from the lack of gaps, or openings in traffic, to accommodate turning or crossing vehicles. There are no gaps because there are no forms of traffic control such as signals or roundabouts that would produce openings in the flow. Heavy volumes results in an almost continuous flow of traffic during peak hours, and in some off-peak conditions as well. Vehicles attempting to turn to or from Keaʻau-Pāhoa Road or cross the highway are confronted with a challenge to find an opening, and make risky maneuvers as a result.

HDOT collects crash statistics statewide. Crash statistics reflect only major crashes that are reported to HDOT. Major crashes include those resulting in death, bodily injury, and/or property damage exceeding $3,000 in cost.

FHWA has initiated a Highway Safety Improvement Program (HSIP) as part of Section 1401 of SAFETEA-LU. As part of this program, FHWA has requested all states to determine the locations within each state that have accident rates in the top five percentile statewide, covering both intersections and highway segments. "Five Percent" reports are produced annually.

In HDOT's 2008 Five Percent Report to FHWA, 79 intersections throughout the State of Hawaiʻi on the State Highway System had at least three crashes per year for each of the past three years. The top five percentile of these 79 high-crash locations statewide is four intersections, all four of which are located on the Island of Hawaiʻi, in the Puna District, and three of which are located along Keaʻau-Pāhoa Road: at Ainaloa Boulevard, at Kahakai Boulevard, and at Old Pāhoa Road. Traffic signals were identified in the report as measures to address the first two intersections.

Table 1-1: Top Five Percent Intersections in Hawaii With Most Severe Safety Needs summarizes the intersections cited in the 2008 HSIP Five Percent Report for Hawai'i.

Table 1-1: Top Five Percent Intersections in Hawaii With Most Severe Safety Needs

Location	Potential Remedies	Estimated Costs	Implementation Impediments	Comments
Volcano Rd @ Old Volcano Rd	n/a	n/a	Will monitor this intersection upon completion of widening project in this area.	n/a
Kea'au-Pāhoa Rd @ Ainaloa Blvd	Traffic Signal Installation recommended	$600,000	n/a	Proposed HSIP FY 07
Kea'au-Pāhoa Rd @ Kahakai Blvd	Traffic Signal Installation recommended	$450,000	n/a	Proposed HSIP FY 06
Kea'au-Pāhoa Rd @ Old Pāhoa Rd & Old Government Rd	Project at Kahakai intersection (above) should have positive influence on this location.	n/a	Will monitor this intersection upon completion of project at Kahakai intersection (above).	Cost benefit analysis favors Kahakai Blvd

Source: FHWA, accessed at http://safety.fhwa.dot.gov/hsip/fivepercent/2008/08hi.htm

Available crash data from the years 2004 through 2007has been analyzed as part of the traffic study provided in **Appendix C: Traffic Study**. The following discussion summarizes portions of that report.

Table 1-2: General Summary of Crashes on Kea'au-Pāhoa Road 2004 - 2007 provides an overview of the crashes that occurred within that four-year period and backs up the Five Percent Report that there is an urgent need to reduce crashes in the corridor. There were a total of 411 crashes, ten fatalities, and 435 injuries in that time period. Since the corridor is approximately 9.5 miles long, that means there are an average of approximately 11 crashes per mile per year, or about one per month per mile of road. Crashes, however, are not distributed evenly along the corridor, but rather are clustered at intersections and other critical locations.

Table 1-2: General Summary of Crashes on Kea'au-Pāhoa Road 2004 - 2007

Item	Number
Total number of crashes	411
Total vehicles involved	778
Total with motorcycles involved	7
Total with bicycles involved	2
Total with pedestrians involved	3
Total number of persons injured	435
Total number of persons killed	10

Source: HDOT, as described in Appendix C: Traffic Study

The majority of crashes along Kea'au-Pāhoa Road between 2004 to 2007 were located at intersections, specifically 219 crashes out of the 318 total, or 69 percent. A major issue at intersections are gaps, which are not frequent enough and hard for motorists to judge. **Table 1-3: Summary of Intersection Crashes on Kea'au-Pāhoa Road, 2004-2007** breaks down the number and severity of crashes.

Table 1-3: Summary of Intersection Crashes on Kea'au-Pāhoa Road, 2004-2007

Intersection of Kea'au-Pāhoa Road at*	Total Crashes	Crash Rate**	Crashes With Injuries	Number of Injuries	Fatal Crashes	Number of Fatalities	Percent Crashes with Injuries or Fatalities
Ainaloa Blvd.	49	2.49	30	53	0	0	61%
Kahakai Blvd.	31	2.45	17	37	0	0	55%
Old Pāhoa Road	40	2.10	21	36	0	0	53%
Maku'u Drive	33	1.57	26	55	0	0	79%
Paradise Drive	27	1.20	17	30	0	0	63%
Orchidland Dr.	21	0.91	11	21	0	0	52%
Pāhoa-Kapoho Road	16	0.83	7	14	0	0	44%
Nanawale Homestead Rd.	4	0.62	4	5	1	1	100%
Shower Drive	17	0.48	11	26	0	0	65%
Kaloli Drive	16	0.56	9	15	1	1	56%
Pōhaku Place	9	0.33	6	6	1	1	78%
Aulii Street	4	0.21	3	4	1	1	100%
Kaluahine Street	3	0.16	0	0	0	0	0%
Pōhaku Circle	3	0.12	2	2	0	0	67%
Unnamed Rd.	2	0.31	1	1	0	0	50%
Ilima Street	2	0.11	1	2	0	0	50%
Ka Ohuwalu	2	0.11	2	3	0	0	100%
Kea'au Transfer Station	5	0.14	2	2	0	0	40%
Paved Road	2	0.06	1	1	0	0	50%
Poni Moi Ave. (29th Ave.)	1	0.04	1	2	0	0	100%
Puakalo (30th Ave.)	2	0.07	2	2	0	0	100%
Totals	**289**	**n/a**	**192**	**317**	**4**	**4**	**66%**

*Only intersections that had crashes from 2004 - 2007 are shown in this table.
**Crash Rate is in number of crashes per million vehicles entering intersection
Source: Appendix C: Traffic Study

The rate of crashes shown in the table is the number of crashes per million vehicles entering the intersection, and is the best determinant for showing which locations have the most need for improvement rather than the total number of crashes, since higher-volume locations would be expected to have the highest number of crashes as well. Data was not available to indicate an average statewide rate of crashes at intersections for comparison. However, a rate above 1.0 is usually considered worthy of more detailed review to determine if countermeasures can

be identified and implemented. The intersections with the greatest need for improvement are Ainaloa Blvd., Kahakai Blvd., Old Pāhoa Road, Makuʻu Drive, Paradise Drive, Orchidland Drive and Pāhoa-Kapoho Road.

As the table also shows, 66 percent of the crashes had either injuries or fatalities. Among intersections having five or more total crashes, the intersections with the highest percentages of crashes with injuries or fatalities were at Makuʻu Drive, Pōhaku Place, Shower Drive and Ainaloa Boulevard.

The segments of roadway between intersections also have some dangerous locations for motorists. **Table 1-4: Summary of Kea'au-Pāhoa Road Crashes by Segment, 2004 - 2007** provides a breakdown of crashes in roadway segments between intersections.

Table 1-4: Summary of Kea'au-Pāhoa Road Crashes by Segment, 2004 - 2007

From	To	Crash Rate*	Total Crashes	Crashes with Injuries	Number of Injuries	Crashes with Fatalities	Fatalities	Percent with Injuries or Fatalities
Opukahaia	Shower	65.0	45	22	47	1	1	51%
Shower	Pōhaku Place	51.4	8	6	17	1	1	88%
Pōhaku Place	Kaloli	84.3	11	5	6	0	0	45%
Kaloli	Pōhaku Circle	55.4	4	3	3	0	0	75%
Pōhaku Circle	Orchidland	77.6	9	6	9	0	0	67%
Orchidland	Paradise	34.0	2	2	4	0	0	100%
Paradise	Aulii	55.3	4	4	6	0	0	100%
Aulii	Makuʻu	47.2	6	2	4	0	0	33%
Makuʻu	Ilima	41.9	1	0	0	0	0	0%
Ilima	Ainaloa	26.5	1	1	1	0	0	100%
Ainaloa	Ka Ohuwalu	27.5	5	4	8	0	0	80%
Ka Ohuwalu	Kaluahine	23.1	3	1	2	1	3	67%
Kaluahine	Old Pāhoa	43.4	10	6	7	1	1	70%
Old Pāhoa	Kahakai	105.5	2	2	5	0	0	100%
Kahakai	Nanawale	86.2	3	1	1	0	0	33%
Nanawale	Unnamed	150.1	3	2	2	0	0	67%
Unnamed	Kapoho	134.6	5	2	2	0	0	40%
Totals		57.0	122	68	124	4	6	59%

Source: HDOT

*Crash Rate is in number of crashes per hundred million vehicle miles of travel

As **Table 1-4: Summary of Kea'au-Pāhoa Road Crashes by Segment, 2004 - 2007** also shows, 59 percent of the accidents between intersections involved injuries or fatalities.

One deficiency of the existing two-lane Keaʻau-Pāhoa Road is the relative lack of opportunities for traffic to pass other vehicles. Even in the portions of the corridor striped as a passing zone,

heavy traffic volumes preclude motorists from passing slower-moving vehicles during most hours of the day. Motorist frustration with slower-moving vehicles may result in dangerous passing maneuvers, and potential head-on collisions.

The improvements to Keaʻau-Pāhoa Road will have a pronounced effect on improving safety in the corridor. The traffic analysis in **Appendix C: Traffic Study** has conservatively calculated a crash reduction figure of at least 25 percent with the Build alternatives, and it is likely that this reduction could be higher. The overall estimate is that at least 22 accidents a year and 25 injuries per year could be avoided with improvements to Keaʻau-Pāhoa Road.

Improved safety will result from a number of factors:

- Safer turning movements at traffic-controlled intersections (either a signal or a roundabout)
- Control of access and elimination of left-turn movements away from traffic controlled points with divided medians.
- Provision of turn lanes and acceleration lanes that will offer a refuge for turning traffic and safer turning movements.
- Consistent, improved shoulder areas that will enable bicycles and pedestrians to travel a safe distance from motor vehicles. The shoulders will provide a safer area for disabled vehicles to get out of the stream of traffic.
- Improved opportunity for vehicles of different speeds to pass each other and maintain a safe travel distance apart from each other.

1.1.2.2 Mobility and Congestion

As the only route into and out of Lower Puna, existing congestion on Keaʻau-Pāhoa Road already greatly limits mobility, and future traffic volumes are only slated to increase further. Because many lower Puna residents presently travel to Hilo or locations in Puna closer to Hilo for medical care, shopping, work, school, and other needs, Keaʻau-Pāhoa Road is of great importance to provide mobility for these basic life needs. The PCDP will try to direct future development towards village and town centers that reduce the area's dependence on the Hilo area and thereby increase Puna's ability to serve these life needs. There will also be future efforts by the County to provide an alternative parallel route, though the timeframe and funding for such a route is indeterminate. Nonetheless, there are already thousands of homes in lower Puna subdivisions, and for the foreseeable future, Keaʻau-Pāhoa Road will continue to provide the daily mobility needed by these residents.

Considering the corridor and all intersection approaches, an estimated 480 person-hours of delay from congestion is experienced by travelers in the corridor and at cross-streets during the AM and PM peak hours each weekday (2006 figures), using a national average occupancy of 1.6 persons per vehicle. Strictly from growth in traffic, this level of delay is expected to increase to 4771 person-hours of delay during the AM and PM peak hours each weekday in the year 2038 if nothing is done to address congestion. If nothing is done to increase capacity in the corridor,

congested conditions are likely to spread to a larger portion of the day as volumes increase and motorists choose to travel during non-peak hours.

Level of Service (LOS) is used to describe the overall performance of intersections and roadway segments and cover a scale from A - F. **Section 3.2: Traffic and Transportation** explains the concept of Level of Service in much greater detail. In very basic terms, a LOS of A is the optimal performance, with minimal traffic, and LOS F means the roadway or intersection is over capacity and is experiencing heavy delays, slow speeds, and stop-and-go conditions. For Peak Hour conditions, a LOS D is considered acceptable and LOS C is considered desirable.

Another way of considering traffic congestion and operations is the ratio of volume to capacity (V/C) of a roadway. As the volume of traffic approaches the capacity of the road, the V/C gets closer to a value of 1.0. Once volumes have exceeded capacity, V/C is greater than 1.0 and the roadway is in a gridlock condition.

Section 3.2: Traffic and Transportation also describes the concept of V/C in greater detail.

For the purposes of the traffic analyses, the direction "westbound" means towards Keaʻau and Hilo, and the direction "eastbound" is towards Pāhoa and Kalapana. For cross-streets, "northbound" is heading towards the ocean (makai) and "southbound" is heading inland (mauka). The assessment of future-year traffic assumes that the Puna Makai Alternate Route (PMAR) has not been constructed.

As is demonstrated in **Table 1-5: Existing (2006) Roadway Segment Volumes, Level of Service and Capacity**, the existing Keaʻau-Pāhoa corridor already experiences heavy congestion during AM and PM peak hours. The worst conditions (LOS E or LOS F or a V/C ratio greater than 0.85) are shown in **bold** in the table. The PM peak hour is most acute, with above-capacity congestion and a LOS F for Pāhoa-bound (eastbound) traffic between the beginning of the project near the merge in Keaʻau (Opukahaia Street area) and Pōhaku Circle. Near-capacity conditions (LOS E) are experienced between Pōhaku Circle and Auliʻi Drive. The AM peak hour traffic heading towards Keaʻau also experiences extreme congestion between Kaloli Drive and Shower Drive (LOS F), and LOS E conditions between Kaloli Drive and Pōhaku Circle. Beyond Shower Drive, the AM congestion is mitigated through the use of the temporary shoulder lane as a travel lane (which will be made permanent as part of the Shoulders Conversion project, see **Section 1.2.2.1: The Keaʻau-Pāhoa Road Shoulder Lane Conversion Project**.)

Table 1-5: Existing (2006) Roadway Segment Volumes, Level of Service and Capacity

From	To	AM Peak Hour						PM Peak Hour					
		Volume Ebd	Volume Wbd	Ebd V/C	Wbd V/C	Ebd LOS	Wbd LOS	Volume Ebd	Volume Wbd	Ebd V/C	Wbd V/C	Ebd LOS	Wbd LOS
Opukahaia	Transfer Sta	687	2143*	0.49	0.79*	C	D*	1662	740	**1.18**	0.52	**F**	C
Transfer Sta	Shower	653	2115*	0.46	0.78*	C	D*	1573	672	**1.12**	0.48	**F**	C
Shower	Pōhaku Pl	618	1436	0.44	**1.02**	C	**F**	1522	638	**1.08**	0.45	**F**	C
Pōhaku Pl	Kaloli Dr.	595	1417	0.42	**1.00**	C	**F**	1415	682	**1.00**	0.48	**F**	C
Kaloli Dr.	Pōhaku Cr.	491	941	0.44	0.83	C	**E**	1139	547	**1.01**	0.48	**F**	C
Pōhaku Cr.	Orchidland	536	849	0.38	0.60	C	D	1186	556	0.84	0.39	**E**	C
Orchidland	Paradise	512	954	0.36	0.68	C	D	1180	670	0.84	0.48	**E**	C
Paradise	Auli‘i	527	827	0.47	0.73	C	D	1015	519	**0.90**	0.46	**E**	C
Auli‘i	Maku‘u	491	809	0.35	0.57	C	D	865	536	0.61	0.38	D	C
Maku‘u	Ilima	557	837	0.40	0.59	C	D	923	506	0.65	0.36	D	C
Ilima	Ainaloa	558	880	0.40	0.62	C	D	884	536	0.63	0.38	D	C
Ainaloa	Ka Ohuwalu	459	671	0.33	0.48	C	C	761	494	0.54	0.35	C	C
Ka Ohuwalu	Kaluahine	550	674	0.49	0.60	C	D	724	501	0.64	0.44	D	C
Kaluahine	Old Pāhoa	556	661	0.39	0.47	C	C	693	481	0.49	0.34	C	C
Old Pāhoa	Kahakai	402	627	0.29	0.44	B	C	576	377	0.41	0.27	C	B
Kahakai	Nanawale	378	445	0.34	0.39	C	C	369	340	0.33	0.30	C	C
Nanawale	Unnamed	328	405	0.29	0.36	B	C	360	279	0.32	0.25	C	B
Unnamed	Kapoho	322	416	0.29	0.37	B	C	319	285	0.28	0.25	B	B

*Includes temporary use of shoulder as a travel lane during AM peak hour

Note: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.

Source: Roger Dyar, P.E.

If nothing is done to increase the capacity of the corridor between now and 2038, the LOS along the corridor is expected to become markedly worse, as shown in **Table 1-6: Volumes, Level of Service and Capacity, 2038 No-Build Conditions, Between Intersections**. In the AM peak hour in 2038, heading towards Keaʻau, the corridor will be operating poorly (LOS E or LOS F) for the entire length between Old Pāhoa Road and Shower Drive. Furthermore, even in what is considered the "off peak" direction for the AM hour (towards Pāhoa), much of the corridor between Pōhaku Place and Old Pāhoa Road will be have congested conditions (LOS E or LOS F) and operate poorly. Therefore, mobility in the corridor will be greatly limited for a much longer portion of the day, even in what is not today considered "peak conditions" or in the "peak direction."

A similar, if even more extreme level of congestion is anticipated in the PM Peak Hour in 2038, as the entire corridor heading towards Pāhoa will operate at a LOS F (above capacity) from Old Pāhoa Road back to Shower Drive. Even the segment of roadway between Opukahaia Street and Shower Drive, which has two travel lanes in the peak hour (resulting from the Shoulder Lane Conversion Project) will operate at LOS E because of the lengthy backup ahead of it. It is likely that the Keaʻau Bypass will also be adversely impacted by congestion further ahead. The off-peak direction (heading towards Keaʻau) will even experience five segments operating at LOS E, approaching capacity.

The performance of many corridor intersections themselves is already poor today, and slated to deteriorate further without improvements. With the exception of the Pāhoa-Kapoho Road intersection, none of the project intersections are currently signalized. (The Shower Drive intersection will be provided a signal as part of the Shoulders Conversion Project). Most intersections have turn lanes that are not adequate in length to accommodate turning vehicles, either along Keaʻau-Pāhoa Road, or on cross streets. High traffic levels only add to the problem. In many cases, a particular movement, especially left turns, is especially pronounced as operating at a poor LOS.

As **Table 1-7: Existing LOS and V/C, AM Peak Hour, Year 2006, Study Corridor Intersections** demonstrates, many cross-street intersections have a challenge in navigating turns or through movements during the AM peak hour. The intersections of Keaʻau-Pāhoa Road with the Keaʻau Transfer Station, Shower/Pōhaku Drive, Pōhaku Place, Kaloli Drive, Orchidland Drive, Ainaloa Boulevard, and Kahakai Boulevard all have movements from the cross streets that operate at an LOS F, meaning that it is extremely difficult for these cross-streets to get a break in traffic to turn, particularly for left turns. Turning traffic will often back up as the first vehicle waits for an opening. Makuʻu Drive, Paradise Drive, Auliʻi Street and Old Pāhoa Road have cross-street movements functioning at LOS E, which is only marginally better and essentially at capacity. Since traffic on Keaʻau-Pāhoa Road has the right-of-way over the stopped traffic at the cross streets, these intersections do not generally limit capacity for through traffic along Keaʻau-Pāhoa Road itself, though in one case, the combined westbound left turn and through movement at Ilima Street is over capacity.

Table 1-6: Volumes, Level of Service and Capacity, 2038 No-Build Conditions, Between Intersections

From	To	AM Peak Hour						PM Peak Hour					
		Volume Ebd	Volume Wbd	Ebd V/C	Wbd V/C	Ebd LOS	Wbd LOS	Volume Ebd	Volume Wbd	Ebd V/C	Wbd V/C	Ebd LOS	Wbd LOS
Opukahaia	Transfer Sta	837	2646	0.25	0.78	B	D	2792	1249	0.82	0.37	**E**	C
Transfer Sta	Shower	857	2614	0.61	0.77	D	D	3137	1235	0.93	0.36	**E**	C
Shower	Pōhaku Pl	900	2001	0.64	1.42	D	**F**	2409	1082	1.71	0.77	**F**	D
Pōhaku Pl	Kaloli Dr.	1144	2156	0.81	1.53	**E**	**F**	2391	1074	1.70	0.76	**F**	D
Kaloli Dr.	Pōhaku Cr.	1211	1841	1.07	1.63	**F**	**F**	1990	980	1.41	0.87	**F**	**E**
Pōhaku Cr.	Orchidland	1295	2093	0.92	1.48	**E**	**F**	2158	971	1.53	0.69	**F**	D
Orchidland	Paradise	1488	2183	1.06	1.55	**F**	**F**	2114	1120	1.50	0.79	**F**	**E**
Paradise	Auli'i	1167	1705	1.03	1.51	**F**	**F**	1944	952	1.72	0.84	**F**	**E**
Auli'i	Maku'u	1287	1705	0.91	1.21	**E**	**F**	1885	1047	1.34	0.74	**F**	D
Maku'u	Ilima	1109	1554	0.79	1.10	D	**F**	1792	891	1.27	0.63	**F**	D
Ilima	Ainaloa	1233	1734	0.87	1.23	**E**	**F**	1792	1052	1.27	0.75	**F**	D
Ainaloa	Ka Ohuwalu	1393	1666	0.99	1.18	**E**	**F**	1678	1118	1.19	0.79	**F**	**E**
Ka Ohuwalu	Kaluahine	1303	1697	1.16	1.50	**F**	**F**	1568	1038	1.39	0.92	**F**	**E**
Kaluahine	Old Pāhoa	1274	1697	0.90	1.20	**E**	**F**	1757	1038	1.25	0.74	**F**	D
Old Pāhoa	Kahakai	687	1190	0.49	0.84	C	**E**	944	774	0.67	0.55	D	C
Kahakai	Nanawale	543	641	0.48	0.57	C	D	486	508	0.43	0.45	C	C
Nanawale	Unnamed	444	601	0.39	0.53	C	C	453	400	0.40	0.35	C	C
Unnamed	Kapoho	459	582	0.41	0.52	C	C	466	366	0.41	0.32	C	C

Note: LOS worse than LOS D are displayed in **bold** text.

Source: Roger Dyar, P.E.

Table 1-7: Existing LOS and V/C, AM Peak Hour, Year 2006, Study Corridor Intersections

Intersection with Kea‘au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			0.47		A	0.71		C		C			
Kea‘au Transfer Station	Stop		C	0.44			0.71					**F**		**F**
Shower Drive	Stop		C	0.41		A	0.96			**F**			**F**	
Pōhaku Place	Stop			0.42		A	0.64		**F**		**F**			
Kaloli Drive	Stop		B	0.32			0.64						**F**	
Pōhaku Circle	Stop			0.33		A	0.57			C				
Orchidland Dr.	Stop			0.32	0.05	A	0.59			**F**				
Paradise Drive	Stop		A	0.29			0.40	0.03					**E**	
Auli’i Street	Stop			0.35	0.01	A	0.54			**E**				
Maku‘u Drive	Stop		B	0.28			0.39	0.17					**E**	
Ilima Street	Stop			0.38		**1.06**			D		D			
Ainaloa Blvd.	Stop			0.30	0.08	A	0.41			**F**				
Ka Ohuwalu	Stop		A	0.39			0.46					C		C
Kaluahine St.	Stop		A	0.36		A	0.45			D			C	
Old Pāhoa Rd.	Stop			0.23	0.15	A	0.35		**E**		**E**			
Kahakai Blvd.	Stop		A	0.17			0.24	0.06					**F**	
Nanawale Homestead Rd	Stop			A			A			C			C	
Unnamed Road	Stop			A			A			A			A	
Kapoho Rd.	Signal	C	D	C	C	C	C	C	A	A		B	B	

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
Source: SSFM International and Roger Dyar, P.E.

Table 1-8: Existing LOS and V/C, PM Peak Hour, Year 2006, Study Corridor Intersections demonstrates a similar situation in the PM Peak hour. Opukahaia Street, the Keaʻau Transfer Station, Shower Drive/Pōhaku Drive, Pōhaku Place, Kaloli Drive, Orchidland Drive, and Paradise Drive all have movements over capacity, at Level of Service F, greatly hindering the mobility of turning traffic from these cross-streets. Pōhaku Circle, Makuʻu Drive, Ainaloa Boulevard, and Old Pāhoa Road all have movements functioning at LOS E. Again, the intersections do not generally create problems for through traffic on Keaʻau-Pāhoa Road itself, although the eastbound approach to the intersection at Opukahaia Street is over capacity, a function of high volumes leaving Keaʻau within a single travel lane.

These challenging conditions for turning or crossing traffic result in motorists often having to make risky maneuvers.

As poor as the intersections perform currently, the operations at intersections in 2038 will be even more deficient. As seen in **Table 1-9: No-Build LOS and V/C, AM Peak Hour, Year 2038, Study Corridor Intersections**, the AM peak hour has LOS E or worse and/or V/C ratios over 0.85 for the westbound direction for the seven mile distance between Kaluahine Drive and Opukahaia Street. The only exception is one approach to Makuʻu Drive, which would operate at an acceptable level of service. Almost all side street approaches between Kaluahine Drive and Opukahaia Street will operate at LOS E or worse for the AM peak hour.

The next table, **Table 1-10: No-Build LOS and V/C, PM Peak Hour , Year 2038, Study Corridor Intersections**, shows that the PM peak hour has even greater congestion problems in the eastbound direction. From Opukahaia Street to Kaluahine Street, the V/C ratios for the eastbound movements are all above 0.85, with all but two being over 1.0. Almost every side street movement has LOS E or worse in the PM Peak hour. In essence, it will be extremely difficult for cross-street traffic to safely turn onto Keaʻau-Pāhoa Road in a reasonable amount of time.

As discussed in greater detail in **Section 4.2: Traffic and Transportation**, there will also be congestion in interim years (2018, 2028) as well. The proposed improvements in the corridor will greatly alleviate regional mobility by reducing congestion in the corridor.

Table 1-8: Existing LOS and V/C, PM Peak Hour, Year 2006, Study Corridor Intersections

Intersection with Kea‘au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			**1.09**		C	0.49		**F**		**F**			
Kea‘au Transfer Station	Stop		A	1.03			0.48					**F**		**F**
Shower Drive	Stop		A	0.96		B	0.41		**F**			D		
Pōhaku Place	Stop			1.01		B	0.44		**F**		**F**			
Kaloli Drive	Stop		B	0.73			0.37					**F**		
Pōhaku Circle	Stop			0.75		B	0.36		**E**					
Orchidland Dr.	Stop			0.71	0.08	B	0.37		**F**					
Paradise Drive	Stop		A	0.62			0.30	0.04				**F**		
Auli’i Street	Stop			0.65	0.02	B	0.35		**E**					
Maku‘u Drive	Stop		A	0.48			0.28	0.05				**E**		
Ilima Street	Stop			0.61		0.89			D		D			
Ainaloa Blvd.	Stop			0.42	0.16	B	0.27		**E**					
Ka Ohuwalu	Stop		A	0.50			0.33					C		C
Kaluahine St.	Stop		A	0.48		A	0.32		B			C		
Old Pāhoa Rd.	Stop			0.27	0.19	B	0.17		**E**		**E**			
Kahakai Blvd.	Stop		A	0.21			0.16	0.06				D		
Nanawale Homestead Rd	Stop		A			A			C			A		
Unnamed Road	Stop		A			A			A			C		
Kapoho Rd.	Signal	B	C	C	C	C	C	C	A	A		B	B	

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
Source: SSFM International and Roger Dyar, P.E.

Table 1-9: No-Build LOS and V/C, AM Peak Hour, Year 2038, Study Corridor Intersections

Intersection with Kea‘au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			0.60		B	**0.88**		D		D			
Kea‘au Transfer Station	Stop		**E**	0.58			**0.87**					**F**		**F**
Shower Drive	Signal*	**F**	A	A	A	A	**F**		D			**F**		
Pōhaku Place	Stop			0.61		B	**1.44**		**F**		**F**			
Kaloli Drive	Stop		**F**	0.62			**1.24**					**F**		**F**
Pōhaku Circle	Stop			0.83		B	**1.40**		**F**		**F**			
Orchidland Dr.	Stop			0.76	0.11	C	**1.36**		**F**		**F**			
Paradise Drive	Stop		**F**	0.82			**1.07**	0.08				**F**		**F**
Auli’i Street	Stop			0.77	0.02	B	**1.19**		**F**		**F**			
Maku‘u Drive	Stop		D	0.73			0.73	0.33				**F**		**F**
Ilima Street	Stop			0.75		**3.61**			**F**		**F**			
Ainaloa Blvd.	Stop			0.68	0.18	C	**1.03**		**F**		**F**			
Ka Ohuwalu	Stop		C	**0.93**			**1.15**					**F**		**F**
Kaluahine St.	Stop		A	**0.86**	0.02	B	**1.11**		**F**		**F**	**F**		**F**
Old Pāhoa Rd.	Stop			0.53	0.34	C	0.66		**F**		**F**			
Kahakai Blvd.	Stop		B	0.29			0.35	0.09				**F**		**F**
Nanawale Homestead Rd	Stop		0.69			0.70			**F**			**F**		
Unnamed Road	Stop		0.55			0.63			A			A		
Kapoho Rd.	Signal	**F**	C	D	C	**E**	**F**	D	C	B		B	**F**	

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
*Installed as part of the Shoulders Conversion Project.
Source: SSFM International and Roger Dyar, P.E.

Table 1-10: No-Build LOS and V/C, PM Peak Hour , Year 2038, Study Corridor Intersections

Intersection with Kea‘au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			**1.22**		**E**	0.41		**F**		**F**			
Kea‘au Transfer Station	Stop		B	**0.90**			0.41					**F**		**F**
Shower Drive	Signal*	**F**	**F**	**F**		D	C		**E**			**F**		
Pōhaku Place	Stop			**1.59**		D	0.70		**F**		**F**			
Kaloli Drive	Stop		**E**	**1.23**			0.65					**F**		**F**
Pōhaku Circle	Stop			**1.32**		C	0.64		**F**		**F**			
Orchidland Dr.	Stop			**1.28**	0.14	**F**	0.62		**F**		**F**			
Paradise Drive	Stop		D	**1.12**			0.55	0.08				**F**		**F**
Auli’i Street	Stop			**1.25**	0.04	C	0.68		**F**		**F**			
Maku‘u Drive	Stop		C	**1.05**			0.55	0.11				**F**		**F**
Ilima Street	Stop			**1.18**		**4.11**			**F**		**F**			
Ainaloa Blvd.	Stop			**0.86**	0.32	**E**	0.61		**F**		**F**			
Ka Ohuwalu	Stop		B	**1.10**			0.75					**F**		**F**
Kaluahine St.	Stop		B	**1.02**	0.01	A	0.69		**E**			**F**		
Old Pāhoa Rd.	Stop			0.60	0.43	**E**	0.36		**F**		**F**			
Kahakai Blvd.	Stop		B	0.34			0.25	0.09				**F**		**F**
Nanawale Homestead Rd	Stop		0.50			0.44			**F**			B		
Unnamed Road	Stop		0.44			0.38			A			C		
Kapoho Rd.	Signal	C	C	C	B	C	C	C	B	B		B	C	

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
*Installed as part of the Shoulders Conversion Project.
Source: SSFM International and Roger Dyar, P.E.

1.1.2.3 Alternative Modes

Keaʻau-Pāhoa Road serves more than simply motor vehicle traffic; it is an important route for transit, bicyclists, pedestrians, agricultural vehicles, and even scooters. Dangerous conditions, heavy congestion, and unpredictable delays will compromise the ability of these alternative modes to effectively function along Keaʻau-Pāhoa Road unless improvements are made.

The County of Hawaiʻi's Mass Transit Agency (MTA) operates its Hele-On buses on Keaʻau-Pāhoa Road for its Hilo to Pāhoa Route, a heavily used service. The current bus service in the corridor includes 11 trips on weekdays in both directions between Hilo and Pāhoa. Four trips are provided in each direction on Saturdays. Eight of the weekday runs are with a 33 passenger bus, and three are with a 47 passenger bus.

With free fares for riders, ridership on the Hele-On system has been increasing. According to the most recent statistics available (July, 2009) shown in **Table 1-11: Ridership Increase on Hele-On Bus Routes, 2008-2009**, ridership on the Hele-On system overall has increased 18.49% from July, 2008 to July, 2009. In July, 2009 there were 13,053 riders on the Hilo to Pāhoa route, an increase of 26.49% over the same month in 2008. In terms of overall numbers of passengers, the Hilo to Pāhoa Route is the second-most heavily used service island-wide, only exceeded by the East Hawaiʻi - South Kohala route, which shuttles workers in East Hawaiʻi to Kohala resorts.

Table 1-11: Ridership Increase on Hele-On Bus Routes, 2008-2009

Route	July, 2009 Monthly Riders	July, 2008 Monthly Riders	Percent Change
Intra Hilo	8,961	5,380	66.56%
Intra Kona	4,796	2,879	66.59%
Kona/Hilo	4,237	3,645	16.24%
Honokaʻa/Hilo	807	755	6.89%
Pāhoa/Hilo	**13,053**	**10,319**	**26.49%**
Volcano/Hilo	1,176	939	25.24%
Kau/Hilo	2,362	2,078	13.67%
Kau/South Kohala	1,174	1,765	-33.48%
Kau/Kona	2,539	1,135	123.70%
Waimea	2,940	2,354	24.89%
East Hawaiʻi/South Kohala	22,512	23,357	-3.62%
North Kohala/South Kohala	1,084	1,611	-32.71%
North Kohala/Kona	972	491	97.96%
Hilo /Waimea	581	0	n/a
Total Bus Ridership	**67,194**	**56,708**	**18.49%**

Source: County of Hawaiʻi Mass Transit Agency, July 2009 Statistics, accessed 11/10/09 at http://www.heleonbus.org/transit-info-and-statistics/bus-ridership/2009%20-%20july%20monthly%20report.pdf

Presently, there are no amenities for passengers boarding or disembarking from buses in the corridor. Passengers wait for and depart from buses on the roadway shoulder. The MTA and HDOT are considering designated bus pullouts and bus stops at several locations with plans for improvements for passenger safety and comfort.

Bus pullouts and improved amenities for transit users will greatly improve the safety, comfort, schedule reliability, and viability of transit service in the corridor. Improvements will also enable the County's Mass Transit Agency to provide increased routes and service frequencies, and viable transit hubs. Other forms of transit, such as paratransit and school buses will benefit as well.

Because parallel roadways only travel relatively short distances, Keaʻau-Pāhoa Road also serves pedestrians and bicycles as well in much higher levels than might be expected for a rural area. While the existing Keaʻau-Pāhoa Road corridor does not provide a safe or welcoming environment for bicycles or pedestrians to use the corridor, there is a modest amount of pedestrian and bicycling travel along the roadway shoulders. Much of the pedestrian activity comes from accessing transit service in the corridor.

The grades in the corridor are generally flat to moderate, and therefore the corridor would be an attractive route for bicyclists if conditions were safer. While shoulders in the corridor are generally provided for much of the study area, they vary in width and quality for non-motorized travel.

The current use of the Keaʻau-bound shoulder as a temporary AM Peak Hour travel lane precludes safe travel for bicycles or pedestrians in this area. The Shoulder Improvements project will remedy this problem with a new travel lane and shoulder in the Keaʻau-bound direction. However, it will create a similarly dangerous condition in the Pāhoa-bound direction as that shoulder will be improved to be used as a temporary travel lane in the PM Peak Hour.

In addition to pedestrians and bicyclists using the shoulders, there also is regular use of the shoulders by scooters and mopeds. Scooters and mopeds are usually limited to a top speed of about 35 mph and therefore cannot maintain the operating speeds of other motor vehicle traffic.

All these different users of Keaʻau-Pāhoa Road will benefit from improvements to the corridor. Transit will be better served by bus pull-outs at eight intersections, which will afford safer operations in picking up and dropping off passengers. Pedestrians will be accommodated by facilities off the side of the highway. Bicycles will have defined shoulder/bikeway areas that will provide greater separation with motorized traffic and a consistent travel area. Scooters and mopeds will also benefit from these shoulder areas.

1.1.2.4 Future Traffic Increases

The Puna makai area is expected to experience steady growth in coming decades because of the availability of affordable, buildable undeveloped property, especially in the large subdivisions that flank Keaʻau-Pāhoa Road. Traffic volumes and overall Vehicle Miles Traveled (VMT) are expected to increase. Given the existing levels of congestion and past trends of

growth, addressing future traffic levels is clearly an urgent need for the area. The Keaʻau-Pāhoa Road project is an important element in meeting this need.

The project team prepared traffic forecasts for future years in the Keaʻau-Pāhoa Road corridor based on a number of data sources, including the PCDP, the PRCP, the 2000 Census, the Hawaiʻi County 2030 Traffic Demand Model, HDOT Traffic Counts (2002), traffic counts taken for the project in 2006, and population forecasts produced for the PCDP. A travel demand model for future year volumes was developed starting with traffic counts from 2002 and 2006, and modified to account for the very high level of growth in the Puna District.

At the beginning of project planning in 2008, it was assumed that the project would be fully completed by 2018, ten years later. A design year twenty years beyond that 2018 completion date was assumed, as per FHWA guidelines so the modeling and forecasting was projected out to the year 2038. The year 2028 was also modeled during the traffic analyses as an interim year midway between the completion of the road and the design year.

Between the base year of 2006 and the year 2038, overall traffic in the corridor is anticipated to increase 2.34% annually, assuming no Puna Makai Alternative Route (PMAR) is constructed in that intervening time. (See **Section 1.2.3: Related Actions** for more information.) From 2008 to 2038, a 2.34% annual increase, compounded over time, translates into exactly a 100 percent increase, or a full doubling in traffic. If a two-lane PMAR were constructed for the entire proposed length, the corridor would increase in volume 1.74% per year, resulting in a 67.7 percent increase in traffic compounded over thirty years from 2008 to 2038.

Table 1-12: Estimated Average Daily Traffic (ADT) on Keaau - Pahoa Road, 2006-2038 Illustrates the existing and forecasted Average Daily Traffic (ADT) within segments of roadway between 2006 and 2038.

Table 1-12: Estimated Average Daily Traffic (ADT) on Keaau - Pahoa Road, 2006-2038

From	To	Bi-Directional				Percent Change 2006 to 2038
		2006 ADT	2018 ADT	2028 ADT	2038 ADT	
Keaʻau Bypass	Keaʻau Transfer Station	22,588	31,900	41,000	50,400	223%
Keaʻau Transfer Station	Shower Drive	24,148	31,500	39,300	49,800	206%
Shower Drive	Pōhaku Place	18,355	24,400	30,900	38,800	211%
Pōhaku Place	Kaloli Drive	18,348	24,300	30,800	38,500	210%
Kaloli Drive	Pōhaku Circle	18,055	22,800	27,700	33,000	183%
Pōhaku Circle	Orchidland Drive	15,233	20,500	26,200	32,700	215%
Orchidland Drive	Paradise Drive	15,191	20,300	25,800	32,000	211%
Paradise Drive	Auliʻi Street	13,263	17,500	21,900	27,200	205%
Auliʻi Street	Makuʻu Drive	13,257	17,400	21,900	27,200	205%
Makuʻu Drive	Ilima Street	12,985	16,000	19,100	23,700	183%
Ilima Street	Ainaloa Boulevard	12,985	16,000	19,100	23,700	183%
Ainaloa Boulevard	Ka Ohuwalu Drive	12,575	15,600	18,700	23,300	185%
Ka Ohuwalu Drive	Kaluahine Place	12,620	15,800	19,100	23,600	187%
Kaluahine Place	Old Pāhoa Road	12,650	11,000	16,100	23,600	187%
Old Pāhoa Road	Kahakai Boulevard	5,958	7,400	10,600	16,000	269%
Kahakai Boulevard	Nanawale Homestead Rd.	4,467	6,200	8,200	10,800	242%
Nanawale Homestead Rd.	Unnamed Road	4,434	6,000	7,800	10,100	228%
Unnamed Road	Pāhoa-Kapoho Road	6,283	7,900	8,900	10,400	166%
Average Daily Traffic, Full Corridor		**13,600**	**n/a**	**n/a**	**29,950**	**220%**

Sources: Wilbur Smith Associates, Keaʻau -Pāhoa Road Corridor Traffic Forecasting Report, November 9, 2009 (2018 and 2028 data) and Roger Dyar, P.E. (2006 and 2038 data)
*Assumes no Puna Makai Alternate Route is constructed.

Clearly, there will be heavy demand for travel on Keaʻau-Pāhoa Road in the future. The project will be an important way to address these future capacity needs.

1.1.2.5 Support Future Land Use Objectives

The PCDP recognizes that current land use in the Puna District has been strongly influenced by past actions, and that the current trends of spread-out rapid growth and dependency on the Hilo area for services and employment are unsustainable over the long-term. **Section 3.1.3.3: Puna Community Development Plan (PCDP)** outlines in detail the PCDP's plans for future development to be concentrated in a collection of Village and Town Centers. The vision for these Village and Town Centers is for them to serve the immediate area in a live-work-play capacity, and reduce the dependency on automobile access to these centers.

Greater mobility through the lower Puna District from improvements to Keaʻau-Pāhoa Road will increase the viability of these Village and Town Centers' ability to serve the larger community, especially for motorists and users of alternative modes like transit and bicycling. The PCDP calls

for Mass Transportation options to be improved, with a greater percentage of commuters using mass transit. Improvements to Keaʻau-Pāhoa Road will support this goal.

The PCDP calls for improvements to Keaʻau-Pāhoa Road that increase capacity and also integrate multi-modal travel, emphasize safety and traffic calming over efficient travel speed, and incorporate aesthetic features that are compatible with Puna's character into the road design. All of these objectives are supported by the proposed project.

The PCDP calls for an improved roadway network, with emergency and evacuation routes, connectivity between subdivisions, and an alternative, redundant route parallel to Keaʻau-Pāhoa Road (the Puna Makai Alternative Route, or PMAR). In general, the proposed improvements to Keaʻau-Pāhoa Road will be complementary toward this goal and not preclude any implementation of PMAR.

1.1.2.6 Civil Defense, Emergency Travel, and Evacuations

Emergency response in the study area is often hindered by congestion along the roadway during peak hours. Improved shoulders and additional travel lanes will assist emergency responders in getting around traffic and traveling through the corridor.

In the event of a natural disaster such as a lava flow, earthquake, etc., it may be necessary for large numbers of people to evacuate the area. Keaʻau-Pāhoa Road is the only evacuation route available for much of Lower Puna at this time. In addition, a multi-lane facility such as those under consideration for Alternatives 3, 4, and 5 would permit a temporary contra-flow configuration during an emergency situation to accommodate even greater volumes in the direction of evacuating vehicles.

The future consideration of a Puna Makai Alternate Route (PMAR) will eventually improve the situation for evacuations if it is built, but for the foreseeable future, improvements to Keaʻau-Pāhoa Road will be critical to address this situation.

1.1.3 Other Goals and Objectives

The following elements were also identified by KPAG as issues that need to be resolved as part of a successful solution to the problems within the study area:

- Improve highway operations so that the highway will continue to serve as a effective rural minor arterial; the classification of minor arterial is a federal aid definition and in no means diminishes the very major use of the road in the region and the importance of safe usage for all users;
- Be cost-conscious when making recommendations for changes;
- Consider underground relocation of electrical utilities along the route;
- Improve drainage along the route, and correct where there are known drainage problems;

- Support the overall quality of life for the Puna community, including more pleasant travel;
- Improvements should be consistent with County land use and community plans, including the General Plan, Puna Community Development Plan (PCDP) and the Hawaiʻi Long-Range Land Transportation Plan (HLRLTP);
- Support early and effective interagency and community involvement;
- Improve the reliability of access to and from Keaʻau and Pāhoa.

1.2 Project History

1.2.1 Past Planning for Project

Improvements along Keaʻau-Pāhoa Road have been proposed for decades as the area's residential development and population has grown and traffic levels have steadily increased. There have been incremental improvements. Much of the current alignment between the Keaʻau Bypass and the Pāhoa Bypass dates to the 1960s as improvements were made to flood-prone county roads. Planning and environmental studies for a bypass of Pāhoa town were performed in the 1970s and the bypass was constructed in 1990. Planning and environmental studies for the bypass of Keaʻau town were performed in the 1990s with completion of the bypass in 1999.

The Puna Regional Circulation Plan (PRCP), produced in 2005, identified five key problems that affect transportation and the quality of life. These problems included the lack of emergency bypass routes, the Puna District's relatively high motor vehicle fatality rate, the region's rapid growth, the lack of provisions for equal access to transportation, and the auto-dependency created by existing land use patterns.

The PRCP called for improved traffic safety by improving intersections and safe routes to school. It recommended improved accommodation of peak-hour traffic for commuters with wider roads, an alternate parallel route, connectivity between subdivisions, transportation demand management, bike paths, and a variety of transit improvements. Connectivity between different modes was emphasized and mixed-use developments that would serve transit and pedestrians were recommended. A major element of the PRCP was widening of Keaʻau-Pāhoa road to 4 lanes between Keaʻau and Pāhoa as well as widening Highway 11 to four lanes wide between Keaʻau and Kurtistown.

The Puna Community Development Plan (CDP) was first issued in 1995 and updated in 2008. In 1995, the plan called for study of feasibility of widening Highway 130 to a four-lane arterial between the Pāhoa Bypass and planned Keaʻau Bypass, and to eliminate frontage access. The 2008 plan introduced a plan for land use changes that would provide destinations within Puna (Village/Town Centers concept). The 2008 PCDP also called for a variety of transportation improvements, including traffic demand management, mass transit, constructing alternative routes, and improvements to highways. For Highway 130 specifically, it called for increasing

the capacity of the highway to four lanes between Keaʻau Bypass and Ainaloa Boulevard, reducing the speed limit in this segment to 45 mph, various intersection improvements, studying safety for pedestrians/traffic calming, and implementing interim improvements described below in **Section 1.2.2: Interim Improvements**.

As noted earlier, HDOT recognized the value in getting community involvement into the planning stages of this project through a Context Sensitive Solutions (CSS) process. The community was solicited for representatives to serve on the Keaʻau-Pāhoa Advisory Group (KPAG) in 2008. KPAG first met in August of 2008 and the group met a total of eight times as of the end of 2009 and they will continue to meet until the EA process is completed. KPAG considered traffic counts/forecasts and the environmental review process. The group looked at a wide range of alternative options, then built consensus on the set of reasonable alternatives through an evaluation process of ranking and screening criteria. The CSS process undertaken by the KPAG ultimately identified the reasonable alternatives (studied in this EA) that met the community needs and values, with an emphasis on safety, quality of life, and the environment. KPAG also came to a consensus on a purpose and need statement for this project. See **Section 1.3: Community Participation in Determination of Project Purpose and Need** along with **Section 7.1: Community Participation and CSS Process** for additional details of this process.

1.2.2 Interim Improvements

To address the pressing short term needs for safety and operational improvements on Keaʻau-Pāhoa Road within the study area, HDOT is pursuing improvements. These improvements will address more immediate needs that can be performed for low cost, in a faster timeframe than the project under study in this EA. Therefore, these interim improvements should be considered complementary actions to the proposed action, but are not part of the alternatives in the EA. This EA assumes that the quick fix improvements will have already been implemented before the improvements outlined in Chapter 2 have been initiated. Where necessary, HDOT is performing separate environmental review for the quick fix improvements under NEPA and Hawaiʻi Chapter 343.

The primary interim improvements under consideration include the Keaʻau-Pāhoa Road Shoulder Lane Conversion Project, and a group of other improvements described below.

1.2.2.1 The Keaʻau-Pāhoa Road Shoulder Lane Conversion Project

A Draft Environmental Assessment was issued in November, 2009 for the Keaʻau-Pāhoa Road Shoulder Lane Conversion project, Keaʻau Bypass Road to Shower Drive, Project No. 130-B-01-02, which is slated for completion in 2012. The Shoulder Lane Conversion project calls for:

- A new lane to be constructed on Keaʻau-Pāhoa Road between Shower Drive and the Keaʻau Bypass heading in the Hilo-bound direction, and a 10-foot shoulder will be added. Therefore, there will be two Hilo-bound travel lanes available 24 hours a day, with a shoulder that functions exclusively as a shoulder.

- The shoulder in the Pāhoa-bound direction to be improved and made continuous between the Keaʻau Bypass and Shower Drive. Therefore, during the PM peak hour only, the Pāhoa-bound shoulder would be opened as a second travel lane to handle peak volumes. There would only be one Pāhoa-bound travel lane in off-peak times.
- To accommodate the wider cross-section, the Waipāhoehoe Bridge would be widened.
- An abandoned 1930s-era concrete bridge immediately upstream of the Waipāhoehoe Bridge would be demolished to improve drainage in the area.
- A traffic signal would be installed at the intersection of Keaʻau-Pāhoa Road and Shower/Pōhaku Drives.

1.2.2.2 Other Interim Improvements

Several "quick fix" actions are being considered by HDOT to improve safety in the corridor prior to the full build-out of the Keaʻau-Pāhoa Road Improvements suggested in this EA:

- Reducing speed limits on one mile of the Pāhoa Bypass to create a uniform 45 mph limit
- Seeking funding to install left-turn acceleration pockets at problem intersections
- Interim bus stops as per EA's recommendations outlined in **Section 4.2.8: Transit**
- Improved signage, striping, and channelization at Kahakai Boulevard (starting late 2010)
- Interim access modifications at Route 130/Old Pāhoa Road intersection

1.2.3 Related Actions

As recognized by the PRCP and PCDP, there has been a pressing need within the growing Puna District for an alternative roadway under Hawaiʻi County's jurisdiction to provide redundancy with Keaʻau-Pāhoa Road. Besides the acute congestion resulting from only a single access highway in lower Puna, it is possible that hazards such as traffic accidents, lava flows, hurricanes, and flooding could cause closure of SR 130 between Keaʻau and Pāhoa. In the case of such closures, an alternative county route may be warranted.

When funds become available, the County of Hawaiʻi intends to pursue a separate study, the Puna Makai Alternative Route (PMAR). PMAR will require extensive study of options for constructing such an alternative facility makai of Keaʻau-Pāhoa Road to connect Puna Makai and the Hilo area. The timeframe for the PMAR study and any construction is indeterminate at this time. While that highway would clearly complement this project, it is not part of the proposed action. Nothing in the alternatives studied in this EA will preclude constructing PMAR.

1.3 Community Participation in Determination of Project Purpose and Need

As noted above, HDOT and the consultant team are currently conducting a rigorous community participation program over a twelve-month period for the proposed project. From a community issues perspective, this effort is important because development of the proposed

project included a representative group of community leaders in the KPAG. Further, it also means that a portion of the community was aware of the project processes due to the networks of members of the KPAG.

Highlights of the community participation program that has occurred thus far are as follows:

- A project website, http://keaau-pahoa.com/ provides an overview of the project, notices about KPAG meetings, KPAG meeting summaries, KPAG presentation/handout materials, and an opportunity for the public to comment or make inquiries about issues related to the project.

- A public meeting was held at the onset of the project in April 2008 at the Kea'au Community Center. The project approach was presented, including the process for developing alternatives, the use of the Context Sensitive Solutions approach in project development, and the overall public involvement program that included the KPAG.

- Between August 2008 and October 2009, KPAG and the project team held eight meetings, one of which occurred over a two-day period. These meetings were designed to ensure that community values were incorporated in the understanding the purpose and need of the project, in the evaluation of criteria for weighing the range of alternatives, and in the identification of alternatives for the project corridor.

- Two public meetings were held in April 2009 at the Pāhoa Intermediate/High School and Kea'au Elementary School to present the findings of the KPAG process to date.

KPAG meetings will continue throughout the EA process.

The use of the Context Sensitive Solutions, or CSS, approach was fundamental in designing and implementing the community participation program. The core principles of CSS apply to transportation processes, outcomes and decision making, and include:

- Strive towards a shared stakeholder vision to provide a basis for decisions,
- Demonstrate a comprehensive understanding of contexts,
- Foster continuing communication and collaboration to achieve consensus, and
- Exercise flexibility and creativity to shape effective transportation solutions, while preserving and enhancing community and natural environments.

In keeping with the CSS approach, the project team and KPAG worked on understanding how participants feel about their community, how they use the roadway system and what is the purpose and need for the proposed project. **Table 1-13: Summary of KPAG's Purpose and Need for the Proposed Project** presents the categories of purpose and need for the proposed project that emerged in KPAG meetings. These categories, as well as the criteria and ways to measure the needs, were unanimously approved by the KPAG in December 2008.

As the KPAG worked with the project team, a series of alternatives emerged, as discussed in greater detail in **Chapter 2: Alternatives**.

Table 1-13: Summary of KPAG's Purpose and Need for the Proposed Project

Categories of Purpose and Need	Criteria	Ways to Measure
Improve roadway safety	• Reduce the number of accidents and their severity • Reduce the number of points of conflict at intersections • Improve merge movements • Improve or eliminate movements out of driveways	• Number of accidents • Number of driveways • Adequate distance for Merge movements • Reduced number of driveway left turns • Use on and off ramps for side streets entering the main road
Configure the road for safe use by transit vehicles and school buses, bicyclists, pedestrians and agriculture vehicles	• Increased transit ridership and level of transit service • Increased use of the corridor by bicyclists and pedestrians • Create safe and attractive bus waiting areas that are user-friendly and barrier free	• Number and percent of transit riders • Number and percent of bicycle riders • Number of improved bus waiting areas • Number of barrier free staging areas
Improve corridor mobility and capacity to meet future demand	• Ability to accommodate future average daily use of the corridor • Ability to accommodate traffic during future peak periods • Reduction in delay • Improved levels of service • Equity • Efficiency	• Level of Service (LOS) • Travel Time • Delay Time • Number of daily vehicles (AADT) • Number of vehicles in AM and PM peaks • LOS is improved for different segments of the community
Respect the natural beauty of Puna	• Preserve scenic vistas o towards Mauna Kea o at the Catholic Church o towards the ocean • Preserve canopy trees • Bury utility lines • Use materials and landscape plantings that are sensitive to the area	• Vistas are retained • Landscape materials include canopy trees • Choice of materials and plants are endorsed by community • Number of utility poles are reduced
Complement creation of an alternate road that can be used both as an additional travel route and for emergency use	• Improve access for emergency vehicles • Create connections between Highway 130 and any new alternate route • Reserve right-of-way for other means of travel • Create redundancy for temporary closures	• Successful completion of a second route in Puna district by County that creates redundancy • Emergency vehicles have lanes available for their use during emergencies • Intersections improved for use by emergency vehicles

1.4 Environmental Justice

Project team efforts to engage minority and low income groups in the planning and alternatives development for the proposed project are discussed in **Section 3.3.2.3: Incorporation of Title VI and Environmental Justice Requirements into the Proposed Project**. The anticipated effects of the project on Environmental Justice communities are discussed in **Section 4.3.3: Impacts on Environmental Justice Communities**.

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CHAPTER 2: ALTERNATIVES

The section that follows covers the alternatives that will be evaluated for their environmental impacts in **Chapter 4: Environmental Impacts and Mitigation Measures.** It also identifies alternatives that were considered during the planning phase of the project, then eliminated from further consideration.

Five Alternatives, called Alternative 1 through Alternative 5 are discussed in this Chapter. In the discussions that follow throughout this EA, the term "Build Alternatives" collectively refers to Alternative 3, Alternative 4, and Alternative 5.

2.1 Alternative 1 - No-Build Alternative

The No-Build Alternative would generally keep the existing facility in its existing condition, and only includes any improvements that are already programmed and funded. While the No-Build Alternative would not fulfill the Purpose and Need for the project, it is always included in EA documents as a baseline condition for comparison to other alternatives.

As noted in **Section 1.2.2, Interim Improvements**, a number of actions are programmed and funded to improve Keaʻau-Pāhoa Road prior to the full construction of the project as outlined in this EA. These improvements are considered as part of the No-Build Alternative. These interim improvements include the Keaʻau-Pāhoa Shoulder Lane Conversion project, which would make the improvements outlined in **Table 2-1: Improvements in Keaʻau-Pāhoa Shoulder Lane Conversion Project**.

Table 2-1: Improvements in Keaʻau-Pāhoa Shoulder Lane Conversion Project

Construct a new Keaʻau-bound shoulder lane and a second Keaʻau-bound travel lane available for use 24 hours a day
Improve the Pāhoa-bound shoulder such that it would serve as a temporary travel lane during the PM Peak hours (along with the existing Pāhoa-bound travel lane)
Provide a traffic signal at the intersection of Shower Drive/Pōhaku Drive and Keaʻau-Pāhoa Road.
To accommodate the wider cross-section, the Waipāhoehoe Bridge would be widened.
An abandoned 1930s-era concrete bridge immediately upstream of the Waipāhoehoe Bridge would be demolished to improve drainage in the area

Source: HDOT

The No-Build Alternative also includes interim plans for improved signage, striping, and channelization at Kahakai Boulevard.

2.2 Alternative 2 - TSM Alternative

A Transportation Systems Management (TSM) alternative will provide another measure for comparison to the "Build Alternatives" as it considers low-cost and low-impact improvements that could be implemented easily and quickly with minimal levels of construction. TSM actions attempt to address the needs of the project without full implementation of the Build Alternatives. **Appendix A: Roadway Design Plans** show where TSM improvements would be implemented. It should be noted that any of the elements of the TSM Alternative could be incorporated as well into the Build Alternatives 3 through 5.

Actions that are evaluated under the TSM alternative include the following:

- Traffic control: Signals or Roundabouts
- Turn Lanes
- Access Management
- Transit Improvements
- Other Improvements

2.2.1 Traffic Control Improvements: Signals or Roundabouts

As part of the TSM Alternative, locations where intersection improvements with traffic signals or roundabouts are warranted are discussed in greater detail in **Section 2.4.1: Signalized Intersections** and in **Section 2.4.3: Roundabouts.** It should be noted that roundabouts are only assessed when they can be accommodated on a two-lane road cross-section since HDOT's official policy on roundabouts does not allow multi-lane roundabouts. The analysis of roundabouts discussed in **Section 4.2.3: Roundabouts** notes that under the TSM Alternative (and Alternative 3 as well), based on the traffic volumes in 2038, a roundabout could be considered in place of a traffic signal at Kahakai Boulevard, but other locations may be viable for improvements prior to 2038. Therefore traffic analyses took the added step of determining in what future years roundabouts would be feasible. In later years, and if HDOT policy changes to allow two-lane roundabouts, these locations could be widened, otherwise they could be converted to traffic signals.

2.2.2 Turn Lanes

Some of the intersections in the corridor have adequate turn lanes and others need new or lengthened turn lanes. As part of the TSM Alternative, turn lane additions and/or lengthening and other intersection improvements can be made at locations with available right-of-way and minimal construction impacts. Widening certain cross-streets may improve traffic operations, with or without new traffic signals or roundabouts. **Table 2-2: Turn Lane Additions or Lengthening Under TSM Alternative** indicates the locations where turn lanes (with a taper transition area) would be added or lengthened. Acceleration lanes would also be provided for turning traffic exiting intersections in these locations.

Table 2-2: Turn Lane Additions or Lengthening Under TSM Alternative

Intersection	Traffic Control	Travel Direction	Modification	Length (ft.), Including Tapers
Shower Drive	Committed Signal*	Mauka	New right turn lane	430
Kaloli Drive	New Signal	Mauka	New right turn lane	430
Orchidland Drive	New Signal/Roundabout	Makai	New right turn lane	305
Paradise Drive	New Signal/Roundabout	Mauka	New right turn lane	430
Makuʻu Drive	New Signal/Roundabout	Mauka	New right turn lane	455
Ainaloa Boulevard	New Signal/Roundabout	Makai	New left turn lane	455
Ka Ohuwalu Drive	Stop Sign	Mauka	New right turn lane	230
Old Pāhoa Road	New Signal	Makai	New right turn lane	630
Kahakai Boulevard	New Signal/Roundabout	Mauka	New right turn lane	430
Nanawale Homestead Rd.	Stop Sign	Mauka	New right turn lane	355
Pāhoa-Kapoho Road	Existing Signal	Makai	Lengthen existing left turn lane	430
		Mauka	New right turn lane	430

*Will already be in place as part of Shoulder Improvements Project

2.2.3 Access Management

One of the major problems compromising safety on Keaʻau-Pāhoa Road is the uncontrolled access along the corridor. An important element of the TSM Alternative will be to limit the number of access points along the most intensively-developed portion of the corridor. When the Hawaiian Paradise Park and Orchidland subdivisions were developed, none of the access streets were connected across the highway, and this has resulted in a large number of three-way intersections (T-intersections). There may also be a large number of driveways that will become right-in/right-out only access points. By consolidating access points to a smaller number of traffic-controlled intersections (which will use traffic signals or roundabouts), the TSM Alternative will greatly improve safety, particularly for those vehicles that wish to make a left turn to/from a cross-street and need to cross opposing flows of traffic.

The access management changes that are proposed will support the PCDP's goals of Village and Town Centers by providing improved, direct access to those areas from Keaʻau-Pāhoa Road. Refer to **Section 3.1.3.3: Puna Community Development Plan (PCDP)** for more information.

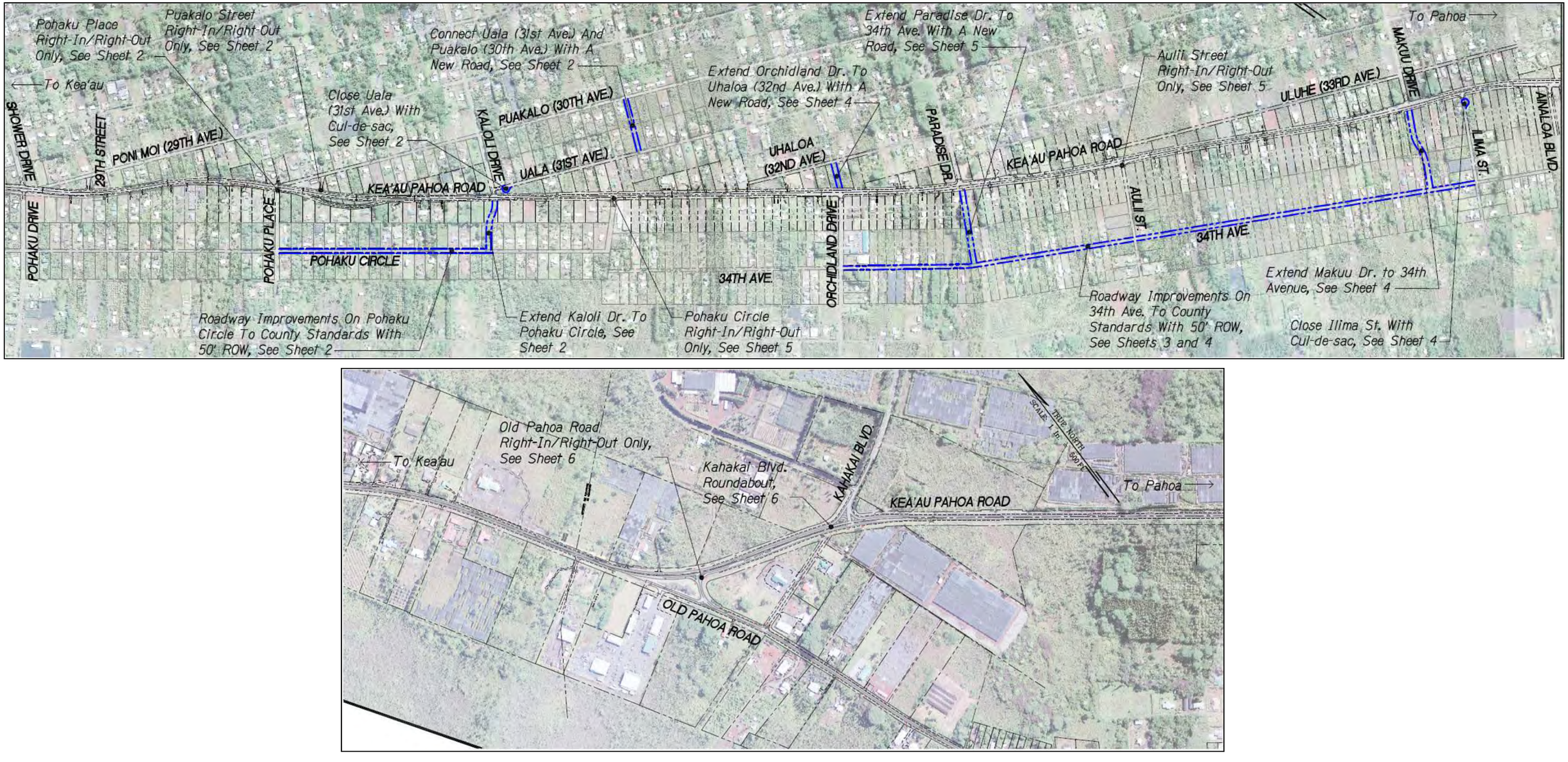
One effect of limiting access is that travelers will often incur some longer trips than they do today, and may need to make U-turns at a controlled intersection or otherwise modify their routes to get to their destination.

Figure 2-1: Access Management Changes Along Keaʻau-Pāhoa Road shows the access management strategy under the TSM Alternative. **Figure 2-2: U-Turn Options** provides a schematic view of how the two-lane TSM alternative would accommodate U-turn movements.

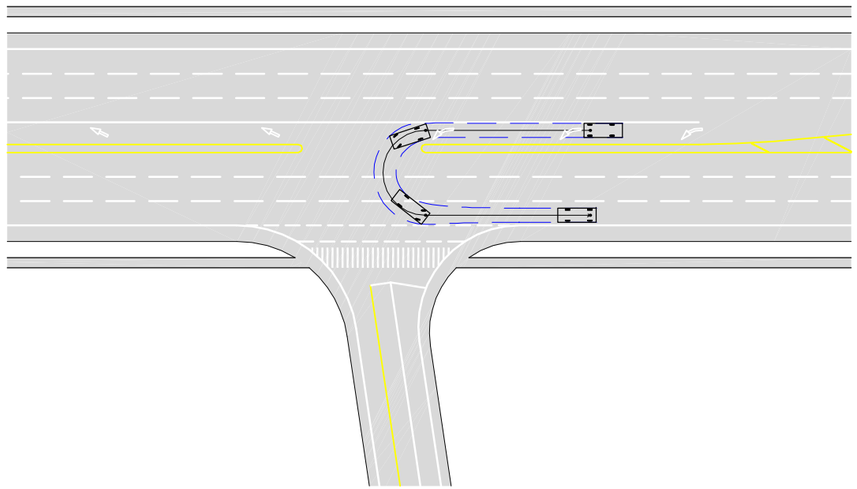
The strategy for controlling access would close off some accesses build new roadways, and improve current substandard roads to county standards, paved, with a 50-foot right-of-way. The locations and features include:

- A new two-lane Kaloli Drive extension constructed to county standards would extend opposite Kaloli Drive about 620 feet to connect with Pōhaku Circle, traversing two vacant properties. The Kaloli Drive intersection now would be a four-way intersection, and be served with a traffic signal or roundabout. The new Kaloli Drive extension would serve traffic that now uses Pōhaku Place and Pōhaku Circle. About a half mile of Pōhaku Circle between Pōhaku Place and the extension of Kaloli Drive would be brought up to County standards.
- To improve the Kaloli Drive intersection's operations, Uala Avenue (31st Avenue) would be turned into a cul-de-sac just before its intersection with Kaloli Drive. To provide properties on Uala/31st Avenue with access to Kaloli Drive (and Keaʻau-Pāhoa Road), a new connector road about 700 feet in length would be constructed between Uala/31st Avenue and Puakalo Avenue (30th Avenue). There may be the need to upgrade some subdivision roads to county standards depending on traffic volumes. This will be determined during final design.
- The intersection of Puakalo Avenue (30th Avenue) and Keaʻau-Pāhoa Road would be converted to a right-in-right-out configuration for Puakalo/30th Avenue traffic. Travelers that now make a left turn to or from Puakalo/30th Avenue would use Kaloli Drive and the traffic control provided at that intersection.
- The intersection of Pōhaku Place and Keaʻau-Pāhoa Road would be converted to a right-in-right-out configuration for Pōhaku Place traffic. Travelers that now make a left turn to or from Pōhaku Place would use the new Kaloli Drive extension via Pōhaku Circle (described above).
- The intersection of Pōhaku Circle and Keaʻau-Pāhoa Road would be converted to a right-in-right-out configuration for Pōhaku Circle traffic. Travelers that now make a left turn to or from Pōhaku Circle would use the new Kaloli Drive extension described above.
- A new two-lane Orchidland Drive extension constructed to county standards would extend opposite Orchidland Drive about 320 feet to connect with ʻUhaloa Avenue (32nd Avenue), traversing one vacant proprerty. The Orchidland Drive intersection now would be a four-way intersection, and be served with a traffic signal or roundabout. The new roadway would improve access between Hawaiian Paradise Park and the Orchidland subdivision, and enhance the village center proposed for the commercial area on Orchidland Drive. There may be the need to upgrade some subdivision roads to county standards depending on traffic volumes. This will be determined during final design.

Figure 2-1: Access Management Changes Along Kea'au-Pāhoa Road

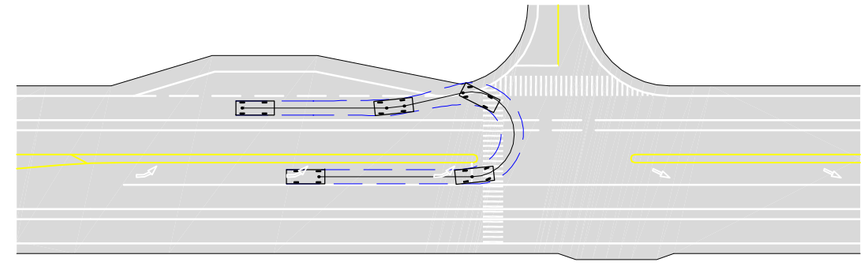


Note: Images not to scale. Refer to **Appendix A-3: TSM Alternative Access Management Plan** for more details and sheets that are referred to in this figure.



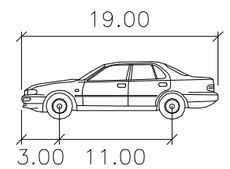
U–TURN 6 LANE OPTION

SCALE: 1" = 75'



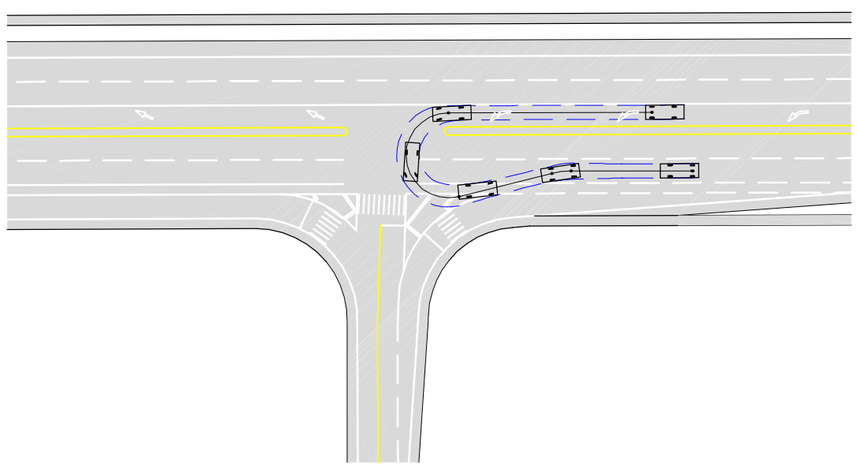
U–TURN 2 LANE OPTION

SCALE: 1" = 75' (BUS STOP)



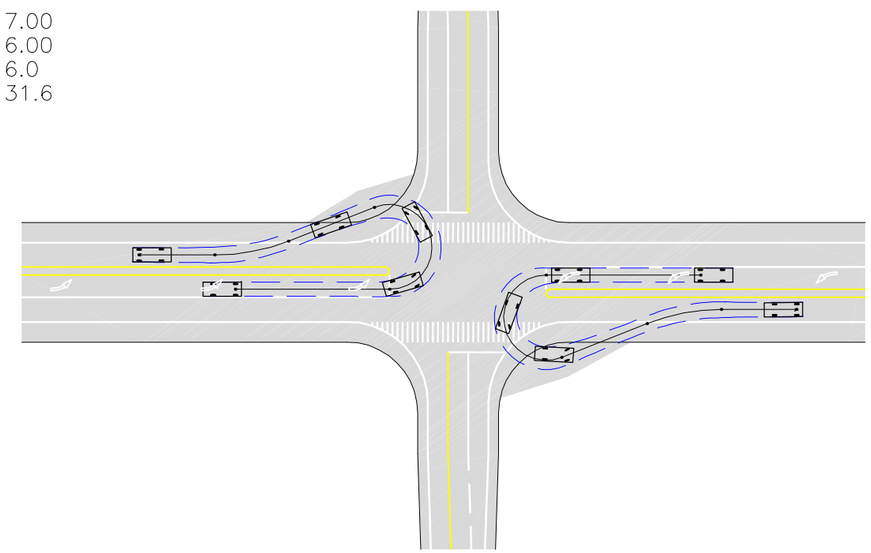
P

		feet
Width	:	7.00
Track	:	6.00
Lock to Lock Time	:	6.0
Steering Angle	:	31.6



U–TURN 4 LANE OPTION

SCALE: 1" = 75'



U–TURN 2 LANE OPTION

SCALE: 1" = 75' (NO BUS STOP)

SSFM INTERNATIONAL

SSFM INTERNATIONAL, INC.
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

U–TURN OPTIONS

FIGURE 2–2

- Between Orchidland Drive and Ilima Street, 34th Avenue will be upgraded to county standards for a distance of about 1.5 miles to serve several access changes at Orchidland Drive, Paradise Drive, Auliʻi Street, and Ilima Street.
- A new two-lane Paradise Drive extension constructed to county standards would extend opposite Paradise Drive about 950 feet to connect with an upgraded 34th Avenue (described above), traversing one property with a house and one vacant property. The Paradise Drive intersection now would be a four-way intersection, and be served with traffic control (traffic signal or roundabout). The new roadway would improve access between Hawaiian Paradise Park and the Orchidland subdivision, and enhance the village center proposed for the commercial area on Orchidland Drive by providing an alternative access route mauka of Keaʻau-Pāhoa Road.
- The intersection of Auliʻi Street would be converted to right-in-right-out access. Traffic that now makes left turns to or from Auliʻi Street would use the controlled intersection at either Orchidland Drive, Paradise Drive (extended), or Makuʻu Drive (extended, as described below).
- A new two-lane Makuʻu Drive extension constructed to county standards would extend opposite Makuʻu Drive about 1,050 feet to connect with an upgraded 34th Avenue, traversing two vacant properties. The Makuʻu Drive intersection now would be a four-way intersection, and be served with a traffic signal or roundabout. The new roadway would serve traffic that now uses Auliʻi Street and Ilima Street.
- Ilima Street would be closed off with a cul-de-sac at Keaʻau-Pāhoa Road. Traffic that currently uses Ilima Street to access Keaʻau-Pāhoa Road would use the improved traffic controlled intersection at the extension of Makuʻu Drive (about 600 feet away) via upgraded 34th Avenue.
- Old Pāhoa Road (at the north end of Pāhoa near Pāhoa Marketplace) would be converted to right-in-right-out access, while Kahakai Boulevard would be re-opened as a full four-way intersection with a signal or roundabout providing traffic control. Traffic that now makes left turns to or from Old Pāhoa Road would use Kahakai as an alternative access to/from the Pāhoa Marketplace and Pāhoa Village. An additional option in this area may be to provide a direct right-turn access from Pāhoa-bound Keaʻau-Pāhoa Road into the Pāhoa Marketplace using the "old" roadway that runs directly in front of the shopping center. The feasibility of such a design would depend on a deceleration/turn lane in the area that permits this traffic movement to be made safely.

These access management improvements would provide benefits by shifting left-turning traffic from uncontrolled intersections to traffic-controlled intersections (signal or roundabout.) **Table 2-3: Reduction in Intersection Turning Movements at Right-In-Right-Out Intersections** shows the reduction in traffic when five intersections are converted to right-in-right-out configurations.

Table 2-3: Reduction in Intersection Turning Movements at Right-In-Right-Out Intersections

Right-In-Right-Out Intersection of Keaʻau-Pāhoa Road at	Total Turning Movements Eliminated in Year 2018 (Vehicles per Day)	Total Turning Movements Eliminated in Year 2038 (Vehicles per Day)
Pōhaku Place	535	635
Pōhaku Circle	140	190
Auliʻi Street	330	390
Ilima Street	65	65
Old Pāhoa Road	3,850	4,015
Total 5 Intersections	**4,920**	**5,295**

Source: SSFM International and Roger Dyar, P.E.

2.2.4 Transit Improvements

Transit improvements such as the installation of bus stops, bus pull-outs, park and ride lots and other measures designed to increase transit usage and decrease the number of automobiles using the corridor. Locations for bus pull-outs/bus stops were selected after consultation with the Hawaiʻi County Mass Transit Agency. Bus pull-outs with bus stops are proposed along both sides of the roadway corridor near:

- Shower Drive
- Kaloli Drive
- Pōhaku Circle (Pāhoa - bound direction only)
- Orchidland Drive
- Paradise Drive
- Makuʻu Drive
- Ainaloa Boulevard
- Makuʻu Farmer's Market

2.2.5 Other Improvements

2.2.5.1 Approach to Shower/Pōhaku Drives Intersection

While the Shoulder Improvements project (see **Section 1.2.2.1: The Keaʻau-Pāhoa Road Shoulder Lane Conversion Project**) will provide a new traffic signal at the intersection of Keaʻau-Pāhoa Road and Shower/Pōhaku Drives, TSM adds a second through-lane in the Keaʻau-bound direction on the approach to this intersection. This will increase the capacity of the intersection by taking advantage of the two travel lanes beyond the intersection provided by the Shoulder Improvements project.

2.2.6 Land Use Strategies Identified in the PCDP

The TSM Alternative (as well as the Build Alternatives 3, 4, and 5) assumes "Village Centers" and "Town Centers" are developed as per the Puna Community Development Plan. Refer to **Section 3.1.3.3: Puna Community Development Plan (PCDP)** for more detailed information on what these developments would entail. A series of village oriented development centers might result in lower overall traffic volumes in the corridor, and therefore better traffic operations with less roadway construction.

An assessment of the timing and implementation of the likely village and town centers was performed to enable assumptions of traffic generated by the centers under the TSM and other alternatives. (Colliers Monroe Friedlander Consulting, 2009). The assessment sought to determine what conditions would be necessary to encourage the village and town center developments, what comparable neighborhoods in Hawaiʻi have had similar developments, and how many years it would take for the centers to initiate development and be fully built out. This assessment was based on population growth, housing sales, economic growth projections, available infrastructure, public support, financing availability, and other factors.

Table 2-4: Estimated Development Timeline for Commercial Centers in PCDP indicates the estimated progression of development for the various targeted markets identified in the Puna CDP. The anticipated timeline of development will follow various stages, starting with no development, followed by limited owner-user development, then by limited owner user development and small commercial development. Neighborhood centers will be later considered then regional center projects once the population base and market demand reach appropriate levels.

The Puna trade area is widely dispersed over a large geographic area, and as a result a village center concept would best be applied to only those areas with the heaviest resident population density. Areas such as Keaʻau and Pāhoa best meet those pre-conditions in order to elicit commercial development interest. However, as the table illustrates, it is likely that much of the development suggested in the PCDP might be at least 15 to 20 years into the future, with full build out to the levels prescribed by the PCDP occurring far beyond that.

Table 2-4: Estimated Development Timeline for Commercial Centers in PCDP

PCDP Market	PCDP Proposed Center* (see Sec. 3.1.3.3)	Estimated Commercial Development Timeline				
		5 years	10 years	15 years	20 years	25 years
Kea'au	Regional Town Center	Limited owner user development, small commercial	Neighborhood Centers	Community Centers	Community Centers	Community Centers
Pāhoa	Regional Town Center	Limited owner user development	Small commercial	Neighborhood Centers	Neighborhood Centers	Neighborhood Centers
Hawaiian Paradise Park	1- Regional Town Center, 1-Community Village Center 1-Neighborhood Village Center	No Development	Limited owner user development	Limited owner user development, small commercial	Neighborhood Centers	Community Centers
Orchidland	Neighborhood Village Center	No Development	Limited owner user development	Limited owner user development, small commercial	Neighborhood Centers	Neighborhood Centers
Hawaiian Acres	Community Village Center (in Kurtistown)	No Development	Limited owner user development	Limited owner user development, small commercial	Neighborhood Centers	Neighborhood Centers
Ainaloa	Community Village Center	No Development	Limited owner user development	Limited owner user development, small commercial	Neighborhood Centers	Neighborhood Centers
Hawaiian Beaches	Neighborhood Village Center	No Development	No Development	Limited owner user development	Limited owner user development, small commercial	Limited owner user development, small commercial
Nanawale	Future location subject to Community Review	No Development	No Development	Limited owner user development	Limited owner user development, small commercial	Limited owner user development, small commercial
Leilani Estates	Future Location Subject to Community Review	No Development	No Development	Limited owner user development	Limited owner user development, small commercial	Limited owner user development, small commercial
Kapoho	Future Location Subject to Community Review	No Development	No Development	Limited owner user development	Limited owner user development, small commercial	Limited owner user development, small commercial

*Key: Regional Town Center = >30 acres, up to 250,000 sq. ft.; Community Village Center = 10-30 acres, up to 150,000 sq. ft.; Neighborhood Center = <10 acres, up to 50,000 sq. ft. Source: Colliers Monroe Friedlander Consulting, 2009 and PCDP, 2008.

2.3 Build Alternatives 3, 4, and 5

Alternatives 3, 4, and 5, which collectively are described as the "Build Alternatives," will widen the highway to varying levels to address the Purpose and Need for this project. The cross-sections of the roadway are described in detail in the sections that follow.

The Build Alternatives assume a design year of 2038. The design is currently at a very conceptual level. Decisions about curve radii, grades, slopes, etc. will be finalized during final design. The design of the highway will be consistent with HDOT standards and the design standards of the American Association of State Highway Transportation Officals (AASHTO).

2.3.1 Alternative 3 - Four-/Two-Lane Section

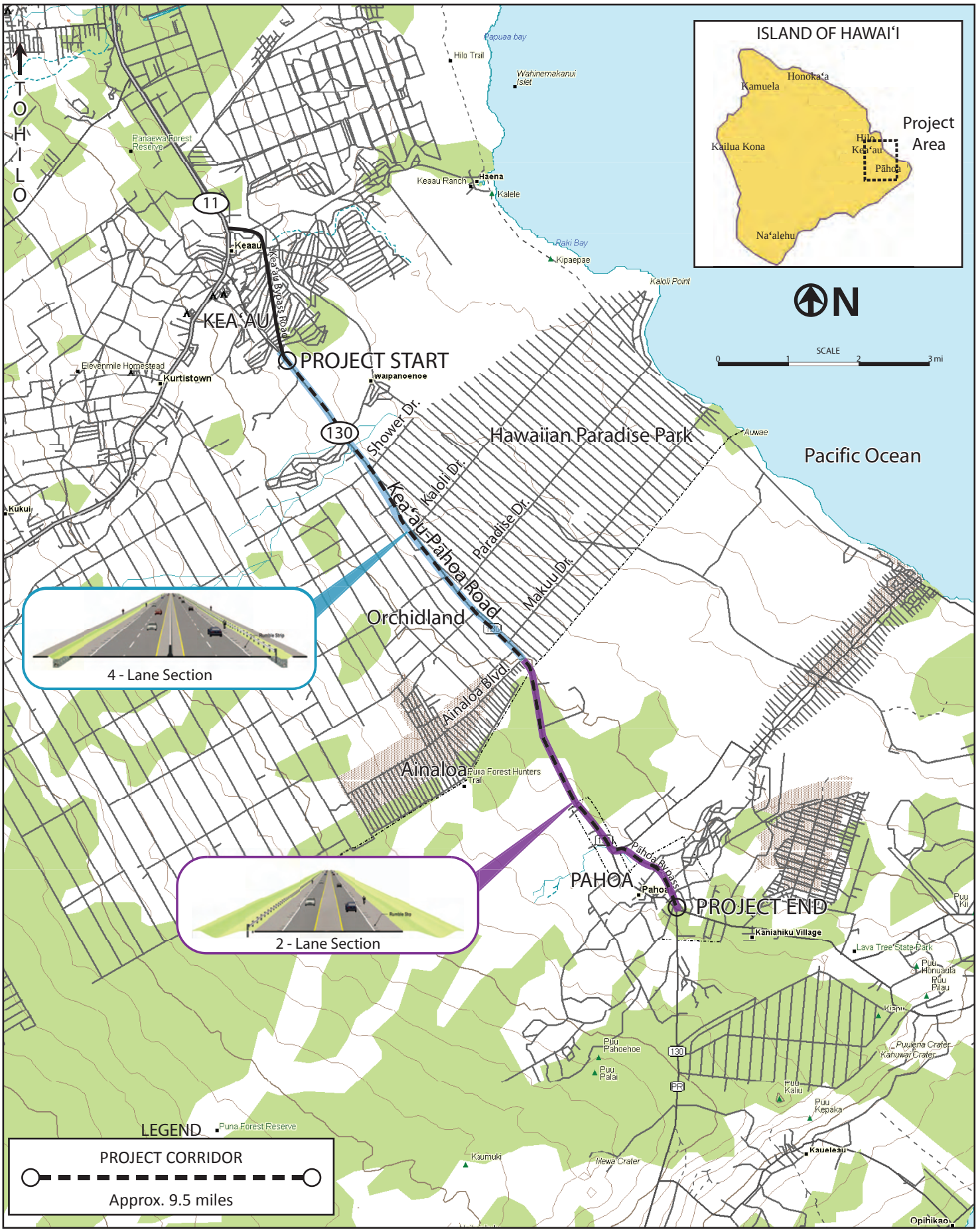
Alternative 3 (see) would widen the highway to contain a four-lane divided cross section between the end of the Keaʻau Bypass and Ainaloa Boulevard. The segment from Ainaloa Boulevard to Pāhoa-Kapoho Road would remain with two travel lanes, but would have safety improvements at intersections and access points to greatly improve safety compared to current conditions. **Appendix A: Roadway Design Plans** shows detailed design of Alternative 3.

Alternative 3 will incorporate designs that contain Context Sensitive features, in an effort to make the future roadway as compatible as possible with the surrounding communities. While many of the elements will not be designed until the final design stage, these features would incorporate the community's preferences and include landscaping (with preference for non-invasive native species) and context sensitive designs of walls/structures, etc. If practicable, design exceptions may be considered on a case-by-case basis where protection of an important community or cultural feature constrains the design.

Improvements to intersections such as signalization and roundabouts are discussed in **Section 2.4, Intersection Treatment Alternatives** below.

2.3.1.1 Alternative 3 Cross Section

Figure 2-4: Typical Cross Section for Four-Lane Segments shows the conceptual cross-section for the four-lane roadway, and **Figure 2-5: Typical Cross Section for Two-Lane Segments** shows the conceptual cross section for the two lane roadway. These cross-sections are only representative and could vary in specific locations, such as where turn lanes are provided. Alternative designs that include context-sensitive elements like landscaping or other decorative features may be considered where appropriate. The concrete median barrier shown in the four-lane cross section is for conceptual purposes to represent some type of median treatment. The specific type of median treatment will be specified during the later stages of design.



Build Alternative 3 - Combination of 4 Lanes to Ainaloa Blvd; 2 Lanes to Kapoho Road

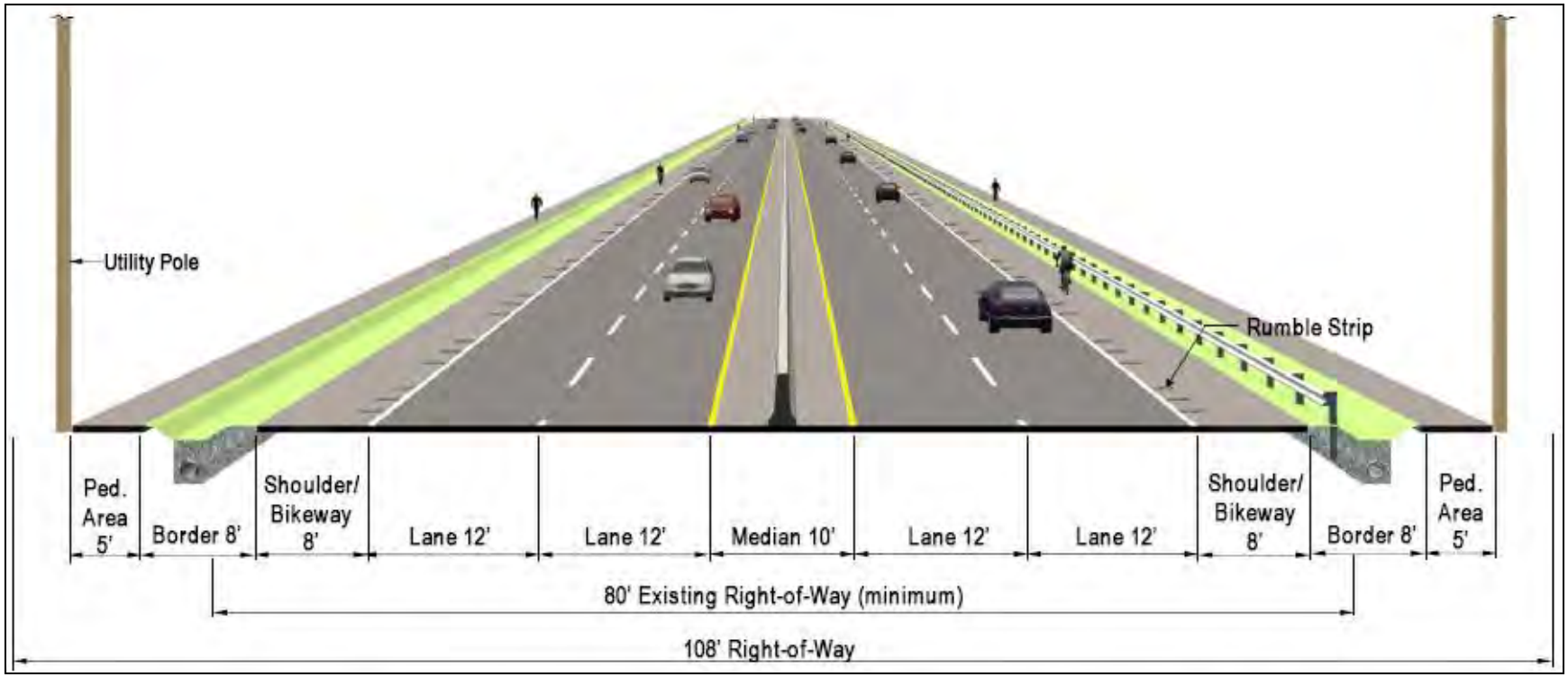
Kea'au-Pāhoa Road Improvements Environmental Assessment, Kea'au to Pāhoa, Project No. STP-0130(27)

State of Hawai'i, Department of Transportation

Figure 2-3

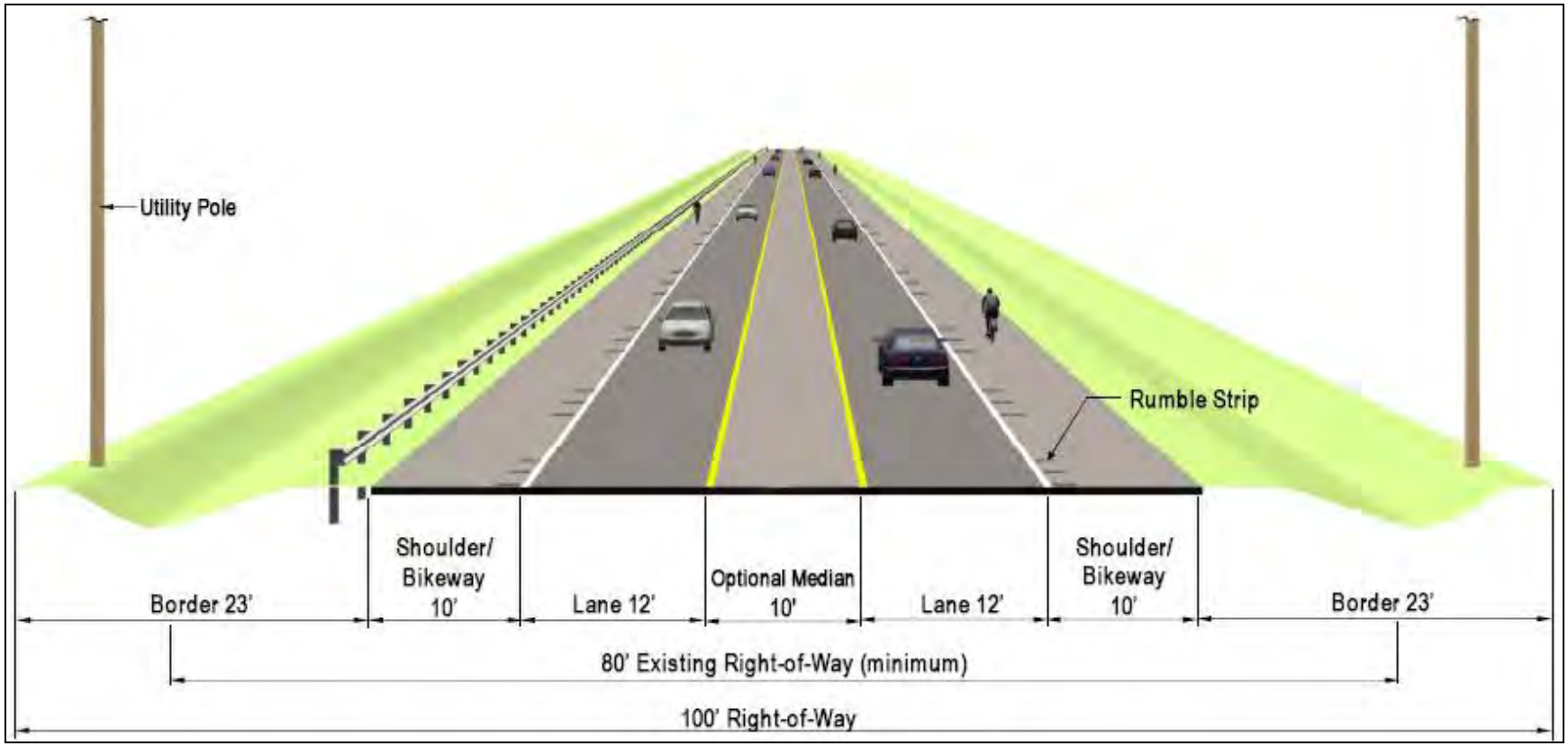
Source:
DeLorme 3-D TopoQuads

Figure 2-4: Typical Cross Section for Four-Lane Segments



Note: Not to scale. Representative view; features such as guardrails may or may not be provided as needed on either or both sides at any given location.

Figure 2-5: Typical Cross Section for Two-Lane Segments



Note: Not to scale. Representative view; features such as guardrails may or may not be provided as needed on either or both sides at any given location.

For the four-lane section, travel lanes would be 12 feet wide, and a full eight foot shoulder/bikeway area would be provided in both directions. Outside of intersection areas, an impervious median with a raised barrier would divide the four-lane highway and generally be 10 feet wide, but could vary in width. Grass-lined border swale areas (typically eight feet wide) would buffer a five-foot wide pedestrian area from the roadway traffic, and contain an impervious bottom to collect drainage. Some additional pedestrian accommodations may be needed at bus pull-outs to meet requirements of the Americans with Disabilities Act (ADA). A guard rail may or may not be provided at the inside edge of the border area as specific conditions (utility poles, access driveways, etc.) dictate.

The two lane segment would contain travel lanes that are 12 feet wide. The shoulder/bikeway area would be 10 feet wide. There would be no dedicated pedestrian area, though pedestrians could use the shoulder/bikeway area. Some pedestrian accommodations may be needed at bus pull-outs to meet ADA requirements. The two-lane segment may or may not contain a ten-foot median depending on the need for access control. A guard rail may or may not be provided at the inside edge of the border area as specific conditions (utility poles, access driveways, etc.) dictate. Border areas on each side of the two-lane highway would typically be 23-feet wide and contain a grass-lined surface ditch for containment and treatment of runoff, unless constraints warrant a narrower border area as in the four-lane segment.

While the existing right-of-way varies in width between roughly 80 feet and 100 feet in width, the four-lane segment between Ainaloa Boulevard and Keaʻau would generally fit within a 108-foot right-of-way, and the two-lane segment between Ainaloa Boulevard and Pāhoa-Kapoho Road would contain a 100-foot right-of-way with a wider buffer area to the sides.

These right-of-way needs would vary along the corridor and the right-of-way could be wider in places where the grade of the highway requires slopes to the sides of the highway to be wider than normal.

2.3.1.2 Alternative 3 Access Control

A primary objective to improve safety in the corridor is to control access in the corridor. The four-lane segment between Keaʻau and Ainaloa Boulevard would contain a median barrier that would limit movements across the highway. Left turns or cross-road traffic movements would be controlled at specified intersections (which could have signals, roundabouts, or no signal as discussed in **Section 2.4, Intersection Treatment Alternatives**). Driveway access along the highway would be limited to right turns into and right turns out of the driveway. Access to or from the other direction would require travel to a signalized or roundabout intersection, where a U-turn could be performed safely.

Under Alternative 3, the design will accommodate permitted U-Turns at nine locations where intersection improvements with traffic signals or roundabouts are warranted, as discussed in greater detail in **Section 2.4.1: Signalized Intersections** and in **Section 2.4.3: Roundabouts.** Refer back to **Figure 2-2: U-Turn Options** for conceptual diagrams showing how U-turns would be accommodated in Alternative 3's Four-Lane and Two-Lane segments.

The access management measures described above in **Section 2.2.3: Access Management** for the TSM Alternative are also included under Alternative 3. There may be additional modifications to access along the roadway to improve safety besides those mentioned above. This could include consolidating driveways where possible, closing other minor intersections, and realigning other cross-streets.

The two-lane segment between Ainaloa Boulevard and Keaʻau may or may not have a median in the middle of the highway to control access to driveways along the road. Construction of barriers or no barriers will be fully decided during the final design process.

By changing access from full access today to right turns in and out of driveways, it is estimated that Alternative 3 would affect the direct access of 133 driveways (serving 152 parcels) along Keaʻau-Pāhoa Road, assuming the entire corridor had median barriers constructed where feasible. If Alternative 3 was constructed with no median barrier in the two-lane segment, it is estimated to affect 102 driveways (serving 121 parcels).

Intersections would be improved from current conditions (either with signals, roundabouts, or no signal as discussed in **Section 2.4: Intersection Treatment Alternatives**).

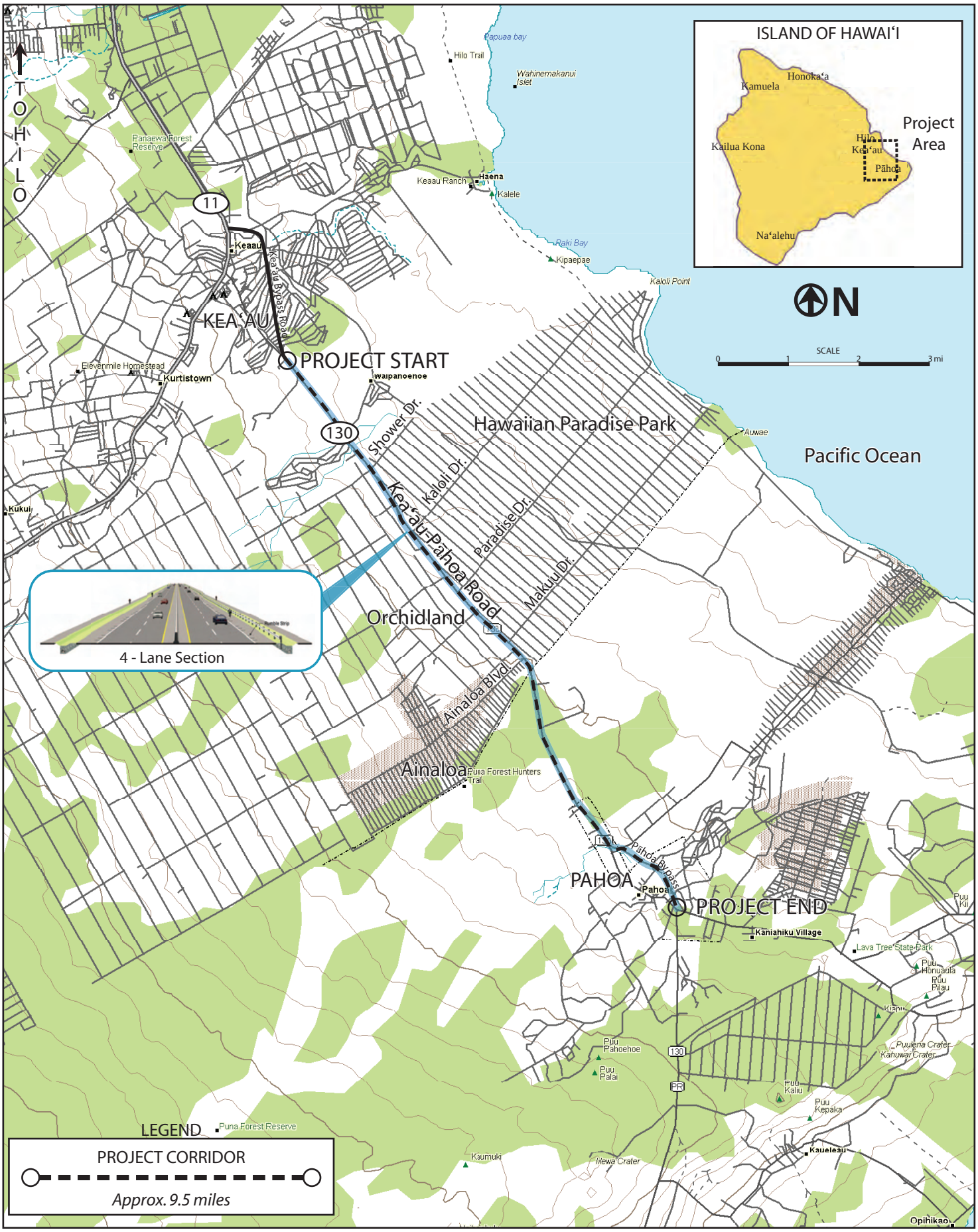
2.3.2 Alternative 4 - Four-Lane Section Corridor-Wide

Alternative 4 as shown in **Figure 2-6: Alternative 4** would construct a highway that contains a four-lane divided cross section between the end of the Keaʻau Bypass and Pāhoa-Kapoho Road. **Appendix A: Roadway Design Plans** shows detailed design of Alternative 4.

Alternative 4 will incorporate designs that contain Context Sensitive features, in an effort to make the future roadway as compatible as possible with the surrounding communities. While many of the elements will not be designed until the final design stage, these features would incorporate the community's preferences and include landscaping (with preference for non-invasive native species) and context sensitive designs of walls/structures, etc. If practicable, design exceptions may be considered on a case-by-case basis where protection of an important community or cultural feature constrains the design.

2.3.2.1 Alternative 4 Cross Section

Figure 2-4 showed the conceptual cross-section for the four-lane roadway. This cross-section is only representative and could vary in specific locations, such as where turn lanes are provided. Alternative designs that include context-sensitive elements like landscaping or other decorative features may be considered where appropriate. The concrete median barrier shown is for conceptual purposes to represent some type of median treatment. The specific type of median treatment will be specified during the later stages of design.



Build Alternative 4 - 4 Lanes Entire Length

Kea'au-Pāhoa Road Improvements Environmental Assessment, Kea'au to Pāhoa, Project No. STP-0130(27)

State of Hawai'i, Department of Transportation

Figure 2-6

Source:
DeLorme 3-D TopoQuads

For the four-lane section, travel lanes would be 12 feet wide, and a full eight foot shoulder/bikeway area would be provided in both directions. Outside of intersection areas, an impervious median with a raised barrier would divide the four-lane highway and generally be 10 feet wide, but could vary in width. Grass-lined border swale areas (typically eight feet wide) would buffer a five-foot wide pedestrian area from the roadway traffic, and contain an impervious bottom to collect drainage. Some additional pedestrian accommodations may be needed at bus pull-outs to meet requirements of the ADA. A guard rail may or may not be provided at the inside edge of the border area as specific conditions (utility poles, access driveways, etc.) dictate.

While the existing right-of-way varies in width between roughly 80 feet and 100 feet in width, the four-lane roadway would generally fit within a 108-foot right-of-way. The right-of-way needs would vary along the corridor and the right-of-way could be wider in places where the grade of the highway requires slopes to the sides of the highway to be wider than normal.

2.3.2.2 Alternative 4 Access Control

A primary objective to improve safety in the corridor is to control access in the corridor. The access management measures described above in **Section 2.2.3: Access Management** for the TSM Alternative are also included under Alternative 4. There may be additional modifications to access along the roadway to improve safety besides those mentioned above. This could include consolidating driveways where possible, closing other minor intersections, and realigning other cross-streets.

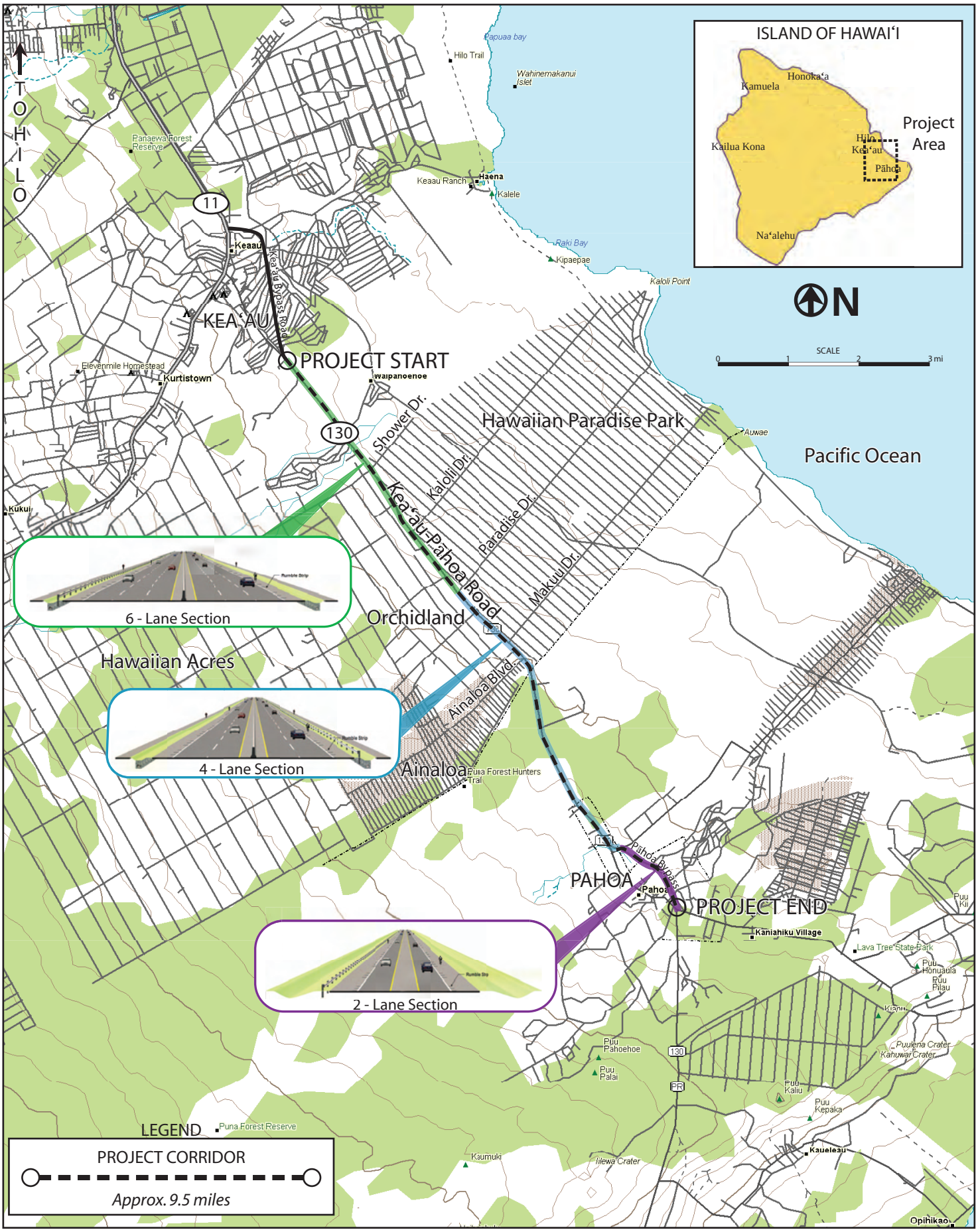
The four-lane roadway would contain a median barrier that would limit movements across the highway. Left turns or cross-road traffic movements would be controlled at specified intersections (which could have signals or no signal as discussed in **Section 2.4, Intersection Treatment Alternatives**). Driveway access along the highway would be limited to right turns in and right turns out of the driveway. Access from the other direction would require travel to a signalized intersection, where a U-turn could be performed safely.

Under Alternative 4, the design will accommodate permitted U-Turns at nine locations where intersection improvements with traffic signals are warranted, as discussed in greater detail in **Section 2.4.1: Signalized Intersections.** Refer back to **Figure 2-2: U-Turn Options** for conceptual diagrams showing how U-turns would be accommodated in Alternative 4's Four-Lane cross-section.

By changing access from full access today to right turns in and out of driveways, it is estimated that Alternative 4 would affect the direct access of 133 driveways (serving 152 parcels) along Keaʻau-Pāhoa Road.

2.3.3 Alternative 5 - Six-/Four-/Two-Lane Section

Alternative 5 (refer to **Figure 2-7: Alternative 5**) would construct a highway that contains a six-lane divided cross section between the end of the Keaʻau Bypass and Paradise Drive and a four-lane divided highway between Paradise Drive and Kahakai Boulevard.



Build Alternative 5 - Combination of 6 Lanes to Paradise Drive; 4 Lanes to Kahakai Blvd; 2 lanes to Kapoho Road

Kea'au-Pāhoa Road Improvements Environmental Assessment, Kea'au to Pāhoa, Project No. STP-0130(27)

State of Hawai'i, Department of Transportation

Figure 2-7

Source:
DeLorme 3-D TopoQuads

The segment from Kahakai Boulevard and Pāhoa-Kapoho Road would remain two lanes wide, but would have safety improvements at intersections and access points to greatly improve safety compared to current conditions. **Appendix A: Roadway Design Plans** shows detailed design of Alternative 5.

Alternative 5 will incorporate designs that contain Context Sensitive features, in an effort to make the future roadway as compatible as possible with the surrounding communities. While many of the elements will not be designed until the final design stage, these features would incorporate the community's preferences and include landscaping (with preference for non-invasive native species) and context sensitive designs of walls/structures, etc. If practicable, design exceptions may be considered on a case-by-case basis where protection of an important community or cultural feature constrains the design.

Improvements to intersections such as signalization and roundabouts are discussed in **Section 2.4, Intersection Treatment Alternatives** below.

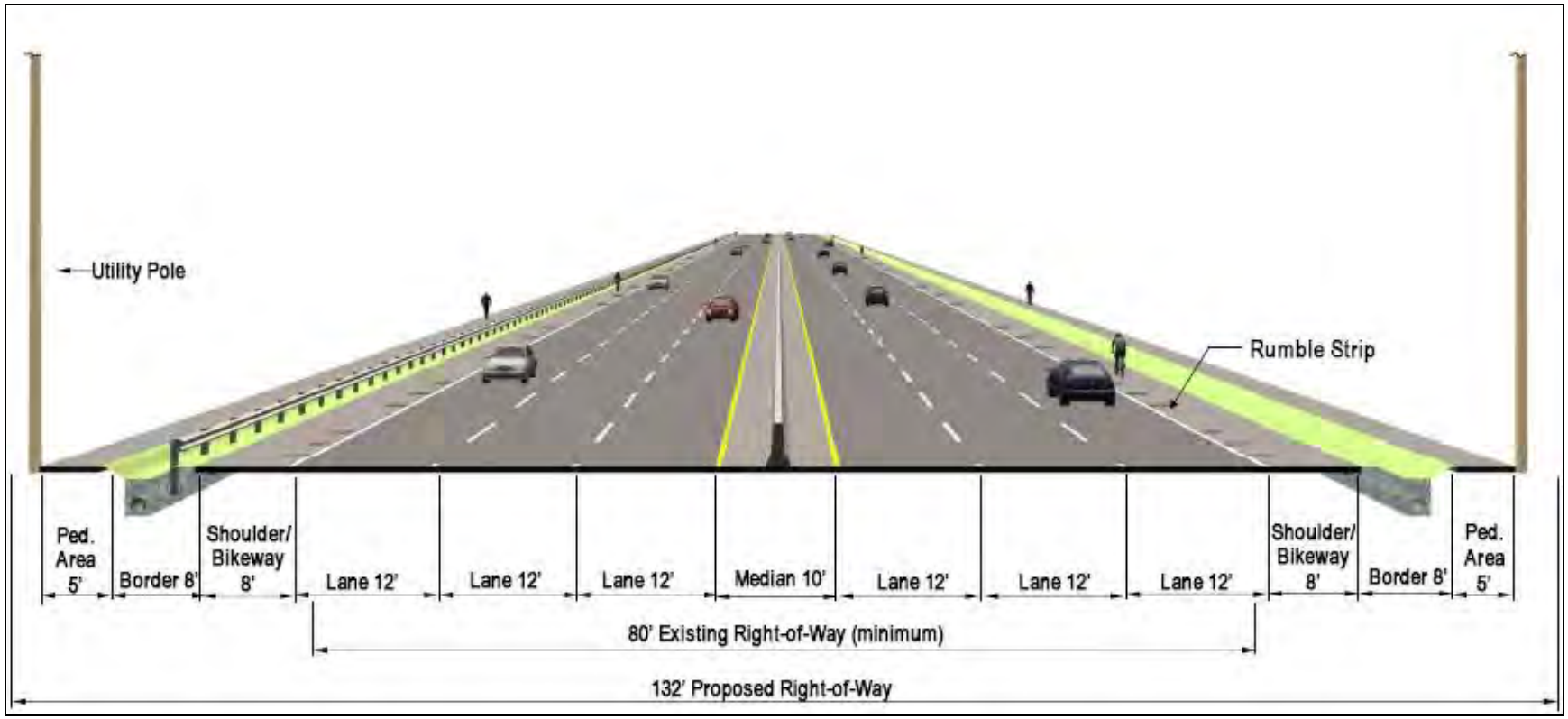
2.3.3.1 Alternative 5 Cross Section

Figure 2-8: Typical Cross Section for Six-Lane Segment below shows the conceptual cross-section for the six-lane roadway, **Figure 2-4: Typical Cross Section for Four-Lane Segments** above shows the conceptual cross section for the four-lane roadway, and **Figure 2-5: Typical Cross Section for Two-Lane Segments** above shows the conceptual cross section for the two-lane roadway. These cross-sections are only representative and could vary in specific locations, such as where turn lanes are provided. The concrete median barrier shown in the four-lane and six-lane cross section is for conceptual purposes to represent some type of median treatment. The specific type of median treatment will be specified during the later stages of design.

For both the four-lane and six-lane segments, travel lanes would be 12 feet wide, and a full eight foot shoulder/bikeway area would be provided in both directions. Outside of intersection areas, an impervious median with a raised barrier would divide the four-lane highway and generally be 10 feet wide, but could vary in width. Grass-lined border swale areas (typically eight feet wide) would buffer a five-foot wide pedestrian area from the roadway traffic, and contain an impervious bottom to collect drainage. Some additional pedestrian accommodations may be needed at bus pull-outs to meet requirements of the ADA. A guard rail may or may not be provided at the inside edge of the border area as specific conditions (utility poles, access driveways, etc.) dictate.

The two lane segment would contain travel lanes that are 12 feet wide. The shoulder/bikeway area would be 10 feet wide. Some pedestrian accommodations may be needed at bus pull-outs to meet ADA requirements. The two-lane segment may or may not contain a ten-foot median depending on the need for access control. A guard rail may or may not be provided at the inside edge of the border area as specific conditions (utility poles, access driveways, etc.) dictate. Border areas on each side of the two-lane highway would typically be 23-feet wide and contain a grass-lined surface ditch for containment and treatment of runoff, unless constraints warrant a narrower border area as in the four-lane segment.

Figure 2-8: Typical Cross Section for Six-Lane Segment



Note: Not to scale. Representative view; features such as guardrails may or may not be provided as needed on either or both sides at any given location.

While the existing right-of-way varies in width between roughly 80 feet and 100 feet in width, the six-lane segment between Keaʻau and Paradise Drive would require 132 feet of right-of-way, the four-lane segment between Paradise Drive and Kahakai Boulevard would generally fit within a 108-foot right-of-way, and the two-lane segment between Kahakai Boulevard and Pāhoa-Kapoho Road would contain a 100-foot right-of-way with a wider buffer area to the sides. These right-of-way needs would vary along the corridor and the right-of-way could be wider in places where the grade of the highway requires slopes to the sides of the highway to be wider than normal.

2.3.3.2 Alternative 5 Access Control

A primary objective to improve safety in the corridor is to control access in the corridor. The access management measures described above in **Section 2.2.3: Access Management** for the TSM Alternative are also included under Alternative 5. There may be additional modifications to access along the roadway to improve safety besides those mentioned above. This could include consolidating driveways where possible, closing other minor intersections, and realigning other cross-streets.

The four-lane and six-lane segments between Keaʻau and Kahakai Boulevard would contain a median barrier that would limit movements across the highway. Left turns or cross-road traffic movements would be controlled at specified intersections (which could have signals, roundabouts, or no signal as discussed in **Section 2.4: Intersection Treatment Alternatives**). Driveway access along the highway would be limited to right turns in and right turns out of the driveway. Access from the other direction would require travel to a signalized intersection, where a U-turn could be performed safely. The two-lane segment between Kahakai Boulevard and Pāhoa-Kapoho Road may or may not have a median in the middle of the highway to control access to driveways along the road. Construction of barriers or no barriers will be fully decided during the final design process.

Under Alternative 5, the design will accommodate permitted U-Turns at nine locations where intersection improvements with traffic signals or roundabouts are warranted, as discussed in greater detail in **Section 2.4.1: Signalized Intersections** and in **Section 2.4.3: Roundabouts.** Refer back to **Figure 2-2: U-Turn Options** for conceptual diagrams showing how U-turns would be accommodated in Alternative 5's Six-, Four-, and Two-Lane segments.

By changing access from full access today to right turns in and out of driveways, it is estimated that Alternative 5 would affect the direct access of 133 driveways (serving 152 parcels) along Keaʻau-Pāhoa Road. This total is identical regardless of whether the two-lane segment contains a median barrier or not.

2.4 Intersection Treatment Alternatives

2.4.1 Signalized Intersections

Under Alternative 2 (TSM) and Alternatives 3 through 5, signalized intersections are warranted in the design year 2038 at:

- Shower/Pōhaku Drives (signal already committed in Shoulder Improvements project)
- Kaloli Drive
- Orchidland Drive
- Paradise Drive
- Makuʻu Drive
- Ainaloa Boulevard
- Old Pāhoa Road
- Kahakai Boulevard
- Kapoho Road (signal already in place)

Signalized intersections will provide safe crossing for vehicles, and full access would be provided, including U-turns where needed. Where a median is provided, the 10-foot median would widen in the transitional approach to intersections.

In the circumstance that would need the most widening, specifically a four-way intersection with widening for turn lanes on both sides of the roadway mainline, the overall cross-section would typically become approximately 30 feet wider. This is a result of providing a 14- or 15-foot left-turn lane for each approach (in place of the 10-foot median), plus a right-turn lane added to the outside of each approach.

In contrast, at a T-intersection (3-way intersection with cross street only on one side of the intersection), the cross-section would be approximately 17 feet wider in total from a left-turn lane in the median on one approach and a right-turn lane on the other approach.

Where provided, shoulders/bikeways would be continuous through all intersections to ensure safe travel for bicycles.

Pedestrian areas, where provided, would be continuous through all intersections to ensure safe travel for pedestrians. Bus pullout areas may have different amenities as noted above.

2.4.2 Stop Sign Controlled Intersections

With the exception of several low-volume streets that are to be closed off with a cul-de-sac, all cross-streets not mentioned in **Section 2.4.1: Signalized Intersections** would contain intersections that are not controlled with a traffic signal or roundabout. These locations would not warrant such traffic control because of lower traffic volumes or because a nearby intersection is controlled. All stop sign controlled intersections will have stop sign control on the cross-street. Traffic along Keaʻau-Pāhoa Road would not be required to stop at these locations.

Some stop sign controlled intersections may have a median that prevents left turns, thereby restricting traffic movement to right-in right-out access. Other stop sign controlled intersections would be allowed full access across the highway.

Roadway dimensions and features at stop sign controlled intersections would be similar to those described above for signalized intersections.

2.4.3 Roundabouts

Used all over the world, a roundabout is a type of circular intersection that requires entering traffic to yield to traffic already within the circle. When they are feasible to be constructed, modern roundabouts can be a viable measure to control intersection traffic in place of a conventional signalized intersection. They have demonstrable benefits over signalized intersections:

- More than 90% reduction in fatalities (Transportation Research Board, 2001)
- 76% reduction in injuries (Transportation Research Board, 2007)
- 35% reduction in all crashes (Transportation Research Board, 2007)
- Slower speeds are generally safer for pedestrians
- Typically less delay than a signalized intersection
- Reduced pollution and energy use from fewer stops, hard acceleration and less idling
- No signal to maintain
- May require less right-of-way
- Aesthetically pleasing and offer options for landscaping

The roundabouts analysis (See **Section 4.2.3: Roundabouts** below and **Appendix C: Traffic Study**) considered six intersections for the feasibility of roundabouts in place of a conventional traffic signal to accommodate traffic in the design year 2038. HDOT guidelines state that multi-lane roundabouts will not be considered due to safety concerns. Therefore the possible use of roundabouts in this study would be limited to those alternatives that provide single-lane through movements at the intersections in question.

While HDOT policy currently limits roundabouts to a road with a two-lane cross-section, the findings of the traffic study determined that none of the intersections in the corridor would fall into that category by 2038 because of traffic capacity needs. Therefore, the analysis performed for Roundabouts has taken the added step of analyzing roundabouts in the year 2018 as well as 2038, as there could be benefits to implementing roundabouts on a shorter timeframe than 2038. In later years, and if HDOT policy changes to allow two-lane roundabouts, those locations could be widened and/or converted to traffic signals as appropriate. The intersection of Keaʻau-Pāhoa Road at Ainaloa Boulevard would be one such location where roundabouts could be considered as an interim improvement due to its high accident rate and ease of implementation. The intersection of Keaʻau-Pāhoa Road at Orchidland Drive could be another potential location due to a comparatively high accident rate and due to the existing and proposed retail/commercial development and proposed future Neighborhood Village Center.

The findings of the traffic study indicated that under the TSM Alternative and Alternative 3, a single-lane modern roundabout could be considered in place of a traffic signal at Kahakai Boulevard. This design would include right-turn slip lanes to handle right-turning traffic, so the roundabout would only handle through- or left-turn movements. It would require a reduction in speeds on the approach to the roundabout.

It may be possible to combine the traffic destined for Old Pāhoa Road and Kahakai Boulevard in this roundabout as a combined system. In such a scenario, Kahakai Boulevard's roundabout would provide the primary access into the Pāhoa Marketplace (Malāma Market) area as well as the northern approach into Pāhoa Town. The Old Pāhoa Road access, which suffers from poor operations presently, could be restricted to a right-in-right-out configuration, since left-turning traffic would be served more efficiently and safely at the roundabout.

2.5 Project Cost Estimates

The overall cost of the project is only one factor that is considered as part of the decision-making process for selecting a Preferred Alternative, along with the Purpose and Need for the project and environmental impacts. Nonetheless, cost it is an important consideration. **Table 2-5: Preliminary Estimated Project Construction Costs for Alternatives, 2009 Dollars** provides estimates for constructing the project. The cost estimates provided do not include engineering costs or right-of-way acquisition costs, nor do they cover operational and maintenance costs once the improved Kea'au-Pāhoa Road is fully open for public use. As the table shows, the TSM Alternative is estimated to cost approximately $20 million to construct, whereas the three Build Alternatives would range between approximately $113 million and $136 million. These figures are in current-year dollars.

Table 2-5: Preliminary Estimated Project Construction Costs for Alternatives, 2009 Dollars

Element	TSM Alternative	Alternative 3	Alternative 4	Alternative 5
Construction*	$19,900,000	$107,270,000	$118,150,000	$125,880,000
Utility Relocations**	n/a	$6,000,000 to $9,000,000	$7,000,000 to $10,000,000	$7,000,000 to $10,000,000
TOTALS***	$19,900,000	$113,270,000 to $116,270,000	$125,150,000 to $128,150,000	$132,880,000 to $135,880,000

*Includes 15% contingencies, site electrical and signalized intersections, Force Account Allowances, Archaeological Monitoring and 5% cost escalation

** Assumes relocation of utility poles but not moving any new utilities underground. Cost range provided due to different possible types of poles. See Section **4.13: Utilities** for more information.

***Estimates do not include engineering, right-of-way, operational or maintenance costs

Source: SSFM International

2.6 Alternatives Considered But Not Analyzed

As described above in greater detail in **Chapter 1: Purpose and Need for Project**, prior to the EA process, HDOT worked extensively with the affected communities to implement a Context Sensitive Solutions (CSS) process. The Kea'au-Pāhoa Advisory Group (KPAG) identified a full range of alternatives to be carried forward into this Environmental Assessment.

As part of KPAG’s efforts, a number of alternative design elements were considered, but not carried forward into the EA. The elements not carried forward into this EA and the explanations for why they were not carried forward are described next.

Selected Treatments for Transit, Bicycle and Pedestrian Use of Kea‘au-Pāhoa Road

- Create a bus lane only. This was eliminated because it did not increase the capacity of the corridor; furthermore, it was not consistent with purpose and need.
- Add a 12-foot multi-use path separated from roadway by 10-foot landscaping. This was eliminated due to the need of additional right-of-way. KPAG Members wanted to minimize impacts of right-of-way takings on adjacent landowners.
- Create a High Occupancy Vehicle (HOV) lane or contra-flow lane during peak hours. This was eliminated because it did not sufficiently increase the capacity of the corridor; furthermore, it was not consistent with purpose and need.

Turning Movements, Merges and Intersections

- Left hand merge lanes at u-turns, if signalized. This was eliminated due to the need for additional right-of-way. KPAG Members wanted to minimize the right-of-way takings.
- Frontage Roads in residential sections are still up for discussion, but the access control strategy outlined in **Section 2.2.3: Access Management** contains many of the same benefits and would provide superior opportunities for mobility between subdivisions and is thus considered a superior treatment.

Widening Alternatives

- Four-lane widening from Kea‘au Bypass to Shower Drive. This was eliminated because it did not sufficiently increase the capacity of the corridor (the segment was too short); thus, it was not consistent with purpose and need.
- Four-lane widening from Kea‘au Bypass to Paradise Drive. This was eliminated because it did not sufficiently increase the capacity of the corridor; thus, it was not consistent with purpose and need.
- Widen Hilo bound side only. This was eliminated because it did not increase the capacity of the corridor; thus, it was not consistent with purpose and need.
- Add a lane in middle for contraflow during peak hours only. This was eliminated because it did not increase sufficiently the capacity of the corridor; furthermore, this was not consistent with purpose and need. This would also be costly to maintain on a daily basis.
- A three-lane section (one travel lane in each direction with a two-way-left-turn-lane in the middle). This was eliminated because it did not increase the capacity of the corridor and would pose safety concerns with the operation of the middle turn lane.

Other

- Underground utilities. This was considered too expensive to construct. KPAG Members felt money would be wisely spent on other aspects of the project.
- Utilities in berms on side. This would be expensive to construct. KPAG Members felt money would be better spent on other aspects of the project.
- Scenic vistas. This was considered too expensive to construct. KPAG Members felt money would be better spent on other aspects of the project.

KPAG Members determined the various lane combinations along the corridor as presented in the preceding sections of this chapter. In segments where project alternatives are proposed to have a four-lane cross section, alternatives with three and five lanes were eliminated due to lack of capacity and impacts to right-of-way, respectively.

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CHAPTER 3: AFFECTED ENVIRONMENT

3.1 Land Use and Zoning

3.1.1 Existing Communities and Land Uses

Keaʻau-Pāhoa Road is located within the Puna District, one of nine districts that make up Hawaiʻi County and the Island of Hawaiʻi. Puna encompasses 320,142 acres, which accounts for 12 percent of the island's total land area. The portion of Puna served by Keaʻau-Pāhoa Road from Keaʻau to the south and east are often referred to as Puna Makai or lower Puna.

The Keaʻau-Pāhoa Road study corridor serves the larger area of Puna Makai or lower Puna. Puna Makai's landscape is influenced by high levels of rainfall (greater than 100 inches annually) and by volcanic activity, primarily from Kīlauea volcano. (See **Section 3.8: Geographic Setting and Natural Hazards** for more information). Lava flows of varying ages have created a landscape of some diversity.

Traditionally, land in Hawaiʻi was divided into units called ahupuaʻa, which were wedge-shaped divisions that ran from ocean to mountains. The Keaʻau-Pāhoa Road corridor passes through the following ahupuaʻa: Keaʻau, Waikahekahe Nui and Iki, Makuʻu, Hālona, Keonepoko Nui and Iki, and Waiakahiula.

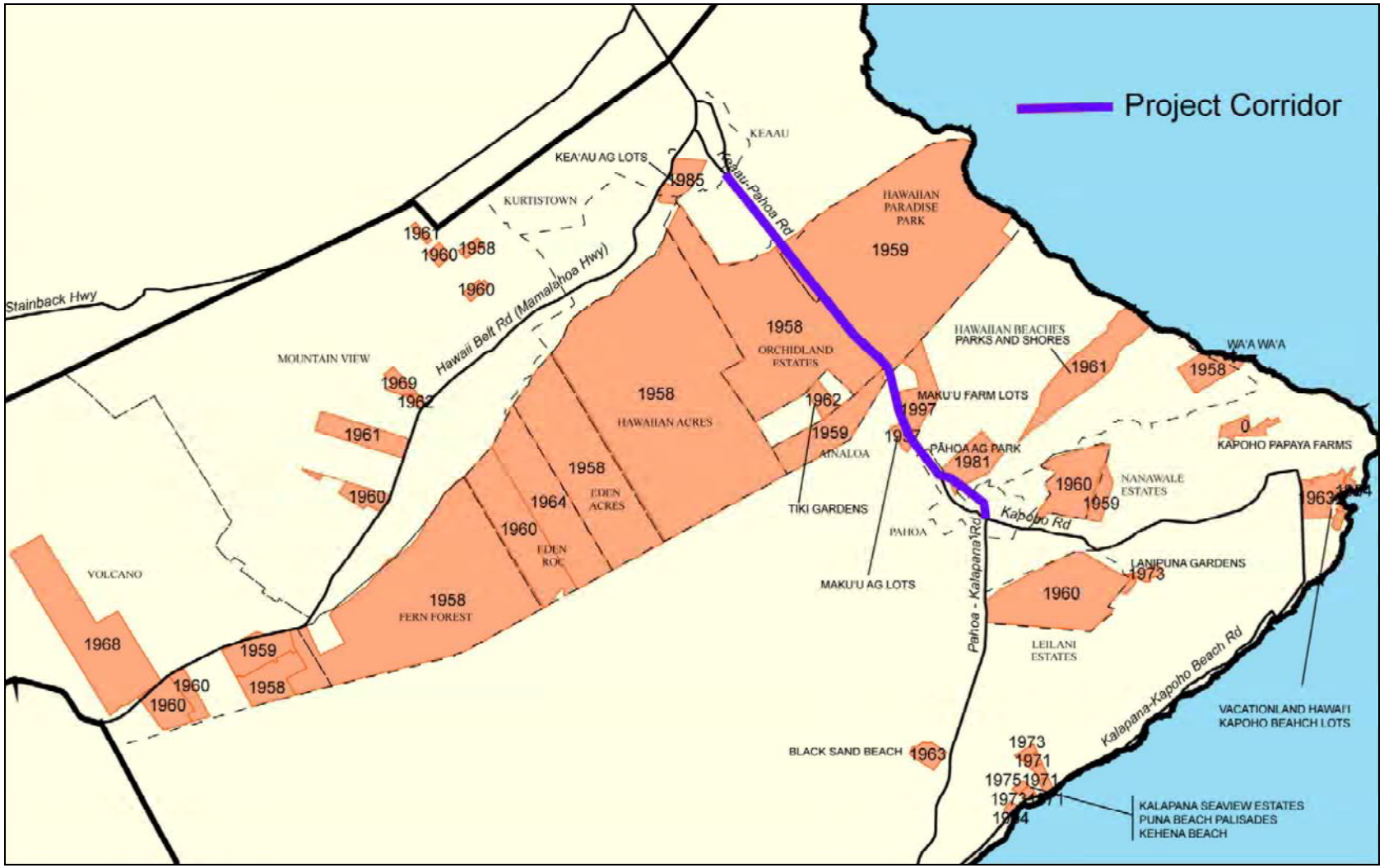
In pre-contact times, most human settlements were located near the shoreline. Inland areas became more prominent as large-scale agriculture and plantations grew in importance. The towns of Keaʻau, at the northern end of the corridor and Pāhoa at the southern end were key in the rise of the sugar industry in this region. Lumber was also an important commodity. Railroads were built to serve sugar plantations and lumber mills.

The ʻŌlaʻa Sugar Company became one of Hawaiʻi's largest sugar plantations through land acquisition and leases. They cleared thousands of acres of land for cane fields and mills. ʻŌlaʻa Sugar Company built new housing and relocated outlying houses into nine main employee villages, each of which were miniature towns with necessary infrastructure, and typical services and establishments found in residential communities. In 1930, the plantation population numbered 5,999 persons. Mechanization of harvesting operations began in the late 1940s, and layoffs were necessary. The industry began a slow decline in the late 20th century as other markets and sweeteners hurt the sugar market.

While sugar is no longer produced, a diversified agricultural industry is supported in Puna. Today, approximately 97 percent of Hawaii's papaya production occurs in Puna. Puna produces at least 40 different agricultural products, including cut flowers, fruits, vegetables and livestock (PCDP, p. 1-3).

Besides the older central town centers of Keaʻau and Pāhoa, the Keaʻau-Pāhoa Road corridor passes between a number of large subdivisions that were platted in the mid-20th Century. **Figure 3-1: Puna Subdivisions By Year of Establishment** illustrates these subdivisions.

Figure 3-1: Puna Subdivisions By Year of Establishment



Source: Adapted from Townscape, Inc. Puna Regional Circulation Plan, 2005.

Puna's recent pattern of residential development and population growth comes from this widespread subdivision of land. The study corridor directly serves Orchidland Estates, Hawaiian Paradise Park, 'Āinaloa, and Hawaiian Beaches/Parks/Shores. A number of other subdivisions in points south and east of Pāhoa Town do not directly border onto the Kea'au-Pāhoa Road study area, but are nonetheless strongly dependent on Kea'au-Pāhoa Road as it is the only route into and out of Puna Makai. The larger of these other subdivisions include Nanawale Estates, Leilani Estates, Kapoho Beach Lots, and Vacationland, among others.

Between 1958 and 1973, more than 52,500 subdivision lots were created in Puna. The magnitude of approved lots is directly related to the early lack of effective land use controls and growth management awareness. Some subdivisions were approved just prior to statehood in 1959. By the time Hawaii adopted the State Land Use Law in 1961, thousands of acres had already been subdivided. When formal land use boundaries were established in 1964, most of the Puna district lands were placed in either the Conservation or Agriculture Districts, and this helped to curtail the number of subdivision applications. However, more effective controls did not come until the 1973 adoption of the County's subdivision ordinance, which called for more rigorous lot sizes and infrastructure standards. Large subdivisions with minimal services were hence discouraged.

Since 1973, nearly 2,500 of these lots have been covered by lava flows or have been rendered unbuildable by shoreline subsidence, reflecting the risks of building on a landscape subject to volcanic and seismic hazards. Moreover, most subdivision lots are accessed by private, unpaved roads. The streets generally lack sidewalks and lighting, and do not meet current County standards in terms of pavement width, vertical geometrics, drainage and other design parameters. None of the subdivisions have central sewer systems and only a couple have private water systems. Most lots rely on individual catchment systems supplemented with private delivery trucks for potable water. Large sections of some subdivisions are off the power grid. (PCDP, p. 1-3).

Despite these sub-standard conditions and natural hazards, Puna is the fastest growing district on Hawaii Island. Only 25 percent of the available subdivision lots have been developed so far, so there is potential for much greater growth in these already-approved parcels. The region's environmental beauty, its climate, affordable prices, and proximity to Hilo's transportation terminals continue to attract new residents. In the 30-year period from 1970 to 2000, the Puna District's population increased six-fold from approximately 5,100 to 31,335 persons. The demographics and population of the study area are discussed in greater detail in **Section 3.3.1: Population**.

3.1.2 State Land Use Designations

Hawaii was the first of the fifty States to have a State Land Use Law and a State General Plan. Today, Hawaii remains unique among the fifty states with respect to the extent of control that the state exercises in land use regulation. The state has four classifications: Agricultural, Conservation, Rural and Urban. The State Land Use Commission (LUC) initially set the boundaries. Changes to boundaries for areas less than 15 acres can be approved at the County

level; larger modifications must be approved by the LUC by a 6-3 vote. Counties have full control over the use of urban-designated area, whereas only the LUC can take land out of the Conservation District. There is also a "Special Management Area" (SMA), near the coastline, which has additional controls; Keaʻau-Pāhoa Road does not directly abut property in the SMA.

The land use designations and zoning reflect the timing of subdivision approvals and the non-conforming nature of much of the Puna District. Approximately 55 percent of Puna's lands are in the State Agriculture Land Use District, followed by 43 percent in the State Conservation District. Only two percent of Puna's land area is designated Urban, and a miniscule 0.04 percent is designated Rural. (2005 Hawaiʻi County General Plan, Table 14-1).

Keaʻau-Pāhoa Road is an existing permitted use in an Agricultural area. The County has oversight of Urban areas, and would permit a public roadway in an Urban area.

3.1.3 Hawaiʻi County Plans and Policies

Hawaiʻi County has a three-tiered comprehensive planning system. The first tier is the General Plan, which encompasses long-range goals, policies, standards, and courses of action for the entire County. It provides the legal basis for all other elements of the County's planning structure.

The second tier comprises short and mid- range plans that clarifies and expands upon the General Plan long range goals and policies of the General Plan. These plans are of three types. 1) Regional plans (Community Development Plans) address the County's nine districts, including the Puna District, 2) Area Improvement Plans address certain geographic areas (example, Hilo Downtown Development Plan), and 3) functional plans (example, County Recreation Plan) address specific responsibilities under the County's jurisdiction.

The third tier provides tools to implement the two higher tiers of the planning hierarchy. These include the Zoning and Subdivision Codes along with the operating and capital improvement program budgets.

3.1.3.1 County of Hawaiʻi General Plan

The General Plan for Hawaiʻi County (2005) implements land use planning at the county level, and works in concert with the Community Development Plans. General Plan land use policies for the Puna District are summarized as follows:

- Assist in the further development of agriculture.
- Centralize commercial activities in Pāhoa Town, expand Keaʻau's commercial services to meet the needs of the growing population, and allow the establishment of small neighborhood commercial areas within existing, non-conforming, residential-agricultural subdivisions.
- Identify suitable sites for future industrial activities and provide industrial-commercial mixed use districts in appropriate locations.

- Work with community groups in exploring possible avenues for financing infrastructure improvements in non-conforming subdivisions, and improve and develop roadways, water and sewerage systems and other basic facilities to encourage residential development of lands suitable for residential use.

The County has dictated future land use plans in the Land Use Pattern Allocation Guide (LUPAG) Map. The LUPAG Map is shown in **Figure 3-2 : Hawaii County Land Use Pattern Allocation Guide (LUPAG).**

3.1.3.2 County of Hawaiʻi Zoning

The Zoning Code for the County of Hawaii is the legal instrument that regulates the use of land. Virtually all of the area around Keaʻau-Pāhoa Road is zoned Agricultural, at varying levels of density, as shown in **Figure 3-3: County of Hawaii Zoning.** In terms of County zoning, 62 percent of Puna's land is zoned Agriculture, and only two percent is zoned Open. Less than one percent is zoned for Single Family. (2005 General Plan, Table 14-3).

3.1.3.3 Puna Community Development Plan (PCDP)

The Puna Community Development Plan (PCDP) was first issued in 1995 and revised and adopted in September, 2008. The PCDP was developed with an extensive community participation program. The PCDP's vision for the Puna District is that "Residents of Puna live in harmony with the ʻaina while promoting a sustainable vibrant local economy, healthy communities, and a viable transportation system that is accessible, friendly and safe for now and future generations." (PCDP, Page 1-6). The PCDP process is currently entering the implementation phase.

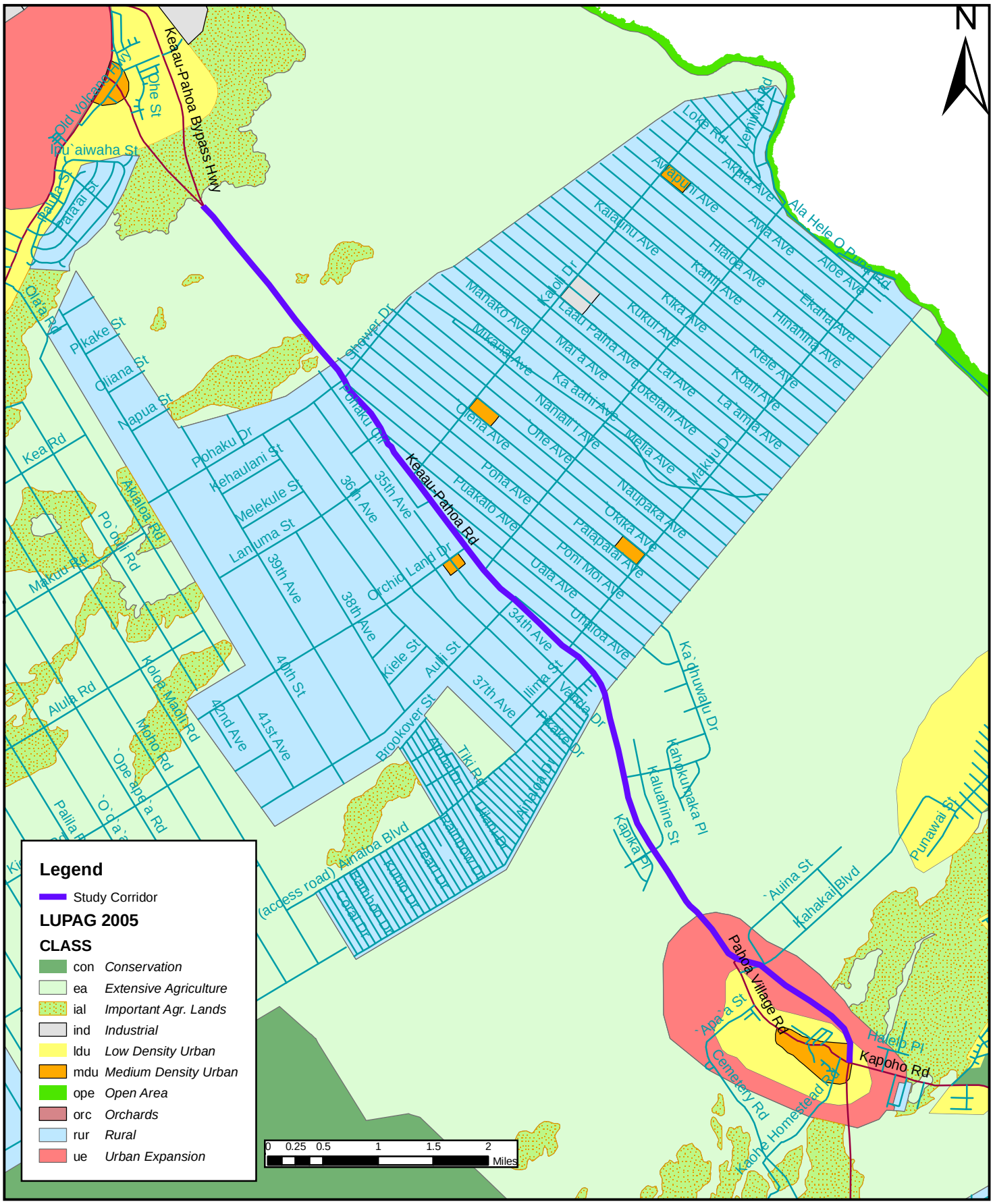
The PCDP recognized that if the growth trends of the Puna District continue unabated, there will be several types of dramatic long-term consequences.

- All of Puna is located in the three most hazardous lava risk zones, so an increasing number of people and properties will be at risk. (See **Section 3.8.2: Lava Flows** for information on the two zones that Keaʻau-Pāhoa Road lies within.) Evacuation of large subdivisions with few arterial streets will be problematic in the event of a lava flow, earthquake, tsunami or hurricane.

- Expectations for improved infrastructure will increase as population grows.

- Development will continue in an uneven "leap-frog" pattern, spreading out lots in a low-density pattern and making it difficult to develop infrastructure and provide services. Resultant travel distances are often long for residents to access jobs, schools, shopping and other life needs.

- It will be increasingly difficult to keep small-lot agricultural uses viable as it becomes less compatible with growing residential in-fill development.



Hawaii County Land Use Pattern Allocation Guide (LUPAG)

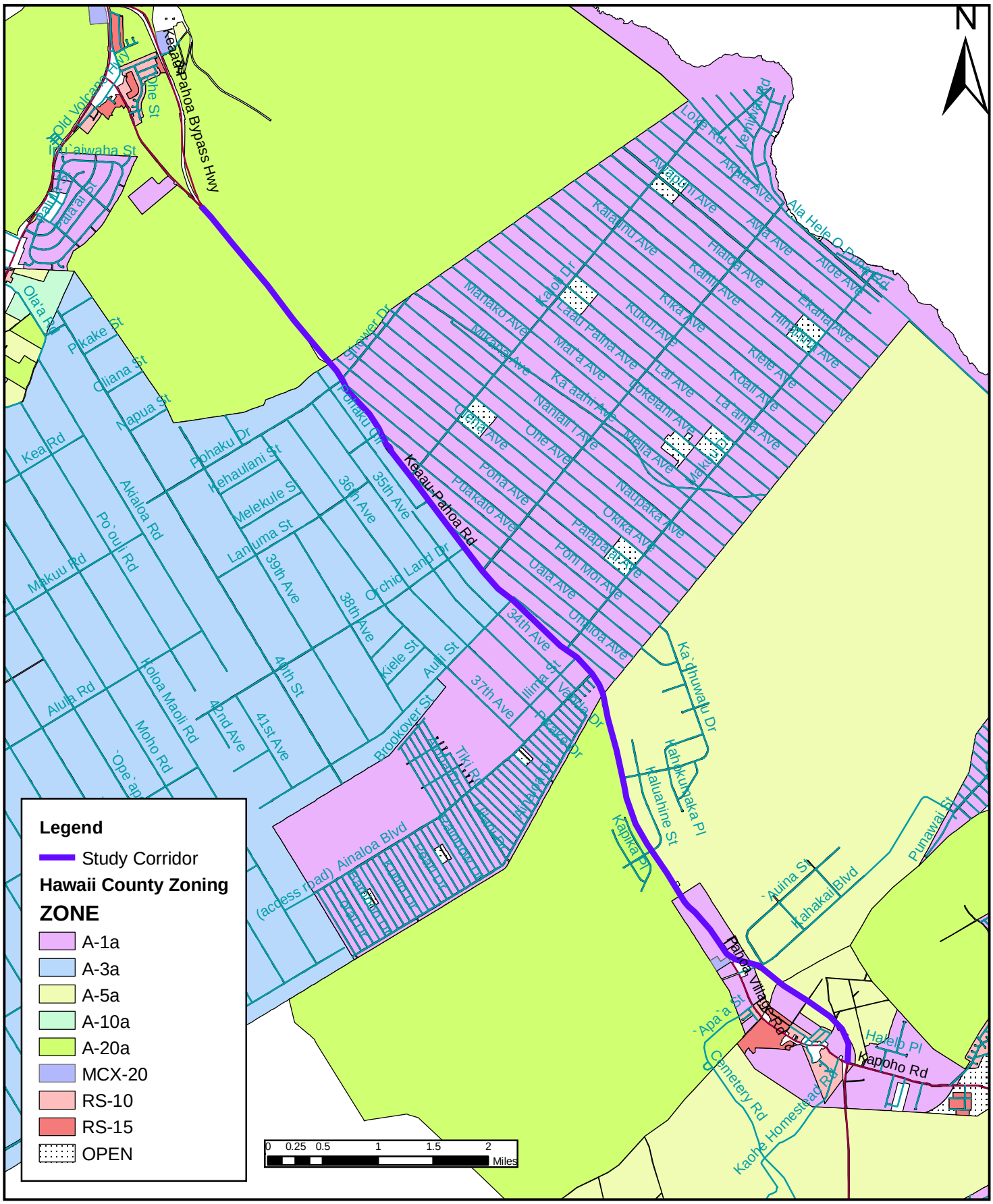
Figure 3-2

Kea'au-Pāhoa Road Improvements, Kea'au to Pāhoa, Project No. STP-0130(27)

State of Hawai'i, Department of Transportation

Source:

Hawaii County



County of Hawaii Zoning

Figure 3-3

Kea'au-Pāhoa Road Improvements, Kea'au to Pāhoa, Project No. STP-0130(27)

State of Hawai'i, Department of Transportation

Source:

Hawaii County

- Native forest will be adversely impacted as it becomes more fragmented, has edges invaded by non-native species, experiences changes in microclimate, is graded, etc.

To counteract these trends, the PCDP recommends a new land use pattern along the project corridor. To redirect Puna's extensive subdivisions from their present course of development, the PCDP proposes three types of village/town centers. (See **Figure 3-4: PCDP Proposed Town and Village Center Locations**). The village/town center categories and the locations near Keaʻau-Pāhoa Road are:

- Regional Village Centers - These are located at Puna's largest existing communities and are intended to provide a wide range of services and amenities. In the study area, they are proposed for Keaʻau, Hawaiian Paradise Park and Pāhoa.

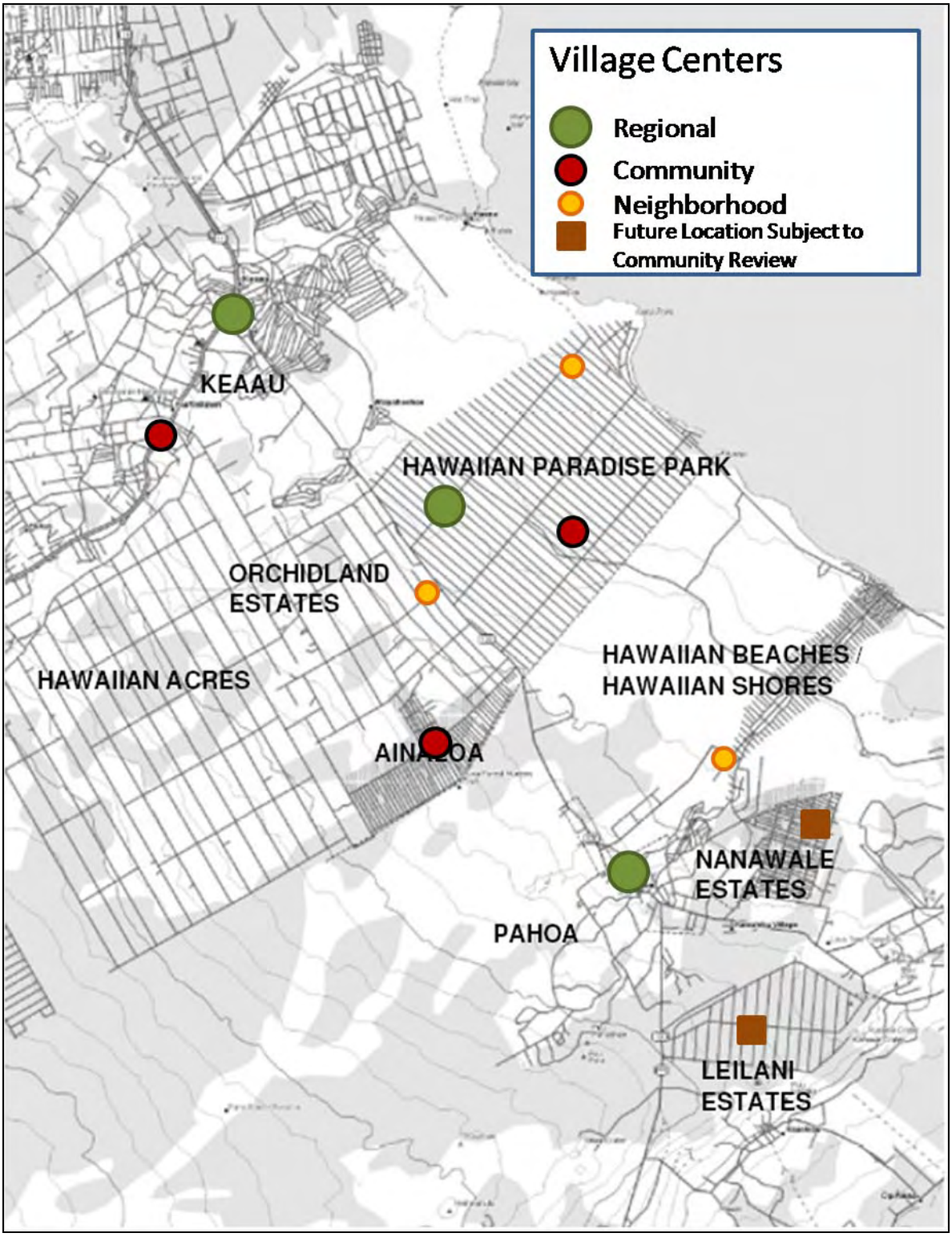
- Community Village Centers - These would provide a more limited range of services in smaller existing urban settlements and subdivisions that have nevertheless been experiencing the highest rates of growth. In the study area, these are proposed for Hawaiian Paradise Park and Ainaloa.

- Neighborhood Centers - These would serve smaller or more remote communities with relatively small lot sizes. In the immediate study area, these are proposed for Orchidland Estates, Hawaiian Paradise Park, and Hawaiian Beaches. Neighborhood centers would also be provided in Nanawale Estates, Leilani Estates, and Kapoho.

Table 3-1: PCDP General Use and Design Criteria by Village/Town Center Type provides more description of the PCDP's vision for the village and town centers. Refer to **Section 2.2.6: Land Use Strategies Identified in the PCDP** for more information on the estimated timeframe for these developments.

The PCDP has recommended preliminary boundaries for these Village/Town center areas. In the case of Keaʻau and Pāhoa towns, the existing village centers are the locations of interest, though the Pāhoa Regional Town Center also extends to the Keaʻau-Pāhoa Road corridor and includes the Pāhoa Marketplace shopping center and the future Woodland Center development as regional uses of interest. The Orchidland Neighborhood Village Center borders on the study corridor as it includes the existing retail area near the junction of Orchidland Drive and Keaʻau-Pāhoa Road. All other Village/Town center areas proposed are not directly adjacent to Keaʻau-Pāhoa Road, though they clearly influence (and will be influenced by) traffic access from the study corridor.

Figure 3-4: PCDP Proposed Town and Village Center Locations



Source: Adapted from 2008 Puna Community Development Plan, Figure 3-2

Table 3-1: PCDP General Use and Design Criteria by Village/Town Center Type

Criterion	Regional Town Center	Community Village Center	Neighborhood Village Center
Service Area Population	20,000 to 50,000 residents	7,000 to 15,000 residents	3,000 to 6,000 residents
Typical Uses	More than 40 tenant spaces for full range of retail and personal services, repair shops and other light industrial uses	20 to 40 small tenant spaces for retail and personal services, repair shops	5 to15 small tenant spaces for convenience retail and personal services
Commercial Land Area	More than 30 acres	10-30 acres	Up to 10 acres
Commercial Floor Area	Up to 250,000 square feet aggregate, but no tenant spaces larger than 50,000 square feet.	Up to 150,000 square feet aggregate, but no tenant spaces larger than 25,000 square feet.	Up to 50,000 square feet
Other Uses	Regional park; schools (all grades); community hall, theater; outdoor events area; bed-and-breakfast homes and small inns; elderly or other special needs housing; transit hub; medical facility with emergency room; police and fire station; walking and bicycling paths.	Community park, elementary or middle school, community center and outdoor events area; bed-and-breakfast homes and small inns; elderly or other special needs housing; transit stop; medical clinic; walking and bicycling paths.	Neighborhood park, elementary school, multi-purpose meeting room or (minimum) place to congregate or post community notices; outdoor events area (e.g., barbeques and farmer's markets); small bed-and-breakfast homes; transit (or paratransit) stop; connections to walking and bicycling paths.
Design Character	Vernacular architecture that respects the historic context and scale of the community; light industrial uses on periphery to avoid building forms or activities that conflict with the pedestrian-oriented character in the Town Center core; small repair shops in Town Center core subject to performance/design criteria.	Informal, vernacular architecture that utilizes natural exterior materials and earth-tone colors and respects the context and scale of the community, especially where historic structures are present, such as in Volcano Village and the older area of Mountain View.	Informal, vernacular architecture that is small in scale and reflects a rural residential ambience, using natural exterior materials and earth-tone colors.
Access	Access to one or more paved roads; commercial or public uses without direct driveway access to Highway 11 or Highway 130.	Access to one or more paved roads; commercial or public uses without direct driveway access to Highway 11 or Highway 130; no "drivethru" commercial use.	Access to a paved road, except that there should be no direct access or visibility from either Highway 11 or Highway 130; no "drivethru" commercial use.

Source: 2008 Puna Community Development Plan, Table 5-1

The PCDP recommends a number of mechanisms to facilitate these changes to the land use pattern in Puna. These can be summarized in general terms as follows:

1. Transfer of Development Rights (TDRs) to re-distribute development rights of subdivision lots that are located in high hazard zones or high-value native forests;
2. Land pooling to form village centers and grow town centers while preventing sprawl development;
3. Adjustments to County and State tax codes to discourage land speculation and provide tax relief for long-time homeowners and renters and to provide an incentive for removing development rights from property;
4. District-wide rezoning and tighter restrictions on variances from subdivision standards to discourage further subdivision of properties that are not within designated village/town centers; and
5. Amendments to the County zoning code to discourage excessive lot clearance and speculative building practices.

3.1.3.4 Puna Regional Circulation Plan (PRCP)

From the standpoint of land use, the PRCP emphasized mixed-use village center developments that provide mixed land uses and services within neighborhoods. These would serve transit and pedestrians and counteract the auto-dependent focus of past land use decisions in the region. The strategies called for changing land use to emphasize village center land use development while also supporting Puna's rural character.

The PRCP examined three different land use scenarios:

- Continuing existing and projected trends, which would make 75% of the travel demand dependent on commuting to the regional center (Hilo) and only 20% of demand centered on existing town centers (Pāhoa, Keaʻau, Mountain View, and Volcano)
- A "town centers" concept, which would emphasize eight town centers (including Pāhoa, Keaʻau, Orchidland, Hawaiian Beaches, and Nanawale.) and distribute about 55% of the traffic there, while 40% of demand would still be oriented towards Hilo.
- A "village centers" concept, which would build a number of smaller neighborhood-level village centers, and focus 50% of traffic within village centers, with 25% of traffic demand oriented towards the town centers and the last 25% oriented to Hilo.

The village centers concept was recommended in the PRCP as a way to reduce overall vehicle miles traveled and demand. The PRCP recommended continued assessment of this land use concept in the PCDP, which followed it.

3.1.4 State of Hawaiʻi Department of Hawaiian Homelands

The State Department of Hawaiian Home Lands, hereafter referred to DHHL, has jurisdiction over 116,963 acres on Hawaiʻi Island. DHHL prepared its Hawaiʻi Island Plan in 2002 to assess

and recommend future uses for its undeveloped land holdings. In its baseline analysis, geographic preferences were identified, as well as critical constraints and opportunities for each of its parcels.

In the general vicinity of Keaʻau-Pāhoa Road, DHHL has four holdings in its Makuʻu Region that are of interest, illustrated in **Figure 3-5: DHHL Lands Near Keaʻau-Pāhoa Road**. The following is adapted from the April, 2008 DHHL Makuʻu Regional Plan:

- Keonepoko Nui - Keonoepoko Nui is a 100-acre parcel located behind Keonepoko Homestead, approximately one mile southeast of the Pāhoa landing strip, and just under a mile northwest of Main Street Pāhoa. State lands border the east portion of the property with Keonepoko Homestead to the west. Access is provided through a dedicated flag off Keaʻau-Pāhoa Road. Current surrounding land uses are agricultural, despite marginal soil quality. Access limitations and parcel size are primary constraints.

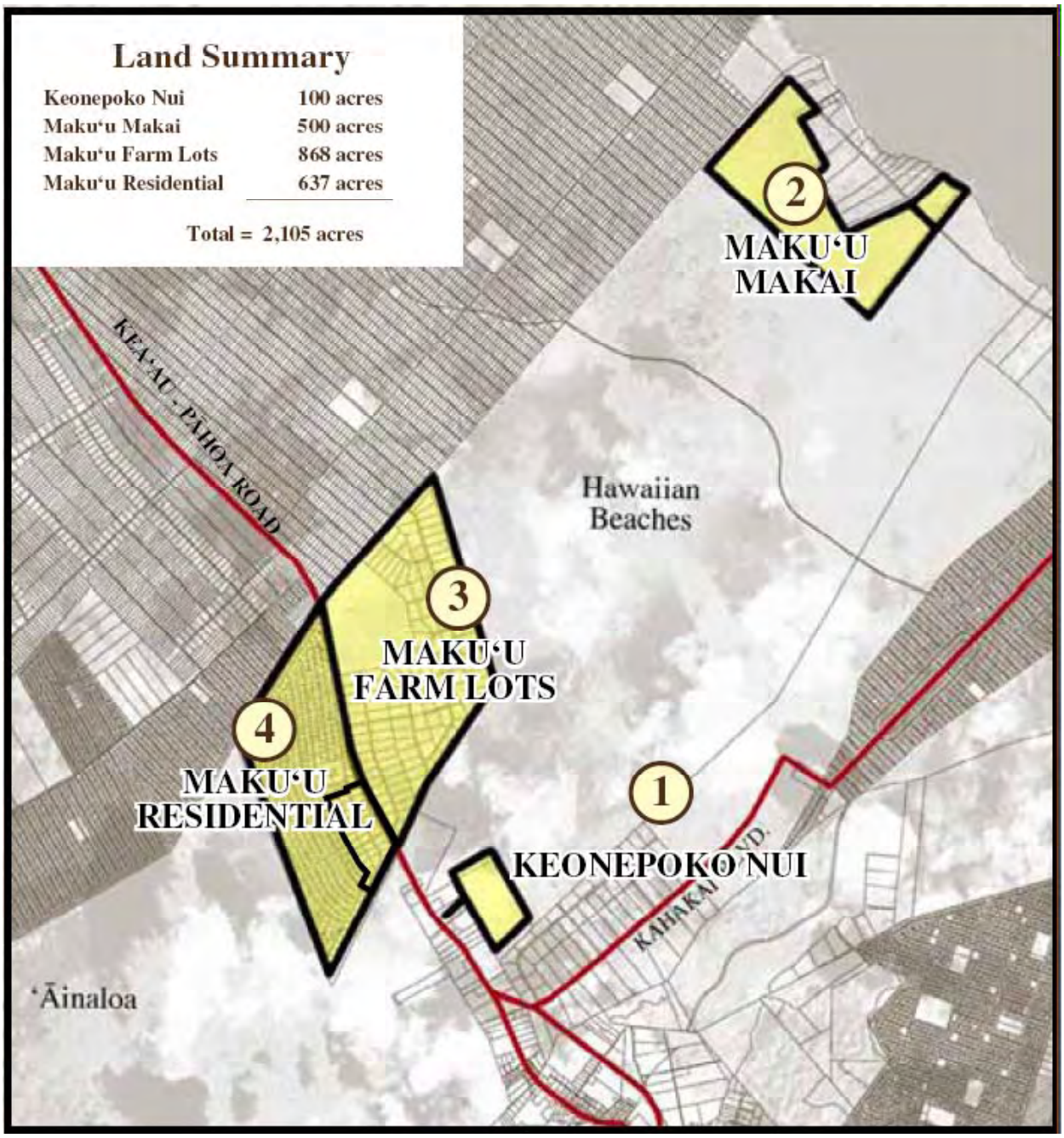
- Makuʻu Makai - Makuʻu Makai totals approximately 500 acres. Most of this seaward parcel is mauka of the Beach Road extension. A portion of the property extends across the Ala Hele O Puna Road extension to the coastline. The western boundary is adjacent to Hawaiian Paradise Park subdivision and State lands lie to the south and east. The parcel is accessible via an extension of Ala Hele O Puna Road. Kaʻaahi Road is adjacent to the mauka boundary. The site is presently overgrown, with lowland shrubs and sparse tree cover predominating. Water and sewer service is currently not available for the parcel. Water and sewer system needs and associated costs constrain priority development at this time.

- Makuʻu Farm Lots - Makuʻu Farmlots is approximately 868 acres makai of Keaʻau-Pāhoa Road. Hawaiian Paradise Park is located to the north and Keaʻau-Pāhoa Road is the west. The majority of the 868-acre parcel was developed in 1998 as 127 five-acre farmlot parcels. Access to the farmlots is from Keaʻau-Pāhoa Road. Smaller arterial streets have been developed by DHHL to provide access to the developed agriculture lots. 181 acres are designated for two Federal Aviation Administration facilities. Nine acres are licensed to the Makuʻu Farmers' Association (MFA), which operates the Sunday Makuʻu Farmers' Market and its Mala Training facility. MFA proposes to build a Community Center.

- Makuʻu Residential - The Makuʻu Residential parcel is 640 acres mauka of the Makuʻu Farm Lots and Keaʻau-Pāhoa Road. There are three projects within the Makuʻu Residential parcel.

  The first project, "Makuʻu Agricultural Lots, Unit 1" was developed in 1998 as 50 two-acre agriculture lots. Twelve will be consolidated and re-subdivided into residential lots and folded into DHHL's Makuʻu - Hālona Subdivision and Makuʻu - Pōpōkī Subdivision described below. All but one of these lots lack a connection to the county's Department of Water Supply system.

Figure 3-5: DHHL Lands Near Kea‘au-Pāhoa Road



Source: DHHL Maku‘u Regional Plan, April 2008

The second and third projects are the Makuʻu - Hālona and Makuʻu - Pōpōkī residential subdivisions (approximately 540 acres total), planned concurrently. Phase 1 is approximately 240 acres, with 374 residential and subsistence agriculture lots. Phase 2, approximately 300 acres, will have 361 residential lots (average 20,000 square feet or 0.46 acre) and 13 agriculture lots ranging from about 1.0 to 3.42 acres. A 12.7-acre parcel has been set aside for a future park. Site improvements for both subdivisions include roads, drainage, water, overhead electric, road lighting, and underground telecommunications.

In addition to the holdings mentioned above, DHHL controls its ʻŌlaʻa site, which is located in northwest Puna, near Hawaiʻi Volcanoes National Park and the Puʻu Makaʻala Natural Area Reserve. Development of this 708-acre parcel is a non-priority, given limited access, significant rainfall, and surrounding pastoral uses.

3.2 Traffic and Transportation

As described in **Section 1.1.2.2: Mobility and Congestion**, Keaʻau-Pāhoa Road already carries high volumes of traffic, which are anticipated to increase in future years as population and development increase. The sections that follow discuss the operations of these volumes along the highway and at intersections.

The performance of traffic operations is reflected by the term Level of Service (LOS). LOS describes traffic operations on roadway segments and at intersections. The LOS represents the degree of traffic congestion, with a rating of A (best) to F (worst). For example, an LOS of A represents no traffic congestion and free flowing travel conditions. An LOS of F corresponds to extreme congestion, long delays, and forced flow conditions. Transportation engineers and planners try to design roadways to achieve an LOS C although LOS D is acceptable during peak periods in urban areas. LOS E and LOS F are typically considered unacceptable.

Traffic analyses typically look at both an AM and PM peak hour, which are the hours of the day with the heaviest traffic, even though congested conditions can certainly persist longer than an hour. For the studies that follow, the AM peak hour is defined as the hour between 7:00 AM and 8:00 AM, and the PM peak hour is defined as the hour between 4:15 PM and 5:15 PM.

Volume-to-capacity, or v/c ratio, is a measure indicating the traffic demand relative to the roadway's capacity. The 2000 Highway Capacity Manual defines capacity as "the maximum number of vehicles that can pass a given point during a specified period under prevailing roadway, traffic flow, and traffic control conditions." Capacity varies with the number of travel lanes and other specific features to the roadway. A v/c ratio of 0.50 indicates that the traffic demand is utilizing 50 percent of the roadway's capacity. A v/c ratio in excess of 1.00 indicates that the traffic demand exceeds the capacity of the roadway or highway facility.

LOS and v/c can be calculated by roadway segment (how the traffic is flowing between intersections) as well as at each individual intersection (how the traffic performs overall within that intersection). Individual turning movements (example, a westbound-to-southbound left turn) or through-traffic movements within intersections can also be assessed for their LOS.

The discussions that follow establish the existing conditions along Kea'au-Pāhoa Road. For the purposes of the traffic analyses, the direction "westbound" means towards Kea'au and Hilo, and the direction "eastbound" is towards Pāhoa and Kalapana. For cross-streets, "northbound" is heading towards the ocean (makai) and "southbound" is heading inland (mauka).

3.2.1 Existing Roadway Volumes and Level of Service

As noted above, the LOS for roadway operations is described by a letter scale ranging from A to F. **Figure 3-6: Representations of Level of Service Along a Multi-Lane Highway** shows illustrative images of LOS along the segments of a highway between cross-streets.

The LOS for Kea'au-Pāhoa Road segments between intersections was calculated based on the v/c ratio as described in **Table 3-2: Definition of Level of Service Between Intersections**. LOS A through D are generally considered acceptable conditions for motorists, and have a v/c ratio under 0.80, meaning that the roadway has more capacity than the traffic demand. As the LOS becomes LOS E (v/c between 0.80 and 1.00), conditions are close to or at capacity, and traffic operations become poorer, with greater delay, slower speeds, and increased conflicts between vehicles Once traffic congestion reaches LOS F (v/c greater than 1.00), the capacity of the roadway has been exceeded, and delay is severe, with slow speeds.

Table 3-2: Definition of Level of Service Between Intersections

Level of Service	Volume to Capacity Ratio (v/c)
A	Less than 0.10
B	Between 0.10 and 0.30
C	Between 0.30 and 0.55
D	Between 0.56 and 0.80
E	Between 0.80 and 1.00
F	Greater than 1.00

Source: Adapted from Transportation Research Board, 2000 Highway Capacity Manual

Figure 3-6: Representations of Level of Service Along a Multi-Lane Highway

Level Of Service	Flow Conditions	Technical Descriptions
A		Highest level of service. Traffic flows freely with little or no restrictions in maneuverability. **No Delays**
B		Traffic flows freely, but drivers have slightly less freedom to maneuver. **No Delays**
C		Density becomes noticeable with ability to maneuver limited by other vehicles. **Minimal Delays**
D		Speed and ability to maneuver is severely restricted by increasing density of vehicles. **Minimal Delays**
E		Unstable traffic flow. Speeds vary greatly and are unpredictable. **Minimal Delays**
F		Traffic flow is unstable, with brief periods of movement, followed by forced stops. **Significant Delays**

Source: Adapted from and Courtesy of California Department of Transportation, based on 2000 Highway Capacity Manual, Exhibit 21-3, Speed-Flow Curves with LOS Criteria for Multi-Lane Highways

The existing (year 2006) traffic operations between intersections in the corridor are outlined in **Table 3-3: Volumes, Capacity and LOS Along Corridor, Existing Year (2006), AM Peak Hour** and in **Table 3-4: Table 3-4: Volumes, Capacity and LOS Along Corridor, Existing Year (2006),** PM Peak Hour**.** As the tables demonstrate, both AM and PM peak hours show pronounced levels of delay. It should be noted that these levels of service are only associated with the roadway between intersections. Intersection operations are discussed below in **Section 3.2.2: Intersection LOS**.

A substantial portion of the corridor is subjected to poor traffic operations. Heading towards Keaʻau in the AM hour, existing traffic between Pāhoa and Kaloli Drive operates at a generally acceptable LOS, either LOS C or LOS D. However, between Kaloli Drive and Pōhaku Circle, the traffic operates at a LOS E, which is close to capacity conditions, and would be typified by lower speeds and increased conflicts between vehicles. The traffic between Pōhaku Circle and Shower Drive operates at a LOS F, which is at or above capacity, and would be indicative of very low speeds, high congestion, and stop-start conditions. Even with much higher volumes, traffic operations improve beyond Shower Drive to an acceptable LOS D because of the temporary additional lane provided on the shoulder during the AM peak hour. The Shoulder Improvements Project, to be constructed prior to the implementation of this project, will make the second Keaʻau-bound travel lane beyond Shower Drive permanent and available throughout the day.

Table 3-3: Volumes, Capacity and LOS Along Corridor, Existing Year (2006), AM Peak Hour

From	To	Westbound to Kea‘au				Eastbound to Pāhoa			
		Volume	Capacity	v/c	LOS	Volume	Capacity	v/c	LOS
Opukahaia Street	Transfer Station Driveway	2143*	2712*	0.79*	D*	687	1410	0.49	C
Transfer Station Driveway	Pōhaku Drive/Shower Drive	2115*	2712*	0.78*	D*	653	1410	0.46	C
Pōhaku Drive/Shower Drive	Pōhaku Place	1436	1410	1.02	F	618	1410	0.44	C
Pōhaku Place	Kaloli Drive	1417	1410	1.00	F	595	1410	0.42	C
Kaloli Drive	Pōhaku Circle (South)	941	1128	0.83	E	491	1128	0.44	C
Pōhaku Circle (South)	Orchidland Drive	849	1410	0.60	D	536	1410	0.38	C
Orchidland Drive	Paradise Drive	954	1410	0.68	D	512	1410	0.36	C
Paradise Drive	Auli‘i Street	827	1128	0.73	D	527	1128	0.47	C
Auli‘i Street	Maku‘u Drive	809	1410	0.57	D	491	1410	0.35	C
Maku‘u Drive	Ilima Street	837	1410	0.59	D	557	1410	0.40	C
Ilima Street	Ainaloa Boulevard	880	1410	0.62	D	558	1410	0.40	C
Ainaloa Boulevard	Ka Ohuwalu Drive	671	1410	0.48	C	459	1410	0.33	C
Ka Ohuwalu Drive	Kaluahine Place	674	1128	0.60	D	550	1128	0.49	C
Kaluahine Place	Old Pāhoa Road	661	1410	0.47	C	556	1410	0.39	C
Old Pāhoa Road	Kahakai Boulevard	627	1410	0.44	C	402	1410	0.29	B
Kahakai Boulevard	Nanawale Homestead	445	1128	0.39	C	378	1128	0.34	C
Nanawale Homestead	Unnamed	405	1128	0.36	C	328	1128	0.29	B
Unnamed	Kapoho Road	416	1128	0.37	C	322	1128	0.29	B

*Includes temporary use of shoulder as a travel lane during AM peak hour

Source: SSFM International

Table 3-4: Volumes, Capacity and LOS Along Corridor, Existing Year (2006), PM Peak Hour

From	To	Westbound to Kea‘au				Eastbound to Pāhoa			
		Volume	Capacity	v/c	LOS	Volume	Capacity	v/c	LOS
Opukahaia Street	Transfer Station Driveway	740	1410	0.52	C	1662	1410	1.18	F
Transfer Station Driveway	Pōhaku Drive/Shower Drive	672	1410	0.48	C	1573	1410	1.12	F
Pōhaku Drive/Shower Drive	Pōhaku Place	638	1410	0.45	C	1522	1410	1.08	F
Pōhaku Place	Kaloli Drive	682	1410	0.48	C	1415	1410	1.00	F
Kaloli Drive	Pōhaku Circle (South)	547	1128	0.48	C	1139	1128	1.01	F
Pōhaku Circle (South)	Orchidland Drive	556	1410	0.39	C	1186	1410	0.84	E
Orchidland Drive	Paradise Drive	670	1410	0.48	C	1180	1410	0.84	E
Paradise Drive	Auli‘i Street	519	1128	0.46	C	1015	1128	0.90	E
Auli‘i Street	Maku‘u Drive	536	1410	0.38	C	865	1410	0.61	D
Maku‘u Drive	Ilima Street	506	1410	0.36	C	923	1410	0.65	D
Ilima Street	Ainaloa Boulevard	536	1410	0.38	C	884	1410	0.63	D
Ainaloa Boulevard	Ka Ohuwalu Drive	494	1410	0.35	C	761	1410	0.54	C
Ka Ohuwalu Drive	Kaluahine Place	501	1128	0.44	C	724	1128	0.64	D
Kaluahine Place	Old Pāhoa Road	481	1410	0.34	C	693	1410	0.49	C
Old Pāhoa Road	Kahakai Boulevard	377	1410	0.27	B	576	1410	0.41	C
Kahakai Boulevard	Nanawale Homestead	340	1128	0.30	C	369	1128	0.33	C
Nanawale Homestead	Unnamed	279	1128	0.25	B	360	1128	0.32	C
Unnamed	Kapoho Road	285	1128	0.25	B	319	1128	0.28	B

Source: SSFM International

Even higher levels of congestion are currently experienced by motorists during the PM Peak Hour on Keaʻau-Pāhoa Road. Heading from Keaʻau towards Pāhoa, traffic is subjected to over-capacity stop-and-start conditions, LOS F, between the area of the Keaʻau merge and Opukahaia Street and Pōhaku Circle. The traffic remains close to capacity, with slow speeds and a LOS E between Pōhaku Circle and Auliʻi Street. Beyond Auliʻi Street to Pāhoa and the end of the project corridor, the traffic operates at a LOS D or better, which would be considered acceptable conditions by most motorists.

3.2.2 Intersection LOS

Intersection delay reflects the difference between the travel time actually experienced and the time that would result during ideal operating conditions. At intersections, LOS is a product of approach delay and traffic progression. As shown in **Table 3-5: Level of Service and Delay at Signalized Intersections and Roundabouts** and **Table 3-6: Level of Service and Delay at Unsignalized Intersections**, the values of intersection delay corresponding to LOS grades used for signalized intersections are different from unsignalized intersections because drivers expect different levels of performance from varying types of transportation facilities.

Table 3-5: Level of Service and Delay at Signalized Intersections and Roundabouts

LOS	Delay Range (sec./vehicle)	Comments
A	0-10	Progression is extremely favorable, and most vehicles arrive during the green phase (for signals). Most vehicles do not stop at all. Short cycle lengths (for signals) may also contribute to low delay.
B	10-20	Good progression and/or short cycle lengths (for signals). More vehicles stop than for LOS A, causing higher levels of average delay.
C	20-35	Fair progression and/or longer cycle lengths (for signal). Individual signal cycle failures may begin to appear at this level, although many still pass through the intersection without stopping.
D	35-55	Congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle length (for signals), or high volume/capacity ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual signal cycle failures are noticeable.
E	55-80	Usually considered to be the limit of acceptable delay. High delay values generally (but not always) indicate poor progression, long cycle lengths (for signals), and high volume/capacity ratios. Individual signal cycle failures are frequent occurrences.
F	80+	Considered to be unacceptable to most drivers. This condition often occurs with oversaturation. It may also occur at high volume/capacity ratios below 1.0 with many individual signal cycle failures. Poor progression and long signal cycle lengths may also contribute to such high delay values

Source: Adapted from Transportation Research Board, 2000 Highway Capacity Manual

Table 3-6: Level of Service and Delay at Unsignalized Intersections

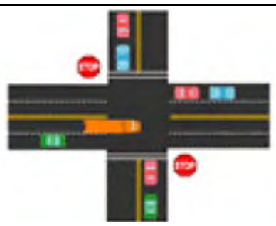
LOS	Delay Range (sec./vehicle)	Comments
A	0-10	• Nearly all drivers find freedom of operation. • Very seldom is there more than one vehicle in queue.
B	10-15	• Some drivers begin to consider the delay an inconvenience. • Occasionally there is more than one vehicle in queue.
C	15-25	• Many times there is more than one vehicle in queue. • Most drivers feel restricted, but not objectionably so.
D	25-35	• Often there is more than one vehicle in queue. • Drivers feel quite restricted.
E	35-50	• Represents a condition in which the demand is near or equal to the probable maximum number of vehicles that can be accommodated by the movement. • There is almost always more than one vehicle in queue. • Drivers find the delays approaching intolerable levels.
F	50+	• Forced flow. • Represents an intersection failure condition that is caused by geometric and/or operational constraints external to the intersection.

Source: Adapted from Transportation Research Board, 2000 Highway Capacity Manual

The LOS for unsignalized intersections vary by the available gap space (space between vehicles in opposing streams of traffic). The LOS for signalized intersections is affected by the traffic signal's cycle length (length of time for all phases of the signal to operate, usually between 30 and 120 seconds) and the number of phases, which both add additional delay. Roundabouts can handle much higher demand flow levels than minor movements at stop-sign controlled intersections; therefore, LOS criteria for signalized intersections can be used for roundabouts as well.

Figure 3-7: Representations of Levels of Service for Stop-Sign Controlled Intersections provides a visual representation of Levels of Service at unsignalized intersections, with the main highway running from left-to-right in the illustrations, and the cross streets running up and down. As the illustrations show, once the LOS starts approaching LOS E or LOS F, there are few gaps available for the cross-street traffic to maneuver as desired.

Figure 3-7: Representations of Levels of Service for Stop-Sign Controlled Intersections

Level Of Service	Flow Conditions	Technical Descriptions
A		Short Delays
B		Short Delays
C		Minimal Delays
D		Minimal Delays
E		Significant Delays
F		Considerable Delays

Source: Adapted from and Courtesy of California Department of Transportation, based on 2000 Highway Capacity Manual, Exhibit 17-2, LOS Criteria for Two Way Stop Controlled Intersections

The two tables that follow document either Level of Service or the ratio of volume to capacity (V/C) at all the major intersections in the corridor, based on the computer model Synchro, which uses algorithms based on the 2000 Highway Capacity Manual. The tables list LOS for overall intersections or traffic movements where the computer model calculates LOS. For the traffic movements where the computer models do not calculate LOS, the volume to capacity (V/C) ratios are shown instead. Any traffic operations that are worse than a LOS D or have a higher V/C ratio than 0.85 are shown in **bold** in the tables.

The calculated LOS for 2006 (existing conditions) is provided in **Table 3-7: Existing LOS and V/C, AM Peak Hour, Year 2006, Study** Corridor Intersections and in **Table 3-8: Existing LOS and V/C, PM Peak Hour, Year 2006, Study Corridor Intersections**. The tables illustrate problems with a number of intersections that currently operate at a poor LOS. In some cases, there is an acute problem for particular approaches and movements.

As **Table 3-7: Existing LOS and V/C, AM Peak Hour, Year 2006, Study Corridor Intersections** demonstrates, many cross-street intersections have a challenge in navigating turns or through movements during the AM peak hour. The intersections of Keaʻau-Pāhoa Road with the Keaʻau Transfer Station, Shower/Pōhaku Drive, Pōhaku Place, Kaloli Drive, Orchidland Drive, Ainaloa Boulevard, and Kahakai Boulevard all have movements from the cross streets that operate at an LOS F, meaning that it is extremely difficult for these cross-streets to get a break in traffic to turn, particularly for left turns. Turning traffic will often back up as the first vehicle waits for an opening. Makuʻu Drive, Paradise Drive, Auliʻi Street and Old Pāhoa Road have cross-street movements functioning at LOS E, which is only marginally better and essentially at capacity. Since traffic on Keaʻau-Pāhoa has the right-of-way over the stopped traffic at the cross streets, these intersections do not generally limit capacity for through traffic along Keaʻau-Pāhoa Road itself, though in one case, the combined westbound left turn and through movement at Ilima Street is over capacity.

Table 3-8: Existing LOS and V/C, PM Peak Hour, Year 2006, Study Corridor Intersections demonstrates a similar situation in the PM Peak hour. Opukahaia Street, the Keaʻau Transfer Station, Shower Drive/Pōhaku Drive, Pōhaku Place, Kaloli Drive, Orchidland Drive, and Paradise Drive all have movements over capacity, at Level of Service F, greatly hindering the mobility of turning traffic from these cross-streets. Pōhaku Circle, Makuʻu Drive, Ainaloa Boulevard, and Old Pāhoa Road all have movements functioning at LOS E. Again, the intersections do not generally create problems for through traffic on Keaʻau-Pāhoa Road itself, although the eastbound approach to the intersection at Opukahaia Street is over capacity, a function of high volumes leaving Keaʻau within a single travel lane.

These challenging conditions for turning or crossing traffic result in motorists often having to make risky maneuvers.

Table 3-7: Existing LOS and V/C, AM Peak Hour, Year 2006, Study Corridor Intersections

Intersection with Kea'au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			0.47		A	0.71		C		C			
Kea'au Transfer Station	Stop		C	0.44			0.71					**F**		**F**
Shower Drive	Stop		C	0.41		A	**0.96**			**F**			**F**	
Pōhaku Place	Stop			0.42		A	0.64		**F**		**F**			
Kaloli Drive	Stop		B	0.32			0.64						**F**	
Pōhaku Circle	Stop			0.33		A	0.57			C				
Orchidland Dr.	Stop			0.32	0.05	A	0.59			**F**				
Paradise Drive	Stop		A	0.29			0.40	0.03					**E**	
Auli'i Street	Stop			0.35	0.01	A	0.54			**E**				
Maku'u Drive	Stop		B	0.28			0.39	0.17					**E**	
Ilima Street	Stop			0.38		**1.06**			D		D			
Ainaloa Blvd.	Stop			0.30	0.08	A	0.41			**F**				
Ka Ohuwalu	Stop		A	0.39			0.46					C		C
Kaluahine St.	Stop		A	0.36		A	0.45			D			C	
Old Pāhoa Rd.	Stop			0.23	0.15	A	0.35		**E**		**E**			
Kahakai Blvd.	Stop		A	0.17			0.24	0.06				**F**		**F**
Nanawale Homestead Rd	Stop			A			A			C			C	
Unnamed Road	Stop			A			A			A			A	
Kapoho Rd.	Signal	C	D	C	C	C	C	C	A	A		B	B	

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
Source: SSFM International and Roger Dyar, P.E.

Table 3-8: Existing LOS and V/C, PM Peak Hour, Year 2006, Study Corridor Intersections

Intersection with Kea‘au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			**1.09**		C	0.49		**F**		**F**			
Kea‘au Transfer Station	Stop		A	**1.03**			0.48					**F**		**F**
Shower Drive	Stop		A	**0.96**		B	0.41			**F**			D	
Pōhaku Place	Stop			**1.01**		B	0.44		**F**		**F**			
Kaloli Drive	Stop		B	0.73			0.37						**F**	
Pōhaku Circle	Stop			0.75		B	0.36			**E**				
Orchidland Dr.	Stop			0.71	0.08	B	0.37			**F**				
Paradise Drive	Stop		A	0.62			0.30	0.04					**F**	
Auli’i Street	Stop			0.65	0.02	B	0.35			**E**				
Maku‘u Drive	Stop		A	0.48			0.28	0.05					**E**	
Ilima Street	Stop			0.61		**0.89**			D		D			
Ainaloa Blvd.	Stop			0.42	0.16	B	0.27			**E**				
Ka Ohuwalu	Stop		A	0.50			0.33					C		C
Kaluahine St.	Stop		A	0.48		A	0.32			B			C	
Old Pāhoa Rd.	Stop			0.27	0.19	B	0.17		**E**		**E**			
Kahakai Blvd.	Stop		A	0.21			0.16	0.06				D		D
Nanawale Homestead Rd	Stop			A			A			C			A	
Unnamed Road	Stop			A			A			A			C	
Kapoho Rd.	Signal	B	C	C	C	C	C	C	A	A		B	B	

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
Source: SSFM International and Roger Dyar, P.E.

3.2.3 Corridor-Wide Delay

An analysis was performed of the overall performance of the corridor in addressing the problem of delay in the corridor. **Table 3-9: Total Daily Delay in Project Corridor, Kea'au-Pāhoa Road and Cross-Streets** provides the calculations. For the 2038 TSM and Build Alternatives, this table assumes signals have been implemented in place of roundabouts, and it does not include any access management measures such as discussed above in **Section 2.2.3: Access Management**. A national average of 1.6 persons per vehicle was assumed.

Table 3-9: Total Daily Delay in Project Corridor, Kea'au-Pāhoa Road and Cross-Streets

Year	Alternative (*)	Total Daily AM and PM Peak Hour Vehicle Delay (hrs)	Persons per vehicle	Daily Person-hours Delay
2006	Existing	300.2	1.6	480
2038	No-Build	2982.1	1.6	4771
2038	TSM Alternative	1981.0	1.6	3170
2038	Alternative 3	1005.8	1.6	1609
2038	Alternative 4	591.1	1.6	946
2038	Alternative 5	434.4	1.6	695

*Assumes intersections under TSM and Alternatives 3-5 are signalized and no access management measures have been implemented.
Source: Roger Dyar, PE

As the table shows, delay will increase substantially compared to existing levels between 2006 and the 2038 No-Build scenario as traffic in the corridor grows. The TSM Alternative would reduce delay by roughly a third compared to the No-Build Alternative. Alternatives 3 through 5 would substantially reduce the delay much further, between 67 and 85 percent. The reduction would be primarily based on the number of through lanes of traffic in the corridor.

3.2.4 Safety

Safety has been a recognized concern along Keaʻau-Pāhoa Road. Intersections are one critical safety concern, given high volumes and poor access control along the corridor. Another problem comes from areas between intersections, where traffic of different speeds has conflicts in free-flowing conditions and passing is challenging. A third problem with safety along the corridor comes from uncontrolled access, with numerous driveways in some more-developed segments of the corridor. To exacerbate these problems, emergency response in the study area is often hindered by congestion along the roadway during peak hours.

A detailed analysis of safety in the corridor is provided in **Appendix C: Traffic Study**. The following sections summarize the assessment of existing problems in the corridor. The benefits to safety that will come from improvements in the corridor are discussed in **Section 4.2.5: Safety** below.

HDOT collects crash statistics statewide. Crash statistics reflect only major crashes that are reported to HDOT. Major crashes include those resulting in death, bodily injury, and/or property damage exceeding $3,000 in cost.

In total, there were 411 documented crashes along Keaʻau-Pāhoa Road between the years 2004 and 2007. Of those crashes, 289 occurred at an intersection, and 122 occurred away from an intersection.

3.2.4.1 Intersection Safety

FHWA has initiated a Highway Safety Improvement Program (HSIP) as part of Section 1401 of the *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users* (SAFETEA-LU). As part of this program, FHWA has requested all states to determine the locations within each state that have accident rates in the top five percentile statewide, covering both intersections and highway segments. "Five Percent" reports are produced annually.

In HDOT's most recent 2008 Five Percent Report to FHWA, 79 intersections on the State Highway System had at least three crashes per year for each of the past three years. The top five percentile of these 79 high-crash locations statewide is four intersections, all four of which are in the Puna District, and three of which are located along Keaʻau-Pāhoa Road: at Ainaloa Boulevard, at Kahakai Boulevard, and at Old Pāhoa Road. Traffic signals were identified in the report as measures to address the first two intersections.

Table 3-10: Top Five Percent Intersections in Hawaii With Most Severe Safety Needs summarizes the intersections cited in the 2008 HSIP Five Percent Report for Hawaiʻi.

Table 3-10: Top Five Percent Intersections in Hawaii With Most Severe Safety Needs

Location	Potential Remedies	Estimated Costs	Implementation Impediments	Comments
Volcano Rd @ Old Volcano Rd	-	-	Will monitor this intersection upon completion of widening project in this area.	-
Kea'au-Pāhoa Rd @ Ainaloa Blvd	Traffic Signal Installation recommended	$600,000	-	Proposed HSIP FY 07
Kea'au-Pāhoa Rd @ Kahakai Blvd	Traffic Signal Installation recommended	$450,000	-	Proposed HSIP FY 06
Kea'au-Pāhoa Rd @ Old Pāhoa Rd & Old Government Rd	Project at Kahakai intersection (above) should have positive influence on this location.	-	Will monitor this intersection upon completion of project at Kahakai intersection (above).	Cost benefit analysis favors Kahakai Blvd

Source: FHWA, accessed at http://safety.fhwa.dot.gov/hsip/fivepercent/2008/08hi.htm

Table 3-11: Kea'au - Pāhoa Road Intersection Crash Types and Rates, 2004-2007 provides information on numbers of crashes and overall rates in the study corridor between the years 2004 and 2007. The worst intersections for crashes in the corridor based on the crash rate (crashes per million vehicles entering the intersection) are at Ainaloa Boulevard, Kahakai Boulevard, Old Pāhoa Road, and Maku'u Drive.

Table 3-11: Kea'au - Pāhoa Road Intersection Crash Types and Rates, 2004-2007

Intersection of Kea'au-Pāhoa Road at	Non-collision	Ran off road	Fixed object	Pedes-trian	Bike	Head-on	Rear-end	Sideswipe Same Side	Sideswipe Different Side	Angle Same Side	Angle Different Side	Broad-side	Other	Total for Intersection	Crash Rate*
Kahakai Blvd.		1		1		2			1		16	9	1	31	2.49
Ainaloa Blvd.		4	2			1	2	1			19	19	1	49	2.45
Old Pāhoa Road						1	1	1	2	1	20	13	1	40	2.10
Maku'u Drive		2	1		1	1	1	1		1	13	12		33	1.57
Paradise Drive		1	2			2	3		3	1	12	3		27	1.20
Orchidland						2	1	1		1	9	6	1	21	0.91
Kapoho Rd.						1	2				10	3		16	0.83
Nanawale							1					3		4	0.62
Kaloli Drive		3	3				2		1		2	5		16	0.56
Shower/Pōhaku	1	1					6				1	8		17	0.48
Pōhaku Place		2	1				2				3	1		9	0.33
Unnamed		1					1							2	0.31
Auli'i St.		1									1	2		4	0.21
Kaluahine St.							2			1				3	0.16
Transfer Station						1		1				3		5	0.14
Pōhaku Circle				1			2							3	0.12
Ka Ohuwalu St.											1	1		2	0.11
Ilima St.							1	1						2	0.11
Puakalo Ave. (30th Ave.)							2							2	0.07
Paved Road						1	1							2	0.06
Poni Moi Ave. (29th Ave.)												1		1	0.04

*Rate Per Million Vehicles Entering Intersection
Source: HDOT

3.2.4.2 Roadway Segments Between Intersections

One deficiency of the existing two-lane Kea‘au-Pāhoa Road is the relative lack of opportunities for traffic to pass other vehicles. Even in the portions of the corridor striped as a passing zone, heavy traffic volumes preclude motorists from passing slower-moving vehicles during most hours of the day. Motorist frustration with slower-moving vehicles may result in dangerous passing maneuvers, and potential head-on collisions.

Table 3-12: Kea‘au-Pāhoa Road Crash Numbers and Rates Between Intersections, 2004-2007 and **Table 3-13: Kea‘au-Pāhoa Road Crash Types, Segments Between Intersections, 2004-2007** provide information on crash rates and types in the study corridor between the years 2004 and 2007. The segment of roadway between Opukahaia Street and Shower Drive had the largest number of crashes compared to the rest of the corridor, but this is in part due to the length of the segment and high traffic volume in the segment. The highest crash rates, at locations with a much higher rate than the rest of the corridor, were actually observed in the segment between between Old Pāhoa Road and Kahakai Boulevard, between Nanawale Homestead Road and the Unnamed Road, and between the unnamed road and Pāhoa-Kapoho Road.

Table 3-12: Kea‘au-Pāhoa Road Crash Numbers and Rates Between Intersections, 2004-2007

From	To	Number of Crashes	Crash Rate (per 100 million Vehicle Miles)
Opukahaia	Shower	45	65.0
Shower	Pōhaku Place	8	51.4
Pōhaku Place	Kaloli	11	84.3
Kaloli	Pōhaku Circle	4	55.4
Pōhaku Circle	Orchidland	9	77.6
Orchidland	Paradise	2	34.0
Paradise	Aulii	4	55.3
Aulii	Maku’u	6	47.2
Maku’u	Ilima	1	41.9
Ilima	Ainaloa	1	26.5
Ainaloa	Ka Ohuwalu	5	27.5
Ka Ohuwalu	Kaluahine	3	23.1
Kaluahine	Old Pāhoa	10	43.4
Old Pāhoa	Kahakai	2	105.5
Kahakai	Nanawale Homestead	3	86.2
Nanawale Homestead	Unnamed Road	3	150.1
Unnamed Road	Kapoho	5	134.6
Total/Average		122	57.0

Source: HDOT

Table 3-13: Keaʻau-Pāhoa Road Crash Types, Segments Between Intersections, 2004-2007

From	To	Ran off Road	Rear End	Sideswipe same direction	Animal	Head on	Sideswipe opposite direction	Broad-side	Bike	Angle same dir	Guard rail	Others	Totals
Opukahaia	Shower	19	14	2	0	1	2	2	0	1	1	3	45
Shower	Pōhaku Place	0	4	1	0	1	1	0	0	0	0	1	8
Pōhaku Place	Kaloli	4	3	0	0	0	0	0	1	0	0	3	11
Kaloli	Pōhaku Circle	3	1	0	0	0	0	0	0	0	0	0	4
Pōhaku Circle	Orchidland	2	2	1	0	2	0	0	1	0	0	1	9
Orchidland	Paradise	1	0	0	0	0	0	0	0	0	0	1	2
Paradise	Aulii	1	1	0	0	0	1	0	0	0	0	1	4
Aulii	Makuʻu	2	4	0	0	0	0	0	0	0	0	0	6
Makuʻu	Ilima	0	0	1	0	0	0	0	0	0	0	0	1
Ilima	Ainaloa	0	1	0	0	0	0	0	0	0	0	0	1
Ainaloa	Ka Ohuwalu	0	3	1	0	0	0	0	0	0	0	1	5
Ka Ohuwalu	Kaluahine	2	0	0	0	1	0	0	0	0	0	0	3
Kaluahine	Old Pāhoa	3	2	0	0	2	0	0	1	0	0	2	10
Old Pāhoa	Kahakai	1	0	0	0	0	0	1	0	0	0	0	2
Kahakai	Nanawale	1	0	0	0	0	0	0	0	0	1	1	3
Nanawale	Homestead	0	1	0	0	0	0	0	0	0	1	1	3
Homestead	Kapoho	2	2	0	1	0	0	0	0	0	0	0	5
	Totals	**41**	**38**	**6**	**1**	**7**	**4**	**3**	**3**	**1**	**3**	**15**	**122**

Source: HDOT

3.2.4.3 Uncontrolled Access

The frequency of driveways along the corridor poses safety concerns. With an existing two-lane undivided cross-section along Keaʻau-Pāhoa road, vehicles turning into or out of driveway areas must transition into or out of high-speed highway traffic. Left turns are particularly dangerous as they involve crossing traffic lanes. During peak hour conditions, it is often challenging for vehicles from driveways to find an opening to make left turns and some motorists avoid that maneuver.

3.2.5 Bicycles and Pedestrians

The Keaʻau-Pāhoa Road Advisory Group (KPAG) has noted repeatedly during meetings that the existing Keaʻau-Pāhoa Road corridor does not provide a safe or welcoming environment for bicycles or pedestrians to use the corridor. Nonetheless, there is a modest amount of pedestrian and bicycling travel along the roadway shoulders. Much of the pedestrian activity comes from accessing transit service in the corridor.

The grades in the corridor are generally flat to moderate, and therefore the corridor would be an attractive route for bicyclists if conditions were safer. While shoulders in the corridor are generally provided for much of the study area, they vary in width and quality for non-motorized travel.

The current use of the Keaʻau-bound shoulder as a temporary AM Peak Hour travel lane precludes safe travel for bicycles or pedestrians in this area. The Shoulder Improvements project will remedy this problem with a new travel lane and shoulder in the Keaʻau-bound direction. However, it will create a similar condition in the Pāhoa-bound direction as that shoulder will be improved to be used as a temporary travel lane during the PM Peak Hour.

In addition to pedestrians and bicyclists using the shoulders, there also is regular use of the shoulders by scooters and mopeds. Scooters and mopeds are usually limited to a top speed of about 35 mph and therefore cannot maintain the operating speeds of the rest of the motor vehicle traffic.

3.2.6 Transit

The County of Hawaiʻi's Mass Transit Agency (MTA) operates the Hele-On Bus service county-wide. The system operates Monday through Saturday. The MTA has had success in increasing ridership and has ordered buses to increase and improve service.

Fares are free, but passengers wishing to transport large items or bicycles are charged $1.00. Outside of downtown areas, the system operates on a "flag stop" method, where passengers board or disembark from buses anywhere along a route (at a safe location) by request.

The Pāhoa/Pohoiki-Hilo Route is the route that serves the study area and the rest of lower Puna. From Hilo, the route follows Highway 11, circulates within Keaʻau town, then follows Keaʻau-Pāhoa Road to Pāhoa. The route also serves the Hawaiian Beaches subdivision. The Kapoho, Pohoiki and Kalapana areas are also served on a more limited schedule. As the route

passes through Pāhoa town on Old Pāhoa Road, the only segment of the study corridor not served by direct transit service is the Pāhoa Bypass between Old Pāhoa Road and Pāhoa-Kapoho Road.

The current bus service in the corridor includes 11 trips on weekdays in both directions between Hilo and Pāhoa. Four trips are provided in each direction on Saturdays. Eight of the weekday trips are with a 33 passenger bus and three are with a 47 passenger bus.

Presently, there are no amenities for passengers boarding or disembarking from buses in the corridor. Passengers wait for and depart from buses on the roadway shoulder. The MTA and HDOT are considering designated bus stops at several locations with plans for improvements for passenger safety and comfort. These stops would include bus pull-outs to enable the bus to safely enter and exit the flow of traffic and also increase the separation between waiting passengers and the traffic. Future designated stops will have to be compliant with the Americans with Disabilities Act, and will include signage at all locations. Where appropriate, shelters or other features may be provided as well.

Bus pull-outs are proposed along both sides of the roadway corridor near:

- Shower Drive
- Kaloli Drive
- Pōhaku Circle (Pāhoa - bound direction only)
- Orchidland Drive
- Paradise Drive
- Makuʻu Drive
- Ainaloa Boulevard
- Makuʻu Farmer's Market

According to the Mass Transit Agency's latest available ridership statistics at the time of this writing (July, 2009), the Pāhoa/Hilo route carried 13,053 passengers that month compared to 10,319 passengers in July of 2008, a 26.5% increase. Ridership has been steadily increasing in recent years system-wide.

One segment along the study corridor that presently cannot serve passengers with flag stops during the AM peak hour is the shoulder of the Keaʻau-bound roadway between Shower Drive and Opukahaia Street, since the shoulder is opened for peak hour traffic. There are few residences or destinations in this segment. Once the Shoulder Improvements project is completed (see **Section 1.2.2.1: The Keaʻau-Pāhoa Road Shoulder Lane Conversion Project**), this problem will be remedied, though a comparable situation will be created in the Pāhoa-bound direction as that shoulder becomes used during the PM Peak Hour.

3.3 Socioeconomic Environment

The following discussion considers the profile of the existing community. A detailed Social Impact Assessment, which goes into much greater detail, is found in **Appendix G: Social Impact Assessment**. A Social Impact Assessment (SIA) was performed for this project. Refer to **Section**

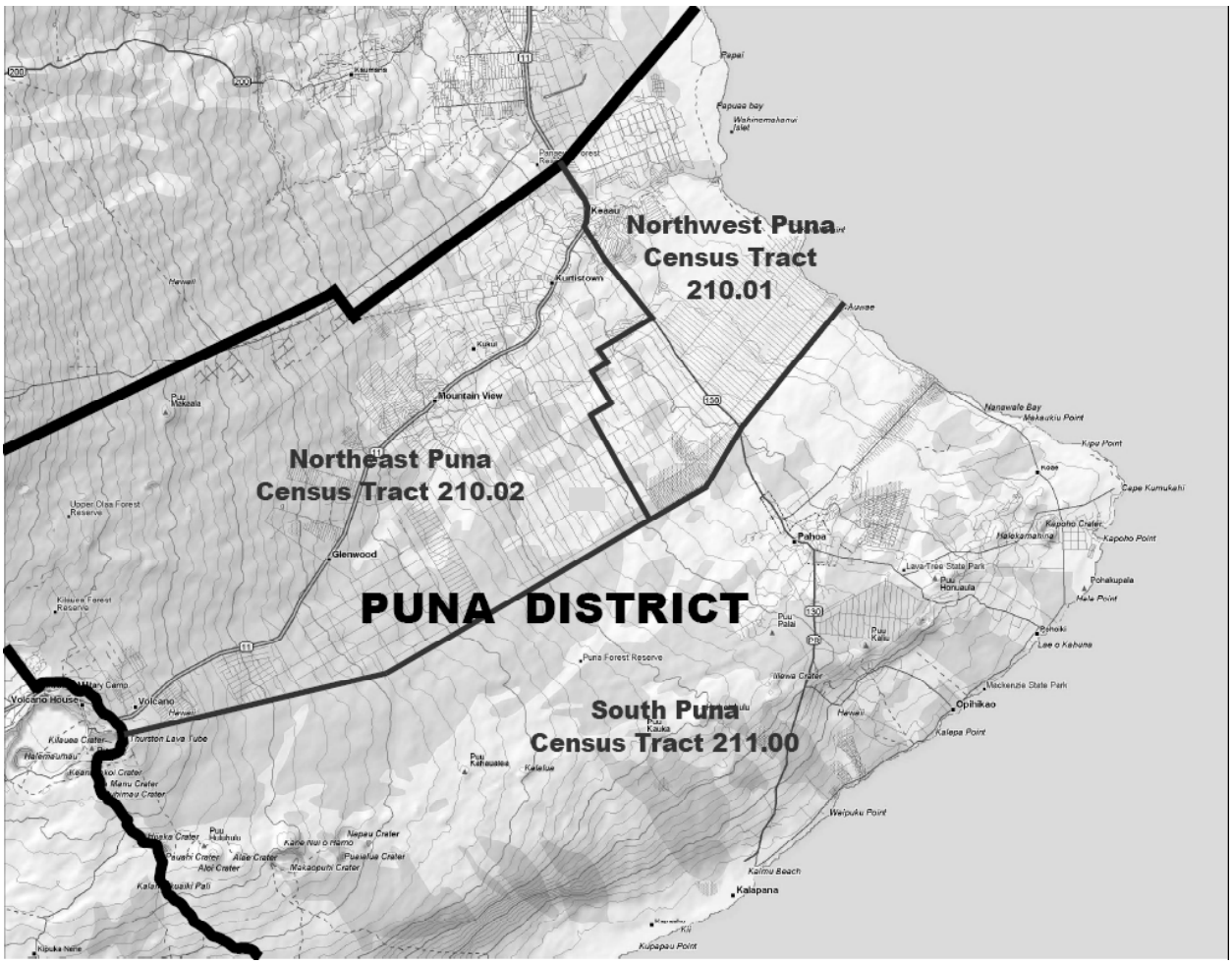
4.3.1: Social Impact Interview Findings for more information about the community's views on Puna's current state and future impacts.

3.3.1 Population and Housing

3.3.1.1 Puna District Study Area Census Tracts

The Puna District is bounded by the South Hilo and Kau Districts to the north and west, respectively. The Puna District is generally coterminous with Census Tracts 210.01, 210.02 and 211.00, as defined by the U.S. Census Bureau in the 1990 census. **Figure 3-8: Census Tracts in Regional Study Area** illustrates the Regional Study Area, which for this section of the document is defined as the Puna District.

Figure 3-8: Census Tracts in Regional Study Area



Prior to 1990, Census Tracts 210.01 and 210.02 were designated as one tract, 210.00. Generally, Census Tract 210.00 extended from slightly mauka of Volcano Highway from the outskirts of Hilo towards Volcano and to the southern boundaries of Volcano, Fern Forest, Eden Roc, Fern Acres, Hawaiian Acres, Ainaloa, and Hawaiian Paradise Park subdivisions. In the 2000

census, the tract was divided in two. Census Tract 210.01 includes Kea'au, Hawaiian Paradise Park, Orchidland and Ainaloa. Census Tract 210.02 includes Kurtistown, Hawaiian Acres and other communities west of Highway 130, not including Orchidland and Ainaloa.

Census Tract 211 includes communities south of Volcano, Fern Forest, Eden Roc, Fern Acres, Ainaloa and Hawaiian Paradise Park.

For the purposes of this report, in the sections that follow, Census Tracts 210.01 and 210.02 are referred to as Northeast and Northwest Puna, respectively, and Census Tract 211 is referred to South Puna.

3.3.1.2 Regional Population and Housing Trends from 1970 to 2000

In the 30-year period from 1970 to 2000, the Puna District population experienced over a six-fold increase in population, from approximately 5,100 to 31,335 persons. **Table 3-14: Population in Hawai'i County and Puna District, 1970 to 2000** provides the population statistics for Hawaii County and the Puna District.

Table 3-14: Population in Hawai'i County and Puna District, 1970 to 2000

	1970	1980	1990	2000
Hawai'i County	63,468	92,053	120,317	148,677
Puna District	**5,154**	**11,753**	**20,781**	**31,335**
Northeast (210.01)	3,802	7,055	6,844	11,776
Northwest (210.02)			7,235	10,962
South (211.00)	1,352	4,698	6,702	8,597

Sources: 1970 population for Hawaii County is from The State of Hawaii Data Book 2000, Table 1.01, "Population of Counties: 1831 to 2000." 1970 population for Census Tracts 210.0 and 211.00 is from 1970 Census of Population and Housing Census Tracts, Honolulu, Hawaii SMSA, PHC (1)-88. 1980 population for Census Tracts 210 and 211.00 is from Census of Population and Housing, 1980 Summary Tape File 1-A, Hawai'i. 1990 and 2000 population for Hawaii County and Puna District Census Tracts is from U.S. Census Bureau, American Fact Finder, available online at http://factfinder.census.gov

In 1970, Puna's population accounted for eight percent of Hawaii County's total population. By 2000, Puna accounted for 21 percent of the island population.

While the sheer numbers indicate significant growth in the Puna District, the magnitude of this population increase is further illustrated in the percent change and average annual growth rate, as provided in **Table 3-15: Population Average Annual Growth Rate, 1970 to 2000.**

Table 3-15: Population Average Annual Growth Rate, 1970 to 2000

	1970 to 1980		1980 to 1990		1990 to 2000		1970 to 2000 (30 years)	
	Percent Change	**Average Annual Rate of Growth**	**Percent Change**	**Average Annual Rate of Growth**	**Percent Change**	**Average Annual Rate of Growth**	**Percent Change**	**Average Annual Rate of Growth**
Hawai'i County	45.0%	3.8%	30.7%	2.7%	23.6%	2.1%	134.3%	2.9%
Puna District	**128.0%**	**8.6%**	**76.8%**	**5.9%**	**50.8%**	**4.2%**	**508.0%**	**6.2%**
Northeast (210.01)	85.6%	6.4%	99.6%	7.2%	72.1%	5.6%	498.1%	6.1%
Northwest (210.02)					51.5%	4.2%		
South (211.00)	247.5%	13.3%	42.7%	3.6%	28.3%	2.5%	535.9%	6.4%

In the decade from 1970 to 1980, the Puna District population more than doubled, and grew at an average of 8.6 percent annually. Growth in South Puna was exceptionally strong, increasing almost 248 percent, or by almost 3.5 times. This suggests an average annual growth rate of over 13 percent.

Growth continued to be robust in the 1980s, when Puna's population increased almost 77 percent, or about six percent each year. In that decade, growth occurred mostly in North Puna, where the population almost doubled, and increased at an average of over seven percent a year.

North Puna continued significant population increases in the 1990s, with Northeast Puna experiencing a 72 percent population increase between 1990 and 2000. At the same time, the population in Northwest Puna increased almost 52 percent. The South Puna population increased over 28 percent.

The sustained growth rate over the 30-year period between 1970 and 2000 is notably high for both the district and its northern and southern components. The Puna District increased at a rate of 6.2 percent a year. North Puna increased at an average annual rate of 6.1 percent a year, with South Puna's average annual growth rate at a slightly higher 6.4 percent.

It is estimated that the Puna District population in March 2007 was 43,071 persons, which represents an annual average population rate of six percent from 2000. (PlanPacific, Inc, 2008)

Housing information is provided in **Table 3-16: Housing Units in Hawai'i County and Puna District, 1970 to** 2000 and reflects the same patterns of growth as the region's population.

Table 3-16: Housing Units in Hawai'i County and Puna District, 1970 to 2000

	1970	1980	1990	2000
Hawai'i County	18,972	34,215	48,253	62,674
Puna District	**1,829**	**4,575**	**8,597**	**13,068**
Northeast (210.01)	1,301	2,863	2,646	4,459
Northwest (210.02)			3,229	4,895
South (211.00)	528	1,712	2,722	3,714

Sources: 1970 housing information for Hawaii County and Census Tracts 210 and 211.00 is from 1970 Census of Population and Housing Census Tracts, Honolulu, Hawaii SMSA, PHC (1)-88. 1980 housing information for Hawaii County and Census Tracts 210 and 222.00 from Census of Population and Housing, 1980 Summary Tape File 1-A, Hawaii. 1990 and 2000 housing information for Hawaii County and Puna District Census Tracts is from U.S. Census Bureau, American Fact Finder.

The Puna region's housing supply increased from 1,829 units in 1970 to over 13,000 units in 2000. The region's share of housing units in the island-wide supply grew from ten percent in 1970 to 21 percent in 2000.

As indicated in **Table 3-17: Average Annual Growth Rate, Housing Units, 1970 to 2000**, the general patterns of housing unit increases are similar to those of the population trends. The extent of increase in the island-wide and regional housing supplies was generally higher than the population increases, which indicates a housing market with available supply of units.

Table 3-17: Average Annual Growth Rate, Housing Units, 1970 to 2000

	1970 to 1980		1980 to 1990		1990 to 2000		1970 to 2000 (30 years)	
	Percent Change	Average Annual Rate of Growth	Percent Change	Average Annual Rate of Growth	Percent Change	Average Annual Rate of Growth	Percent Change	Average Annual Rate of Growth
Hawai'i County	80.3%	6.1%	41.0%	3.5%	29.9%	2.6%	230.3%	4.1%
Puna District	**150.1%**	**9.6%**	**87.9%**	**6.5%**	**52.0%**	**4.3%**	**614.5%**	**6.8%**
Northeast (210.01)	120.1%	8.2%	105.2%	7.5%	68.5%	5.4%	619.0%	6.8%
Northwest (210.02)					51.6%	4.2%		
South (211.00)	224.2%	12.5%	59.0%	4.7%	36.4%	3.2%	603.4%	6.7%

3.3.1.3 Puna District Characteristics from 2000 Census

The census looks at both families (which are two or more people who reside together and who are related by birth, marriage, or adoption) and households, which includes all the people who occupy a housing unit as their usual place of residence, and may not be related.

In 2000, the estimated population of the Puna District was 31,335 persons, which accounted for 21 percent of Hawaii County's total population. Within Puna, 38 percent lived in Northeast Puna, 35 percent in Northwest Puna, and 27 percent in South Puna at that time.

As indicated in **Table 3-18: Selected Characteristics of Puna District, 2000**, the Northeast Puna population tended to be younger than the rest of Puna and Hawaii County. Its median age was 33.8 years in 2000, compared to 38.6 years in Hawaii County and South Puna, and 38.2 years in Northwest Puna.

Table 3-18: Selected Characteristics of Puna District, 2000

	Hawai'i County	Total Puna District	Northeast Puna	Northwest Puna	South Puna
			CT 210.01	CT 210.02	CT 211.00
Population and Age					
Population	148,677	31,335	11,776	10,962	8,597
Median age	38.6	N/A	33.8	38.2	38.0
Households					
Population in households	145,873	31,109	11,771	10,743	8,595
Number of households	52,985	11,134	3,987	4,032	3,115
Average household size	2.75	2.79	2.95	2.66	2.76
Families					
Population in family households	124,566	26,547	10,343	8,971	7,233
Percent of family members of total population	84%	85%	88%	82%	84%
Number of families	36,903	7,612	2,908	2,631	2,073
Average family size	3.24	3.49	3.56	3.41	3.49
Housing Units					
Housing Units	62,674	13,068	4,459	4,895	3,714
Occupied housing units	52,985	11,134	3,987	4,032	3,115
Percent of total housing units	85%	85%	89%	82%	84%
Percent vacant units	15%	15%	11%	18%	16%
Owner occupied units	34,175	7,924	2,781	3,019	2,124
Percent of total owner occupied units	64%	71%	70%	75%	68%
Percent rental units	36%	29%	30%	25%	32%

Source: 2000 demographic and housing information for Hawaii County and Puna District Census Tracts is from U.S. Census Bureau, American Fact Finder, available at http://factfinder.census.gov/home/saff/main.html?_lang=en

The Puna region contained only a nominal number of institutional living quarters in 2000, as over 99 percent of the population lived in households. As a whole, Puna's 2000 average household size of 2.79 persons was similar to that of Hawaii County's average of 2.75 households. Within the Puna District, however, the Northeast communities tended to have slightly larger households with an average of 2.95 persons.

The younger median age and larger households in Northeast Puna is related to higher presence of family households and larger family households. In 2000, families comprised 88 percent of its households, compared to 85 percent in the overall Puna District and 84 percent in Hawaii County. Northwest Puna had a lower proportion of family households at 82 percent. Further, Northeast Puna had a relatively high average of 3.56 persons in its family households, compared to 3.49 and 3.24 persons in the Puna District and in Hawaii County, respectively.

While Northeast Puna had the largest population, Northwest Puna had more housing units and a higher housing vacancy rate in 2000. Approximately 37 percent of Puna's housing units were located in Northwest Puna, with 34 and 28 percent in Northeast and South Puna, respectively. Northwest Puna had the highest vacancy rate at 18 percent, followed by South Puna at 16 percent.

In 2000, homeowners lived in 75 percent of Northwest Puna's occupied units, which is the higher than the Puna District percentage of 71 percent of owner-occupied units. South Puna had the highest proportion of renters, who live in almost one-third of the occupied housing units.

In terms of income, the 2000 census reported that, in 1999, the Puna region had consistently lower median incomes than Hawaii County as a whole. As shown in **Table 3-19: Income Distribution and Poverty Levels, Puna Households and Families, 2000 Census**, Hawaii County's household median income was $39,805 in the 2000 census. In the Puna region, the highest household median income was in Northeast Puna, at $33,042. Households in South Puna had a significantly lower median income at $27,920.

Table 3-19: Income Distribution and Poverty Levels, Puna Households and Families, 2000 Census

	Hawai'i County	Northeast Puna	Northwest Puna	South Puna
		CT 210.01	CT 210.02	CT 211.00
Household and Family Median Income				
Household median income	$ 39,805	$ 33,042	$ 31,500	$ 27,920
Family median income	$ 46,480	$ 37,777	$ 39,338	$ 31,757
Married couples	$ 53,344	$ 45,889	$ 47,250	$ 37,333
Female householder*	$ 26,523	$ 15,160	$ 20,938	$ 17,039
Nonfamily householder	$ 22,359	$ 16,289	$ 18,459	$ 15,104
Percent of family members of total population	84%	88%	82%	84%
Families Below Poverty Level**				
Total	11.0%	19.4%	16.1%	22.3%
Married couples	6.1%	9.4%	9.5%	13.1%
Female householder*	28.1%	48.1%	34.2%	46.9%
Nonfamily householder	23.5%	28.5%	32.2%	33.3%

*No husband present

** Percentages of families below the poverty level were calculated by the U.S. Census Bureau In the 2000 Census based upon 61 different 1999 national poverty thresholds that vary according to size of family, number of children, and, for one- and two-person families, age over or under 65. Thresholds are not locally adjusted. Some representative 1999 poverty thresholds used to calculate the percentages in this table: One person (average): $8,501, two people (average): $10,869, three people (average): $13,290, four people (average): 17,029. Higher thresholds are also available for larger families (up to nine people). For more information, refer to: http://factfinder.census.gov/servlet/MetadataBrowserServlet?type=subject&id=POVERTYSF3&dsspName=DEC_2000_SF3&back=update&_lang=en.

Source: U.S. Census Bureau, Income Distribution in 1999 of Households and Families: 2000, as contained in Summary File 3 - Sample Data and available online at http://factfinder.census.gov/home/saff/main.html?_lang=en.

Table 3-19: Income Distribution and Poverty Levels, Puna Households and Families, 2000 Census also presents median family incomes and provides detail in terms of three categories: married couples, female householder with no husband present, and “nonfamily householder” (who lives either alone or with nonrelatives only). Generally, median incomes of married couples tend to be higher than those of female householders and nonfamily householders.

The median family income in Hawai‘i County was $46,480. In the Puna region, the median family income ranged from a high of $37,777 in Northeast Puna to a low of $31,757 in South Puna.

The median incomes of female headed households were particularly low in the Puna District. Compared with the Hawaii County 2000 median income of $26,523 for female-headed households, Puna region’s median incomes in this category ranged from $20,938 in Northwest Puna to a notably low $15,160 in Northeast Puna.

Consistent with lower median incomes in the Puna region were higher poverty levels.[1] In Hawaii County, eleven percent of its families had incomes below poverty level. In the Puna region, families below poverty level ranged from 16.1 percent in Northwest Puna to 22.3 percent in South Puna.

The highest levels of poverty were found in female householder families. Compared to 28.1 percent of Hawaii County’s female householder families in this category, Northeast and South Puna’s female householder families had significantly high proportions of poverty levels with 48.1 percent and 46.9 percent, respectively.

Table 3-20: Race of Hawai‘i County and Puna Residents, 2000 provides racial breakdowns for Hawai‘i County and the Puna region. In the 2000 Census, race is a self-identification data item in which respondents choose the race or races with which they most closely identify. This allows for the reflection of the increasing diversity of the population, stemming from growth in interracial marriages and immigration.

[1] In the U.S. Census, poverty is defined at the family level and not the household level, and the poverty status of the household is determined by the poverty status of the householder. Households are classified as poor when the total 1999 income of the householder's family is below the appropriate poverty threshold. The poverty thresholds vary depending upon three criteria: size of family, number of children, and, for one- and two-person families, age of the householder.

Table 3-20: Race of Hawai'i County and Puna Residents, 2000

	Hawai'i County	Total Puna District	Northeast Puna CT 210.01	Northwest Puna CT 210.02	South Puna CT 211.00
Single Race					
White	31.1%	34.0%	30.8%	34.3%	38.0%
Black or African American	0.5%	0.3%	0.3%	0.3%	0.4%
Amerian Indian and Alaskan Native	0.4%	0.5%	0.7%	0.3%	0.4%
Asian	26.7%	21.8%	22.9%	22.4%	19.4%
Native Hawaiian and Other Pacific Islander	10.9%	11.2%	11.0%	10.2%	12.7%
Other race	1.0%	1.2%	1.4%	1.2%	0.9%
Two or More Races					
Two or more races	29.3%	31.0%	32.9%	31.2%	28.2%

Source: U.S. Census Bureau, Race,: 2000, as contained in Summary File 3 - Sample Data and available online at http://factfinder.census.gov/home/saff/main.html?_lang=en.

In Hawai'i County, the largest group comprised Whites at 31.1 percent, followed by those who reported two or more races at 29.3 percent, and Asians at 26.7 percent. Native Hawaiians and other Pacific Islanders comprised 10.9 percent.

The Puna region generally followed this profile, with Whites comprising the largest group (34 percent), followed by those who reported two or more races (31 percent), and Asians (21.8 percent). Native Hawaiians and other Pacific Islanders comprised 11.2 percent of the overall Puna District population.

Of note within the Puna District is the relatively higher proportion of Whites (38 percent) and Native Hawaiians and other Pacific Islanders (12.7 percent) in South Puna.

3.3.1.4 Future Population Projections

The 2005 Hawai'i County General Plan offered twenty-year population projections. Forecasts for employment and population in Hawai'i County were based on an analysis of relationships between economic activity, employment and population. Employment is projected in basic industries, and the population forecasts are based on the employment effects on the population. This analysis considered agriculture, tourism, the manufacturing of export products, and research and development, plus secondary effects.

The Hawaii County General Plan developed three sets of projections:

- **Series A:** Assumes a one percent average annual growth rate in the visitor rate, and an average annual growth rate of one percent in the papaya industry. It further assumes that certain previously anticipated public projects will not be implemented. It is the most conservative set of the projections.

- **Series B:** This medium set of forecasts has an overall employment growth rate between two and 2.2 percent annually. It also assumes a modest two percent average annual growth rate in the visitor industry.

- **Series C:** This assumes a higher level of growth due to an assumed three percent average annual growth rate in the visitor industry, a four percent growth in the papaya industry, and the realization of a proposed State prison project.

Table 3-21: Hawaii County General Plan Projections, 2020 presents projected population ranges for the County and Puna District under the three scenarios.

Table 3-21: Hawaii County General Plan Projections, 2020

	2000 population	Projected 2020 Population			Average Annual Growth Rate, 2000 to 2020		
		Series A	Series B	Series C	Series A	Series B	Series C
Hawai'i County	148,677	213,452	217,718	237,323	1.8%	1.9%	2.4%
Puna District	31,335	57,105	58,246	63,941	3.0%	3.1%	3.6%

Source: County of Hawaii General Plan, Table 1-9. District Resident Population Distribution, Year 2020, page 1-17.

The General Plan forecasts indicate that the Puna District is anticipated to grow at rates higher than the island-wide projections, regardless of the forecast series.

An alternative method of population forecast was used in the preparation of the PCDP. Based on an estimated projection of building permits for new dwellings, it was forecasted that the region may have a population of 62,776 persons in 2020. Though slightly lower, this projection is within the range of the General Plan Series C projections, which reflect rapid growth.

The Puna Regional Circulation Plan (PRCP) in 2005 projected population for its 2030 forecast year, 2030 based on existing development, water service, road condition, lava hazards, flooding, past growth trends, and proximity to regional centers. These growth indicators were applied to the eleven census block groups in the Puna District's three census tracts. The PRCP's projected 2030 population for the Puna District is 80,162 persons, which is over two times the 2000 population, and represents an average annual growth rate of 3.2 percent over the 30-year period.

3.3.1.5 Immediate Study Area Demographics in 2000 Census

For the purposes of this study, the "Immediate Study Area" is defined as Census Designated Places that designate specific towns and subdivisions that are either adjacent to the project corridor, or rely heavily on Highway 130 for north - south access. These Census Designated Places from the 2000 census include:

- the town of Kea'au to the north of the project corridor;

- the communities of Hawaiian Paradise Park and Hawaiian Beaches / Hawaiian Shores to the east of the project corridor;
- the communities of Orchidland, Ainaloa and Hawaiian Acres to the west of the project corridor; and
- Pāhoa town and the communities of Nanawale and Leilani Estates at the south end of the project corridor.

Of note is that these subdivisions were all approved in or prior to 1961, which is prior to the establishment of land use boundaries and subdivision controls. **Figure 3-9: Immediate Study Area Communities** depicts the subdivisions and towns in the Immediate Study Area.

Table 3-22: Selected Characteristics of Immediate Study Area, 2000 Census provides information on Census Designated Places. Over 21,200 people lived in the Immediate Study Area in 2000, which accounted for 68 percent of the total Puna District population. The largest communities are located east of the project corridor, including Hawaiian Beaches / Hawaiian Shores and Hawaiian Paradise Park, and these collectively housed over 10,700 people in 2000.

Slightly over 2,000 people lived in the town of Keaʻau, and the communities west of the project corridor contained a combined population of approximately 5,400 persons. Almost 3,100 people lived south of the project corridor, which includes the town of Pāhoa.

The youngest community was Ainaloa, whose median age was 29.5 years in 2000. The oldest communities were south of the project corridor, in the town of Pāhoa and in the Leilani Estates subdivision, with median ages of 40.6 and 40.5, respectively.

Compared to the Puna District's average household size of 2.79 persons, households in the Immediate Study Area were generally larger in 2000. The largest households were found in Keaʻau and Hawaiian Beaches / Hawaiian Shores, which had average household sizes of 3.29 and 3.11 persons, respectively. Only Leilani Estates and Hawaiian Acres had relatively smaller households, with averages of 2.52 and 2.54 persons, respectively.

In the Puna District, 85 percent of the households were family households. In the Immediate Study Area, proportions of family households to total households ranged from a high of 91 percent in Keaʻau, Pāhoa and Hawaiian Beaches to a low of 80 percent in Leilani Estates.

The Immediate Study Area had a housing supply of 8,205 units in 2000. With the exception of Hawaiian Acres and Nanawale, which had high housing vacancy rates of 17 and 18 percent, respectively, the Immediate Study Area had vacancy rates lower than the 15 percent in the overall Puna District. The lowest housing vacancy rate was in Keaʻau, at eight percent.

Figure 3-9: Immediate Study Area Communities

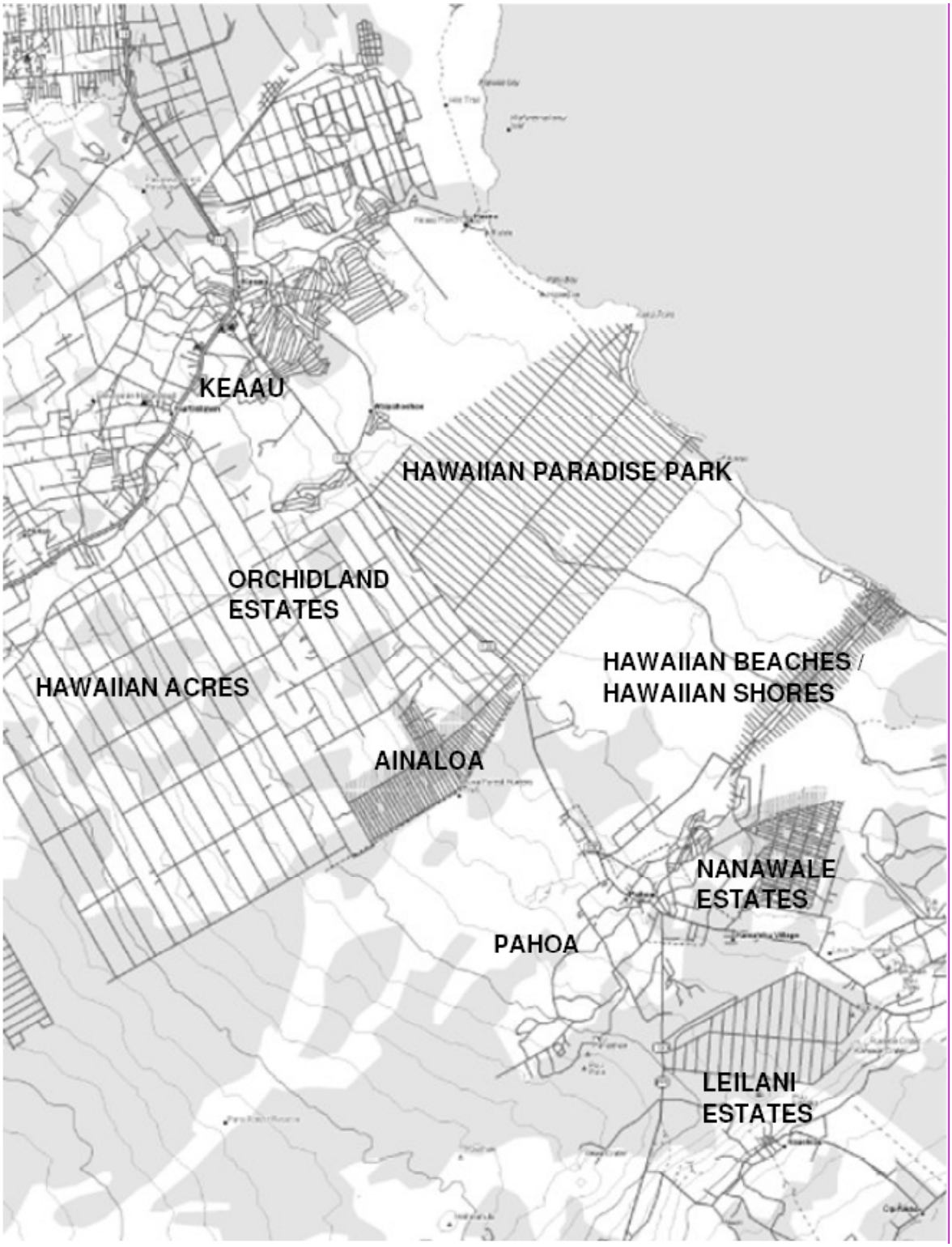


Table 3-22: Selected Characteristics of Immediate Study Area, 2000 Census

	Total Puna District	North of Corridor	West of Project Corridor			East of Project Corridor		South End of Project Corridor		
		Kea'au	Orchidland Estates	Ainaloa	Hawaiian Acres	Hawaiian Paradise Park	Hawaiian Beaches / Shores	Pāhoa	Nanawale Estates	Leilani Estates
Population and Age										
Population	31,335	2,010	1,731	1,910	1,776	7,051	3,709	962	1,073	1,046
Median age	N/A	37.3	34.6	29.5	38.4	34.7	34.4	40.6	31.6	40.5
Households										
Population in households	31,109	2,003	1,730	1,910	1,776	7,046	3,709	962	1,073	1,046
Number of households	11,134	608	587	632	698	2,426	1,192	314	356	415
Average household size	2.79	3.29	2.95	3.02	2.54	2.90	3.11	3.06	3.01	2.52
Family Households										
Population in family households	26,547	1,838	1,508	1,689	1,432	6,165	3,371	873	924	833
Percentage of family members of total population	85%	91%	87%	88%	81%	87%	91%	91%	86%	80%
Number of families	7,612	481	414	470	424	1,767	924	242	247	252
Average family size	3.49	3.68	3.49	3.39	3.22	3.34	3.49	3.47	3.57	3.19
Housing Units										
Housing Units	13,068	659	668	722	843	2,671	1,383	352	433	474
Occupied housing units	11,134	608	587	632	698	2,426	1,192	314	356	415
Percent of total housing units	85%	92%	88%	88%	83%	91%	86%	89%	82%	88%
Percent vacant units	15%	8%	12%	12%	17%	9%	14%	11%	18%	12%
Owner occupied units	7,924	444	409	412	536	1,737	842	190	211	326
Percent of total owner occupied units	71%	73%	70%	65%	77%	72%	71%	61%	59%	79%
Percent rental units	29%	27%	30%	35%	23%	28%	29%	39%	41%	21%

Source: 2000 demographic and housing information for these Census Designated Places is from U.S. Census Bureau, American Fact Finder, available at http://factfinder.census.gov/home/saff/main.html?_lang=en

Renters occupied 29 percent of Puna District's occupied units in 2000. There was a variation in the percentages of rental units throughout the Immediate Study Area. On the low end, only 21 percent of Leilani Estates' occupied housing units were rentals, followed by 23 percent in Hawaiian Acres. On the high end, 41 percent of Nanawale's occupied housing units were rentals, followed by Pāhoa at 39 percent.

Table 3-23: Income Distribution and Poverty Levels of Households and Families in the Immediate Study Area, 2000 Census provides median incomes of households and families in communities along the project corridor. With a median household income of $39,772, Keaʻau was the only Census Designated Place that had a median higher than Hawaii County's $39,805. This high was followed by Hawaiian Paradise Park at $36,300 and Nanawale at $35,703. The lowest household median incomes were found in Orchidland and Ainaloa, with $27,083 and $25,698, respectively.

The Immediate Study Area also had consistently lower family median incomes than the Hawaii County median of $46,480. The highest family median incomes were in Keaʻau and Pāhoa, at $43,347 and $43,571, respectively. The lowest were in Orchidland and Hawaiian Beaches, with $31,290 and $30,104, respectively.

Significantly low median incomes were found in female householder and nonfamily member families. In Ainaloa, the median income for families headed by single females was $6,463. Very low median incomes of nonfamily member households were found in Orchidland ($9,844), Hawaiian Acres ($9,583) and Ainaloa ($10,283).

3.3.2 Environmental Justice Communities in Immediate Study Area

Title VI of the Civil Rights Act of 1964 (42 USC 2000d and 49 CFR 21), as amended, is the foundation for most federal rules, regulations, and mandates concerning nondiscrimination in federal activities. Title VI protects individuals from discrimination on the basis of their race, color, national origin, sex, age, or disability in programs that receive federal financial assistance. Under Title VI, Federal agencies are required to ensure that no person is excluded from participation in, denied the benefit of, or subjected to discrimination under any program or activity receiving Federal financial assistance on the basis of race, color, national origin, age, sex, disability, or religion.

In response to growing public concern and mounting evidence of disparate treatment, President Bill Clinton signed Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, on February 11, 1994. (59 CFR 7629, 62 CFR 18377, and 60 CFR 33896). The purpose of E.O. 12898 was to focus federal attention on the environmental and human health conditions of minority and low-income populations with the goal of achieving environmental protection for all communities. The executive order directed the Federal Highway Administration and other federal agencies to develop environmental justice strategies to help address disproportionately high and adverse human health or environmental effects of their programs on minority and low-income populations. The order also intended to promote nondiscrimination in federal programs that affect human health and the environment, and aimed to provide minority and low-income

Table 3-23: Income Distribution and Poverty Levels of Households and Families in the Immediate Study Area, 2000 Census

	North of Corridor	West of Project Corridor			East of Project Corridor		South End of Project Corridor		
	Kea'au	Orchidland Estates	Ainaloa	Hawaiian Acres	Hawaiian Paradise Park	Hawaiian Beaches / Shores	Pāhoa	Nanawale Estates	Leilani Estates
Household and Family Median Income									
Household	$ 39,722	$ 27,083	$ 25,698	$ 30,039	$ 36,300	$ 28,467	$ 33,333	$ 35,703	$ 31,541
Family	$ 43,347	$ 31,290	$ 37,647	$ 35,726	$ 38,312	$ 30,104	$ 43,571	$ 36,875	$ 32,692
Married couples	$ 45,417	$ 41,250	$ 44,844	$ 48,207	$ 47,135	$ 35,037	$ 49,500	$ 47,188	$ 40,909
Female householder *	$ 24,375	$ 15,000	$ 6,463	$ 24,271	$ 17,798	$ 18,636	$ 18,750	$ 13,594	$ 30,268
Nonfamily	$ 18,542	$ 9,844	$ 10,283	$ 9,583	$ 23,125	$ 17,344	$ 20,625	$ 13,750	$ 17,011
Families Below Poverty Level**									
Total	9.6 %	24.1 %	27.2 %	22.5 %	17.0 %	23.8 %	15.7 %	28.9 %	13.7 %
Married couples	4.7 %	17.2 %	14.4 %	14.8 %	7,5 %	15.0 %	5.0 %	25.5 %	7.8 %
Female householder *	26.0 %	50.0 %	77.3 %	34.9 %	40.0 %	49.5 %	47.2 %	57.4 %	24.0 %
Nonfamily	26.8 %	35.3 %	47.8 %	48.1 %	17.8 %	26.6 %	15.2 %	0.0 %	51.0 %

* - no husband present

** Percentages of families below the poverty level were calculated by the U.S. Census Bureau In the 2000 Census based upon 61 different 1999 national poverty thresholds that vary according to size of family, number of children, and, for one- and two-person families, age over or under 65. Thresholds are not locally adjusted. Some representative 1999 poverty thresholds used to calculate the percentages in this table: One person (average): $8,501, two people (average): $10,869, three people (average): $13,290, four people (average): 17,029. Higher thresholds are also available for larger families (up to nine people). For more information, refer to:
http://factfinder.census.gov/servlet/MetadataBrowserServlet?type=subject&id=POVERTYSF3&dsspName=DEC_2000_SF3&back=update&_lang=en.

Source: 2000 demographic and housing information for these Census Designated Places is from U.S. Census Bureau, American Fact Finder, available at http://factfinder.census.gov/home/saff/main.html?_lang=en

communities with access to public information and public participation in matters relating to human health and the environment.

In 2006, the State of Hawaiʻi enacted Act 294 (2006), which called for the Chapter 343 process to consider Environmental Justice in the context of Hawaiʻi's unique ethnic composition, where no group is a "majority." Subsequently, guidance was prepared by the State of Hawaiʻi Environmental Council in January, 2008 to address this concern (Kahikikolo, 2008). The guidance recommended consideration of project effects on "under-represented populations," specifically Native Hawaiian, minority, and/or low-income persons.

According to this reference, the definition of Environmental Justice in Hawaiʻi is as follows:

> Environmental justice is the right of every person in Hawai`i to live in a clean and healthy environment, to be treated fairly, and to have meaningful involvement in decisions that affect their environment and health; with an emphasis on the responsibility of every person in Hawai`i to uphold traditional and customary Native Hawaiian practices that preserve, protect, and restore the `aina for present and future generations. Environmental justice in Hawai`i recognizes that no one segment of the population or geographic area should be disproportionately burdened with environmental and/or health impacts resulting from development, construction, operations and/or use of natural resources.

Through its title VI/Environmental Justice Programs in the Office of Civil Rights (OCR), HDOT's latest Title VI Plan (January 18, 2009) outlines its policies and procedures for compliance with Title VI, Executive Order 12898 and Act 294.

In the context of these three pieces of legislation, the Immediate Study Area Communities was evaluated with regards to their share of "Environmental Justice Communities" or under-represented populations, specifically, Native Hawaiian, minority and/or low-income. The objective is to ensure that the Keaʻau-Pāhoa Road project will not have a disproportionate burden on these groups, and that beneficial and adverse effects will be borne by all groups within the community fairly and equitably.

This section presents income and poverty level information from the 2000 Census. Due to the lack of more recent information for Hawaii County Census Tracts and Census Designated Places, the poverty information is based on U.S. Census Bureau poverty thresholds in 2000, and not on the U.S. Department of Health and Human Services poverty guidelines, which is referred to in the HDOT Title VI Plan.

Poverty thresholds are the original version of the federal poverty measure and are used to calculate all official poverty population statistics. They are based on a detailed matrix that varies by family size, number of children and, for one- and two- person units, the presence of elderly.

Poverty guidelines comprise a simplified version of the federal poverty thresholds and are used for administrative purposes, such as determining financial eligibility for certain federal programs. The guidelines vary by family size.

While both poverty thresholds and poverty guidelines are updated annually, there is no income or poverty-related information for Hawaiʻi County census tracts or Census Designated Places more recent than the 2000 census.

3.3.2.1 Low-Income Communities in Immediate Study Area

Information on income and race above in **Section 3.3.1.3: Puna District Characteristics from 2000 Census**, specifically **Table 3-19: Income Distribution and Poverty Levels, Puna Households and Families, 2000 Census** and **Table 3-20: Race of Hawaiʻi County and Puna Residents, 2000**, gives a picture of the Puna District. Income statistics indicate that the Puna District as a whole has household and family median incomes lower than those of Hawaii County. Further, there is a significant presence of families with incomes below poverty, particularly in South Puna, where over 22 percent of its families have incomes below poverty level. Further, female householder families exhibit a significantly high presence of poverty.

Moreover, as indicated in **Table 3-23: Income Distribution and Poverty Levels of Households and Families in the Immediate Study Area, 2000 Census** in **Section 3.3.1.5: Immediate Study Area Demographics in 2000 Census** above, the presence of poverty is high in communities adjacent to the project corridor. Over one-fifth of families in Orchidland, Ainaloa, Hawaiian Acres, Hawaiian Beaches / Hawaiian Shores and Nanawale have incomes below poverty level. Further, female-led families have consistently high proportions of incomes below poverty levels, with the highest level found in Ainaloa where over 77 percent are in this category. Poverty levels were especially high throughout the Immediate Study Area, with the exception of Keaʻau. Notably high levels were found in families headed by single females in Ainaloa (77.3 percent), Nanawale (57.4 percent), Orchidland (50.0 percent), Hawaiian Beaches (49.5 percent) and Pāhoa (47.2 percent).

3.3.2.2 Racial Minorities in Immediate Study Area

HDOT's Title VI Plan (page 10, updated January 18, 2009) defines "minorities" to include:

- American Indian or Alaskan native;
- Black
- Hispanic
- White
- Asian Indian (having origins in any of the original peoples of the Indian subcontinent)
- Chinese;
- Filipino;
- Guamanian
- Hawaiian (having origins in any of the original peoples of Hawaii including peoples who are Part-Hawaiian and identify most closely with the Hawaiian category);
- Japanese;
- Korean;
- Samoan;
- Vietnamese, and

- Other (those not identifying with any of the above).

These races are all represented in the Census categories of White, Black or African American, American Indian and Alaskan Native, Asian, Native Hawaiian and other Pacific Islanders, and Other Races. In addition, information is presented on people who reported two or more races. All of these minority races are present in the Puna District and Immediate Study Areas, as indicated in **Table 3-20: Race of Hawaiʻi County and Puna Residents, 2000** above and in **Table 3-24: Race of Immediate Study Area Residents, 2000 Census** below.

Table 3-24: Race of Immediate Study Area Residents, 2000 Census provides a racial breakdown of the Immediate Study Area and indicates distinctive profiles within the various communities. The largest racial group on the older towns of Keaʻau and Pāhoa was Asian, at 55.7 percent and 52.8 percent, respectively. All other groups were proportionately lower than the Hawaiʻi County and Puna District profiles, with the exception of Native Hawaiian and other Pacific Islanders in Pāhoa, which comprised 12.3 percent of the population. Native Hawaiians and other Pacific Islanders were also well-represented in Nanawale (21.2 percent), Hawaiian Beaches (13.5 percent), Orchidland (12.9 percent) and Ainaloa (12.2 percent).

Whites comprised more than half the populations in Leilani Estates and Hawaiian Acres at 60.2 percent, and 54 percent, respectively. Blacks and African-Americans were virtually not present in Keaʻau, Hawaiian Acres, Pāhoa, Nanawale and Leilani Estates in 2000.

The anticipated impacts of the project on Environmental Justice communities will be discussed in **Section 4.3.3: Impacts on Environmental Justice Communities**.

3.3.2.3 Incorporation of Title VI and Environmental Justice Requirements into the Proposed Project

The proposed project is recommended in the Puna Regional Circulation Plan, which is discussed in **Section 4.1.1.4: Puna Regional Circulation Plan (PRCP)**. The PRCP noted that, in 2000, a Sustainability Committee, comprised of citizens of Puna and Kaʻu, filed a discrimination complaint against HDOT and Hawaiʻi County. They requested investigation and correction of discriminatory planning in the Hawaii Long Range Transportation Plan. The Federal Highway Administration (FHWA) concluded that evidence supported the allegations of the discrimination complaint. The investigation found that HDOT had discriminated by failing to recognize actual land uses, economic development, and multi-modal needs of low-income communities. The PRCP considered the effects of circulation and transportation on minority and low income groups, and included land use scenarios and multi-modal projects that provide choices and access for all community members. The Keaʻau-Pāhoa Road project was one effort to address Title VI requirements.

This project has been conducted for consistency with HDOT's Title VI Plan (updated January 18, 2009). Every effort has been made to include Title VI/Environmental Justice target populations in the planning for this project and social impacts analysis.

Table 3-24: Race of Immediate Study Area Residents, 2000 Census

	North of Corridor	West of Project Corridor			East of Project Corridor		South End of Project Corridor		
	Kea'au	Orchidland Estates	Ainaloa	Hawaiian Acres	Hawaiian Paradise Park	Hawaiian Beaches / Shores	Pāhoa	Nanawale Estates	Leilani Estates
Single Race									
Caucasian	11.9%	33.4%	35.6%	54.0%	33.0%	29.8%	8.4%	22.8%	60.2%
Black or African American	0.0%	0.4%	0.4%	0.0%	0.3%	0.2%	0.0%	0.0%	0.0%
American Indian and Alaskan Native	0.0%	2.3%	1.1%	0.5%	0.3%	0.3%	0.9%	0.0%	1.8%
Asian	55.7%	22.5%	16.2%	10.9%	19.6%	18.2%	52.8%	24.3%	4.7%
Native Hawaiian and Other Pacific Islander	5.0%	12.9%	12.2%	6.9%	10.6%	13.5%	12.3%	21.2%	11.4%
Other race	1.2%	3.0%	1.7%	0.2%	0.8%	1.1%	0.8%	0.0%	2.2%
Two or More Races									
Two or more races	26.2%	25.5%	32.9%	27.4%	35.3%	36.9%	24.7%	31.6%	19.7%

Source: U.S. Census Bureau, Race: 2000, as contained in Summary File 3 - Sample Data and available online at http://factfinder.census.gov/home/saff/main.html?_lang=en.

In the planning of the proposed project, which included the development of alternatives studied in the Social Impact Assessment (SIA), the project team employed several activities to reach and include Title VI target groups. All Public Information Meetings were widely advertised in the following ways:

- Press releases sent to the local radio and newspaper media
- Flyers posted in shopping areas and community bulletin boards
- Invitation letters mailed to approximately 610 people in the area and emailed certain stakeholders
- Met with elected officials and Hawaii County Planning Department staff
- Meeting notifications posted on the Hawaii County Planning Department website
- Meeting notifications posted on a website hosted specifically on this project (www.keaau-pahoa.com)
- Provided a Chinese language interpreter at the first public meeting

In the formation of the KPAG, similar efforts were employed to reach out to Title VI target groups, and the project team worked closely with the HDOT Title VI Specialist. Community members also had the opportunity to be part of the Friends of KPAG group, which has been receiving the same information as KPAG members.

The Social Impact Assessment interviews described in **Section 4.3.1: Social Impact Interview Findings**, also directly considered the needs of Title VI/Environmental Justice target groups. The project team sought to include a very broad cross section of interests so that the issues and needs of these target populations were directly expressed or reflected in interview input. This was achieved by interviewing:

- Residents in all of the communities abutting the project corridor, particularly those in which there may be a high presence of Environmental Justice groups,
- Service providers who serve these groups and are aware of their needs, including health care, educational, youth-at-risk programs, transportation, civil defense and police protection services,
- People in various walks of life, lifestyles and levels of use of the project corridor, and
- People with varying levels of awareness and participation in community efforts, with an emphasis on those who may not be active in organized efforts.

3.3.3 Economic Environment

The PCDP notes that Puna is primarily an agricultural district. While sugar is no longer produced, a diversified agricultural industry is supported in Puna. Today, approximately 97 percent of Hawaii's papaya production occurs in Puna. Puna produces at least 40 different agricultural products, including cut flowers, fruits, vegetables and livestock (PCDP, p. 1-3). Puna's agriculture faces challenges as the cost of land rises, particularly for residential uses. Continued subdivision of land is another challenge, despite the large number of parcels already

available. Small farming operations often cannot lease or buy the best land. (PCDP, pp. 3-7 and 3-8)

Currently, much of the Puna District is dependent upon commercial activity in the Hilo area for jobs and shopping. The PCDP tries to increase the Puna District's self-reliance and economic strength by re-shaping the land use patterns in the district through a group of Village and Town Centers as described in greater detail above in **Section 3.1.3.3: Puna Community Development Plan (PCDP)**. These new centers would provide opportunities for commercial development that is at a scale and level that is desired by Puna's residents.

The PCDP also suggests a wide range of economic development measures that include in part encouraging additional farmers' markets; agri/eco-tourism; business incubator districts in Keaʻau, Pāhoa, and Mountain View; Enterprise Zone, renewable energy. (PCDP, pp. 3-10 and 3-11).

The 2005 Hawaiʻi County General Plan recognizes Puna as an agricultural district and seeks to promote various diversified agricultural operations. The presence of geothermal resource potential is also recognized, as is the presence of the Kamehameha Schools East Hawaii campus which opened in 2001. The General Plan's courses of action that are relevant to this study include:

- Assist the further development of the agricultural industry by providing support services to commodity groups and other organizations such as farmer's cooperatives, protecting important agricultural lands, and requesting and providing necessary capital improvements.
- Resort growth should enhance and be in keeping with the area's rural character.

3.3.4 Community Character and Facilities

Much of the Keaʻau-Pāhoa corridor is notable for large subdivisions that were approved by the county in the 1950s. While the current character can best be described as "agricultural" there is substantial potential for future residential growth as much of the subdivisions' lots are undeveloped at this time. The overall density of the district is relatively low, with subdivisions containing lots that range in size from about a third-acre to several acres. The older communities of Keaʻau and Pāhoa themselves are centers of commerce and community services, but have proportionately small percentages of the population.

The Puna Makai area prides itself on its diversity in ethnic background, lifestyles, landscape, culture, and philosophy of its residents. As the Puna Community Development Plan's vision statement has noted, there is a desire to maintain a sustainable vibrant local economy, healthy communities, and a vibrant transportation system that is accessible, friendly and safe for now and future generations. There is a strong community identity in Puna, and also a sense by some in the community that Puna has not received a "fair share" of community amenities.

A great part of Puna's Makai's growth in recent decades can be attributed to the relative affordability and development potential of land, even in cases of land that lacks some services

(paved road, water, electricity, etc.) The relative accessibility of the area to Hilo for employment, schools, and shopping has also encouraged growth.

The discussions that follow talk about community services like medical facilities, police and fire. Parks and recreational facilities are discussed in **Section 3.10: Parks and Recreational Resources**.

3.3.4.1 Medical Facilities

The nearest comprehensive hospital serving the Puna region is the Hilo Medical Center, which is about a 10-mile drive from the Kea‘au terminus of the corridor and about a 21-mile drive from the other terminus of the study corridor. Expanded in 1984, this complex offers 130 acute care beds, 22 skilled nursing beds, a 20-bed psychiatric unit and a 120-bed extended care facility. Also on the 20.5 acre campus is Hilo Surgical Associates’ office, the Liberty Dialysis Center, the Veteran Administration Community Based Outpatient Clinic, and the Hawaii Pacific Oncology center.

Kea‘au-Pāhoa Road is on the primary route from the Immediate Study Area to Hilo Medical Center, and the road is central to the service populations of regional medical facilities, which include:

- Puna Community Medical Center - Located in the Pāhoa Marketplace shopping center, this facility opened in February 2009 and offers emergency and urgent care services. The clinic has three exam rooms, a reception area, an electronically-kept medical records room, office and bathroom. This new facility has begun to address some of the urgent need for medical providers in lower Puna.

- Kea‘au Family Health Center and the Pāhoa Family Health Center - These are operated by Bay Clinic, Inc. and offer a range of medical services, including diagnostic cancer services and screening, prenatal care, women’s health care, and HIV/AIDS services. These centers also offer dental and behavioral services. Both facilities are located in their respective village centers.

- *Women’s Health Clinic* - This facility is also operated by Bay Clinic, Inc. and is located in Pāhoa Village.

- *Hui Mālama Ola Nā ‘Ōiwi* - This private non-profit organization has an office in the Pāhoa Family Health Center and serves Native Hawaiians by facilitating access to health care through outreach, referrals, transportation and health screening and networking with other health care providers, public agencies, schools and community organizations. Other services include health risk appraisals, medication management, blood pressure and glucose checks and health assessments; and health promotion disease prevention programs which focus on Native Hawaiian health, diabetes, cardiovascular diseases, breast cancer awareness, smoking cessation, nutrition, weight management, prenatal care, and substance abuse.

3.3.4.2 Educational Facilities

The larger schools in the Puna District are administered by the State Department of Education. The two public education complexes serving the area around Keaʻau-Pāhoa Road are the Keaʻau Complex, which includes Keaʻau Elementary, Intermediate and High Schools, and the Pāhoa Complex, which includes Keonepoko Elementary, Pāhoa Elementary, and Pāhoa High and Intermediate Schools. Table 15 provides current and projected enrollment for these facilities.

The decrease in the high school enrollments coincided with the opening of the new campus of the Keaʻau High School approximately five years ago, and the establishment of the Kamehameha Schools Hawaii campus in 2001.

Table 3-25: Current and Projected Enrollments for Keaʻau and Pāhoa Complex Public Schools also provides enrollment projections in both complexes, and shows that the larger increases will occur in the intermediate and high schools.

The 2005 Hawaiʻi County General Plan notes that natural population growth and in-migration into the subdivisions in the area are contributing to pressures to serve all students in the Pāhoa Complex. At the time the General Plan was written, facilities were being expanded to serve students, but there was overcrowding at the elementary schools.

The General Plan notes that joint community-school branch library facilities are found in Keaʻau, Mountain View, and Pāhoa. The Keaʻau facility has 21,332 volumes. The Pāhoa and Mountain View facilities house 34,365 volumes and 18,345 volumes, respectively. Both library facilities are inadequate in size to meet the needs of the students and community. Furthermore, the lack of adequate pedestrian access and parking at these facilities is an ongoing problem.

Kamehameha Schools constructed a campus in 2001 just off Volcano Highway in Keaʻau. It is currently home to 1,118 students in an elementary, middle school, and high school that together serve kindergarten through 12th grade. Kamehameha Schools is the largest independent school system in the United States and gives preference to children of Hawaiian ancestry to the extent permitted by law. Almost all of its students are bused to school. While this campus is located on Highway 11 and does not abut directly onto Keaʻau-Pāhoa Road, many of its students live near Keaʻau-Pāhoa Road. (Personal communication, Peter Fuchs, Director of Campus Operations at Kamehameha Schools Hawaii Campus, on August 31, 2009.)

Table 3-25: Current and Projected Enrollments for Kea'au and Pāhoa Complex Public Schools

	Official Enrollment Count			6 Year Enrollment Projection (completed 5/27/09)						Percent Change School Yr. 2009-10 to School Yr. 2014-15
School	School Yr. 2008-09	School Yr. 2009-10	Percent Change	School Yr. 2009-10	School Yr. 2010-11	School Yr. 2011-12	School Yr. 2012-13	School Yr. 2013-14	School Yr. 2014-15	
Kea'au Complex										
Kea'au Elementary	760	803	5.7%	762	760	773	802	818	818	1.9%
Kea'au Intermediate	593	621	4.7%	586	588	612	628	659	692	11.4%
Kea'au High	971	946	-2.6%	965	967	969	985	1001	1061	12.2%
Pāhoa Complex										
Keonepoko Elementary	650	614	-5.5%	661	654	657	670	668	667	8.6%
Pāhoa Elementary	394	410	4.1%	408	408	409	412	413	413	0.7%
Pāhoa High and Intermediate	762	717	-5.9%	750	742	742	734	767	780	8.8%

Source: Personal communication with Edwin Ramones of Information Management Architecture of the State Department of Education, on September 16, 2009. Projections were completed in May 2009.

3.3.4.3 Police Services

Information in this section was adapted from the Hawaiʻi Police Department's Annual Report: Fiscal Year 2007-2008, the County of Hawaiʻi Annual Report, Fiscal 2007 - 2008, the County of 2005 Hawaiʻi General Plan, and personal communication with the District Commander for the Puna District, September 1, 2009.

The Puna District is part of Area 1, East Hawaiʻi, served by the Hawaiʻi County Police Department. The Puna Patrol Division is in a 683-square-mile district, which is patrolled by 35 patrol officers, four sergeants and one lieutenant. The district is situated between the South Hilo District at Papai and the Kau District at Keauhou Landing.

The police station headquarters for the Puna region is housed in the Keaʻau public office complex covering the entire district. A district substation is located in Pāhoa. There are three shifts, with an average of seven officers per shift.

A new Police Station and Vehicle Registration & Licensing Division complex is under construction in Pāhoa to replace the facility in Pāhoa town, and is slated for completion in 2010. The site of the new facility is located along Keaʻau-Pāhoa Road just north of town next to the newly-opened fire station (described in **Section 3.3.4.4: Fire/EMS Services**). The facility is approximately 8,200 square feet in size, which includes a public reception area, clerical space, office space, interview rooms, a processing room, two holding cells, a juvenile booking room and a conference room to handle a minimum of ten people. The facility will be utilized by six to seven officers per shift who are responsible for patrolling the area from Shower Drive down to Kalapana.

This new police station will centralize public safety services in an area visible and accessible to the public. It will also permit faster response times to some of the subdivisions outside Pāhoa (notably Hawaiian Paradise Park, Ainaloa, Orchidland and Hawaiian Beaches).

Traffic control is an important part of the Police Department's function, and Puna officers participated in an Aggressive Driving Project between April 22, 2008, and June 30, 2008. The intent of this project was to target periods of high vehicular traffic between the main traveled corridors from Puna to South Hilo, especially during the commuting traffic hours. During the enforcement period, 74 separate projects were conducted in Puna and South Hilo. The goal was to reduce aggressive driving habits, such as speeding, passing violations, red light/stop sign violations, tailgating and improper lane usage. Officers also issued citations for other moving violations or regulatory traffic infractions.

Puna experienced a 28 percent reduction in major traffic accidents between Fiscal Year 2007 and Fiscal Year 2008. In Fiscal Year 2007, there were 38 major traffic accidents; in Fiscal Year 2008, 22 major traffic accidents. This reduction is due, in part, to increased gasoline prices and a subsequent decrease in driving activity.

Currently, emergency vehicles are slowed by traffic congestion conditions, particularly during traffic peak hours.

3.3.4.4 Fire/EMS Services

Fire protection and Emergency Medical Services (EMS) services are provided by Hawaiʻi County through facilities in Keaʻau and Pāhoa. The Pāhoa operations serve the Pāhoa-Hawaiian Paradise Park and Kalapana-Kapoho areas. Keaʻau has a 24-hour fire/EMS facility. A dual use county/volunteer fire station is found in Hawaiian Paradise Park. Other 24-hour volunteer-only fire stations are found in Hawaiian Beaches, Waa Waa, Hawaiian Acres, Fern Acres and Volcano Village. (The locations of subdivisions in the study area were shown in **Figure 3-1: Puna Subdivisions By Year of Establishment.**)

Opened officially in December, 2009, a new fire station in Pāhoa includes a building approximately 8,000 square feet in size, a pump house and storage shed, recreation area, parking and an emergency helipad. The station includes three bays which offers a total capacity for six vehicles, accommodation for up to eight fire fighters per shift, exercise room, training room, lounge/ready room/kitchen, office space, hose maintenance room and storage.

The fire station supports the improvement of health and safety services provided to the lower Puna community. This energy efficient facility improves response readiness for the community and will allow continued service during natural disasters. Its location permits faster response times to some of the subdivisions outside Pāhoa (notably Hawaiian Paradise Park, Ainaloa, Orchidland and Hawaiian Beaches).

Currently, emergency vehicles are slowed by traffic congestion conditions, particularly during traffic peak hours.

3.4 Climate and Air Quality

A detailed study of air quality has been performed and is found in **Appendix F: Air Study**.

The climate of the Puna District varies considerably from comparatively sunny rocky shoreline to rainforests in upper elevations, and this has an influence on air quality. Within the immediate study area, temperatures are uniform throughout the year, generally ranging from high average daily temperatures in the low-80s to low average daily temperatures in the low-to-mid-60s. The extreme minimum temperature recorded at nearby Hilo is 53°F, while the extreme maximum temperature is 94°F. Rainfall within the immediate area surrounding the study corridor is uniformly high, ranging from approximately 120 inches to 160 inches per year. Cooler temperatures and heavier rainfall generally occur during winter months (October through April) and warmer temperatures and lighter rainfall occur during summer months (May through September). The climate is influenced by the generally constant presence of northeasterly trade winds and the effects of coastal areas and nearby mountains.

Emissions of sulfur dioxide (SO_2) and particulates from Kīlauea volcano, called “vog” can be of concern to persons with asthma and respiratory conditions. The prevailing winds typically carry these emissions away from the study area and towards the Kaʻu District, but periodically, when wind directions change, these emissions can be of concern in lower Puna.

Air quality within the study area is excellent with regards to human-generated pollution. There are very few industrial sources of pollution in the region, and Hawaiʻi's geographic isolation limits the transport of industrial pollution from other places. The constant trade winds also serve to disperse any pollution that does come from human activity.

Table 3-26: Air Pollution Emissions Inventory for Island of Hawaii, 1993 presents a summary of pollutant emissions for the Island of Hawaiʻi for calendar year 1993, the most recent inventory that is available. The emissions rates shown in the table pertain to manmade emissions only, i.e., emissions from natural sources are not included. As suggested in the table, much of the manmade particulate emissions on Hawaii originate from area sources, such as the mineral products industry and agriculture. Manmade sulfur oxides are emitted almost exclusively by point sources, such as power plants and other fuel-burning industries. Nitrogen oxides emissions emanate predominantly from area sources (mostly motor vehicle traffic), although industrial point sources contribute a significant share. The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic), while hydrocarbons are emitted mainly from point sources.

Table 3-26: Air Pollution Emissions Inventory for Island of Hawaii, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulates (PM)	30,311	9,157	39,468
Sulfur Oxides (SOx)	9,345	nil	9,345
Nitrogen Oxides (NOx)	4,054	8,858	12,912
Carbon Monoxide (CO)	3,357	23,934	27,291
Hydrocarbons (VOC)	1,477	203	1,680

Source: J.L. Shoemaker and Associates, Inc., 1996

Both the US Environmental Protection Agency (EPA) and the State of Hawaiʻi have instituted Ambient Air Quality Standards (AAQS) to maintain air quality in the interest of public health and secondary public welfare. **Table 3-27: State of Hawaiʻi and National Ambient Air Quality Standards** illustrates the AAQS and the units of measure (micrograms per cubic meter, $\mu g/m^3$ and milligrams per cubic meter, mg/m^3). At the present time, seven parameters are regulated including: particulate matter, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone and lead. Hawaiʻi's AAQS are comparable to the national AAQS except for nitrogen dioxide and carbon monoxide, which are more stringent than the national standards. In particular, the Hawaiʻi one-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit.

Table 3-27: State of Hawai'i and National Ambient Air Quality Standards

Pollutant	Units	Averaging Time	Maximum Allowable Concentration		
			National Primary	National Secondary	State of Hawaii
Particulate Matter (<10 microns)	μg/m^3	Annual 24 Hours	- 150[a]	- 150[a]	50 150[b]
Particulate Matter (<2.5 microns)	μg/m^3	Annual 24 Hours	15[c] 35[d]	15[c] 35[d]	- -
Sulfur Dioxide	μg/m^3	Annual 24 Hours 3 Hours	80 365[b] -	- - 1300[b]	80 365[b] 1300[b]
Nitrogen Dioxide	μg/m^3	Annual 1 Hour	100 189[d]	100 -	70 -
Carbon Monoxide	mg/m^3	8 Hours 1 Hour	10[b] 40[b]	- -	5[b] 10[b]
Ozone	μg/m^3	8 Hours 1 Hour	157[e] 235[f]	157[e] 235[f]	157[e] -
Lead	μg/m^3	3 Months Quarter	0.15[g] 1.5[h]	0.15[g] 1.5[h]	- 1.5[h]
Hydrogen Sulfide	μg/m^3	1 Hour	-	-	35[b]

Notes:
[a]Not to be exceeded more than once per year on average over three years.
[b]Not to be exceeded more than once per year.
[c]Three-year average of the weighted annual arithmetic mean.
[d]98th percentile value averaged over three years.
[e]Three-year average of fourth-highest daily 8-hour maximum.
[f]Standard is attained when the expected number of exceedances is less than or equal to 1.
[g]Rolling 3-month average.
[h]Quarterly average.
Source: BD Neal and Associates

The State of Hawai'i is in conformity with the National Ambient Air Quality Standards (NAAQS) for all pollutants regulated by the EPA.

Limited air monitoring data is available for Hawai'i Island. A monitoring station within Pāhoa measures sulfur dioxide and hydrogen sulfide only. Measurements of sulfur dioxide concentrations at Pāhoa during the 2005-2008 monitoring period were consistently low in terms of the annual average concentrations which ranged from 3 to 5 μg/m^3 only. This represents about 6 percent of the state and national standard. Between 2005 and 2008, the highest annual second-highest 3-hour and 24-hour concentrations (which are how the standards are based) for these four years were 159 and 55 μg/m^3, respectively; these are about 12 to 15 percent of the applicable standards. The higher short-term concentrations reflect periodic episodes of vog. While these concentrations are relatively high compared to most

other locations in the state, no exceedances of the state/national 3-hour and 24 hour AAQS for sulfur dioxide were recorded.

The highest second-highest one-hour concentration of hydrogen sulfide for the four-year period 2005-2008, 14 $\mu g/m^3$, is about 40 percent of the state standard. There were no violations of the state AAQS.

Particulate matter previously was monitored in Hilo prior to the end of 2004. From 2000 to 2003, concentrations were between 13 and 25 percent of the state/national AAQS.

No measurements of lead, ozone, nitrogen dioxide, or carbon monoxide, which are typically associated with motor vehicle emissions, are available. Lead, ozone and nitrogen dioxide typically are regional-scale problems. Concentrations of lead and nitrogen dioxide generally have not been found to exceed the AAQS elsewhere in the state. Ozone concentrations have been found to exceed the state standard at times at Sand Island on Oʻahu. Carbon monoxide is typically a microscale (intersection-level) problem at areas with traffic congestion such as urban Honolulu, and carbon monoxide concentrations occasionally exceed the state's AAQS.

Although relatively little ambient air quality data are available to characterize existing conditions for pollutants created by motor vehicles in the project area, it is likely that state and federal ambient air quality standards are currently being met in the project area (despite chronic vog conditions), except perhaps for occasional exceedances of the stringent state carbon monoxide standards within small areas near high-volume traffic-congested locations.

A more detailed discussion of the modeling that was performed for both existing and future conditions is described in **Section 4.4: Air Quality**. To summarize the findings described in that section for existing conditions:

- At the regional level, the Keaʻau-Pāhoa Road corridor in 2006 contributed an estimated 780 tons per year of carbon monoxide (CO), 93 tons per year of nitrogen oxides (NOx), and 63 tons per year of volatile organic compounds (VOC). These are a very small proportion of the overall emissions island-wide.
- Eight representative intersections in the corridor were selected for intersection-level modeling of CO based on existing and future levels of delay. The highest modeled levels of CO for a one-hour period in 2006 were calculated at 8.4 mg/m^3 at Shower Drive. This is less than the Hawaiʻi AAQS of 10 mg/m^3 and the National AAQS of 40 mg/m^3. The highest modeled CO concentration for an eight-hour period was 4.2 mg/m^3, again at Shower Drive, which is less than the Hawaiʻi AAQS of 5 mg/m^3 and the National AAQS of 10 mg/m^3. Therefore, all existing emissions at intersections in the corridor are within the stringent Hawaiʻi AAQS as well as the less-stringent federal standards.

In addition to the pollutants described above, the EPA also regulates air toxics, of which 188 are created by motor vehicles. There are no tools available at the present time to qualitatively model air toxics, but emissions of air toxics from motor vehicles on a per-mile basis are expected to decline over time. See **Section 4.4.3: Mobile Source Air Toxics** for more information.

3.5 Noise

A detailed noise study has been performed for this project. Refer to **Appendix E: Noise Study** for more information than is provided below.

3.5.1 Introduction to the Concepts of Noise

Noise is defined as excessive or unwanted sound. Sound intensity is measured in decibels (dB), based on a logarithmic scale. The human ear does not respond identically to sound levels of different frequencies, being more sensitive to middle and high pitched sounds (such as from speech, horns, and whistles) than low frequencies (such as made by motors and engines) at the same level (Robinson and Dadson, 1956). When sound is described in terms of the frequencies humans are capable of hearing, the term 'dBA' is used. This refers to an 'A weighted' scale, which does not consider those frequencies outside of the human hearing range. Different sounds with the same A-weighted noise level are perceived as being equally as loud.

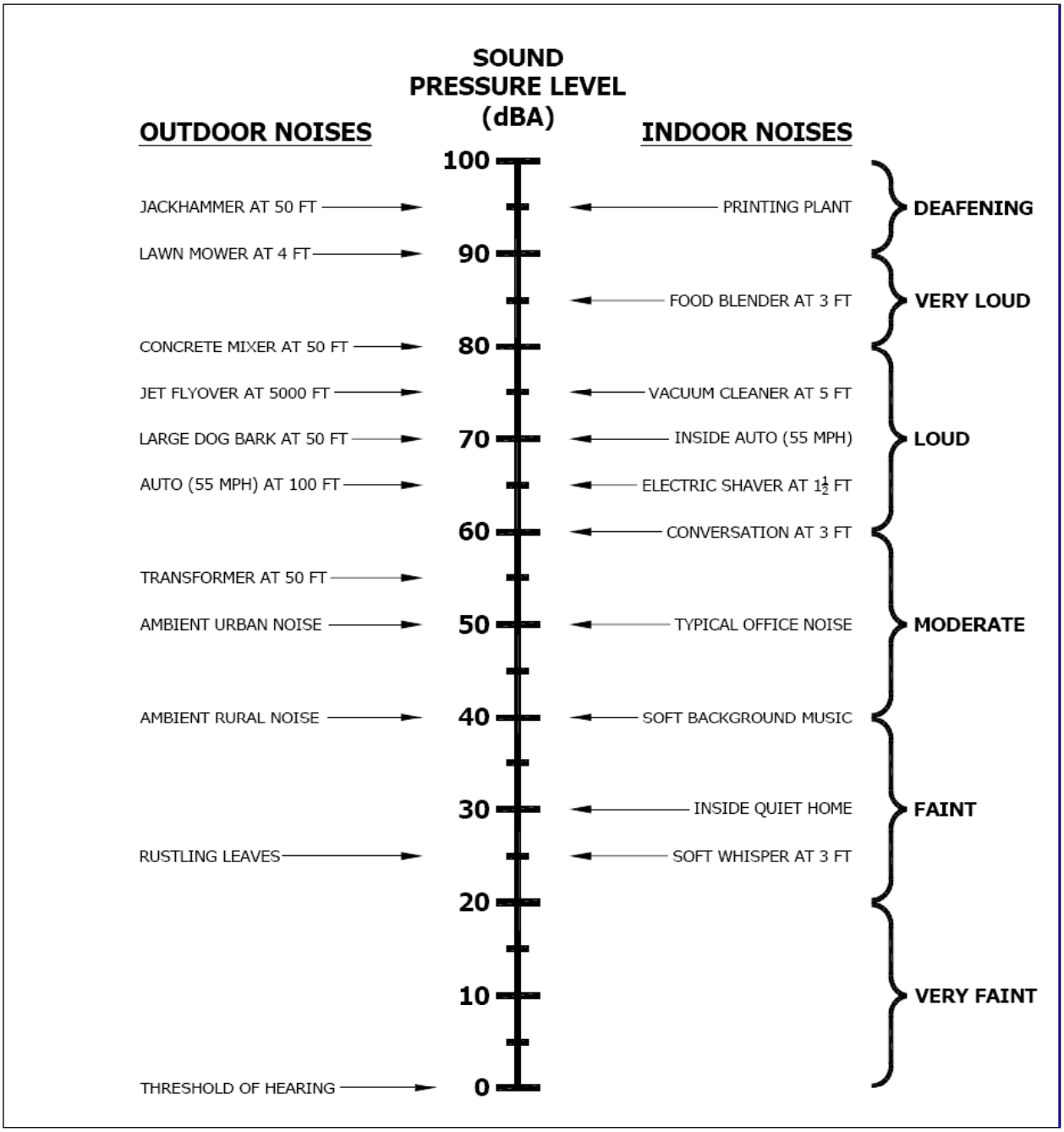
Figure 3-10: Common Outdoor and Indoor Sound Levels in dBA shows a representation of different noise sources under the A-weighted scale.

Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, time of occurrence, duration, and psychological factors such as emotions and expectations. However, in general, a change of 1 or 2 dBA in the level of sound is difficult for most people to detect. A 3 dBA change is commonly taken as the smallest perceptible change and a 6 dBA change corresponds to a noticeable change in loudness. A 10 dB increase or decrease in sound level corresponds to a perceived approximate doubling or halving of loudness, respectively. Since dBA is a logarithmic scale, two equivalent sources of noise does not result in an arithmetic doubling of the noise level, but rather a logarithmic doubling.

Therefore, to illustrate these rules of thumb:

- If existing noise levels are 63 dBA, an increase to 66 dBA would be the minimum change that could generally be perceived as a “louder” noise by a typical listener.
- A 60 dBA noise level is perceived as “twice as loud” as a 50 dBA noise level
- If a 50 dBA source of noise was placed next to another 50 dBA source of noise, the combined noise level would be 53 dBA, not 100 dBA.

Figure 3-10: Common Outdoor and Indoor Sound Levels in dBA



Source: DL Adams Associates

In an environment such as Keaʻau-Pāhoa Road, noise is made up of two distinct parts. One is ambient or background noise. Wind noise, birds, distant traffic noise, etc. make up some of the acoustical environment surrounding the project. These sounds are not readily recognized, but combine to produce a non-irritating ambient sound level. The other component of noise along Keaʻau-Pāhoa Road is intermittent and louder than the background noise. Traffic noise is the primary source, along with other human-generated noises.

Noise levels from transportation facilities are influenced by several variables:

- Traffic volumes are a factor, though the effect is logarithmic, not directly linear. 2,000 vehicles per hour will be perceived as "twice as loud" as 200 vehicles per hour.
- Speed is a factor. Traffic traveling at 65 mph is perceived as "twice as loud" as the equivalent traffic traveling at 30 mph.
- Roadway vehicle noise comes from tires, engines, and exhaust.
- Engines typically will be louder when accelerating or traveling uphill versus moving a constant speed and/or traveling on a horizontal surface. Trucks downshifting down a steep downhill slope also increase engine noise.
- Heavy trucks create a disproportionate contribution to noise levels. The sound sources associated with trucks are noises from tires, engines, and exhaust.
- The worst-case noise levels will be achieved under a condition where traffic is moving the fastest while carrying the largest volume of vehicles (especially trucks). Therefore, on congested roadways, the peak traffic hour of the day may not be appropriate for a noise study because traffic would be moving very slowly from congestion.

Traffic noise is not constant. It varies continuously over time as each vehicle passes a point. The L_{eq}, or Equivalent Sound Level, is the steady-state sound level during a given amount of time, L_{eq} represents the low and high sound levels averaged over a given time period (such as one hour) equated to a single continuous sound level. The term $L_{eq(h)}$ or "hourly L_{eq}" is used to describe the L_{eq} in an hour's time. The A-weighted L_{eq} is a common index for measuring noise.

Other statistical descriptors are often used in regulations and standards to express a single value for sound that varies over a period of time. The L_n represents the sound level that is exceeded for n percent of the measurement time period. For example, L_{10} = 60 dBA indicates that for the duration of the measurement period, the sound level exceeded 60 dBA for 10 percent of the time. The L_{50} is the noise level exceeded 50 percent of the time, and the L_{90} is exceeded 90 percent of the time.

The Day-Night Equivalent Sound Level, L_{dn}, is the Equivalent Sound Level, L_{eq}, measured over a 24-hour period. However, a 10 dB penalty is added to the noise levels recorded between 10 PM and 7 AM to account for people's higher sensitivity to noise at night when the background noise level is typically lower. The L_{dn} is a commonly used noise descriptor in assessing land use compatibility, and is widely used by federal and local agencies and standards organizations.

3.5.2 Noise Guidelines, Standards and Regulations

Various local and federal agencies have established guidelines and standards for assessing environmental noise impacts and to set noise limits as a function of land use.

3.5.2.1 State of Hawaii, Community Noise Control

The State of Hawaii Community Noise Control Rule does not address most *moving* sources, such as vehicular traffic noise, air traffic noise, or rail traffic noise. However, the Community Noise Control Rule does regulate noise related to construction activities, which may not be stationary. These regulations will be discussed in greater detail in the discussion of construction impacts in **Section 4.5.3: Construction Noise Impacts and Mitigation**.

3.5.2.2 U.S. Federal Highway Administration (FHWA)

The FHWA defines four land use categories and assigns corresponding maximum hourly equivalent sound levels in $L_{eq(h)}$, or "noise abatement criteria" (NAC), for traffic noise exposure (Federal Highway Administration, 2005), and found at 23 CFR 772. The NAC are listed in **Table 3-28: FHWA and HDOT Noise Abatement Criteria**. For example, Category B, defined as picnic and recreation areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals, has a corresponding maximum exterior L_{eq} of 67dBA. In this study, most land can be considered to fall into land use category B or C. HDOT has adopted the FHWA's NAC.

Table 3-28: FHWA and HDOT Noise Abatement Criteria

Activity Category	Maximum L_{eq} (1 Hr period)	Description of Activity Category / Land Uses
A	57 dBA (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the lands are to continue to serve their intended purpose.
B	67 dBA (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries and hospitals.
C	72 dBA (Exterior)	Developed lands, properties or activities not included in Categories A or B above.
D	---	Undeveloped lands.
E	52 dBA (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

Source: Code of Federal Regulations, Title 23 Part 772, Revised April 2005

3.5.2.3 Hawaii Department of Transportation (HDOT)

The HDOT has adopted FHWA's design goals and NAC for traffic noise exposure in its noise analysis and abatement policy (State of Hawai'i Department of Transportation, 1997).

According to the policy, a traffic noise impact occurs when the predicted traffic noise levels "approach" or exceed FHWA's design goals or when the predicted traffic noise levels "substantially exceed the existing noise levels." The policy also states that "approach" means comes within at least 1 dB of FHWA's design goals and "substantially exceed the existing noise levels" means an increase of at least 15 dBA.

3.5.2.4 U.S. Environmental Protection Agency (EPA)

The U.S. EPA has identified a range of yearly day-night equivalent sound levels, L_{dn}, sufficient to protect public health and welfare from the effects of environmental noise (U.S. Environmental Protection Agency, 1977). The EPA has established a goal to reduce exterior environmental noise to an L_{dn} not exceeding 65 dBA and a future goal to further reduce exterior environmental noise to an L_{dn} not exceeding 55 dBA. Additionally, the EPA states that these goals are not intended as regulations as it has no authority to regulate noise levels, but rather they are intended to be viewed as levels below which the general population will not be at risk from any of the identified effects of noise.

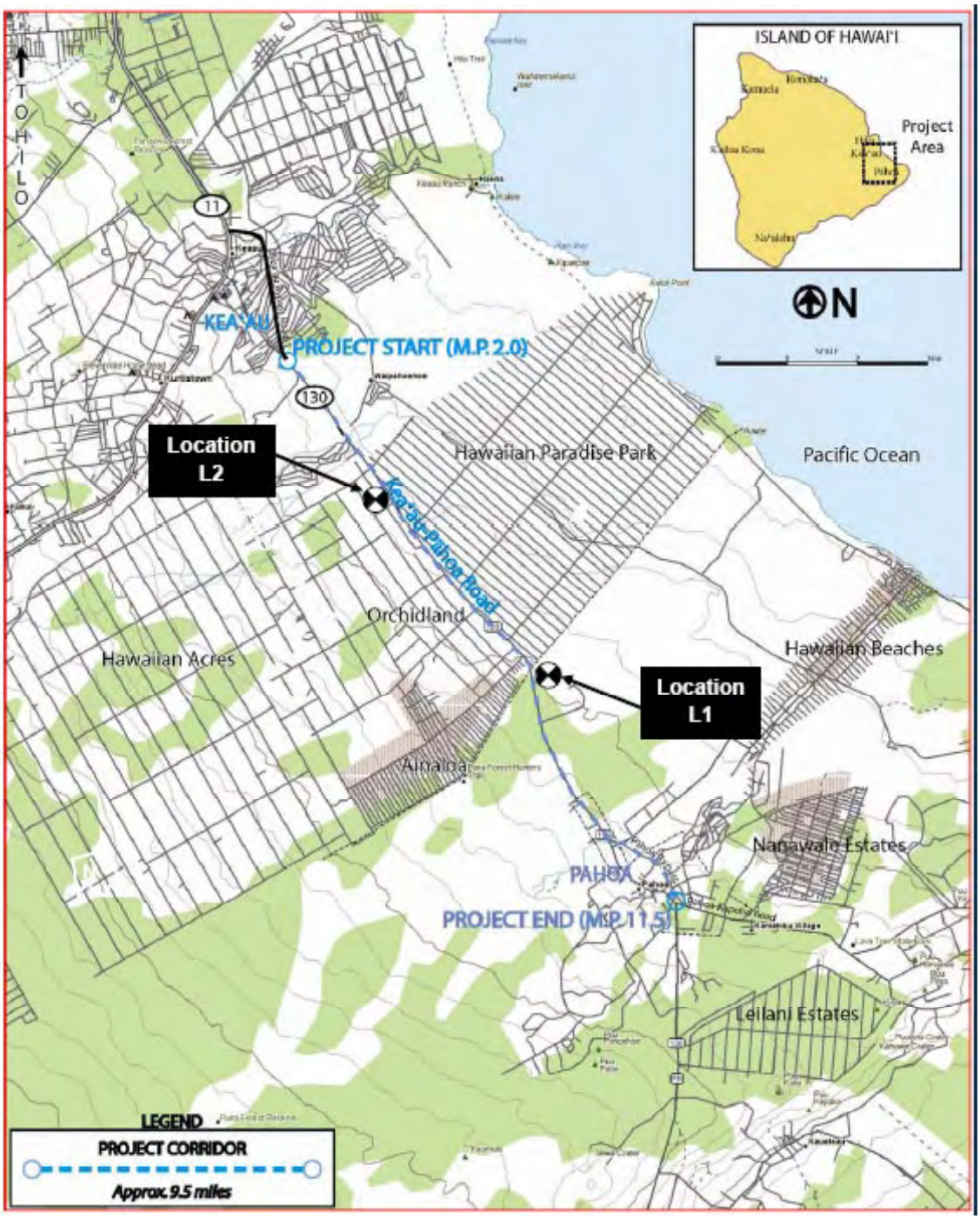
3.5.3 Measured Noise Environment Along Keaʻau-Pāhoa Road

Two types of noise measurements were conducted to assess the existing acoustical environment within the project corridor. The first noise measurement type consisted of continuous long-term ambient noise level measurements (Locations L1 and L2). The measurement locations are illustrated in **Figure 3-11: Noise Measurement Locations**. The sites that were used for measurements included:

- Location L1: The Makuʻu Farmers Market, at a location approximately 105 feet east of the centerline of Keaʻau-Pāhoa Road
- Location L2: A private residence on the mauka side of the highway between Shower Drive and Pōhaku Place, at a location approximately 70 feet west of the centerline of the road.

Noise measurements were taken between January 20th and 21st using Type 1 Sound Level Meters that had been previously calibrated by the manufacturer and also calibrated before and after measurements in the field. Microphones were mounted on tripods approximately 5 to 6 feet above grade.

Figure 3-11: Noise Measurement Locations



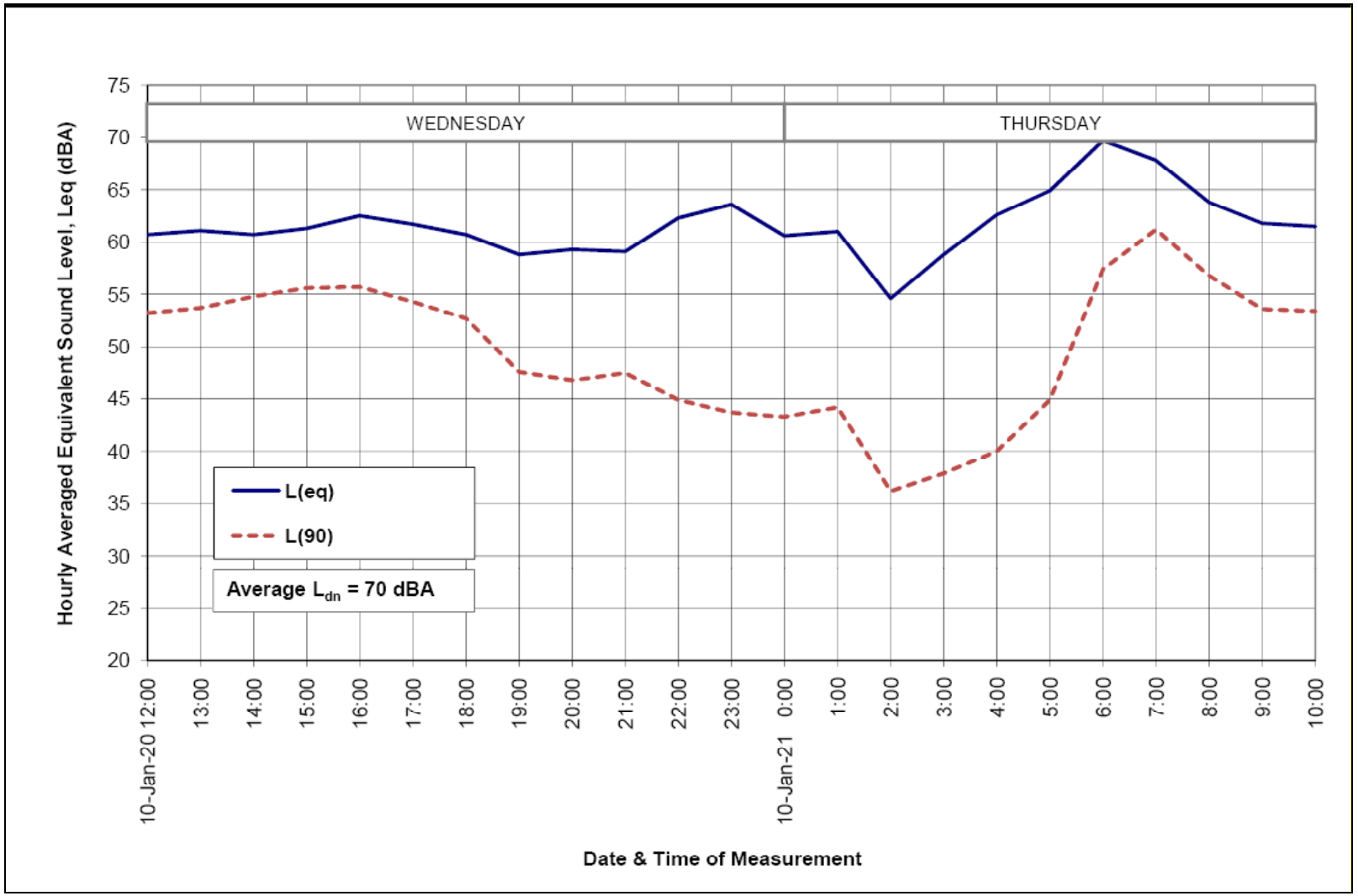
Source: DL Adams Associates

The results from these long-term sound measurements are graphically presented in **Figure 3-12: Location L1 - Long Term Noise Measurement Results**, and **Figure 3-13: Location L2 - Long Term Noise Measurement Results** which show the measured hourly equivalent sound level, L_{eq}, and the sound level exceeded 90 percent of the time, L_{90}, in A-weighted decibels (dBA) as a function of the measurement date and time. The graph for Location L2 shows an "overload" condition which occurred on the evening of January 20th. This error may have been caused by wet weather conditions.

As the figures show, the ambient sound levels at both locations are relatively dynamic and are strongly influenced by the vehicular traffic patterns of Keaʻau-Pāhoa Road. The dominant noise source for both locations is vehicular traffic noise along Keaʻau-Pāhoa Road. Secondary noise sources include birds, wind, rain, and occasional aircraft flyovers. The measurements show that noise levels range from 61 to 69 dBA during peak traffic hours and 55 to 64 dBA at night.

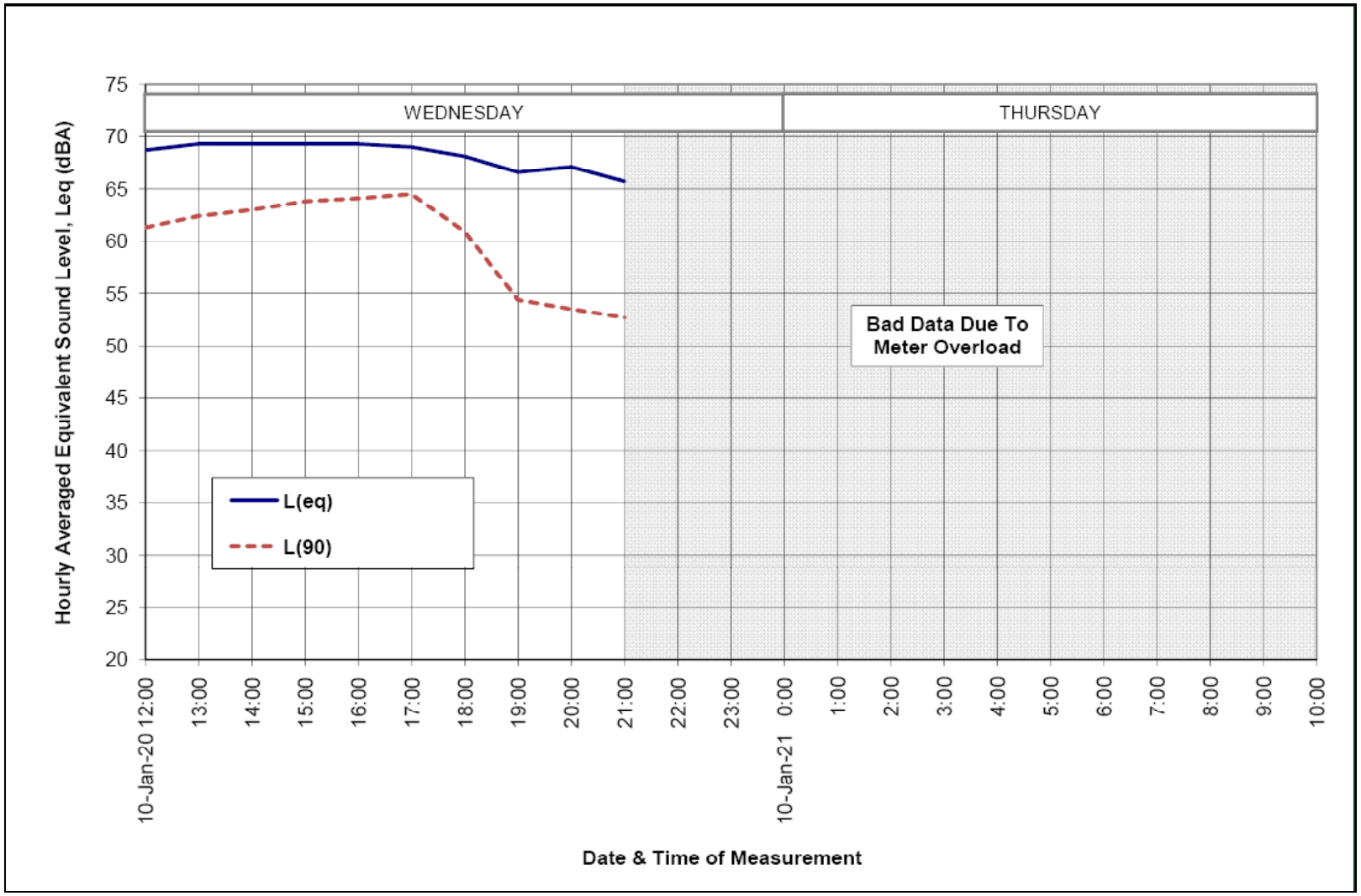
Short term measurements were also taken at the Makuʻu Farmers Market site, with the objective of getting data to validate the modeling.

Figure 3-12: Location L1 - Long Term Noise Measurement Results



Source: DL Adams Associates

Figure 3-13: Location L2 - Long Term Noise Measurement Results



Source: DL Adams Associates

3.5.4 Modeled Existing Noise Levels Along Keaʻau-Pāhoa Road

As part of the modeling effort to predict future noise levels on Keaʻau-Pāhoa Road, the existing levels were predicted along the corridor at 182 noise receiver locations (most of which are single family homes). The purpose of the modeling of existing levels was to establish existing noise levels and to validate the model. All modeling used the Federal Highway Administration's Traffic Noise Model (TNM) Version 2.5. The TNM model is a computer-based application that calculates noise at receivers based on traffic volumes, speeds, terrain, and physical location of the roadway relative to the receivers.

The traffic noise analysis is also based on the peak hour AM and PM traffic volumes generated for the project. Noise level measurements and traffic counts taken in the field were used to validate the traffic noise model prediction software. Vehicular traffic was modeled under free flow conditions at a worst-case speed of 55 miles per hour, though actual operating speeds, particularly under a no-build scenario, would be expected to be lower. The terrain surrounding the project corridor was assumed to be hard (i.e., acoustically reflective) and flat (i.e., no change in elevation), which again reflects a worst-case scenario. Sound levels predicted at the receiver locations have been calculated at approximately 13 feet above the ground. This height represents the worst-case scenario of a listener on a second story lanai or in a second story bedroom with an open window. While most of the residences along Keaʻau-Pāhoa Road are single story structures, they are often built on a raised foundation. In almost all cases, predicted sound levels at 5 feet height would be equal to or slightly less than at 13 feet.

Table 3-29: Existing Properties Approaching or Exceeding Noise Abatement Criteria summarizes those properties that current are exceeding the FHWA and HDOT Noise Abatement Criteria. Out of 182 noise receivers (mostly residential in nature) bounding Keaʻau-Pāhoa Road, there are 117 existing properties shown in the table that are calculated to already approach or exceed the FHWA/HDOT Noise Abatement Criteria (NAC). Therefore, there are existing high noise levels already affecting properties along Keaʻau-Pāhoa Road, particularly those that are close to the existing highway.

The overall results of the TNM modeling for existing (2006) conditions are shown in the discussion on noise impacts that follow in **Section 4.5.1: Future Year Noise Impacts and Mitigation**. In **Table 4-35: Predicted Peak Hour Traffic Noise Levels and Resulting Increases Due to Project**, the reader is shown all the modeling results for both existing conditions and future year. As the table shows, the distance from the building façade to the road has a substantial influence on the noise levels modeled. Houses and other buildings that are over 100 feet away from the corridor generally showed lower noise levels than those structures that were closer to the highway.

Table 3-29: Existing Properties Approaching or Exceeding Noise Abatement Criteria

Road Segment	TMK	Distance to Road (feet)	NAC Land Use Category	Maximum Peak Hour Traffic Noise Levels (dBA)
Opukahaia Street to Shower Drive	1-6-04:47	113	B	70.5
	1-5-36:117	130	B	69.3
	1-5-36:116	131	B	68.9
	1-6-64:287	217	B	66.9
	1-6-64:286	166	B	68.3
	1-5-36:120	89	B	71.2
	1-6-64:284	141	B	68.9
	1-6-64:283	149	B	68.8
	1-5-36:121	117	B	69.8
Shower Drive to Pōhaku Place	1-6-64:269	203	B	67.1
	1-6-64:267	230	B	66.3
	1-6-64:266	163	B	68.2
	1-6-64:265	178	B	67.6
	1-6-64:263	151	B	68.4
	1-5-36:153	68	B	72.2
	1-6-64:261	172	B	67.6
	1-5-36:151	91	B	71.0
	1-5-36:150	153	B	68.3
	1-6-64:260	156	B	68.2
	1-6-64:258	243	B	66.1
	1-5-36:148	164	B	67.7
	1-6-64:257	168	B	68.0
	1-6-64:256	154	B	68.6
	1-6-64:255	126	B	69.5
	1-5-36:145	218	B	66.3
	1-6-64:253	230	B	66.4
	1-5-35:148	98	B	70.5
	1-6-64:251	115	B	70.0
	1-5-35:149	92	B	70.4
	1-6-64:249	173	B	67.7

Table 3-29: Existing Properties Approaching or Exceeding Noise Abatement Criteria

Road Segment	TMK	Distance to Road (feet)	NAC Land Use Category	Maximum Peak Hour Traffic Noise Levels (dBA)
Pōhaku Place to Kaloli Drive	1-5-35:182	92	B	70.1
	1-6-10:270	168	B	67.5
	1-5-35:181	98	B	70.0
	1-5-35:180	207	B	66.4
	1-6-10:271	158	B	67.7
	1-5-35:184	111	B	69.5
	1-6-10:273	70	B	72.1
	1-6-10:274	138	B	68.7
	1-5-35:185	127	B	68.9
	1-6-10:275	138	B	68.4
	1-5-35:186	100	B	70.1
	1-5-35:187	103	B	69.8
	1-6-10:276	192	B	67.0
Kaloli Drive to Pōhaku Circle	1-6-10:281	171	B	67.5
	1-6-10:284	214	B	66.2
	1-5-34:215	129	B	68.1
	1-6-10:286	168	B	67.3
	1-6-10:287	208	B	66.3
	1-6-10:288	123	B	68.8
	1-5-34:210	118	B	68.7
Poahaku C.ircle to Orchidland Drive	1-5-34:219	126	B	68.2
	1-5-34:220	159	B	67.1
	1-6-10:123	125	B	68.4
	1-6-10:124	147	B	67.7
	1-5-34:222	136	B	67.9
	1-5-33:221	172	B	66.7
	1-6-10:289	138	B	68.1
	1-5-34:218	83	B	70.2
	1-6-10:126	134	B	68.1
	1-6-10:127	124	B	68.4
	1-5-33:222	127	B	67.5
	1-6-10:129	135	B	68.0
	1-5-33:254	68	B	71.3
	1-5-33:253	157	B	67.1
	1-6-10:134	136	B	68.0
Orchidland Drive to Paradise Drive	1-6-9:388-390	189	B	66.1
	1-6-9:391	98	B	69.6
	1-5-33:256	91	B	69.4
	1-5-33:257	114	B	68.4
	1-6-9:401	140	B	67.7

Table 3-29: Existing Properties Approaching or Exceeding Noise Abatement Criteria

Road Segment	TMK	Distance to Road (feet)	NAC Land Use Category	Maximum Peak Hour Traffic Noise Levels (dBA)
	1-6-9:394	123	B	68.5
Paradise Drive to Aulii Street	1-6-9:402	126	B	68.3
	1-6-9:405	124	B	68.4
	1-5-17:143	104	B	68.8
	1-6-9:406	158	B	67.0
	1-5-17:145	108	B	68.6
	1-5-17:147	108	B	68.9
	1-5-17:148	126	B	68.1
	1-5-14:150	120	B	68.2
	1-5-17:154	89	B	69.7
Aulii St./Maku'u Dr.	1-6-9:214	111	B	68.6
	1-6-9:220	135	B	67.3
	1-6-9:222	144	B	67.1
	1-6-9:223	141	B	67.1
	1-5-16:174	110	B	68.1
	1-6-9:225	123	B	67.6
	1-6-9:227	118	B	67.9
	1-5-16:173	161	B	66.3
	1-6-9:228	111	B	68.3
	1-5-16:170	90	B	69.0
	1-6-9:233	154	B	66.6
	1-5-16:167	77	B	69.9
	1-6-9:236	162	B	66.4
	1-6-9:237	138	B	67.2
	1-5-16:165	109	B	68.0
	1-5-16:164	122	B	67.6
	1-6-9:238	148	B	67.0
	1-6-9:241	103	B	69.1
	1-6-9:243	122	B	68.1
Maku'u Drive to Ilima Street	1-6-9:168	110	B	68.2
	1-6-9:166	114	B	68.2
Ilima Street to Ainaloa Blvd	1-5-15:175	110	B	67.5
	1-6-9:158	126	B	67.4
Ainaloa Boulevard Ka Ohuwalu Drive	1-5-15:182	133	B	67.2
	1-6-99:6	73	B	70.2
	1-6-99:2	68	B	70.9
	1-5-15:187	162	B	66.1
Ka Ohuwalu Drive to Kaluahine Street	None Approaching or Exceeding Standard			

Table 3-29: Existing Properties Approaching or Exceeding Noise Abatement Criteria

Road Segment	TMK	Distance to Road (feet)	NAC Land Use Category	Maximum Peak Hour Traffic Noise Levels (dBA)
Kaluahine Street to Old Pāhoa Road (Pāhoa Village Junction)	1-5-7:13	66	B	69.7
	1-5-7:73	107	B	67.4
	1-5-7:75	60	B	69.3
	1-5-7:12	87	B	68.4
	1-5-7:52	61	B	70.0
	1-5-7:11	135	B	66.1
	1-5-7:68	125	B	66.6
	1-5-7:78	129	B	66.6
	1-5-7:53	93	B	68.0
	1-5-7:10	89	B	68.3
Old Pāhoa Road (Pāhoa Village Junction) to Pāhoa-Kapoho Road	None Approaching or Exceeding Standard			

Source: DL Adams Associates

3.6 Biological Resources

3.6.1 Flora

To document the vegetative communities in the study area, a botanical field review of the corridor was made in May and June, 2009. The project team visited areas at least 60 feet beyond the existing right-of-way limits except where this encroached into active residential, commercial or agricultural uses. The team noted the general vegetation communities, listed all species encountered, and searched for any federally threatened or endangered species present. The full report on the botanical study is found in **Appendix I: Botanical Study**.

The area's vegetation can be classified as Lowland Wet ʻOhiʻa/Uluhe Fern Forest (Gagne and Cuddihy 1990). In the variant of this type found in much of Puna, ʻohiʻa trees (*Metrosideros polymorpha*) are abundant but generally small (15-40 feet high; 2-10 inches in diameter at breast height) and sparsely to moderately distributed among patches of native uluhe (*Dicranopteris linearis*) fern, with the introduced grass broomsedge (*Andropogon virginicus*) and shrub melastoma (Melastoma candidum) often common as well. Even if evidence of direct human disturbance may not always be obvious, fires and historic cattle grazing have probably reduced native plant diversity and increased the prevalence of weed species throughout much of lowland Puna.

Vegetation adjacent to the highway has been generally disturbed by invasive weeds, herbicides, litter, and motorists driving on the vegetation. It also has been disturbed by intersecting roads and driveways, and utility lines and trenches.

Beyond the highway, a patchwork of farms, landscaped residences, businesses and agriculture have caused extensive disturbance. These often have a high diversity of ornamental and agricultural species, and to a lesser degree, mowed lawn, herbicided lava, or cinder patches. There are also areas of miscellaneous disturbed secondary growth from native forest that was cleared or farmed and then left to re-grow with alien tree and shrub species such as gunpowder tree (*Trema orientalis*), Melochia (*Melochia umbellata*), and albizia (*Falcataria moluccana*).

There are many patches of native ʻohiʻa-uluhe forest, mostly degraded by invasives (strawberry guava [*Psidium cattleianum*] and/or other plants). A few common native ferns and sedges and the ubiquitous low shrub ʻuhaloa (Waltheria indica) are present, but there are very few other native trees or shrubs. However, some ʻohiʻa-uluhe forest patches are almost pristine. The least disturbance is often on the largest parcels, owned by W.H. Shipman Ltd. and the Department of Hawaiian Homes lands.

During the field visits, a total of 211 plant species were documented. Twenty-four of the plant species present in the corridor are natives, most of them very common throughout Puna and much of the Hawaiian Islands. Five endemic natives (found in Hawaiʻi and nowhere else) were found: hapuʻu (*Cibotium glaucum*), ʻohiʻa, ʻuki (*Machaerina mariscoides* subsp. *meyenii)*, neneleau (*Rhus sandwicensis*), and a single specimen of *Hibiscus arnottianus* (which was purposefully planted). A total of 19 indigenous natives (found in Hawaiʻi as well as elsewhere)

were observed. Aside from uluhe, most prominent were the sedges *Cyperus polystachyos*, *Fimbristylis dichotoma*; the ferns ʻekaha (*Lepisorus thunbergianus*), sword fern (*Nephrolepis exaltata*), Cretan brake (*Pteris cretica*), and palaʻa (*Sphenomeris chinensis*); the fern ally club moss (*Lycopodiella cernua*); and the shrubs ʻuhaloa and popolo (*Solanum americanum*).

For some of the native species, most or all of the specimens observed were planted by humans, including hapuʻu, alaheʻe (*Psydrax odorata*), hala (*Pandanus tectorius*), naupaka kahakai (*Scaevola sericea*), and, as discussed above, the one *Hibiscus arnottianus* that was found.

No listed or proposed threatened or endangered plant species were found. Given the context and limited vegetated area, it is somewhat unlikely that one would be found unless it were planted intentionally as part of landscaping.

3.6.2 Fauna

One-time short duration field surveys of the type typically performed for environmental assessments, are by their very nature, snapshots in time. The data that is generated by these surveys is augmented and put into a broader perspective by comparing the data generated to previous surveys and the experience of the investigator. The discussions that follow below and the assessment of impacts in **Section 4.6.2: Fauna** consider both species that were present in the corridor during field surveys and those species of particular interest not detected during a short-term survey that are likely to be present on a seasonal basis.

Avian and mammalian surveys were conducted by walking the entire length of both sides of the project corridor between July 9, and July 13, 2009. The objective was to determine if there were any species currently listed as endangered, threatened, or proposed for listing under either the federal or the State of Hawaiʻi's endangered species programs on, or within the immediate vicinity of the corridor. Federal and State of Hawaiʻi 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, 2009). The vegetative habitat in the corridor is described in greater detail in **Section 3.6.1: Flora**.

3.6.2.1 Avian Survey and Resources

In addition to walking the entire corridor, 22 eight-minute point counts were sighted along the roadway corridor. Field observations were made with binoculars, and by listening for vocalizations. Counts took place between 7:30 AM and 10:00 AM, the peak of daily bird activity. A search was made for species and habitats that were not detected during count sessions.

A total of 461 individual birds of 15 different species representing eight families were recorded. One species, Hawaiʻi Amakihi (*Hemignathus virens*) is endemic to (found only on) the Island of Hawaiʻi. The other 14 species are alien to the Hawaiian Islands. No species currently listed as threatened, endangered or proposed for Federal/State listing was detected during the course of this survey.

Avian diversity and densities were relatively low, due to the disturbance from heavy traffic. Two species, Japanese White-eye (*Zosterops japonicus*), and House Finch (*Carpodacus mexicanus*) accounted for over 60 percent of the total number of birds recorded.

The endangered Hawaiian Hawk or *ʻio* (*Buteo solitarius*), is endemic to the Island of Hawaiʻi. Although not detected during this survey, the Hawaiian Hawk uses resources within the general project area on a seasonal basis. Hawaiian Hawks are found in nearly all habitats with large trees on the island. They are regularly seen foraging in South Hilo and Puna. 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 (two of which were detected in the mammal survey), all of which are prey for the hawk. This habitat also provides numerous suitable perches and nesting sites (Klavitter 2000).

Current population estimates are 1,450 Hawaiian Hawks living in the wild, equal to/higher than the population in pre-contact times (Klavitter 2000). The Hawaiian Hawk breeding season starts in late March, chicks hatch in May, and begin to fledge in July (Griffin et al. 1998). Although hawks use resources in most forest habitats, they usually nest in *ʻōhiʻa* trees (*Metrosideros polymorpha*). There are no appropriate nesting trees in the study area for this species. The USFWS has proposed to de-list the Hawaiian Hawk; the proposal is still open.

Although not detected during the course of the field surveys, it is almost a certainty that two migratory indigenous shorebird species, Pacific-Golden Plover (Kolea, or *Pluvialis fulva*), and Ruddy Turnstone (ʻakekeke, or *Arenaria interpres*) use resources within the general project area on a seasonal basis. Both of these shorebird species nest in the high Arctic during the late spring and summer months, returning to their wintering grounds in Hawaiʻi, Japan, Okinawa, Polynesia, Micronesia, Melanesia, New Zealand, Australia, Indonesia, Philippines, southern China, southeast Asia, Bangladesh, Nepal, India, Sri Lanka, Pakistan, Iran, Bahrain, and northeast and southern Africa (Johnson and Conners 1996). Wintering birds usually leave Hawaiʻi for their trip back to the Arctic in late April or the very early part of May, and return to their wintering grounds in late July. Some individuals overwinter in Hawaiʻi, and thus are present all year. There is little suitable habitat within the proposed right-of-way suitable for these or other shorebird species.

While not observed in the surveys, it is probable that small numbers of the endangered endemic Hawaiian Petrel (*Pterodroma sandwichensis*), or *uaʻu*, and the threatened Newell's Shearwater (*Puffinus auricularis newelli*), or *ʻaʻo*, over-fly the project area between May and November, as ornithological radar studies conducted in the Pāhoa, Hawaiian Beaches, and Paradise Park area in 2001, 2002 and 2003 recorded small numbers of birds flying inland (Day and Cooper 2003). There is no suitable nesting habitat within or close to the study area for either of these pelagic seabird species. Both formerly were common on the Island of Hawaiʻi.

The primary cause of mortality in both Hawaiian Petrels and Newell's Shearwaters is thought to be predation by alien mammals. Collision with man-made structures is considered to be the second most likely cause of mortality, when nocturnally-flying birds become disoriented by

exterior lighting. If they are not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals.

3.6.2.2 Mammalian Survey and Resources

All observations of mammalian species were of an incidental nature, based on visual and auditory detection or visual signs (scat, tracks, etc.) With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or ʻōpeʻapeʻa as it is known locally, all terrestrial mammals on the Island of Hawaiʻi are alien species, and most are ubiquitous.

Eight mammals were detected during the course of this survey. Domestic dogs, cattle, and house cats were observed. Roof rats (*Rattus r rattus*), European house mice (*Mus musculus domesticus*), and Indian mongooses (*Herpestes a. auropunctatus*) were seen in the right-of-way. Horses (*Equus c. caballus*) were seen outside the right-of-way in pastures along the corridor. Track, sign and scat of pigs (*Sus s. scrofa*), was encountered in numerous locations. While not detected, it is probable that the alien Norway rat (*Rattus norvegicus*), and alien Polynesian rat (*Rattus exulans hawaiiensis*) also use resources within the project corridor.

While no Hawaiian hoary bats were detected during the course of this survey, it is probable they do occasionally use resources within the general project area. Hawaiian hoary bats are regularly seen in the general project area on a seasonal basis (Jacobs 1994, David 2009). Recent research on this species has shown that the species is present on the Island of Hawaiʻi on a seasonal basis in almost all areas with dense vegetation and tree cover. The bat is also attracted to tree farms, agriculture, and outdoor lights that draw insects on which this species forages (Bonaccorso et al. 2004, 2007).

3.6.3 Aquatic Biota

In May 2009, the project team conducted water quality and aquatic resource surveys along both sides of the entire Keaʻau-Pāhoa Road study corridor to ascertain aquatic resources and assess water quality within a 200 foot (60 m) wide area. Dominant vegetation, aquatic biota, water quality, and stream bed morphology were recorded for all culverts, drainage ditches, and streams within the proposed project area.

A few, isolated pools present in stream channels in the project vicinity are ephemeral features that would likely disappear during dry periods. The pools may support aquatic insect biota, perhaps including native species, though none were observed in the May, 2009 aquatic surveys performed for this project.

An intermittent unnamed stream (referred to as Waipahoehoe Stream by some sources) is found about 1.8 miles south of the Keaʻau Bypass merge. The surface flow of the unnamed stream, even when considerable from heavy rainfall, does not reach the ocean, precluding recruitment of diadromous fish (fish using both marine and freshwater habitats in their life cycle), such as native ʻoʻopu or ʻopae.

No threatened or endangered species (DLNR, 1998; USFWS, 2009a) associated with aquatic environments were encountered in the survey area and none is expected since no suitable habitats are present.

3.6.3.1 Snails

As part of the aquatic resources surveys in May, 2009, the only invertebrate observed within the survey area was the giant African snail (*Achatina fulica*), a terrestrial species observed in a tributary north of the intermittent unnamed stream about 1.8 miles south of the Keaʻau Bypass merge and in the large box culverts at the area between the Keaʻau Bypass merge and Opukahaia Street.

A March, 2004 survey of the same area, taken for the Shoulder Improvements Project, under dry conditions in the unnamed stream, identified the mimic lymnaea (*Pseudosuccinea columella*), a freshwater snail. (*AECOS*, Inc., 2004)

Neither species is protected as a listed endangered or threatened species.

3.6.3.2 Dragonflies

No dragonflies were observed during the May, 2009 field surveys.

The March, 2004 survey identified a dragonfly nymph, the globe skimmer (*Pantala flavescens*). This species is neither an endangered nor threatened species.

3.6.3.3 Damselflies

Although only very scattered, isolated pools were observed in the unnamed stream in the project area (none of the drainage features had standing or flowing water), and these supported only small numbers of snails and insect juvenile forms as noted above, the issue was raised by the public concerning native damselflies in the project area, and particularly native damselflies that are listed as threatened or endangered.

The only damselflies currently proposed for listing are the Flying Earwig Hawaiian Damselfly (*Megalagrion nesiotes*) and Pacific Hawaiian Damselfly (*M. pacificum*; Federal Register, 2009). Neither of these species would be expected to be present in the area of Hawaiʻi Island near Keaʻau - Pāhoa Road. Four species of *Megalagrion* are candidate species, and three of the four are known to be endemic only to Oʻahu.

Historically, the Flying Earwig Hawaiian damselfly was known from the Big Island and Maui. The species has not been seen on the Big Island for over 80 years, although extensive surveys within apparently suitable habitat in the Kaʻu and Olaʻa areas were conducted from 1997 to 2008. Little is known about the breeding biology of *M. nesiotes*; what is known suggests this species breeds in "scattered pockets of water [in the forest] or in the bases [leaf axils] of leaves of tropical plants" (Perkins, related by Kennedy, 1934). Adults appear not to associate with streams. The east rift zone of Kīlauea is given as having potentially suitable habitat for this species (Federal Register, 2009).

The Pacific Hawaiian damselfly is now believed to be extirpated from Oʻahu, Kauaʻi, and Lanaʻi (Polhemus and Asquith, 1996). It was believed that the species had also been extirpated from the Big Island when in 1998 a population was discovered within a small stream located just above, but isolated from, Maili Stream on the Hamakua Coast (Englund, 1998). *M. pacificum* breeds in seepage-fed pools bordering the terminal reaches of perennial streams (Moore and Gagne, 1982; Polhemus and Asquith, 1996). They seem to prefer dense vegetation, and seem not to stray far from breeding pools. This habitat is not present in the project area.

M. xanthomela, the Orangeblack Hawaiian damselfly, was once considered Hawaiʻi's most abundant species of damselfly, yet is now believed to be extirpated from Kauaʻi, and is very rare on Oʻahu, Molokaʻi and Lānaʻi. This species tends to breed in coastal wetlands fed by basal springs or in the lower reaches of perennial streams, although it will opportunistically exploit temporary pools bordering flashy streams. Eggs are laid on aquatic vegetation (Polhemus and Asquith, 1996). Several large populations exist in coastal wetlands on Hawaiʻi in the following localities: Anaehoomalu Bay, Hawa Bay, Hilea Stream, Hilo, Honokohau, Kiholo Bay, Ninole Springs, Whittington Beach (Polhemus 1995) and Onomea Bay (Asquith 1995).

The Orangeblack Hawaiian damselfly is perhaps the only species that potentially could be found in the project vicinity, although habitat requirements appear not to be met anywhere along the road corridor. Given the paucity (or complete absence) of suitable habitat for any of these rare damselflies, and the absence of observations of any native *Megalagrion* during the project field surveys, it is reasonable to conclude that the proposed changes to Keaʻau-Pāhoa Road will have no impacts on members of this group.

3.7 Water Resources

3.7.1 Surface and Groundwater

The project area is marked geologically by an extensive deposit of Pahala ash (MacDonald and Abbott, 1970), a weathered material which accounts for the presence of some surface streams here in contrast to the fact that very few streams exist anywhere else on Mauna Loa or Kilauea volcanoes. The youthful lavas of these mountains are typically too porous to support channelized water flow for any significant distance (MacDonald and Abbott, 1970).

A total of 34 culverts, one bridge, and drainage ditches are present along the highway within the proposed project area. There are a total of 38 watersheds drained by the drainages that cross the highway. The bridge and the culverts pass runoff from the mauka areas to the makai side of the roadway. There are a number of low areas along the road where runoff crosses over the pavement during moderate to large storms. Drainage ditches capture runoff and direct it parallel to the roadway to a culvert feature. Most of the drainage in the corridor is poorly defined due to the youthful geology of area, but US Geological Survey (USGS) mapping shows three intermittent streams in the corridor with well-defined stream bed characteristics. The watersheds associated with the intermittent streams heading from north to south are as follows:

- The first watershed contains an unnamed intermittent stream about 1.7 miles south of the Keaʻau Bypass merge. This stream is a tributary of the second unnamed stream (described below) located approximately 600 feet south (towards Pāhoa) of the first unnamed stream. The two streams converge several thousand feet downstream of Keaʻau-Pāhoa Road. **Figure 3-14: Unnamed Stream and Tributary Location** illustrates the location of this intermittent stream (labeled as "1").
- The second watershed contains an unnamed intermittent stream (called Waipāhoehoe Stream by some sources). The stream crosses under Keaʻau-Pāhoa Road about 1.8 miles south of the Keaʻau Bypass merge. **Figure 3-14: Unnamed Stream and Tributary Location** illustrates the location of this intermittent stream (labeled as "2").
- A third unnamed intermittent drainage with defined stream bed characteristics is located in the Pāhoa area in the vicinity of the Pāhoa Marketplace shopping center and Old Pāhoa Road.

In May 2009, the project team conducted water quality and aquatic resource surveys along both sides of the entire Keaʻau-Pāhoa Road study corridor to ascertain aquatic resources and assess water quality within a 200 foot (60 m) wide area. Dominant vegetation, aquatic biota, water quality, and stream bed morphology were recorded for all culverts, drainage ditches, and streams within the proposed project area.

The second watershed described above is the only location where aquatic resources of interest were found. In the second watershed, a depression area that contains some characteristics of a wetland area is also associated with the intermittent unnamed stream and is discussed in **Section 3.7.2: Wetlands**. The one bridge within the Keaʻau-Pāhoa Road study corridor crosses this intermittent stream.

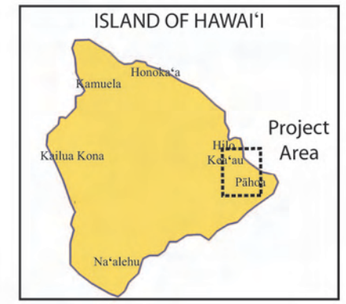
This stream system includes several branches upslope, one arising around the 2,500-foot elevation on the east slope of Mauna Loa above Mountain View. The stream (from the first watershed) and the small tributary (from the second watershed) converge at around 280-foot elevation, down-slope from Keaʻau-Pāhoa Road. Flows (when present) continue within a discernable channel to around the 200-ft elevation, where stream water is directed out onto the highly permeable Kīlauea lava flows. The stream disappears in this area (USGS topographic map, 1981). Consequently, when flowing, this stream does not empty into the ocean; stream flow is distributed across an area of pāhoehoe lava with depressions that infiltrate all flow water into the ground approximately 3.7 miles inland from the ocean shoreline.

During the May 21, 2009 survey, the only water present within the project area was located in small, isolated pools in the tributary north of the larger channel of the unnamed stream and in a center culvert at 0.2 mi (0.3 km) south of the Keaʻau Bypass merge (before Opukahaia Street). Though these pools may be semi-permanent aquatic features, their small size precluded any collection of samples for water quality analyses.

RECEIVING WATERS

[1] - N 19 35.324' W 155 0.828'
UNNAMED TRIBUTARY
ELEVATION 309 FT. MSL

[2] - N 19 35.230' W 155 0.737'
UNNAMED STREAM
ELEVATION 305 FT. MSL



LEGEND

- Keaau-Pahoa Road Improvments Study Corridor
- # Location of Receiving Water

Graphic Scale
0 1,000 2,000 ft.

North

Keaau-Pahoa Road Improvemets Project
Department of Transportation, State of Hawaii

Unnamed Stream and Tributary Location

Source: Delorme 3D Topo Quads (2004)

Figure 3-14

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The unnamed stream in the first watershed is not listed on the State of Hawaiʻi list of impaired waters (State of Hawaiʻi, Department of Health, 2008). A water quality survey of the unnamed stream had been performed in March, 2004 during wetter conditions, at a location roughly 260 feet downstream of Keaʻau-Pāhoa Road. Water quality at that time was noted as good overall.

A preliminary coordination meeting was held with staff from the US Army Corps of Engineers on September 17, 2009 to discuss the surface waters within the study area and the jurisdictional likelihood of there being any Waters of the United States (WOUS) under the Corps' jurisdiction as regulated under Section 404 of the Clean Water Act. If the project would result in the deposition of material into a WOUS, a Department of the Army Permit will be necessary under Section 404. The Corps' determination will be made subsequent to their review of this Environmental Assessment and the supporting materials. Based on the coordination, it is believed that none of the resources within the corridor will be determined to be WOUS under the Corps' jurisdiction under Section 404. This determination is expected because none of the aquatic resources in the corridor connect directly with the ocean as described above.

There is abundant water travelling through this area from Mauna Loa, but it flows underground, exiting usually at or near the ocean via springs. These underground sources of water are known to be quite pristine, having been filtered through miles of lava rock. The project area is located mauka of the Hawaiʻi Department of Health Underground Injection Control Area line, meaning that the underlying aquifer is considered a drinking water source, and needs to be protected from injection well activity.

The Pāhoa aquifer system underlies the entire study area, and is an important source of water for the County's Department of Water Supply (DWS), with the highest sustainable yield (435 million gallons per day) of an aquifer system on the island. It is part of the larger Kīlauea Aquifer Sector. Most domestic use of water in the area is provided by rain catchment, with the exception of some users immediately along Keaʻau-Pāhoa Road. The DWS' Pāhoa water system, serving select locations around Pāhoa has good quality water with chloride content between 4 and 27 parts per million (ppm). The supply will readily be able to serve future development demands. (County of Hawaiʻi Department of Water Supply, 2006).

3.7.2 Wetlands

As noted **Section 3.7.1: Surface and Groundwater** above, in the vicinity of the unnamed intermittent stream (referred to by some as Waipāhoehoe Stream) between the Keaʻau Bypass and Shower Drive, there is a depression area close to the mauka side of Keaʻau-Pāhoa Road with characteristics that suggest a wetland. This depressed area adjacent to a farm, is covered with para or California grass (*Urochloa mutica*), a facultative wetland indicator species (FACW).

A soil sample was taken at this location. The uppermost layer appears to be a silty sandy loam with Munsell soil color 5YR 2.5/2 grading to 7.5YR 2.5/3 (anon, 1994). A soil with a chroma value (last number) of /0 to /2 is potentially hydric (positive wetland soil indicator). Somewhat deeper, the soil profile shows yellowish-red mottling (5YR 4/6) of increasing prominence, blending into a layer predominantly this yellowish-red color. Soil charts (Sato et al., 1973) show

this area to be pāhoehoe lava flow, although clearly the depression is a local variant, possibly where sediment has been collecting since the road was first built across an existing depression.

This area exhibits some wetland characteristics, specifically positive vegetation and hydrology indicators, and a possible soil indicator requiring more in-depth study. As noted in **Section 3.7.1: Surface and Groundwater** above, the unnamed intermittent stream system with which this potential wetland is associated is not expected to be classified as a Water of the US. This would result in this depression not being classified as a jurisdictional wetland under the regulatory oversight of the US Army Corps of Engineers, even if it otherwise meets the federal definition (USACE, 1987) of a wetland.

A review of National Wetlands Inventory maps (USFWS, 2009b) show no wetlands in the project area. While non-jurisdiction removes federal permitting requirements, Executive Order 11990 (Protection of Wetlands) requires that federal projects minimize harm to wetlands over and above any permit issues.

As part of pre-assessment coordination with the Natural Resources Conservation Service (NRCS), NRCS requested consideration of hydric soils within the corridor as they are a potential indicator of wetlands. (Refer to **Appendix B: Pre-Consultation Comments Received**to see the correspondence from NRCS and mapping of the area). The definition of a hydric soil is a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic (low oxygen) conditions in the upper part of the soils profile. NRCS hydric soils mapping indicates that some areas are found in the vicinity of the Pāhoa Bypass towards the southern end of the corridor. No vegetation or hydrology indicative of wetlands was identified by the survey team in this area.

3.7.3 Floodplains and Hydrology

The regional watershed located upstream and tributary to the project consists primarily of forest reserves, Hawaiʻi Volcanoes National Park and several residential subdivisions. The residential developments consist primarily of large-lot residential subdivisions. Only the major roadways within these subdivisions are paved. There are no formal storm drain systems within the subdivision developments.

The lands located downstream of the project are similar to the lands located upstream. Drainage away from the highway is provided primarily by overland flow and/or open streams and ditches.

Recorded flood damage has mainly been caused by surface sheet flows that are likely to occur anywhere when heavy storms strike. Examples of this are found in some of the subdivisions in the area, including Orchidland and Hawaiian Paradise Park; flooding also occurs in certain areas of Pāhoa. Surface drainage patterns in other areas, such as Hawaiian Acres, may be more defined.

The flood hazard areas for the study area and larger Puna district are difficult to delineate due to the lack of defined drainage ways. The Federal Emergency Management Agency (FEMA), which maps floodplains for the purposes of the National Flood Insurance Program, has

designated the entire area of lower Puna that includes the study corridor as Zone X. Zone X has no base flood elevations or depths mapped and actions in Zone X are not regulated by the National Flood Insurance Program.

There are 35 existing drainage crossings of Keaʻau-Pāhoa Road within the project limits. Of these, one is a bridge and one is a box culvert, and the other 33 are pipe culverts. Culverts are generally between 24 and 48 inches in diameter. There are also existing drywells located within the project limits. Each of these culverts has been analyzed for hydraulic capacity in **Appendix L: Culvert Drainage Study**. Where necessary due to increased flow, the post-project capacity of the crossings would be increased through the installation of additional culverts or larger culverts.

Approximately 16 low points have been identified along the highway, based on a review of the topographic mapping or input from citizens and HDOT staff. Several of these locations have ponding of water during heavy rainfall events.

3.8 Geographic Setting and Natural Hazards

The climate of the Puna District varies considerably from the rocky shoreline to the rain forest areas in the upper elevation. Rainfall amounts are generally heavy and most of the district receives over 100 inches per year.

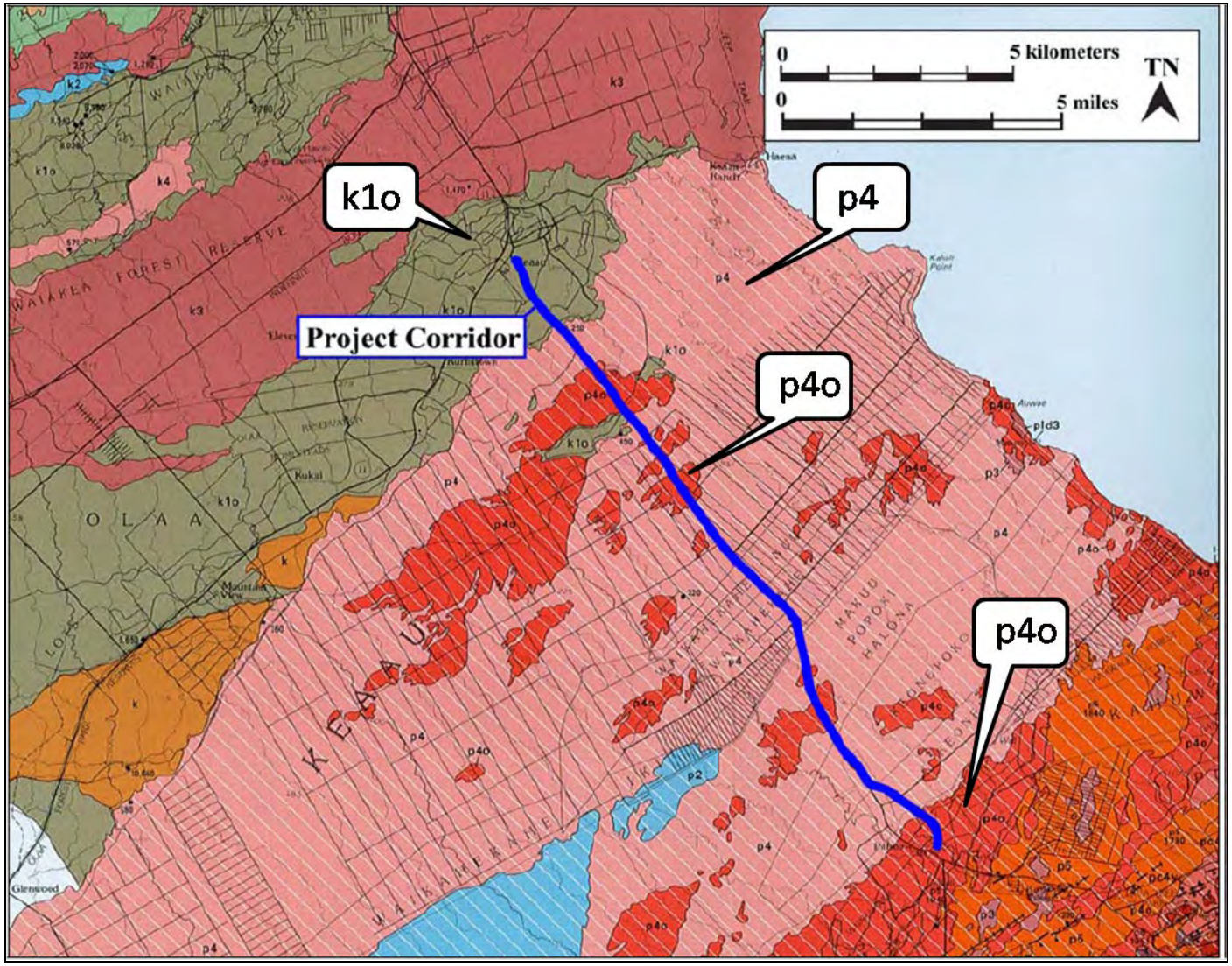
The project corridor varies in elevation from approximately 320 ft above mean sea level (amsl) at the terminus of the Keaʻau Bypass to approximately 675 feet amsl at the intersection with Pāhoa-Kapoho Road. The distance of the project corridor from the coastline ranges between approximately 6.4 km (3.5 miles) and 9.6 km (5.2 miles). The landscape appears generally level, though it does increase in overall elevation by 300 feet over the total 9.5 miles. Occasional rises and dips through which the corridor passes are products of the lava flows that make up this part of the island.

The study area is outside of the tsunami inundation zone. The primary hazards to the study area come from volcanic eruptions (lava flows) and earthquakes. Floods and floodplains are discussed above in **Section 3.7.3: Floodplains and Hydrology**.

3.8.1 Geology

The U. S. Geological Survey documented the geology of Hawaiʻi Island (Wolfe and Morris, 1996). The geology of the greater region has been heavily influenced by lava flows from two active volcanoes in the area, Kīlauea and Mauna Loa. **Figure 3-15: Lava Flows Surrounding Project Corridor** shows the locations of lava flows in the corridor, with flow types described in the text below.

Figure 3-15: Lava Flows Surrounding Project Corridor



Note: Refer to text for definition of flow types. Source: Cultural Surveys Hawai‘i 2010, as adapted from Wolfe and Morris, 1996

The Mauna Loa flow is found near the northern end of the project corridor, coming out of Keaʻau town, and in a couple of small pockets just north of Orchidland Estates and Hawaiian Paradise Park. This flow is classified as "k1o," which is dated at 5,000 to 10,000 years before present (B.P.). The remainder of the project corridor runs through flows from Kīlauea Volcano. These flows are classified as "p4," dated 200 to 750 years B.P. Within this flow, along the corridor, are pockets of "p4o," a more specific type of "p4" flow, which dates from 400 to 750 years B.P. The southern end of the project corridor, at and around Pāhoa town consists entirely of "p4o" flow.

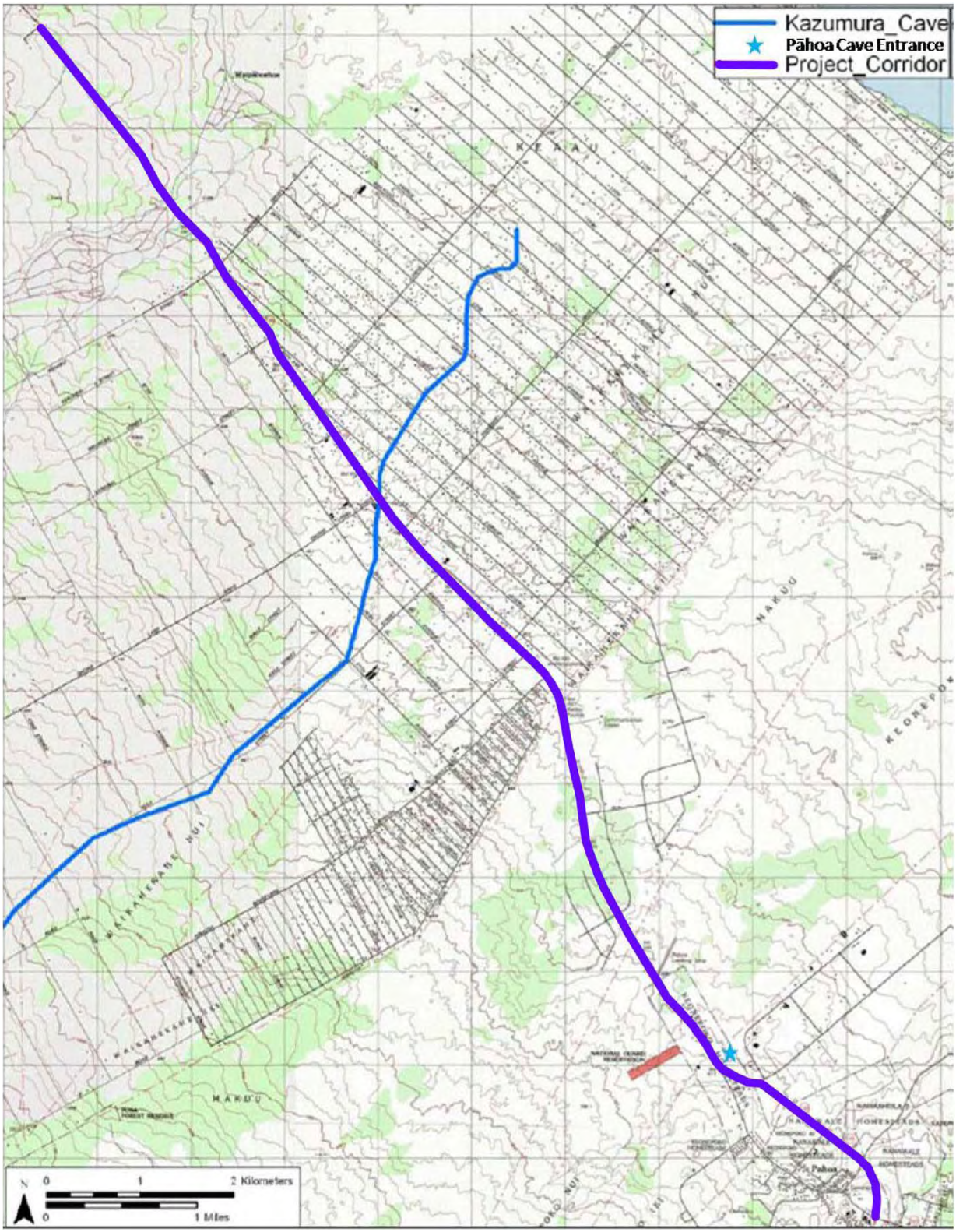
Lava tubes and lava tube caves are a notable geological feature underlying the study area. When pāhoehoe lava flows in a channel, the outside of the flow cools faster and solidifies as it is exposed to air. This insulates the inside of the flow in the channel. When the flow drains away, a lava tube remains. In many cases, the presence of a lava tube is not known unless a cave roof collapses from construction activity or vegetation clearing otherwise results in the discovery of a skylight. The depth of lava tube caves often cannot be determined without detailed surveying. Recent studies (Allred and Allred 1997; Rechtman 2004) have emphasized the possibility of extensive lava tube systems underlying the present study corridor.

At more than 60 km long and 1,101 m deep the Kazumura Cave (lava tube) has been called the longest and deepest lava tube in the world and the deepest cave in the USA (www.showcaves.com/english/usa/caves/Kazumura.html, accessed October, 2009). **Figure 3-16: Location of Kazumura and Pāhoa Lava Tube Caves Relative to Project Corridor** shows the approximate location of where Kazumura Cave crosses (underlies) the area in close proximity to the intersection of Keaʻau-Pāhoa Road with Orchidland Drive. There are no known entrances to the Kazumura Cave in the vicinity of the project corridor. While the actual depth of the Kazumura Cave (or any other cave) underlying the current project area is unknown, profile views shown in the Allred and Allred (1997) study suggest that the upper portion of the lava tube typically lies within ten to twenty meters of the surface.

Pāhoa Cave is another lava tube cave that crosses under the study area between Kahakai Boulevard and the recently-constructed Pāhoa fire station complex. There are two entrances several hundred feet makai of Keaʻau-Pāhoa Road. **Figure 3-16: Location of Kazumura and Pāhoa Lava Tube Caves Relative to Project Corridor** shows the approximate location of these entrances.

There are several soil and land types found along the project corridor. The predominant land type along most of the corridor is classified as Lava flows, pāhoehoe (rLW), a miscellaneous land type (Sato et al. 1973). Pāhoehoe lava has a billowy, glassy surface which can be relatively smooth or rough and broken. Hummocks and pressure domes are common. Bare pāhoehoe lava typically can support mosses and lichens, while in areas with more rainfall ʻōhiʻa trees, ʻōhelo berry, and ʻaʻaliʻi can grow from cracks and crevices. In areas of higher rainfall, this lava contributes to the ground-water supply. (Sato et al. 1973).

Figure 3-16: Location of Kazumura and Pāhoa Lava Tube Caves Relative to Project Corridor



Sources: Cultural Surveys Hawai‘i, 2010, Rechtman 2004b

Small pockets of other soil types are found in the study area, and these tend to be thin soils overlaying pāhoehoe or ʻaʻā lava rock. Soil pockets are found near the Keaʻau Bypass (ʻŌlaʻa silty loams and Hilo silty clay loams) and near Pāhoa town (Keaukaha extremely rocky muck, Panaʻewa very rocky silty clay loam, and ʻŌlaʻa extremely stony silty clay loam) (Sato et al. 1973).

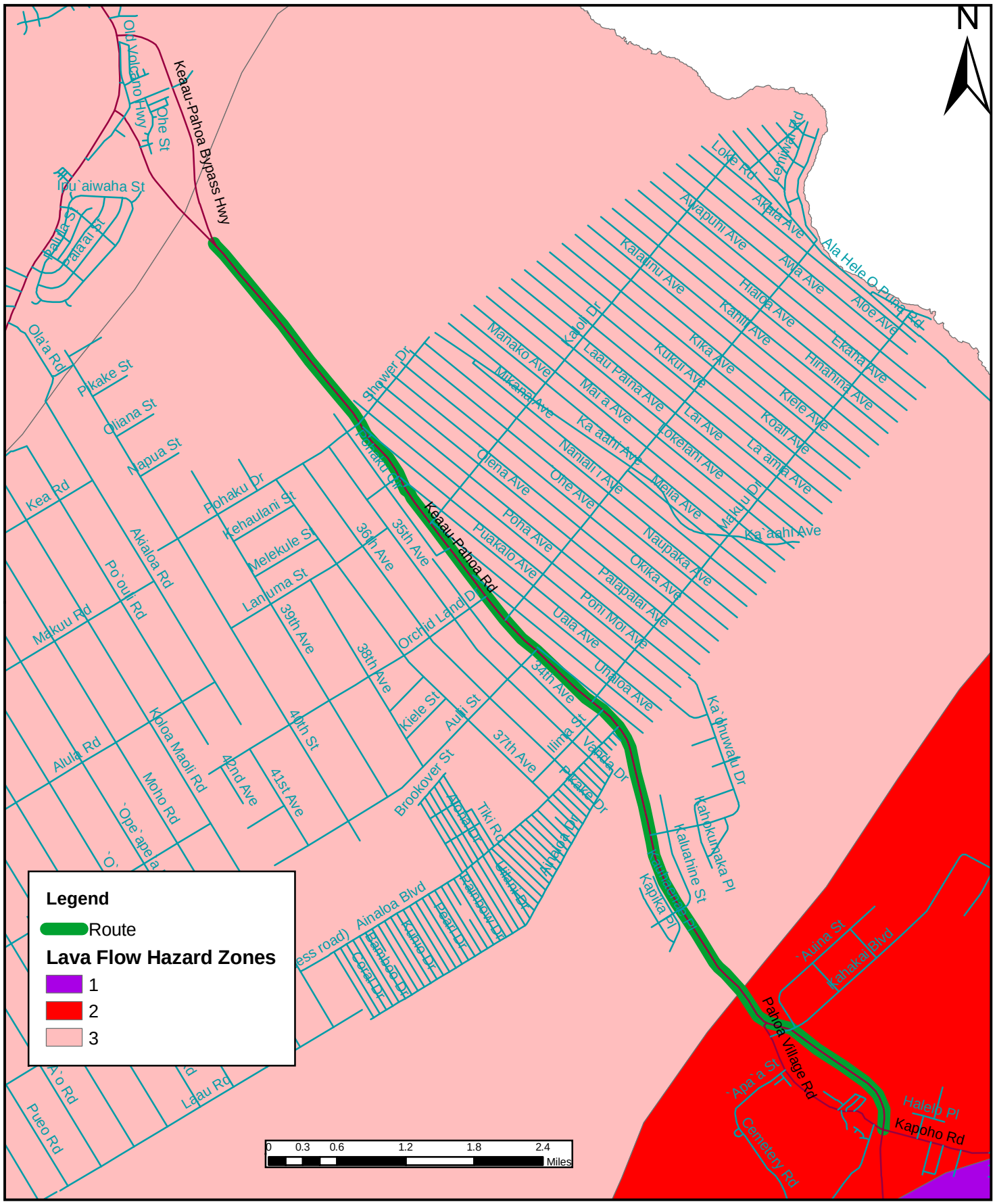
As part of pre-assessment coordination with the Natural Resources Conservation Service (NRCS), NRCS requested consideration of hydric soils within the corridor as they are a potential indicator of wetlands. (Refer to **Appendix B: Pre-Consultation Comments Received** to see the correspondence and mapping of the area from NRCS). The definition of a hydric soil is a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions (low oxygen) in the upper part of the soils profile. NRCS hydric soils mapping indicates that some areas are found in the vicinity of the Pāhoa Bypass towards the southern end of the corridor. No vegetation indicative of wetlands was identified by the survey team in this area.

3.8.2 Lava Flows

The study area is within the path of flows from Kīlauea and Mauna Loa. The Island of Hawaii has been divided into zones by the US Geological Survey (USGS) according to the degree of hazard from lava flows. Hazard zones from lava flows on the Island of Hawaiʻi are based chiefly on the location and frequency of historic and prehistoric eruptions and the topography of the volcanoes. The USGS zones that are ranked from 1 through 9 based on the relative likelihood of coverage by lava flows. Zone 1 is the area of the greatest hazard, Zone 9 of the least. **Figure 3-17: USGS Lava Flow Hazard Zones** illustrates the rankings of lava zones in the study area.

From roughly the Pāhoa Bypass to Pāhoa-Kapoho Road, the area is located within Lava Zone 2. Lava Zone 2 has had between 15 and 25 percent of its area covered by lava since 1800 and between 25 and 75 percent of its area covered by lava in the last 750 years. It is an area adjacent to and downslope of active rift zones.

Between the Keaʻau Bypass and just north of the Pāhoa Bypass, the area is located within Lava Zone 3. Lava Zone 3 has had between one and five percent of its area covered by lava since 1800 and between 15 and 75 percent of its area covered by lava in the last 750 years. It is an area gradationally less hazardous than Zone 2 because of greater distance from recently active vents and/or because the topography makes it less likely that flows will cover these areas.



USGS Lava Flow Hazard Zones

Figure 3-17

Kea'au-Pāhoa Road Improvements, Kea'au to Pāhoa, Project No. STP-0130(27)

State of Hawai'i, Department of Transportation

Source:

USGS

3.8.3 Earthquakes

The study area, as with the rest of Hawaiʻi, is a seismically active region. Most of Hawaiʻi's earthquakes are directly related to volcanic activity caused by magma moving beneath the earth's surface. Other earthquakes less directly related to volcanism originate in zones of structural weakness deep within the earth beneath the island. The volcanic related earthquakes are concentrated primarily beneath the south flanks of Kīlauea and Mauna Loa; however, the effects of a large earthquake beneath Kīlauea or Mauna Loa are not limited to the localized overlying areas and may cause damage over much of the island.

The October 15, 2006 Kiholo Bay Earthquake included two primary quakes (magnitude 6.7 and 6.0) and over 50 aftershocks. Centered roughly 13 miles north of Kailua-Kona, it caused extensive damage in the parts of the island closest to the epicenter. Damage was much more limited in the Puna district with isolated effects on a few older structures that were not up to current building codes

3.9 Cultural Resources

The Keaʻau-Pāhoa Road Improvements project is a federal undertaking requiring compliance with Section 106 of the National Historic Preservation Act (NHPA) (under the Code of Federal Regulations Title 36 CFR Part 800). As an HDOT project within state right-of-way, the project is also subject to Hawaiʻi State environmental and historic preservation review legislation [HawaiʻI Revised Statutes (HRS) Chapter 343 and HRS 6E-8 / Hawaiʻi Administrative Rules (HAR) Chapter 13-275, respectively]. An assessment of potential archaeological, historic, and cultural resources was prepared to support the proposed project's historic preservation review under Hawaiʻi Revised Statutes (HRS) Chapter 6E-48, HAR Chapter 13-275 and relevant Federal acts.

Under Hawaiʻi and Federal historic preservation legislation, archaeological inventory surveys are designed to identify, document, and provide significance and mitigation recommendations for historic properties. Under this legislation, which is similar at both state and federal levels, historic properties are defined as any "building, structure, object, district, area, or site, including heiau [temples] and underwater sites, which is over fifty years old." A project's effect and potential mitigation measures are evaluated based on the project's potential impact to "significant" historic properties (those historic properties determined eligible, based on established significance criteria, for inclusion in the Hawaiʻi Register of Historic Places [Hawaiʻi Register] or the National Register of Historic Places [NHRP]). Determinations of eligibility for the National or Hawaiʻi Registers result when a historic property's "significance assessment" is approved by the State Historic Preservation Division/Department of Land and Natural Resources (SHPD/DLNR), or when SHPD/DLNR itself makes an eligibility determination for an historic property (HAR Chapter 13-284).

Cultural, historical, and archaeological background research and fieldwork was conducted n consideration of the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation and was conducted to identify, document, and make National Register of Historic Places (National Register) and Hawaiʻi Register of Historic Places (Hawaiʻi Register)

eligibility recommendations for the subject parcel's cultural resources. The investigation also fulfills Hawaiʻi State archaeological inventory survey requirements (per HAR Chapter 13-276). The investigation includes an undertaking-specific effect recommendation and treatment/mitigation recommendations for the cultural resources that are eligible for the National/Hawaiʻi Registers. This document is intended to support project-related historic preservation consultation among stake-holding federal and state agencies and interested Native Hawaiian and community groups.

The background research focused on summarizing the project area's pre-contact and post-contact land use, cultural significance, and types and locations of potential historic properties within the project area and its vicinity.

Fieldwork for the archaeological inventory survey was accomplished between July 21, 2009 and July 29, 2009 and required approximately 15 person-days to complete. It consisted of a ground survey of the entire project area to document any historic properties. Limited subsurface testing, possibly with a backhoe, would be performed if subsurface deposits were located, and samples would be tested if appropriate. Supplementary research was also performed as needed. All these efforts were documented in the Archaeological Inventory Survey report, which is found in **Appendix J: Archaeological Inventory Survey.**

The Archaeological Inventory Survey is currently under review by SHPD. FHWA will initiate Section 106 consultation with SHPD (the State Historic Preservation Division) based on their concurrence with this study. Full coordination will take place with the SHPD, and County of Hawaiʻi relating to archaeological matters. This coordination takes place after consent of the owner or representatives has been given.

To be considered eligible for listing on the Hawaiʻi Register and/or National Register, a cultural resource must possess integrity of location, design, setting, materials, workmanship, feeling, and association, and meet one or more of the following broad cultural/historic significance criteria:

A. Associated with events that have made an important contribution to the broad patterns of our history;

B. Associated with the lives of persons important in our past;

C. Embodies the distinctive characteristics of a type, period, or method of construction, represents the work of a master, or possesses high artistic value;

D. Have yielded, or is likely to yield information important for research on prehistory or history; and,

E. (Hawaiʻi Register only) Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property, or due to associations with traditional beliefs, events or oral history accounts - these associations being important to the group's history.

3.9.1 Natural and Historic Context of Area

Section **3.8.1: Geology** discusses the geologic history of the area, and the lava flows that have created the current natural environment in the study corridor. Young lava flows have destroyed pre-contact archaeological features, and have altered the landscape, particularly in the southern portion of the project area.

Native Hawaiian traditions centered on Puna suggest the area's significance and association with the people of ancient times. Mythological literature shows Puna prominently associated with legendary and historical figures including Kāne, Pele, Hi`iaka, Hōpoe, Kūka`ōhi`akalaka, Keamalu, Iwa, Chief Kumukahi, Chief Kali`ikuku, Kalohalani, Halemano, Kamalalawalu, and Kamapua`a. These associations suggest an ancient and continuous occupation of the area, and indicate that there are several wahi pana (places sacred to Hawaiian culture and spirituality) associated with these deities and people at various locations in the Puna district.

Historical accounts associated with Puna show the early history of Hawaiʻi and the ruling chiefs, each ruling one or several ahupuaʻa, entire districts or several districts. These historical accounts date far back into the history of Hawaiʻi Island and relate stories of the great battles between ʻUmi son of Līloa, Pōʻimaiwaʻa, Huaʻa, Kalaniʻōpūʻu, Kiwalaʻo, ʻĪmakakoloa, and Kamehameha I.

Among the first foreigners to see the district of Puna were members of Captains Cook's voyage in 1779. Their early documentation describes the landscape of Puna as well populated, with cultivation between the southwestern sections of Puna and the more eastern areas.

According to 19th-century missionary accounts, the lands of Puna were rich in agriculture field systems and its people were kindly and orderly. The lands of Puna were well cultivated, the vegetation luxuriant, the soil light and fertile, abundant in rain. Puna was a district of beautiful groves of coconuts, breadfruit, pandanus, ʻōhiʻa, and abundant rainfall.

Mid-19th century Land Commission Award documentation shows the lands of Keaʻau Ahupuaʻa were granted to Chief William C. Lunalilo. In 1860 the estate of Lunalilo was mortgaged to Mr. Charles R. Bishop, and then leased to Rufus A. Lyman. Keaʻau was eventually sold to Samuel Damon, William H. Shipman, and J. Elderts in 1882. Shipman later purchased the interest of his other partners to become the sole owner.

According to historical records, and interview testimony, by the 1890s the lands of Puna were used as pasture for grazing cattle. In some areas such as Keaʻau to Ahalanui cattle grazed up to at least 1979. Also in the late 19th century, lands were leased by ʻŌlaʻa Sugar Company to be cleared for the cultivation of sugar cane. The development of the sugar industry in Puna, with cane cultivation stretching from South Hilo to Cape Kumukahi, began a massive landscape alteration, which would obliterate most of the archaeological sites on these lands and any related cultural uses for these properties.

Immigrants from Japan, Puerto Rico, China, and Portugal, and Hawaiians came to work the cane fields living in segregated camps along the old Plantation Road.

The Hilo Railway Company was established and in 1900 extended tracks along the coast to the sugar fields in Kapoho passing through Keaʻau, Kahuwai, Puʻalaʻa, Kauaea, and Kaueleau Ahupuaʻa.

In Puna, as it is elsewhere in Hawaiʻi, agricultural practices are environmentally and ecologically adaptive. Historic accounts support the presence of several cultural modifications and adaptive measures in the Puna district through the use of various environmental zones ideally suited to the cultivation of specific types of agriculture

Research and legendary sources demonstrate that the people of Puna settled primarily in the coastal region, with temporary habitation in the uplands related to agricultural pursuits with the exception of the inland settlement of ʻŌlaʻa. These settlements were located primarily along the Ala Loa (the ancient trail system that circuits the island of Hawaiʻi).

The Ala Loa was eventually improved and renamed in the 1800s and began to be called the "Old Government Road." While this trail (eventually a road) was essentially the main thoroughfare through the Puna district before the late 1800s, as communities on the coastline began to die out, focus began to shift to the center of the Puna District and the developing sugar and related industries near Olaʻa, Hilo, and the volcano region.

As a result of developing industries in the upland regions of Puna, and the presence of remaining communities along the coast, the original mauka-makai trail that led from the coast to the Maku'u region was improved and extended to the recently constructed Volcano Road, effectively linking the Hilo, Volcano, and lower communities of Puna, first by foot, then by horse, cart and buggy, and finally by automobile. (See early Hawaiian government documents)

Trails in Puna and elsewhere served political, economic, social and cultural needs. Remaining trails after the "New Puna Road" (today's Keaʻau-Pāhoa Road) was built are still located in the upland region of Puna (and extending to the coast), however their use declined over time with the installation of the new road, and were adapted later for use by cowboys of the region, who planted mango trees at key points along the path both to mark their crossing with the Keaʻau-Pāhoa corridor, and to provide food and shade as they traveled.

According to interview testimony there are ancient trails that still remain alongside the roadway, many that abut the present day road. Entries to these trails are marked by mango trees that have dotted the landscape since before the 1950s. According to Hawaiian boundary commission reports, these trails were vital links between communities and between agricultural areas mauka and habitation sites in the makai region of Puna as a whole. They remain a part of the cultural legacy of Puna.

While the roadway has evolved over time, as first a trail, then a carriage and cart road, and then overtime, increasingly wider and wider, more developed roadway, it remains a major thoroughfare for communities living along the coast as it once did in the past.

3.9.2 Archaeological Resources

The corridor passes through both developed and undeveloped lands. The undeveloped sections of land exist primarily in two areas: between the Keaʻau Bypass and the northern boundaries of

Hawaiian Paradise Park and Orchidland Estates; and between the southern boundaries of Hawaiian Paradise Park and ʻĀinaloa Estates and Pāhoa town

The archaeological inventory survey involved a pedestrian inspection of the entire project area. The archaeologists conducted sweeps, with personnel spaced five to ten meters apart. All cultural resources encountered were recorded and documented with a written field description, scale drawings, and photographs. Each site was located using a Geographic Positioning System (GPS) device.

The pedestrian survey identified two historic properties within the current project area, discussed in greater detail in **Section 3.9.3: Historic Resources** below.

Based upon previous research, sugarcane cultivation and young lava flows have destroyed pre-contact features. Lava tubes, particularly in the southern portion of the project area, remnants of historic structures related to cattle ranching, the sugarcane industry, and/or railroad infrastructure, were anticipated as potential finds within the project area. However, none of the anticipated potential finds were identified in the course of fieldwork within the project area, likely due to the original construction of Keaʻau-Pāhoa Road and on-going development.

The majority of land within the current project area has been significantly altered during the construction of the current Keaʻau-Pāhoa Road and adjacent roadways, subdivisions, and private residences. The majority of development has occurred at the northern end of the project area in Keaʻau, near the center of the project area between Shower Drive and Makuʻu Drive, and at the southern end of the project area near Pāhoa. Developed areas generally consisted of the existing Keaʻau-Pāhoa Road paved surface, a wide mowed-grass easement, and features related to individual house lots including fences, stone walls, shrubbery, and driveways.

Ground visibility within developed portions of the current project area was generally high. Two sections along the sides of the current Keaʻau-Pāhoa Highway were determined to be generally undeveloped. These areas extended from Opukahaia Street southeast to Pōhaku/Shower Drives and from the Makuʻu Farmer's Market southeast to Pāhoa.

These two undeveloped areas generally consisted of the existing Keaʻau-Pāhoa Road pavement, a narrow mowed berm, and dense vegetation comprised of uluhe fern, guava, strawberry guava, and other exotic grasses and shrubs. Ground visibility within undeveloped portions of the current project area was generally low due to thick, nearly impassable vegetation.

Bulldozer push piles, alignments, and grading were observed near the edges of the existing Keaʻau-Pāhoa Road in several locations throughout the project area. These basalt stone features often mimic pre- and early post-contact archaeological sites. However, the bulldozer modifications within the current project area consisted of angular to subangular basalt boulders and cobbles showing evidence of bulldozer scarring and lacking any formal construction features.

Agricultural terraces found during a previous archaeological inventory survey (Komori 1987) near the current project area were not visible from the survey area due to dense vegetation.

Since the terraces are more than 50 feet west of the survey area no attempt was made to find them.

While no lava tubes were found during the fieldwork, their presence may have been obscured by dense vegetation, particularly in the southern portion of the project area in the vicinity of Pāhoa. Rechtman (2004) found a lava tube that extended mauka/makai beneath Keaʻau-Pāhoa Road. Kazumura Cave crosses (underlies) the project area in close proximity to the intersection with Orchidland Drive. **Figure 3-16: Location of Kazumura and Pāhoa Lava Tube Caves Relative to Project Corridor** showed the general locations of both caves. There is no known entrance to the Kazumura Cave anywhere near the present study area and it may be that the lava tube lies at a substantial depth below the ground surface where it crosses beneath Keaʻau-Pāhoa Road. It is asserted that: "Prehistoric use of the cave by humans was heavy in the downstream nine kilometers nearest the ocean" (Allred and Allred 1997:67) - which would appear to include the vicinity of the portion of the lava tube underlying the present project area.

Based on Hawaiian Government Reports, workers constructing the original Keaʻau-Pāhoa Road could hear machinery echoes coming from the cave beneath the roadway, supposedly from the Kazumura lava tube system.

3.9.3 Historic Resources

A complete pedestrian survey identified one historic property within the Area of Potential Effect (APE) of the project. A second historic property lies just outside the APE, but is discussed below. The definition of the APE is presently being reviewed by the State Historic Preservation Division (SHPD) as part of their review of the Archaeological Inventory Survey. Further discussion of the APE and SHPD concurrence with the APE boundaries will follow with formal initiation of Section 106 consultation by FHWA.

3.9.3.1 1930s-Era Concrete Bridge

An abandoned concrete bridge likely constructed in the 1930s and associated asphalt-paved roadway, SIHP# 50-10-44-26874, is located adjacent and parallel to the southwestern edge of the existing Keaʻau-Pāhoa Road. The SIHP# 50-10-44-26874 bridge is located approximately 630 meters (2,067 feet) northwest of the intersection of Pōhaku/Shower Drives and Keaʻau-Pāhoa Road. The bridge is constructed across an intermittent unnamed stream (also called Waipāhoehoe Stream, see **Section 3.7.1: Surface and Groundwater**) which was dry during the current survey. **Figure 3-18** through **Figure 3-21** show representative views of the bridge and roadway.

Figure 3-18: Abandoned 1930s-Era Concrete Bridge, View to Northeast

Figure 3-19: Abandoned 1930s-Era Concrete Bridge, Close-up View to North

Figure 3-20: View of Existing Keaʻau–Pāhoa Road to Southeast from Abandoned Bridge

Figure 3-21: Asphalt-Paved Roadway at Southeastern End Abandoned Bridge, View to South

This bridge will be demolished as part of the separate Shoulder Lane Conversion project described in **Section 1.2.2.1: The Keaʻau-Pāhoa Road Shoulder Lane Conversion Project**, and therefore the bridge will no longer be present at the time that the project covered in this EA is constructed. A separate Environmental Assessment for the Shoulder Lane Conversion was issued in November, 2009. That EA included an Archaeological Inventory Survey (Haun and Henry, 2008). The finding in that study was that the bridge was significant under Criterion D (have yielded or is likely to yield information important for research on prehistory or history). Their recommendation is that their documentation adequately documents the site and no further work or preservation is recommended.

The bridge measures 28.2 meters (92.5 feet) long by 5.8 meters (19.0 feet) wide with an approximate height of 2.8 m (9.1 feet) from the surface of the dry streambed. The bridge is constructed of four angled concrete supports bearing a solid concrete slab measuring approximately 40 cm (16 inches) thick. The bridge is constructed on solid bedrock with pipe and rail posts inset into both the southwestern and northeastern sides of the bridge. Thick vegetation has obscured the northwest end of the bridge as well as the northwestern extension of the associated asphalt-paved roadway. No date or inscriptions were observed on any surface of the bridge. The associated roadway was observed to extend from the southeastern end of the bridge and continue southeast to become an unnamed paved subdivision road that is currently in use. This subdivision road continues southeast to nearly reconnect with Keaʻau-Pāhoa Road but has been blockaded at its southeastern end.

The bridge and associated roadway likely functioned as an older alignment of the highway. The stretch of former roadway would have extended approximately 487 meters (1,598 feet) connecting to the present Keaʻau-Pāhoa Road at both ends.

A quick review of maps including the 1928 Hawaiʻi Territory map, the 1944 Hawaiʻi Island map and the Tax Map Key Zone map does not show the paved roadway adjacent to Keaʻau-Pāhoa Road. However, TMK 1-6-04, dated "March 1935, Revised January 27, 1959 and August 6, 1964" shows a bypass identified as State PAR. 30A [4.853 Ac.] in the location of SIHP # 50-10-44-26874. A Geographic Information Systems (GIS) review of the portion of Keaʻau-Pāhoa Road containing SIHP # 50-10-44-26874, indicates that the bypass containing the bridge and Keaʻau-Pāhoa Road itself are within the same parcel. The associated asphalt-paved roadway and unnamed paved subdivision road that it becomes is visible on an aerial photograph of the project area. The bridge is not listed in the Historic Bridge Inventory and Evaluation (Alvarez 1987) for the island of Hawaiʻi, nor is it in the State of Hawaii Historic Bridge Inventory and Evaluation (Spencer Mason Architects 1996), but the bridge is constructed in a style that is similar to 1930s concrete slab bridges.

SIHP # 50-10-44-26874 is recommended as significant under Criterion D (in accordance with the significance evaluation of Haun and Henry 2008:18) under the HRHP and the NRHP.

3.9.3.2 Sacred Heart Catholic Church Cemetery

Adjacent to, but outside of the Area of Potential Effect for this project, is a cemetery associated with the Sacred Heart Catholic Church in Pāhoa. **Figure 3-22** to **Figure 3-25** show representative views.

The cemetery abuts the current right-of-way limits, at the intersection of the Pāhoa Bypass and Pāhoa-Kapoho Road (Old Pāhoa Road). The Sacred Heart Catholic Church and its cemetery are components of the Pāhoa Historic and Commercial District, SIHP # 50-10-55-7388 (Department of Transportation 1979:F1). Original documentation describes the church building that was constructed in 1898. Other buildings are briefly described as, "an outhouse and the rectory". The only description of the cemetery is, "A small graveyard is located in the rear" [of the lot] (Department of Transportation 1979:F-3).

A "path of meditation" was noted within 16 meters (52.5 feet) from the edge of the asphalt of the existing Keaʻau-Pāhoa Road at the intersection with Old Pāhoa Road. This path of meditation includes landscaped areas containing basalt stone alignments, basalt pebble pavement, cement and basalt constructions, wooden crosses, and at least one wooden placard inscribed with family names. No burials are believed to be associated with this path of meditation. A miniature replica of Sacred Heart Catholic Church is found on the eastern edge of the church property. The church property improvements and amenities do not extend into the existing or future anticipated highway right-of-way limits but the path of meditation landscaping extends to the edge of the existing highway right-of-way.

3.9.3.3 Roadside Memorials

Six roadside memorials were found within the project area that do not appear to be historic properties but are associated with bereavement.

Figure 3-22: Path of Meditation, Sacred Heart Catholic Church, View to Northwest

Figure 3-23: Placard on Path of Meditation Showing Family Who Helped Construct Path

Figure 3-24: Sacred Heart Catholic Church Path of Meditation, View to South

Figure 3-25: Sacred Heart Path of Meditation and Kea‘au-Pāhoa Road, View to North

3.9.4 Cultural Practices

Hawaiʻi's Act 50 (2000) sought to "promote and protect cultural beliefs, practices, and resources of native Hawaiians and other ethnic groups" and requires the project proposers under Chapter 343 to consider cultural practices in a cultural impact assessment (CIA). To ensure compliance with Act 50, a Cultural Impact Assessment (CIA) study was performed for this project. The full report is found in **Appendix K: Cultural Impact Assessment**. The discussion that follows is greatly summarized from the full assessement.

A background research effort for the CIA produced much of the findings described above in **Section 3.9.1: Natural and Historic Context of Area**. Refer back for more information.

The corridor passes through both developed and undeveloped lands. The undeveloped sections of land exist primarily in two areas: between the Keaʻau Bypass and the northern boundaries of Hawaiian Paradise Park and Orchidland Estates; and between the southern boundaries of Hawaiian Paradise Park and ʻĀinaloa Estates and Pāhoa town.

The currently developed lands along the project corridor are dominated by housing subdivisions, including Hawaiian Paradise Park, Orchidland Estates, ʻĀinaloa Estates, and a few smaller subdivisions. An area of Hawaiian Home Land, called "Parcel A" on TMK [3] 1-5, is located along the corridor within Makuʻu and Hālona Ahupuaʻa, below the southern boundary of Hawaiian Paradise Park. A large outdoor farmers' market is located south of Maku'u Drive. Less than one mile south of the Hawaiian Home Lands along the corridor are churches and a fire station. Some retail and commercial establishments are also located along the project corridor, particularly at Orchidland Drive and within Pāhoa town. The built-up environment includes the existing highway (State Route 130), cross streets, and driveways. Utility poles and roadway barriers and signage are also present along the length of the project corridor. A bridge has been constructed where an intermittent stream encounters the roadway north of Shower Drive. (The name of the stream is unknown although a bridge abutment contains the name "Waipāhoehoe," this is believed not to be Waipāhoehoe Stream. A settlement once located makai of the highway was also named Waipāhoehoe.)

As described above in **Section 3.9.3: Historic Resources**, SIHP # 50-10-44-26874 is an abandoned circa 1935 concrete bridge. The Sacred Heart Catholic Church cemetery, part of the Pāhoa Historic and Commercial District, SIHP # 50-10-55-7388 (DOT 1979:F1), lies just outside the Area of Potential Effect for the project. Six roadside memorials were found within the project area that do not appear to be historic properties but are associated with bereavement.

For this CIA, the project team attempted to contact 91 community members (government agency or community organization representatives, or individuals such as cultural and lineal descendants, and cultural practitioners). Thirty-three people responded, nine people provided telephone comments and 11 kūpuna (elders) and/or kamaʻāina (native born) were interviewed for more in-depth contributions.

The results of cultural consultations indicate that there are concerns regarding potential adverse impacts on social and customary practices within the community that the new expanded road will bring to Puna. It is a general concern that the safety issue will not be

addressed properly with the newly expanded road, and it is a major concern of many respondents that the newly expanded road will bring urban change to Puna's country landscape.

In terms of impacts to cultural and natural resources and associated beliefs and practices as result of the proposed development, most people were not concerned about such impacts, with the exception of the ongoing cultural programs and activities at the Makuʻu Farmers Market Association site. Much of the corridor is not used for cultural purposes, however there is a concern that the removal of trees and shrubbery along the roadway will expose cultural sites just outside of the project area to adverse effects in the future.

All of the community consultants interviewed for this study indicated that the roadside areas are not used for cultural purposes with the exception of the Maku'u Farmers Market area. Many of the respondents were concerned about the loss of more land to more road improvements now and in the future. None of the respondents indicated, with the exception of those who refused to comment, that they are not in support of the roadway expansion. Two respondents advocated for the installation of roundabouts as a traffic calming measure to alleviate safety issues. One group advocated the replanting of native trees along the new roadway to hide sites and trails that may be located just outside of the project area.

Results of this CIA demonstrate that there is no anticipated impact to traditional cultural practices along the corridor, with the exception of the activities that are ongoing at the Makuʻu Farmers Market Association site where ongoing cultural activities still survive into the 21st century.

3.10 Parks and Recreational Resources

FHWA regulates impacts on publicly-owned park and recreational facilities in its Section 4(f) regulations. Refer to **Chapter 5: Section 4(f) Evaluation** for more information. There are no existing publicly-owned recreational facilities in immediate vicinity of the study area corridor.

Section 6(f) of the Land and Water Conservation Fund Act (16 USC 4601-4 et seq.) requires impacts on recreational facilities funded under the Land and Water Conservation Fund (LWCF) to be avoided and fully compensated in-kind if impacts are unavoidable (36 CFR 59). The National Park Service oversees these regulations. There are no properties regulated under Section 6(f) in the immediate vicinity of Keaʻau-Pāhoa Road.

For passive recreation, there are a number of resources in Puna, all located miles from the study corridor. Hawaiʻi Volcanoes National Park is the most prominent resource in the region and 60,000 acres of the 229,176-acre park is in Puna. MacKenzie State Recreation Area is located between Pohoiki and Opihikao, and Lava Tree State Monument lies between Pāhoa and Kapoho/Pohoiki. The County's Isaac Hale Beach Park and the Ahalanui Hot Pond are also located near Pohoiki Bay. The state-owned Kehena Beach Park is further down the coast. The County also developed a park in Hawaiian Beaches near the shoreline. The State has an undeveloped 78.3 acre site along the Puna Coastal Road between Kapoho and the Hawaiian Beaches area that has been suggested in the past for park use.

For active recreation, the Puna district is the fastest growing district within Hawaiʻi County, yet both the 2005 Hawaiʻi County General Plan and Puna Community Development Plan note that the parks within the district are inadequate to serve increasing demand. The County operates community parks within the Hawaiian Beaches subdivision, and outside of the immediate study area in Mountain View and Kurtistown. The Pāhoa Neighborhood Center in the middle of Pāhoa town offers educational, cultural and senior citizens programs, health and welfare programs, and indoor recreational activitites. It also has a 50-meter Olympic-size swimming pool. Tennis courts and ballfields are located in Keaʻau town at the Shipman Gym.

Several of the study area subdivisions were developed with private facilities intended for the use of their residents. The PCDP has recommended additional community parks and improvements to the existing park system. The PCDP's Village Centers concepts would include new parks.

The Hawaiʻi Department of Education offers gymnasiums and outdoor ballfields at school facilities, though school activities take precedence over public use.

The County of Hawaiʻi requested in 2006 a Capital Improvement Project grant for a conceptual Pāhoa recreational complex. The complex would be located beside Keaʻau-Pāhoa Road adjacent to the recently-opened Pāhoa fire station and future Pāhoa police station north of Pāhoa town. The complex was envisioned to include a full gym with amenities, an attached community center, a field that could be used for both football and soccer, baseball fields, comfort stations, pavilions, and parking. This project has not progressed beyond the concept stage because of concerns about a lava tube underlying the property that would constrain the available space. The project has not been programmed by the county as part of any long-term plans, and no conceptual design plans have been produced to date. (Personal Communication, Robert Fitzgerald, County of Hawaiʻi Director of Parks and Recreation, 11/12/09).

3.11 Agricultural Lands

The Puna district has a long history of agriculture. Large-scale agriculture and plantations grew in importance towards the end of the 19th Century. The towns of Keaʻau and Pāhoa were key in the rise of the sugar industry in this region. Lumber was also an important commodity.

The ʻŌlaʻa Sugar Company became one of Hawaiʻi's largest sugar plantations, clearing thousands of acres of land for cane fields and mills, and creating nine main employee villages. In 1930, the plantation population numbered 5,999 persons. Mechanization of harvesting operations began in the late 1940s, and layoffs were necessary. The industry began a slow decline in the late 20th century as other markets and sweeteners hurt the sugar market. The Puna Sugar Company, a later operation, closed in 1984.

A diversified agricultural industry has replaced sugar cultivation in Puna. Today, approximately 97 percent of Hawaii's papaya production occurs in Puna. Puna produces at least 40 different agricultural products, including cut flowers, fruits, vegetables and livestock (PCDP, p. 1-3). 62 percent of Puna's land is zoned Agriculture (2005 Hawaiʻi County General Plan, Table 14-3).

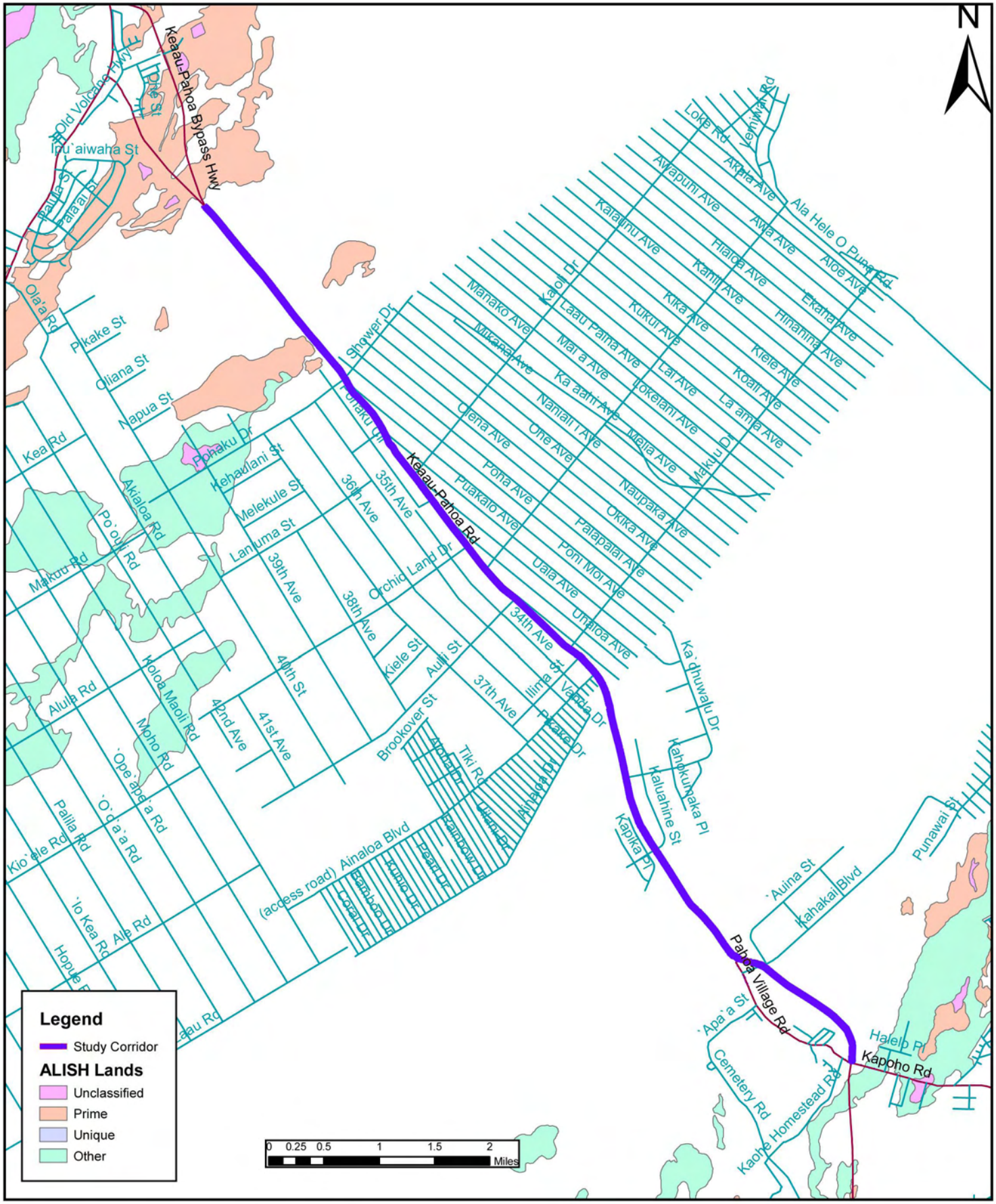
The Hawaiʻi State Department of Agriculture and the Natural Resources Conservation Service (NRCS, formerly the Soil Conservation Service) have established a classification system, Agricultural Lands of Importance to the State of Hawaiʻi (ALISH) in the interest of protecting agriculturally important lands. Three classes of agriculturally important lands were established for the State of Hawaiʻi with the intent of facilitating the NRCS effort to inventory prime farmlands nationally and adapting the classification to the types of agricultural activity in Hawaii. The designation of ALISH lands considers soil types, agricultural capability, and current land use. The objective is to provide decision makers with an awareness of the long-term implications of various land use options for production of food, feed, forage, and fiber crops in Hawaiʻi.

The ALISH classes are:

- Prime Agricultural Land is land best suited for the production of food, feed, forage and fiber crops. The land has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed, including water management, according to modern farming methods.
- Unique Agricultural Land is land other than prime agricultural land and is used for the production of specific high-value food crops. The land has the special combination of soil quality, growing season, temperature, humidity, sunlight, air drainage, elevation, aspect, moisture supply, or other conditions, such as nearness to market, that favor the production of a specific crop of high quality and/or high yield when the land is treated and managed according to modern farming methods. In Hawaiʻi, some examples of such crops are coffee, taro, rice, watercress and non-irrigated pineapple.

  Land that qualifies as prime agricultural land and is used for a specific high-value crop is classified as prime agricultural land rather than as unique agricultural land.
- Other important agricultural land is land other than prime or unique agricultural land that is of state-wide or local importance for the production of food, feed, fiber and forage crops. The lands in this classification are important to agriculture in Hawaiʻi yet they exhibit properties, such as seasonal wetness, erodibility, limited rooting zone, slope, flooding, or droughtiness, that exclude them from the prime or unique agricultural land classifications.

Figure 3-26: Agricultural Lands of Significance to the State of Hawaiʻi (ALISH) shows the ALISH classifications in the study area. As the figure demonstrates, little of the study area borders directly onto important agricultural land. Prime agricultural lands are found on two Shipman-owned parcels mauka of the highway just north of Shower Drive. There are prime agricultural lands found just beyond the northern terminus of the project, and other important agricultural lands found just beyond the southern terminus of the project.



Agricultural Lands of Importance to the State of Hawai'i (ALISH)

Kea'au-Pāhoa Road Improvements, Kea'au to Pāhoa, Project No. STP-0130(27)

State of Hawai'i, Department of Transportation

Figure 3-26

Source:

Hawaii Dept. of Agriculture

There are a number of scattered small agricultural parcels in immediate proximity to Keaʻau-Pāhoa Road, primarily in the Pāhoa area, as well as one large agricultural landowner, W.H. Shipman Limited near Keaʻau. Most agricultural activity is set back a distance from the highway.

The primary large-scale agricultural property owner in the corridor is W.H. Shipman Limited. The company has 17,000 acres in the Puna district devoted to agriculture and commercial/industrial development and leasing, and is headquartered in Keaʻau. Shipman leases over 4,850 acres to independent farmers.

Agricultural properties that border on Keaʻau-Pāhoa Road are listed in **Table 3-30: Parcels With Agricultural Activity Directly Bordering Study Corridor**, and are found both mauka and makai of the highway between the Keaʻau Bypass and Shower Drive. For properties not owned by W.H. Shipman, the table only includes those properties that have agricultural operations in close proximity to Keaʻau-Pāhoa Road that could potentially be affected by the project. The table does not include parcels with fields, greenhouses or shade houses that are set back distant from highway and would not be affected by project.

As the table shows, many of the parcels owned by W.H. Shipman are large pieces of land, all are wooded open space in the immediate proximity of Keaʻau-Pāhoa Road, and the borders just the edge of a portion of the property. None are currently in cultivation near the highway. W.H. Shipman lands on Keaʻau-Pāhoa Road currently under cultivation are only found beyond the northern terminus of the project along the 4-lane Keaʻau Bypass.

There are two gated driveways to the Shipman properties on the mauka side of the highway between Shower Drive and the Keaʻau Bypass, and one gated driveway on the makai side. Access to these parcels is important to ensure their continued use.

Most of the agricultural parcels in the vicinity of Pāhoa are larger shade-house operations. The Sacred Heart Roman Catholic Church in Pāhoa has extensive gardens and a cemetery on the mauka side of the southern terminus of the corridor.

Table 3-30: Parcels With Agricultural Activity Directly Bordering Study Corridor

Tax Map Key (TMK)	Total Acres	Acres ALISH	Current Use Next to Keaʻau-Pāhoa Road	Approximate Location
W.H. Shipman Ltd. Agricultural Properties Between Keaʻau and Shower Drive**				
16001015	989.5	-	Wooded open space	Makai side north of Shower Drive
16003002	38.6	-	Wooded open space	Makai side south of Transfer Station
16004011	1154.1	-	Wooded open space	Mauka side south of Opukahaia Street
16004048	366.3	266.2 Prime*	Wooded open space	Mauka side north of Shower Drive
16004049	0.7	-	Woods, Agricultural access	Mauka side north of Shower Drive
16004050	25.2	-	Woods, Agricultural access	Mauka side south of Transfer Station access
16004055	21.3	-	Wooded open space	Mauka side opposite Transfer Station
16004056	2.1	-	Wooded open space	Mauka side opposite Transfer Station
Other Agricultural Properties near Pāhoa				
15007075	5.6	-	Large shade house immediately next to road	Makai side, approximately 1,400 feet north of new Pāhoa fire station
15116019	15.3	-	Several large shade houses next to road	Mauka side, immediately south of Kahakai Boulevard
15006005	15.4	-	Several large shade houses next to road	Makai side, north of Nanawale Homestead Road
15006026	6.6	-	Agricultural field next to road	Makai side, south of Nanawale Homestead Road
15005001	10.7	-	Abandoned shade houses	Makai side north of Pāhoa-Kapoho Road
15006017	14.5	-	Church property with gardens	Mauka side north of Pāhoa-Kapoho Road

*Parcel contains two separate pieces of Prime Agricultural Farmland, 9.1 acres and 257.1 acres respectively.
**Does not include non-agricultural properties leased to institutions by W. H. Shipman that border Keaʻau-Pāhoa Road, including Keaʻau Transfer Station.
Source: County of Hawaiʻi, Real Property Tax Office, Hawaiʻi Department of Agriculture

3.12 Visual Environment

The corridor ranges in elevation from about 320 feet above sea level at the Keaʻau Bypass to roughly 675 feet above sea level at Pāhoa-Kapoho Road. The ocean generally cannot be seen in the distance from Keaʻau-Pāhoa Road (except just beyond the project limits along the Keaʻau Bypass) and the corridor itself ranges in distance from roughly three to five miles inland. Distant views of both Mauna Loa and Mauna Kea are afforded to Keaʻau-bound traffic when conditions are clear. The Hawaiʻi County General Plan designates the various locations where these two mountains can be viewed along Keaʻau-Pāhoa Road as “Natural Beauty” sites. (2005 Hawaiʻi County General Plan, page 7-4).

Despite the overall change in elevation through the entire length of the corridor, the corridor is generally level, with gentle grades that afford some distant views as they rise and dip over past lava flows. Rainfall levels of approximately 120 to 160 inches per year result in green vegetative growth, despite thin layers of soil. Much of the corridor was at one time in intensive sugar cultivation, and some isolated remnants of that history can be observed.

The project corridor can be viewed from two perspectives, the view from the road, and the view of the road from nearby properties.

3.12.1 View From the Corridor

Viewers travelling along Keaʻau-Pāhoa Road experience a mix of visual elements.

Along the entire length of the corridor, the roadway right-of-way itself is generally disturbed from its original state, with mowed, weedy areas and utility poles flanking the graded sides of the highway. Many residential properties that abut the corridor are fenced/gated, which provide a visual separation from the roadway environment.

Between the end of the Keaʻau Bypass (near Opukahaia Street) and Shower Drive, the property that abuts the highway is generally a degraded native forest punctuated by agricultural open space with some thicker levels of trees and vegetation flanking the sides of the roadway. A single roadway bridge crosses an intermittent stream. Visually, this area is mostly uniform, and vegetated.

From Shower Drive to Ainaloa Boulevard, the corridor is lined with a mixture of primarily open parcels and lower-density residential properties associated with the Hawaiian Paradise Park, Orchidland and Ainaloa subdivisions. Residential properties are mostly landscaped with ornamental plants, and homes are varying distances from the highway, generally set back some distance from the road to reduce disturbance. A commercial area is located on Orchidland Drive mauka of the study corridor. Visually, this area offers a mixture of views of homes and yards and open land that reflects a somewhat rural, but developing area. Views vary greatly depending upon the perspective of the viewer and the individual property viewed. The corridor is fairly straight and affords the viewer some distant views of the road.

Between Ainaloa Boulevard and Old Pāhoa Road, the corridor is more undeveloped and contains a mixture of native forest and agricultural properties, punctuated with occasional residential properties. The forest is generally low-stature ʻōhiʻa trees and uluhe ferns, a representative, uniform vegetation community in this area. Several prominent features in this segment include the Makuʻu Farmer's Market, Department of Hawaiian Homelands properties, a water tank, a potable water filling facility, and the new Pāhoa Fire Station (and future Police Station) site. There are some gentle curves in this segment of the road, so distant views along the road itself are somewhat limited compared to the segments described above, though the overall gentle topography allows some views distant to the sides of the road.

In the area around Old Pāhoa Road, the northern gateway into Pāhoa town is a commercial area landscaped with planted palms and grassy mowed roadside areas. The Pāhoa Village Marketplace shopping center is a commercial focus of the area, and contains bright-colored

storefront buildings surrounding an asphalt parking lot. The future Woodland Center shopping area (under construction) will add to this commercial viewshed.

Between Kahakai Boulevard and Pāhoa-Kapoho Road, the highway bypasses Pāhoa town, a 100-year old community with older storefronts and homes in its urban center. Instead, the highway follows a generally sweeping curve around the community, passing by larger agricultural parcels. Near Pāhoa-Kapoho Road, the viewshed contains several distinctive visual elements, notably some tall albizia trees, the elaborately-landscaped cemetery behind the Sacred Heart Catholic Church, the Pāhoa High School complex, and the southern gateway into Pāhoa town.

3.12.2 View of the Corridor

Within the study area limits, adjoining properties are currently exposed to a typical view of a rural two-lane highway. The highway right-of-way varies in width but generally is between 80 and 100 feet wide. Viewers see a paved roadway. Paved shoulders and graded and mowed areas beyond the shoulders vary in width depending upon the available space and road design. Since the corridor contains generally gentle grades, there are few areas where adjoining properties are far above or below the elevation of the highway.

During peak hour congested conditions, adjoining properties are subjected to views of heavy traffic. Other visual elements of the corridor include roadway elements such as signs, striping, lighting, etc. Utility poles are also part of the visual landscape through virtually the entire corridor.

3.13 Utilities

A number of utilities serve the project area. Coordination with utilities will be ongoing during final alignment and construction.

3.13.1 Electrical Service

Electrical service is provided on the island of Hawaiʻi by the Hawaiʻi Electric Light Company (HELCO), a privately owned utility company regulated by the State Public Utilities Commission.

On Keaʻau-Pāhoa Road, HELCO has one major 69 kV overhead transmission line with 12 kV distribution and communication lines (Hawaiian Telcom and Oceanic Time Warner Cable) along the mauka side of the highway, and a second major 69 kV overhead transmission line with 34.5 kV subtransmission lines along a portion of the makai side of the highway. The wood poles and guy wires abut the existing highway right-of-way lines. There are also street lights attached to the wood poles as well as standard metal street light poles at the various intersections. A number of utility poles will have to be relocated depending on the alternative selected and whether the future cross-section is two lanes, four lanes, or six lanes.

3.13.2 Telecommunications

Hawaiian Telcom presently maintains telephone service facilities near Keaʻau. A switching station located on Milo Street in Keaʻau is currently being expanded to keep pace with existing demand. Hawaiian Telcom lines use the mauka-side poles described in **Section 3.13.1: Electrical Service.**

Sandwich Isles Communications (SIC) is currently in its final design phase for construction of a 9.38-mile fiber-optic line that will extend between Highway 11 in Keaʻau and the Department of Hawaiian Home Lands (DHHL) property down at the Makuʻu Farmers Market. (See **Section 3.1.4: State of Hawaiʻi Department of Hawaiian Homelands** for more information on the planned development that would be served by this fiber optic line.) The line is slated for construction in the third quarter of 2010 and would follow the mauka side of Keaʻau-Pāhoa Road in an underground conduit. The conduit will be located fully within HDOT right-of-way in a utility easement. The line would be located anywhere between three and ten feet below the existing grade. SIC will have a full agreement with HDOT regarding SIC's responsibility for relocating the line if HDOT needs the easement area.

3.13.3 Water Service

Most of the properties within the study area are not served by public water supplies but rather rely on rainwater catchment to serve their needs. The only subdivision fully served by a private water utility is the Hawaiian Beaches area, which has water provided by the Hawaiian Beaches Water Company (Miller and Lieb Water Company). The County Department of Water Supply (DWS) public services in the study area is limited to customers in immediate proximity of water mains (along Keaʻau-Pāhoa Road) and in town centers (Pāhoa and Keaʻau).

Currently, there are four major water public systems in the district: ʻŌlaʻa-Mt. View, Pāhoa, Kapoho and Kalapana. The total average consumption of these systems is 1.2 million gallons per day (mgd).

The Olaa-Mt. View water system consists of eleven service areas and extends along the Volcano Road from the former Puna Sugar Company mill to the ʻŌlaʻa Reservation Lots and along Keaʻau-Pāhoa Road to the vicinity of Kaloli Drive. Water for this system is supplied by three deep wells. Two of the wells are located at the former Puna Sugar Co. mill site and the third is near ʻŌlaʻa, between Keaʻau and Kurtistown. The average consumption of this system is about 0.82 mgd. Olaa Well C, the primary source for this system, has a maximum pump capacity of 2.0 mgd. Olaa Wells A and B have capacities of 1.6 mgd and 0.72 mgd, respectively.

The Pāhoa water system, located in the geographic center of the lower Puna region, extends from Keonepoko Homesteads down along portions of the Kapoho and Pohoiki Roads to Kapoho. The present average consumption is 0.40 mgd.

The Kalapana Water System extends from the Keauohana Forest Reserve along Highway 130 down to the Kaimu Beach intersection and continues in a southwesterly direction along Highway 130, ending in the vicinity of Kaimu. The water for the Kalapana system is supplied by two deep wells at Keauhana with maximum pump capacities of 0.38 mgd and 0.50 mgd.

DWS provides potable water for residents on catchment at filling spigots along Keaʻau-Pāhoa Road. One water-filling station is located between Pāhoa town and Kaluahine Street on the makai side of the highway. This water-filling station also includes facilities for commercial water-haulers, for the transport of bulk water. There is also a potable water spigot located on the mauka side of the highway (on an old highway remnant) just north of Shower Drive, and an additional one located just outside the gate of the Keaʻau Transfer Station. DWS has proposed providing improved facilities at the Keaʻau transfer station to provide enhanced service.

DWS has a 12-inch water line located on the makai side of Keaʻau-Pāhoa Road, generally situated within the existing paved shoulder between Shower Drive and Ka Ohuwalu Drive, a distance of approximately 4.4 miles.

The DWS has a 12-inch water line on the makai side, extending from Kaluahine Street to Old Pāhoa Road, a distance of approximately 1.2 miles.

The DWS also has a 12-inch water line on the mauka side, extending from Kaluahine Street to the existing water tank (approximately 0.4 miles). The mauka-side water line then reduces to a 6-inch pipe between the existing water tank and Old Pāhoa Road, for a distance of approximately 0.8 miles.

DWS also owns and operates approximately 40 fire hydrants located along the project corridor on both sides of the highway.

3.13.4 Wastewater Services

The developed areas bordering the study area are rural properties and large non-conforming subdivisions that have no centralized sanitary sewer service. Most residents in the Puna district are served by individual sewerage systems. The use of cesspools and individual household aerobic treatment units will probably be continued until such time as increased population distribution and densities make it economically feasible to install municipal sewerage systems.

Residences near the coastal areas are much more vulnerable to unsatisfactory results with individual disposal systems because of the relative proximity of the groundwater table to the ground surface. The close proximity of the groundwater table reduces the efficiency of individual disposal systems because there is less filtration that can occur before the effluent reaches the ground water. This reduced efficiency may also affect the quality of nearshore waters due to the reduced filtration.

There are no County of Hawaiʻi public wastewater facilities within the project limits.

3.14 Hazardous Materials

Present and past human activities could conceivably have resulted in subsurface contamination by hazardous materials. The Keaʻau-Pāhoa Road corridor generally contains very few adjacent properties that would have a land use history with a high potential for subsurface contamination. Typically, the highest potential for risk comes from existing or previous industrial properties, electrical substations, gas stations, dry cleaners, and other land uses that

would involve the storage, use, and disposal of hazardous materials. The presence of unknown contamination at an adjacent property could pose safety concerns to construction workers if there has been migration of the contamination to the highway right-of-way where excavation takes place. There could also be liability concerns associated with the purchase of contaminated property for right-of-way needs.

The Hawaiʻi State Department of Health, Office of Hazard Evaluation and Emergency Response (HEER) maintains databases that document releases and "sites of interest", accessible at http://hawaii.gov/health/environmental/hazard/records.html. Currently available data is from April 2008. The federal "Superfund," or Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database is another source of information on properties of concern at the federal level, accessible at http://www.epa.gov/enviro/html/cerclis/cerclis_query.html.

There are various HEER database records for sites in the study area communities. In the immediate proximity of the corridor right-of-way, the Keaʻau transfer station had an incident of used oil being dumped in 1990; this has since been remediated. The air traffic control beacon near the Makuʻu Farmer's Market had a release of gear oil in 1992. Two 55-gallon drums of an unknown liquid were found under a wooden classroom structure at Pāhoa High School in 2000.

There are no CERCLIS database sites in immediate proximity to the study corridor. Sites with historic contamination are in Keaʻau's former sugar plantation operations (8.5. and 9.5 mile camps, and the Puna Sugar Mill on Milo Road) and at Puna Geothermal Venture on Pāhoa-Kapoho Road. None of these sites are on the National Priorities List (highest concern).

The Makuʻu Farm Lots agricultural subdivision (Department of Hawaiian Home Lands) is being remediated by the US Army Corps of Engineers for unexploded ordnance that was left behind from Navy bombing practices on the land during World War II, when it was known as the Popoki Target Area. The areas of highest risk being remediated are a 93-acre bombing target area, and a 15-acre troop maneuver area. Neither area abuts directly onto Keaʻau-Pāhoa Road.

CHAPTER 4: ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1 Land Use

4.1.1 Consistency with Government Plans, Policies and Controls

A number of separate plans and policies influence the current and future land use and transportation goals for the area.

4.1.1.1 County of Hawaiʻi General Plan

The current County of Hawaiʻi General Plan was approved in February 2005. It looks at a range of issues, including the local economy, housing, education, protective services, recreation, transportation and land use. In general, the proposed improvements to Keaʻau-Pāhoa Road are neutral towards or consistent with the goals of the plan in all these areas. Refer to Section **3.1.3.1: County of Hawaiʻi General Plan** for a discussion of the primary issues of relevance.

The General Plan (page 13-8) specifically calls for the state "to widen Highway 130 to four lanes with a median and channelized intersections or modern roundabouts." It does not specify the endpoints within which this widening should take place. Alternatives 3, 4, and 5 are generally consistent with that general course of action, though Alternative 5 would be wider than four lanes between Keaʻau and Paradise Drive, and both Alternatives 3 and 5 contain portions of the corridor that would remain two lanes wide. In more general terms, the plan calls for secondary arterials to have a minimum right-of-way of 80 feet, which will be the case under all build alternatives.

The No-Build and TSM alternatives are not consistent with the General Plan because they would not widen the highway.

Alternatives 3, 4, and 5 are consistent with other facets of the Hawaiʻi County General Plan in the following ways:

- They will be generally supportive of agriculture, the primary economic sector in Puna
- They will not exacerbate flooding (and will possibly improve drainage) across the highway
- They will not block distant vistas of Mauna Loa or Mauna Kea, which are recognized as "Natural Beauty" sites.
- They will be supportive of infrastructure improvements in nonconforming subdivisions.
- They will be generally supportive of public facilities and services (education, protective services, health, etc.) through improved mobility. Emergency services' response times will be improved in the corridor.

- They will mitigate any effects on public utilities to ensure no reduction in service.
- They will improve access to recreational facilities in the corridor and will not cause impacts on recreational facilities.
- They will improve transportation service and address present and future demands.
- They will support shared use by multi-modal uses, including mass transit, bicycle, and pedestrians and provide a bike facility in the shoulder area.
- They will not preclude but rather be complementary of an alternative parallel roadway (PMAR).

4.1.1.2 County of Hawaiʻi Zoning

Most of the study area is zoned Agricultural of varying acreages. Many of the properties in subdivisions that were platted from the 1950s through 1970s are non-conforming with county zoning that was put in place after the subdivisions.

The No-Build Alternative will not require acquisition of any property and therefore will not change any properties or their conformity with zoning.

Under Alternatives 3, 4, and 5, the project's primary effects on property will arise from any right-of-way that needs to be acquired from abutting properties. In general, land acquisition is not likely to create nonconforming properties from currently-conforming ones except in rare cases where existing setbacks are small or properties are at the minimum size for their zoning classification. To a lesser degree, any property acquisition needed for intersection improvements under Alternative 2 (TSM) could result in similar effects.

4.1.1.3 Puna Community Development Plan (PCDP)

The PCDP recognizes that current land use in the Puna District has been strongly influenced by past actions, and that the current trends of spread-out rapid growth and dependency on the Hilo area for services and employment are unsustainable over the long-term. **Section 3.1.3.3: Puna Community Development Plan (PCDP)** outlines in detail the PCDP's plans for future development to be concentrated in a collection of Village and Town Centers. Improvements to Keaʻau-Pāhoa Road will be supportive of the PCDP's vision for Village and Town Centers, especially if access improvements that extend cross streets into adjoining subdivisions (via a four-way intersection) such as those outlined in **Section 2.2.3: Access Management** are pursued in the Preferred Alternative.

The vision for these Village and Town Centers is for them to serve the immediate area in a live-work-play capacity, and reduce the dependency on automobile access to these centers. On the other hand, greater mobility through the lower Puna District from improvements to Keaʻau-Pāhoa Road will increase the viability of these Village and Town Centers' ability to serve the larger community for motorists and users of alternative modes like transit and bicycling.

The Pāhoa Regional Town Center and Orchidland Neighborhood Village Center border on the study corridor as they include existing and future retail areas along Keaʻau-Pāhoa Road.

Improvements to Keaʻau-Pāhoa Road will need to be sensitive to and complementary with these areas' planned roles as Town and Village centers, particularly with encouraging a pedestrian-oriented character and design feel that encourages persons to visit. All other Village/Town center areas proposed are not directly adjacent to Keaʻau-Pāhoa Road, so there will not be any direct impacts on these areas, though they clearly influence (and will be influenced by) traffic access from the study corridor.

The PCDP also looks at transportation issues themselves, and notes the extreme dependency of Lower Puna on Highway 130 between Pāhoa and Keaʻau. The lack of alternative routes, congested conditions, intersections with substandard private streets, poor suitability for transit operations, and dangers for pedestrians and bicyclists are all noted. The PCDP outlines a number of goals, objectives and actions that are needed to improve transportation in the district. Improvements to Keaʻau-Pāhoa Road are generally supportive of or neutral towards most of the goals, which are outlined below.

- The PCDP calls for Travel Demand Management (TDM) measures to reduce single-occupancy vehicle use, encourage telecommuting, reduce commuting outside Puna, and reduce reliance on fossil fuels. While Keaʻau-Pāhoa Road's improvement could offer opportunities for ride-sharing, van-pools, car-pooling, transit, and other alternative modes, it would also reduce congestion and travel times and therefore make single-occupancy vehicle use a more viable choice for travelers than it is today. It would, however, improve accessibility to the services and employment in the Puna Village and Town Centers and potentially encourage Village and Town Center development that keeps employment and services within Puna.
- The PCDP calls for Mass Transportation options to be improved, with a greater percentage of commuters using mass transit. Improvements to Keaʻau-Pāhoa Road will support this goal. Bus pullouts and improved amenities for transit users will greatly improve the safety, comfort, schedule reliability, and viability of transit service in the corridor. Improvements will also enable the County's Mass Transit Agency to provide increased routes and service frequencies, and viable transit hubs. Other forms of transit, such as paratransit and school buses will benefit as well.
- The PCDP calls for an improved roadway network, with emergency and evacuation routes, connectivity between subdivisions, and an alternative, redundant route to Keaʻau-Pāhoa Road (the Puna Makai Alternative Route, or PMAR). In general, the proposed improvements to Keaʻau-Pāhoa Road are complementary towards, or support this goal:
    - An improved Keaʻau-Pāhoa Road will improve the lower Puna District's ability to evacuate persons from areas of natural disaster. Multi-lane facilities under Alternatives 3, 4, and 5 will also permit use of a contra-flow configuration when large numbers of vehicles would need to be evacuated quickly.
    - If they are pursued, access improvements that extend cross streets into adjoining subdivisions (via a four-way intersection) such as those outlined in

Section 2.2.3: Access Management will greatly improve connectivity between subdivisions.

- The project will not preclude the County’s ability to construct an alternative PMAR roadway.

- The PCDP acknowledges that Kea‘au-Pāhoa Road is under state jurisdiction, but calls for specific improvements to Kea‘au-Pāhoa Road that are complementary to the PCDP’s overall goals. The PCDP calls for HDOT to integrate multi-modal travel, emphasize safety and traffic calming over efficient travel speed, and incorporate aesthetic features that are compatible with Puna’s character into the road design. It also calls for other improvements that are outside the purview of this study, such as the Shoulder Lane Conversion Project and other interim improvements described in greater detail in **Section 1.2.2: Interim Improvements**.

  Some, but not all, of the specific improvements to Kea‘au-Pāhoa Road that are called for in the PCDP are supported by this project. The PCDP calls for:

  - A reduction in speed limit to 45 mph between the Kea‘au Bypass and Ainaloa Boulevard. The traffic study has considered a proposed posted speed limit under the Alternatives as follows:

    - Alternative 2, the TSM Alternative, will be 45 miles per hour throughout the entire two-lane corridor (south of Shower Drive).
    - Alternative 3 will be 55 miles per hour in the four-lane segment between the Kea‘au Bypass Ainaloa Boulevard and 45 miles per hour for the two-lane segment between Ainaloa Boulevard and Pāhoa-Kapoho Road.
    - Alternative 4 will be 55 miles per hour over its entire four-lane length.
    - Alternative 5 will be 55 miles per hour in the six-lane and four-lane segments between the Kea‘au Bypass and Kahakai Boulevard and 45 miles per hour through the two-lane segment between Kahakai Boulevard and Pāhoa-Kapoho Road.

    Therefore, with the exception of the TSM Alternative, none of the alternatives will reduce the speed between Kea‘au and Ainaloa Boulevard as called for in the PCDP. Refer to **Appendix C: Traffic Study** for more information on the justification for speeds that were selected for the corridor.

  - A study to create greater highway safety for all travel modes, including cost-benefit of improvements, consideration of a wide range of traffic calming features, use of frontage roads, and intersection controls. Safety and the anticipated reduction of accidents have been analyzed as part of this EA, specifically in the safety section of **Appendix C: Traffic Study**.

  - Increased capacity on Keaʻau-Pāhoa Road between the Keaʻau Bypass and Ainaloa Boulevard. This is clearly supported by Alternatives 3, 4, and 5 and to a lesser degree by TSM Alternative 2.
  - A right-hand turn lane from Pāhoa-Kapoho Road (Highway 132) onto Highway 130. This improvement is supported by Alternatives 2, 3, 4, and 5.

- The PCDP calls for improvements to non-motorized travel and for scenic byways, given the limited bicycle and pedestrian facilities in place today. It specifically notes the lack of safe pedestrian crossings on Keaʻau-Pāhoa Road. The proposed improvements to Keaʻau-Pāhoa Road under Alternatives 3, 4, and 5, and to a lesser degree, Alternative 2 (TSM), are supportive of these goals and will greatly improve safety for pedestrians and bicyclists. All Build Alternatives will include crosswalks at critical intersections, and signals or roundabouts at high-volume intersections will greatly improve safety for both pedestrians and bicyclists crossing both Keaʻau-Pāhoa Road and cross-streets. Depending on the cross-section of the roadway, the accommodations for pedestrians and bicyclists along Keaʻau-Pāhoa Road will include pedestrian areas and/or shoulder/bikeway areas (ranging from eight to ten feet in width). Landscape improvements along Keaʻau-Pāhoa Road will also improve the experience for all users.

4.1.1.4 Puna Regional Circulation Plan (PRCP)

The Puna Regional Circulation Plan (PRCP), issued in November 2005, reflected many of the values expressed later in the 2008 PCDP, including the Village Centers concept. The PRCP was intended to address five key problems that affect transportation and the quality of life. These problems included the lack of emergency bypass routes, the Puna District's relatively high motor vehicle fatality rate, the region's rapid growth, the lack of provisions for equal access to transportation, and the auto-dependency created by existing land use patterns.

To address these problems, the PRCP includes specific proposals for:

- Bus transit expansion, addressing schedules, headways, and fleet providing more equity in transportation service for elderly, children, low income. All the Build Alternatives are consistent with this goal. They will facilitate improvements in bus service by the County's Mass Transit Agency. Bus pull-outs will enable buses to more safely transition into and out of traffic. Safer designs near bus stops, including crosswalks and signalization at busy intersections, will make conditions safer for passengers. Bus service will be much more reliable when congestion is reduced and schedules are more consistent day to day.
- Bike and pedestrian facilities, and specifically improvements called for in Bike Plan Hawaiʻi (see **Section 4.1.1.8: Bike Plan Hawaiʻi** below.) The Build Alternatives are consistent with this improvement.
- Improved connectivity between subdivisions. The Keaʻau-Pāhoa Road project is supportive of this concept, and if they are included in the Preferred Alternative, the access management concepts proposed in **Section 2.2.3: Access Management** will

improve direct travel between subdivisions by creating new accesses into and out of the subdivisions that line up on both sides of Keaʻau-Pāhoa Road.

- An alternate route (PMAR) parallel to Highway 130. In general, the proposed improvements to Keaʻau-Pāhoa Road are neutral towards this goal. The project will not preclude the County's ability to construct an alternative PMAR roadway. Once a PMAR route is determined, connections to Highway 130 can be made.
- Widening of Highway 130 from two to four lanes from Keaʻau to Pāhoa and Highway 11 from two to four lanes from Keaʻau to Kurtistown. The PRCP also calls for study of various intersections along Keaʻau-Pāhoa Road. Alternatives 4 and 5 are fully consistent with these goals, whereas Alternative 3, which would only extend 4 lanes as far as Ainaloa Boulevard is partially consistent with this goal.

4.1.1.5 State of Hawaiʻi Statewide Transportation Plan

The Hawaiʻi Statewide Transportation Plan was last updated in September, 2002 and is currently being revised. The 2002 plan had a horizon to 2025. The overall mission was to provide for the safe, economic, efficient and convenient movement of people and goods, specifically through an integrated multi-modal transportation system that provides mobility and accessibility for people and goods. Capacity is to be increased to address current needs and anticipated growth. Multi-modal transportation choices (transit, bicycling, walking) are encouraged. The Build Alternatives are consistent with all these elements, as capacity will be increased, while transit, bicycling, and pedestrian activity will be enhanced.

4.1.1.6 Hawaiʻi Long-Range Land Transportation Plan (HLRLTP)

The Hawaiʻi Long-Range Land Transportation Plan (HLRLTP), completed in May 1998, was a cooperative effort between HDOT and the County of Hawaiʻi. The HLRLTP identified the transportation improvements needed to support growth of the Big Island until 2020. It noted the potential for very extensive development in the Puna region due to availability of approximately 56,000 residential lots. Based on the resulting 2020 traffic forecast, the HLRLTP recommended the need to increase the capacity of Keaʻau-Pāhoa Road by widening from two to four lanes along two segments: between the Keaʻau Bypass and Paradise Drive, and between Paradise Drive and the Pāhoa Bypass. While this plan is dated now and has not been revised, Alternatives 4 and 5 are totally consistent with the plan's identified needs for the area. Alternative 3 would provide a wider cross-section only as far as Ainaloa Boulevard.

4.1.1.7 State of Hawaiʻi Statewide Transportation Improvement Program (STIP)

The Hawaiʻi Statewide Transportation Improvement Program (STIP) provides a multi-year listing of HDOT and County projects and identifies those projects slated for federal funding. It recognizes the projects that HDOT and FHWA have in the pipeline for priority funding. This Keaʻau-Pāhoa Road improvements project is listed in the STIP for design in Fiscal Year 2010 and construction is tentatively scheduled for Fiscal Year 2013.

4.1.1.8 Bike Plan Hawaiʻi

Last updated in 2003, Bike Plan Hawaiʻi is the most recent bicycle plan covering the neighbor islands. It calls for a range of improvements statewide to provide an improved bicycle network for safe travel. Improvements include shared signed bike routes (bikes use shoulder areas on existing roads), bike lanes (dedicated striped bike lanes specifically for bicycles), and multi-use paths, which are separate from roadways. In the study area, the Plan calls for:

- A shared signed bike route along Keaʻau-Pāhoa Road between Shower Drive and the Keaʻau Bypass. (Route 32 in the plan). Alternatives 3, 4, and 5 are consistent with this goal. Along Keaʻau-Pāhoa Road, they will provide bicyclists and pedestrians with an eight-foot shoulder for this purpose in the Route 32 segment. The project will actually provide such amenities for bicyclists and pedestrians and greatly improve conditions along the entire length of the corridor between the Keaʻau Bypas and Pāhoa-Kapoho Road.
- A shared signed bike route running from Shower Drive, across Keaʻau-Pāhoa Road, then along Pōhaku Drive, ʻŌlaʻa, and 40th Avenue to connect with Volcano Highway. (Route 33 in the plan). Route 33 would provide a connection between Hawaiian Paradise Park, Orchidland Estates, Hawaiian Acres, and Kurtistown. Signalization and geometric improvement of the Shower Drive/Pōhaku Drive intersection will take place as part of the Shoulder Improvements project (see **Section 1.2.2.1: The Keaʻau-Pāhoa Road Shoulder Lane Conversion Project**). Improvements and signalization will greatly improve safety for bicyclists wishing to cross Keaʻau-Pāhoa Road as part of Route 33. Therefore, all Alternatives are supportive of a bike route on Route 33.

4.1.1.9 Hawaiian Paradise Park Master Plan

The Hawaiian Paradise Park subdivision released a draft Master Plan in September, 2005. The primary element of relevance to the Keaʻau-Pāhoa Road Project states: "If Route 130 or any other highway or roadway that abuts HPP is constructed or improved, the governmental entity under whose jurisdiction the roadway falls shall provide adequate protection against noise pollution, water runoff, and other unforeseen environmental hazards."

This Environmental Assessment is evaluating impacts of the project on adjoining properties and will recommend mitigation as necessary, consistent with the Master Plan.

4.1.1.10 State of Hawaiʻi Department of Hawaiian Homelands

As described in **Section 3.1.4: State of Hawaiʻi Department of Hawaiian Homelands**, the Department of Hawaiian Homelands (DHHL) has prepared a Hawaiʻi Island Plan in 2002 and a regional Plan for its Makuʻu Region properties in 2008. Both note the importance of Keaʻau-Pāhoa Road in serving its Makuʻu properties, and the 2008 plan notes improvements to Keaʻau-Pāhoa Road in the vicinity of the DHHL properties as a priority project. The intersection of the Makuʻu Farmers' Market with Keaʻau-Pāhoa Road was improved with a Pāhoa-bound left turn lane and approach from the market to the highway in 2008-2009. DHHL fully supports

improvements to Keaʻau-Pāhoa Road and Build Alternatives 3, 4, and 5 are fully consistent with DHHL's plans for the area.

4.1.1.11 Hawaiʻi 2050 Sustainability Plan

The current statewide plan, the "Hawaiʻi 2050 Sustainability Plan: Charting a Course for Hawaiʻi's Sustainable Future" was produced in January, 2008 by the Hawaiʻi 2050 Sustainability Task Force. The Plan notes that functioning infrastructure is critical to the state's economic health. The Build Alternatives are generally consistent with this plan, which generally called for improved energy efficiency and options for transportation, especially public transportation. The project will reduce congestion, improve mobility for motorists, pedestrians and bicyclists, and encourage transit use, all consistent with these goals.

4.1.2 Induced Development

Alternatives 2, 3, 4, and 5 will increase the number of traffic signals or roundabouts at intersections in the corridor. The project corridor currently has one intersection that is already signalized, and the Shower Drive/Pōhaku Drive intersection is slated for signalization as part of an interim project that is independent of the proposed project. The Build Alternatives include signalization or roundabouts at seven new intersections. Therefore, the 9.5-mile stretch of road will have nine controlled intersections between Shower Drive and Pāhoa-Kapoho Road.

The presence of these controlled intersections may stimulate interest in developing commercial uses in these locations. If access management concepts discussed in **Section 2.2.3: Access Management** are pursued, these would align intersections so that they lead to village centers.

The stimulation of interest in commercial development is a direct project impact. The project's direct impact on actual commercial development is remote, however. Control of adjacent land uses is outside the scope of this project and not under the jurisdiction of HDOT. Such control is under the purview of land use controls exercised by the County and State. Current land use controls do not permit such developments, and the PCDP clearly disapproves of new commercial development along the project corridor.

4.2 Traffic and Transportation

The following section discusses the impacts of the project alternatives on motorized traffic and other transportation modes in the future. **Appendix C: Traffic Study** provides a much more detailed presentation on the discussion that follows. All alternatives, including the No-Build Alternative, will have an effect on the transportation system.

For the purposes of the traffic analyses, the direction "westbound" means towards Keaʻau and Hilo, and the direction "eastbound" is towards Pāhoa and Kalapana. For cross-streets, "northbound" is heading towards the ocean (makai) and "southbound" is heading inland (mauka). The assessment of future-year traffic assumes that the Puna Makai Alternate Route (PMAR) has not been constructed.

For the traffic analyses, the design year is considered to be the year 2038. A second design year of 2018 was used for analysis of the TSM Alternative, using volumes for the year 2018, to show the short term effects realized by the changes made in the alternative. The AM Peak Hour is defined as the hour between 7:00 AM and 8:00 AM, and the PM Peak Hour is defined as the hour between 4:15 PM and 5:15 PM.

The design speed used in the traffic analyses is 60 mph (posted speed limit of 55 mph) for any segments where the ultimate roadway cross-section will include two or more through lanes in each direction. For segments where the ultimate roadway cross-section has only one through lane in each direction, the design speed is reduced to 50 mph (posted speed limit of 45 mph). The appropriate design speed and posted speed limits for analysis were determined through a detailed process that considered a number of separate factors:

- Safety considerations,
- Standard engineering references such as the American Association of State Highway Transportation Officials' (AASHTO) "Green Book" and the National Cooperative Highway Research Project (NCHRP) Report 504
- Roadway geometrics and the functional classification of the road,
- The likely speeds that the road's capacity could accommodate,
- Existing speeds measured on Keaʻau-Pāhoa Road from travel time measurements,
- The number of traffic-controlled access points (signals, stop signs, roundabouts)
- The number of driveways and other access points along Keaʻau-Pāhoa Road
- The severity of vertical grades and horizontal curves along the facility

4.2.1 Roadway LOS Between Intersections

All alternatives, including the No-Build Alternative, will have an impact on the LOS of the roadway. The traffic analysis that follows has calculated delay and level of service (LOS) along Keaʻau-Pāhoa Road at areas between intersections for existing conditions, and for future conditions under all five alternatives during AM and PM peak hour periods. These are areas, away from intersections, that would be "free-flowing" under ideal conditions. Performance of traffic within the intersections themselves is discussed separately in **Section 4.2.2: Intersection LOS**.

4.2.1.1 No-Build Alternative Roadway LOS Between Intersections

By 2038, the LOS along the corridor is expected to become markedly worse than it is today without improvements. As shown in **Table 4-1: Volumes, Level of Service and Capacity, 2038 No-Build Conditions, Between Intersections,** in the AM peak hour in 2038, heading towards Keaʻau, the corridor will be above its capacity (LOS F) for the entire length between Old Pāhoa Road and Shower Drive in the No-Build Alternative. Furthermore, even in what is considered the "off peak" direction for the AM hour (towards Pāhoa), much of the corridor between Pōhaku Place and Old Pāhoa Road will be near or above capacity (LOS E or LOS F) and operate poorly. Therefore, mobility in the corridor will be greatly limited for a much longer portion of the day, even in what is not today considered "peak conditions" or the "peak direction."

Table 4-1: Volumes, Level of Service and Capacity, 2038 No-Build Conditions, Between Intersections

From	To	AM Peak Hour						PM Peak Hour					
		Volume Ebd	Volume Wbd	Ebd V/C	Wbd V/C	Ebd LOS	Wbd LOS	Volume Ebd	Volume Wbd	Ebd V/C	Wbd V/C	Ebd LOS	Wbd LOS
Opukahaia	Transfer Sta	837	2646	0.25	0.78	B	D	2792	1249	0.82	0.37	**E**	C
Transfer Sta	Shower	857	2614	0.61	0.77	D	D	3137	1235	0.93	0.36	**E**	C
Shower	Pōhaku Pl	900	2001	0.64	1.42	D	**F**	2409	1082	1.71	0.77	**F**	D
Pōhaku Pl	Kaloli Dr.	1144	2156	0.81	1.53	**E**	**F**	2391	1074	1.70	0.76	**F**	D
Kaloli Dr.	Pōhaku Cr.	1211	1841	1.07	1.63	**F**	**F**	1990	980	1.41	0.87	**F**	**E**
Pōhaku Cr.	Orchidland	1295	2093	0.92	1.48	**E**	**F**	2158	971	1.53	0.69	**F**	D
Orchidland	Paradise	1488	2183	1.06	1.55	**F**	**F**	2114	1120	1.50	0.79	**F**	**E**
Paradise	Auli'i	1167	1705	1.03	1.51	**F**	**F**	1944	952	1.72	0.84	**F**	**E**
Auli'i	Maku'u	1287	1705	0.91	1.21	**E**	**F**	1885	1047	1.34	0.74	**F**	D
Maku'u	Ilima	1109	1554	0.79	1.10	D	**F**	1792	891	1.27	0.63	**F**	D
Ilima	Ainaloa	1233	1734	0.87	1.23	**E**	**F**	1792	1052	1.27	0.75	**F**	D
Ainaloa	Ka Ohuwalu	1393	1666	0.99	1.18	**E**	**F**	1678	1118	1.19	0.79	**F**	**E**
Ka Ohuwalu	Kaluahine	1303	1697	1.16	1.50	**F**	**F**	1568	1038	1.39	0.92	**F**	**E**
Kaluahine	Old Pāhoa	1274	1697	0.90	1.20	**E**	**F**	1757	1038	1.25	0.74	**F**	D
Old Pāhoa	Kahakai	687	1190	0.49	0.84	C	**E**	944	774	0.67	0.55	D	C
Kahakai	Nanawale	543	641	0.48	0.57	C	D	486	508	0.43	0.45	C	C
Nanawale	Unnamed	444	601	0.39	0.53	C	C	453	400	0.40	0.35	C	C
Unnamed	Kapoho	459	582	0.41	0.52	C	C	466	366	0.41	0.32	C	C

Note: LOS worse than LOS D are displayed in **bold** text.

Source: SSFM International and Roger Dyar, P.E.

A microscopic modeling effort was performed using the SimTraffic model to look at speeds approaching the intersections. **Table 4-2: 2038 No-Build, Operational Speeds on Approaches to Intersections** indicates that the speeds and delays for both the AM and PM peak hours will vary widely, but will generally be lower than the 45 or 55 mph posted speeds, and in some segments will be extremely low.

For the PM peak hour, the table demonstrates a similar, if even more extreme level of congestion that is anticipated in the PM Peak Hour in 2038, for the No-Build Alternative as the entire corridor heading towards Pāhoa will operate at a LOS F (above capacity) from Old Pāhoa Road back to Kea'au. This congestion will extend towards the Kea'au Bypass and even Highway 11. The off-peak direction (heading towards Kea'au) will experience some segments operating at LOS E, approaching capacity.

Table 4-2: 2038 No-Build, Operational Speeds on Approaches to Intersections

Approaching Cross Street	AM Peak Hour		PM Peak Hour	
	Eastbound Approach Avg. Speed (mph)	Westbound Approach Avg. Speed (mph)	Eastbound Approach Avg. Speed (mph)	Westbound Approach Avg. Speed (mph)
Opukahaia St.	50	41	22	47
Kea'au Transfer Station	41	49	18	53
Shower Drive	38	13*	6*	27
Pōhaku Place	44	45	37	52
Kaloli Drive	38	42	44	40
Pōhaku Circle	40	47	46	53
Orchidland Dr.	23	46	45	51
Paradise Drive	30	46	43	48
Auli'i Street	50	49	48	52
Maku'u Drive	46	34	45	40
Ilima Street	35	44	13	50
Ainaloa Blvd.	41	46	27	47
Ka Ohuwalu	50	47	48	51
Kaluahine St.	48	36	47	51
Old Pāhoa Rd.	46	41	44	7
Kahakai Blvd.	45	42	45	10
Nanawale Homestead	49	50	52	49
Unnamed Road	50	55	52	55
Kapoho Rd.	3*	2*	5*	5*

*Comparatively low speeds at this intersection are indicative of the effect of traffic signals, which are not present at the other intersections.

Source: SSFM International and Roger Dyar, P.E.

The overall conclusion that can be drawn from these analyses is that existing congestion along the roadway corridor will become markedly worse in the future year 2038 under the No-Build Alternative, and speeds and flow will deteriorate. Intersections under the No-Build Alternative, covered below in **Section 4.2.2.1: No-Build Alternative Intersection Operations**, show similar problems.

4.2.1.2 TSM Alternative Roadway LOS Between Intersections

TSM actions include intersection improvements, traffic control device changes, speed limit changes, access management, consolidation of street access points and special treatments for bicycle and pedestrian traffic. In most cases, projects to implement TSM actions can be planned, designed, approved and constructed in much shorter time periods than major roadway widening projects.

The analysis of the TSM Alternative has been performed for both the years 2018 and 2038. During the analysis, it became clear that the TSM Alternative would not be able to meet the traffic capacity needs of the area in 2038. However, because TSM measures could be implemented quickly and would provide some short-term benefit, they have been analyzed for 2018 as well. Therefore the discussions that follow consider the implementation of roundabouts as well as signals in both years.

TSM Alternative Between Intersections in 2018

Table 4-3: Volumes, Level of Service and Capacity, 2018 TSM Alternative 2, Between Intersections analyzes corridor performance based on volumes and roadway capacity for the TSM alternative. The TSM alternative shows little improvement in this analysis since this investigation is looking at free-flowing segments between intersections, whereas most improvements under the TSM alternative take place at intersections, where signals or roundabouts and turn lanes have been added. TSM adds no capacity to the highway in the form of additional travel lanes. Therefore, in the peak directions (westbound in the AM Peak, eastbound in the PM peak), traffic flow would be generally poor, with much of the corridor between Shower Drive and Old Pāhoa Road operating at LOS E or LOS F.

As seen in **Table 4-4: 2018 TSM Alternative, Operational Speeds on Approaches to Intersections**, the TSM Alternative will result in some improvements in speed approaching selected intersections. However, the installation of the roundabouts, which reduce the capacity of the through movement on Kea'au-Pāhoa Road, will slow operations somewhat at a number of other intersection approaches.

Table 4-3: Volumes, Level of Service and Capacity, 2018 TSM Alternative 2, Between Intersections

From	To	AM Peak Hour						PM Peak Hour					
		Volume Ebd	Volume Wbd	Ebd V/C	Wbd V/C	Ebd LOS	Wbd LOS	Volume Ebd	Volume Wbd	Ebd V/C	Wbd V/C	Ebd LOS	Wbd LOS
Opukahaia	Transfer Sta	556	1669	0.39	0.49	C	C	1755	789	0.62	0.23	D	B
Transfer Sta	Shower	531	1659	0.38	0.49	C	C	1991	783	0.71	0.23	D	B
Shower	Pōhaku Pl	571	1205	0.40	0.85	C	**E**	1528	687	1.35	0.49	**F**	C
Pōhaku Pl	Kaloli Dr.	760	1353	0.54	0.96	C	**E**	1515	674	1.34	0.48	**F**	C
Kaloli Dr.	Pōhaku Cr.	738	1192	0.52	0.85	C	**E**	1243	625	1.10	0.44	**F**	C
Pōhaku Cr.	Orchidland	812	1312	0.58	0.93	D	**E**	1346	609	1.19	0.43	**F**	C
Orchidland	Paradise	869	1246	0.62	0.88	D	**E**	1189	651	1.05	0.46	**F**	C
Paradise	Auli'i	746	1097	0.53	0.78	C	D	1252	613	1.11	0.43	**F**	C
Auli'i	Maku'u	871	1133	0.62	0.80	D	**E**	1217	666	1.08	0.47	**F**	C
Maku'u	Ilima	747	1078	0.53	0.76	C	D	1210	667	1.07	0.47	**F**	C
Ilima	Ainaloa	832	1162	0.59	0.82	D	**E**	1220	712	1.08	0.50	**F**	C
Ainaloa	Ka Ohuwalu	933	1115	0.66	0.79	D	**E**	1105	787	0.98	0.56	**E**	C
Ka Ohuwalu	Kaluahine	872	1109	0.62	0.79	D	D	1054	759	0.93	0.54	**E**	C
Kaluahine	Old Pāhoa	853	1137	0.60	0.81	D	**E**	1043	695	0.92	0.49	**E**	C
Old Pāhoa	Kahakai	322	787	0.23	0.56	B	C	632	402	0.56	0.29	C	B
Kahakai	Nanawale	314	399	0.22	0.28	B	B	290	399	0.26	0.28	B	B
Nanawale	Unnamed	264	363	0.19	0.26	B	B	269	237	0.24	0.17	B	B
Unnamed	Kapoho	274	347	0.19	0.25	B	B	278	218	0.25	0.15	B	B

Source: SSFM International and Roger Dyar, P.E

Table 4-4: 2018 TSM Alternative, Operational Speeds on Approaches to Intersections

Approaching Cross Street	AM Peak Hour		PM Peak Hour	
	Eastbound Approach Avg. Speed (mph)	Westbound Approach Avg. Speed (mph)	Eastbound Approach Avg. Speed (mph)	Westbound Approach Avg. Speed (mph)
Opukahaia St.	57	57	53	49
Keaʻau Transfer Station	51	51	44	58
Shower Drive	49	49	5	44
Pōhaku Place	55	55	8	57
Kaloli Drive	9*	9*	4*	30
Pōhaku Circle	39	39	39	47
Orchidland Dr.	15*	15*	15*	16*
Paradise Drive	11	11	13	35
Auli'i Street	42	42	44	58
Makuʻu Drive	9*	9*	5*	9*
Ilima Street	32	32	8	36
Ainaloa Blvd.	19*	19*	6*	7*
Ka Ohuwalu	57	57	57	55
Kaluahine St.	54	54	55	55
Old Pāhoa Rd.	52	52	51	54
Kahakai Blvd.	16*	16*	13*	24*
Nanawale Homestead	46	46	56	53
Unnamed Road	54	54	52	57
Pāhoa-Kapoho Rd.	8*	8*	9*	7*

*Comparatively low speeds approaching this intersection are indicative of the effect of roundabouts or signals.

Source: SSFM International and Roger Dyar, P.E.

TSM Alternative Between Intersections in 2038

Similar to the preceding analysis in 2018, **Table 4-5: Volumes, Level of Service and Capacity, 2038 TSM Alternative 2, Between Intersections** shows that the TSM alternative will not address capacity problems in free-flowing segments between intersections because TSM adds no capacity to the highway in the form of additional travel lanes. By 2038, traffic flow will have deteriorated further, with much of the corridor operating at LOS E or LOS F in both directions in the AM Peak Hour. In the PM Peak hour, the eastbound direction will perform very poorly between Opukahaia Street and Old Pāhoa Road (LOS E and LOS F), and a couple segments in the westbound direction will have a LOS E.

As seen in **Table 4-8: 2038 Alternative 3, Operational Speeds on Approaches to Intersections**, in the AM Peak Hour, the TSM Alternative will result in generally range from 14 to 50 mph eastbound and 7 to 55 mph westbound. The lowest speeds eastbound are seen from approximately Makuʻu Drive to Shower Drive, and there is also an area with low speeds in the vicinity of Old Pāhoa Road and Kahakai Boulevard. In the PM Peak Hour, speeds will range from 6 to 54 mph eastbound and 11 to 56 mph westbound. The lowest speeds eastbound are seen from approximately Makuʻu Drive to Shower Drive and there is also an area with low speeds in the vicinity of Old Pāhoa Road and Kahakai Boulevard.

Overall, the operations and speed profile would not meet with the expectations of the traveling public in the year 2038 with the TSM alternative in place. By 2038, under the TSM Alternative, congestion along the roadway corridor will become markedly worse in the future year 2038, and speeds and flow will deteriorate markedly. Therefore, the TSM Alternative would not fulfill the Purpose and Need of the project from the standpoint of traffic movement in the corridor.

Table 4-5: Volumes, Level of Service and Capacity, 2038 TSM Alternative 2, Between Intersections

From	To	AM Peak Hour						PM Peak Hour					
		Volume Ebd	Volume Wbd	Ebd V/C	Wbd V/C	Ebd LOS	Wbd LOS	Volume Ebd	Volume Wbd	Ebd V/C	Wbd V/C	Ebd LOS	Wbd LOS
Opukahaia	Transfer Sta	882	2646	0.26	0.94	B	**E**	2792	1249	0.82	0.37	**E**	C
Transfer Sta	Shower	837	2614	0.25	0.93	B	**E**	3337	1235	0.98	0.36	**E**	C
Shower	Pōhaku Pl	900	2001	0.64	1.77	D	**F**	2409	1082	1.71	0.77	**F**	D
Pōhaku Pl	Kaloli Dr.	1144	2156	0.81	1.91	**E**	**F**	2391	1074	1.70	0.76	**F**	D
Kaloli Dr.	Pōhaku Cr.	1211	1841	0.86	1.63	**E**	**F**	1990	980	1.41	0.70	**F**	D
Pōhaku Cr.	Orchidland	1295	2093	0.92	1.86	**E**	**F**	2158	971	1.53	0.69	**F**	D
Orchidland	Paradise	1488	2183	1.06	1.94	**F**	**F**	2114	1120	1.50	0.79	**F**	**E**
Paradise	Auli'i	1167	1705	0.83	1.51	**E**	**F**	1944	952	1.38	0.68	**F**	D
Auli'i	Maku'u	1287	1705	0.91	1.51	**E**	**F**	1885	1047	1.34	0.74	**F**	D
Maku'u	Ilima	1109	1554	0.79	1.38	D	**F**	1792	891	1.27	0.63	**F**	D
Ilima	Ainaloa	1233	1734	0.87	1.54	**E**	**F**	1792	1052	1.27	0.75	**F**	D
Ainaloa	Ka Ohuwalu	1393	1666	0.99	1.48	**E**	**F**	1678	1118	1.19	0.79	**F**	**E**
Ka Ohuwalu	Kaluahine	1303	1697	0.92	1.50	**E**	**F**	1568	1038	1.11	0.74	**F**	D
Kaluahine	Old Pāhoa	1274	1697	0.90	1.50	**E**	**F**	1757	1038	1.25	0.74	**F**	D
Old Pāhoa	Kahakai	687	1190	0.49	1.05	C	**F**	944	774	0.67	0.55	D	C
Kahakai	Nanawale	543	641	0.39	0.57	C	D	486	508	0.34	0.36	C	C
Nanawale	Unnamed	444	601	0.31	0.53	C	C	453	400	0.32	0.28	C	B
Unnamed	Kapoho	459	582	0.33	0.52	C	C	466	366	0.33	0.26	C	B

Source: SSFM International and Roger Dyar, P.E

Table 4-6: 2038 TSM Alternative, Operational Speeds on Approaches to Intersections

Approaching Cross Street	AM Peak Hour		PM Peak Hour	
	Eastbound Approach Avg. Speed (mph)	Westbound Approach Avg. Speed (mph)	Eastbound Approach Avg. Speed (mph)	Westbound Approach Avg. Speed (mph)
Opukahaia St.	33	29	27	45
Kea‘au Transfer Station	22	43	21	51
Shower Drive	42	53	6*	39
Pōhaku Place	45	48	38	51
Kaloli Drive	23	10	24	20
Pōhaku Circle	42	19	42	45
Orchidland Dr.	33	13	29	22
Paradise Drive	14	8*	17	36
Auli’i Street	40	17	41	51
Maku’u Drive	20	7*	24	11
Ilima Street	35	36	36	47
Ainaloa Blvd.	25	28	28	40
Ka Ohuwalu	50	39	51	49
Kaluahine St.	48	43	49	50
Old Pāhoa Rd.	46	52	45	53
Kahakai Blvd.	15	15	15	12
Nanawale Homestead	49	50	53	53
Unnamed Road	50	55	54	56
Pāhoa-Kapoho Rd.	7*	2**	11*	6*

*Comparatively low speeds approaching this intersection are indicative of the effect of roundabouts or traffic signals.

** In addition to the low speeds noted above, this leg of the intersection is at the terminus of the project, and therefore approach speeds only reflect the immediate area at the intersection.

Source: SSFM International and Roger Dyar, P.E.

4.2.1.3 Alternative 3 Roadway LOS Between Intersections

Alternative 3 will provide needed improvement in traffic operations along Keaʻau-Pāhoa Road.

Table 4-7: Volumes, Level of Service and Capacity, 2038, Alternative 3, Between Intersections shows one analysis of the corridor with Alternative 3 in place looking at approach volumes and roadway capacity. In 2038 under Alternative 3, there would still be some congestion problems in the AM Peak Hour from Kahakai Boulevard to Ainaloa Boulevard for travel in both directions on Keaʻau-Pāhoa Road. For the PM Peak hour, there would be poor operations with the segments from Ainaloa Boulevard to Old Pāhoa Road and also for the eastbound direction from Opukahaia Street to Shower Drive.

Speeds in 2038 under Alternative 3 were derived from the SimTraffic microsimulation model. **Table 4-8: 2038 Alternative 3, Operational Speeds on Approaches to Intersections** shows the results. In the AM Peak Hour, the table shows speeds generally varying from 12 to 54 mph in the westbound direction in the AM Peak hour. The lower speeds are at the approaches to the signalized intersections. For the segments without traffic signals, the speeds generally vary from 32 to 54 mph. For the eastbound direction, the speeds generally vary from 24 to 55 mph. For the segments without traffic signals, the speeds generally vary from 43 to 55 mph in the eastbound direction.

The table also shows speeds generally ranging from 17 to 52 mph in the eastbound direction in the PM Peak hour. The lower speeds are at the approaches to the signalized intersections. For the segments without traffic signals, the speeds generally vary from 17 to 52 mph. For the westbound direction, the speeds vary from 14 to 55 mph in the PM Peak hour. For the segments without traffic signals, the speeds vary from 46 to 55 mph in the eastbound direction.

The conclusion that can be drawn from these analyses is that the LOS of the roadway between intersections will be improved compared to the No-Build Alternative, with improved traffic flow and reductions in delay, though there would still be substantial areas of delay along the corridor itself between Old Pāhoa Road and Ainaloa Boulevard. Speeds will be improved at several problem areas that are projected to operate poorly under the No-Build Alternative. Alternative 3 would mostly fulfill the Purpose and Need of the project from the standpoint of traffic movement in the corridor, notwithstanding the delay noted above.

Table 4-7: Volumes, Level of Service and Capacity, 2038, Alternative 3, Between Intersections

From	To	AM Peak Hour						PM Peak Hour					
		Volume Ebd	Volume Wbd	Ebd V/C	Wbd V/C	Ebd LOS	Wbd LOS	Volume Ebd	Volume Wbd	Ebd V/C	Wbd V/C	Ebd LOS	Wbd LOS
Opukahaia	Transfer Sta	872	2646	0.26	0.78	B	D	2782	1249	0.82	0.37	**E**	C
Transfer Sta	Shower	827	2614	0.24	0.77	B	D	3137	1235	0.93	0.36	**E**	C
Shower	Pōhaku Pl	900	2001	0.27	0.59	B	D	2409	1082	0.71	0.32	D	C
Pōhaku Pl	Kaloli Dr.	1144	2156	0.34	0.64	C	D	2391	1074	0.71	0.32	D	C
Kaloli Dr.	Pōhaku Cr.	1211	1841	0.36	0.54	C	C	1990	980	0.59	0.29	D	B
Pōhaku Cr.	Orchidland	1295	2093	0.38	0.62	C	D	2158	971	0.64	0.29	D	B
Orchidland	Paradise	1488	2183	0.44	0.64	C	D	2114	1120	0.62	0.33	D	C
Paradise	Auli'i	1167	1705	0.34	0.50	C	C	1944	952	0.57	0.28	D	B
Auli'i	Maku'u	1287	1705	0.38	0.50	C	C	1885	1047	0.56	0.31	C	C
Maku'u	Ilima	1109	1554	0.33	0.46	C	C	1792	891	0.53	0.26	C	B
Ilima	Ainaloa	1233	1734	0.36	0.51	C	C	1792	1052	0.53	0.31	C	C
Ainaloa	Ka Ohuwalu	1393	1666	0.99	1.18	**E**	**F**	1678	1118	1.19	0.79	**F**	**E**
Ka Ohuwalu	Kaluahine	1303	1697	0.92	1.20	**E**	**F**	1568	1038	1.11	0.74	**F**	D
Kaluahine	Old Pāhoa	1274	1697	0.90	1.20	**E**	**F**	1757	1038	1.25	0.74	**F**	D
Old Pāhoa	Kahakai	687	1190	0.49	0.84	C	**E**	944	774	0.67	0.55	D	C
Kahakai	Nanawale	543	641	0.39	0.45	C	C	486	508	0.34	0.36	C	C
Nanawale	Unnamed	444	601	0.31	0.43	C	C	453	400	0.32	0.28	C	B
Unnamed	Kapoho	459	582	0.33	0.41	C	C	466	366	0.33	0.26	C	B

Source: SSFM International and Roger Dyar, P.E

Table 4-8: 2038 Alternative 3, Operational Speeds on Approaches to Intersections

Approaching Cross Street	AM Peak Hour		PM Peak Hour	
	Eastbound Approach Avg. Speed (mph)	Westbound Approach Avg. Speed (mph)	Eastbound Approach Avg. Speed (mph)	Westbound Approach Avg. Speed (mph)
Opukahaia St.	55	35	46	46
Kea‘au Transfer Station	51	46	40	51
Shower Drive	50	32	31	35
Pōhaku Place	52	49	44	53
Kaloli Drive	38	19	36	31
Pōhaku Circle	50	47	48	54
Orchidland Dr.	45	43	40	51
Paradise Drive	36	28	35	40
Auli’i Street	51	51	50	54
Maku‘u Drive	33	12	30	14
Ilima Street	43	45	38	48
Ainaloa Blvd.	25	38	22	43
Ka Ohuwalu	50	43	30	47
Kaluahine St.	48	32	17	48
Old Pāhoa Rd.	24	12	10	16
Kahakai Blvd.	34	19	36	23
Nanawale Homestead	47	48	52	50
Unnamed Road	49	54	52	55
Pāhoa-Kapoho Rd.	8*	2**	9*	5*

*Comparatively low speeds at this intersection are indicative of the effect of traffic signals.

** In addition to the low speeds noted above, this leg of the intersection is at the terminus of the project, and therefore approach speeds only reflect the immediate area at the intersection.

Source: SSFM International and Roger Dyar, P.E.

4.2.1.4 Alternative 4 Roadway LOS Between Intersections

Alternative 4 will provide substantial improvement in traffic operations along Keaʻau-Pāhoa Road.

Table 4-9: Volumes, Level of Service and Capacity, 2038, Alternative 4, Between Intersections, shows one analysis of the corridor with Alternative 4 in place looking at approach volumes and roadway capacity. In 2038 under Alternative 4, the predicted LOS for the corridor is D or better for all segments in the AM Peak Hour. For the PM Peak hour, the effort predicted LOS D or better for all segments except for the eastbound segments at the intersections approaching the Transfer Station and Shower Drive. This analysis would indicate the potential for some minor congestion issues in the PM Peak hour eastbound in the segments west of Shower Drive. All other segments have LOS D or better in the peak travel direction and C or better in the off-peak travel direction.

The SimTraffic model was used to predict speeds in the corridor under Alternative 4 in 2038. **Table 4-10: 2038 Alternative 4, Operational Speeds on Approaches to Intersections** shows the results. In the AM Peak Hour, speeds are predicted to generally vary from 10 to 53 mph in the westbound direction and 28 to 55 mph in the eastbound direction. The lower predicted speeds are indicated at the intersections with traffic signals and reflect the effect of the signal operations. These speeds might be improved with a coordinated signal system that can reduce the number of stops on Keaʻau-Pāhoa Road. Except for the approaches to the traffic signals, the speeds shown are generally above 45 mph in the westbound direction and slightly higher in the eastbound direction. These predicted speeds indicate a good level of service for the mainline through volumes.

The table also shows speeds generally ranging from 11 to 54 mph in the eastbound direction in the PM Peak hour with the 11 mph value being on the approach to the signal at Pāhoa-Kapoho Road. All the other speeds are typically above 28 mph with the lower speeds at the approaches to the signals. Speeds in the westbound direction are generally higher than those predicted for the eastbound direction for the Peak hour. Again, these speed predictions indicate the need for a coordinated signal system to minimize mainline stops where possible and increase through traffic speeds.

The conclusion that can be drawn from these analyses is that the LOS of the roadway between intersections will be greatly improved from the No-Build Alternative, with improved traffic flow and reductions in delay. Speeds will be improved at several problem areas that are projected to operate poorly under the No-Build Alternative. Alternative 4 would fulfill the Purpose and Need of the project from the standpoint of traffic movement in the corridor.

Table 4-9: Volumes, Level of Service and Capacity, 2038, Alternative 4, Between Intersections

From	To	AM Peak Hour						PM Peak Hour					
		Volume Ebd	Volume Wbd	Ebd V/C	Wbd V/C	Ebd LOS	Wbd LOS	Volume Ebd	Volume Wbd	Ebd V/C	Wbd V/C	Ebd LOS	Wbd LOS
Opukahaia	Transfer Sta	882	2646	0.26	0.78	B	D	2792	1249	0.82	0.37	**E**	C
Transfer Sta	Shower	837	2614	0.25	0.77	B	D	3137	1235	0.93	0.36	**E**	C
Shower	Pōhaku Pl	900	2001	0.27	0.59	B	D	2409	1082	0.71	0.32	D	C
Pōhaku Pl	Kaloli Dr.	1144	2156	0.34	0.64	C	D	2391	1074	0.71	0.32	D	C
Kaloli Dr.	Pōhaku Cr.	1211	1841	0.36	0.54	C	C	1990	980	0.59	0.29	D	B
Pōhaku Cr.	Orchidland	1295	2093	0.38	0.62	C	D	2158	971	0.64	0.29	D	B
Orchidland	Paradise	1488	2183	0.44	0.64	C	D	2114	1120	0.62	0.33	D	C
Paradise	Auli'i	1167	1705	0.34	0.50	C	C	1944	952	0.57	0.28	D	B
Auli'i	Maku'u	1287	1705	0.38	0.50	C	C	1885	1047	0.56	0.31	C	C
Maku'u	Ilima	1109	1554	0.33	0.46	C	C	1792	891	0.53	0.26	C	B
Ilima	Ainaloa	1233	1734	0.36	0.51	C	C	1792	1052	0.53	0.31	C	C
Ainaloa	Ka Ohuwalu	1393	1666	0.41	0.49	C	C	1678	1118	0.49	0.33	C	C
Ka Ohuwalu	Kaluahine	1303	1697	0.38	0.50	C	C	1568	1038	0.46	0.31	C	C
Kaluahine	Old Pāhoa	1274	1697	0.38	0.50	C	C	1757	1038	0.52	0.31	C	C
Old Pāhoa	Kahakai	687	1190	0.20	0.35	B	C	944	774	0.28	0.23	B	B
Kahakai	Nanawale	543	641	0.16	0.19	B	B	486	508	0.14	0.15	B	B
Nanawale	Unnamed	444	601	0.13	0.18	B	B	453	400	0.13	0.12	B	B
Unnamed	Kapoho	459	582	0.14	0.17	B	B	466	366	0.14	0.11	B	B

Source: SSFM International and Roger Dyar, P.E

Table 4-10: 2038 Alternative 4, Operational Speeds on Approaches to Intersections

Approaching Cross Street	AM Peak Hour		PM Peak Hour	
	Eastbound Approach Avg. Speed (mph)	Westbound Approach Avg. Speed (mph)	Eastbound Approach Avg. Speed (mph)	Westbound Approach Avg. Speed (mph)
Opukahaia St.	55	35	45	44
Keaʻau Transfer Station	50	46	39	51
Shower Drive	50	32	31	35
Pōhaku Place	53	49	30	53
Kaloli Drive	39	21	33	30
Pōhaku Circle	52	49	46	54
Orchidland Dr.	47	44	39	51
Paradise Drive	35	30	34	42
Auli'i Street	51	51	50	54
Makuʻu Drive	31	10	29	13
Ilima Street	42	43	38	49
Ainaloa Blvd.	28	34	28	43
Ka Ohuwalu	54	51	52	53
Kaluahine St.	53	51	52	54
Old Pāhoa Rd.	40	16	37	18
Kahakai Blvd.	39	30	44	27
Nanawale Homestead	53	55	54	55
Unnamed Road	54	56	54	56
Pāhoa-Kapoho Rd.	7	2	11	6

Source: SSFM International and Roger Dyar, P.E.

4.2.1.5 Alternative 5 Roadway LOS Between Intersections

Alternative 5 will provide the highest level of improvement in traffic operations along Keaʻau-Pāhoa Road.

Table 4-11: Volumes, Level of Service and Capacity, 2038, Alternative 5, Between Intersections, shows one analysis of the corridor with Alternative 5 in place looking at approach volumes and roadway capacity. In 2038 under Alternative 5, the predicted LOS for the corridor is C or better for all segments in the AM Peak Hour. For the PM Peak hour, the effort predicted LOS C or better for all segments except the segments between Opukahaia Street and Shower Drive and Paradise Drive to Auli'i Drive in the eastbound direction, which would operate at a LOS D, which would generally be considered acceptable operations.

The SimTraffic microsimulation model was used to predict speeds in the corridor under Alternative 5 in 2038. **Table 4-12: 2038 Alternative 5, Operational Speeds on Approaches to Intersections** shows the results. In the AM Peak Hour, speeds are predicted to generally vary from 11 to 53 mph in the westbound direction and 27 to 53 mph in the eastbound direction. Slower predicted speeds are assocated with traffic signals and reflect the effect of the signal operations. For the eastbound direction in the AM Peak hour, the speeds would generally vary from 29 to 53 mph, again with the lower speeds on the approaches to signalized intersections. In segments approaching intersections with no traffic control the speeds generally range from 39 to 53 mph.

The table also shows speeds would generally vary from 27 to 53 mph in the eastbound direction towards Pāhoa in the PM Peak hour. The slower speeds are indicated on the approaches to the signalized intersections as would be expected. For the segments without traffic signals, speeds are predicted by to be above 39 mph. For the westbound direction in the PM Peak hour, the speeds would generally vary from 14 to 55 mph, again with the lower speeds on the approaches to signalized intersections. In segments approaching intersections with no traffic control the speeds range from 47 to 55 mph. This data indicates overall a very good picture of traffic operations in the corridor for the P.M. peak hour with Alternative 5 in place in the year 2038.

The conclusion that can be drawn from these analyses is that the LOS of the roadway between intersections will be markedly improved from the No-Build Alternative, with greatly improved traffic flow and reductions in delay. Alternative 5 would also provide the best traffic operations compared to Alternatives 3 and 4. Speeds will be improved at several problem areas that are projected to operate poorly under the No-Build Alternative. Alternative 5 would fulfill the Purpose and Need of the project from the standpoint of traffic movement in the corridor.

Table 4-11: Volumes, Level of Service and Capacity, 2038, Alternative 5, Between Intersections

From	To	AM Peak Hour						PM Peak Hour					
		Volume Ebd	Volume Wbd	Ebd V/C	Wbd V/C	Ebd LOS	Wbd LOS	Volume Ebd	Volume Wbd	Ebd V/C	Wbd V/C	Ebd LOS	Wbd LOS
Opukahaia	Transfer Sta	882	2646	0.17	0.52	B	C	2792	1249	0.55	0.25	C	B
Transfer Sta	Shower	837	2614	0.16	0.51	B	C	3137	1235	0.62	0.24	D	B
Shower	Pōhaku Pl	900	2001	0.18	0.39	B	C	2409	1082	0.47	0.21	C	B
Pōhaku Pl	Kaloli Dr.	1144	2156	0.23	0.42	B	C	2391	1074	0.47	0.21	C	B
Kaloli Dr.	Pōhaku Cr.	1211	1841	0.24	0.36	B	C	1990	980	0.39	0.19	C	B
Pōhaku Cr.	Orchidland	1295	2093	0.25	0.41	B	C	2158	971	0.42	0.19	C	B
Orchidland	Paradise	1488	2183	0.29	0.43	B	C	2114	1120	0.42	0.22	C	B
Paradise	Auli'i	1167	1705	0.34	0.50	C	C	1944	952	0.57	0.28	D	B
Auli'i	Maku'u	1287	1705	0.38	0.50	C	C	1885	1047	0.56	0.31	C	C
Maku'u	Ilima	1109	1554	0.33	0.46	C	C	1792	891	0.53	0.26	C	B
Ilima	Ainaloa	1233	1734	0.36	0.51	C	C	1792	1052	0.53	0.31	C	C
Ainaloa	Ka Ohuwalu	1393	1666	0.41	0.49	C	C	1678	1118	0.49	0.33	C	C
Ka Ohuwalu	Kaluahine	1303	1697	0.38	0.50	C	C	1568	1038	0.46	0.31	C	C
Kaluahine	Old Pāhoa	1274	1697	0.38	0.50	C	C	1757	1038	0.52	0.31	C	C
Old Pāhoa	Kahakai	687	1190	0.20	0.35	B	C	944	774	0.28	0.23	B	B
Kahakai	Nanawale	543	641	0.39	0.45	C	C	486	508	0.34	0.36	C	C
Nanawale	Unnamed	444	601	0.31	0.43	C	C	453	400	0.32	0.28	C	B
Unnamed	Kapoho	459	582	0.33	0.41	C	C	466	366	0.33	0.26	C	B

Source: SSFM International and Roger Dyar, P.E

Table 4-12: 2038 Alternative 5, Operational Speeds on Approaches to Intersections

Approaching Cross Street	AM Peak Hour		PM Peak Hour	
	Eastbound Approach Avg. Speed (mph)	Westbound Approach Avg. Speed (mph)	Eastbound Approach Avg. Speed (mph)	Westbound Approach Avg. Speed (mph)
Opukahaia St.	56	44	52	49
Keaʻau Transfer Station	53	49	48	53
Shower Drive	50	37	40	35
Pōhaku Place	54	52	47	55
Kaloli Drive	43	32	38	31
Pōhaku Circle	52	52	49	55
Orchidland Dr.	46	47	44	52
Paradise Drive	38	20	39	29
Auli'i Street	54	50	53	54
Makuʻu Drive	32	11	29	14
Ilima Street	43	43	39	47
Ainaloa Blvd.	29	34	27	39
Ka Ohuwalu	53	52	53	54
Kaluahine St.	53	50	52	54
Old Pāhoa Rd.	41	18	37	19
Kahakai Blvd.	32	16	33	24
Nanawale Homestead	48	48	51	49
Unnamed Road	50	53	51	54
Pāhoa-Kapoho Rd.	7	2	10	5

*Comparatively low speeds at this intersection are indicative of the effect of traffic signals, which are not present at the other intersections.

Source: SSFM International and Roger Dyar, P.E.

4.2.2 Intersection LOS

The traffic analysis for intersections has calculated intersection delay and level of service (LOS) for existing conditions, and future conditions under all five alternatives during AM and PM peak hour periods. All alternatives, including the No-Build Alternative, will have an impact on the LOS of the intersections throughout the corridor. The analysis that follows assumes all locations that would receive traffic control are signalized. A separate analysis of roundabouts is provided further below in **Section 4.2.3: Roundabouts**.

A number of tables that follow document either Level of Service or the ratio of volume to capacity (V/C) at all the major intersections in the corridor, based on the computer model Synchro, which uses algorithms based on the 2000 Highway Capacity Manual. The tables list LOS for overall intersections or traffic movements where the computer model calculates LOS. For the traffic movements where the computer models do not calculate LOS, the volume to capacity (V/C) ratios are shown instead. Any traffic operations that are worse than a LOS D or have a higher V/C ratio than 0.85 are shown in **bold** in the tables.

4.2.2.1 No-Build Alternative Intersection Operations

Two tables that follow, **Table 4-13: No-Build LOS and V/C, AM Peak Hour, Year 2038,** Study Corridor Intersections and **Table 4-14: No-Build LOS and V/C, PM Peak Hour , Year** 2038, Study Corridor Intersections, demonstrate the capacity of the intersections along Kea‘au-Pāhoa Road in the No-Build Alternative (which would not include any improvements other than what is programmed to be improved in the near future in the Shoulders Conversion project).

As seen in **Table 4-13: No-Build LOS and V/C, AM Peak Hour, Year 2038,** Study Corridor Intersections, the AM peak hour has LOS E or worse and/or V/C ratios over 0.85 for the westbound direction for the seven mile distance between Kaluahine Drive and Opukahaia Street. The only exception is one approach to Maku‘u Drive, which would operate at an acceptable level of service. Almost all side street approaches between Kaluahine Drive and Opukahaia Street will operate at LOS E or worse for the AM peak hour.

The next table, **Table 4-14: No-Build LOS and V/C, PM Peak Hour , Year** 2038, Study Corridor Intersections, shows that the PM peak hour has even greater congestion problems in the eastbound direction. From Opukahaia Street to Kaluahine Street, the V/C ratios for the eastbound movements are all above 0.85, with all but two being over 1.0. Almost every side street movement has LOS E or worse in the P.M. peak hour. In essence, it will be extremely difficult for cross-street traffic to safely turn onto Kea‘au-Pāhoa Road in a reasonable amount of time.

The No-Build Alternative would not fulfill the purpose and need of the project from the standpoint of intersection operations.

Table 4-13: No-Build LOS and V/C, AM Peak Hour, Year 2038, Study Corridor Intersections

Intersection with Kea‘au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			0.60		B	**0.88**		D		D			
Kea‘au Transfer Station	Stop		**E**	0.58			**0.87**					**F**		**F**
Shower Drive	Signal*	**F**	A	A	A	A	**F**		D			**F**		
Pōhaku Place	Stop			0.61		B	**1.44**		**F**		**F**			
Kaloli Drive	Stop		**F**	0.62			**1.24**					**F**		**F**
Pōhaku Circle	Stop			0.83		B	**1.40**		**F**		**F**			
Orchidland Dr.	Stop			0.76	0.11	C	**1.36**		**F**		**F**			
Paradise Drive	Stop		**F**	0.82			**1.07**	0.08				**F**		**F**
Auli’i Street	Stop			0.77	0.02	B	**1.19**		**F**		**F**			
Maku‘u Drive	Stop		D	0.73			0.73	0.33				**F**		**F**
Ilima Street	Stop			0.75		**3.61**			**F**		**F**			
Ainaloa Blvd.	Stop			0.68	0.18	C	**1.03**		**F**		**F**			
Ka Ohuwalu	Stop		C	**0.93**			**1.15**					**F**		**F**
Kaluahine St.	Stop		A	**0.86**	0.02	B	**1.11**		**F**		**F**	**F**		**F**
Old Pāhoa Rd.	Stop			0.53	0.34	C	0.66		**F**		**F**			
Kahakai Blvd.	Stop		B	0.29			0.35	0.09				**F**		**F**
Nanawale Homestead Rd	Stop		0.69			0.70			**F**			**F**		
Unnamed Road	Stop		0.55			0.63			A			A		
Pāhoa-Kapoho Rd.	Signal	**F**	C	D	C	**E**	**F**	D	C	B		B	**F**	

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
*Installed as part of the Shoulders Conversion Project.
Source: SSFM International and Roger Dyar, P.E.

Table 4-14: No-Build LOS and V/C, PM Peak Hour , Year 2038, Study Corridor Intersections

Intersection with Kea‘au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			**1.22**		**E**	0.41		**F**		**F**			
Kea‘au Transfer Station	Stop		B	**0.90**			0.41					**F**		**F**
Shower Drive	Signal*	**F**	**F**	**F**		D	C		**E**			**F**		
Pōhaku Place	Stop			**1.59**		D	0.70		**F**		**F**			
Kaloli Drive	Stop		**E**	**1.23**			0.65					**F**		**F**
Pōhaku Circle	Stop			**1.32**		C	0.64		**F**		**F**			
Orchidland Dr.	Stop			**1.28**	0.14	**F**	0.62		**F**		**F**			
Paradise Drive	Stop		D	**1.12**			0.55	0.08				**F**		**F**
Auli’i Street	Stop			**1.25**	0.04	C	0.68		**F**		**F**			
Maku‘u Drive	Stop		C	**1.05**			0.55	0.11				**F**		**F**
Ilima Street	Stop			**1.18**		**4.11**			**F**		**F**			
Ainaloa Blvd.	Stop			**0.86**	0.32	**E**	0.61		**F**		**F**			
Ka Ohuwalu	Stop		B	**1.10**			0.75					**F**		**F**
Kaluahine St.	Stop		B	**1.02**	0.01	A	0.69		**E**			**F**		
Old Pāhoa Rd.	Stop			0.60	0.43	**E**	0.36		**F**		**F**			
Kahakai Blvd.	Stop		B	0.34			0.25	0.09				**F**		**F**
Nanawale Homestead Rd	Stop		0.50			0.44			**F**			B		
Unnamed Road	Stop		0.44			0.38			A			C		
Pāhoa-Kapoho Rd.	Signal	C	C	C	B	C	C	C	B	B		B	C	

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
*Installed as part of the Shoulders Conversion Project.
Source: SSFM International and Roger Dyar, P.E.

4.2.2.2 TSM Alternative Intersection Operations

As noted above in **Section 4.2.1.2: TSM Alternative Roadway LOS Between Intersections**, the analysis of the TSM Alternative has been performed for both the years 2018 and 2038. While the TSM Alternative would not meet the traffic capacity needs of the area in 2038, it would provide some short-term benefit, so both years have been considered. The analysis considers roundabouts at six intersections in Year 2018. By 2038, all of the intersections are assumed to have been converted to conventional traffic signals for capacity reasons. All access management measures mentioned in **Section 2.2.3: Access Management** are included.

TSM Alternative at Intersections in 2018

The six intersections that would have roundabouts in 2018 are as follows:

- Kaloli Drive
- Orchidland Drive
- Paradise Drive
- Makuʻu Drive
- Ainaloa Boulevard
- Kahakai Boulevard. (Old Pāhoa Road would have a stop-sign controlled right-in-right-out configuration in conjunction with a roundabout at Kahakai Boulevard.)

As seen in **Table 4-15: TSM Alternative LOS and V/C, AM Peak Hour, Year 2018, Study Corridor Intersections**, during the AM peak hour under the TSM Alternative in 2018, the westbound through movement has LOS E or worse or a V/C ratio above 0.85 for six of the segments and intersections west of Old Pāhoa Road. There are no eastbound segments showing poor LOS. Two cross streets (Ka Ohuwalu Street and Kaluahine Street) would also have poor LOS. Therefore, the TSM alternative would not provide the desired LOS for the westbound direction, as the single through lane would not have adequate capacity. The side street difficulties would relate to the lack of gaps in traffic needed to enter or cross the traffic stream along Keaʻau-Pāhoa Road.

The next table, **Table 4-16: TSM Alternative LOS and V/C, PM Peak Hour, Year 2018, Study Corridor Intersections**, shows that in the PM peak hour under the TSM Alternative in 2018, the eastbound direction between Pōhaku Place and Ainaloa Boulevard has V/C ratios approaching or greater than 0.85. Pōhaku Place, Ka Ohuwalu Street, and Nanawale Homestead Road also operate at LOS E or worse. Again, the single through lane cannot handle the large volumes of through traffic in each direction at the peak hours, and some cross-street traffic cannot enter due to a lack of gaps in traffic.

While the TSM alternative might be acceptable for intersection operations in the year 2018 for most hours of the day, there would still be congestion in the AM and PM Peak hours. The TSM alternative would not meet the objectives of the Purpose and Need statement for this project regarding improving intersections in the corridor.

Table 4-15: TSM Alternative LOS and V/C, AM Peak Hour, Year 2018, Study Corridor Intersections

Intersection with Kea‘au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			0.38		A	0.55		C		C			
Kea‘au Transfer Station	Stop		C	0.37			0.73					C		C
Shower Drive	Signal	A	A	A	A	A	A		C			C		A
Pōhaku Place	Stop			0.39			**0.91**				B			
Kaloli Drive	Roundbt		0.64			**1.16**			0.08			0.09		
Pōhaku Circle	Stop			0.49	0.01		**0.89**				B			
Orchidland Dr.	Roundbt		0.66			**1.17**			0.07			0.10		
Paradise Drive	Roundbt		0.75			**0.93**			0.04			0.08		
Auli’i Street	Stop			0.50	0.01		0.77				B			
Maku‘u Drive	Roundbt		0.82			0.72			0.04			0.19		
Ilima Street	Stop			0.51		A	0.78		C		C			
Ainaloa Blvd.	Roundbt		0.60			**1.04**			0.20					
Ka Ohuwalu	Stop		B	0.62			0.75					**F**		D
Kaluahine St.	Stop		A	0.58	0.01	B	0.70	0.04	**F**			**F**		
Old Pāhoa Rd.	Stop			0.42	0.16		0.53				B			
Kahakai Blvd.	Roundbt		0.35			0.48			0.38			0.35		
Nanawale Homestead Rd	Stop		A	0.20		A	0.24		D			C		C
Unnamed Road	Stop		A	0.18		A	0.23		A		A	A		A
Pāhoa-Kapoho Rd.	Signal	C	C	C	C	B	C	C	B	B	B	C	C	C

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
Source: SSFM International and Roger Dyar, P.E.

Table 4-16: TSM Alternative LOS and V/C, PM Peak Hour, Year 2018, Study Corridor Intersections

Intersection with Kea‘au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			0.79		C	0.26		D		D			
Kea‘au Transfer Station	Stop		A	0.58			0.34					C		C
Shower Drive	Signal	A	A	A	A	A	A		D			D		A
Pōhaku Place	Stop			**1.03**			0.46				**E**			
Kaloli Drive	Roundbt		**1.29**			0.65			0.08			0.05		
Pōhaku Circle	Stop			0.84	0.00		0.41				D			
Orchidland Dr.	Roundbt		**1.14**			0.63			0.07			0.05		
Paradise Drive	Roundbt		**1.00**			0.51			0.03			0.04		
Auli’i Street	Stop			0.84	0.01		0.45					D		
Maku‘u Drive	Roundbt		**1.10**			0.56			0.04			0.14		
Ilima Street	Stop			0.82		A	0.48		C		C			
Ainaloa Blvd.	Roundbt		0.82			0.69			0.11					
Ka Ohuwalu	Stop		A	0.75			0.51					**F**		C
Kaluahine St.	Stop		A	0.70	0.01	A	0.47	0.00	C			D		
Old Pāhoa Rd.	Stop			0.50	0.21		0.36				C			
Kahakai Blvd.	Roundbt		0.53			0.36			0.40			0.21		
Nanawale Homestead Rd	Stop		A	0.20		A	0.16		D			F		F
Unnamed Road	Stop		A	0.18		A	0.15		A			B		
Pāhoa-Kapoho Rd.	Signal	B	B	B	B	B	C	B	A	A	B	B	B	B

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
Source: SSFM International and Roger Dyar, P.E.

TSM Alternative at Intersections in 2038

The six intersections that were studied above with single-lane modern roundabouts in 2018 would not be able to operate at acceptable levels of service in 2038, so the TSM analysis for 2038 assumes they have all been signalized. All access management measures mentioned in **Section 2.2.3: Access Management** are included.

As seen in **Table 4-17: TSM Alternative LOS and V/C, AM Peak Hour, Year 2038, Study Corridor Intersections** for the AM Peak hour, the westbound through movement has LOS E or worse or a V/C ratio above 0.85 for all the segments and intersections west of Old Pāhoa Road with the TSM alternative in place in the westbound direction, both at signalized and unsignalized locations. There are also some eastbound segments showing poor LOS and several side streets with poor LOS. The TSM alternative would not provide the sufficient capacity for the desired LOS for the westbound direction, even with signals in place. The side street difficulties would relate to the difficulty in turning traffic to enter or cross the traffic stream on Keaʻau-Pāhoa Road. In the eastbound direction there are also congestion problems indicated between Ainaloa Boulevard and Kaluahine Street. Overall, the traffic operations in the AM Peak hour would not be acceptable with the TSM alternative in place in 2038.

Table 4-18: TSM Alternative LOS and V/C, PM Peak Hour, Year 2038, Study Corridor Intersections shows analysis of TSM in the PM Peak hour in 2038. For the eastbound direction, the through movements have V/C ratios approaching or over 0.85 from Opukahaia Street to Ilima Street. The signalized intersections at Shower Drive, Kaloli Drive, Orchidland Drive, Paradise Drive, and Makuʻu Drive all show overall LOS of E or F. Numerous side street movements have LOS E or F from Kahakai Boulevard to the west. Traffic operations at intersections in the PM Peak Hour would not be acceptable with the TSM alternative in place in 2038.

In general, by 2038, the TSM Alternative would not meet the project's Purpose and Need in addressing intersection operations, as considerable delays and congestion would remain. Volumes for 2038 are projected to be so large that roundabouts would not be feasible with a single-lane design, except possibly at Kahakai Boulevard.

Table 4-17: TSM Alternative LOS and V/C, AM Peak Hour, Year 2038, Study Corridor Intersections

Intersection with Kea‘au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			0.60		B	**0.88**		D		D			
Kea‘au Transfer Station	Stop		**E**	0.58			**1.14**					**F**		**F**
Shower Drive	Signal	A	A	A	A	A	A		D			D		A
Pōhaku Place	Stop			0.61			**1.44**				C			
Kaloli Drive	Signal	**F**	C	A		A	**F**		**E**			**E**		A
Pōhaku Circle	Stop			0.78	0.03		**1.42**				C			
Orchidland Dr.	Signal	**F**	A	D	A	D	**F**		**F**			**E**		
Paradise Drive	Signal	**F**	B	D		**F**	**F**	A	D			**F**		
Auli’i Street	Stop			0.77	0.01		**1.19**					C		
Maku‘u Drive	Signal	**E**	C	D		B	**F**	B	C			D		C
Ilima Street	Stop			0.75		B	**1.16**		**F**		**F**			
Ainaloa Blvd.	Signal	D		B	A	C	**F**		**F**		**E**			
Ka Ohuwalu	Stop		C	0.93			**1.15**					**F**		**F**
Kaluahine St.	Stop		A	**0.86**	0.02	B	**1.04**		**F**			**F**		
Old Pāhoa Rd.	Stop			0.55	0.31		0.71				C			
Kahakai Blvd.	Signal	C	C	B		B	C	B	**F**			D		B
Nanawale Homestead Rd	Stop		A	0.34		A	0.41		**F**			**F**		
Unnamed Road	Stop		A	0.30		A	0.39		A			A		
Pāhoa-Kapoho Rd.	Signal	C	C	C	C	C	D	C	B	B		C	C	C

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
Source: SSFM International and Roger Dyar, P.E.

Table 4-18: TSM Alternative LOS and V/C, PM Peak Hour, Year 2038, Study Corridor Intersections

Intersection with Kea‘au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			0.82		A	0.48		**F**		**F**			
Kea‘au Transfer Station	Stop		B	**0.92**			0.53					**F**		**F**
Shower Drive	Signal	**E**	A	**F**	A	D	A		D			**E**		A
Pōhaku Place	Stop			**1.63**			0.73				**F**			
Kaloli Drive	Signal	**F**	**F**	**F**		A	C		**E**			**E**		A
Pōhaku Circle	Stop			**1.33**	0.01		0.65				**F**			
Orchidland Dr.	Signal	**F**	C	**F**	A	A	B		**F**			**F**		
Paradise Drive	Signal	**F**	C	**F**		C	B	A	**E**			**F**		
Auli’i Street	Stop			1.28	0.03		0.71				**F**			
Maku‘u Drive	Signal	**E**	C	**F**		A	B	A	**E**			**F**		D
Ilima Street	Stop			0.82		A	0.48		**F**		**F**			
Ainaloa Blvd.	Signal	B		B	A	B	A		D		C			
Ka Ohuwalu	Stop		A	0.75			0.51	0.09				**F**		C
Kaluahine St.	Stop		A	0.70	0.01	A	0.47	0.00	C			D		
Old Pāhoa Rd.	Stop			0.54	0.39		0.51				C			
Kahakai Blvd.	Signal	D	D	A		B	B	B	**F**			B		A
Nanawale Homestead Rd	Stop		A	0.20		A	0.16		D			**F**		**F**
Unnamed Road	Stop		A	0.18		A	0.15		A			B		
Pāhoa-Kapoho Rd.	Signal	B	C	C	B	C	C	C	A	A		B	B	B

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
Source: SSFM International and Roger Dyar, P.E.

4.2.2.3 Alternative 3 Intersection Operations

Alternative 3 will widen Keaʻau-Pāhoa Road to four lanes between Keaʻau Bypass and Ainaloa Boulevard, and retain the two lane cross-section between Ainaloa Boulevard and Pāhoa-Kapoho Road. In analyzing the performance of intersections, there are two potential scenarios that were considered in this analysis:

- Traffic signals at Shower Drive, Kaloli Drive, Orchidland Drive, Paradise Drive, Makuʻu Drive, Ainaloa Boulevard, Old Pāhoa Road, Kahakai Boulevard, and Pāhoa-Kapoho Road.
- Roundabouts at Ainaloa Boulevard and Kahakai Boulevard, with a stop-sign control of a right-in-right-out intersection at Old Pāhoa Road. All the other intersections would still have traffic signals.

Table 4-19: Alternative 3 LOS and V/C, AM Peak Hour, Year 2038, Study Corridor Intersections, provides an overview of the performance of intersections in the AM peak hour under the Alternative 3. The bottom of the table shows the performance of the three intersections that would vary under the roundabouts scenario.

The overall intersection LOS for all the intersections with signals are D or better for all the intersections in the corridor. Through movements through the signalized intersections perform at a satisfactory level of service. During the AM Peak Hour, the side streets which do not have traffic signals have movements that perform at LOS F except at Opukahaia Street, Kaluahine Street, and the Unnamed Road, which have very low traffic volumes. The V/C ratios westbound along Keaʻau-Pāhoa Road are over 0.85 at Kaluahine Street, Ka Ohuwalu Street, the Transfer Station, and at Opukahaia Street. For the eastbound movement, the V/C ratios are above 0.85 at Ka Ohuwalu Street and at Kaluahine Street. Therefore, there will be some areas that do not perform optimally near non-signalized intersections.

In the scenario where roundabouts are provided, the roundabout at Kahakai Boulevard would have V/C ratios of less than 1.0 for all approaches except for the eastbound movement in the AM Peak hour. The Old Pāhoa Road intersection would perform acceptably in the AM Peak Hour. The roundabout at Ainaloa Boulevard would not perform adequately, with a high level of delay for traffic approaching in the Westbound direction.

The next table, **Table 4-20: Alternative 3 LOS and V/C, PM Peak Hour , Year 2038, Study Corridor Intersections,** shows that in the PM peak hour under Alternative 3 there would be some congestion issues for the eastbound movement on Keaʻau-Pāhoa Road. These problems occur at Opukahaia Street, the Transfer Station, Ka Ohuwalu Street, and Kaluahine Street. These locations have V/C ratios over 0.85. All the signalized intersections have overall LOS of D or better. All the side streets have LOS worse than D, although the majority of these are at stop sign controlled intersections, with the LOS relating to the difficulty of making left turns. The westbound through movements all have LOS C or better; although one mainline left turn movement has LOS E due to the difficulty in making left turns across the heavy oncoming eastbound traffic.

Table 4-19: Alternative 3 LOS and V/C, AM Peak Hour, Year 2038, Study Corridor Intersections

Intersection with Kea'au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			0.38		B	**0.88**		C		C			
Kea'au Transfer Station	Stop		**E**	0.29			**1.14**					**F**		**F**
Shower Drive	Signal	B	C	A	A	A	B		**E**			**E**		A
Pōhaku Place	Stop			0.39		B	0.84		**F**		**F**			
Kaloli Drive	Signal	C	**F**	A	D		D					**E**		A
Pōhaku Circle	Stop			0.39	0.04	B	0.82		**F**		**F**			
Orchidland Dr.	Signal	A		A	A	A	A		D		D			
Paradise Drive	Signal	C	**F**	A			C	A				D		A
Auli'i Street	Stop			0.39	0.02	B	0.71		**F**		**F**			
Maku'u Drive	Signal	B	C	A			C	B				C		C
Ilima Street	Stop			0.49		B	0.58		**F**		**F**			
Ainaloa Blvd.	Signal	B		B	A	A	A		C		C			B
Ka Ohuwalu	Stop		C	**0.93**			**1.15**					**F**		**F**
Kaluahine St.	Stop		A	**0.86**	0.02	B	**1.11**		**F**			**F**		
Old Pāhoa Rd.	Signal	D		F	C	B	C		C		B			
Kahakai Blvd.	Signal	B	A	A			C	B				C		A
Nanawale Homestead Rd	Stop		A	0.34		A	0.41		**F**		B	**F**		**F**
Unnamed Road	Stop		A	0.30		A	0.39		A			A		
Pāhoa-Kapoho Rd.	Signal	C	C	C	C	C	D	C	B	B		C	C	C
ROUNDABOUTS SCENARIO AT AINALOA BOULEVARD AND KAHAKAI BOULEVARD														
Ainaloa Blvd.	Roundbt			**0.93**		**1.60**			0.32					
Old Pāhoa Road	Stop			0.55	0.31		0.71				A			
Kahakai Boulevard	Roundbt		**1.01**			0.67			0.48			0.56		

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
Source: SSFM International and Roger Dyar, P.E.

Table 4-20: Alternative 3 LOS and V/C, PM Peak Hour , Year 2038, Study Corridor Intersections

Intersection with Kea‘au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			**1.22**		**E**	0.41		**F**		**F**			
Kea‘au Transfer Station	Stop		B	**0.90**			0.52					**F**		**F**
Shower Drive	Signal	D	A	**F**	A	D	A		D			**E**		A
Pōhaku Place	Stop			0.80		D	0.35		**F**		**F**			
Kaloli Drive	Signal	B	D	A			B					C		A
Pōhaku Circle	Stop			0.65	0.01	C	0.32		**F**		**F**			
Orchidland Dr.	Signal	B		B	A	**E**	A		**E**		D			
Paradise Drive	Signal	A	B	A			A	A				D		A
Auli’i Street	Stop			0.62	0.04	C	0.34		**F**		**F**			
Maku‘u Drive	Signal	A	A	A			B	B				C		A
Ilima Street	Stop			0.78		A	0.35		**F**		**F**			
Ainaloa Blvd.	Signal	B		B	B	B	A		C		C			
Ka Ohuwalu	Stop		B	**1.10**			0.75					**F**		**F**
Kaluahine St.	Stop		B	**1.02**	A	0.68	**E**		**F**					
Old Pāhoa Rd.	Signal	E		**F**	**E**	B	A		C		B			
Kahakai Blvd.	Signal	A	A	A			B	B				C		A
Nanawale Homestead Rd	Stop		A	0.33		A	0.26		**F**		B	**F**		**F**
Unnamed Road	Stop		A	0.30		A	0.24		A			C		
Pāhoa-Kapoho Rd.	Signal	B	B	C	B	B	C	C	B	B		B	B	C
ROUNDABOUTS SCENARIO AT AINALOA BOULEVARD AND KAHAKAI BOULEVARD														
Ainaloa Blvd.	Roundbt			**1.25**		**0.96**			0.19					
Old Pāhoa Road	Stop			0.53	0.38		0.49				A			
Kahakai Boulevard	Roundbt		**0.87**			0.62			0.80			0.33		

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
Source: SSFM International and Roger Dyar, P.E.

In the scenario where roundabouts are provided, the roundabout at Kahakai Boulevard would have V/C ratios of less than 1.0 for all approaches. The Old Pāhoa Road intersection would perform acceptably in the PM Peak Hour. The roundabout at Ainaloa Boulevard would not perform adequately, with a high level of delay for traffic approaching in the Eastbound direction.

In summary, Alternate 3 provides improved operations at signalized intersections. There would still be some congestion and poor levels of service in the P.M. in the eastbound direction. Overall, Alternate 3 would represent an improvement over the No-Build Alternative, although there would likely still be congestion problems as noted above. Therefore, Alternative 3 would substantially meet the purpose and need of the proposed from the standpoint of improving unsafe and poorly-operating intersections.

It is likely that further traffic signal optimization (changing the signal cycle times and phases) may be able to improve operations at the few signalized turning movements that still have poor operations.

A number of smaller cross-streets that are not signalized at their intersections with Keaʻau-Pāhoa Road will continue to have some poor LOS with their turning movements. To some degree, these problems could be mitigated with the optional access management measurements suggested in **Section 2.2.3: Access Management**, which was not part of the modeling discussed above. The access management measures will eliminate a number of problematic turning movements and direct traffic instead to the controlled signals.

The use of Alternative 3 along with the scenario of a roundabout at Kahakai Boulevard with the conversion of Old Pāhoa Road to a right-in-right-out intersection appears to be a better solution than the scenario of Alternative 3 with a signal at Kahakai and Old Pāhoa Road. The Alternative 3 with the roundabout at Kahakai Boulevard and the modifications to Old Pāhoa Road would meet the majority of the objectives of the Purpose and Need.

4.2.2.4 Alternative 4 Intersection Operations

The next two tables document Alternative 4, which will widen Keaʻau-Pāhoa Road to four lanes between Keaʻau Bypass and Pāhoa-Kapoho Road. As seen in **Table 4-21: Alternative 4 LOS and V/C, AM Peak Hour, Year 2038, Study Corridor Intersections**, the AM peak hour under Alternative 4 has all the intersections with traffic signals operating at an overall intersection LOS of C or better. Furthermore, the LOS on the along Kea'au-Pāhoa Road for through traffic movements within the intersections is also a LOS C or better in each direction. The side street approaches to signalized intersections have LOS D or better for all movements except for at Shower Drive and Kaloli Drive. The side street approaches at stop sign controlled intersections show LOS measures of F except for at the Unnamed Road and at Opukahaia St. which have very low traffic volumes. The intersections at Opukahaia St. and the Keaʻau Transfer Station also show V/C ratios over 0.85 for the westbound direction in the AM Peak hour.

The next table, **Table 4-22: Alternative 4 LOS and V/C , PM Peak Hour , Year 2038, Study Corridor Intersections,** shows that the PM peak hour under Alternative 4 has all the intersections with traffic signals operating at an overall intersection LOS of C or better. There would be some congestion issues for the eastbound movement on Kea'au-Pāhoa Road. These problems occur at Opukahaia St., the Transfer Station access, and Shower Drive. There are also a number of cross streets with movements that have a LOS worse than D, although the majority of these are at stop sign controlled intersections, with the LOS relating to the difficulty of making left turns. The westbound through movements all have LOS C or better; although two westbound left turn movements (at Opukahaia Street and Orchidland Drive) have LOS E due to the difficulty in making left turns across the heavy oncoming eastbound traffic.

The overall conclusion that can be drawn is that Alternative 4 will provide substantial improvement at all of the intersections that will receive traffic signals. Operations for through traffic along Keaʻau-Pāhoa Road will be very good, and the signalized crossroads will have mostly good operations for turning onto/off of Keaʻau-Pāhoa Road, which will greatly improve safety in the corridor. It Is likely that further traffic signal optimization (changing the signal cycle times and phases) may be able to improve operations at the few signalized turning movements that still have poor operations.

A number of smaller cross-streets that are not signalized at their intersections with Keaʻau-Pāhoa Road will continue to have some poor LOS with their turning movements. To some degree, these problems could be mitigated with the optional access management measurements suggested in **Section 2.2.3: Access Management**, which was not part of the modeling discussed above. The access management measures will eliminate a number of problematic turning movements and direct traffic instead to the controlled signals.

Alternative 4 would fulfill the Purpose and Need of the project from the standpoint of improving unsafe and poorly-operating intersections.

Table 4-21: Alternative 4 LOS and V/C, AM Peak Hour, Year 2038, Study Corridor Intersections

Intersection with Kea‘au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			0.38	0.22	B	**0.88**		C		C			
Kea‘au Transfer Station	Stop		**E**	0.29			**0.88**					**F**		**F**
Shower Drive	Signal	B	C	A	A	A	B	B	**E**			**E**		A
Pōhaku Place	Stop			0.39		B	.84		**F**		**F**			
Kaloli Drive	Signal	C	**F**	A			D					**E**		A
Pōhaku Circle	Stop			0.39	0.04	B	0.82		**F**		**F**			
Orchidland Dr.	Signal	A		A	A	A	A		D		D			
Paradise Drive	Signal	C	**F**	A			C	A				D		A
Auli’i Street	Stop			0.39	0.02	B	0.71		**F**		**F**			
Maku‘u Drive	Signal	B	C	A			C	B				C		C
Ilima Street	Stop			0.49		B	0.58		**F**		**F**			
Ainaloa Blvd.	Signal	B		B	A	A	A		C		C			
Ka Ohuwalu	Stop		C	0.47			0.76					**F**		**F**
Kaluahine St.	Stop		A	0.43		B	0.52	0.06	**F**			**F**		
Old Pāhoa Rd.	Signal	B		B	C	A	A		C		B			
Kahakai Blvd.	Signal	A	A	A			B	B				C		A
Nanawale Homestead Rd	Stop		A	0.20		A	0.26		**F**		B	**E**		**E**
Unnamed Road	Stop		A	0.20		A	0.26		A		A	A		A
Pāhoa-Kapoho Rd.	Signal	C	C	C	C	C	D	C	B	B	C	C	C	C

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
Source: SSFM International and Roger Dyar, P.E.

Table 4-22: Alternative 4 LOS and V/C , PM Peak Hour , Year 2038, Study Corridor Intersections

Intersection with Kea‘au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			**1.22**		**E**	0.41		**F**		**F**			
Kea‘au Transfer Station	Stop		B	**0.90**			0.52					**F**		**F**
Shower Drive	Signal	D	A	**F**	A	D	A		D			**E**		A
Pōhaku Place	Stop			**1.03**		D	0.35		**F**		**F**			
Kaloli Drive	Signal	B	D	A			B					C		A
Pōhaku Circle	Stop			0.65	0.01	C	0.32		**F**		**F**			
Orchidland Dr.	Signal	B		B	A	**E**	A		**E**		D			
Paradise Drive	Signal	A	B	A			A	A				D		A
Auli’i Street	Stop			0.62	0.04	B	0.34		**F**		**F**			
Maku‘u Drive	Signal	B	A	A			B	B				C		C
Ilima Street	Stop			0.78		A	0.35		**F**		**F**			
Ainaloa Blvd.	Signal	B		B	B	B	A		C		C			
Ka Ohuwalu	Stop		B	0.55			0.49					D		D
Kaluahine St.	Stop		B	0.51	0.01	A	0.34	0.01	C			**E**		
Old Pāhoa Rd.	Signal	C		C	**E**	A	A		C		B			
Kahakai Blvd.	Signal	A	A	A			B	B				C		A
Nanawale Homestead Rd	Stop		A	0.20		A	0.17		**F**		B	**F**		**F**
Unnamed Road	Stop		A	0.20		A	0.16		A			C		
Pāhoa-Kapoho Rd.	Signal	B	B	C	B	B	C	C	B	B		B	B	C

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
Source: SSFM International and Roger Dyar, P.E.

4.2.2.5 Alternative 5 Intersection Operations

The next two tables document Alternative 5, which will widen Keaʻau-Pāhoa Road to six lanes between Keaʻau Bypass and Paradise Drive, widen to four lanes between Paradise Drive and Kahakai Boulevard, and retain the two lane cross-section between Kahakai Boulevard and Pāhoa-Kapoho Road. As seen in **Table 4-23: Alternative 5 LOS and V/C, AM Peak Hour , Year 2038, Study Corridor Intersections**, the AM peak hour under Alternative 5 has most of the intersections with traffic signals operating at an overall intersection LOS of A or B. Only Pāhoa-Kapoho Road would operate at LOS C, which is still very good. Furthermore, the LOS along Kea'au-Pāhoa Road for through traffic movements within the intersections is also a LOS C or better for westbound traffic and LOS B or better in the eastbound direction. The side street approaches to signalized intersections have LOS D or better for all movements except for at Shower Drive and Kaloli Drive. The side street approaches at stop sign controlled intersections show LOS measures of E and F except for at the Unnamed Road and at Opukahaia St. which have very low traffic volumes.

The next table, **Table 4-24: Alternative 5 LOS and V/C, PM Peak Hour , Year 2038, Study Corridor Intersections**, shows that the PM peak hour under Alternative 5 has the intersections with traffic signals operating mostly at an overall intersection LOS of A or B, with only Old Pāhoa Road operating at a satisfactory LOS C. Eastbound through traffic would experience no LOS worse than C. There are a number of cross streets with movements that have a LOS worse than D, although these all are at stop sign controlled intersections, with the LOS relating to the difficulty of making left turn across heavy traffic volumes on Keaʻau-Pāhoa Road. The westbound through movements all have LOS A or B.

The overall conclusion that can be drawn is that Alternative 5 will provide substantial improvement at all of the intersections that will receive traffic signals. Operations for through traffic along Keaʻau-Pāhoa Road will be excellent, and the signalized crossroads will have mostly good operations for turning onto/off of Keaʻau-Pāhoa Road, which will greatly improve safety in the corridor.

A number of smaller cross-streets that are not signalized at their intersections with Keaʻau-Pāhoa Road will continue to have some poor LOS with their turning movements. To some degree, these problems could be mitigated with the optional access management measurements suggested in **Section 2.2.3: Access Management**, which was not part of the modeling discussed above. The access management measures will eliminate a number of problematic turning movements and direct traffic instead to the controlled signals.

Alternative 5 would fulfill the Purpose and Need of the project from the standpoint of improving unsafe and poorly-operating intersections.

Table 4-23: Alternative 5 LOS and V/C, AM Peak Hour , Year 2038, Study Corridor Intersections

Intersection with Kea'au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			0.23		B	0.58		C		C			
Kea'au Transfer Station	Stop		**E**	0.19			0.69					**F**		**F**
Shower Drive	Signal	A	A	A	A	A	A		D			D		A
Pōhaku Place	Stop			0.24		B	.56		**F**		**F**			
Kaloli Drive	Signal	B	D	A			B					D		A
Pōhaku Circle	Stop			0.26	0.04	B	0.55		**F**		**F**			
Orchidland Dr.	Signal	A		A	A	A	A		D		C			A
Paradise Drive	Signal	B	C	A			B	A				C		B
Auli'i Street	Stop			0.39	0.02	B	0.71		**F**		**F**			
Maku'u Drive	Signal	B	C	A			C	B				C		B
Ilima Street	Stop			0.49		B	0.58		**F**		**F**			
Ainaloa Blvd.	Signal	B		B	A	A	A		C		C			B
Ka Ohuwalu	Stop		C	0.47			0.76					**F**		**F**
Kaluahine St.	Stop		A	0.43	0.02	B	0.52	0.06	**F**			**F**		
Old Pāhoa Rd.	Signal	B		B	C	A	A		C		B			
Kahakai Blvd.	Signal	B	A	A			C	B				C		A
Nanawale Homestead Rd	Stop		A	0.34		A	0.41		**F**			**F**		**F**
Unnamed Road	Stop		A	0.30		A	0.39		A			A		
Pāhoa-Kapoho Rd.	Signal	C	C	C	C	C	D	C	B	B		C	C	C

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
Source: SSFM International and Roger Dyar, P.E.

Table 4-24: Alternative 5 LOS and V/C, PM Peak Hour , Year 2038, Study Corridor Intersections

Intersection with Kea‘au-Pāhoa Road			Individual Traffic Movements											
Cross Street	Traffic Control	Overall LOS	Eastbound			Westbound			Northbound			Southbound		
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Opukahaia St.	Stop			0.73		**E**	0.27		**F**		**F**			
Kea‘au Transfer Station	Stop		B	0.60			0.31					**F**		**F**
Shower Drive	Signal	A	A	A	A	B	A		D			D		A
Pōhaku Place	Stop			0.62		D	0.23		**F**		**F**			
Kaloli Drive	Signal	A	B	A			B					C		A
Pōhaku Circle	Stop			0.43	0.01	C	0.21		**F**		**F**			
Orchidland Dr.	Signal	A		A	A	C	A		D		D			A
Paradise Drive	Signal	A	B	A			A	A				D		A
Auli’i Street	Stop			0.62	0.04	C	0.34		**F**		**F**			
Maku‘u Drive	Signal	B	A	A			B	B				C		B
Ilima Street	Stop			0.78		A	0.35		**F**		**F**			
Ainaloa Blvd.	Signal	B		B	B	B	A		C		C			B
Ka Ohuwalu	Stop		B	0.55			0.49					D		D
Kaluahine St.	Stop		B	0.51	A	0.34			C			**E**		
Old Pāhoa Rd.	Signal	C		C	**E**	A	A		C		B			C
Kahakai Blvd.	Signal	A	A	A			B	B				C		A
Nanawale Homestead Rd	Stop		A	0.33		A	0.26		**F**			**F**		**F**
Unnamed Road	Stop		A	0.30		A	0.24		A			C		
Pāhoa-Kapoho Rd.	Signal	B	B	C	B	B	C	C	B	B		B	B	C

Notes: LOS worse than LOS D, or V/C ratios greater than 0.85 are displayed in **bold** text.
Where a number is given for an individual movement, HCM does not provide a LOS Value, in which case the value displayed is the v/c ratio.
Traffic movements that do not exist are shaded in grey.
Source: SSFM International and Roger Dyar, P.E.

4.2.3 Roundabouts

As described above in **Section 2.4.3: Roundabouts**, a roundabout is a type of circular intersection that requires entering traffic to yield to traffic already within the circle. When they are feasible to be constructed, modern roundabouts can be a viable measure to control intersection traffic in place of a conventional signalized intersection. They offer a number of safety and performance benefits.

Roundabouts have been analyzed at length in **Appendix C: Traffic Study**. The discussion below is a summarization of the study.

HDOT has a policy guideline on Modern Roundabouts (dated December 19, 2008) that states that multi-lane roundabouts will not be considered due to safety concerns. Therefore the possible use of roundabouts in this study was limited to those alternatives and locations that provide single-lane through movements at the intersections in question.

The TSM Alternative would be able to accommodate roundabouts throughout the corridor. Alternatives 3 and 5 provide two or more through lanes along Keaʻau-Pāhoa Road in each direction for portions of their length, precluding the intersections in those wider segments from being considered for roundabout installation. Alternative 4 has no possible location for a roundabout, as it is four lanes wide for the entire corridor.

Based on traffic movements and other characteristics, the following six intersections with Keaʻau-Pāhoa Road were identified as candidates for installation of traffic signals and were therefore reviewed as possible locations for roundabouts:

- Kaloli Drive
- Paradise Drive
- Makuʻu Drive
- Ainaloa Boulevard
- Old Pāhoa Rd.
- Kahakai Boulevard

The Level of Service (LOS) for Roundabouts follows the same criteria as for non-signalized intersections discussed above in **Section 3.2.2: Intersection LOS**. Roundabouts were considered both by themselves, and together with right-turn slip lanes to accommodate right turns separate with the main roundabout. The slip lanes help to improve the performance of the roundabout by separating the right turning traffic from the main operations within the roundabout itself.

The two tables that follow, **Table 4-25: Assessment of Roundabouts Without Right Turn Slip Lanes, 2038 Volumes** and **Table 4-26: Assessment of Roundabouts With Right Turn Slip Lanes, 2038 Volumes** summarize the findings of the roundabouts analysis. Approaches that operate at a LOS E or LOS F are show in **bold** text.

Table 4-25: Assessment of Roundabouts Without Right Turn Slip Lanes, 2038 Volumes

Cross-Street at Roundabout (No Slip Lanes)	Alternative (s)	Capacity Analysis Measures	AM Peak Hour				PM Peak Hour			
			Eastbound Kea'au-Pāhoa Rd.	Westbound Kea'au-Pāhoa Rd.	South-bound Cross-Street	North-bound Cross-Street	Eastbound Kea'au-Pāhoa Rd.	Westbound Kea'au-Pāhoa Rd.	South-bound Cross-Street	North-bound Cross-Street
Kaloli Drive	TSM	V/C Ratio	**1.06**	**2.05**	n/a	**2.12**	**2.23**	**1.47**	n/a	0.39
		LOS	**F**	**F**	n/a	**F**	**F**	**F**	n/a	B
Paradise Drive	TSM	V/C Ratio	**1.37**	**1.89**	n/a	**1.41**	**1.99**	**1.32**	n/a	0.39
		LOS	**F**	**F**	n/a	**F**	**F**	**F**	n/a	B
Maku'u Drive	TSM	V/C Ratio	**1.34**	**1.70**	n/a	0.61	**1.92**	**1.19**	n/a	0.53
		LOS	**F**	**F**	n/a	C	**F**	**F**	n/a	C
Ainaloa Blvd.	TSM	V/C Ratio	**1.27**	**1.73**	0.56	n/a	**1.92**	**1.06**	0.42	n/a
		LOS	**F**	**F**	C	n/a	**F**	**F**	C	n/a
Old Pāhoa Rd.	TSM & Alt. 3	V/C Ratio	**1.40**	**1.41**	0.70	n/a	**1.74**	0.89	**0.83**	n/a
		LOS	**F**	**F**	C	n/a	**F**	D	**E**	n/a
Kahakai Blvd.	TSM & Alt. 3	V/C Ratio	0.77	0.74	n/a	0.36	0.95	0.69	n/a	0.57
		LOS	C	B	n/a	A	D	B	n/a	B

Note: Approaches with a LOS worse than D shown in **bold.**

Source: SSFM International and Roger Dyar, P.E.

Table 4-26: Assessment of Roundabouts With Right Turn Slip Lanes, 2038 Volumes

Cross-Street at Roundabout (With Right Turn Slip Lanes)	Alternative (s)	Capacity Analysis Measures	AM Peak Hour				PM Peak Hour			
			Eastbound Kea'au-Pāhoa Rd.	Westbound Kea'au-Pāhoa Rd.	South-bound Cross-Street	North-bound Cross-Street	Eastbound Kea'au-Pāhoa Rd.	Westbound Kea'au-Pāhoa Rd.	South-bound Cross-Street	North-bound Cross-Street
Kaloli Drive	TSM	V/C Ratio	**1.06**	**2.03**	NA	0.27	**2.23**	**1.35**	NA	0.11
		LOS	**F**	**F**	NA	D	**F**	**F**	NA	A
Paradise Drive	TSM	V/C Ratio	**1.37**	**1.76**	NA	0.32	**1.99**	**1.16**	NA	.09
		LOS	**F**	**F**	NA	C	**F**	**F**	NA	A
Maku'u Drive	TSM	V/C Ratio	**1.34**	**1.17**	NA	0.42	**1.92**	**1.00**	NA	0.28
		LOS	**F**	**F**	NA	C	**F**	**E**	NA	B
Ainaloa Blvd.	TSM	V/C Ratio	1.00	**1.73**	0.37	NA	**1.40**	**1.06**	0.23	NA
		LOS	D	**F**	B	NA	**F**	**E**	C	NA
Old Pāhoa Rd.	TSM & Alt. 3	V/C Ratio	0.85	**1.41**	0.56	NA	**1.01**	0.89	0.58	NA
		LOS	C	**F**	C	NA	**E**	D	C	NA
Kahakai Blvd.	TSM & Alt. 3	V/C Ratio	0.77	0.59	NA	0.36	0.95	0.50	NA	0.16
		LOS	C	A	NA	A	D	A	NA	A

Note: Approaches with a LOS worse than D shown in **bold.**

Source: SSFM International and Roger Dyar, P.E.

In summary, only the intersection with Kahakai Boulevard would be able to acceptably accommodate the volumes that would be present in 2038 within a roundabout. Other intersections show operational problems with single-lane roundabouts. In most cases, this is not due to anticipated problems with the side streets, but rather due to the high volume of through traffic on Keaʻau-Pāhoa Road. The high volume of traffic approaching the roundabouts eastbound and westbound along Keaʻau-Pāhoa Road results in V/C ratios over 1.0 and extensive queues that may not be acceptable.

If the TSM Alternative or Alternative 3 are selected as the preferred alternative, it is recommended to install a single-lane modern roundabout at the intersection of Keaʻau-Pāhoa Road at Kahakai Boulevard in lieu of a traffic signal using right turn slip lanes as part of the design. As part of that design, a speed reduction to 45 miles per hour maximum in the approaches should be considered to address concerns about whether roundabouts should be used on high-speed facilities. The reduction should slow traffic for approximately one-quarter mile on either side of the roundabout on the Keaʻau-Pāhoa Road approaches.

Even though most of the roundabouts do not have the capacity to accommodate 2038 volumes at the intersections studied above, one consideration may be to construct roundabouts in the short-to-medium term at intersections while traffic volumes are low enough to adequately handle the volumes, particularly at locations that have high accident rates. Once the roundabouts approach capacity, if HDOT has changed its policy at that time to allow multi-lane roundabouts, such a solution could be investigated, otherwise the intersection could be converted back to a conventional signalized intersection. The intersection of Keaʻau-Pāhoa Road at Ainaloa Boulevard could be one such location where roundabouts should be considered as an interim improvement due to its high accident rate and ease of implementation. The intersection of Keaʻau-Pāhoa Road at Orchidland Drive could be another potential location due to a comparatively high accident rate and due to the existing and proposed retail/commercial development and proposed future Neighborhood Village Center.

4.2.4 Configuration of Old Pāhoa Road and Kahakai Boulevard

The two closely-spaced T-intersections with the Pāhoa Bypass at Old Pāhoa Road and Kahakai Boulevard were created when the bypass was constructed. Kahakai Boulevard originally connected the Hawaiian Beaches subdivision with Old Pāhoa Road, but the mauka leg of this intersection was closed off with a cul-de-sac at the Pāhoa Bypass.

One of the considerations of the traffic study was to investigate re-opening Kahakai Boulevard to provide full access, with potential access changes at Old Pāhoa Road. It may be possible to combine the traffic destined for Old Pāhoa Road and Kahakai Boulevard as a combined system. In such a scenario, Kahakai Boulevard would provide the primary access into the Pāhoa Marketplace (Malāma Market) area as well as the northern approach into Pāhoa Town. The Old Pāhoa Road access, which suffers from poor operations presently, could be restricted to a right-in-right-out configuration, since left-turning traffic would be served more efficiently and safely at Kahakai Boulevard.

Appendix C: Traffic Study analyzes in detail four options that would either reconnect Kahakai Boulevard or maintain the T-intersections as they are today. The analysis considered the re-assignment of traffic between the two intersections along with access changes and the capacity of intersections or roundabouts.

The study determined that two options would have satisfactory traffic operations as part of the preferred alternative in 2038:

- Install a traffic signal at a full-access Kahakai Boulevard, with Old Pāhoa Road configured as a right-in-right-out intersection controlled by a stop sign on Old Pāhoa Road.
- Install a modern roundabout at Kahakai Boulevard, with Old Pāhoa Road configured as a right-in-right-out intersection controlled by a stop sign on Old Pāhoa Road. This would only be applicable if the preferred alternative is the TSM Alternative 2, Alternative 3 or Alternative 5. Alternative 4 would have two travel lanes in each direction, and therefore could not accommodate a single-lane roundabout as required under HDOT's current Roundabout Policy.

4.2.5 Safety

As is discussed in greater detail in **Section 1.1.2.1: Safety** and in **Section 3.2.4:** Safety**,** the Keaʻau-Pāhoa Road Corridor has very high accident rates, and several of the state's most dangerous intersections are located in the corridor. The need to improve safety and reduce the numbers and rates of accidents is a compelling one that has driven much of the public concern for improvements in this corridor.

The No-Build Alternative will not improve safety within the corridor. The existing deficiencies and high accident rates that currently impact users of Keaʻau-Pāhoa Road will continue to adversely affect users of Keaʻau-Pāhoa Road in the future. By keeping a two-lane corridor through the entire length of Keaʻau-Pāhoa Road, motorists will be unable to pass other vehicles without dangerous passing movements. As congestion increases, it is likely that some turning movements will become increasingly more difficult than they are today, and motorists may need to undertake risky maneuvers or simply avoid travel in certain routes.

The TSM Alternative will provide moderate benefits in improved safety, primarily at intersections where signals or roundabouts and crosswalks are provided. However, the TSM Alternative will not address safety in the roadway segments between intersections. The primary safety benefit that will come from the TSM Alternative will come from control of left-turning movements at intersections using a traffic signal or roundabout.

If intersection access is controlled with reduction to right-in-right-out access as appropriate intersections, it will reduce accidents at these locations. **Table 4-27: Predicted Reduction in Crashes with Conversion of Intersections to Right-In-Right-Out Operation** shows that almost 12 accidents per year could be prevented with these changes. If these access changes were instituted in the Build Alternatives (Alternatives 3, 4, and 5), a comparable benefit would be expected as well.

Table 4-27: Predicted Reduction in Crashes with Conversion of Intersections to Right-In-Right-Out Operation

Right-In-Right-Out Intersection of Keaʻau-Pāhoa Road at	Total Crashes from 2004 - 2007 of Angle and Broadside Categories	Average Annual Crashes Prevented with Right-In-Right-Out Operation in Place
Pōhaku Place	6	1.50
Pōhaku Circle	2	0.50
Auliʻi Street	3	0.75
Ilima Street	1	0.25
Old Pāhoa Road	35	8.75
Total 5 Intersections	**47**	**11.75**

Source: SSFM International and Roger Dyar, P.E.

Build Alternatives 3, 4, and 5 will have a pronounced effect on improving safety in the corridor. The traffic analysis in **Appendix C: Traffic Study** has conservatively calculated a crash reduction figure based upon crash reduction factors compiled by the Federal Highway Administration (FHWA). FHWA estimates are that there would be 31 percent fewer crashes in locations where travel lanes have been added, 15 percent reduction in crashes where a signal has been installed, a 44 percent reduction in crashes where a roundabout is installed, and a 20 percent reduction in crashes where shoulders have been widened. The overall total reduction in crashes with the Build alternatives is expected to be at least 25 percent, and it is likely that this reduction could be higher. The overall estimate is that at least 22 accidents a year and 25 injuries per year could be avoided.

Table 4-28: Safety Recommendations at Intersections on Keaʻau-Pāhoa Road provides an overview of the suggested improvements at intersections that will improve safety under the TSM Alternative, and Build Alternatives 3, 4, and 5. Signalization or roundabouts will have the greatest influence at high-accident intersections.

Table 4-28: Safety Recommendations at Intersections on Kea'au-Pāhoa Road

Intersection of Kea'au-Pāhoa Road With:	2004 - 2007		Predominant Crash Patterns	Recommended Mitigations to Address Crash Patterns
	Total Crashes	Crash Rate*		
Ainaloa Blvd.	49	2.45	Broadside and angle	Install traffic signal with left turn phase westbound and consider roundabout in lieu of signal
Kahakai Blvd.	31	2.49	Broadside and angle	Install traffic signal with left turn phase eastbound and consider consolidation with Old Pāhoa Road into single intersection with roundabout
Maku'u Drive	33	1.57	Broadside and angle	Install traffic signal with left turn phase eastbound and consider roundabout in lieu of signal
Old Pāhoa Road	40	2.10	Broadside and angle	Install traffic signal with left turn phase westbound and consider consolidation with Old Pāhoa Road into single intersection with roundabout
Paradise Drive	27	1.20	Broadside and angle	Install traffic signal with left turn phase eastbound and consider roundabout in lieu of signal
Shower Drive	17	0.48	Broadside and angle	A traffic signal will be installed with left turn phases as part of the shoulder lane project.
Kaloli Drive	16	0.48	Broadside and angle	Install traffic signal with left turn phase eastbound and consider roundabout in lieu of signal
Orchidland Drive	21	0.91	Broadside and angle	Install traffic signal with left turn phase westbound and consider roundabout in lieu of signal
Pāhoa-Kapoho	16	0.83	Broadside and angle	Review and revise signal timing or phasing as needed
Pōhaku Place	9	0.33	No pattern	No additional recommendations based on crash data
Aulii Street	4	0.21	No pattern	No additional recommendations based on crash data
Kaluahine Street	3	0.16	No pattern	No additional recommendations based on crash data
Pōhaku Circle	3	0.12	No pattern	No additional recommendations based on crash data
Nanwale Homest	4	0.62	No pattern	No additional recommendations based on crash data
Homestead Road	2	0.31	No pattern	No additional recommendations based on crash data
Ilima Street	2	0.11	No pattern	No additional recommendations based on crash data
Ka Ohuwalu	2	0.11	No pattern	No additional recommendations based on crash data
Farmers Market	0	0	No crashes	No additional recommendations based on crash data
Transfer Station	5	0.14	No pattern	No additional recommendations based on crash data
Paved Road	2	0.06	No pattern	No additional recommendations based on crash data
Poni Moi Ave. (29th Ave.)	1	0.04	No pattern	No additional recommendations based on crash data
Puakalo Ave. (30th Ave.)	2	0.07	No pattern	No additional recommendations based on crash data
Totals	**219**			

*Crashes per million vehicles entering intersection

Source: SSFM International and Roger Dyar, P.E.

At locations between intersections, the biggest benefits will come from shoulder improvements, barriers, milled rumble strips, and left turn lanes. **Table 4-29: Safety Recommendations Between Intersections on Kea'au-Pāhoa Road** provides an overview.

Table 4-29: Safety Recommendations Between Intersections on Keaʻau-Pāhoa Road

From	To	Total Crashes	Crash Rate*	Predominant Pattern of Crashes	Recommended Mitigations to Address Crash Patterns
Opukahaia	Shower	45	65.0	Run-off-the-road, rear-end	Shoulder improvements, barriers, rumble strips, left turn lanes
Shower	Pōhaku Place	8	51.4	Rear-end	Same
Pōhaku Place	Kaloli	11	84.3	Run-off-the-road, rear-end	Same
Kaloli	Pōhaku Circle	4	55.4	Run-off-the-road	Same
Pōhaku Circle	Orchidland	9	77.6	None	Same
Orchidland	Paradise	2	34.0	Run-off-the-road	Same
Paradise	Aulii	4	55.3	Run-off-the-road	Same
Aulii	Makuʻu	6	47.2	Rear-end	Same
Makuʻu	Ilima	1	41.9	None	Same
Ilima	Ainaloa	1	26.5	None	Same
Ainaloa	Ka Ohuwalu	5	27.5	Rear-end	Same
Ka Ohuwalu	Kaluahine	3	23.1	Rear-end	Same
Kaluahine	Old Pāhoa	10	43.4	Run-off-the-road, rear-end	Same
Old Pāhoa	Kahakai	2	105.5	Run-off-the-road	Same
Kahakai	Nanawale	3	86.2	None	Same
Nanawale	Unnamed	3	150.1	Rear-end	Same
Unnamed	Kapoho	5	134.6	Run-off-the-road	Same
TOTALS		122	57.0		

*Crashes per million vehicle miles

Source: SSFM International and Roger Dyar, P.E.

4.2.6 Access Changes

The No-Build alternative will have no effect on changing access in the corridor. As congestion increases, however, it will be much more difficult for travelers to make their desired travel movements.

Under the TSM alternative, and to a greater degree, the Build Alternatives, travelers along the project corridor may need to change their traveling patterns. The Build Alternatives will construct divided medians along all sections of highway that are four lanes or six lanes in cross section. Access to individual driveways that front onto Keaʻau-Pāhoa will be changed in many cases to right-in-right-out access. Refer to **Section 4.15.7: Changes to Property Access**, for more information and a breakdown of impacts to driveways.

Access will also be modified at a number of cross streets under the TSM and Build Alternatives to limit the number of access points along the most intensively-developed portion of the corridor. Several minor roads will be converted to right-in-right-out access or even closed off entirely as described in greater detail in **Section 2.2.3: Access Management**. Access would be

modified so that three-way intersections (T-intersections) could be consolidated into four-way traffic-controlled intersections (which will use traffic signals or roundabouts if feasible), thereby improving safety, particularly for those vehicles that wish to make a left turn to/from a cross-street and need to cross opposing flows of traffic.

While these impacts will result in some misdirection and minor inconvenience for some travelers, this will be outweighed by the greater safety provided by limiting access to controlled locations.

Mitigation measures related to changes in travel patterns may require personal notifications and community education. While the long term effects of proposed improvements may be appreciated, it may be difficult for some motorists and residents to accept changes to personal routines. It is noted that, in interviews conducted for the Social Impact Assessment (see **Section 4.3.1: Social Impact Interview Findings**), some people indicated that they already avoid left hand turns from their street or driveways by traveling to a nearby street that provides turn lanes in the appropriate direction. Therefore, changing behaviors may not be a problem for some motorists.

4.2.7 Bicycles and Pedestrians

The No-Build Alternative will offer no new improvements to the corridor for bicycles or pedestrians. As congestion and traffic volumes continue to increase over time, it is expected that the roadway environment will become increasingly unsafe for bicycles and pedestrians. After construction of the Shoulder Lane Conversion Project is completed (see **Section 1.2.2.1: The Keaʻau-Pāhoa Road Shoulder Lane Conversion Project**), the Pāhoa-bound shoulder between the existing Keaʻau Bypass and Shower/Pōhaku Drives will be used as a temporary travel lane during the PM peak hour. Therefore, neither pedestrians nor bicycles could safely use this segment of shoulder during that period under the No-Build Alternative.

The TSM Alternative will offer some modest benefits to bicycles and pedestrians, primarily for those that choose to cross Keaʻau-Pāhoa Road at a signal- or roundabout-controlled intersection. Crosswalks will be provided at such locations, and signals can offer a pedestrian-actuated button to allow a lengthier crossing period. Travel along Keaʻau-Pāhoa Road itself (in the shoulders, which will not be reconstructed) generally will not be improved for bicycles or pedestrians.

The overall effect of the Build Alternatives on bicycle and pedestrian use of the corridor will be positive. In addition to the crosswalks mentioned above, bicycles will be accommodated with a continuous shoulder that is either eight or ten feet in width (depending upon the roadway cross-section). On four-lane or six-lane sections, pedestrians will be provided with a separate walkway; on two-lane sections, they will use the shoulder. Pedestrian and bicycle accommodations will be continuous through intersections. This will be an improvement over today, where shoulders often disappear to accommodate turn lanes. Landscape improvements along Keaʻau-Pāhoa Road will also improve the experience for non-motorized users of the corridor.

The grades in the corridor are generally flat to moderate, and therefore the corridor will be an attractive route for bicyclists once there are improved shoulders.

4.2.8 Transit

The No-Build Alternative will offer no new improvements to the corridor for the Hele-On Transit service or the passengers that use it. As congestion and traffic volumes continue to increase over time, it will be increasingly difficult for transit to maintain consistent schedules. If travel times increase because of congestion, it may make transit a less-competitive option for those that have the discretionary choice to drive. The existing roadway environment, which is not passenger friendly, will remain as it is today.

The TSM Alternative and all Build Alternatives will enable the County Mass Transit Agency to expand and improve its Hele-On Service, particularly for transit-dependent persons. Transit improvements such as the installation of bus stops, bus pull outs, park and ride lots and other measures will increase transit usage and decrease the number of automobiles using the corridor.

Under the TSM and Build Alternatives, bus pull-outs are proposed along both sides of the roadway corridor near:

- Shower Drive
- Kaloli Drive
- Pōhaku Circle (Pāhoa - bound direction only)
- Orchidland Drive
- Paradise Drive
- Makuʻu Drive
- Ainaloa Boulevard
- Makuʻu Farmer's Market

Bus pull-outs near improved bus stops will enable buses to more safely transition into and out of traffic. Safer designs near bus stops, including crosswalks and signalization at busy intersections, will make conditions safer for passengers.

Bus service will be much more reliable when congestion is reduced and schedules are more consistent day to day. The travel time for bus trips will be reduced as overall congestion is likewise reduced. While the TSM Alternative will provide some benefit in this regard (with traffic control at intersections), the Build Alternatives will provide much greater capacity and therefore offer improved travel times and schedule reliability.

4.3 Social and Community Impacts

A Social Impact Assessment (SIA) was performed for this project to gauge the community's sentiment about the Puna District today, the future of the area, and how Keaʻau-Pāhoa Road project fits in with the future of Puna. The SIA is found in full in **Appendix G: Social Impact**

Assessment. Consideration of the needs of Environmental Justice groups is discussed in greater detail in **Section 4.3.3: Impacts on Environmental Justice Communities.**

4.3.1 Social Impact Interview Findings

The SIA looked at the social Impacts that may occur as a result of the proposed action. An issues analysis approach was followed to identify and analyze community concerns because statistical surveys or polls are not conducive to dialogue and the personalized reasons for these opinions are not evident, or need to be inferred from the responses. The only time the quantity of opinion was noted was when there is a notable difference of number or a distinct trend.

Interviews were held in person or by phone if preferred due to interviewee preference or schedule. Interviewees were told that their individual conversations are confidential, and that comments would be collectively analyzed. Those interviewed were asked to share information and opinions as individuals and not to represent or take positions for their organizations.

Interviewees were asked about:

- Their relationship to Keaʻau-Pāhoa road (proximity, importance, involvement).
- What they value about Puna, their immediate community, their ideal vision for Puna in 2030, and the major changes needed to realize this ideal state
- Frequency and purpose of travel on the road, positive or negative experiences
- Awareness of the KPAG and public involvement efforts
- Opinions on the need to improve Keaʻau-Pāhoa Road and project alternatives
- Referrals for other worthwhile persons to interview

A broad cross section of the community was contacted. In addition, efforts were made to include Title VI target populations (Environmental Justice groups) in the issues analysis so that the needs of these target populations were directly expressed or reflected in interview input. This was achieved by eliciting participation from:

- Residents in all communities abutting the project corridor, particularly those with a high presence of Title VI target populations,
- Service providers who serve these target populations and are aware of their needs, including health care, educational, youth-at-risk programs, transportation, civil defense and police protection services,
- People in various walks of life, lifestyles and levels of use of the project corridor, and
- People with varying levels of awareness and participation in community efforts, with an emphasis on those who may not be active in organized efforts.

A total of 39 people were ultimately interviewed for this study. **Appendix G: Social Impact Assessment** provides detail on the 39 persons, their community affiliations, occupations, location of residence, etc. Of the 39 interviewees, 30 lived in Puna, of whom 25 lived in the Immediate Study Area communities along Keaʻau-Pāhoa Road (see **Section 3.3.1.5: Immediate**

Study Area Demographics in 2000 Census for definition of these communities). Nine people, who were public and community service providers, lived outside Puna. Affiliations included:

- Community services (educational and education-related transportation services, medical services, police protection and civil defense)
- Hawaiʻi County or Puna organizations, including the PCDP steering committee
- Business and land owners
- Community Associations or related services
- Other affiliations. Four persons were cyclists. Seven are members of KPAG. KPAG members were contacted because of other affiliations.

Of 32 people who reside in or serve Puna, ten lived in Puna for ten or less years and five lived in the area for ten to 19 years. Nine people had moved to Puna 20 or more years ago, and six were lifelong residents of the Puna district.

The discussions that follow summarize the findings of the community interviews.

4.3.1.1 Community Feelings About Puna

What People Valued Most About Puna

Interviewees commonly expressed four characteristics that they valued about the Puna region and their own community:

- They appreciated that Puna still contains large areas of open and undeveloped land.
- They appreciated that houses and land were affordable in such a desirable setting.
- They valued the overall sense of community, diversity, and striving for a common good or helping each other.
- They valued that the undeveloped and open nature of Puna and its people led to a "country lifestyle." This was described in many ways, including slow paced, no-hurry, mellow, and, as "the broad grasp of laid back old Hawaiian style."

They also noted that Puna is rich in resources: good agricultural land, ample rainfall, resources for renewable energy, and other options to increase sustainability.

Ideal Puna in 2030

While there was a general desire for things to stay the same, it was recognized that changes are coming as Puna's lots continue to be developed. Interviewees' ideal Puna was therefore related to improving services and growth management, while maintaining as much of the natural environment and lifestyle as possible.

- *Increased services* - Health care and medical services were especially important, particularly for communities with large proportions of retirees. Parents with children spent time commuting to jobs. Puna needed more choices in recreational facilities and health care and

medical services. Better police protection was commonly cited as a need that has not kept pace with the growth of the area, especially police per beat and shift. The need for improved fire protection was also expressed.

- *Improved infrastructure* - Infrastructure has not kept pace with growth. Paving of internal roads, extension of the water system, and sanitary sewers were all considered part of the ideal Puna in 2030.
- *Sustainable communities* - Interviewees were eager to see the realization of town and village centers and an increase in regional businesses so that people can work and shop in their own communities. Town and village centers should support the presence of mom-and-pop stores, small businesses and basic services. The region needs to attract qualified medical professionals so that the level of health care improves.
- *Connectivity* - Interviewees wanted connections between subdivisions other than Keaʻau - Pāhoa Road. They also felt transportation is more than roads, and includes transit and bike facilities. They want dedicated bus lanes, park-and-ride facilities, better bus shelters and more effective bus pullouts. Occasionally, an interviewee extended his and her vision to include light rail, trams and pedestrian overpasses.

Changes Needed to Realize the Ideal Puna

Interviewees felt that people need to change their attitudes to realize the ideal Puna:

- Learn to speak up when it counts so that the "vocal minority" does not dictate what happens in Puna.
- Be willing to sacrifice for the greater good.
- Get rid of the "wild wild west" mentality of ruggedness and self-sufficiency that minimizes or trivialize the need for services and facilities appropriate for the region.
- Be willing and open to working with landowners, developers and businesses and avoide the "us-and-them" attitude.

In addition to attitude changes, they feel Puna needs better representation and leadership to receive an equitable share of public services, facilities, and timely infrastructure improvements.

4.3.1.2 Use and Experience with Keaʻau-Pāhoa Road

About half of those interviewed needed to travel along the project corridor every day because of work and school commutes; often during peak times. The other half used Keaʻau-Pāhoa Road on an as-needed basis, or had flexibility to schedule travel during non-peak times.

Interviewees had no positive experiences on Keaʻau-Pāhoa Road. Only one person stated his experience was neutral; he selected travel times for non-peak hours and experienced no problems.

The level of negative experiences was related to the hour of travel. Peak hour travel was always perceived as negative. Interviewees noted safety concerns: unsafe intersections,

inconsiderate and impatient motorists, speeding, motorists passing on the right using the shoulder, motorists slowing to turn without using turn signals, and people carelessly pulling out of driveways. Interviewees expressed frustration about long travel times and congestion.

4.3.1.3 Feelings About Project Alternatives

All interviewed agreed with the need to improve Keaʻau-Pāhoa Road. Reasons included:

- Roadway safety for motorists, cyclists and pedestrians;
- The need to relieve existing traffic congestion; and
- The need to plan for future growth.

Interviewees, were asked to identify positive and negative aspects of project alternatives.

Comments on Alternative 3

Interviewees felt that the most positive aspect of Alternative 3 is its feasibility and timing. It was felt that this alternative could be completed sooner than the other build alternatives, and that it will immediately reduce congestion in the most populated areas. Negative comments related to the creation of a bottleneck at Ainaloa Boulevard and Alternative 3's long-range effectiveness. It was felt that this is a band-aid alternative, and will not handle traffic efficiently as the region continues its growth trend.

Comments on Alternative 4

Alternative 4 elicited the most positive comments. It was felt that this alternative would solve immediate problems and provide some degree of future capacity, especially with anticipated growth in Pāhoa. A consistent four-lane corridor was felt to treat all communities equitably.

Negative characteristics related to long-range limitations on traffic flow; interviewees feared the region would eventually outgrow the four-lane road. Also, an extended four-lane highway would encourage faster speeds, whereas the PCDP encouraged reducing vehicular speed. One person felt Alternative 4 is "overkill," and would encourage more growth in the corridor.

Comments on Alternative 5

Positive characteristics of Alternative 5 related to long-term traffic demand since communities adjacent to the six-lane portion between the Keaʻau Bypass and Paradise Drive have the most undeveloped lots. Alternative 5 was thus seen as logical for the future.

However, Alternative 5 elicited the most negative comments related to its sheer width, the creation of two bottlenecks/merges (at Paradise Drive and Kahakai Boulevard), and its feasibility. The six-lane portion was described as a freeway, contrary to the rural nature of the region. It was feared that a road of this magnitude would encourage increased speeds, and present more safety problems.

In terms of feasibility, Alternative 5 was considered very costly for construction and property acquisition. The perceived level of property acquisition was considered negative, since it would be difficult to achieve public acceptance if property owners vehemently opposed

condemnation. Interviewees believed that a six-lane roadway was not compatible with the many driveways in the corridor.

Comments Common to All Build Alternatives

- Driveways along Keaʻau-Pāhoa Road prohibit the development of a true limited access road, and there is no simple solution to reducing the number of driveways.
- Regardless of the alternative, there is a great need for PMAR and alternative routes between subdivisions. Three people strongly felt that this project should only proceed in concert with planning for PMAR and subdivision connection roads.
- While signalized intersections improve safety and traffic flow, there is concern they will encourage strip commercial development in the corridor.
- Roundabouts were viewed positively or negatively to those aware of them. Advocates of efficient traffic flow felt roundabouts would not work because of the need for lower speeds and few travel lanes. Advocates of lower speeds supported roundabouts.
- Interviewees were concerned about the rural setting becoming too urban, and that the wider the highway, the more urban the region would become. Those using Keaʻau-Pāhoa Road daily were willing to make compromises whereas those with discretionary use of the road wanted to explore options other than improving the corridor.
- Interviewees want the selected alternative to accommodate alternatives to vehicular traffic. Bus lanes, bike facilities and safe pedestrian crossings and walkways were considered a must.

4.3.1.4 Conclusions About Community Opinion

The following general conclusions came out of the SIA interviews:

1. *There is strong expectation for some level of improvement of the Keaʻau - Pāhoa Road.*

Interviewees agreed with the need to improve the corridor. All interviewed acknowledged the region will continue to grow faster than the rest of Hawaiʻi County, and existing Keaʻau-Pāhoa Road is tangible, daily evidence of the need to upgrade the region's infrastructure.

2. *Dependency on Keaʻau-Pāhoa Road directly relates to the level of urgency to improve the corridor.*

The more dependent one is upon Keaʻau-Pāhoa Road, the stronger the urgency to implement improvements. Daily users who depend on Keaʻau-Pāhoa Road for work and school trips felt that something needed to be done now. While they expressed the need to explore options like alternative routes and transit, they opposed delays while such studies are being conducted. Travelers who use Keaʻau-Pāhoa Road on an as-needed or selective basis also felt urgency to improve the corridor, but were more open to explore regional and transportation alternatives and were less concerned about the timing of the project.

3. *Interviewees in the Northeast portion of the Immediate Study Area tended to express needs suggested by demographic information.*

As discussed in **Section 3.3.1.3: Puna District Characteristics from 2000 Census**, residents in Northeast Puna, which includes Kea‘au, Hawaiian Paradise Park, Orchidland and Ainaloa, had a lower median age, larger households, a higher presence of families, and larger families. This suggests that these communities had a high presence of young families whose employment and educational needs require a daily commute in the corridor. Residents of Hawaiian Paradise Park and Ainaloa tended to indicate that they were daily users of Kea‘au-Pāhoa Road.

4. *People seek balance between transportation solutions and the level of improvements.*

Collectively, interviewees sought to balance Puna’s rural quality while addressing existing problems and future needs with conventional solutions. Roadway widening, traffic signals and raised medians were viewed as conventional solutions to congestion typically found in urban or suburban areas. While interviewees accepted some of these conventions, tolerance for change varied. A four-lane Kea‘au-Pāhoa Road was cautiously accepted for various reasons.

Many participants drew the line at a six-lane cross-section, likening it to a freeway, and felt it was too urban. Interviewees accepting Alternative 5 felt it effectively addresses long term transportation demand, though it seemed infeasible given its cost and community opposition.

4.3.2 Social Impacts Anticipated on the Project

4.3.2.1 Community Expectations

The SIA attempted to address how the Puna community will adapt to changing conditions. Over the last 30 years, lower Puna has transformed from a predominantly rural agricultural landscape with two small towns to a mixture of larger residential lots, smaller residential lots, two small towns, flower/fruit farms, and neighborhood shopping centers. Puna has increased from 5,100 residents in 1970 to over 47,000 people in 2007. This transformation evolved socially from isolated pockets of hardy pioneers to subdivision communities with residents from all over the world.

The PCDP seeks to address the different community expectations of Puna’s diverse lifestyles in a common context. It presents recommendations based on three themes: mālama i ka ‘āina (preservation and respect for the land), growth management and transportation. Collectively, these three themes allow the community to protect what is valued, while striving for a future that accommodates the range of expectations held by a diverse group of people. While mālama i ka ‘āina protects that which already exists and is commonly valued, growth management advocates changes that meet the growing needs of a diverse community within the context of the rural landscape.

The KPAG outlined its community expectations in its purpose and need statement, covered in greater detail in **Chapter 1: Purpose and Need for Project** as follows:

- Improve roadway safety
- Configure the road for safe use by transit vehicles and school buses, bicycles, pedestrians and agriculture vehicles
- Improve corridor mobility and capacity to meet future demand
- Respect the natural beauty of Puna
- Complement creation of an alternate road that can be used both as an additional travel route and for emergency use
- Be context sensitive in use of materials and sustainability
- Respond to intra-regional connectivity needs and future land use strategies such as Village Center

4.3.2.2 Project Relationship to Community Expectations

Generally Consistent With Public Plans and Policies

Puna's significant growth and settlement patterns are fundamental to the public plans and policies reviewed in **Section 4.1.1: Consistency with Government Plans, Policies and Controls**, and the need to improve Keaʻau-Pāhoa Road is repeatedly expressed. The proposed project is generally consistent with these objectives.

Further, regardless of the selected alternative, the proposed project is consistent with community expectations regarding the improvement of Keaʻau-Pāhoa Road to improve roadway safety, allow multi-modal uses along the corridor and increase mobility and capacity. It will also generally address the PCDP recommended actions for the corridor.

Change in Character of Immediate Area

In the larger context of respecting the regional character and creating an alternate road, the project itself has limited opportunities to be in complete harmony with these objectives. Regardless of the alternative, widening and improving Keaʻau-Pāhoa Road will result in increased surfaces covered with asphalt, visual demarcations, raised medians, traffic signals, possible roundabouts and signage typical of urban environments. This alteration in character of the immediate area is a direct and unavoidable impact.

Create an Alternate Route

Though part of the regional roadway system, the proposed project cannot, nor is it intended to, meet all the requirements of the regional system outlined in the PRCP and PCDP. The project corridor is under State jurisdiction. The responsibility for planning alternate routes or series of routes lies with the County of Hawaiʻi. Further, the future of alternate routes is unknown at this time. While funding for preliminary engineering and environmental studies for a Puna Makai Alternate Route, or PMAR, is included in the Hawaiʻi County Capital Improvement Program, the monies have not been released as of this writing.

4.3.3 Impacts on Environmental Justice Communities

As described in greater detail in **Section 3.3.2: Environmental Justice Communities in Immediate Study Area**, Title VI of the Civil Rights Act of 1964 and Executive Order 12898 are the primary laws that direct federal agencies to avoid discrimination of minority and low-income populations by ensuring that federal actions do not result in disproportionately high and adverse human health or environmental effects on minority and low-income populations. This concept is referred to as "Environmental Justice" and low-income and minority populations are referred to below as "Environmental Justice communities."

In 2006, the State of Hawaiʻi enacted Act 294 (2006), which called for the Chapter 343 process to consider Environmental Justice in the context of Hawaiʻi's unique ethnic composition, where no group is a "majority." Guidance by the State of Hawaiʻi Environmental Council recommended consideration of project effects on "under-represented populations," specifically Native Hawaiian, minority, and/or low-income persons.

Through its title VI/Environmental Justice Programs in the Office of Civil Rights (OCR), HDOT's latest Title VI Plan (January 18, 2009) outlines its policies and procedures for compliance with Title VI, Executive Order 12898 and Act 294.

A detailed breakdown of low-income persons near Keaʻau-Pāhoa Road is described in **Section 3.3.2.1: Low-Income Communities in Immediate Study Area**. In summary, there are some notable pockets of poverty within the study area based on 2000 Census data:

- Over one-fifth of families in Orchidland, Ainaloa, Hawaiian Acres, Hawaiian Beaches / Hawaiian Shores and Nanawale had incomes below poverty level.
- 22 percent of families in South Puna had income below the poverty level
- Notably high levels of poverty were found in families headed by single females in Ainaloa (77.3 percent), Nanawale (57.4 percent), Orchidland (50.0 percent), Hawaiian Beaches (49.5 percent) and Pāhoa (47.2 percent).

A detailed racial breakdown of the area near Keaʻau-Pāhoa Road is provided in **Section 3.3.2.2: Racial Minorities in Immediate Study Area**. In summary, the study area is very racially diverse. Based on 2000 Census data, there are some notable under-represented minority populations within the study area, at levels higher than the county as a whole:

- Native Hawaiian and other Pacific Islanders comprised 12.3 percent of Pāhoa.
- Native Hawaiians and other Pacific Islanders were also well-represented in Nanawale (21.2 percent), Hawaiian Beaches (13.5 percent), Orchidland (12.9 percent) and Ainaloa (12.2 percent).

Therefore, the study area has a high presence of Title VI/Environmental Justice target populations.

While it will have minimal direct effects, the No-Build Alternative (Alternative 1) will have an adverse impact on Environmental Justice populations. Residents of Lower Puna have indicated a perception that their district and area has been underserved by community services and

investments, including provision of transportation, and the No-Build Alternative will generally maintain the status quo. As congestion worsens, this will have an adverse effect on the quality of life for Environmental Justice populations. It will be more difficult for these persons to gain access to work, social services, education, and healthcare. Safety will remain a growing concern for this group, including motorists, bicyclists, transit users, and pedestrians.

The TSM Alternative (Alternative 2) will make modest improvements to transportation in the corridor, with few direct adverse effects, but it will not achieve the purpose and need for the project. While it will not have an adverse effect on underserved minority or low-income persons, it will not represent a substantial investment in the community that has been called for by members of the public. Congestion will still increase.

The Build Alternatives (Alternatives 3, 4, and 5) will generally have beneficial effects to Environmental Justice populations. Potential impacts of Alternatives 3, 4, and 5 specific to these populations include:

- *Improvement of traffic circulation* - Adverse impacts defined by HDOT in its Title VI plan include "increased traffic congestion, isolation, exclusion or separation of racial or ethnic minority or low-income individuals within a given community or from the broader community." The proposed project will improve vehicular circulation, thereby providing for safer and more efficient travel from one community to another, as well as to services, such as health care and schools, goods and employment.
- *Improved emergency access* - The proposed project will provide for faster and more efficient emergency access to communities all along the proposed corridor, thereby ensuring equal access to Title VI/Environmental Justice target populations.
- *Provisions for multi-modal transportation* - Owning a vehicle may be prohibitive for those with low incomes, and alternative means of transportation will provide equitable options. The Hele-On bus system is presently free for all passengers, which is a notable benefit for Title VI/Environmental Justice populations that are transit-dependent. The proposed project will enhance transit and other multi-modal opportunities by including a widened shoulder for bicycles and pedestrians, and bus pullouts. These amenities will enhance transportation venues for the target populations.
- *Supportive of village centers* - The project is intended to support village, community and neighborhood centers, as proposed in the PCDP. For Environmental Justice populations, these centers will help to lower transportation costs and provide economic and lifestyle choices.
- *Increased Safety* - The project will provide a much safer environment to people using all modes of travel, including transit-dependent persons, bicyclists, and pedestrians that are members of Environmental Justice groups. Motorists will benefit as well.
- *Equitable Investment to Environmental Justice Populations* - The project will reflect a direct investment in a community that has been underserved by public investments in infrastructure. As described in **Section 3.3.2.3: Incorporation of Title VI and Environmental**

Justice Requirements into the Proposed Project, a Sustainability Committee, comprised of citizens of Puna and Kaʻu, filed a discrimination complaint in 2000 against HDOT and Hawaiʻi County to address discriminatory planning in the Hawaii Long Range Transportation Plan. The Federal Highway Administration (FHWA) concluded that evidence supported the allegations and that HDOT had discriminated by failing to recognize actual land uses, economic development, and multi-modal needs of low-income communities. The Puna Regional Circulation Plan (PRCP) considered the effects of circulation and transportation on minority and low-income groups, and recommended improvement of Keaʻau-Pāhoa Road as a way to address Title VI requirements.

The design of the project has been focused on minimizing direct impacts to adjacent parcels and avoiding relocations wherever possible. Upon selection of a preferred alternative, HDOT will identify those properties that will require right-of-way acquisition or relocations that may be occupied by those with low incomes. The acquisition of dwellings and businesses or portions of property will need to be conducted according to the HDOT Right-of Way Procedure Manual to ensure equitable treatment of all businesses and persons. Further, during construction, Title VI reviews of program activities will be needed to ensure compliance and appropriate corrective actions.

For all the reasons cited above, the Build Alternatives (Alternatives 3, 4, and 5) will not have a disproportionately high and adverse human health or environmental effect on minority and low-income populations.

4.3.4 Impacts on Community Facilities

4.3.4.1 Medical Facilities

Keaʻau-Pāhoa Road is a primary route from the Immediate Study Area to Hilo Hospital, and is central to the service populations of regional facilities. All alternatives other than No-Build will have a positive impact on for those traveling to and from these facilities. They will improve existing traffic flow and safety conditions. As the project proceeds, it is recommended that medical facilities in the area be included in information programs to help staff and facility patients prepare for construction-related activities that may affect travel to and from these facilities.

Increasing congestion under the No-Build Alternative will likely compromise access to medical facilities.

4.3.4.2 Educational Facilities

All alternatives other than No-Build will have a positive impact on the students and staff of the area's schools because they will improve existing traffic flows and safety conditions, and accommodate the projected enrollment increases. As the project proceeds, it is recommended that school officials and parent groups be included in information programs to help them in prepare for construction-related changes.

Increasing congestion under the No-Build Alternative will likely compromise access to educational facilities.

4.3.4.3 Police Services

Currently, emergency vehicles are slowed by traffic congestion conditions, particularly during traffic peak hours. The No-Build Alternative will result in a worsening of this condition as congestion increases over time. All alternatives other than No-Build will positively impact police protection services by improving traffic flow and safety conditions. Further, the project build alternatives that add travel lanes (Alternatives 3, 4, and 5) will significantly improve the passage of emergency vehicles.

A wider highway as found in Alternatives 3, 4, and 5 may also encourage aggressive driving actions, and consultation with the Hawaiʻi Police Department is recommended to coordinate roadway improvements that could deter such actions.

4.3.4.4 Fire/EMS Services

Currently, emergency vehicles are slowed by traffic congestion conditions, particularly during traffic peak hours. The No-Build Alternative will result in a worsening of this condition as congestion increases over time. All alternatives other than No-Build will positively impact police protection services by improving traffic flow and safety conditions. Further, the project build alternatives that add travel lanes (Alternatives 3, 4, and 5) will significantly improve the passage of emergency vehicles. Currently, emergency vehicles are slowed by traffic congestion conditions, particularly during traffic peak hours.

4.4 Air Quality

There are several different types of air impacts that are considered in this section. To assess the potential long-term impact of emissions from vehicles operating on roadways within the project corridor, both microscale (intersection-level) and mesoscale (regional-level) analyses were performed, and a qualitative assessment of mobile source air toxics was prepared as well. There are also potential short-term impacts that would occur during construction from fugitive dust and machinery emissions, and these temporary impacts are considered as well.

The federal and state Ambient Air Quality Standards (AAQS) were identified previously in **Section 3.4: Climate and Air Quality**.

4.4.1 Microscale Air Quality Impacts

In most traffic-related air quality assessments, roadway intersections are one of the primary concerns because of traffic congestion and because of the increase in vehicular emissions associated with traffic queuing. To investigate potential air quality impacts near roadway intersections within the project area, microscale analyses were performed for selected locations using computerized emission and atmospheric dispersion models to estimate worst-case ambient carbon monoxide concentrations. Carbon monoxide (CO) was selected for the

microscale analyses because it is both the most stable and the most abundant of the pollutants generated by motor vehicles. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem that can be addressed locally to some extent, whereas other air pollutants most often are regional issues that cannot be addressed by a single highway improvement.

The selected locations for microscale analyses included eight representative intersections along the project corridor that were selected based upon high levels of existing and future delay, either for the entire intersection, or for particular traffic movements. Thus, these locations are expected to be representative of areas within the project study area where air quality impacts may be greater. The eight intersections studied were:

- Keaʻau-Pāhoa Road at Opukahaia Street
- Keaʻau-Pāhoa Road at Shower Drive
- Keaʻau-Pāhoa Road at Kaloli Drive
- Keaʻau-Pāhoa Road at Orchidland Drive
- Keaʻau-Pāhoa Road at Paradise Drive
- Keaʻau-Pāhoa Road at Ilima Street
- Keaʻau-Pāhoa Road at Old Pāhoa Road
- Keaʻau-Pāhoa Road at Kahakai Boulevard

In the future with the Build Alternatives, intersections at Shower Drive, Kaloli Drive, Orchidland Drive, Paradise Drive, Old Pāhoa Road and Kahakai Boulevard were assumed to be signalized. While the traffic study has recommended a roundabout as a potential option at Kahakai Boulevard, for the purposes of this analysis, signalization likely provides a worst case as vehicle queues and delays at roundabouts are generally lower than at a signal in the same location. Therefore, modeling was only performed for a traffic signal at this location.

The main objective of the microscale analyses was to estimate worst-case one-hour average carbon monoxide concentrations for each of the scenarios studied. Five scenarios were studied for the microscale analyses. These included the existing (2006) case and the 2038 No-Build and Build Alternatives (3, 4, and 5). The TSM alternative was not modeled because it would not add any capacity to Keaau-Pahoa Road, and thus was not a realistic scenario as it would not meet the purpose and need for the project. In addition, the No-Build Alternative constitutes a worst-case compared to the TSM scenario.

Based on the traffic study, traffic volumes generally are or will be higher during the afternoon peak hour than during the morning peak period. However, worst-case emission and meteorological dispersion conditions typically occur during the morning hours at most locations. Thus, both AM and PM peak traffic hours were examined to ensure that worst-case concentrations were identified.

The US EPA's emission rate model MOBILE6.2 was used to determine vehicle emission rates for the years studied and the approach speeds of both moving and idling traffic. The EPA's atmospheric dispersion model CAL3QHC was then used to calculate CO concentrations based on vehicle movement, vehicle queuing, and atmospheric dispersion near the intersections.

CAL3QHC predicts one-hour average pollutant concentrations near roadway intersections based on input traffic and emission data, roadway/receptor geometry and meteorological conditions. Although CAL3QHC is intended primarily for use in assessing atmospheric dispersion near signalized roadway intersections, it can also be used to evaluate unsignalized intersections using estimated queue lengths, and for this study, both types of intersections were modeled.

A number of meteorological inputs were defined to provide "worst-case" results. As a result, the determined values should be considered conservative.

Existing background concentrations of CO in the project vicinity are believed to be at relatively low levels. Hence, background contributions of carbon monoxide from sources or distant roadways not directly considered in the analysis were accounted for by adding a small background concentration of 0.5 parts per million (ppm) to all predicted concentrations for 2006. Although substantial development and increased traffic are expected to occur within the project area in the future, background CO concentrations may not change significantly since individual emissions from motor vehicles are forecast to decrease with time. Hence, a background value of 0.5 ppm was assumed to persist for the 2038 scenarios that were studied.

A summary of the calculated one-hour ambient CO concentrations in milligrams per cubic meter is found in **Table 4-30: Modeled One-Hour CO Concentrations at Corridor Intersections (mg/m3)**. The locations of these estimated worst-case one-hour concentrations all occurred at or very near the intersections.

Table 4-30: Modeled One-Hour CO Concentrations at Corridor Intersections (mg/m^3)

Intersection of Kea'au-Pāhoa Road With:	2006 Existing		2038 No-Build		2038 Alternative 3		2038 Alternative 4		2038 Alternative 5	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Opukahaia Street	7.2	3.8	4.8	3.2	4.8	3.1	4.8	3.1	4.5	3.0
Shower Drive	8.4	3.7	5.4	3.2	5.1	3.1	5.1	3.1	4.5	3.0
Kaloli Drive	6.3	3.7	5.9	3.1	5.5	2.4	5.5	2.4	5.1	2.8
Orchidland Drive	5.0	3.2	5.0	2.6	5.2	2.8	5.2	2.8	4.6	2.8
Paradise Drive	4.1	3.4	4.9	2.8	4.4	2.3	4.4	2.3	3.9	2.2
Ilima Street	4.2	2.4	4.4	2.4	3.7	2.3	3.7	2.3	3.7	2.3
Old Pāhoa Road	4.5	2.8	5.0	2.4	5.1	2.6	4.3	2.6	4.3	2.6
Kahakai Boulevard	6.2	2.6	5.0	2.4	3.4	1.7	3.0	1.7	3.4	1.7
One-Hour CO State of Hawai'i Ambient Air Quality Standard: 10 mg/m^3										
One-Hour CO National Ambient Air Quality Standard: 40 mg/m^3										

Source: BD Neal and Associates

As indicated in the table, the highest estimated worst-case one-hour concentration for the existing (2006) scenario was 8.4 mg/m^3, and this occurred during the morning at the intersection of Kea'au-Pāhoa Road and Shower Drive. Worst-case values for other locations

ranged from 2.4 to 7.2 mg/m^3. These concentrations are within both the national AAQS of 40 mg/m^3 and the state standard of 10 mg/m^3.

In the year 2038, under the No-Build scenario, the predicted highest worst-case one-hour concentration occurred during the morning at the intersection of Kea'au-Pāhoa Road and Kaloli Drive with a value of 5.9 mg/m^3, which is about 30 percent lower than the existing case. Other concentrations for this scenario ranged between 2.4 and 5.4 mg/m^3. For the 2038 No-Build scenariot, CO concentrations were predicted to decrease compared to the existing case at locations in the northern portion of the project corridor and increase at several locations in the southern portion of the corridor. Even with the increase in carbon monoxide concentrations in the southern portion of project corridor, worst-case values modeled are within the state and federal standards at all locations.

In the year 2038 under Alternatives 3, 4 and 5, the results would be substantially the same. CO concentrations were predicted to be lower than the No-Build Alternative and lower than 2006 levels at most locations. In all three Build Alternatives, the highest worst-case concentration was predicted to occur during the morning at the intersection of Kea'au-Pāhoa Road and Kaloli Drive. A worst-case one-hour concentration of 5.5 mg/m^3 was predicted to occur at this location and time for Alternatives 3 and 4, and a slightly lower concentration of 5.1 mg/m^3 was predicted to occur with Alternative 5. At all of the intersections that were studied, CO concentrations under Alternative 5 were slightly lower than or equal to those for Alternatives 3 and 4. Worst-case one-hour concentrations for all alternatives at all locations studied are calculated to remain well within both the national and state standards in 2038.

For an eight-hour averaging period, worst-case CO concentrations were estimated by multiplying worst-case one-hour values by a persistence factor of 0.5. This accounts for two factors:

- traffic volumes averaged over eight hours are lower than peak one-hour values, and
- meteorological conditions are more variable (and hence more favorable for dispersion of pollutants) over an eight-hour period than they are for a single hour.

The use of a persistence factor is standard practice and has been based upon a number of studies that consider both monitoring and modeling results, as well as guidelines from the US EPA and the Hawai'i Department of Health. Considering the location of the project and the traffic pattern for the area, a one-hour to eight-hour persistence factor of 0.5 will likely yield reasonable estimates of worst-case eight-hour concentrations.

The resulting estimated worst-case eight-hour concentrations are indicated in **Table 4-31: Modeled Eight-Hour CO Concentrations at Corridor Intersections (mg/m3)**. For existing (2006) conditions, the estimated worst-case eight-hour carbon monoxide concentrations for the eight locations studied ranged from 2.0 mg/m^3 at the Paradise Drive intersection to 4.2 mg/m^3 at the intersection of Kea'au-Pāhoa Road and Shower Drive. Both these concentrations were within both the national limit of 10 mg/m^3 and the state standard of 5 mg/m^3.

Table 4-31: Modeled Eight-Hour CO Concentrations at Corridor Intersections (mg/m^3)

Intersection of Keaʻau-Pāhoa Road With:	2006 Existing	2038 No-Build	2038 Alternative 3	2038 Alternative 4	2038 Alternative 5
Opukahaia Street	3.6	2.4	2.4	2.4	2.2
Shower Drive	4.2	2.7	2.6	2.6	2.2
Kaloli Drive	3.2	3.0	2.8	2.8	2.6
Orchidland Drive	2.5	2.5	2.6	2.6	2.3
Paradise Drive	2.0	2.4	2.2	2.2	2.0
Ilima Street	2.1	2.2	1.8	1.8	1.8
Old Pāhoa Road	2.2	2.5	2.6	2.2	2.2
Kahakai Boulevard	3.1	2.5	1.7	1.5	1.7
Eight-Hour CO State of Hawaiʻi Ambient Air Quality Standard: 5 mg/m^3					
Eight-Hour CO National Ambient Air Quality Standard: 10 mg/m^3					

Source: BD Neal and Associates

For the No-Build Alternative in 2038, worst-case CO concentrations decreased at four of the eight locations studied compared to 2006 conditions. Concentrations increased slightly at three locations and remained unchanged at one location. Worst-case concentrations ranged from 2.2 mg/m^3 at the intersection of Keaʻau-Pāhoa Road and Ilima Street to 3.0 mg/m^3 at the intersection of Keaʻau-Pāhoa Road and Kaloli Drive. Even with the predicted increases at some locations, all predicted eight-hour concentrations under No-Build were within both the national and the state AAQS.

There was little difference predicted among the three Build Alternatives for 2038. All three alternatives provided a reduction in worst-case CO concentrations at most locations studied compared to both the 2038 No-Build and 2006 existing scenarios. Alternative 5 would provide for the lowest (best) worst-case concentrations. Worst-case concentrations generally ranged between 1.5 and 2.8 mg/m^3 with the highest concentration occurring at the intersection of Keaʻau-Pāhoa Road and Kaloli Drive. All predicted eight-hour concentrations for all Build Alternatives in 2038 were well within both the national and the state standards.

It should be noted that many of the assumptions in this study were extremely conservative. For example, the modeling assumes a wind speed of one meter per second with a steady direction will occur for a full hour. A steady wind of one meter per second blowing from a single direction for an hour is extremely unlikely and may occur only once a year or less, and the modeling assumes it would occur during the peak hour of traffic. With wind speeds of two meters per second, for example, computed CO concentrations would be only about half the values given above. The eight-hour estimates are also conservative in that it is unlikely that anyone would occupy the assumed receptor sites (within three meters of the roadways) for a period of eight hours.

In general, mitigation of long-term traffic related air pollution is not warranted on this project, given that standards are not anticipated to be exceeded and changes in pollution levels will

generally be beneficial or neutral. Impacts from vehicular emissions could be reduced through travel demand measures such as encouraging use of carpools and transit, adjusting school and business hours, and encouraging telecommuting. While the project will be supportive of increased transit use, the other measures would be beyond the control of HDOT. Provision of roundabouts where feasible would offer another measure for further reducing pollution levels.

4.4.2 Mesoscale Air Quality Impacts

The regional emissions associated with the project were considered as part of the mesoscale analysis, which evaluated daily and annual emissions from the roadway. The mesoscale analysis was designed to quantify gross levels of project-related emissions of carbon monoxide (CO), nitrogen oxides (NOx) and volatile organic compounds (VOC) occurring within the study area for 2006 and for the project alternatives in 2038. The mesoscale analysis was primarily influenced by:

- Vehicle Miles of Travel, which will increase in the future
- Vehicle speed, as emissions are inversely proportional to vehicle speed below about 40 miles per hour; above about 40 miles per hour, emissions generally increase with speed
- Vehicle mix and year, as future emissions will decline when older, more-polluting vehicles are retired. A default national vehicle mix was used in the absence of local data.

Vehicle miles of travel and average speeds on each segment of road were derived from the project's traffic study. Emission estimates were then prepared for each scenario based on the estimated vehicle-miles of travel, average travel speeds, and emission factors obtained using the US EPA's current mobile emission computer model MOBILE6.2 and the variables noted above.

Table 4-32: Results of Mesoscale Analysis shows the calculated tons of pollutants generated each year from Kea'au-Pāhoa Road in the mesoscale analysis.

Table 4-32: Results of Mesoscale Analysis

Year and Alternative	Emissions (tons/year)		
	CO	NOx	VOC
2006 Existing	780	93	63
2038 No-Build Alternative	914	36	51
2038 TSM (Alternative 2)	909	36	54
2038 Alternative 3	945	37	56
2038 Alternative 4	955	37	55
2038 Alternative 5	930	36	50

Source: BD Neal and Associates

In comparison to the island-wide emissions in 1993 (the latest figures available) shown back in **Table 3-26: Air Pollution Emissions Inventory for Island of Hawaii, 1993**, emissions in the year

2006 from traffic within the project area were of a relatively small magnitude, but not insignificant. CO, NOx and VOC emissions from traffic in the project area during 2006 likely account for a few percent of total island-wide emissions.

By the year 2038, under the No-Build Alternative, CO emissions within the project area are estimated to increase by about 17 percent compared to existing emissions. On the other hand, VOC emissions are estimated to decrease by about 19 percent, and NOx emissions are estimated to decrease by about 61 percent.

There are no appreciable differences calculated between the other alternatives in 2038. The TSM Alternative would provide for slightly lower CO emissions than either the Build or No-Build Alternatives, while Alternative 5 would provide for slightly lower VOC emissions and would have the lowest CO emissions of the three build alternatives . Neither the TSM nor the Build Alternatives would result in substantial changes in the amounts of emissions compared to No-Build.

It should be noted that the estimated emissions under the TSM and Build Alternatives may not fully reflect some of the potential benefits for the proposed roadway improvements in terms of the area-wide emissions from motor vehicle traffic. The emission estimates given above pertain only to traffic using Keaʻau-Pāhoa Road. Intersections along the roadway would be improved under all alternatives except No-Build, and this is expected to improve traffic flow on cross streets at these intersections, which would serve to reduce traffic queuing and reduce excess emissions from cross-street traffic idling and accelerating at the intersections.

4.4.3 Mobile Source Air Toxics

In addition to the criteria air pollutants for which there are National Ambient Air Quality Standards (NAAQS), the US EPA also regulates air toxics. Most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (e.g., airplanes), area sources (e.g., dry cleaners) and stationary sources (e.g., factories or refineries). Mobile Source Air Toxics (MSATs) are a subset of the 188 air toxics defined by the Clean Air Act. The MSATs are compounds emitted from highway vehicles and non-road equipment. Some toxic compounds are present in fuel and are emitted to the air when the fuel evaporates or passes through the engine unburned. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Metal air toxics also result from engine wear or from impurities in oil or gasoline.

The EPA is the lead Federal Agency for administering the Clean Air Act and has certain responsibilities regarding the health effects of MSATs. The EPA issued a Final Rule on Controlling Emissions of Hazardous Air Pollutants from Mobile Sources on March 29, 2001. This rule was issued under the authority in Section 202 of the Clean Air Act. In its rule, EPA examined the impacts of existing and newly promulgated mobile source control programs, including its reformulated gasoline (RFG) program, its national low emission vehicle (NLEV) standards, its Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements, and its proposed heavy duty engine and vehicle standards and on-highway diesel fuel sulfur control requirements. Between 2000 and 2020, Federal Highway Administration

(FHWA) projects that even with a 64 percent increase in VMT, these programs will reduce on-highway emissions of benzene, formaldehyde, 1,3-butadiene, and acetaldehyde by 57 percent to 65 percent, and will reduce on-highway diesel PM emissions by 87 percent. As a result, EPA concluded that no further motor vehicle emissions standards or fuel standards were necessary to further control MSATs. The agency is preparing another rule under authority of the Clean Air Act (CAA) Section 202(l) that will address these issues and could make adjustments to the full 21 and the primary six MSATs.

4.4.3.1 Unavailable Information for Project Specific MSAT Impact Analysis

This document includes a basic analysis of the likely MSAT emission impacts of this project. However, available technical tools do not enable prediction of the project-specific health impacts of the emission changes associated with the project alternatives. Due to these limitations, the following discussion is included in accordance with Council on Environmental Quality (CEQ) regulations (40 CFR 1502.22(b)) regarding incomplete or unavailable information.

Information that is Unavailable or Incomplete

Evaluating the environmental and health impacts from MSATs on a proposed highway project would involve several key elements, including emissions modeling, dispersion modeling in order to estimate ambient concentrations resulting from the estimated emissions, exposure modeling in order to estimate human exposure to the estimated concentrations, and then final determination of health impacts based on the estimated exposure. Each of these steps as outlined below is encumbered by technical shortcomings or uncertain science that prevents a more complete determination of the MSAT health impacts of this project.

- **Emissions:** The EPA tools to estimate MSAT emissions from motor vehicles are not sensitive to key variables determining emissions of MSATs in the context of highway projects. While MOBILE 6.2 is used to predict emissions at a regional level, it has limited applicability at the project level. MOBILE 6.2 is a trip-based model, and emission factors are projected based on a typical trip of 7.5 miles and on average speeds for this typical trip. This means that MOBILE 6.2 does not have the ability to predict emission factors for a specific vehicle operating condition at a specific location at a specific time. Because of this limitation, MOBILE 6.2 can only approximate the operating speeds and levels of congestion likely to be present on the largest-scale projects, and cannot adequately capture emissions effects of smaller projects. For particulate matter, the model results are not sensitive to average trip speed, although the other MSAT emission rates do change with changes in trip speed. Also, the emissions rates used in MOBILE 6.2 for both particulate matter and MSATs are based on a limited number of tests of mostly older-technology vehicles. Lastly, in its discussions of particulate matter under the conformity rule, EPA has identified problems with MOBILE6.2 as an obstacle to quantitative analysis. These deficiencies compromise the capability of MOBILE 6.2 to estimate MSAT emissions. MOBILE6.2 is an adequate tool for projecting emissions trends, and performing relative analyses between alternatives for very large projects, but it is not sensitive enough to capture the effects of travel changes tied to smaller projects or to predict emissions near specific roadside locations.

- **Dispersion.** The tools to predict how MSATs disperse are also limited. The EPA's current regulatory models, CALINE3 and CAL3QHC, were developed and validated more than a decade ago for the purpose of predicting episodic concentrations of carbon monoxide to determine compliance with the national ambient air quality standards. The performance of dispersion models is more accurate for predicting maximum concentrations that can occur at some time at some location within a geographic area. This limitation makes it difficult to predict accurate exposure patterns at specific times at specific highway project locations across an urban area to assess potential health risk. The National Cooperative Highway Research Program (NCHRP) is conducting research on best practices in applying models and other technical methods in the analysis of MSATs. This work also will focus on identifying appropriate methods of documenting and communicating MSAT impacts in the National Environmental Policy Act (NEPA) process and to the general public. Along with these general limitations of dispersion models, FHWA is also faced with a lack of monitoring data in most areas for use in establishing project-specific MSAT background concentrations.
- **Exposure Levels and Health Effects.** Finally, even if emission levels and concentrations of MSATs could be accurately predicted, shortcomings in current techniques for exposure assessment and risk analysis preclude us from reaching meaningful conclusions about project-specific health impacts. Exposure assessments are difficult because it is difficult to accurately calculate annual concentrations of MSATs near roadways, and to determine the portion of a year that people are actually exposed to those concentrations at a specific location. These difficulties are magnified for 70-year cancer assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over a 70-year period. There are also considerable uncertainties associated with the existing estimates of toxicity of the various MSATs, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population. Because of these shortcomings, any calculated difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with calculating the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against other project impacts that are better suited for quantitative analysis.

Summary of Existing Credible Scientific Evidence Relevant to Evaluating the Impacts of MSATs

Research into the health impacts of MSATs is ongoing. For different emission types, there are a variety of studies that show that some either are statistically associated with adverse health outcomes through epidemiological studies (frequently based on emissions levels found in occupational settings) or that animals demonstrate adverse health outcomes when exposed to large doses. Exposure to toxics has been a focus of a number of EPA efforts. Most notably, the agency conducted the National Air Toxics Assessment (NATA) in 1996 to evaluate modeled estimates of human exposure applicable to the county level. While not intended for use as a measure of or benchmark for local exposure, the modeled estimates in the NATA database best illustrate the levels of various toxics when aggregated to a national or State level.

The EPA is in the process of assessing the risks of various kinds of exposures to these pollutants. The EPA Integrated Risk Information System (IRIS) is a database of human health effects that may result from exposure to various substances found in the environment. The IRIS database is located at http://www.epa.gov/iris. The following toxicity information for the six prioritized MSATs was taken from the IRIS database *Weight of Evidence Characterization* summaries. This information is taken verbatim from EPA's IRIS database and represents the Agency's most current evaluations of the potential hazards and toxicology of these chemicals or mixtures.

- **Benzene** is characterized as a known human carcinogen.
- The potential carcinogenicity of **acrolein** cannot be determined because the existing data are inadequate for an assessment of human carcinogenic potential for either the oral or inhalation route of exposure.
- **Formaldehyde** is a probable human carcinogen, based on limited evidence in humans, and sufficient evidence in animals.
- **1,3-butadiene** is characterized as carcinogenic to humans by inhalation.
- **Acetaldehyde** is a probable human carcinogen based on increased incidence of nasal tumors in male and female rats and laryngeal tumors in male and female hamsters after inhalation exposure.
- **Diesel exhaust** (DE) is likely to be carcinogenic to humans by inhalation from environmental exposures. Diesel exhaust as reviewed in this document is the combination of diesel particulate matter and diesel exhaust organic gases.
- **Diesel exhaust** also represents chronic respiratory effects, possibly the primary noncancer hazard from MSATs. Prolonged exposures may impair pulmonary function and could produce symptoms, such as cough, phlegm, and chronic bronchitis. Exposure relationships have not been developed from these studies.

There have been other studies that address MSAT health impacts in proximity to roadways. The Health Effects Institute, a non-profit organization funded by EPA, FHWA, and industry, has undertaken a major series of studies to research near-roadway MSAT hot spots, the health implications of the entire mix of mobile source pollutants, and other topics. The final summary of the series is not expected for several years.

Some recent studies have reported that proximity to roadways is related to adverse health outcomes, particularly respiratory problems. Much of this research is not specific to MSATs, instead surveying the full spectrum of both criteria and other pollutants. The FHWA cannot evaluate the validity of these studies, but more importantly, they do not provide information that would be useful to alleviate the uncertainties listed above and enable one to perform a more comprehensive evaluation of the health impacts specific to this project.

Relevance of Unavailable or Incomplete Information to Evaluating Reasonably Foreseeable Significant Adverse Impacts on the Environment, and Evaluation of impacts based upon theoretical approaches or research methods generally accepted in the scientific community.

Because of the uncertainties outlined above, a quantitative assessment of the effects of air toxic emissions impacts on human health cannot be made at the project level. While available tools do allow us to reasonably predict relative emissions changes between alternatives for larger projects, the amount of MSAT emissions from each of the project alternatives and MSAT concentrations or exposures created by each of the project alternatives cannot be predicted with enough accuracy to be useful in estimating health impacts. (As noted above, the current emissions model is not capable of serving as a meaningful emissions analysis tool for smaller projects.) Therefore, the relevance of the unavailable or incomplete information is that it is not possible to make a determination of whether any of the alternatives would have "significant adverse impacts on the human environment."

Within this document, a quantitative analysis of MSAT emissions relative to the various project alternatives cannot be provided, and it is acknowledged that the project alternatives may result in increased exposure to MSAT emissions in certain locations, although the concentrations and duration of exposures are uncertain, and because of this uncertainty, the health effects from these emissions cannot be estimated.

4.4.3.2 Qualitative Assessment of Project MSATs

As discussed above, technical shortcomings of emissions and dispersion models and uncertain science with respect to health effects prevent meaningful or reliable estimates of MSAT emissions and effects of this project. However, even though reliable methods do not exist to accurately estimate the health impacts of MSATs at the project level, it is possible to qualitatively assess the levels of future MSAT emissions under the project. Although a qualitative analysis cannot identify and measure health impacts from MSATs, it can give a basis for identifying and comparing the potential differences among MSAT emissions, if any, from the various alternatives. The qualitative assessment presented below is derived in part from U.S. Department of Transportation, Federal Highway Administration Memorandum from April Marchese to Division Administrators dated September 30, 2009.

For each project alternative, the amount of MSATs emitted would be proportional to the vehicle miles traveled, or VMT, assuming that other variables such as fleet mix are the same for each alternative. For this project, the estimated daily VMT for each year and Alternative are provided in **Table 4-33: Vehicle Miles Traveled per Day in Corridor Under Project Alternatives**.

Table 4-33: Vehicle Miles Traveled per Day in Corridor Under Project Alternatives

Scenario	VMT/day
2006 Existing	120,750
2038 No-Build Alternative	248,810
2038 TSM Alternative 2	248,810
2038 Alternative 3	248,810
2038 Alternative 4	248,810
2038 Alternative 5	248,810

As indicated in the table, for this project, there are expected to be no differences in the estimated VMT for the year 2038 amongst the project alternatives. This is because Kea'au-Pāhoa Road is the only available roadway for arterial traffic in the project area. Thus, on the basis of VMT, the proposed project is not expected to result in an increase in MSAT emissions.

The proposed project will include both roadway widening and the signalization of several intersections in the project area, which could affect average travel speeds. The relationship between travel speed and MSAT emission rates has not been well established. If it is assumed that the average travel speed is not a factor, then the expected fixed VMT for the various project alternatives means that MSATs emissions for any of the alternatives would probably be unchanged compared to the No-Build Alternative.

Regardless of the alternative chosen, emissions will likely be lower than present levels in the design year as a result of EPA's national control programs that are projected to reduce MSAT emissions by 57 to 87 percent from 2000 to 2020. Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the study area are likely to be lower in the future in virtually all locations.

In sum, under the Build alternatives in 2038, it is expected MSAT emissions in the immediate area of the project would remain unchanged relative to the No-Build Alternative, due to the fact the project alternatives are not expected to cause an increase in the VMT. In comparing the project alternatives, MSAT levels could potentially be higher in some locations than others, but current tools and science are not adequate to quantify them. However, on a regional basis, EPA's vehicle and fuel regulations, coupled with fleet turnover, will over time cause substantial reductions that, in almost all cases, will cause region-wide MSAT levels to be significantly lower than today.

4.4.4 Construction Impacts on Air Quality

Short-term direct and indirect impacts on air quality could potentially occur during project construction. For a project of this nature, there are two potential types of air pollution emissions that could directly result in short-term air quality impacts during construction:

- Fugitive dust from vehicle movement and soil excavation; and
- Exhaust emissions from on-site construction equipment.

Indirectly, there also could be short-term impacts from slow-moving construction equipment traveling to and from the project site and from the disruption of traffic due to road construction.

Fugitive dust emissions may arise from the grading and dirt-moving activities associated with land clearing and preparation work. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately because of its elusive nature of emission and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of dirt disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The US EPA has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled fugitive dust emissions in the project area would likely be somewhere near this level or possibly lower due to the wet climate. In any case, State of Hawaii Air Pollution Control Regulations in Chapter 11-60 of the Hawaiʻi Administrative Rules prohibit visible emissions of fugitive dust from construction activities at the project boundary, and thus an effective dust control plan for the project construction phase is essential.

Adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare dirt surfaces in construction areas from becoming significant sources of dust. In dust-prone or dust-sensitive areas, other control measures such as limiting the area that can be disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens may be necessary. Control regulations further stipulate that open bodied trucks be covered at all times when in motion if they are transporting materials that could be blown away. Haul trucks tracking dirt onto paved streets from unpaved areas is oftentimes a significant source of dust in construction areas. Some means to alleviate this problem, such as road cleaning or tire washing, may be appropriate. Paving and/or establishment of landscaping as early in the construction schedule as possible can also lower the potential for fugitive dust emissions.

On-site mobile and stationary construction equipment also will emit air pollutants from engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines, on

the other hand, are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Indirectly, slow-moving construction vehicles on roadways leading to and from the project area could obstruct the normal flow of traffic to such an extent that overall vehicular emissions are increased, but this impact can be mitigated by moving heavy construction equipment during periods of low traffic volume. Likewise, road closures during peak traffic periods should be avoided to the extent possible to minimize air pollution impacts from traffic disruption. Thus, with careful planning and attention to dust control, most potential short-term air quality impacts from project construction can be mitigated.

4.5 Noise

The principles of noise and the measurement of existing noise in the corridor are discussed in detail in **Section 3.5: Noise**.

4.5.1 Future Year Noise Impacts and Mitigation

The FHWA has a design goal of 67 dBA or less for residences, churches, and schools and 72 for agricultural and commercial areas as shown in **Table 4-34: FHWA and HDOT Noise Abatement Criteria**. According to HDOT's Noise Analysis and Abatement Policy (State of Hawai'i, Department of Transportation, 1997), when traffic noise levels "approach" the FHWA design goal, i.e., within one decibel, traffic noise impact will occur and noise abatement measures must be considered. In addition, noise abatement needs to be considered if future noise levels "substantially exceed" existing noise levels. HDOT defines "substantially exceed" as an increase of at least 15 dBA.

Table 4-34: FHWA and HDOT Noise Abatement Criteria

Activity Category	Maximum L_{eq} (1 Hr period)	Description of Activity Category / Land Uses
A	57 dBA (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the lands are to continue to serve their intended purpose.
B	67 dBA (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries and hospitals.
C	72 dBA (Exterior)	Developed lands, properties or activities not included in Categories A or B above.
D	---	Undeveloped lands.
E	52 dBA (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

Source: Code of Federal Regulations, Title 23 Part 772, Revised April 2005

As required by the Federal Highway Administration, traffic noise levels were calculated using the FHWA's Traffic Noise Model Version 2.5. The TNM model is a computer-based application that calculates noise at receivers based on traffic volumes, speeds, terrain, and physical location of the roadway relative to the receivers.

The existing road conditions were modeled for peak hour AM and PM traffic and a vehicular traffic noise analysis was completed for the existing (year 2006) conditions at 182 noise receiver locations (most of which are single family homes). Noise projections were also calculated for the same receiver locations during the peak hour AM and PM traffic for both the "no-build" and "build" alternatives for the year 2038, referred to as "future" year herein. For the "build" noise impact analysis, a worst-case alignment was the basis for the traffic noise model where the roadway lanes are positioned closest to the receivers. This alignment is a combination of Alternative 5 (a six-lane cross-section from the Keaʻau Bypass to Paradise Drive) and Alternative 4 (a four-lane cross-section from Paradise Drive to the southern terminus of the project at Pāhoa-Kapoho Road).

The traffic noise analysis is also based on the peak hour AM and PM traffic volumes generated for the project. Noise level measurements and traffic counts taken in the field were used to validate the traffic noise model prediction software. Vehicular traffic was modeled under free flow conditions at a worst-case speed of 55 miles per hour, though actual operating speeds, particularly under a no-build scenario, would be expected to be lower. The terrain surrounding the project corridor was assumed to be hard (i.e., acoustically reflective) and flat (i.e., no change in elevation), which again reflects a worst-case scenario. Sound levels predicted at the receiver locations have been calculated at approximately 13 feet above the ground. This height represents a listener on a second story lanai or in a second story bedroom with an open window.

Traffic outside the project corridor may also impact residences, schools, or businesses on side streets connecting to Keaʻau-Pāhoa Road. However, these streets were outside the scope of the study area, which was confined to Keaʻau-Pāhoa Road from the Keaʻau Bypass to Pāhoa-Kapoho Road.

As was noted in the discussion on existing conditions, 117 receivers out of 182 are calculated to already exceed the NAC using 2006 traffic volumes. The NAC were listed in **Table 4-34: FHWA and HDOT Noise Abatement Criteria** above.

The No-Build Alternative will not directly create any new noise impacts, though noise will be expected to increase over time just from increases in traffic as shown in **Table 4-35: Predicted Peak Hour Traffic Noise Levels and Resulting Increases Due to Project**. Noise levels that approach or exceed NAC are shown in bold. The TSM Alternative is expected to have similar noise levels to the No-Build Alternative as most improvements will be limited to the vicinity of intersections and the number of travel lanes will not increase. A sound level increase of 0.2 dBA to 3.7 dBA over existing (2006) levels is predicted for the No-Build Alternative in 2038. Under the No-Build Alternative, an additional 33 receivers will approach or exceed the NAC for a total of 150 receivers out of 182.

Table 4-35: Predicted Peak Hour Traffic Noise Levels and Resulting Increases Due to Project (7 Pages Total) Approach/Exceed in **Bold**

Segment	Location: TMK	NAC	Distance to Road Centerline (ft) to Facade	Modeled 2006 (dBA)		2038 No-Build Alternative (dBA)		2038 Build Alternative 4+5 (dBA)		Future Increase Without Project (dB)		Future Increase With Project (dB)		Future Increase Due to Project (dB)	
				AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Opukahaia/Shower Dr.	1-6-04:47	B	113	**70.2**	**70.5**	70.6	72.3	71.5	73.0	0.4	1.8	1.3	2.5	0.9	0.7
	1-6-04:51	C	132	69.0	69.7	69.5	**71.1**	70.7	**72.0**	0.5	1.4	1.7	2.3	1.2	0.9
	1-6-03:2	C	138	68.8	68.2	69.0	69.6	70.8	70.6	0.2	1.4	2.0	2.4	1.8	1.0
	1-6-03:74	C	96	70.9	70.3	**71.1**	**71.6**	**73.6**	**72.9**	0.2	1.3	2.7	2.6	2.5	1.3
	1-6-64:289	B	291	64.6	65.1	65.1	**66.4**	**66.9**	**67.7**	0.5	1.3	2.3	2.6	1.8	1.3
	1-5-36:117	B	130	**69.3**	**69.1**	**69.6**	**70.3**	**71.6**	**71.4**	0.3	1.2	2.3	2.3	2.0	1.1
	1-6-64:288	B	278	64.8	65.4	65.3	**66.7**	**67.1**	**67.9**	0.5	1.3	2.3	2.5	1.8	1.2
	1-5-36:116	B	131	**68.9**	**68.7**	**69.2**	**69.9**	**71.2**	**71.0**	0.3	1.2	2.3	2.3	2.0	1.1
	1-6-64:287	B	217	**66.3**	**66.9**	**66.8**	**68.1**	**68.4**	**69.4**	0.5	1.2	2.1	2.5	1.6	1.3
	1-6-64:286	B	166	**67.7**	**68.3**	**68.1**	**69.6**	**69.8**	**70.9**	0.4	1.3	2.1	2.6	1.7	1.3
	1-5-36:120	B	89	**71.2**	**70.6**	**71.4**	**71.9**	**73.6**	**73.0**	0.2	1.3	2.4	2.4	2.2	1.1
	1-6-64:284	B	141	**68.2**	**68.9**	**68.7**	**70.2**	**70.4**	**71.6**	0.5	1.3	2.2	2.7	1.7	1.4
	1-6-64:283	B	149	**68.1**	**68.8**	**68.7**	**69.9**	**70.3**	**71.5**	0.6	1.1	2.2	2.7	1.6	1.6
	1-5-36:121	B	117	**69.8**	**69.5**	**70.1**	**70.6**	**72.2**	**71.8**	0.3	1.1	2.4	2.3	2.1	1.2
Shower Dr./Pōhaku Place	1-6-64:269	B	203	**66.6**	**67.1**	**67.2**	**68.0**	**68.8**	**70.0**	0.6	0.9	2.2	2.9	1.6	2.0
	1-6-64:267	B	230	**65.8**	**66.3**	**66.3**	**67.1**	**68.0**	**69.2**	0.5	0.8	2.2	2.9	1.7	2.1
	1-6-64:266	B	163	**67.6**	**68.2**	**68.2**	**68.9**	**69.8**	**71.2**	0.6	0.7	2.2	3.0	1.6	2.3
	1-6-64:265	B	178	**67.1**	**67.6**	**67.6**	**68.3**	**69.3**	**70.5**	0.5	0.7	2.2	2.9	1.7	2.2
	1-6-64:264	B	273	64.7	65.1	65.2	65.9	**67.0**	**68.1**	0.5	0.8	2.3	3.0	1.8	2.2
	1-6-64:263	B	151	**67.9**	**68.4**	**68.5**	**69.1**	**70.1**	**71.5**	0.6	0.7	2.2	3.1	1.6	2.4
	1-5-36:153	B	68	**72.1**	**72.2**	**72.6**	**72.9**	**75.0**	**74.6**	0.5	0.7	2.9	2.4	2.4	1.7
	1-6-64:261	B	172	**67.1**	**67.6**	**67.7**	**68.3**	**69.3**	**70.6**	0.6	0.7	2.2	3.0	1.6	2.3
	1-5-36:151	B	91	**70.9**	**71.0**	**71.3**	**71.8**	**73.8**	**73.5**	0.4	0.8	2.9	2.5	2.5	1.7
	1-5-36:150	B	153	**68.1**	**68.3**	**68.5**	**69.0**	**70.7**	**70.8**	0.4	0.7	2.6	2.5	2.2	1.8
	1-6-64:260	B	156	**67.7**	**68.2**	**68.3**	**68.9**	**69.9**	**71.2**	0.6	0.7	2.2	3.0	1.6	2.3
	1-6-64:258	B	243	**65.7**	**66.1**	**66.2**	**66.8**	**67.9**	**69.0**	0.5	0.7	2.2	2.9	1.7	2.2
	1-5-36:148	B	164	**67.5**	**67.7**	**68.0**	**68.5**	**70.1**	**70.3**	0.5	0.8	2.6	2.6	2.1	1.8
	1-6-64:257	B	168	**67.5**	**68.0**	**68.1**	**68.7**	**69.7**	**71.0**	0.6	0.7	2.2	3.0	1.6	2.3

Table 4-35: Predicted Peak Hour Traffic Noise Levels and Resulting Increases Due to Project (7 Pages Total) Approach/Exceed in **Bold**

Segment	Location: TMK	NAC	Distance to Road Centerline (ft) to Facade	Modeled 2006 (dBA)		2038 No-Build Alternative (dBA)		2038 Build Alternative 4+5 (dBA)		Future Increase Without Project (dB)		Future Increase With Project (dB)		Future Increase Due to Project (dB)	
				AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Shower Dr./Pōhaku Place (Cont'd)	1-6-64:256	B	154	**68.1**	**68.6**	**68.7**	**69.3**	**70.3**	**71.6**	0.6	0.7	2.2	3.0	1.6	2.3
	1-6-64:255	B	126	**69.0**	**69.5**	**69.5**	**70.2**	**71.2**	**72.6**	0.5	0.7	2.2	3.1	1.7	2.4
	1-5-36:145	B	218	**66.0**	**66.3**	**66.5**	**67.0**	**68.5**	**68.8**	0.5	0.7	2.5	2.5	2.0	1.8
	1-5-36:144	B	271	64.8	65.1	65.4	65.8	**67.4**	**67.8**	0.6	0.7	2.6	2.7	2.0	2.0
	1-5-36:143	B	280	64.6	64.8	65.1	65.6	**67.2**	**67.6**	0.5	0.8	2.6	2.8	2.1	2.0
	1-6-64:253	B	230	65.9	**66.4**	**66.5**	**67.2**	**68.2**	**69.3**	0.6	0.8	2.3	2.9	1.7	2.1
	1-5-36:142	B	344	63.0	63.3	63.6	64.1	**65.9**	**66.2**	0.6	0.8	2.9	2.9	2.3	2.1
	1-5-35:148	B	98	**70.5**	**70.5**	**71.0**	**71.3**	**73.5**	**73.1**	0.5	0.8	3.0	2.6	2.5	1.8
	1-6-64:251	B	115	**69.4**	**70.0**	**70.1**	**70.8**	**71.7**	**73.3**	0.7	0.8	2.3	3.3	1.6	2.5
	1-5-35:149	B	92	**70.3**	**70.4**	**71.0**	**71.2**	**73.5**	**73.0**	0.7	0.8	3.2	2.6	2.5	1.8
	1-6-64:249	B	173	**67.0**	**67.7**	**67.9**	**68.5**	**69.5**	**70.7**	0.9	0.8	2.5	3.0	1.6	2.2
Pōhaku Place/Kaloli Drive	1-6-10:268	B	270	63.9	65.0	65.5	65.8	**67.2**	**67.9**	1.6	0.8	3.3	2.9	1.7	2.1
	1-5-35:182	B	92	**69.3**	**70.1**	**71.1**	**71.0**	**73.4**	**72.7**	1.8	0.9	4.1	2.6	2.3	1.7
	1-6-10:269	B	242	64.4	65.6	**66.2**	**66.4**	**67.7**	**68.5**	1.8	0.8	3.3	2.9	1.5	2.1
	1-6-10:270	B	168	**66.2**	**67.5**	**68.0**	**68.3**	**69.6**	**70.4**	1.8	0.8	3.4	2.9	1.6	2.1
	1-5-35:181	B	98	**69.1**	**70.0**	**70.9**	**70.9**	**73.1**	**72.5**	1.8	0.9	4.0	2.5	2.2	1.6
	1-5-35:180	B	207	65.3	**66.4**	**67.1**	**67.2**	**69.0**	**68.9**	1.8	0.8	3.7	2.5	1.9	1.7
	1-6-10:271	B	158	**66.5**	**67.7**	**68.3**	**68.5**	**69.8**	**70.7**	1.8	0.8	3.3	3.0	1.5	2.2
	1-5-35:184	B	111	**68.6**	**69.5**	**70.4**	**70.4**	**72.6**	**72.1**	1.8	0.9	4.0	2.6	2.2	1.7
	1-6-10:273	B	70	**70.7**	**72.1**	**72.5**	**72.9**	**73.9**	**75.4**	1.8	0.8	3.2	3.3	1.4	2.5
	1-6-10:274	B	138	**67.4**	**68.7**	**69.2**	**69.5**	**70.8**	**71.7**	1.8	0.8	3.4	3.0	1.6	2.2
	1-5-35:185	B	127	**68.0**	**68.9**	**69.8**	**69.8**	**71.9**	**71.5**	1.8	0.9	3.9	2.6	2.1	1.7
	1-6-10:275	B	138	**67.1**	**68.4**	**68.9**	**69.2**	**70.4**	**71.4**	1.8	0.8	3.3	3.0	1.5	2.2
	1-5-35:186	B	100	**69.3**	**70.1**	**71.2**	**71.1**	**73.4**	**72.7**	1.9	1.0	4.1	2.6	2.2	1.6
	1-5-35:187	B	103	**69.0**	**69.8**	**70.9**	**70.7**	**73.1**	**72.3**	1.9	0.9	4.1	2.5	2.2	1.6
	1-6-10:276	B	192	65.7	**67.0**	**67.5**	**68.6**	**69.9**	**70.7**	1.8	1.6	4.2	3.7	2.4	2.1

Table 4-35: Predicted Peak Hour Traffic Noise Levels and Resulting Increases Due to Project (7 Pages Total) Approach/Exceed in **Bold**

Segment	Location: TMK	NAC	Distance to Road Centerline (ft) to Facade	Modeled 2006 (dBA)		2038 No-Build Alternative (dBA)		2038 Build Alternative 4+5 (dBA)		Future Increase Without Project (dB)		Future Increase With Project (dB)		Future Increase Due to Project (dB)	
				AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Kaloli Drive./Pōhaku C.ircle	1-6-10:281	B	171	**66.2**	**67.5**	**68.5**	**68.3**	**70.1**	**70.3**	2.3	0.8	3.9	2.8	1.6	2.0
	1-6-10:284	B	214	**64.9**	**66.2**	**67.4**	**66.9**	**69.0**	**68.9**	2.5	0.7	4.1	2.7	1.6	2.0
	1-5-34:215	B	129	**67.0**	**68.1**	**69.5**	**68.9**	**71.6**	**70.6**	2.5	0.8	4.6	2.5	2.1	1.7
	1-6-10:286	B	168	**66.0**	**67.3**	**68.5**	**68.0**	**70.1**	**70.1**	2.5	0.7	4.1	2.8	1.6	2.1
	1-6-10:287	B	208	**65.0**	**66.3**	**67.5**	**67.0**	**69.1**	**69.0**	2.5	0.7	4.1	2.7	1.6	2.0
	1-6-10:288	B	123	**67.5**	**68.8**	**70.0**	**69.5**	**71.6**	**71.8**	2.5	0.7	4.1	3.0	1.6	2.3
	1-5-34:212	B	242	64.1	65.2	**66.6**	**66.0**	**68.5**	**67.6**	2.5	0.8	4.4	2.4	1.9	1.6
	1-5-34:211	B	238	**64.2**	**65.3**	**66.7**	**66.1**	**68.6**	**67.7**	2.5	0.8	4.4	2.4	1.9	1.6
	1-5-34:210	B	118	**67.8**	**68.7**	**70.3**	**69.6**	**72.5**	**71.2**	2.5	0.9	4.7	2.5	2.2	1.6
Poahaku Circle/Orchidland Drive	1-6-10:111	B	218	64.5	65.6	**67.1**	**66.5**	**68.7**	**68.3**	2.6	0.9	4.2	2.7	1.6	1.8
	1-6-10:114	B	226	64.5	65.5	**67.2**	**66.5**	**68.7**	**68.2**	2.7	1.0	4.2	2.7	1.5	1.7
	1-6-10:115	B	297	62.7	63.8	65.4	64.8	**67.2**	**66.6**	2.7	1.0	4.5	2.8	1.8	1.8
	1-6-10:116	B	241	64.2	65.2	**66.8**	**66.2**	**68.4**	**67.8**	2.6	1.0	4.2	2.6	1.6	1.6
	1-5-34:219	B	126	**67.4**	**68.2**	**70.0**	**69.3**	**72.0**	**70.7**	2.6	1.1	4.6	2.5	2.0	1.4
	1-5-34:220	B	159	**66.3**	**67.1**	**68.9**	**68.2**	**70.8**	**69.6**	2.6	1.1	4.5	2.5	1.9	1.4
	1-6-10:123	B	125	**67.4**	**68.4**	**70.1**	**69.4**	**71.7**	**71.3**	2.7	1.0	4.3	2.9	1.6	1.9
	1-6-10:124	B	147	**66.7**	**67.7**	**69.4**	**68.7**	**70.9**	**70.4**	2.7	1.0	4.2	2.7	1.5	1.7
	1-5-34:222	B	136	**67.1**	**67.9**	**69.7**	**69.0**	**71.6**	**70.4**	2.6	1.1	4.5	2.5	1.9	1.4
	1-5-33:221	B	172	65.9	**66.7**	**68.5**	**67.8**	**70.3**	**69.1**	2.6	1.1	4.4	2.4	1.8	1.3
	1-6-10:289	B	138	**66.9**	**68.1**	**69.4**	**68.9**	**71.0**	**71.0**	2.5	0.8	4.1	2.9	1.6	2.1
	1-5-34:218	B	83	**69.5**	**70.2**	**72.1**	**71.3**	**74.3**	**72.7**	2.6	1.1	4.8	2.5	2.2	1.4
	1-6-10:126	B	134	**67.0**	**68.1**	**69.7**	**69.1**	**71.3**	**70.9**	2.7	1.0	4.3	2.8	1.6	1.8
	1-6-10:111	B	218	64.5	65.6	**67.1**	**66.5**	**68.7**	**68.3**	2.6	0.9	4.2	2.7	1.6	1.8
	1-6-10:127	B	124	**67.4**	**68.4**	**70.1**	**69.5**	**71.7**	**71.3**	2.7	1.1	4.3	2.9	1.6	1.8
	1-5-33:222	B	127	**66.7**	**67.5**	**69.3**	**68.6**	**71.2**	**69.9**	2.6	1.1	4.5	2.4	1.9	1.3
	1-6-10:129	B	135	**67.0**	**68.0**	**69.7**	**69.1**	**71.3**	**70.8**	2.7	1.1	4.3	2.8	1.6	1.7
	1-6-10:90	B	215	64.7	65.7	**67.4**	**66.8**	**68.9**	**68.4**	2.7	1.1	4.2	2.7	1.5	1.6
	1-5-33:254	B	68	**70.7**	**71.3**	**73.3**	**72.5**	**75.5**	**73.8**	2.6	1.2	4.8	2.5	2.2	1.3

Table 4-35: Predicted Peak Hour Traffic Noise Levels and Resulting Increases Due to Project (7 Pages Total) Approach/Exceed in **Bold**

Segment	Location: TMK	NAC	Distance to Road Centerline (ft) to Facade	Modeled 2006 (dBA)		2038 No-Build Alternative (dBA)		2038 Build Alternative 4+5 (dBA)		Future Increase Without Project (dB)		Future Increase With Project (dB)		Future Increase Due to Project (dB)	
				AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Pohaku Cir./Orchidland cont'd)	1-5-33:253	B	157	**66.2**	**67.1**	**69.0**	**68.2**	**70.8**	**69.6**	2.8	1.1	4.6	2.5	1.8	1.4
	1-6-10:134	B	136	**67.0**	**68.0**	**69.8**	**69.1**	**71.3**	**70.8**	2.8	1.1	4.3	2.8	1.5	1.7
	1-6-10:135	B	208	64.7	65.8	**67.6**	**67.0**	**69.1**	**68.6**	2.9	1.2	4.4	2.8	1.5	1.6
	1-5-33:252	B	164	62.6	63.7	65.9	65.2	**67.5**	**66.6**	3.3	1.5	4.9	2.9	1.6	1.4
Orchidland Dr./ Paradise Dr.	1-6-9:388-390	B	189	64.6	**66.1**	**68.0**	**67.5**	**69.2**	**69.0**	3.4	1.4	4.6	2.9	1.2	1.5
	1-6-9:391	B	98	**68.0**	**69.6**	**71.5**	**71.1**	**72.7**	**72.8**	3.5	1.5	4.7	3.2	1.2	1.7
	1-5-33:256	B	91	**68.2**	**69.4**	**71.9**	**71.1**	**73.5**	**72.3**	3.7	1.7	5.3	2.9	1.6	1.2
	1-5-33:257	B	114	**67.2**	**68.4**	**70.9**	**70.1**	**72.4**	**71.3**	3.7	1.7	5.2	2.9	1.5	1.2
	1-6-9-393	B	274	62.6	64.1	**66.1**	**65.6**	**67.4**	**67.0**	3.5	1.5	4.8	2.9	1.3	1.4
	1-6-9:397	B	263	62.8	64.3	**66.4**	**65.9**	**67.5**	**67.2**	3.6	1.6	4.7	2.9	1.1	1.3
	1-6-9:399	B	261	63.0	64.5	**66.5**	**66.0**	**67.7**	**67.4**	3.5	1.5	4.7	2.9	1.2	1.4
	1-6-9:401	B	140	**66.3**	**67.7**	**69.7**	**69.2**	**70.9**	**70.8**	3.4	1.5	4.6	3.1	1.2	1.6
	1-6-9:394	B	123	**66.9**	**68.5**	**70.4**	**69.9**	**71.6**	**71.6**	3.5	1.4	4.7	3.1	1.2	1.7
Paradise Dr./Aulii St.	1-6-9:402	B	126	**66.9**	**68.3**	**70.2**	**69.8**	**71.5**	**71.4**	3.3	1.5	4.6	3.1	1.3	1.6
	1-6-9:405	B	124	**67.2**	**68.4**	**70.4**	**70.0**	**71.7**	**71.5**	3.2	1.6	4.5	3.1	1.3	1.5
	1-5-17:143	B	104	**68.0**	**68.8**	**71.1**	**70.4**	**72.7**	**71.6**	3.1	1.6	4.7	2.8	1.6	1.2
	1-6-9:406	B	158	65.8	**67.0**	**68.9**	**68.5**	**70.2**	**69.9**	3.1	1.5	4.4	2.9	1.3	1.4
	1-6-9:409	B	192	64.9	66.0	**68.0**	**67.5**	**69.2**	**68.8**	3.1	1.5	4.3	2.8	1.2	1.3
	1-5-17:145	B	108	**67.8**	**68.6**	**70.9**	**70.3**	**72.6**	**71.5**	3.1	1.7	4.8	2.9	1.7	1.2
	1-5-17:147	B	108	**68.1**	**68.9**	**71.2**	**70.6**	**72.7**	**71.7**	3.1	1.7	4.6	2.8	1.5	1.1
	1-5-17:148	B	126	**67.2**	**68.1**	**70.3**	**69.7**	**71.8**	**70.8**	3.1	1.6	4.6	2.7	1.5	1.1
	1-6-9:414	B	224	64.2	65.2	**67.2**	**66.8**	**68.5**	**68.1**	3.0	1.6	4.3	2.9	1.3	1.3
	1-5-14:150	B	120	**67.4**	**68.2**	**70.4**	**69.9**	**71.9**	**71.0**	3.0	1.7	4.5	2.8	1.5	1.1
	1-6-9:418	B	213	64.4	65.5	**67.4**	**67.1**	**68.6**	**68.3**	3.0	1.6	4.2	2.8	1.2	1.2
	1-5-17:153	B	319	62.0	62.7	64.9	64.5	**66.4**	**65.8**	2.9	1.8	4.4	3.1	1.5	1.3
	1-5-17:154	B	89	**69.3**	**69.7**	**72.2**	**71.6**	**73.6**	**72.6**	2.9	1.9	4.3	2.9	1.4	1.0

Table 4-35: Predicted Peak Hour Traffic Noise Levels and Resulting Increases Due to Project (7 Pages Total) Approach/Exceed in **Bold**

Segment	Location: TMK	NAC	Distance to Road Centerline (ft) to Facade	Modeled 2006 (dBA)		2038 No-Build Alternative (dBA)		2038 Build Alternative 4+5 (dBA)		Future Increase Without Project (dB)		Future Increase With Project (dB)		Future Increase Due to Project (dB)	
				AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Aulii St./Maku'u Dr.	1-6-9:214	B	111	**67.9**	**68.6**	**70.3**	**70.6**	**70.9**	**71.6**	2.4	2.0	3.0	3.0	0.6	1.0
	1-6-9:217	B	316	62.2	62.7	64.7	64.8	65.5	65.9	2.5	2.1	3.3	3.2	0.8	1.1
	1-6-9:218	B	390	60.7	61.2	63.2	63.3	64.3	64.6	2.5	2.1	3.6	3.4	1.1	1.3
	1-6-9:220	B	135	**66.8**	**67.3**	**69.2**	**69.4**	**69.7**	**70.4**	2.4	2.1	2.9	3.1	0.5	1.0
	1-6-9:222	B	144	**66.7**	**67.1**	**69.1**	**69.2**	**69.6**	**70.3**	2.4	2.1	2.9	3.2	0.5	1.1
	1-6-9:223	B	141	**66.6**	**67.1**	**69.0**	**69.2**	**69.6**	**70.2**	2.4	2.1	3.0	3.1	0.6	1.0
	1-5-16:174	B	110	**67.8**	**68.1**	**70.3**	**70.2**	**70.9**	**71.0**	2.5	2.1	3.1	2.9	0.6	0.8
	1-6-9:225	B	123	**67.1**	**67.6**	**69.5**	**69.7**	**70.1**	**70.8**	2.4	2.1	3.0	3.2	0.6	1.1
	1-6-9:227	B	118	**67.4**	**67.9**	**69.8**	**70.0**	**70.4**	**71.1**	2.4	2.1	3.0	3.2	0.6	1.1
	1-5-16:173	B	161	**66.0**	**66.3**	**68.4**	**68.5**	**69.0**	**69.2**	2.4	2.2	3.0	2.9	0.6	0.7
	1-6-9:228	B	111	**67.8**	**68.3**	**70.2**	**70.4**	**70.8**	**71.5**	2.4	2.1	3.0	3.2	0.6	1.1
	1-5-16:170	B	90	**68.8**	**69.0**	**71.2**	**71.1**	**71.9**	**71.9**	2.4	2.1	3.1	2.9	0.7	0.8
	1-6-9:233	B	154	**66.1**	**66.6**	**68.5**	**68.7**	**69.1**	**69.7**	2.4	2.1	3.0	3.1	0.6	1.0
	1-5-16:167	B	77	**69.8**	**69.9**	**72.3**	**72.1**	**72.8**	**72.8**	2.5	2.2	3.0	2.9	0.5	0.7
	1-6-9:236	B	162	65.9	**66.4**	**68.3**	**68.5**	**68.8**	**69.5**	2.4	2.1	2.9	3.1	0.5	1.0
	1-6-9:237	B	138	**66.6**	**67.2**	**69.0**	**69.2**	**69.6**	**70.3**	2.4	2.0	3.0	3.1	0.6	1.1
	1-5-16:166	B	258	63.5	63.8	65.9	65.9	**66.5**	**66.8**	2.4	2.1	3.0	3.0	0.6	0.9
	1-5-16:165	B	109	**67.9**	**68.0**	**70.3**	**70.2**	**71.0**	**71.0**	2.4	2.2	3.1	3.0	0.7	0.8
	1-5-16:164	B	122	**67.5**	**67.6**	**69.9**	**69.8**	**70.5**	**70.6**	2.4	2.2	3.0	3.0	0.6	0.8
	1-6-9:238	B	148	**66.4**	**67.0**	**68.8**	**69.0**	**69.3**	**70.0**	2.4	2.0	2.9	3.0	0.5	1.0
	1-6-9:239	B	181	65.4	65.9	**67.8**	**68.0**	**68.3**	**68.9**	2.4	2.1	2.9	3.0	0.5	0.9
	1-6-9:241	B	103	**68.3**	**69.1**	**70.7**	**71.1**	**71.3**	**72.1**	2.4	2.0	3.0	3.0	0.6	1.0
	1-6-9:243	B	122	**67.5**	**68.1**	**69.9**	**70.2**	**70.4**	**71.1**	2.4	2.1	2.9	3.0	0.5	0.9
	1-5-16:163	B	256	63.7	63.9	**66.1**	**66.0**	**66.8**	**67.0**	2.4	2.1	3.1	3.1	0.7	1.0

Table 4-35: Predicted Peak Hour Traffic Noise Levels and Resulting Increases Due to Project (7 Pages Total) Approach/Exceed in **Bold**

Segment	Location: TMK	NAC	Distance to Road Centerline (ft) to Facade	Modeled 2006 (dBA)		2038 No-Build Alternative (dBA)		2038 Build Alternative 4+5 (dBA)		Future Increase Without Project (dB)		Future Increase With Project (dB)		Future Increase Due to Project (dB)	
				AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Maku'u Dr./ Ilima St.	1-6-9:168	B	110	**68.0**	**68.2**	**70.1**	**70.3**	**71.2**	**71.7**	2.1	2.1	3.2	3.5	1.1	1.4
	1-5-15:179	B	233	64.1	64.1	**66.3**	**66.2**	**67.4**	**67.4**	2.2	2.1	3.3	3.3	1.1	1.2
	1-5-15:178	B	246	63.6	63.7	65.9	65.8	**67.1**	**67.1**	2.3	2.1	3.5	3.4	1.2	1.3
	1-5-15:177	B	212	64.4	64.5	**66.7**	**66.6**	**67.8**	**67.8**	2.3	2.1	3.4	3.3	1.1	1.2
	1-5-15:176	B	232	63.8	64.0	**66.3**	**66.3**	**67.4**	**67.4**	2.5	2.3	3.6	3.4	1.1	1.1
	1-6-9:166	B	114	**67.9**	**68.2**	**70.2**	**70.4**	**71.1**	**71.6**	2.3	2.2	3.2	3.4	0.9	1.2
Ilima St./ Ainaloa Blvd.	1-5-15:175	B	110	**67.3**	**67.5**	**70.0**	**70.0**	**71.2**	**71.0**	2.7	2.5	3.9	3.5	1.2	1.0
	1-5-15:174	B	196	64.6	65.0	**67.4**	**67.5**	**68.4**	**68.3**	2.8	2.5	3.8	3.3	1.0	0.8
	1-5-15:173	B	245	63.4	63.8	**66.2**	**66.3**	**67.1**	**67.0**	2.8	2.5	3.7	3.2	0.9	0.7
	1-5-15:172	B	282	62.5	62.9	65.4	65.4	**66.4**	**66.3**	2.9	2.5	3.9	3.4	1.0	0.9
	1-6-9:158	B	126	**66.8**	**67.4**	**69.7**	**70.0**	**70.2**	**70.5**	2.9	2.6	3.4	3.1	0.5	0.5
	1-5-15:171	B	310	61.8	62.4	64.8	64.9	**66.0**	**65.9**	3.0	2.5	4.2	3.5	1.2	1.0
	1-5-15:181	B	301	61.8	62.4	64.8	64.9	**66.1**	**66.0**	3.0	2.5	4.3	3.6	1.3	1.1
Ainaloa Blvd./ Ka Ohuwalu Dr.	1-5-15:182	B	133	**66.0**	**67.2**	**69.5**	**69.4**	**71.5**	**71.2**	3.5	2.2	5.5	4.0	2.0	1.8
	1-6-99:6	B	73	**68.9**	**70.2**	**72.4**	**72.6**	**71.6**	**71.8**	3.5	2.4	2.7	1.6	-0.8	-0.8
	1-6-99:4	B	241	63.1	64.4	**66.6**	**66.7**	**66.9**	**67.0**	3.5	2.3	3.8	2.6	0.3	0.3
	1-6-99:3	B	201	64.0	65.4	**67.6**	**67.7**	**67.8**	**67.9**	3.6	2.3	3.8	2.5	0.2	0.2
	1-6-99:2	B	68	**69.5**	**70.9**	**73.1**	**73.2**	**72.7**	**73.0**	3.6	2.3	3.2	2.1	-0.4	-0.2
	1-6-99:31	B	301	61.5	62.9	65.1	65.2	**66.0**	**66.1**	3.6	2.3	4.5	3.2	0.9	0.9
	1-5-15:187	B	162	64.7	**66.1**	**68.3**	**68.3**	**69.2**	**69.1**	3.6	2.2	4.5	3.0	0.9	0.8
	1-5-10:17	B	208	63.6	65.1	**67.3**	**67.2**	**68.0**	**67.9**	3.7	2.1	4.4	2.8	0.7	0.7
Ka Ohuwalu Kaluahine	1-5-118:24	C	164	65.1	65.3	68.5	68.0	69.3	68.6	3.4	2.7	4.2	3.3	0.8	0.6
	1-5-118:17	B	188	64.9	64.8	**68.2**	**67.6**	**69.1**	**68.2**	3.3	2.8	4.2	3.4	0.9	0.6
	1-5-119:45	B	243	63.5	63.4	**66.8**	**66.4**	**67.6**	**67.0**	3.3	3.0	4.1	3.6	0.8	0.6
	1-5-119:44	B	317	61.7	61.6	65.0	64.6	**66.1**	**65.4**	3.3	3.0	4.4	3.8	1.1	0.8
	1-5-118:49	B	233	63.8	63.5	**66.9**	**66.4**	**67.7**	**67.0**	3.1	2.9	3.9	3.5	0.8	0.6

Table 4-35: Predicted Peak Hour Traffic Noise Levels and Resulting Increases Due to Project (7 Pages Total) Approach/Exceed in **Bold**

Segment	Location: TMK	NAC	Distance to Road Centerline (ft) to Facade	Modeled 2006 (dBA)		2038 No-Build Alternative (dBA)		2038 Build Alternative 4+5 (dBA)		Future Increase Without Project (dB)		Future Increase With Project (dB)		Future Increase Due to Project (dB)	
				AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Kaluahine St./ Old Pāhoa Road (Pāhoa Village Junction)	1-5-7:13	B	66	**69.7**	**69.4**	**72.5**	**72.5**	**73.3**	**72.9**	2.8	3.1	3.6	3.5	0.8	0.4
	1-5-7:73	B	107	**67.4**	**66.9**	**70.0**	**70.0**	**71.1**	**70.4**	2.6	3.1	3.7	3.5	1.1	0.4
	1-5-7:75	B	60	**69.3**	**69.2**	**71.9**	**71.8**	**73.3**	**72.5**	2.6	2.6	4.0	3.3	1.4	0.7
	1-5-7:12	B	87	**68.4**	**68.1**	**71.2**	**71.3**	**72.2**	**71.9**	2.8	3.2	3.8	3.8	1.0	0.6
	1-5-7:15	C	69	**69.0**	**68.5**	**71.6**	**71.6**	**72.4**	**71.7**	2.6	3.1	3.4	3.2	0.8	0.1
	1-5-7:52	B	61	**70.0**	**69.4**	**72.6**	**72.6**	**73.0**	**72.3**	2.6	3.2	3.0	2.9	0.4	-0.3
	1-5-7:11	B	135	**66.1**	65.7	**68.8**	**68.9**	**69.9**	**69.5**	2.7	3.2	3.8	3.8	1.1	0.6
	1-5-7:67	B	348	60.9	60.5	63.6	63.7	65.1	64.5	2.7	3.2	4.2	4.0	1.5	0.8
	1-5-7:68	B	125	**66.6**	**66.3**	**69.4**	**69.5**	**70.9**	**70.5**	2.8	3.2	4.3	4.2	1.5	1.0
	1-5-7:78	B	129	**66.6**	**66.1**	**69.3**	**69.2**	**69.7**	**69.1**	2.7	3.1	3.1	3.0	0.4	-0.1
	1-5-7:53	B	93	**68.0**	**67.5**	**70.7**	**70.6**	**71.0**	**70.3**	2.7	3.1	3.0	2.8	0.3	-0.3
	1-5-7:10	B	89	**68.3**	**68.2**	**71.1**	**71.1**	**72.3**	**72.0**	2.8	2.9	4.0	3.8	1.2	0.9
	1-5-7:17	C	199	64.2	63.9	66.9	66.9	67.6	67.1	2.7	3.0	3.4	3.2	0.7	0.2
	1-5-7:9	B	193	64.4	64.0	**67.1**	**67.2**	68.0	67.6	2.7	3.2	3.6	3.6	0.9	0.4
	1-5-7:19	C	102	68.3	67.7	70.9	70.8	**71.6**	**71.0**	2.6	3.1	3.3	3.3	0.7	0.2
	1-5-7:80	C	149	65.1	64.8	68.0	68.0	68.8	68.5	2.9	3.2	3.7	3.7	0.8	0.5
Old Pāhoa Road / Kapoho Rd.	1-5-7:20	C	171	64.3	64.2	67.2	67.5	67.6	67.9	2.9	3.3	3.3	3.7	0.4	0.4
	1-5-7:79	B	311	61.1	61.0	63.9	64.2	64.6	64.7	2.8	3.2	3.5	3.7	0.7	0.5
	1-5-7:21	C	208	63.3	63.4	66.2	66.5	66.6	66.9	2.9	3.1	3.3	3.5	0.4	0.4
	1-5-116:19	C	86	67.0	67.5	69.2	69.5	69.8	70.3	2.2	2.0	2.8	2.8	0.6	0.8
	1-5-06:05	C	80	67.1	67.5	68.9	69.2	69.6	70.2	1.8	1.7	2.5	2.7	0.7	1.0
	1-5-06:26	B	243	61.7	61.3	63.4	62.6	64.4	64.4	1.7	1.3	2.7	3.1	1.0	1.8
	1-5-04:05	B	268	59.2	59.6	61.0	60.2	61.7	61.4	1.8	0.6	2.5	1.8	0.7	1.2
	1-5-2:25	B	214	61.0	61.3	62.7	62.0	63.5	63.2	1.7	0.7	2.5	1.9	0.8	1.2
TOTAL of 182 APPROACH-EXCEED NAC				**117**		**150**		**166**		**33**		**49**		**16**	

This reflects the increase in noise solely attributed to increases in traffic during the intervening time. The increase in traffic noise at the northern end of the project (from the Keaʻau Bypass to Shower Drive) is small compared to the remainder of the project because the area that would be widened by the Shoulders Conversion project is currently in use by morning commuters in the Keaʻau-bound direction.

For the Build Alternatives, a comparison of projected future peak hour traffic noise levels with and without the roadway improvements is presented in **Table 4-35: Predicted Peak Hour Traffic Noise Levels and Resulting Increases Due to Project**. Sound level increases of 1.3 dBA to 5.5 dBA over existing (2006) levels are predicted for the 2038 Build Alternative and vary over the length of the roadway. The most pronounced increases occur between Pōhaku Place and Makuʻu Drive. Since none of these increases are greater than 15 dBA, none of the future noise levels would "substantially exceed" existing levels.

The projected increase in vehicular traffic noise levels due specifically to the Keaʻau-Pāhoa Road improvements project is demonstrated by comparing the difference between 2038 No-Build levels and 2038 Build levels. The increase associated solely from the project is expected to vary from 0 to 2.5 dB, depending on the noise receiver location. An increase of less than 3 dB is usually considered to be below the threshold of perceptible level change for humans and is, therefore, not considered to be significant. Therefore, the overall change from the future 2038 No-Build scenario to the worst-case Build scenario is expected to be imperceptible.

In the year 2038 worst-case Build scenario (under Alternatives 4 or 5), the traffic noise levels will increase over No-Build Levels such that an additional 16 receivers (166 total) of the properties along Keaʻau-Pāhoa Road are calculated to approach or exceed the FHWA and HDOT criteria. This reflects an increase of 49 over existing conditions.

The proposed new lanes will improve the traffic flow along the roadway. Noises that are likely to increase due to the new lanes are noises caused by more vehicles traveling at the posted speed limit of 55 mph. Vehicles will not need to slow or stop to wait for turning vehicles. Another factor that should be considered is the fact that the highway will be widened on both sides throughout the project limits. Thus, the highway widening will move the noise source closer to a noise receptor (i.e., for each home along the highway). Essentially, the nearest traffic lane will become closer. Consequently, the occupants of these residences will experience a traffic noise increase. It is important to note that the Traffic Noise Model was based on a "worst-case" roadway alignment which is a combination of alternatives 4 and 5. The predicted traffic noise levels may be less for certain sections of the project corridor based on potentially narrower cross-sections in the chosen alternative.

The EPA has an existing design goal of L_{dn} less than 65 dBA and a future design goal L_{dn} less than or equal 55 dBA for exterior noise levels. In the future, increased traffic noise will contribute to the overall ambient noise level. Although some of the residences currently experience noise levels that exceed the EPA guidelines, the expected increase in L_{dn} due to the widening of Keaʻau-Pāhoa Road is expected to be less than 3 dBA. It is important to note that the EPA noise guidelines are design goals and not enforceable regulations. However, these guidelines and design goals are useful tools for assessing the noise environment.

4.5.2 Mitigation of Project-Related Noise

Although the added lanes under the Build Alternative do not substantially increase future traffic noise levels over the no-build alternative noise levels, a traffic noise impact still occurs since the traffic noise levels exceed the FHWA/HDOT criteria. Therefore, noise abatement measures must be considered.

Abatement consideration should weigh the abatement benefits, costs, and overall social, economic, and environmental effects. The FHWA considers a 5 dB reduction in noise level to be significant. Per FHWA/HDOT's standards, mitigation measures need to be economically reasonable (meet a monetary cost guideline per mitigated property) and feasible (i.e., acceptable to the affected residents). Possible mitigation measures, listed in order of effectiveness, include:

1. Air-conditioning or forced ventilation for those impacted residences along Keaʻau-Pāhoa Road. At the impacted homes, jalousie windows should be replaced with standard storm windows with acoustical gaskets. Typical exterior-to-interior noise reduction for naturally ventilated homes, i.e., with open windows, is only 9 dB. Noise reduction for air-conditioned homes with the windows closed is significantly higher. This measure does not address exterior noise.

2. Construction of noise barriers (that incorporate landscaping for aesthetic purposes) whether within or outside the highway right-of-way. Factors such as distances to roadways and setbacks, intervening ground conditions, barrier construction, barrier height, roadway elevations, etc., influence the noise reduction afforded by a traffic noise barrier. Barriers also need the support of property owners, who may or may not support their installation.

A review of the feasibility of barriers was made based on the impacted locations in the corridor. Typically, a sound level reduction of at least 5 dB can be expected where a noise barrier just breaks the line-of-sight from the receiver to the roadway. However, many of the residences have driveways off of Keaʻau-Pāhoa Road which would necessitate a break or gap in the noise barrier wall. The reduction in traffic noise will be much lower for areas of the project corridor where gaps in the noise barrier wall would be common. In the case of multiple story or elevated structures, it is not likely that a 5 dB reduction could be achieved without using excessively high walls. Therefore, noise barriers would not be feasible on this project as the numerous breaks in the wall needed for driveways would compromise the ability of the barrier to adequately attenuate noise for the required 5 dB reduction. Noise barriers typically are only feasible on limited-access highways where a continuous barrier can block affected receivers from the roadway noise.

3. Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development which would be adversely impacted by traffic noise. This measure would not address noise at existing properties, and efforts have been made to reduce community disruption by minimizing right-of-way acquisition.

4. Traffic management measures (e.g., traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and

exclusive land designations). Given that Keaʻau-Pāhoa Road is the only highway serving this area of lower Puna, time restrictions would not be expected to be feasible.

HDOT will determine if any of these noise mitigation measures are feasible and reasonable at affected properties in later stages of design when the Preferred Alternative is known and exact impacts can be determined. If noise mitigation is feasible and reasonable, HDOT will work with property owners to implement these measures.

4.5.3 Construction Noise Impacts and Mitigation

The State of Hawaiʻi Community Noise Control Rule at Chapter 11-46 of the Hawaiʻi Administrative Rules defines three classes of zoning districts and specifies corresponding maximum permissible sound levels due to stationary noise sources such as air-conditioning units, exhaust systems, generators, compressors, pumps, etc. The Community Noise Control Rule does not address most moving sources, such as vehicular traffic noise, air traffic noise, or rail traffic noise. However, the Community Noise Control Rule does regulate noise related to construction activities, which may not be stationary.

The maximum permissible noise levels are enforced by the State Department of Health (DOH) for any location at or beyond the property line and shall not be exceeded for more than 10% of the time during any 20-minute period. The specified noise limits which apply are a function of the zoning and time of day as shown in **Figure 4-1: Hawaiʻi Maximum Permissible Sound Levels for Various Zoning Districts**.

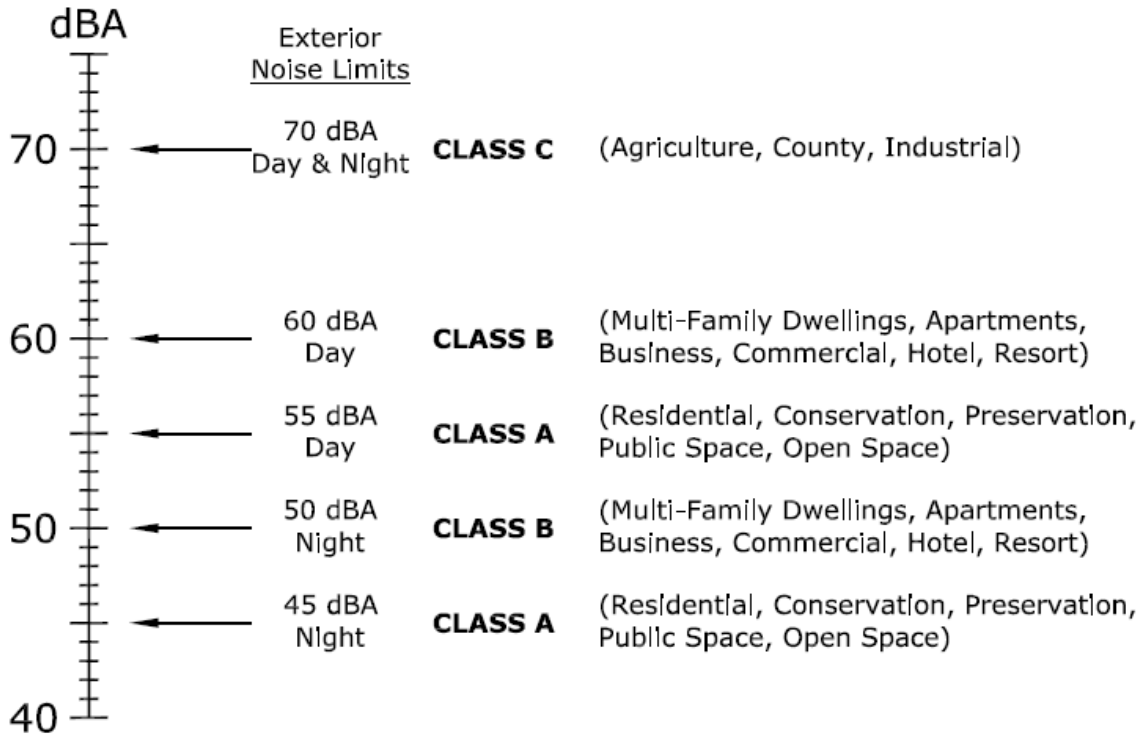
With respect to mixed zoning districts, the rule specifies that the primary land use designation shall be used to determine the applicable zoning district class and the maximum permissible sound level. In determining the maximum permissible sound level, the background noise level is taken into account by the DOH.

In cases where construction noise exceeds, or is expected to exceed the DOH's "maximum permissible" property line noise levels, a permit must be obtained from the State DOH to allow the operation of vehicles, cranes, construction equipment, power tools, etc., which emit noise levels in excess of the "maximum permissible" levels.

Much of the project area can be considered noise sensitive as residences and businesses along Keaʻau-Pāhoa Road may be impacted by the project construction noise due to their proximity to the project. The actual noise levels produced during construction will be a function of the methods employed during each stage of the construction process. Typical ranges of construction equipment noise are shown in **Figure 4-2: Typical Sound Levels from Construction Equipment**.

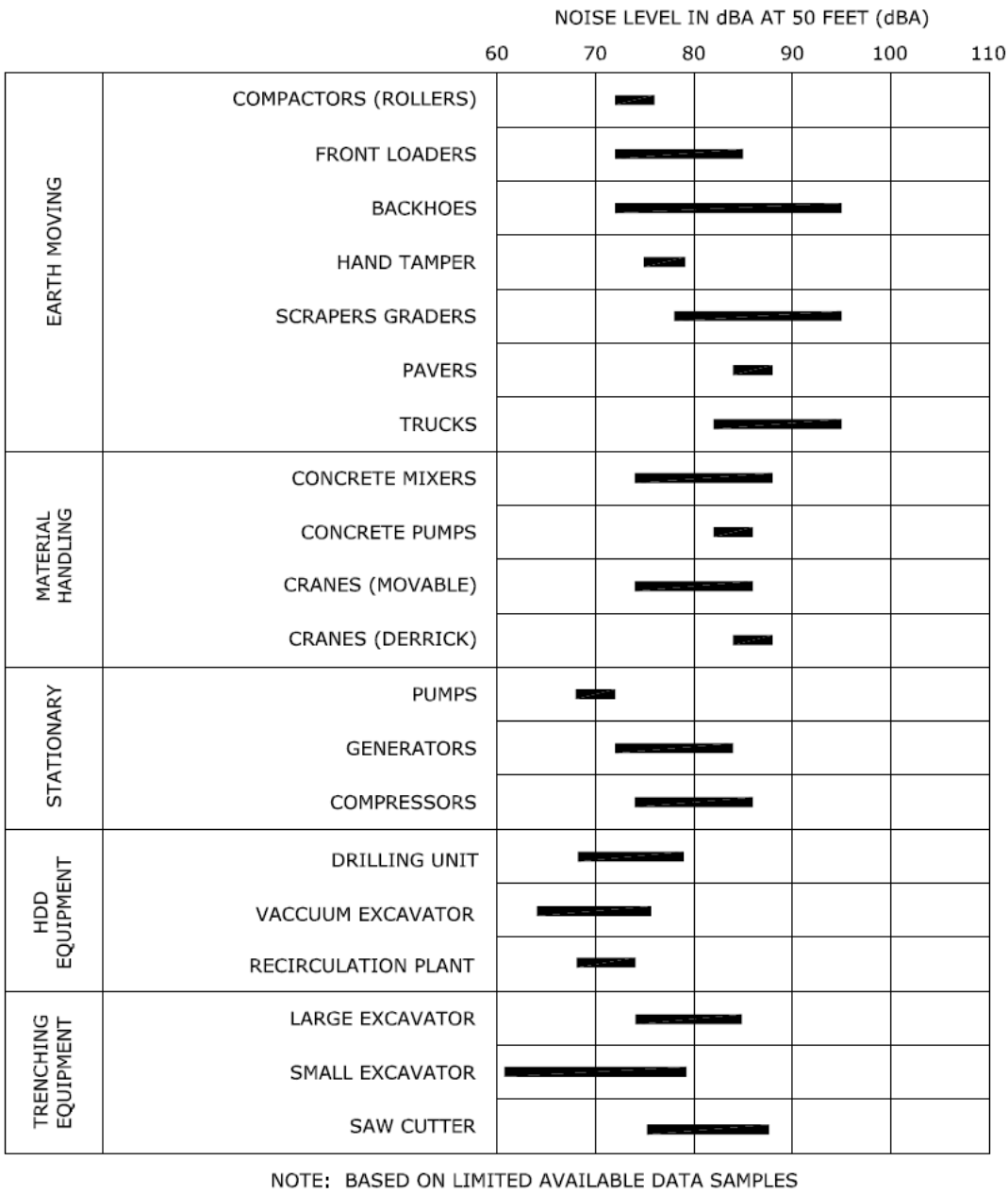
Figure 4-1: Hawai'i Maximum Permissible Sound Levels for Various Zoning Districts

Zoning District	**Day Hours** (7 AM to 10 PM)	**Night Hours** (10 PM to 7 AM)
CLASS A Residential, Conservation, Preservation, Public Space, Open Space	55 dBA (Exterior)	45 dBA (Exterior)
CLASS B Multi-Family Dwellings, Apartments, Business, Commercial, Hotel, Resort	60 dBA (Exterior)	50 dBA (Exterior)
CLASS C Agriculture, Country, Industrial	70 dBA (Exterior)	70 dBA (Exterior)



Source: DL Adams Associates, Based on Hawai'i Department of Health

Figure 4-2: Typical Sound Levels from Construction Equipment



Source: DL Adams Associates

Construction noise levels are expected to exceed the daytime limits and a permit must be obtained from the State DOH to allow the operation of construction equipment. The Keaʻau-Pāhoa Road improvements may include involve roadway excavation and embankment; drain line trenching and backfilling, concrete work, utility pole relocation, and roadway paving., etc. and will utilize equipment such as jackhammers, saw cutters, backhoes, front loaders, dump trucks, generators, and compressors. Pavement cutters, jackhammers, backhoes and earthmoving equipment, e.g., bulldozers and diesel-powered trucks will probably be the loudest equipment used during construction.

In order for the DOH to issue a construction noise permit, the Contractor must submit a noise permit application to the DOH, which describes the construction activities for the project. Prior to issuing the noise permit, the DOH may require action by the Contractor to incorporate noise mitigation into the construction plan. The DOH may also require the Contractor to conduct noise monitoring or community meetings inviting the neighboring residents and business owners to discuss construction noise. The Contractor should use reasonable and standard practices to mitigate noise, such as using mufflers on diesel and gasoline engines, using properly tuned and balanced machines, etc. However, the DOH may require additional noise mitigation, such as temporary noise barriers, or time of day usage limits for certain kinds of construction activities.

Specific permit restrictions for construction activities in the Noise Control Rule are:

- "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels ... before 7:00 AM and after 6:00 PM of the same day, Monday through Friday."
- “No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels... before 9:00 AM and after 6:00 PM on Saturday."
- “No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels on Sundays and on holidays."

The use of hoe rams and jack hammers 25 lbs. or larger, high pressure sprayers, chain saws, and pile drivers are restricted to 9:00 AM to 5:30 PM, Monday through Friday. In addition, construction equipment and on-site vehicles or devices whose operations involve the exhausting of gas or air, excluding pile hammers and pneumatic hand tools weighing less than 15 pounds, must be equipped with mufflers.

The State DOH noise permit does not limit the noise level generated at the construction site, but rather the times at which noisy construction can take place. Therefore, noise mitigation for construction activities should be addressed using project management, such that the time restrictions within the State DOH permit are followed.

4.6 Biological Resources

4.6.1 Flora

The No-Build Alternative (Alternative 1) will have no direct effect on vegetation in the study corridor. The TSM Alternative (Alternative 2) will have a minimal effect as construction would be generally limited to minor improvements near intersections.

As noted in **Section 3.6.1: Flora**, much of the property in immediate proximity to Keaʻau-Pāhoa Road has been disturbed by development, mostly residential. In less-developed portions of the corridor, the vegetation along the corridor is a patchwork of native ʻōhiʻa-uluhe forest, mostly degraded by invasive species, but in some cases almost pristine. None of the area is designated as conservation, and most will eventually be disturbed as development continues, regardless whether the highway is reconstructed. No rare, threatened or endangered species were found in the field surveys performed for this project.

The Build Alternatives (Alternatives 3, 4, and 5) will convert a narrow strip of vegetation immediately next to the existing roadway to roadway right-of-way. Given the disturbed nature of the corridor and the lack of important botanical resources, none of the build alternatives are expected to have any direct adverse impact on the botanical resources or vegetation of Puna or the island of Hawaiʻi.

In order to minimize indirect adverse impacts, care should be taken during and after the construction of the road to avoid introduction of any invasive alien species particularly on equipment from other islands or the mainland. If efforts are undertaken to landscape with appropriate native species, the project could benefit the biological resources of the area.

4.6.2 Fauna

As described in greater detail in **Section 3.6.2: Fauna**, the corridor contains low diversity and densitites of avian species, in large part to the disturbance caused by the existing roadway.

The No-Build Alternative (Alternative 1) will have no direct effect on fauna in the study corridor. The TSM Alternative (Alternative 2) will have a minimal effect as construction would be generally limited to minor improvements near intersections.

Under the Build Alternatives (Alternatives 3, 4, and 5), the modification of the current habitat within the proposed right-of-way is not expected to result in substantial impacts to any avian or mammalian species currently listed as threatened, endangered or proposed for listing under either the Federal, or State of Hawaiʻi endangered species programs. Additionally, there will be no appreciable difference in impacts associated with any of the build alternatives currently under consideration. This opinion is based on the fact that relatively simple minimization measures, described in the sections that follow, can be implemented to reduce the potential for deleterious impacts to occur as a direct result of this action on the four listed species that are known to occur in the project area.

Based on the habitat along Keaʻau-Pāhoa Road, it is not expected that the improvements proposed to the existing roadway will result in any deleterious impacts to any migratory shorebird species.

4.6.2.1 Hawaiian Hawk

The principal potential impact the Keaʻau-Pāhoa Road Build Alternatives pose to Hawaiian Hawks is if active nests are disturbed during clearing and grubbing. However, there is very little suitable hawk nesting habitat within the proposed right-of-way, with the exception of the last 500-meters (1,640-feet) of right-of-way on the southern terminus of the project near Pāhoa-Kapoho Road. There are large exotic trees along this section that potentially could be used by hawks as nest trees.

To minimize the potential that clearing and grubbing activity might disturb nesting Hawaiian Hawks, it is recommended that an audio playback nesting survey be conducted for hawks along the last kilometer of the proposed roadway corridor on the southern terminus of the project if clearing will occur during the Hawaiian Hawk nesting period. Typically such surveys are conducted in the month of January.

Individual foraging hawks potentially could be temporarily disturbed by construction activity. Such potential disturbance to foraging Hawaiian Hawks is not likely to be significant, as there are miles and miles of suitable foraging habitat surrounding the length of the project corridor.

4.6.2.2 Hawaiian Petrel and Newell's Shearwater

The principal potential threat that the construction and operation of the Build Alternatives pose to Hawaiian Petrels and Newell's Shearwaters comes from birds potentially being downed after becoming disoriented by lights associated with night time construction, or by street lights. With that said it should be borne in mind that multi-year ornithological radar studies conducted in the general project area have detected extremely small passage rates of these species through the area (Day and Cooper 2003).

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 if nighttime construction is necessary, all lights associated with the construction activities should be shielded and or directed at the ground.

Following build-out it is recommended that any streetlights that may be required for public safety reasons along the new road be shielded (Reed et al. 1985, Telfer et al. 1987). This minimization measure 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.

4.6.2.3 Hawaiian Hoary Bat

The principal potential impact that the Build Alternatives pose to bats is during the clearing and grubbing phases of construction as vegetation is removed. The removal of vegetation within the project corridor may temporarily displace individual bats, which may use the vegetation as a roosting location. As bats use multiple roosts within their home territories the potential disturbance resulting from the removal of the vegetation is likely to be minimal. During the pupping season, females carrying their pups may be less able to rapidly vacate a roost site as the vegetation is cleared. Additionally, adult female bats sometimes leave their pups in the roost tree while they themselves forage, and very small pups may be unable to flee a tree that is being felled.

Potential adverse effects from such disturbance can be avoided or minimized by not clearing woody vegetation taller than 4.6 meters (15 feet), between April 15 and August 15, the period in which bats are potentially at risk from vegetation clearing.

4.6.2.4 Migratory Shorebirds

Two migratory indigenous shorebird species, Pacific-Golden Plover (Kolea, or *Pluvialis fulva*), and Ruddy Turnstone ('akekeke, or *Arenaria interpres*) use resources within the general project area on a seasonal basis. Neither species is threatened or endangered. There is little suitable shorebird habitat for these or other wide-ranging shorebird species within the proposed right-of-way, and impacts on these species will be negligible and not requiring mitigation.

4.6.3 Aquatic Biota

Field surveys in the corridor, as described in **Section 3.6.3: Aquatic Biota**, documented that there are few aquatic resources in the corridor, and no listed (or proposed for listing) species were found during field visits.

The No-Build Alternative (Alternative 1) will have no direct effect on aquatic species in the study corridor. The TSM Alternative (Alternative 2) will have a minimal effect as construction would be generally limited to minor improvements near intersections.

Under the Build Alternatives (Alternatives 3, 4, and 5), given the lack of aquatic resources identified during the field surveys and the intermittent nature of the water in the unnamed stream, there is limited potential for impact to habitat for aquatic species. There is no difference in the effect of any of the alternatives under consideration. This conclusion holds true for the unnamed stream because aquatic resources here are limited to ephemeral pools formed in depressions in the basalt bed, seen away from the vicinity of the highway crossing.

Any impacts to the limited aquatic resources in the corridor will be mitigated with use of Best Management Practices and National Pollution Discharge Elimination System (NPDES) permitting as needed during construction to limit sedimentation or deposition of soil in streams. Treatment of runoff through swales or structures such as drywells or infiltration trenches will prevent pollutants from entering waterways.

4.7 Water Resources

4.7.1 Surface and Groundwater

The No-Build Alternative (Alternative 1) will have no direct effect on surface or groundwater in the study corridor. The TSM Alternative (Alternative 2) will have a minimal effect as construction would be generally limited to minor improvements near intersections.

There are very limited surface water resources discussed in **Section 3.7.1: Surface and Groundwater** that will be affected by the Build Alternatives (Alternatives 3, 4, and 5). As noted in the May 21, 2009 survey, the only water present within the project area was located in small, isolated pools in the tributary north of the larger channel of the unnamed stream and in a center culvert at 0.2 mi (0.3 km) south of the Keaʻau Bypass merge (before Opukahaia Street).

Under the Build Alternatives (Alternatives 3, 4, and 5), given the lack of aquatic resources identified during the field surveys and the intermittent nature of the water in the unnamed stream, there is limited potential for impact to affect surface water resources. This conclusion holds true for the unnamed stream because aquatic resources here are limited to ephemeral pools formed in depressions in the basalt bed, seen away from the vicinity of the highway crossing.

Any impacts to the limited aquatic resources in the corridor will be mitigated with use of Best Management Practices (BMPs) and National Pollution Discharge Elimination System (NPDES) permitting as needed during construction to limit sedimentation or deposition of soil in streams.

Coordination with the US Army Corps of Engineers, as described in **Section 3.7.1: Surface and Groundwater**, will continue, and a determination on the jurisdictional status on the unnamed stream will occur after submission of this EA document.

After a roadway facility is completed and open for operation, stormwater quality could degrade with urban development and increased impervious surfaces, as various pollutants are introduced into the stormwater runoff. Therefore, the quality of storm water runoff leaving the roadway corridor is of concern. HDOT requires that the project provide permanent water quality treatment of the roadway runoff prior to discharging off right-of-way. The project would incorporate permanent BMPs in conformance with HDOT and good engineering practice to accomplish this goal.

The first half-inch of runoff during a storm is referred to as the Water Quality Volume (WQV) or the “first-flush” volume (FHWA- HEC-22). This portion of the runoff from a storm contains measurably more suspended solids plus other contaminants per cubic foot than would be expected in runoff occurring later in the storm. Accepted permanent BMP practice is to provide at least for on-site storage and disposal of this first-flush runoff.

Permanent BMPs that would be considered during final design include detention basins, infiltration facilities and/or drywells. Each of these facilities provide temporary storage to control peak flow and would also provide permanent storage and infiltration area in order to

control both the increase in storm volume and the first-flush discharge resulting from the project. A full assessment of all available BMP's would be provided during final design of the project to optimize water quality benefits. The proposed permanent BMP facilities will fit entirely within the proposed right of way limits for the two, four and six lane cross sections.

Impacts on groundwater are expected to be minimal. Treatment of runoff will prevent pollution from percolating down to groundwater through the permeable soil and lava found in the study area. No underground injection is expected.

4.7.2 Wetlands

The No-Build and TSM Alternatives will have no impact upon wetlands.

For Alternatives 3, 4, and 5, as noted in **Section 3.7.2: Wetlands**, there is one depression area that exhibits some wetland characteristics, specifically positive vegetation and hydrology indicators, and a possible soil indicator requiring more in-depth study. However, this depression is not expected to be classified as a jurisdictional wetland under the regulatory oversight of the US Army Corps of Engineers. Therefore, no Department of the Army Permit under Section 404 of the Clean Water Act is anticipated to be necessary for any impacts on this area, pending the Corps' final determination of jurisdiction.

While non-jurisdiction removes federal permitting requirements, Executive Order 11990 (Protection of Wetlands) requires that federal projects minimize harm to wetlands over and above any permit issues. Therefore, as design proceeds, this area should be avoided to the greatest degree possible, and impacts minimized.

To minimize impacts upon this area, Best Management Practices (BMPs) will be followed during construction to limit sedimentation or deposition of soil within this depression. Treatment of runoff through Permanent BMPs as described in **Section 4.7.1: Surface and Groundwater** will also protect water quality in this area.

4.7.3 Floodplains and Hydrology

As noted above in **Section 3.7.3: Floodplains and Hydrology**, the entire region of lower Puna that includes Keaʻau-Pāhoa Road is designated as Zone X under the National Flood Insurance Program. Therefore, none of the Alternatives will impact an area regulated as a floodway.

The engineering analyses conducted for this project considered precipitation in the area, the watersheds and topography upstream of Keaʻau-Pāhoa Road, the soils found in the vicinity, and the existing and future land uses. Using this information, designers estimated the design flow at each of 35 locations where drainage structures cross the highway. Designers have determined the adequacy of the existing drainage features, and, where necessary, will recommend new or replacement drainage measures order to meet current highway design standards. The proposed changes to drainage within the corridor are documented at length in **Appendix L: Culvert Drainage Study**.

The No-Build Alternative will have no effect on drainage in the corridor. Low spots that experience ponding during strong storms will continue to have this problem during future storm events. The TSM Alternative is expected to have a minimal effect on drainage in the area overall, as most improvements would be limited to the immediate vicinity of intersections.

Build Alternatives 3, 4, and 5 will increase the amount of impervious pavement within the highway facility, and therefore, it will be necessary for Keaʻau-Pāhoa Road to be designed such that it can accommodate larger volumes and peak flow rates of runoff. Permanent Best Management Practices (BMPs) that would be considered during final design include detention basins, infiltration facilities and/or drywells. Refer to **Appendix M: Pavement Drainage Report & BMP Assessment** for more information. In all cases, the sizing of storage for the detention and treatment of runoff during final design will ensure that the rate and quantity of peak flow from roadway runoff will meet HDOT standards. These features will detain and dispose of the runoff from storm events and release the water over a longer time period to prevent flooding.

Under Build Alternatives 3, 4, and 5, bridges shall be designed to withstand a 100-year flood without damage, and to provide at least two feet of clearance between the water surface and the low chord of the bridge. Bridge design will avoid increasing backwater, to ensure there is no flooding upstream. Existing flow distribution and velocities will be maintained as much as possible to prevent scour or other damage to the structure or adjacent property.

Widening the highway under Alternatives 3, 4, and 5 will also require longer culverts, and possibly larger culverts, to ensure that there is no adverse change in the flow of drainage across the highway facility. Culverts will be designed to accommodate a 50-year flow, and to avoid ponding, erosion, and scouring.

To improve drainage in the area of the unnamed stream near the Waipāhoehoe Bridge, it is recommended that a 1930s-era abandoned concrete bridge immediately upstream (mauka) of Keaʻau-Pāhoa Road be removed. This structure is slated to be removed as part of the Shoulder Lane Conversion project, described in **Section 1.2.2.1: The Keaʻau-Pāhoa Road Shoulder Lane Conversion Project**, which will take place prior to the improvements discussed in this Environmental Assessment.

4.8 Geographic Setting and Natural Hazards

4.8.1 Geology

The No-Build Alternative (Alternative 1) will result in no construction. The TSM Alternative (Alternative 2) will have a negligible effect on geological features as construction would be generally limited to minor improvements near intersections.

Construction of the Build Alternatives (Alternatives 3, 4, and 5) could possibly result in the opening or discovery of lava tubes. While a number of lava tubes are documented in the area, there might be others that have not been identified to date. The depth to these lava tubes below the existing terrain generally has not been established.

While the depth to the Kazumura Cave (or any other cave) underlying the current project area is uncertain, profile views shown in the Allred and Allred (1997) study suggest that the upper portion of the lava tube typically lies within ten to twenty meters of the surface. The proposed project may potentially breach or cause adverse direct or indirect impacts to the Kazumura Cave or other caves throughout the corridor, many of which are poorly documented.

Sections 4.9.1: Archaeological Resources and **4.9.2: Historic Resources** below discuss measures for archaeological monitoring to avoid or minimize effects on lava tubes (and other resources) throughout the length of the corridor. Whether possible impacts to the Kazumura Cave (or any other cave) underlying the current project area would have an adverse impact to any cultural resources that may be present in these cave systems is uncertain.

4.8.2 Natural Disasters

Until an alternate parallel route to Kea'au-Pāhoa Road can be constructed, for now, it provides the only route into and out of Lower Puna. This means that in the event of a natural disaster such as an earthquake, lava flow, hurricane or tsunami, it would serve as the primary evacuation route for Civil Defense needs and it also is the primary route first responders use to reach local subdivisions and transport people to Hilo Medical Center, the region's only hospital.

The No-Build Alternative (Alternative 1) will not improve Kea'au-Pāhoa Road and as a result, will leave the area vulnerable in the event of an evacuation. While the TSM Alternative will make minor improvements to intersections, it will not appreciably increase the capacity of the highway overall.

In the event of an evacuation, Alternatives 3, 4, and 5 would increase the capacity of the highway in the segments that are four lanes or six lanes wide. Such wider facilities would also enable a temporary contra-flow configuration in travel lanes to evacuate even greater numbers of vehicles in an emergency.

4.9 Cultural Resources

As noted earlier, the Archaeological Inventory Survey is under review by the State Historic Preservation Division (SHPD).

4.9.1 Archaeological Resources

Neither the No-Build Alternative (Alternative 1) nor the TSM Alternative (Alternative 2) will have an effect on archaeological resources.

The archaeological survey did not identify any resources that would be impacted the Build Alternatives (Alternatives 3, 4, and 5). In part, this was a result of low visibility of much of the undisturbed areas within the corridor. Nonetheless, two historic properties were identified as described below in **Section 4.9.2: Historic Resources**.

Based on the project team's research of the project area and its importance as a thoroughfare in the past, and into the future, it is recommended that as a mitigative measure, archaeological

monitoring of construction activities take place during all phases of construction of any of the Build Alternatives. Archaeological monitoring will potentially prevent accidental damage to the Kazumura Cave system and its associated features and burials. Monitoring of construction activities will also prevent access or damage to the ancient trails system that abuts the corridor. Further, on-site monitors will be able to point out archaeological features and trails alongside the roadway from areas of low visibility during the archaeological survey, or in areas of increased visibility due to vegetation clearance during the construction phase. Specifics of the archaeological monitoring will be addressed in the archaeological monitoring plan to be reviewed and approved by the State Historic Preservation Division (SHPD). This monitoring program will facilitate the identification and proper treatment of any burials that might be discovered during project construction, and will gather information regarding the project's non-burial archaeological deposits, should any be discovered.

4.9.2 Historic Resources

One historic property, a 1930s-era concrete bridge was identified within the Area of Potential Effect (APE). A second historic property, a cemetery, lies just beyond the APE and was previously identified (State of HawaiʻI, Department of Transportation 1979). Both historic properties identified within the survey area are recommended eligible to the Hawaiʻi and National Registers:

- SIHP # 50-10-44-26874, 1930s Bridge, Criterion D
- SIHP # 50-10-55-7388, Sacred Heart Catholic Church cemetery, a component of the Pāhoa Historic and Commercial District, Criterion D

Although the proposed project will most likely alter a small portion of the historic fabric of Keaʻau-Pāhoa Road, this alteration is suggested to represent routine maintenance to an in-use road that is consistent with the Secretary of the Interior's standards for the treatment of historic properties (36 CFR part 68). A project specific effect determination of "no adverse effect" is warranted for the proposed road widening project overall.

4.9.2.1 SIHP # 50-10-44-26874, Circa 1930s Concrete Slab Bridge and Roadway

This bridge will be demolished as part of the separate Shoulder Lane Conversion project described in **Section 1.2.2.1: The Keaʻau-Pāhoa Road Shoulder Lane Conversion Project**, and therefore the bridge will no longer be present at the time that the project covered in this EA is constructed. Thus, none of the alternatives in this project will have any direct impact on this bridge, and this project is considered to have "no effect" on the historic bridge.

This bridge is not listed on the State of Hawaiʻi Historic Bridge inventory.

While the project is expected to have no effect on the bridge, inasmuch as this identified historic property is present in the defined Area of Potential Effect at this time, the Archaeological Impact Survey treated it as if it might be affected by this Keaʻau-Pāhoa Road improvements project. Under Federal Section 106 guidelines a project specific effect determination of "no adverse effect" is warranted for the proposed road widening project with

the understanding that the recommended mitigation measures will be acted upon. Because the project must also comply with Hawaiʻi State historic preservation review legislation (HAR Chapter 13-275), a project effect recommendation of "effect, with proposed mitigation commitments" is warranted.

A separate Environmental Assessment for the Shoulder Lane Conversion was issued in November, 2009. The Archaeological Inventory Survey for that project (Haun and Henry, 2008) found the bridge was significant under Criterion D, consistent with the finding in this study. Haun and Henry's recommendation is that their documentation adequately documents the site and no further work or preservation is recommended.

Data recovery in the form of Historic American Building Survey and Historic American Engineering Record (HABS/HAER) documentation of the bridge is recommended, consistent with the finding in the other Archaeological Impact Survey. Consultation with and the approval of the SHPD with the mitigation proposed above is recommended prior to any proposed alteration to SIHP # 50-10-44-26874.

4.9.2.2 SIHP # 50-10-55-7388, Sacred Heart Catholic Church Cemetery

During project planning a great deal of effort was put into insuring that the project Area of Potential Effect did not encroach on the Sacred Heart Church property component of the Pāhoa Historic and Commercial District designated as SIHP # 50-10-55-7388. The Sacred Heart Church property improvements, specifically a Meditation Path, are immediately adjacent to, but do not intrude into, the existing and future road right-of-way or into the designated Area of Potential Effect. Therefore, the project will have no effect on this resource.

A temporary construction barrier is proposed as an appropriate precaution given the proximity of the church property to insure that project related activities do not stray outside of the APE. Specifically, the erection of continuous, orange-web "event fencing" or some similar barrier is recommended prior to any project related work within 50 feet of the Sacred Heart Catholic Church property. This interim protection could be carried out and documented under monitoring archaeologist supervision.

4.9.2.3 Lava Tubes

While no lava tubes were identified during the inventory survey, entrances are often obscured. Background research has indicated that there are lava tubes in the vicinity of the southern portion of the project corridor. The research indicated that findings in one of the lava tubes indicated this area was utilized by pre-contact Hawaiians. Thus it is possible that subsurface historic properties, associated with pre- and possibly post-contact land use, are present within the southern portion of the project corridor. In order to mitigate the potential damage to these potential historic properties within the project area, it is recommended that project construction proceed under an archaeological monitoring program. Specifics of the archaeological monitoring will be addressed in the archaeological monitoring plan to be reviewed and approved by the State Historic Preservation Division. This monitoring program will facilitate the identification and proper treatment of any burials that might be discovered

during project construction, and will gather information regarding the project's non-burial archaeological deposits, should any be discovered.

4.9.2.4 Roadside Memorials

Six roadside memorials that are not historic properties were identified within the project area. HDOT has a Roadside Memorials Policy, which states that memorials are permitted under certain conditions but must be removed within 30 days, otherwise, "the Department will remove and dispose of the memorial." Thus current HDOT policies allow removing these ad-hoc shrines. However, in the interests of good public relations with the concerned families and friends it is recommended that consideration be given to avoidance and that if the road improvements require the removal of these memorials that notification of intended removal be posted on each memorial 30 days prior to removal.

4.9.3 Cultural Practices

Neither the No-Build Alternative (Alternative 1) nor the TSM Alternative (Alternative 2) will have an effect on any Cultural Practices in the Keaʻau-Pāhoa Road corridor.

As noted above in **Section 3.9.4: Cultural Practices**, the Cultural Impact Assessment (CIA) found that the Build Alternatives (Alternatives 3, 4, and 5) would create no impact to traditional cultural practices along the corridor, with the potential exception of the activities that are ongoing at the Maku'u Farmers Market Association site where ongoing cultural activities still survive into the 21st century.

HDOT and DHHL have recently worked together to improve the access from Keaʻau-Pāhoa Road into a new intersection, constructed in 2008-2009 that better serves the site, providing a left-turn lane for Pāhoa-bound traffic to access the property. It is anticipated that future cooperation in a similar vein, along with mitigation described below, will ensure that improvements to Keaʻau-Pāhoa Road enable the Makuʻu Farmers' Market and activities on the site to continue to thrive.

The design of the roadway in the vicinity of this site has been focused on avoiding impacts on the site to the greatest degree possible. Under Alternatives 2, 3, 4, and 5, a bus stop and bus pullout area will help improve accessibility of the site to transit-dependent persons but will affect a narrow strip of the property immediately next to Keaʻau-Pāhoa Road. Alternative 3 will not increase the number of lanes in this area and is anticipated to have no impact with the exception of the bus stop and bus pullout area. If a four-lane cross-section is constructed under Alternatives 4 and 5, impacts will be limited to the need to relocate power poles in the area and to provide the bus stop and pullout area.

Based on issues raised during the telephone and talk story in-person interviews with local *kūpuna* (elders) and/or *kamaʻāina* (native born), the following mitigative measures are proposed to avoid impact under Alternatives 3, 4, and 5:

- Archaeological monitoring, as described above in **Sections 4.9.1: Archaeological Resources** and **4.9.2: Historic Resources** to avoid or minimize impacts on lava tubes and

other potential archaeological resources that were not identified during the archaeological field inventory due to poor visibility.

- Once trails and sites are located that potentially will be impacted by their visibility to the public and passersby within the corridor, mitigation measures can be implemented to mask and buffer the sites with native vegetation, thereby restoring some of the traditional fauna to the region once more.
- Extra safety measures should be in place to prevent damage to equipment and persons working on the new highway, especially in the region that the Kazumura cave was previously located.
- W.H. Shipman, the largest landowner in the project area, has requested that access points to their agricultural areas remain open. Keeping these access points open will ensure safe and continued access to farming areas along the route.
- Finally, ongoing activities at the Makuʻu Market should be preserved as a center of Hawaiian culture along the project corridor route. This area should be avoided to avoid damage to existing cultural plantings and ongoing areas of use on the Makuʻu Market Association lands. These lands and the activities ongoing on them meet the requirements listed in accordance with Hawaiʻi State Historic Preservation Statute (Chapter 6E) guidelines for Traditional Cultural Properties (TCPs) of ongoing cultural significance and may be eligible for inclusion on the State Register of Historic Places, under significance criteria (HAR §13-275-6), Criterion E which states to be significant an historic property shall:

    a. Have an important value to the Native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity.

    b. Native Hawaiian traditional practices that are ongoing at this location have been ongoing in some cases for 80 years. Additionally, it is the last remaining site on this corridor where traditional Hawaiian cultural practices are still promoted, taught, observed and transmitted to the next generation, thereby preserving and perpetuating their importance to the history and cultural identity of the Hawaiian people residing in the Puna area and beyond, and therefore this site may be eligible under Chapter 6E guidelines for Traditional Cultural Properties.

4.10 Parks and Recreational Resources

None of the alternatives are anticipated to create any direct impacts on parks or recreational resources as there are none in the immediate vicinity of Keaʻau-Pāhoa Road.

As noted above in **Section 3.10: Parks and Recreational Resources**, Hawaiʻi County Department of Parks and Recreation has investigated the concept of a park beside Keaʻau-Pāhoa Road

adjacent to the new Pāhoa Fire Station. The project has not been programmed by the county as part of any long-term plans, and no conceptual design plans have been produced to date. (Personal Communication, Robert Fitzgerald, County of Hawaiʻi Director of Parks and Recreation, 11/12/09). Several feet of right-of-way would need to be acquired from the County in this area for Alternatives 4 and 5.

4.11 Agricultural Lands

Existing agricultural operations in the corridor were described in **Section 3.11: Agricultural Lands.**

The No-Build will not have any impact on agricultural property.

Table 4-36: Right-of-Way Impacts on Parcels with Agricultural Activity Bordering Corridor provides an overview of the agricultural parcels that have agricultural activity in the immediate proximity of the corridor and could be impacted by the project. The table does not include parcels where agricultural fields, greenhouses, or shade houses are far removed from the roadway and will not be affected.

As the table shows, the TSM Alternative will have a negligible impact on agricultural operations in the corridor. At two parcels, in close proximity to Nanawale Homestead Road, the right-of-way needs for the project would require acquisition of narrow strips of property (less than 0.1 acre each) for adding turn lanes in the area. The TSM Alternative does not affect any Agricultural Lands of Importance to the State of Hawaiʻi (ALISH).

The Build Alternatives (Alternatives 3, 4, and 5) will have a minimal direct impact overall on agricultural land in the study area. Most of the right-of-way that would be necessary for improvements are narrow strips of land along the edge of the highway in the general range of 10 to 20 feet in width, which constitute a minimal percentage of the overall property. Out of a total acreage of 2,669 agricultural acres, Alternative 3 is expected to acquire 4.3 agricultural acres, Alternative 4 is expected to acquire about 5.4 agricultural acres, and Alternative 5 is expected to acquire about 9.8 agricultural acres. The great majority of these totals in all cases is vacant property owned by W.H. Shipman; between 0.2 and 0.5 acres of other agricultural parcels would be acquired under all Build Alternatives.

As the table demonstrates, there is one parcel, 366.3 acres in size that is owned by W.H. Shipman Ltd. that contains 266.2 acres of Prime Agricultural Land in two units (257.1 acres and 9.1 acres). The parcel is mauka of Keaʻau-Pāhoa Road, north of Shower Drive/Pōhaku Drive. Build Alternatives 3, 4, and 5 would affect a miniscule portion of this parcel, 0.04 acres, 0.02 acres, and 0.08 acres respectively. It is not clear if the limits of the Prime Farmland extends fully to the edge of Keaʻau Pāhoa Road

Table 4-36: Right-of-Way Impacts on Parcels with Agricultural Activity Bordering Corridor

Tax Map Key (TMK) Parcel	Total Acres	Acres ALISH	Total Acres Right-of-way Acquired (with Signalized Intersections)				Additional ROW for Roundabout Options
			TSM Alt. 2	Alt. 3	Alt. 4	Alt. 5	
W.H. Shipman Ltd. Agricultural Properties Between Kea‘au and Shower Drive							
16001015	989.5	-	0	2.61	2.62	4.77	0
16003002	38.6	-	0	0.19	0.18	0.33	0
16004011	1154.1	-	0	1.20	1.78	3.46	0
16004048	366.3	266.2 Prime	0	0.04	0.02	0.08	0
16004049	0.7	-	0	0.08	0.08	0.14	0
16004050	25.2	-	0	0.01	0.01	0.03	0
16004055	21.3	-	0	0.02	0.14	0.35	0
16004056	2.1	-	0	0.06	0.06	0.14	0
Subtotal: Shipman	***2597.8***	***266.2***	***0***	***4.21***	***4.89***	***9.30***	***0***
Other Agricultural Properties near Pāhoa							
15007075	5.6	-	0	0.12	0.15	0.15	0
15116019	15.3	-	0	0	0	0	0
15006005	15.4	-	0.09	0	0.17	0.17	0.05
15006026	6.6	-	0.09	0	0.10	0.10	0.05
15005001	10.7	-	0	0	0.06	0.06	0
15006017	14.5	-	0	0	0	0	0
Subtotal: Other	***68.1***	***0***	***0.18***	***0.12***	***0.48***	***0.48***	***0***
TOTALS	**2685.4**	**266.2**	**0.18**	**4.33**	**5.37**	**9.78**	**0.10**

Note: Does not include non-agricultural properties leased to institutions by W. H. Shipman that border Kea‘au-Pāhoa Road, including Kea‘au Transfer Station.

Source: SSFM, Inc., County of Hawai‘i, Real Property Tax Office, Hawai‘i Department of Agriculture

If roundabouts are pursued, there would be additional property totaling about 0.1 acre that would be acquired from the two agricultural parcels near Nanawale Homestead Road.

Because this project is a federal project, as part of the pre-assessment consultation for this project, the Natural Resources Conservation Service (NRCS) requested a Farmland Conversion Impact Rating form (form AD-1006) to be completed if farmlands would be converted to non-farmland uses. This form is required as part of the Farmland Protection Policy Act. (Refer to **Appendix B: Pre-Consultation Comments Received** to see the correspondence from NRCS). The form AD-1006 is provided in **Appendix N: Farmland Conversion Impact Rating Form**. FHWA has completed Parts 1 and 3 of the AD-1006 form as per NRCS instructions, and will submit the AD-1006 form to NRCS together with mapping that documents the affected parcels. NRCS then makes a determination whether prime, unique, statewide or local important

farmland is impacted, and if so, NRCS returns the copy of the form to FHWA to fill out other sections of the form.

During the Cultural Impact Assessment process (see **Section 4.9.3: Cultural Practices**), the management of W.H. Shipman, the largest landowner in the project area, raised concerns that access changes and the roadway design could compromise the ability of agricultural machinery to access fields easily. They requested that access points to their agricultural areas remain open. There are two gated driveways to the Shipman properties on the mauka side of the highway between Shower Drive and the Keaʻau Bypass, and one gated driveway on the makai side.

HDOT will work with W. H. Shipman and other agricultural property owners to ensure that changes in roadway access do not compromise agricultural operations.

4.12 Visual Environment

The project corridor is already affected by the existing roadway and by the highly developed nature of much of the adjoining land use.

The No-Build Alternative will not change the visual landscape, although increasing delay and congestion will have an effect on the appearance of the corridor. The TSM Alternative will have a minimal effect on the corridor as improvements would be very localized to intersection areas.

The Build Alternatives (Alternatives 3, 4, and 5) will result in a widened highway as follows:

- Alternative 3 will widen the highway from the current two lanes to four lanes between the Keaʻau Bypass and Ainaloa Boulevard. The remainder will remain two lanes wide.
- Alternative 4 will widen the highway from the current two lanes to four lanes for the entire corridor between the Keaʻau Bypass and Pāhoa-Kapoho Road.
- Alternative 5 will widen the highway from the current two lanes to six lanes from the Keaʻau Bypass to Paradise Drive. It will be widened to four lanes between Paradise Drive and Kahakai Boulevard. The remainder will remain two lanes wide.

The discussion in **Chapter 2: Alternatives** describes the widening in greater detail, and provides illustrations of the widened cross-sections. In general, the wider the highway will be, the more vegetation will be removed, and the more of the visual environment will be devoted to a highway use. The two-lane cross-sections will have vegetated grass swales in some areas to treat drainage, whereas drainage under the four-lane and six-lane sections will be more likely to be handled with underground collection, and the amount of vegetated area will generally be less.

The Build Alternatives (Alternatives 3, 4, and 5) will not block scenic vistas or viewplanes identified in county or state plans or studies. The project has followed a Context Sensitive Solutions (CSS) process in order to involve the community in the planning for the project to ensure a facility that is appropriate for the context of the lower Puna District. Landscaping and

design decisions in final design will strive for a facility that is complementary to the adjoining properties and community at large.

If they are pursued, implementation of roundabouts will provide landscaping and aesthetic opportunities in the middle of the roundabout.

A landscaping plan will be created as part of the final design effort for this project. Emphasis will be placed on the usage of native species wherever possible, along with ensuring that sources for plantings do not contain invasive species. These efforts will help minimize the spread of invasives while improving aesthetics, reducing maintenance costs and promoting native Hawaiian values of stewardship for the land.

Light pollution can be a concern with street lighting. Following build-out it is recommended that any streetlights that may be required for public safety reasons along the new road be shielded to comply 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.

4.13 Utilities

4.13.1 Electrical

The No-Build Alternative (Alternative 1) would not require relocations of any utilities. Utility relocations for the TSM Alternative (Alternative 2) would be very limited given the limited construction, if necessary at all.

Build Alternatives 3, 4, and 5 will require relocation of the existing utility poles to accommodate the additional travel lanes, shoulder area, and pedestrian accommodations. The new poles will be relocated approximately 10 to 30 feet from their existing locations toward the property line, and placed approximately one to two feet from the property line and within the highway right-of-way. All conductors and fixtures such as insulators and cross-arms will be placed on the highway side of the pole. No conductors will cross over private property. Easements to install pole anchors on private property may be required at selected locations where the highway curves.

Following are the approximate length of pole line and number of poles that will need to be relocated for the build alternatives:

- Alternative 3: 4.2 miles on mauka side and 4.2 miles on makai side (219 utility poles)
- Alternatives 4 and 5: 4.6 miles on mauka side and 4.2 miles on makai side (245 utility poles)

The relocation of individual free-standing metal street light poles is not yet known. This will be finalized during the street lighting design stage of the project.

The relocation of utility poles will require a utility agreement (UA) between the regulated utility companies (HELCO, Hawaiian Telcom, and Oceanic Time Warner Cable) and the HDOT. The UA will provide for cost-sharing for these relocations. Typically all relocations will be one-for-one

(replace one utility pole with a similar utility pole at the new location). Following is a preliminary estimated range of cost of utility pole line relocations (in 2009 dollars) for the three build alternatives, including street lighting. They cover a range of costs because of the variability in materials (wood versus metal poles).

- Alternative 3: $6 million to $9 million
- Alternatives 4 and 5: $7 million to $10 million

Under all the Build Alternatives, relocating only the HELCO lines to an underground conduit would cost between an estimated $65 million and $80 million. Relocating Hawaiian Telcom and Oceanic Time Warner cables underground would add to these costs.

The Public Utilities Commission (PUC) will review the UA and the application for the relocation work, and provide a decision and order to the requesting utilities. The PUC may or may not require a public hearing. This PUC approval process may take at least 12 months.

The following measures are typically incorporated during a construction project to mitigate the effects of utility relocations:

- One side of the highway would be closed off, new utility poles and conductors relocated to the new right-of-way line, and existing utility poles and conductors demolished. Power and communication services may be disrupted periodically as the main lines and services are changed over to the new utility poles.

- The highway improvements including new pedestrian areas, shoulder and guard rails, and travel lanes would be constructed along this closed-off side of the highway.

- Traffic control measures would be incorporated for the side of the highway open to traffic. This may involve temporary signals or flagmen, cones, rerouting of vehicles, etc.

- Upon completion of the one side of the highway, vehicles would then be re-routed to the newly constructed area and the other side of the highway would be closed off to effect utility relocations on the other side of the highway.

- Upon completion, both sides of the highway would then be open to traffic.

4.13.2 Telecommunication

Hawaiian Telcom and Oceanic Time Warner Cable lines share poles with HELCO, and impacts of the five Alternatives on Hawaiian Telcom and Time Warner Cable are covered in the discussion of HELCO's poles for **Section 4.13.1: Electrical**.

As noted above in **Section 3.13.2: Telecommunications**, Sandwich Isles Communications (SIC) is currently in its final design phase for construction of a 9.38-mile fiber-optic line in an underground conduit that will extend between Highway 11 in Keaʻau and the Department of Hawaiian Home Lands (DHHL) property at the Makuʻu Farmers Market. The No-Build Alternative (Alternative 1) would not create any impacts on this future infrastructure. The TSM

Alternative (Alternative 2) would have no or negligible impact given its limited construction effects. Under the Build Alternatives 3, 4, and 5, it is unclear at this time if there would be any direct impact on this future fiber optic line. SIC will have a full agreement with HDOT regarding SIC's responsibility for relocating the line if HDOT needs the easement area.

4.13.3 Water Service

The No-Build Alternative (Alternative 1) would not create any impacts on water lines from the Hawaiʻi County Department of Water Supply (DWS).

The TSM Alternative (Alternative 2) may have minor localized effects on water utility infrastructure in the immediate location of TSM improvements at intersections as widening for turn lanes will result in short segments of the water lines ending up located under travel lanes of the roadway. The majority of the water lines over the entire project corridor will not be affected.

Under Build Alternatives 3, 4, and 5, the 12-inch makai-side waterline along 4.4 miles of Keaʻau-Pāhoa Road between Shower Drive and Ka Ohuwalu Drive will ultimately be situated largely within the Keaʻau-bound driving lanes, as shown in the figures in **Appendix A: Roadway Design Plans**

The existing 12-inch makai-side and mauka-side waterlines for the 1.2-mile distance from Kaluahine Street to Old Pāhoa Road are also located within the existing shoulder areas of Keaʻau-Pāhoa Road. Under Alternatives 3, 4, and 5, these waterlines will both ultimately be situated within the driving lanes of the new roadway.

The precise depths of all waterlines are not known and should be confirmed during final design assignments. Based on the available information from the project's topographic survey, the water line depth appears to be in the range of 2.5 feet to 3 feet below the road surface. Current HDOT standards require a minimum of 3 feet of cover above buried utilities, and a horizontal separation of 5 feet from the edge of pavement.

Under Alternatives 3, 4, and 5, the proposed road elevations will closely match the existing roadway elevation, and as such the depth of the existing waterline will not change more than negligible amounts.

HDOT standards require that underground utilities be located on an alignment as near as practicable to the right-of-way line to provide space for future highway construction and for possible future utility installation consistent with good engineering judgment and economic consideration. In areas where good engineering judgment and economic considerations indicate that it would not be practical to install the utility outside the roadway cross-section, a utility may be located within the shoulder, and preferably located as close as possible to the outside edge of the shoulder.

Relocating the existing water lines to meet HDOT standards for horizontal separation from the edge of pavement or vertical depth below pavement does not appear to be warranted. In applying good engineering judgment and economic considerations, the additional costs to

abandon the existing waterlines and construct new waterlines outside of the roadway prism would not provide significant benefit to the project.

To allow for periodic maintenance of gate valves and/or air release valves, the DWS may require single-lane road closures at these locations. During these periods, traffic would be diverted to the adjacent lane or shoulder to allow for safe and controlled access to the various infrastructure elements.

Construction in the areas above the existing water lines will require additional care and attention to ensure that construction activities and vibratory compaction do not result in waterline leaks or cause damage to the existing facilities.

The existing fire hydrants and residential water meters along the corridor will be impacted under Alternatives 3, 4, and 5, as well as at some isolated areas under the TSM alternatives, and will require removal and relocation to increase the horizontal separation from the roadway. Service interruptions will be minimal and can generally be scheduled to minimize impacts on the existing users. The Hawaiʻi County Fire Department would also be notified when there are interruptions.

The project will not create the need for potable water on the project site. The roadway improvement works will be coordinated with the DWS to ensure that the water infrastructure is not adversely impacted and the service is not interrupted. Thus, the project will not have an adverse affect on demand for the County's water supply system.

The fire hydrant and water meter relocation work will require a Utility Agreement between the DWS and the HDOT. Under the Utility Agreement, HDOT will fund the costs related to the relocation work.

4.13.4 Wastewater Services

There are no County of Hawaiʻi wastewater facilities within the project limits.

None of the alternatives will require wastewater services from the County of Hawaiʻi. Therefore, the Keaʻau-Pāhoa Road Improvement project will not have an adverse affect on the County's wastewater system.

4.14 Hazardous Materials

There is a very low likelihood of contamination in the immediate vicinity of the corridor. The No-Build Alternative would be expected to have no effect on contaminated properties, and the TSM Alternative is expected to have a negligible effect. Under Build Alternatives 3, 4, and 5, there is minimal likelihood of hazardous materials being of concern. However, if hazardous materials are discovered during construction, standard procedures will be followed to prevent exposure to workers and to alert authorities for emergency response as needed.

4.15 Right-of-Way, Relocations, and Access Changes

There are several types of land use impacts on adjoining properties that can result from highway improvement projects, discussed in the sections that follow. Projects could create a partial acquisition impact (strip of property needed near the edge of the highway) or in some cases require full acquisition of the property (which would entail relocating the residents or business on the property). There can also be effects on properties from changes in access, especially for those parcels that currently front onto the highway.

It is very important to note that design on this project is at a very preliminary level. All estimates of right-of-way takings and relocations are subject to change with further refinement of the design during the final design process. Changes in access from closure of streets, modification of access management measures, etc. are also subject to change.

Impacts on utilities that will require relocation are discussed in **Section 4.13: Utilities.**

4.15.1 Right-of-Way Acquisitions for Project Alternatives

The anticipated right-of-way impacts on this project are described in **Table 4-37: Estimated Right-of-Way Acquistions Under Project Alternatives**, and elaborated in the text that follows.

Table 4-37: Estimated Right-of-Way Acquistions Under Project Alternatives

Alternative		Number Parcels Affected	Acreage Acquired
1	No-Build	0	0
2	TSM Alternative	36	0.9
3	4 Lanes Keaʻau - Ainaloa, 2 Lanes S. of Ainaloa	287	18.1
4	4 Lanes Entire Corridor	329	24.6
5	6 Lanes Keaʻau - Paradise, 4 Lanes Paradise - Kahakai, 2 Lanes S. of Kahakai	362	39.7

No-Build Alternative: The No-Build Alternative will not require the acquisition of any property from any adjoining parcels.

Alternative 2: The TSM alternative would primarily create impacts in the vicinity of intersections, where minor widening would take place to accommodate new or lengthened turn lanes and bus pullouts. Alternative 2 would be estimated to require the acquisition of 0.9 acres from 36 parcels along Keaʻau-Pāhoa Road. All the acquisition would be minor strips of property immediately abutting Keaʻau-Pāhoa Road. Alternative 2 would not require the total acquisition of any properties or relocation of any residents.

Alternative 3: Alternative 3 would widen the highway to contain a four-lane divided cross section between the end of the Keaʻau Bypass and Ainaloa Boulevard. The segment from Ainaloa Boulevard to Pāhoa-Kapoho Road would remain with two travel lanes, but would have safety improvements at intersections, improved shoulders, and medians where appropriate.

Alternative 3 would be estimated to require the acquisition of 18.1 total acres of property from 287 parcels. Alternative 3 would not require the total acquisition of any properties or relocation of any residents.

Alternative 4: Alternative 4 would widen the highway to contain a four-lane divided cross section for the entire distance between the Kea'au Bypass and Pāhoa-Kapoho Road. Alternative 4 would be estimated to require the acquisition of 24.6 total acres of property from 329 parcels. Alternative 4 would not require the total acquisition of any properties or relocation of any residents.

Alternative 5: Alternative 5 would widen the highway to a six-lane divided cross section between the end of the Kea'au Bypass and Paradise Drive and a four-lane divided highway between Paradise Drive and Kahakai Boulevard. The segment from Kahakai Boulevard to Pāhoa-Kapoho Road would remain with two travel lanes, but would have safety improvements at intersections, improved shoulders, and medians where appropriate. Alternative 5 is estimated to require the acquisition of 39.7 total acres of property from 362 parcels. Alternative 5 would not require the total acquisition of any properties or relocation of any residents.

For Alternatives 2, 3, 4, and 5, most of the right-of-way needed for this project from adjoining properties will be partial acquisition of strips of property on the general order of 10 to 20 feet in width immediately abutting Kea'au-Pāhoa Road. Most of this acquisition will be permanently needed for highway right-of-way, though there is a possibility that property could be turned back to property owners or other interests if not needed after completion of the project. It is also possible that easements could be acquired for construction purposes from owners.

4.15.2 Right-of-Way Acquisitions for Roundabouts

In addition to the primary alternatives discussed above, another consideration is the potential implementation of roundabouts at selected intersections in place of traffic signals. Roundabouts would generally require the acquisition of additional property not already acquired for the TSM Alternative. If Roundabouts were constructed in place of signals at every possible location where they could be implemented, they would require the estimated acquisition of as much as 1.78 acres from 55 parcels. These parcels in part include other right-of-way acquisitions for the TSM Alternative discussed above in **Section 4.15.1: Right-of-Way Acquisitions for Project Alternatives**.

4.15.3 Right-of-Way Acquisitions From Access Management Options

As noted in **Section 2.2.3: Access Management**, to address access changes created by the project, there are a number of options for providing improved circulation and traffic operations by converting three-way intersections into full four-way intersections, and upgrading additional roads within subdivisions. The access management options described in **Section 2.2.3: Access Management** are all optional measures, and therefore, all or just some of them could be included under Alternatives 2 (TSM), 3, 4, or 5.

Provision of these new roads or improvements to existing roads would require right-of-way acquisition. All roads, either new or existing, would need to be upgraded to current Hawai'i County Standards. **Table 4-38: Right of Way Acquisition and Relocations Associated With Access Management Concepts** provides an overview of the impacts of new or improved roadways. As the table demonstrates, there could be as many as 187 parcels affected by these access management concepts, and up to 7.51 acres of property needed for roadway use.

Table 4-38: Right of Way Acquisition and Relocations Associated With Access Management Concepts also shows that there could be a relocation of one house needed to extend Paradise Drive. More information is provided in **Section 4.15.4: Relocations** and **Section 4.15.5: Mitigation of Right-of-Way Acquisition Impacts**

Table 4-38: Right of Way Acquisition and Relocations Associated With Access Management Concepts

Access Management Concept	Hawai'I County Standard		Number of Parcels Affected	Total Acres Acquired in New Road Right of Way	Number of Relocations
	Road Designation	Right of Way Width (ft.)			
Pōhaku Circle	Minor Street	50	38	0.58	
Kaloli Drive Extension	Collector	60	2	0.83	
Cul-de-sac on Uala Ave (31st Ave.) at Kaloli Drive	n/a	n/a	1	0.13	
Uala Ave (31st Ave.) to Puakalo Ave (30th Ave.)	Minor Street	50	2	0.75	
Orchidland Drive Extension	Collector	60	2	0.43	
34th Ave. improvements from Orchidland Drive to Paradise Drive extension	Minor Street	50	26	0.38	
Paradise Drive Extension	Collector	60	2	1.53	1
34th Ave improvements from Paradise Drive Extension to Ilima St.	Minor Street	50	110	1.39	
Maku'u Drive Extension	Collector	60	3	1.36	
Cul-de-sac on Ilima St at Kea'au -Pāhoa Road	n/a	n/a	1	0.13	
Totals			**187**	**7.51**	**1**

Source: SSFM International, Inc.

4.15.4 Relocations

At the current level of design, none of the Alternatives for widening Kea'au-Pāhoa Road itself are expected to require any relocations of homes or businesses. Property to be acquired will generally be limited to partial acquisitions of narrow strips of property immediately next to the highway.

If optional access management improvements are pursued as noted in **Table 4-38: Right of Way Acquisition and Relocations Associated With Access Management Concepts**, an extension of Paradise Drive mauka from Keaʻau-Pāhoa Road would require the relocation of a single house.

In the event that relocations of businesses or homes are necessary, mitigation will be made through relocation assistance as described below in **Section 4.15.5: Mitigation of Right-of-Way Acquisition Impacts**.

4.15.5 Mitigation of Right-of-Way Acquisition Impacts

Upon selection of a preferred alternative, HDOT will need to identify those properties that will require right-of-way acquisition of land or relocations of occupants with low incomes. The acquisition of dwellings and businesses or portions of property will need to be conducted according to the HDOT Right-of Way Procedure Manual to ensure equitable treatment of all businesses and persons.

Where property acquisition or relocations would occur, compensation will be provided to affected property owners, businesses, or residents in compliance with all applicable Federal and State laws and would follow the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (as amended by the Uniform Relocation Act of 1987), at 49 CFR 24.

HDOT will pay fair and just compensation for fee purchase or easement use of property required for transportation purposes. “Just compensation,” as defined by the courts, is the payment of “fair market value” for the property rights acquired plus allowable damages to any remaining property. “Fair market value” is defined as the highest price estimated, in terms of money, the property would bring if offered for sale on the open market by a willing seller, with a reasonable time allowed to find a purchaser, buying with the knowledge of all the uses to which it is adapted and for which it is capable of being used.

Resources will be made available without discrimination to all property owners or tenants who are relocated. Under the requirements of the Uniform Act no relocations can occur until it is shown that comparable housing is available in the area for relocation purposes. Replacement housing and business locations must be similar both in type and price range.

Relocation advisory services and/or a relocation plan may be necessary in later phases of this project. Every effort will be made, through relocation assistance, to reduce the impact if and when it occurs. HDOT is required to determine the availability of comparable, decent, safe and sanitary housing for eligible displaced individuals and businesses. Appropriate measures will be taken to ensure that all eligible displaced individuals and businesses are advised of the rights and benefits available and course of action open to them.

At the present time, the housing market in East Hawaiʻi has ample available replacement housing in the region.

4.15.6 Private Use of Public Right-of-Way

Over the years, some landowners may have established private uses within the State right-of way such as plantings or other property improvements. Implementation of one of the Build Alternatives (Alternatives 3, 4, or 5) would require termination of private uses. The level of this impact depends on the selected alternative and property location.

4.15.7 Changes to Property Access

Alternative 1, the No-Build Alternative, will not require any modification to property access. Under Alternative 2, the TSM Alternative, there may be isolated locations where access management (through provision of a raised median) may be judged as a prudent measure to improve operations and safety. The decision on such measures would not be known until Final Design if the TSM Alternative was selected.

Under the Build Alternatives (Alternatives 3, 4, and 5), in addition to the direct impacts caused by property acquisition and relocation, a number of properties may be affected indirectly by changes to their property access.

As described above in discussions on access control in **Chapter 2: Alternatives**, under Alternatives 3, 4, and 5, travelers along the project corridor may need to change their traveling patterns. In areas with raised median barriers, access to driveways or minor cross-roads will generally be limited to right-in, right-out access. This would require a U-turn at controlled points if one wanted to make a movement that now is handled by a left turn. Full access would be provided at main intersections which would be controlled by signalization, a roundabout or stop sign on the cross-street.

Table 4-39: Estimated Changes to Driveway Access with Build Alternatives estimates the numbers of driveways that will lose left-turn access with a change to right-in-right-out access based on the current design. In some cases, multiple parcels share a common driveway, so the table describes the number of affected parcels separately from the number of affected driveways. In general, impacts are identical among alternatives. The one variable that could change this finding is whether two-lane segments would contain an uncrossable median barrier or vehicles could cross the middle (with a yellow line or provision of two-way turn lanes). This would change the results in the case of Alternative 3, between Ainaloa Boulevard and Old Pāhoa Road, and result in lower numbers of properties affected in this manner. The two-lane segment of Alternative 5 (between Kahakai Boulevard and Pāhoa-Kapoho Road) has no driveways and therefore the total would not be affected by this variable.

Table 4-39: Estimated Changes to Driveway Access with Build Alternatives

Segment of Road	Alternative 3		Alternative 4		Alternative 5	
	Parcels Affected	Driveways Affected	Parcels Affected	Driveways Affected	Parcels Affected	Driveways Affected
Merge Area to Shower Dr./Pōhaku Dr.	13	6	13	6	13	6
Shower Dr./Pōhaku Dr. to Pōhaku Pl.	16	15	16	15	16	15
Pōhaku Pl. to Kaloli Dr.	11	7	11	7	11	7
Kaloli Dr. to Pōhaku Cir.	7	5	7	5	7	5
Pōhaku Cir. to Orchidland Dr.	23	23	23	23	23	23
Orchidland Dr. to Paradise Dr.	10	9	10	9	10	9
Paradise Dr. to Auliʻi St.	15	15	15	15	15	15
Auliʻi St. to Makuʻu Dr.	21	19	21	19	21	19
Makuʻu Dr. to Ainaloa Blvd.	5	5	5	5	5	5
Ainaloa Blvd. to Kaluahine/Niaulani St.	11*	11*	11	11	11	11
Kaluahine/Niaulani St. to Old Pāhoa Rd.	20*	18*	20	18	20	18
Old Pāhoa Rd. to Kahakai Boulevard	0	0	0	0	0	0
Kahakai Boulevard to Kapoho Rd.	0	0	0	0	0	0
Total Affected Properties*	**152***	**133***	**152**	**133**	**152***	**133***
Total Affected Properties**	121**	102**	152	133	152**	133**

*With Divided Median in Two-Lane Segment of Alternatives 3 and 5
**Without Divided Median in Two-Lane Segment of Alternatives 3 and 5

Access changes may be modified further with future design refinements. For affected properties that front onto both Keaʻau-Pāhoa Road and a cross-street that has full access, it may be possible in some cases to mitigate these access-change impacts by reconfiguring the property so that access is provided off the cross-street. Such opportunities would be determined during final design.

During the Cultural Impact Assessment process (see **Section 4.9.3: Cultural Practices**), the management of W.H. Shipman, the largest landowner in the project area, raised concerns that access changes and the roadway design could compromise the ability of agricultural machinery to access fields easily. They requested that access points to their agricultural areas remain open. There are two gated driveways to the Shipman properties on the mauka side of the highway between Shower Drive and the Keaʻau Bypass, and one gated driveway on the makai side. HDOT will work with W. H. Shipman to ensure that changes in roadway access do not compromise agricultural operations.

Mitigation measures related to changes in travel patterns may require personal notifications and community education. While the long term effects of proposed improvements may be appreciated, it may be difficult for some motorists to accept changes to personal routines. It is noted that in interviews conducted for the Social Impacts Assessment (see **Section 4.3.1: Social Impact Interview Findings**), some people indicated that they already avoid left hand turns from their street or driveways by traveling to a nearby street that provides turn lanes in the appropriate direction. Therefore, changing behaviors may not be a problem for some motorists.

4.16 Construction Impacts

In addition to the long-term impacts that will be created after improvements to Keaʻau-Pāhoa Road are completed and the highway is opened for operation, there are also specific impacts that will result during the construction phase of the project. This section addresses these temporary short-term impacts, which are different in magnitude, intensity and timing than permanent post-construction impacts.

The No-Build Alternative will not produce any construction impacts.

The TSM Alternative will result in minor construction impacts at localized areas. Alternatives 3, 4, and 5 will result in higher levels of disturbance from construction.

In addition to compliance with State and County regulations, HDOT will implement a construction program that includes limited night work, adequate notification for properties adjacent to or impacted by construction activities, and a construction hotline and other contact information for easy access to HDOT and construction personnel.

4.16.1 Construction-Related Air Quality

The No-Build Alternative will not result in any air impacts specific to construction.

Temporary construction activities from the Build Alternatives, and to a lesser degree, the TSM alternative, would result in air quality impacts from several sources. Fugitive dust emissions may result from removal of vegetation in the project corridor. While high rainfall levels in the area would generally control construction dust, during prolonged dry periods, it is possible that dust emissions could become a problem without mitigative measures. A dust control plan would be developed and implemented to minimize fugitive dust as part of the Special Contract Requirements, to be approved by the State Department of Health. The plan would include some or all of the following measures:

- Watering of active work areas
- Screening piles of materials from wind if appropriate
- Cleaning nearby paved roads affected by construction
- Covering open trucks carrying construction materials
- Limiting areas to be disturbed at any given time
- Mulching or chemically stabilizing inactive areas that have been disturbed
- Paving and landscaping areas as soon as practical in the construction schedule

Heavy construction equipment will produce emissions. Contractors will be required to maintain equipment with required emissions controls.

Traffic delays could result from construction activity, and these delays could produce emissions from idling vehicles. Efforts will be made to control what activities happen during traffic peak hours to minimize disruption to traffic.

4.16.2 Construction Noise

The No-Build Alternative will not result in any noise impacts specific to construction.

Temporary construction activities from the Build Alternatives, and to a lesser degree, the TSM alternative, will involve the use of equipment that results in high noise levels adjacent to construction sites. **Section 4.5.3: Construction Noise Impacts and Mitigation** provides an extensive discussion of the noise generated by construction equipment and specific mitigative measures that will be employed.

Special Contract Requirements will require contractors to obtain a community noise permit and/or variance from the State Department of Health in conformance with Chapter 11-46 of Hawaiʻi Administrative Rules (Community Noise Control). As part of the permitting process, the Department of Health will review the construction activities, and impose conditions and mitigative measures, which could include restrictions on the types of equipment used, maintenance requirements, hours of construction, and portable noise barriers.

4.16.3 Construction Impacts on Surface Waters

The No-Build Alternative will not result in any water quality or flooding impacts specific to construction.

Temporary construction activities from the Build Alternatives, and to a lesser degree, the TSM alternative, if not mitigated, would result in impacts to intermittent waterways. Removal of the abandoned bridge upstream of the Waipāhoehoe Bridge will pose addition potential for impact.

During construction, temporary degradation of water quality in intermittent waterways is possible due to sedimentation from disturbance to banks of waterways and increased sediment in storm water runoff. These disturbed areas may also cause an increase in suspended solids and nutrient loading from exposed areas. Construction activities may also introduce pollutants such as oil and grease from construction equipment.

Compliance with the Hawaiʻi County Code, Chapter 10 - Erosion and Sedimentation Control, and the Department of Public Works (DPW) Storm Drainage Standards will be required to control erosion and sedimentation. Furthermore, a National Pollutant Discharge Elimination System (NPDES) permit will be required from the state Department of Health because the project will disturb an area greater than an acre in size.

Special Contract Requirements will implement temporary and permanent Best Management Practices (BMPs) in a stormwater pollution prevention plan to mitigate any impacts to water quality from construction activities. BMPs would include such measures as:

- Timing construction activities such as grading or culvert installation to periods of lesser rainfall
- Limiting area of disturbance at any given time to reduce potential erosion
- Constructing temporary drainage features to divert runoff from areas susceptible to erosion

- Utilizing protective materials such as mulch or geotextiles to minimize erosion and revegetating areas as soon as possible to minimize the amount of time soils are exposed
- Using sedimentation basins and silt fencing to collect sediment before it runs off to drainage structures or streams

4.16.4 Construction Impacts on Vegetation

The No-Build Alternative will not result in impacts on vegetation in the corridor.

Temporary construction activities from the Build Alternatives, and to a lesser degree, the TSM alternative, will result in the removal of vegetation. Vegetation affected will include both landscaping present within the existing highway right-of-way, landscaped areas within what are now private parcels, and areas of native and non-native vegetation of varying levels of disturbance.

To minimize the effects of fugitive dust and erosion, areas disturbed from removal of vegetation would be revegetated as soon as feasible. Furthermore, a landscaping plan for the project will propose the composition of vegetation to be planted. An emphasis will be made on using vegetation native to Hawaiʻi and minimizing the potential for invasive species to establish themselves in the corridor.

4.16.5 Construction Impacts on Traffic and Property Access

The No-Build Alternative will not result in any impacts on traffic specifically from construction.

Temporary construction activities from the Build Alternatives, and to a lesser degree, the TSM alternative, will result in temporary effects on traffic and property access in the corridor. Impacts could be expected from several sources:

- Traffic delays from travel within a construction zone, which will result in reduced speeds, lane closures, potential safety concerns, and temporary realignment of travel lanes
- Potential detours
- Temporary access changes or periods of access closure to individual properties

HDOT will implement a construction information program that includes a public notification effort for both individual properties and the general community to disseminate information on construction activities. A construction hotline and other contact information will be provided for easy access to HDOT and construction personnel. These efforts will hopefully minimize the adverse effects described above by giving travelers options for avoiding delays in construction zones.

Detours will be avoided to the greatest degree possible, to minimize inconvenience to travelers, and to avoid off-site impacts to properties along a detour route. In the unlikely event that detours are warranted, they will be used for as short a period as possible, and preferably during non-peak hours to minimize the number of people inconvenienced. Dissemination of

information in advance on detours will be important to minimize the adverse effects of the detour on the community.

Where needed, flagmen or other traffic-direction measures may be used to improve progression of traffic during construction zones.

Access closures will be addressed through consultation with affected properties. Where necessary, especially for businesses that are affected, signage may need to be provided to direct customers to their destinations.

4.16.6 Construction Impacts on Bicycles, Pedestrians, and Transit

The No-Build Alternative will not result in any impacts from construction on alternative modes in the corridor.

Temporary construction activities from the Build Alternatives, and to a lesser degree, the TSM alternative, will result in effects on the corridor that could affect bicycles, pedestrians, and transit in the area. While Keaʻau-Pāhoa Road poses safety concerns during regular conditions to these users of the corridor, safety for pedestrians, bicycles, and transit vehicles in construction zones will be of even greater importance.

For bicycles and pedestrians, HDOT will implement a construction information program that includes a public notification effort to disseminate information on construction activities and safety in construction zones. A construction hotline and other contact information will be provided for easy access to HDOT and construction personnel.

Information on detours will be disseminated to the greatest degree possible.

HDOT will coordinate closely with the County of Hawaiʻi's Mass Transit Agency to ensure that operators of the Hele-On system are aware of the status of construction. The two agencies will work together to ensure that impacts on transit operations and inconvenience to passengers are minimized to the greatest degree possible.

4.16.7 Construction Impacts on Utilities

The No-Build Alternative will not result in any impacts to utilities.

Temporary construction activities from the Build Alternatives, and to a lesser degree, the TSM alternative could result in effects on utility service in the corridor. As discussed in greater detail in **Section 4.13: Utilities**, efforts will be made to relocate utilities in such a fashion that there is no break in service. Specifically, new lines to serve an area would be constructed before removal of existing lines.

Nonetheless, there may be the need for temporary breaks in utility service to specific properties as a result of construction activities. All affected utility companies would be contacted and proper coordination would ensure minimum disturbance to system users.

4.16.8 Construction Impacts from Hazardous Materials

The No-Build Alternative will not result in any construction, and therefore, no potential for encountering any subsurface contamination.

Temporary construction activities from the Build Alternatives, and to a lesser degree, the TSM alternative could result in the possibility of encountering contamination from unknown sites.

If contamination were encountered during construction, mitigation and disposal of any hazardous material would take place according to state and federal guidelines.

4.16.9 Construction Impacts on Cultural Resources

The No-Build Alternative will not result in any construction, and therefore, no potential for affecting cultural resources (historic or archaeological resources).

Temporary construction activities from the Build Alternatives, and to a lesser degree, the TSM alternative could result in the possibility of encountering archaeological resources. A Memorandum of Agreement (MOA) regarding mitigation of impacts to cultural resources would be signed by HDOT and the State Historic Preservation Division (SHPD) prior to project construction. If any cultural resources are encountered during construction, construction would immediately cease, and materials would be evaluated in accordance with 36 CFR 800.13.

As described in greater detail in **Section 4.9.1: Archaeological Resources**, SHPD will review an archaeological monitoring plan that will facilitate the identification and proper treatment of any burials or other archaeological resources that might be discovered during project construction. Information will be gathered on non-burial archaeological deposits, should any be discovered. Archaeological monitoring will potentially prevent accidental damage to resources in lava tubes. Monitoring of construction activities will also prevent access or damage to the ancient trails system that abuts the corridor. Further, on-site monitors will be able to point out archaeological features and trails alongside the roadway from areas of low visibility during the archaeological survey, or in areas of increased visibility due to vegetation clearance during the construction phase.

Data recovery on the abandoned 1930s era bridge upstream of the Waipahoehoe Bridge will have taken place prior to construction as a result of the Shoulders Improvement Project.

While the site is outside of the Area of Potential Effect, the erection of continuous, orange-web “event fencing” or some similar barrier is recommended prior to any project related work within 50 feet of the Sacred Heart Catholic Church property. This interim protection could be carried out and documented under monitoring archaeologist supervision.

4.16.10 Construction Impacts on Lava Tubes

The No-Build Alternative will not result in any construction, and therefore, no potential for affecting lava tubes.

Lava tubes underlie much of the project corridor and while several prominent ones are documented such as Kazumura Cave and Pāhoa Cave, there is potential for construction resulting in the opening or discovery of lava tubes that have not been identified to date. The depth to these lava tubes below the existing terrain generally has not been established.

In the event of a lava tube being breached, construction would immediately stop to avoid further damage to the resource. Federal and state authorities would be contacted as appropriate, and geological investigations would be conducted to determine if the road could continue to be constructed as planned, or if structural modifications would be necessary. Archaeological monitoring described in **Section 4.16.9: Construction Impacts on Cultural Resources** will potentially prevent accidental damage to the Kazumura Cave system and its associated features and burials.

4.16.11 Economic Effects of Construction

The No-Build Alternative will not result in any construction, and therefore, will not result in any of the beneficial or adverse effects from construction on the local economy.

Temporary construction activities from the Build Alternatives, and to a lesser degree, the TSM alternative will have economic effects.

The primary beneficial economic effect of construction will come from temporary income and employment from construction. These effects in turn would be magnified by additional revenues to the government in the form of sales and income taxes, permits, and other fees.

A temporary adverse effect of construction on the local economy could result if businesses are affected by persons avoiding the construction area. This is likely a minor impact given the lack of alternate routes to Keaʻau-Pāhoa Road. Businesses that are a destination business such as a specialty store will likely be less adversely affected than businesses that serve impulse purchases such as a convenience store/gas station.

Changes in access to businesses could be mitigated by temporary signage or other measures to improve motorist recognition.

4.17 Laws, Permits, Orders and Approvals

Compliance with a number of federal, state, and county laws, permits, approvals, and executive orders are anticipated for this project. In a number of cases, they have been described elsewhere in this document. They are outlined below:

4.17.1 Federal

4.17.1.1 National Environmental Policy Act (NEPA) of 1970

This Environmental Assessment has been prepared under the requirements of the National Environmental Policy Act (NEPA) of 1970 (23 CFR 771 and 40 CFR 1500). NEPA requires federal agencies to consider environmental factors through a systematic interdisciplinary approach

before committing to a course of action. NEPA was also amended by Executive Order 11991, which covered responsibilities under NEPA.

Preparation of this EA has taken place in accordance with the USDOT Technical Advisory 6640.8A, Guidance for Preparing and Processing Environmental and Section 4(f) Documents, dated 30 October 1987 to ensure compliance with these pieces of legislation.

4.17.1.2 US Department of Transportation Act of 1966

Section 4(f) of the U.S. Department of Transportation (USDOT) Act of 1966 (49 USC 303) protects publicly owned parks, recreation areas, wildlife and wildfowl refuges, and historic sites of local, state, or national significance from conversion to transportation uses. **Chapter 5: Section 4(f) Evaluation** discusses in detail two resources adjacent to Keaʻau-Pāhoa Road that would be protected under Section 4(f), and measures to avoid, minimize, and mitigate impacts on these resources.

4.17.1.3 Section 6(f) of the Land and Water Conservation Fund Act of 1965

Section 6(f) of the Land and Water Conservation Fund Act (16 USC 4601-4 et seq.) requires impacts on recreational facilities funded under the Land and Water Conservation Fund (LWCF) to be avoided and fully compensated in-kind if impacts are unavoidable (36 CFR 59). The Secretary of Interior must approve any conversion of property. There are no properties regulated under Section 6(f) in the study area.

4.17.1.4 Uniform Relocation Assistance & Real Property Acquisition Act of 1970

The Uniform Relocation Assistance and Real Property Acquisition Act of 1970 (42 U.S.C. 4601 et seq. and 49 CFR 24) as amended by the Uniform Relocation Act Amendments of 1987 is more commonly referred to as the "Uniform Act." The Uniform Act ensures property owners and tenants are compensated fairly for property acquisition and relocation costs. Refer to Section **4.15: Right-of-Way, Relocations, and Access Changes** for more information.

4.17.1.5 Title VI of the Civil Rights Act of 1964

Title VI of the Civil Rights Act of 1964 (42 USC 2000d and 49 CFR 21), as amended, is the foundation for most federal rules, regulations, and mandates concerning nondiscrimination in federal activities. Title VI protects individuals from discrimination on the basis of their race, color, national origin, sex, age, or disability in programs that receive federal financial assistance. Under Title VI, Federal agencies are required to ensure that no person is excluded from participation in, denied the benefit of, or subjected to discrimination under any program or activity receiving Federal financial assistance on the basis of race, color, national origin, age, sex, disability, or religion.

Refer to **Sections 3.3.2: Environmental Justice Communities in Immediate Study Area** and **4.3.3: Impacts on Environmental Justice Communities** for more information on how Title VI is being addressed by this project.

4.17.1.6 Americans with Disabilities Act of 1990

Building on Title VI, the Americans with Disabilities Act of 1990 (ADA) (42 USC 12101 and 23 CFR 200) extended non-discrimination in the implementation of federal programs to persons with disabilities. The ADA ensures that no qualified individual with a disability shall, by reason of such disability, be excluded from the participation in, be denied the benefits of, or be subjected to discrimination under a federal project.

On the Keaʻau-Pāhoa Road Improvements project, all design elements will comply with the ADA.

4.17.1.7 Executive Order 12898: Environmental Justice

In response to growing public concern and mounting evidence of disparate treatment, President Bill Clinton signed Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, on February 11, 1994. (59 CFR 7629, 62 CFR 18377, and 60 CFR 33896). The purpose of E.O. 12898 was to focus federal attention on the environmental and human health conditions of minority and low-income populations with the goal of achieving environmental protection for all communities. The executive order directed the Federal Highway Administration and other federal agencies to develop environmental justice strategies to help address disproportionately high and adverse human health or environmental effects of their programs on minority and low-income populations. The order also intended to promote nondiscrimination in federal programs that affect human health and the environment, and aimed to provide minority and low-income communities with access to public information and public participation in matters relating to human health and the environment.

The project will not have a disproportionate adverse impact on environmental justice populations in the area, and will provide some benefits to these populations. Refer to **Sections 3.3.2: Environmental Justice Communities in Immediate Study Area** and **4.3.3: Impacts on Environmental Justice Communities** for more information.

4.17.1.8 Section 106 of the National Historic Preservation Act of 1966

The National Historic Preservation Act (NHPA) of 1966 (16 USC 470) established the National Register of Historic Places (NRHP). Section 106 of the NHPA requires federal agencies to consider the effects of federal actions upon historic and archaeological resources that may be eligible for the NRHP by determining if a project will have an adverse effect under a process defined at 36 CFR 800. The Hawaiʻi State Historic Preservation Division (SHPD) is the state agency that oversees this process on behalf of the federal Advisory Council on Historic Preservation. There are also state-level regulations protecting cultural resources under HRS Chapter 6E-8 that are similar in nature.

As described in detail in **Section 4.9: Cultural Resources**, the Section 106 process has been considered as part of the Archaeological Impact Survey and Cultural Impacts Assessment processes, and two historic resources have been identified. The Archaeological Inventory

Survey is currently under review by SHPD. Coordination will take place further with SHPD to ensure their concurrence with the recommended findings of "effect with proposed mitigation measures." FHWA will make a determination of effects after consulting further with SHPD as needed under the Section 106 process, and the findings from this process will be documented in the Final EA.

4.17.1.9 Historic Bridge Program

As part of the Surface Transportation and Uniform Relocation Assistance Act of 1987 [23 USC 144(o)], State highway agencies were required to complete an inventory of bridges on and off the Federal-aid system to determine the historic significance of the bridges.

There is a 1930s-era bridge adjacent to Keaʻau-Pāhoa Road that will be demolished as part of the Shoulder Lane Conversion project that will precede this project (see **Section 1.2.2.1: The Keaʻau-Pāhoa Road Shoulder Lane Conversion Project** for more information). The bridge was recommended for demolition as it impedes stream flow and would cause drainage problems during heavy rain events. This bridge is not listed on the State of Hawaiʻi Historic Bridge inventory. Data recovery in the form of Historic American Building Survey and Historic American Engineering Record (HABS/HAER) documentation of the bridge is recommended and has already taken place. Refer to **Sections 3.9.3: Historic Resources** and **4.9.2: Historic Resources** for more information.

4.17.1.10 Coastal Zone Management Act of 1972

The Coastal Zone Management Act (CZMA) of 1972 (16 USC 1451 et seq.) encourages coastal states to protect coastal resources consistent with the state's coastal zone management program. The objectives of the Coastal Zone Management (CZM) Program are to provide the public with recreational opportunities, protect historic resources, protect scenic and open space resources, protect coastal ecosystems, provide facilities for economic development, reduce hazards and manage development.

Within Hawaiʻi, the CZM program was authorized by HRS Chapter 205A, and is administered by the Office of Planning within the State of Hawaiʻi Department of Business, Economic Development, and Tourism (DBEDT). Actions anywhere within the State of Hawaiʻi must comply with the CZM program.

A consistency determination is required for federal actions that would have reasonably foreseeable direct or indirect effects on any use of or resource in the coastal zone. FHWA has evaluated the Proposed Action and has determined that it is consistent to the maximum extent practicable with the State of HawaiʻI CZM program. The consistency determination will be submitted to the DBEDT Office of Planning.

4.17.1.11 Endangered Species Act of 1973

The Federal Endangered Species Act (ESA) of 1973 (16 USC 1531 et seq.) protects federally listed endangered and threatened plants and wildlife and designated critical habitats for such species. The ESA prohibits federal actions that would likely jeopardize the continued existence

of those species or result in the destruction or adverse modification of designated critical habitat. Hawaiʻi has the most the most species listed as endangered or threatened among all US states and territories. HRS Chapter 195D is the state counterpart to the ESA.

The provision for interagency cooperation within Section 7 of the ESA requires consultations with federal wildlife management agencies on actions that may affect species or designated critical habitat. As noted in **Section 4.6.2: Fauna**, no federal- or state-listed threatened or endangered species or critical habitat were observed in the affected area. FHWA will conduct Section 7 consultation with USFWS, and findings will be documented in the Final EA.

4.17.1.12 Migratory Bird Treaty Act of 1918

The Migratory Bird Treaty Act (MBTA) of 1918, as amended (16 USC 760), protects migratory wild birds found in the United States. The MBTA makes it unlawful to pursue, hunt, take, capture, kill, possess, sell, purchase, barter, import, export, or transport any migratory bird, or any part, nest, or egg of any such bird, unless authorized under a permit issued by the Secretary of the U.S. Department of the Interior. One bird species listed as protected under the MBTA has been found in the general region of the study area, the Pacific Golden Plover, or kolea (*Pluvialis fulva*). As noted in **Section 4.6.2: Fauna**, no shorebirds like the Pacific Golden Plover were observed in the immediate vicinity of the study corridor, which does not offer typical shorebird habitat.

4.17.1.13 Clean Water Act of 1972

The Water Pollution Control Act, more commonly referred to as the Clean Water Act (CWA) provides federal protection for the quality of the nation's waterways. Federal protection of navigable and tidally-influenced waterways is also provided under Section 10 of the Rivers and Harbors Act of 1899 and Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972. There are no navigable waterways within the study area.

Section 404 of the CWA regulates discharge of dredge and fill material (as would be expected with road construction) into the "Waters of the United States," including wetlands, and requires a Department of the Army permit from the US Army Corps of Engineers. Section 401 of the Clean Water Act directs states to establish water quality certification (WQC) programs; in Hawaiʻi, the Section 401 WQC is administered by the Hawaiʻi Department of Health - Clean Water Branch (DOH-CWB). If there will be discharges regulated under Section 404, then Section 401 WQC is required as well.

Section 402 of the CWA requires a National Pollutant Discharge Elimination System (NPDES) permit for discharges from construction activities that disturb one acre or more. The NPDES program within Hawaiʻi is administered by the DOH-CWB as well, as covered in HRS Chapter 342D and HAR Chapter 11-55.

As described above in **Section 3.7.1: Surface and Groundwater**, coordination has taken place with the US Army Corps of Engineers regarding the jurisdictional status of the intermittent waterway affected by the project, and a Determination from the Corps is pending. All permits described in this section will be obtained if necessary.

4.17.1.14 Executive Order 11990: Protection of Wetlands

Executive Order 11990, given by President Carter in 1977 (23 CFR 777, DOT Order 5660.1A), requires the avoidance of direct or indirect support of new construction in wetlands wherever there is a practicable alternative. The executive order requires evaluation and mitigation of impacts on wetlands.

As noted in **Section 4.7.2: Wetlands**, there is one depression area mauka of the highway that exhibits some wetland characteristics, specifically positive vegetation and hydrology indicators, and a possible soil indicator requiring more in-depth study. However, this depression is not expected to be classified as a jurisdictional wetland. Efforts will be made to minimize impacts on this area to the greatest degree possible.

4.17.1.15 Executive Orders 11988 and 12148: Floodplain Management

Executive Order 11988, given by President Carter in 1977 (23 CFR 650), intended to avoid the long- and short-term adverse impacts associated with the occupancy and modification of floodplains, and to restore and preserve the natural and beneficial values served by floodplains. All construction of Federal or Federally aided roads that encroach upon or affect the base floodplain, requires: (1) assessment of floodplain hazards and (2) specific finding required in final environmental document for significant encroachments. This Executive Order was amended by Executive Order 12148, which established the Federal Emergency Management Agency (FEMA) as having oversight of floodplains.

Project design of Keaʻau-Pāhoa Road will seek to minimize effects on floodplains to the greatest degree possible. Refer to **Section 4.7.3: Floodplains and Hydrology** for a discussion of anticipated impacts and mitigation.

4.17.1.16 Executive Order 13112: Invasive Species

Executive Order 13112 (64 FR 6183), issued by President Clinton in 1999, required federal agencies to implement policies to minimize the spread of invasive species. Federal agencies cannot authorize, fund or carry out action believed are likely to cause or promote the introduction or spread of invasive species unless all reasonable measures to minimize risk have been analyzed or considered.

A landscaping plan will be created as part of the final design effort for this project. Emphasis will be placed on the usage of native species wherever possible, along with ensuring that sources for plantings do not contain invasive species. These efforts will help minimize the spread of invasives while improving aesthetics, reducing maintenance costs and promoting native Hawaiian values of stewardship for the land.

4.17.1.17 Farmland Protection Policy Act of 1981

This legislation (7 USC 4201-4209, 7 CFR 658) seeks to minimize impacts on farmland and maximize compatibility with state and local farmland programs and policies. Projects that impact farmland require coordination with the US Department of Agriculture's Natural

Resources Conservation Service (NRCS) and a farmland conversion assessment form must be submitted to NRCS.

A form AD-1006 will be submitted to NRCS and is found in **Appendix N: Farmland Conversion Impact Rating Form**.

4.17.1.18 Clean Air Act and Amendments

The Clean Air Act of 1972 and its 1990 Amendments and subsequent legislation regulate air emissions from area, stationary, and mobile sources. As described above in **Section 3.4: Climate and Air Quality**, the US Environmental Protection Agency has established National Ambient Air Quality Standards (NAAQS) for priority pollutants to protect public health and the environment. The State of Hawaiʻi is in conformity with the NAAQS, and no exceedances of the NAAQS are anticipated at an intersection level as part of this project. The US EPA also has oversight of Mobile Source Air Toxics (MSAT), which are described in **Section 4.4.3: Mobile Source Air Toxics.**

4.17.1.19 RCRA and CERCLA

The Resource Conservation and Recovery Act (RCRA) of 1976, as amended (42 USC 6901 et seq.), is the nation's primary law governing the disposal of solid and hazardous waste. RCRA provides the US Environmental Protection Agency with oversight of generation, transportation, treatment, storage and disposal of hazardous and non-hazardous wastes. As discussed in **Section 4.14: Hazardous Materials**, there is a relatively low likelihood of encountering subsurface contamination in the corridor.

There are no known Superfund sites in immediate proximity to the corridor, as regulated under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended (42 USC 9601 et seq.)

If hazardous materials are encountered during construction, they will be handled in accordance with state and federal regulations.

4.17.2 State of Hawaiʻi

4.17.2.1 Hawaiʻi Revised Statutes, Act 343

This EA is being produced to ensure compliance with Act 343 as well as the National Environmental Policy Act. Act 343 (HAR Chapter 11-200) requires state and county governments to give systematic consideration to the environmental, social, cultural and economic consequences of proposed projects.

4.17.2.2 State Land Use Law, Chapter 205

Along the Keaʻau-Pāhoa Corridor, the entire area abutting the highway within the project study limits is designated as “Agricultural” with the exception of the area between Old Pāhoa Road and Kahakai Boulevard, which is “Urban” on the mauka side of the highway. Keaʻau-Pāhoa

Road is an existing permitted use in an Agricultural area. The County has oversight of Urban areas, and would permit a public roadway in an Urban area. Refer to **Section 3.1.2: State Land Use Designations** for more information.

4.17.2.3 Stream Channel Alteration Permit

The State Water Code (HRS Chapter 174C) established the Water Commission, which regulates activities affecting stream channels, which are defined as any natural or artificial watercourse with a definite bed and banks, which periodically or continuously contains flowing water. A Stream Channel Alteration Permit (SCAP) is required (HAR Chapter 13-169) for any activity that would:

- Obstruct, diminish, destroy, modify, or relocate a stream channel
- Change the direction of flow of water in a stream channel
- Place material or structures in a stream channel, or
- Remove material or structures from a stream channel

Modification to the unnamed intermittent stream north of Shower Drive will potentially require a new bridge so a SCAP is anticipated to be needed.

4.17.2.4 Coastal Zone Management Act, Chapter 205A, Hawaiʻi Revised Statutes

As described above in **Section 4.17.1.10: Coastal Zone Management Act of 1972**, the Coastal Zone Management Act (CZMA) of 1972 (16 USC 1451 et seq.) provides guidelines for development regulations within the coastal zone. The objectives of the Coastal Zone Management (CZM) Program are to provide the public with recreational opportunities, protect historic resources, protect scenic and open space resources, protect coastal ecosystems, provide facilities for economic development, reduce hazards and manage development.

All lands in the State of Hawaii are considered to be within the coastal zone. HRS Chapter 205A implements the CZM program, which is administered by the Office of Planning within the State of Hawaiʻi Department of Business, Economic Development, and Tourism (DBEDT). Actions anywhere within the State of Hawaiʻi must comply with the CZM program.

Chapter 205A delegates authority to the counties to regulate uses close to the shoreline within the coastal zone as Special Management Areas (SMAs). Projects within the SMA require additional permitting. Although located within the coastal zone, Keaʻau-Pāhoa Road is outside the SMA and therefore will not require an SMA permit.

A consistency determination is required for federal actions that would have reasonably foreseeable direct or indirect effects on any use of or resource in the coastal zone. CZM program objectives and a determination of the applicability to the proposed improvements to Keaʻau-Pāhoa Road are discussed in **Section 4.18: Coastal Zone Management Consistency Determination** below.

4.17.2.5 Act 50, Cultural Practices

Hawaiʻi's Act 50 (2000) sought to "promote and protect cultural beliefs, practices, and resources of native Hawaiians and other ethnic groups" and requires the project proposers under Chapter 343 to consider cultural practices in a cultural impact assessment (CIA). A CIA has been performed for this project, as discussed above in **Section 3.9.4: Cultural Practices** and **Section 4.9.3: Cultural Practices**. Based on issues raised during the telephone and talk story in-person interviews with local *kūpuna* (elders) and/or *kamaʻāina* (native born), the following mitigative measures are proposed to avoid impact under the build alternatives:

- Archaeological monitoring
- Masking historic trails crossing Keaʻau-Pāhoa Road that have been obscured by vegetation
- Safety measures to avoid impacting lava tubes and Kazumura Cave
- Maintaining agricultural access for vehicles to W.H. Shipman properties
- Avoiding impact to the greatest degree possible at the Makuʻu Farmers' Market to protect Native Hawaiian traditional practices

4.17.2.6 Underground Injection Control Permit

The State of Hawaiʻi regulates Underground Injection Control (UIC) to protect drinking water quality from underground pollution (HAR Chapter 11-23). The project is located above the UIC line and therefore is within the area regulated for UIC. Drywells will be among the measures used for conveying drainage as part of this project, and a State of Hawaiʻi Department of Health UIC permit will be required for the drywells on this project after preparation of construction plans in final design.

4.17.2.7 Noise Control Permit or Variance

Chapter 11-46 of Hawaiʻi Administrative Rules (Community Noise Control) requires a community noise permit and/or variance from the State Department of Health if construction noise levels exceed certain levels, as typically is the case for highway projects. A permit is expected to be needed on this project, as discussed in greater detail in **Section 4.5.3: Construction Noise Impacts and Mitigation**. As part of the permitting process, the Department of Health will review the construction activities, and impose conditions and mitigative measures, which could include restrictions on the types of equipment used, maintenance requirements, hours of construction, and portable noise barriers.

4.17.3 County of Hawaiʻi

A Grubbing, Grading, Excavation and Stockpiling Permit is anticipated to be needed from the County of Hawaiʻi.

4.17.4 Summary of Permits and Approvals Needed

Table 4-40: Summary of Permits and Approvals Needed provides a list of permits and approvals anticipated to be needed for this project.

Table 4-40: Summary of Permits and Approvals Needed

Permit/Approval	Agency with Authority
Section 4(f) Approval	Federal Highway Administration
Section 106 /Chapter 6E Concurrence	Hawaiʻi State Historic Preservation Division
Endangered Species Act Section 7 Consultation	US Fish and Wildlife Service
Section 404 Department of Army Permit (if needed)	US Army Corps of Engineers
Floodplain Letter of Map Revision (if needed)	Federal Emergency Management Agency
Coastal Zone Management Consistency Determination	State of Hawaiʻi Office of Planning
National Pollution Discharge Elimination System (NPDES)	State of Hawaiʻi Department of Health Clean Water Branch
Section 401 Water Quality Certification (if needed)	State of Hawaiʻi Department of Health Clean Water Branch
Noise Permit/Variance	State of Hawaiʻi Department of Health
Underground Injection Control Permit	State of Hawaiʻi Department of Health
Grubbing, Grading, Excavation, and Stockpile Permits	County of Hawaiʻi

4.18 Coastal Zone Management Consistency Determination

As described above in **Section 4.17.1.10: Coastal Zone Management Act of 1972**, and **Section 4.17.2.4: Coastal Zone Management Act, Chapter 205A, Hawaiʻi Revised Statutes**, the Coastal Zone Management Act (CZMA) of 1972 (16 USC 1451 et seq.) provides guidelines for development regulations within the coastal zone to provide recreational opportunities, protect historic resources, protect scenic and open space resources, protect coastal ecosystems, provide facilities for economic development, reduce hazards and manage development. The entire State of Hawaii is in the coastal zone. HRS Chapter 205A implements the Coastal Zone Management (CZM) program at the state level. Although located within the coastal zone, Keaʻau-Pāhoa Road is outside the Special Management Area and therefore will not require an SMA permit from the County of Hawaiʻi.

A consistency determination is required for federal actions that would have reasonably foreseeable direct or indirect effects on any use of or resource in the coastal zone. CZM program objectives and applicability to the proposed improvements to Kea'au-Pāhoa Road are discussed below:

4.18.1 Recreational Resources

4.18.1.1 CZM Objective for Recreational Resources

The objective is to provide coastal recreational opportunities accessible to the public.

4.18.1.2 CZM Policies for Recreational Resources

The following are the policies for the CZM program's oversight of recreational resources:

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 use 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 non-point 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, county planning commissions; and crediting such dedication against the requirements of Section 46-6, HRS.

4.18.1.3 Recreational Resources Discussion

Kea'au-Pāhoa Road is located roughly three to five miles inland from the shoreline. There are no public recreation facilities in close proximity to the corridor. Therefore, there will be no effect on existing coastal or inland recreational resources.

4.18.2 Historic Resources

4.18.2.1 CZM Objective for Historic Resources

The objective is to 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.

4.18.2.2 CZM Policies for Historic Resources

The following are the policies for the CZM program's oversight of historic resources:

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.

4.18.2.3 Historic Resources Discussion

Improvements to Kea'au-Pāhoa Road will be constructed in keeping with the guidelines and objectives of the aforementioned objective and policies. Plans for the highway have been designed to improve public safety while minimizing impacts on cultural resources.

An Archaeological Impact Survey (AIS) and Cultural Impacts Assessment (CIA) have been undertaken, and two historic resources have been identified as part of the AIS:

1930s-era Concrete Bridge: Demolition of this bridge will occur as part of the Shoulders Conversion project that precedes this project (see Section **1.2.2.1: The Kea'au-Pāhoa Road Shoulder Lane Conversion Project**) and therefore the bridge will be gone before this project commences.

Sacred Heart Church Cemetery: The project will have no effect on this resource, which is outside the Area of Potential Effect (APE). Avoidance and protection of this facility, which is a component of the Pāhoa Historic and Commercial District is recommended.

The following mitigative measures are recommended to minimize the project's effects on cultural practices as recommended in the AIS and CIA:

- Archaeological monitoring
- Masking historic trails crossing Kea'au-Pāhoa Road that have been obscured by vegetation

- Safety measures to avoid impacting lava tubes and Kazumura Cave
- Maintaining agricultural access for vehicles to W.H. Shipman properties
- Avoiding impact to the greatest degree possible at the Makuʻu Farmers' Market to protect Native Hawaiian traditional practices

Coordination will take place further with SHPD to ensure their concurrence with the recommended findings of "no adverse effect." FHWA will make a determination of effects after consulting further with SHPD as needed under the Section 106 process, and the findings from this process will be documented in the Final EA.

The expectation is that with appropriate mitigation that would include sensitivity to cultural histories, practices, materials, and remains, improvements to Keaʻau-Pāhoa Road will have no significant impact on Hawaiian cultural resources, beliefs, and practices.

4.18.3 Scenic and Open Space Resources

4.18.3.1 CZM Objective for Scenic and Open Space Resources

The objective is to protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources.

4.18.3.2 CZM Policies for Scenic and Open Space Resources

The following are the policies for the CZM program's oversight of scenic and open space resources:

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 landforms 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.

4.18.3.3 Scenic and Open Space Resources Discussion

Improvements to Keaʻau-Pāhoa Road will not impact shoreline views or open space resources. The roadway is located roughly three to five miles inland, at a distance from the coastline. Shoreline open space and scenic resources will be preserved, and the project will not block or mar scenic vistas, primarily those of Mauna Loa and Mauna Kea. The project corridor is adjacent to a mixture of developed and undeveloped land both mauka and makai. The Puna Community Development Plan and County zoning will have control over the character of development around the corridor.

4.18.4 Coastal Ecosystems

4.18.4.1 CZM Objective for Coastal Ecosystems

The objective is to protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.

4.18.4.2 CZM Policies for Coastal Ecosystems

The following are the policies for the CZM program's oversight of coastal ecosystems:

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 water ecosystems and maintain and enhance water quality through the development and implementation of point and nonpoint source water pollution control measures.

4.18.4.3 Coastal Ecosystems Discussion

Improvements to Keaʻau-Pāhoa Road will not have any direct impact on coastal ecosystems. The roadway is located roughly three to five miles inland, at a distance from the coastline. The one intermittent stream located within the corridor has no direct hydrological connection to marine resources. The aquatics study found very little aquatics resources within the corridor. Drainage will be designed to maintain acceptable drainage patterns.

The contractor will be required to conform to NPDES permit requirements to protect aquatic resources during the construction phase of the project. An Underground Injection Control (UIC) permit will also be required for this project. Appropriate Best Management Practices (BMPs) will be followed in order to protect the aquatic resources during construction of the project.

4.18.5 Economic Uses

4.18.5.1 CZM Objective for Economic Uses

The objective is to provide public or private facilities and improvements important to the State's economy in suitable locations.

4.18.5.2 CZM Policies for Economic Uses

The following are the policies for the CZM program's oversight of economic uses:

A) Concentrate in appropriate areas the location of coastal dependent development necessary to the State's economy;

B) Insure that coastal dependent development such as harbors and ports, 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 development and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:

   i) Utilization of presently designated locations is not feasible;

   ii) Adverse environmental effects are minimized; and

   iii) Important to the State's economy.

4.18.5.3 Economic Uses Discussion

Improvements to Keaʻau-Pāhoa Road will not have any direct influence on coastal-dependent development, as the corridor is located between three and five miles inland, and is an existing roadway that already serves the greater community. The project is an important long-term investment in an area with lower than average income that has been underserved by public infrastructure in past decades. Improvements to Keaʻau-Pāhoa Road will also have a short term beneficial impact on the economy during construction by providing construction-related employment.

The project is intended to support the economic development initiatives planned in the PCDP, which will encourage planned development through a series of village and town centers rather than the uncontrolled sprawl that has taken place in Puna over the past five decades.

4.18.6 Coastal Hazards

4.18.6.1 CZM Objective for Coastal Hazards

The objective is to reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, and subsidence.

4.18.6.2 CZM Policies for Coastal Hazards

The following are the policies for the CZM program's oversight of coastal hazards:

A) Develop and communicate adequate information on storm wave, tsunami, flood erosion, and subsidence hazard;

B) Control development in areas subject to storm wave, tsunami, flood, erosion, and subsidence hazard;

C) Ensure that developments comply with requirements of the Federal Flood Insurance Program; and

D) Prevent coastal flooding from inland projects.

4.18.6.3 Coastal Hazards Discussion

Keaʻau-Pāhoa Road runs generally parallel to the coastline at a distance of approximately three to five miles inland, and is outside of all potential tsunami and coastal flooding inundation areas. The design of the proposed project will conform to all regulatory requirements to ensure adequate and proper storm drainage and erosion control to the surrounding properties. While it is not listed in the policies above, lava flow is a concern in lower Puna, and the project corridor is located in Lava Zones 2 and 3.

As the only route into and out of lower Puna, Keaʻau-Pāhoa Road is of critical importance in serving as both a route for first responders and an evacuation route. A Puna Makai Alternate Route (PMAR) has been proposed but will not be constructed for the foreseeable future, and Keaʻau-Pāhoa Road will not preclude any alignment of PMAR if it is built.

4.18.7 Managing Development

4.18.7.1 CZM Objective for Managing Development

The objective is to improve the development review process, communication, and public participation in the management of coastal resources and hazards.

4.18.7.2 CZM Policies for Managing Development

The following are the policies for the CZM program's oversight of managing development:

A) Effectively utilize and implement existing law to the maximum extent possible in managing present and future coastal zone development;

B) Facilitate timely processing of application 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 general public to facilitate public participation in the planning and review process

4.18.7.3 Managing Development Discussion

Improving Keaʻau-Pāhoa Road is an integral part of and consistent with a number of State and County land use plans, including the Puna Community Development Plan (PCDP) which was adopted by the County of Hawai'i in 2008, and the Puna Regional Circulation Plan (PRCP). Both

plans had extensive public involvement. The PCDP will have the most influence in steering the development in the Puna District along the lines of the policies above.

Regarding permits, improvements to Keaʻau-Pāhoa Road will require a National Pollution Discharge Elimination System (NPDES) permit for storm water discharges related to construction as well as a County of Hawaiʻi Department of Public Works (DPW) Grubbing, Grading, Excavation and Stockpiling Permit. These permits will require review of plans and documents from State and County agencies, which may include the solicitation for public comment.

The Keaʻau-Pāhoa Road Improvements Project has followed a Context Sensitive Solutions (CSS) process that has included a robust public involvement process to ensure that the community's voice has been heard and their needs are addressed as part of this project. Meetings of the Keaʻau-Pāhoa Advisory Group have brought together a wide cross-section of the community and enabled consensus on the Purpose and Need for this project, as well as the range of Reasonable Alternatives that have been studied in this EA.

A Social Impact Assessment (SIA) for this project has strived to gauge public sentiment to accurately assess the social effects of this project on the community. This included interviews with 39 members of the community.

The project outreach has included an evolving web site, newsletters, and opportunities for public inquiry and comment throughout the history of the project. Three Public Information Meetings have been held to date.

The Environmental Assessment process, which is currently underway, requires public notification and two periods for public comment, one for the Draft EA and one for the Final EA.

4.18.8 Public Participation

4.18.8.1 CZM Objective for Public Participation

The objective is to stimulate public awareness, education, and participation in coastal management.

4.18.8.2 CZM Policies for Public Participation

The following are the policies for the CZM program's oversight of public participation:

A) Maintain a public advisory body to identify coastal management problems and to provide policy advice and assistance to the coastal zone management program;

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-related issues, developments, and government activities; and

C) Organize workshops, policy dialogues, and site-specific mediations to respond to coastal issues and conflicts.

4.18.8.3 Public Participation Discussion

As previously noted, while the project will have little influence over coastal management issues, a Context Sensitive Solutions process has included extensive public input to ensure the public has had a hand in steering this project. Copies of the Draft EA will be sent to applicable agencies and organizations to solicit and encourage comments regarding the project.

Public outreach will continue with the conclusion of the Environmental Assessment phase. It will be of great importance to keep the public engaged as the project moves into final design and construction.

4.18.9 Beach Protection

4.18.9.1 CZM Objective for Beach Protection

The objective is to protect beaches for public use and recreation.

4.18.9.2 CZM Policies on Beach Protection

The following are the policies for the CZM program's oversight of beach protection:

A) Locate new structures inland from the shoreline setback to conserve open space and to 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.

4.18.9.3 Beach Protection Discussion

Keaʻau-Pāhoa Road runs generally parallel to the coastline at a distance of approximately three to five miles inland, and therefore will have no direct effect on beaches or shoreline areas. The design of the proposed project will conform to all regulatory requirements to ensure adequate and proper storm drainage and erosion control to the surrounding properties.

4.18.10 Marine Resources

4.18.10.1 CZM Objective for Marine Resources

The objective is to implement the State's ocean resources management plan.

4.18.10.2 CZM Policies on Marine Resoruces

The following are the policies for the CZM program's oversight of marine resources

A) Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources;

B) Assure that the use and development of marine and coastal resources are ecologically and environmentally sound and economically beneficial;

C) Coordinate the management of marine and coastal resources and activities management to improve effectiveness and efficiency;

D) 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;

E) 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

F) Encourage research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources.

4.18.10.3 Discussion on Marine Resources

Keaʻau-Pāhoa Road runs generally parallel to the coastline at a distance of approximately three to five miles inland, and therefore will have no direct effect on coastal marine resources. The design of the proposed project will avoid, minimize, and mitigate environmental impacts as much as possible to ensure stewardship of resources within the coastal zone.

4.19 Indirect and Cumulative Impacts

Most of the impacts that have been discussed for project alternatives in this Environmental Assessment are "direct impacts," which would result in a direct effect on a resource or the environment. In addition to the direct impacts that have been described so far, there are also indirect and cumulative impacts that are required to be evaluated under the National Environmental Policy Act and Chapter 343.

4.19.1 Indirect Impacts

Indirect impacts are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. (40 CFR 1508.8).

The No-Build and TSM Alternatives are expected to have minimal or no indirect impacts. Indirect impacts from the No-Build Alternative will result from increased congestion and safety concerns that will worsen over time.

The following are indirect impacts that could result from the Build Alternatives (Alternatives 3, 4, and 5):

4.19.1.1 Induced Growth

The cause and effect from population growth and highway construction are often intertwined. Much of the purpose and need for the project has come from congestion coming from several decades of strong population growth in lower Puna's subdivisions. The Puna Community Development Plan (CDP) attempts to steer growth in a controlled manner, and assumes this project as part of the overall long-term plans for the area.

It is likely that improving Keaʻau-Pāhoa Road for the benefit of existing residents and businesses will encourage or "induce" some incremental amount of additional growth in residential or commercial development that would not have otherwise occurred. Since the latent potential for growth is already extremely high from the thousands of vacant developable parcels in the subdivisions along Keaʻau-Pāhoa Road, it is difficult if not impossible to quantify the growth that would only happen from widening Keaʻau-Pāhoa Road.

4.19.1.2 Land Use Changes

It is possible that a wider Keaʻau-Pāhoa Road and access modification may make abutting properties less attractive for residential use and more attractive for commercial, institutional, or industrial use. Such changes in land use would be under the control of the County's zoning and state land use designations. The PCDP has also dictated the district's aspirations for future development.

4.19.1.3 Induced Traffic

Many travelers on Keaʻau-Pāhoa Road make conscious decisions based upon the congestion they experience. It is likely that some commuters make their trips later or earlier than they would ideally prefer in the interest of avoiding the worst peak-hour congestion. Similarly, there may be travelers that deliberately avoid the peak hours altogether for travel if they have the discretionary choice to do so. There may also be very discretionary trips that travelers simply do not make at all (but would make otherwise) because of congestion.

There are generally no viable parallel alternative routes for most trips that use Keaʻau-Pāhoa Road. However, there will likely be some reduction in "cut through" traffic in Hawaiian Paradise Park that currently avoids some congestion on Keaʻau-Pāhoa Road.

For all the reasons mentioned above, it is likely that an indirect effect of the project will be to alter the travel behavior of motorists. Relief from congestion will increase the flexibility for motorists to make trips at the time they would prefer to travel, and in some cases, encourage or "induce" travel that would otherwise not happen without the improvements.

4.19.1.4 Fiscal Effects

While the project is anticipated to create temporary construction employment, it is not expected to have a perceptible effect on the area's population or housing needs, as most workers would be expected to come from the local area.

The project will require minor amounts of right-of-way to be acquired from a number of abutting property owners. This will remove small amounts of taxable land area from the county's tax rolls.

By improving accessibility to lower Puna, the project could encourage economic development (new businesses, institutions, etc.) in the region.

4.19.2 Cumulative Impacts

Cumulative impacts are effects on the environment that result from the incremental impact of the Proposed Action when added to other past, present, and "reasonably foreseeable" future actions, regardless of what entity undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

In general, a particular action or group of actions would be considered to create cumulative impacts with the Keaʻau-Pāhoa Road project if they occur in a common area, are similar in nature, and are long-term in their duration. The following are contributing actions that could result in a cumulative impact when combined with the effects of the Build Alternatives (Alternatives 3, 4, and 5) reconstructing Keaʻau-Pāhoa Road:

- Past and Future Residential Development: Since the late 1950s, the study area has contained thousands of developable parcels, mostly residential, and the ongoing conversion of this open space to developed land has had, is having, and will have future cumulative effects in conjunction with the impacts foreseen for reconstruction of Keaʻau-Pāhoa Road. The large number of parcels still available for development implies that this trend will continue strongly for the foreseeable future.

- Former and Present Agricultural Practices: The sugar industry plantations, now defunct, have had numerous effects on the natural resources and landscape of the Puna district that contributes to the cumulative effect on the environment associated with this project. For example, agricultural activity has removed native vegetation from the landscape, constructed roadways, and likely destroyed cultural artifacts above and beneath the ground. Current agricultural practices in the region continue to have similar effects.

- Commercial Development, Past, Present and Planned: As the lower Puna area has grown in population, there has been the need for additional commercial services for local residents. The traditional town centers of Pāhoa and Keaʻau have been centers of commerce for a century and these areas had many of the development effects associated with conversion of land uses for other uses. There have been newer commercial developments in the area, particularly near Orchidland Drive and on the northern outskirts of Pāhoa Town at the new Pāhoa Marketplace shopping center (Mālama Market). The Woodland Center shopping center is currently under construction near Old Pāhoa Road and the Pāhoa Bypass. The Ulupono shopping center area has been proposed for future development near the Keaʻau

Bypass and Milo Street. All of these developments will have a cumulative effect on the natural landscape in conjunction with the Keaʻau-Pāhoa Road project.

The Puna Community Development Plan has called for an assortment of "Village Centers" that would direct commercial development into targeted areas to serve more local needs.

- Community Facilities: A new fire station has been constructed on Keaʻau-Pāhoa Road just north of Pāhoa, and a Police Station will be constructed on the same site. As the area grows further, similar public services, along with parks, schools, etc. would be expected to warrant construction.

- Other Roads: The original construction of the subdivisions flanking Keaʻau-Pāhoa Road resulted in the construction of hundreds of miles of roads, mostly under private ownership and jurisdiction. Many of these roads are currently unpaved and only serve a local access function. The Puna Emergency Access Road was constructed by Hawaiʻi County to provide an evacuation route between the Ainaloa and Hawaiian Acres subdivisions, and the county is making additional improvements to this road to address drainage and sight distance problems. As noted in **Section 1.2.3: Related Actions**, the County intends to study a Puna Makai Alternate Route (PMAR) to provide an additional road between the Hilo area and lower Puna, but the anticipated timeframe for this improvement is not presently foreseeable. Road construction has cumulatively divided open space and wildlife habitat, and has various impacts on ambient noise, air quality, adjoining properties, etc.

- Past Construction and Improvements to Keaʻau-Pāhoa Road: Keaʻau-Pāhoa Road has been in existence since the early 20th century and has been incrementally improved over time. Recent modifications have included new turn lanes to serve the new Pāhoa Fire Station and Makuʻu Farmers Market. The Keaʻau Bypass and Pāhoa Bypass are relatively recent improvements within the past two decades to address congestion and travel times through town centers. Interim improvements such as the Shoulder Improvements project and "quick fix" improvements (discussed in **Section 1.2.2: Interim Improvements**) will also contribute to cumulative effects. It should be noted that the corridor is highly disturbed today (low wildlife potential, low ecological value of vegetated habitat, high noise levels, etc.) that result in minimal direct impacts on some resources; this is because of past impacts that have brought the highway to its present state.

Together with future construction Keaʻau-Pāhoa Road, some or all of the actions mentioned above will have cumulative effects on resources in the following discussions.

4.19.2.1 Vegetation and Wildlife Habitat

The amount of undisturbed native vegetation and wildlife habitat in lower Puna is declining as property is converted to developed land and used for agriculture and roadway use. The ongoing conversion of land will limit the habitat needed for endangered and threatened species, both plants and animals. While mitigation is proposed in this EA to address the road's

effects on these resources, most small-scale development on previously-subdivided property does not require this assessment. These cumulative effects would be anticipated for all the actions cited above.

4.19.2.2 Water Resources

As projects modify drainage patterns and add impervious surfaces to the landscape, there are potential impacts to these aquatic features. The Keaʻau-Pāhoa Road project will mitigate these impacts as direct impacts are created from the project itself, but the ongoing development of the area in all the actions cited above has created a cumulative effect on these resources.

4.19.2.3 Archaeological/Historic Resources and Cultural Practices

Ongoing development has likely had a destructive effect on archaeological and historic resources throughout the area. While the Keaʻau-Pāhoa Road project is being designed to avoid, mimimize, and mitigate direct effects on cultural resources, there have been numerous incremental effects on these resources from development from all the actions cited above. The current landscape is also less conducive to traditional cultural practices than pre-development.

4.19.2.4 Geological Resources

Lava tubes and caves have importance as both geological features and as locations of archaeological/cultural relics. Past construction activities for the types of development cited above have resulted in the discovery of skylights or unintentional breaching of walls. Furthermore, there have been human uses of lave tube caves from prehistoric times to the present, and some vandalism and destructive impacts have resulted. Allred and Allred (1997) identified sewer pipes, graywater pollution, garbage dumps, and fills from road construction, as well as signs of trash and shoe fragments from recreational use of the cave. Unintentional breaching of lava tube caves as a result of this project would have a cumulative effect along with these other past impacts.

4.19.2.5 Visual Quality

The appearance of the area has been incrementally changed over time from a more naturalistic environment to a more developed landscape as development has progressed. This will change further as development continues in the foreseeable future. The original construction of Keaʻau-Pāhoa Road and its subsequent improvements over time to the present have had created the visual environment in the roadway corridor that exists today. Other developments beyond the road right-of-way have contributed to the current viewshed. The design of the reconstructed Keaʻau-Pāhoa Road will attempt to mitigate adverse visual effects of highway widening with a design that includes opportunities for landscaping, particularly with native species if possible.

4.19.2.6 Environmental Justice Communities

The lower Puna subdivisions surrounding Keaʻau-Pāhoa Road have low incomes with areas of higher-than-average poverty compared to countywide averages. There are also pockets of native Hawaiian population, persons of Filipino descent and other environmental justice groups. These communities have in part ended up in lower Puna because of the relative affordability of the area. The area's affordability comes from the high availability of developable real estate on land that would be marginal for other uses. The relative lack of services and longer commute distance to Hilo also have kept housing costs lower. The actions mentioned above, particularly the historic development patterns, have contributed to this outcome. It is possible that a reconstructed Keaʻau-Pāhoa road could have varied demographic effects of its own; benefits could come from improved access to the area for these underserved communities. There could also be negative social effects from living close to a wider highway.

As noted above in **Section 4.3.3: Impacts on Environmental Justice Communities**, while it will have minimal direct effects, the No-Build Alternative (Alternative 1) can be viewed as having an adverse impact on the larger Puna community, including Environmental Justice populations. Residents of Lower Puna have indicated a perception that their district and area has been consistently underserved by community services and infrastructure. The No-Build Alternative, and to a lesser degree, the TSM Alternative will not achieve the purpose and need for the project, and further perpetuate this cumulative effect.

4.19.2.7 Community Cohesion

The previous construction of Keaʻau-Pāhoa Road to its present condition has created a physical and social separation between the properties and subdivisions on the two sides of the highway. Many of the properties that have been developed along Keaʻau-Pāhoa Road, particularly residential properties, "back" onto the highway rather than "front" onto the highway. It is expected that further widening of Keaʻau-Pāhoa Road would generally serve to increase this lack of cohesion between neighbors on the two sides of the roadway. This effect will be somewhat mitigated if access improvements as suggested in **Section 2.2.3: Access Management** are pursued, as new connections across Keaʻau-Pāhoa Road would serve to increase the cohesion between subdivisions on both sides of the highway.

4.19.2.8 Right-of-Way Impacts

There are some properties along Keaʻau-Pāhoa Road that experienced past partial property takings during roadway construction in earlier decades. It is possible that some of those properties will be impacted further by right-of-way needs during the Shoulder Improvements project (described in **Section 1.2.2: Interim Improvements** above) or the Keaʻau-Pāhoa Road improvements described in this EA. Therefore, there has been a cumulative effect of successive incremental roadway improvements on abutting properties over the decades.

4.20 Relationship Between Short Term Uses and Long Term Productivity

All alternatives under study (including the No-Build Alternative) would involve short-term and long-term tradeoffs. The money, labor, and construction materials used to construct the project will be substantial. Based on all of the improvements included in the project, the ultimate benefits should justify the initial costs. These costs and benefits are not limited to the spending of public dollars, but also include hard-to-quantify items such as safety, people's time, economic development benefits, opportunities to facilitate regional planning efforts, etc. For this discussion, "short-term" refers to the immediate direct consequences of the project while "long-term" refers to its direct or indirect effects on future generations.

Short-term consequences to the environment resulting from the Build Alternatives have been discussed throughout **Chapter 4: Environmental Impacts and Mitigation Measures.** In the case of the No-Build Alternative, there will be few short-term uses of the human environment above and beyond existing use of the roadway by traffic. No property would be converted to highway right-of-way. Over the long term, congestion and delay will likely increase.

In the case of the TSM (Alternative 2) and Build Alternatives (Alternatives 3, 4, and 5), short term uses of the environment would include:

- Temporary air, noise, and visual effects caused by reconstruction of roadways
- Increased cost to motorists in time and fuel efficiency because of construction delays
- Disturbances to businesses, homes, and institutions because of construction
- Conversion of residential area, open space, and agricultural land to transportation use
- Reduction in property tax revenues resulting from conversion of private land to public highway rights of way
- Use of public funds to build the highway

Most of the long-term benefits from making the improvements to Keaʻau-Pāhoa Road are addressed in **Chapter 1: Purpose and Need for Project**. The No-Build Alternative would not provide any long term benefits, and instead, the traffic operations will deteriorate further over time as traffic volumes and congestion increase. Under the TSM and Build Alternatives, there will be long-term benefits including:

- A safer roadway and the attendant benefits that come from reduced accidents
- Improved, safer travel options for alternative modes such as bicyclists, pedestrians, and transit users
- The economic and social benefits that come with improved mobility
- Improvements in driver convenience, safety, travel time, and energy use

As noted above in **Section 4.1.1: Consistency with Government Plans, Policies and Controls**, the improvements to Keaʻau-Pāhoa Road are consistent with the other long range transportation and community development plans for Puna.

4.21 Irreversible & Irretrievable Commitments of Resources

Permanent commitments of resources occur when land or other resources are acquired or modified to accommodate a transportation project. HDOT could attempt to convert these resources back later or replace them, but they will never quite be the same. Irreversible and irretrievable commitments of resources are the funds, materials, and labor put into a project. Some of these resources, like materials, could possibly be recycled. Others would be gone forever.

Irretrievable commitments of the No-Build Alternative include the money, time, and personal hardship related to increasing congestion and safety concerns. As roadway operations deteriorate over time, there would be increasing costs for energy and the time required for business travel and personal driving. As traffic delay and operational inefficiencies increase, safety concerns would affect the local community to a greater extent than exists today.

Construction of the TSM Alternative 2 and Build Alternatives 3, 4, and 5 involves the commitment of a range of natural, physical, social resources and public tax dollars. Land used for construction of the proposed improvements is considered a permanent commitment during the time period that the land is used for a highway. For right-of-way, land resources would be converted from natural, agricultural, residential, and commercial areas. However, if a greater need arises for the use of the land or if the highway facilities, the land can conceivably be converted to another use. There is no reason to believe such a conversion would ever occur.

Construction of the TSM or Build Alternatives would utilize fossil fuels, labor, and construction materials such as cement, stone, and asphalt materials. Such uses of resources would be generally irreversible, although it would be possible to retrieve and reuse these resources to a limited extent. Any construction would also require a substantial one-time expenditure of both state and federal funds which are irretrievable.

The commitment of these resources is based on the concept that the community in lower Puna will benefit from these improvements.

4.22 Summary of Impacts and Mitigation

Table 4-41: Summary of Impacts and Mitigation summarizes the impacts and mitigation outlined in the preceding sections of this chapter.

Table 4-41: Summary of Impacts and Mitigation

EA Sec.	Resource/ Issue	Impacts of:					Mitigation
		No-Build	TSM Alt.	Alternative 3	Alternative 4	Alternative 5	

4.1	Land Use	• Status quo maintained for future
		• **Not consistent** with Puna Community Development Plan (Puna CDP)
		• **Not consistent** with Puna Regional Circulation Plan (PRCP)
		• **Not consistent** with County General Plan and other plans
			• **Not consistent** overall with these elements of Puna CDP:
			  • No increased capacity
			  • Limited improvement for bikes/pedestrians
			  • Will not improve emergency evacuations
			  • Doesn't meet PCDP plan to reduce speed to 45 mph between Kea'au & Ainaloa
			• **Consistent** with these elements of Puna CDP:
			  • Supports Mass Transit
			  • Improved access to Village Centers
			  • Does not preclude PMAR
			• **Not consistent** with PRCP:
			  • Doesn't provide four lanes from Kea'au to Pāhoa
			• **Consistent** with PRCP:
			  • Supports Mass Transit
			  • Limited improvement for bikes/pedestrians
			  • Increased connectivity between subdivisions
			  • Does not preclude PMAR
			• Not generally consistent with County General Plan and other plans
			• Will not change access to properties along highway and will not reduce accidents from turning movements
				• **Mostly consistent/supportive** towards Puna CDP goals:
				  • Increased capacity
				  • Improved access to Village Centers
				  • Supports Mass Transit
				  • Supports bikes/pedestrians
				  • Improved emergency evacuations
				  • Does not preclude PMAR
				• **Not consistent** with this Puna CDP goal:
				  • Doesn't reduce speed to 45 mph between Kea'au & Ainaloa
				• **Generally consistent with and supportive** of PRCP:
				  • Partially meets PRCP plan for four lanes from Kea'au to Pāhoa (four lanes end at Ainaloa)
				  • Supports Mass Transit
				  • Supports bikes/pedestrians
				  • Can provide increased connectivity between subdivisions
				  • Does not preclude PMAR
				• **Generally consistent with and supportive** of County General Plan and other plans
				• Will change access to properties along highway and will reduce accidents from turning movements
					• **Mostly consistent/supportive** towards Puna CDP goals:
					  • Increased capacity
					  • Improved access to Village Centers
					  • Supports Mass Transit
					  • Supports bikes/pedestrians
					  • Improved emergency evacuations
					  • Does not preclude PMAR
					• **Not consistent** with this Puna CDP goal:
					  • Doesn't reduce speed to 45 mph between Kea'au & Ainaloa
					• **Fully consistent with and supportive** of PRCP:
					  • Meets plan for at least four lanes from Kea'au to Pāhoa
					  • Supports Mass Transit
					  • Supports bikes/pedestrians
					  • Can provide increased connectivity between subdivisions
					  • Does not preclude PMAR
					• **Generally consistent with and supportive** of County General Plan and other plans
					• Will change access to properties along highway and will reduce accidents from turning movements
						• **Mostly consistent/supportive** towards Puna CDP goals:
						  • Increased capacity
						  • Improved access to Village Centers
						  • Supports Mass Transit
						  • Supports bikes/pedestrians
						  • Improved emergency evacuations
						  • Does not preclude PMAR
						• **Not consistent** with this Puna CDP goal:
						  • Doesn't reduce speed to 45 mph between Kea'au & Ainaloa
						• **Fully consistent with and supportive** of PRCP:
						  • Meets plan for at least four lanes from Kea'au to Pāhoa
						  • Supports Mass Transit
						  • Supports bikes/pedestrians
						  • Can provide increased connectivity between subdivisions
						  • Does not preclude PMAR
						• **Generally consistent with and supportive** of County General Plan and other plans
						• Will change access to properties along highway and will reduce accidents from turning movements
							• Will continue to involve community with CSS Process to ensure planning goals are considered

Table 4-41: Summary of Impacts and Mitigation

EA Sec.	Resource/ Issue	Impacts of:					Mitigation
		No-Build	TSM Alt.	Alternative 3	Alternative 4	Alternative 5	
4.2	Traffic and Transportation	• Congestion and delay in corridor will continue to decline • Safety deficiencies will not be addressed • No changes in access • No improvements for bikes/peds • No improvements for transit • **Purpose and Need of Project will not be met**	• Level of Service (LOS) will still be poor along roadway because no capacity increases • Level of Service at intersections will be marginally improved, though capacity still limited and LOS still poor generally between Pōhaku Place and Ainaloa Boulevard • Some TSM Measures could be implemented in 2018 timeframe, but TSM would not have acceptable operations by 2038 • Safety deficiencies will be addressed somewhat at intersections but not between intersections • No new passing zones or capacity improvements will be provided. • Access changes can be considered • The only location a roundabout would function in 2038 is at Kahakai Boulevard and would modify Old Pāhoa Road access as well. Ainaloa Boulevard and Orchidland Drive could be considered for shorter-term implementation of a roundabout. • Localized improvement for transit at bus pullout sites • Improvements for pedestrians and bicyclists limited to crossings of road, no new bike/ped facilities along road itself • Does not preclude and can connect with Puna Makai Alternate Route (PMAR) • **Purpose and Need of Project will not be met**	• Poor Level of Service (LOS) along roadway south of Ainaloa Blvd and north of Shower Drive in 2038, generally acceptable elsewhere • Some signalized intersections generally have acceptable LOS though others have poor traffic movements (Shower Drive, Old Pāhoa Road) • The only location a roundabout would function in 2038 is at Kahakai Boulevard and would modify Old Pāhoa Road access as well. Ainaloa Boulevard could be considered for shorter-term implementation of a roundabout. • Some lower-volume stop-sign-controlled intersections will have poor LOS for cross-street traffic • Access changes could be considered to reduce problems at stop-sign-controlled points • 25% fewer crashes estimated • Transit benefits from new bus pullouts, reduced delay, more consistent schedules • Pedestrians and bicyclists benefit from walkways and/or improved shoulders • Does not preclude and can connect with PMAR • **Addresses Purpose and Need of Project though some congestion and delay will remain**	• Mostly satisfactory Level of Service (LOS) along roadway except for north of Shower Drive • Signalized intersections generally have acceptable LOS though some have poor individual traffic movements that may be improved with signal optimization • Some stop-sign-controlled intersections will have poor LOS for cross-street traffic • Access changes could be considered to reduce problems at stop-sign-controlled points • 25% fewer crashes estimated • Transit benefits from new bus pullouts, reduced delay, more consistent schedules • Pedestrians and bicyclists benefit from walkways and/or improved shoulders • Does not preclude and can connect with PMAR • **Addresses Purpose and Need of Project**	• Excellent Level of Service (LOS) along entire corridor • Signalized intersections generally have satisfactory LOS • Some stop-sign-controlled intersections will have poor LOS for cross-street traffic • Access changes could be considered to reduce problems at stop-sign-controlled points • 25% fewer crashes estimated • Transit benefits from new bus pullouts, reduced delay, more consistent schedules • Pedestrians and bicyclists benefit from walkways and/or improved shoulders • Does not preclude and can connect with PMAR • **Addresses Purpose and Need of Project**	• No significant impacts with mitigation • Implementation of additional travel lanes, turn lanes, and signals/roundabouts will enable corridor to handle future traffic volumes adequately and safely

Table 4-41: Summary of Impacts and Mitigation

EA Sec.	Resource/ Issue	Impacts of:					Mitigation
		No-Build	TSM Alt.	Alternative 3	Alternative 4	Alternative 5	
4.3	Social/ Community Impacts	• No direct impact on community • Increased delay over time will compromise community mobility and quality of life • Increased difficulty for residents to access jobs, healthcare, education • Continues perceived underinvestment in Puna, particularly for minority/low-income communities • No way to tie subdivisions together	• Little direct impact on community resources other than near intersections • Modest investment in Puna • Modest reduction in delay and modest improvement in mobility and access • Potential for improving access between subdivisions • Benefits to minority/low-income communities, particularly transit-dependent and pedestrians/bikes • Modest improvement for emergency access	• Substantial investment in Puna • Impacts on neighborhood cohesion of wider four-lane facility between Kea'au and Ainaloa • Potential for improving access between subdivisions • Substantial reduction in delay and improved mobility and access • Benefits to minority/low-income communities, particularly transit-dependent and pedestrians/bikes • Substantial improvement for emergency access	• Substantial investment in Puna • Impacts on neighborhood cohesion of wider four-lane facility in entire corridor • Potential for improving access between subdivisions • Substantial reduction in delay and improved mobility and access • Benefits to minority/low-income communities, particularly transit-dependent and pedestrians/bikes • Substantial improvement for emergency access	• Substantial investment in Puna • Impacts on neighborhood cohesion of wider six-lane facility between Kea'au and Paradise Dr., and of wider four-lane facility between Paradise Dr. and Kahakai Blvd. • Potential for improving access between subdivisions • Substantial reduction in delay and improved mobility and access • Benefits to minority/low-income communities, particularly transit-dependent and pedestrians/bikes • Substantial improvement for emergency access	• No significant impacts with mitigation • Context Sensitive Solutions process seeks to reduce impacts on community from facility • Process has worked to make project process open and equitable for minority/low-income communities
4.4	Air Quality	• Increasing volumes and delay by 2038 will be offset by improved vehicle emission controls, lower intersection-level carbon monoxide (CO) emissions compared to 2006 • Compared to 2006, regional emissions in 2038 of CO will increase 17% with greater traffic; Regional Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOC) will respectively decrease 19% and 61% with emission controls. • No exceedances of state or federal air standards are anticipated • Mobile Source Air Toxics expected to increase over time, proportional to increase in traffic; this may be offset by future emission controls. • No Short-term construction air quality impacts	• No appreciable differences among alternatives in intersection-level emissions; all within state/federal standards in 2038 and lower than today's levels. • If pursued, roundabouts could reduce emissions even further than signals • While regional emission levels will increase/ decrease from 2006 to 2038 comparable to No-Build changes, no appreciable differences in regional emissions between alternatives in 2038. • While levels will increase from 2006 to 2038 comparable to No-Build changes, no appreciable difference in Mobile Source Air Toxics expected among alternatives in 2038. • Short-term construction phase air quality impacts will be mitigated	• No appreciable differences among alternatives in intersection-level emissions; all within state/federal standards in 2038 and lower than today's levels. • If pursued, roundabouts could reduce emissions even further than signals • While regional emission levels will increase/ decrease from 2006 to 2038 comparable to No-Build changes, no appreciable differences in regional emissions between alternatives in 2038. • While levels will increase from 2006 to 2038 comparable to No-Build changes, no appreciable difference in Mobile Source Air Toxics expected among alternatives in 2038. • Short-term construction phase air quality impacts will be mitigated	• No appreciable differences among alternatives in intersection-level emissions; all within state/federal standards in 2038 and lower than today's levels. • While regional emission levels will increase/ decrease from 2006 to 2038 comparable to No-Build changes, no appreciable differences in regional emissions between alternatives in 2038. • While levels will increase from 2006 to 2038 comparable to No-Build changes, no appreciable difference in Mobile Source Air Toxics expected among alternatives in 2038. • Short-term construction phase air quality impacts will be mitigated	• No appreciable differences among alternatives in intersection-level emissions; all within state/federal standards in 2038 and lower than today's levels. • While regional emission levels will increase/ decrease from 2006 to 2038 comparable to No-Build changes, no appreciable differences in regional emissions between alternatives in 2038. • While levels will increase from 2006 to 2038 comparable to No-Build changes, no appreciable difference in Mobile Source Air Toxics expected among alternatives in 2038. • Short-term construction phase air quality impacts will be mitigated	• No significant impacts with mitigation • No mitigation of long term effects warranted as no significant impacts anticipated • Temporary construction-phase air quality impacts will be mitigated to minimize fugitive dust and emissions from equipment

Table 4-41: Summary of Impacts and Mitigation

EA Sec.	Resource/ Issue	Impacts of:					Mitigation
		No-Build	TSM Alt.	Alternative 3	Alternative 4	Alternative 5	
4.5	Noise	• No direct effect on noise in the corridor, though noise levels will increase from existing levels because of traffic increase in intervening time • 117 existing properties exceed HDOT/FHWA Criteria out of 182 in corridor • 150 future properties will exceed HDOT/FHWA Criteria in 2038 out of 182 in corridor	• Minimal direct effect on noise in the corridor compared to No-Build • Noise levels will increase from existing levels because of traffic increase in intervening time • Affected numbers of properties estimated similar to No-Build	• Noise levels will increase from existing levels because of traffic increase in intervening time • Imperceptible (less than 3 dBA) increase in noise compared to a No-Build scenario in 2038 at 23 properties • Between 150 and 166 future properties will exceed HDOT/FHWA Criteria in 2038 out of 182 in corridor compared to 150 in No-Build	• Noise levels will increase from existing levels because of traffic increase in intervening time • Imperceptible (less than 3 dBA) increase in noise compared to a No-Build scenario in 2038 at 23 properties • Up to 166 future properties will exceed HDOT/FHWA Criteria in 2038 out of 182 in corridor, an increase of 16 over No-Build	• Noise levels will increase from existing levels because of traffic increase in intervening time • Imperceptible (less than 3 dBA) increase in noise compared to a No-Build scenario in 2038 at 23 properties • 166 future properties will exceed HDOT/FHWA Criteria in 2038 out of 182 in corridor, an increase of 16 over No-Build	• No significant impacts with mitigation • Mitigation cannot include noise walls as driveway openings preclude walls • Construction Noise will be mitigated with a permit
4.6.1	Flora	• No direct effect on vegetation because no construction	• Minimal effect on vegetation because of limited area of construction	• Conversion of a narrow strip of highly disturbed vegetation to highway use • No adverse impact on sensitive botanical resources	• Conversion of a narrow strip of highly disturbed vegetation to highway use • No adverse impact on sensitive botanical resources	• Conversion of a narrow strip of highly disturbed vegetation to highway use • No adverse impact on sensitive botanical resources	• No significant impacts with mitigation • Landscaping of facility will seek to provide native, non-invasive species that could benefit biological resources in area.
4.6.2	Fauna	• No direct effect on wildlife because of limited habitat in study area and no construction	• Minimal effect on wildlife because of limited habitat in study area and limited area of construction	• Limited habitat in affected area • Limited potential for adverse impacts on wildlife. • Recommended mitigation ensures no significant impacts.	• Limited habitat in affected area • Limited potential for adverse impacts on wildlife. • Recommended mitigation ensures no significant impacts.	• Limited habitat in affected area • Limited potential for adverse impacts on wildlife. • Recommended mitigation ensures no significant impacts.	• No significant impacts with mitigation • Mitigation measures will include consultation in accordance with Section 7 of the Endangered Species Act to ensure that impacts on Hawaiian Hawk, Hawaiian Petrel, Newell's Shearwater, Hawaiian Hoary Bat are avoided.
4.6.3	Aquatic Biota	• No direct effect on aquatic species because limited habitat and no construction	• No direct effect on aquatic species because limited habitat in study area and no construction in areas near aquatic resources	• Limited potential for adverse impacts on aquatic resources because of limited habitat and resources	• Limited potential for adverse impacts on aquatic resources because of limited habitat and resources	• Limited potential for adverse impacts on aquatic resources because of limited habitat and resources	• No significant impacts with mitigation • Runoff treatment through swales, drywells, infiltration trenches, etc. • Best Management Practices (BMPs) and National Pollution Discharge Elimination System (NPDES) permit will minimize potential for impacts on aquatic resources in corridor
4.7.1	Surface/ Groundwater	• No direct effect on surface/groundwater because no construction	• Minimal direct effect on surface/groundwater because very limited construction	• Limited potential for adverse impacts on surface waters because of limited resources and proposed mitigation • Treatment of runoff will prevent impacts on groundwater. • No underground injection.	• Limited potential for adverse impacts on surface waters because of limited resources and proposed mitigation • Treatment of runoff will prevent impacts on groundwater. • No underground injection.	• Limited potential for adverse impacts on surface waters because of limited resources and proposed mitigation • Treatment of runoff will prevent impacts on groundwater. • No underground injection.	• No significant impacts with mitigation • Runoff treatment through swales, drywells, infiltration trenches, etc. • Best Management Practices (BMPs) and National Pollution Discharge Elimination System (NPDES) permit will mitigate impacts on surface water resources in corridor • Treatment of runoff will mitigate impacts on groundwater

Table 4-41: Summary of Impacts and Mitigation

EA Sec.	Resource/ Issue	Impacts of:					Mitigation
		No-Build	TSM Alt.	Alternative 3	Alternative 4	Alternative 5	
4.7.2	Wetlands	• No direct effect on wetlands because no construction	• No direct effect on wetlands because no construction in area of wetlands	• Small area with some wetland characteristics near Waipahoehoe Bridge, but no jurisdictional wetland affected	• Small area with some wetland characteristics near Waipahoehoe Bridge, but no jurisdictional wetland affected	• Small area with some wetland characteristics near Waipahoehoe Bridge, but no jurisdictional wetland affected	• No significant impacts with mitigation • One area near Waipāhoehoe Bridge exhibits some characteristics of wetland but is not a defined jurisdictional wetland. Design will avoid and minimize impacts in this area. • Treatment of runoff will benefit area
4.7.3	Floodplains & Hydrology	• No direct effect on floodplains, as none are mapped in area • Existing areas of flooding problems will not be improved	• No direct effect on floodplains, as none are mapped in area • Drainage on project will ensure roadway is drained adequately and water is transported across highway adequately	• No direct effect on floodplains, as none are mapped in area • Drainage on project will ensure roadway is drained adequately and water is transported across highway adequately	• No direct effect on floodplains, as none are mapped in area • Drainage on project will ensure roadway is drained adequately and water is transported across highway adequately	• No direct effect on floodplains, as none are mapped in area • Drainage on project will ensure roadway is drained adequately and water is transported across highway adequately	• No significant impacts with mitigation • Drainage treatments will include such measures as vegetated swales, drywells, infiltration trenches, etc. to detain and dispose of runoff • Culverts and bridges will be improved as needed and designed to current standards • An existing abandoned concrete bridge will be removed as part of Shoulder Lane Conversion Project to improve drainage
4.8	Natural Hazards	• No direct effect on sensitive lava tubes • The existing facility would have limited capacity in the event of a regional evacuation	• Limited potential for affecting sensitive lava tubes • While intersections would be improved, the facility would have limited capacity in the event of a regional evacuation	• Unknown potential for affecting sensitive lava tubes • Improved capacity for evacuation.	• Unknown potential for affecting sensitive lava tubes • Improved capacity for evacuation.	• Unknown potential for affecting sensitive lava tubes • Improved capacity for evacuation.	• No significant impacts with mitigation • Archaeological monitoring during construction will help avoid or minimize effects on breaching lava tubes.
4.9.1	Archaeological Resources	• No direct effect on archaeological resources because no construction	• No effect on known archaeological resources • Limited potential for affecting unknown resources	• No effect on known archaeological resources • Limited potential for affecting unknown resources	• No effect on known archaeological resources • Limited potential for affecting unknown resources	• No effect on known archaeological resources • Limited potential for affecting unknown resources	• No significant impacts with mitigation • FHWA will consult with the State Historic Preservation Officer as necessary under Section 106 of the National Historic Preservation Act • Archaeological monitoring will help avoid or minimize effects on encountering unknown archaeological resources or the breaching of lava tubes.

Table 4-41: Summary of Impacts and Mitigation

EA Sec.	Resource/ Issue	Impacts of:					Mitigation
		No-Build	TSM Alt.	Alternative 3	Alternative 4	Alternative 5	
4.9.2	Historic Resources	• No effect on historic resources	• No effect on historic resources	• No effect on historic resources because a historic bridge will have been demolished during the Shoulder Lane Conversion project before this project starts • No effect on historic cemetery adjacent to project	• No effect on historic resources because a historic bridge will have been demolished during the Shoulder Lane Conversion project before this project starts • No effect on historic cemetery adjacent to project	• No effect on historic resources because a historic bridge will have been demolished during the Shoulder Lane Conversion project before this project starts • No effect on historic cemetery adjacent to project	• No significant impacts with mitigation • FHWA will consult with the State Historic Preservation Officer as necessary under Section 106 of the National Historic Preservation Act • Mitigative data collection and coordination with State Historic Preservation Division on historic bridge has taken place on Shoulder Lane Conversion project • A barrier will protect cemetery from construction in adjacent highway right-of-way
4.9.3	Cultural Practices	• No effect on cultural practices	• Bus stop and bus pullout near Maku'u Farmer's Market will improve access to this cultural site.	• Bus stop and bus pullout near Maku'u Farmer's Market will improve access to this cultural site. • The highway itself will remain two lanes in this area	• Bus stop and bus pullout near Maku'u Farmer's Market will improve access to this cultural site. • Road widened to four lanes in this area, but impacts on the Maku'u Farmer's Market will be minimized as much as possible within the narrow strip of property between highway and parking areas	• Bus stop and bus pullout near Maku'u Farmer's Market will improve access to this cultural site. • Road widened to four lanes in this area, but impacts on the Maku'u Farmer's Market will be minimized as much as possible within the narrow strip of property between highway and parking areas	• No significant impacts with mitigation • Archaeological monitoring will help avoid or minimize effects on encountering unknown archaeological resources or the breaching of lava tubes. • If ancient trails are made visible because of vegetation clearing, they will be masked and buffered to protect them • Impacts on Maku'u Farmer's Market property will be minimized as much as possible
4.10	Parks and Recreation	• No effects on any parks or recreational facilities	• No effects on any parks or recreational facilities	• No effects on any parks or recreational facilities	• No effects on any parks or recreational facilities	• No effects on any parks or recreational facilities	• No mitigation needed because no effects
4.11	Agricultural Lands	• No effects on any agricultural lands	• Approximately 0.18 acres of agricultural property acquired in narrow strips next to highway	• Approximately 4.33 acres of agricultural property acquired, mostly vacant W.H. Shipman property • Approximately 0.04 acres of Prime Agricultural Land acquired • Highway widening near three Shipman access driveways	• Approximately 5.37 acres of agricultural property acquired, mostly vacant W.H. Shipman property • Approximately 0.02 acres of Prime Agricultural Land acquired • Highway widening near three Shipman access driveways	• Approximately 9.78 acres of agricultural property acquired, mostly vacant W.H. Shipman property • Approximately 0.08 acres of Prime Agricultural Land acquired • Highway widening near three Shipman access driveways	• No significant impacts with mitigation • Fair and just compensation for property acquired as per Uniform Relocation Assistance and Real Property Acquisition Act of 1970 • Coordination will take place with the Natural Resources Conservation Service and form AD-1006 completed • HDOT will work with agricultural property owners regarding accesses to ensure agricultural operations are not compromised

Table 4-41: Summary of Impacts and Mitigation

EA Sec.	Resource/ Issue	Impacts of:					Mitigation
		No-Build	TSM Alt.	Alternative 3	Alternative 4	Alternative 5	
4.12	Visual Environment	• No direct visual effects	• Areas of alteration of visual environment limited to intersection areas. • Roundabouts, if implemented, could provide landscaping and aesthetic opportunities	• Visual effects where highway widened from two lanes to four lanes between the Kea'au Bypass and Ainaloa Boulevard. • Roundabouts, if implemented, could provide landscaping and aesthetic opportunities	• Visual effects where highway widened from two lanes to four lanes for entire corridor from Kea'au to Pāhoa-Kapoho Road	• Visual effects where highway widened from two lanes to six lanes from the Kea'au Bypass to Paradise Drive and to four lanes from Paradise Drive to Kahakai Boulevard	• No significant impacts with mitigation • Context Sensitive Solutions (CSS) process involved the community in the planning for the project to ensure a facility that is appropriate for area's context • A landscaping plan in final design will emphasize native species wherever possible to minimize the spread of invasives, improve aesthetics, reduce maintenance costs and promoting native Hawaiian values of stewardship for the land. • Roundabouts, if implemented, could provide landscaping and aesthetic opportunities • Streetlights will be shielded to avoid light pollution as per County of Hawai'i code
4.13	Utilities	• No impacts on utilities	• Limited impacts on utilities, if at all, near intersections	• Relocation of 4.2 miles of electric/telecommunications utility line on mauka side highway • Relocation of 4.2 miles of electric/telecommunications utility line on makai side highway • Relocation of 219 poles on both sides highway • Potential relocation of not-as-yet-installed fiber optic line between Kea'au and Maku'u Farmer's Market • Three waterlines (approximately 6.8 miles total) may end up being situated under driving lanes after road is widened • 40 fire hydrants will need to be relocated, along with water meters	• Relocation of 4.6 miles of electric/telecommunications utility line on mauka side highway • Relocation of 4.2 miles of electric/telecommunications utility line on makai side highway • Relocation of 245 poles on both sides highway • Potential relocation of not-as-yet-installed fiber optic line between Kea'au and Maku'u Farmer's Market • Three waterlines (approximately 6.8 miles total) may end up being situated under driving lanes after road is widened • 40 fire hydrants will need to be relocated, along with water meters	• Relocation of 4.6 miles of electric/telecommunications utility line on mauka side highway • Relocation of 4.2 miles of electric/telecommunications utility line on makai side highway • Relocation of 245 poles on both sides highway • Potential relocation of not-as-yet-installed fiber optic line between Kea'au and Maku'u Farmer's Market • Three waterlines (approximately 6.8 miles total) may end up being situated under driving lanes after road is widened • 40 fire hydrants will need to be relocated, along with water meters	• No significant impacts with mitigation • HDOT will coordinate with utilities and customers to minimize and mitigate disruption

Table 4-41: Summary of Impacts and Mitigation

EA Sec.	Resource/ Issue	Impacts of:					Mitigation
		No-Build	TSM Alt.	Alternative 3	Alternative 4	Alternative 5	
4.14	Hazardous Materials	• No impacts from hazardous materials	• Very limited potential for impacts from hazardous materials	• Very limited potential for impacts from hazardous materials	• Very limited potential for impacts from hazardous materials	• Very limited potential for impacts from hazardous materials	• No significant impacts with mitigation • If hazardous materials are discovered during construction, standard procedures will be followed to prevent exposure to workers and to alert authorities for emergency response as needed.
4.15	Right of Way, Relocations, and Access Changes	• No direct acquisition of property or relocations of residents or businesses	• 0.9 acres acquired in 36 parcels for Kea'au-Pāhoa Road itself. • No relocations of residents or businesses from improvements to Kea'au-Pāhoa Road itself • Access management measures could require acquisition of up to 7.5 acres in 187 parcels. • Access management measures could require acquisition of one house if Paradise Drive is extended • Minimal effect on driveways in corridor	• 18.1 acres acquired in 287 parcels for Kea'au-Pāhoa Road itself. • No relocations of residents or businesses from improvements to Kea'au-Pāhoa Road itself • Access management measures could require acquisition of up to 7.5 acres in 187 parcels. • Access management measures could require acquisition of one house if Paradise Drive is extended • Up to 133 driveways have access limited to right-in-right-out	• 24.6 acres acquired in 329 parcels for Kea'au-Pāhoa Road itself. • No relocations of residents or businesses from improvements to Kea'au-Pāhoa Road itself • Access management measures could require acquisition of up to 7.5 acres in 187 parcels. • Access management measures could require acquisition of one house if Paradise Drive is extended • Up to 133 driveways have access limited to right-in-right-out	• 39.7 acres acquired in 362 parcels for Kea'au-Pāhoa Road itself. • No relocations of residents or businesses from improvements to Kea'au-Pāhoa Road itself • Access management measures could require acquisition of up to 7.5 acres in 187 parcels. • Access management measures could require acquisition of one house if Paradise Drive is extended • Up to 133 driveways have access limited to right-in-right-out	• No significant impacts with mitigation • Fair and just compensation for property acquired or relocations of residents/businesses as per Uniform Relocation Assistance and Real Property Acquisition Act of 1970.
4.16	Construction Impacts	• No construction impacts	• Very minor localized construction impacts	• Construction impacts on air, noise, surface waters, vegetation, erosion, traffic, property access, utilities, cultural resources, etc.	• Construction impacts on air, noise, surface waters, vegetation, erosion, traffic, property access, utilities, cultural resources, etc.	• Construction impacts on air, noise, surface waters, vegetation, erosion, traffic, property access, utilities, cultural resources, etc.	• No significant impacts with mitigation • Construction program will limit night work, provide adequate for nearby/impacted properties ,and entail outreach with public
4.18	Coastal Zone Management Consistency	• No action in coastal zone.	• Generally consistent with Coastal Zone Management program goals.	• Generally consistent with Coastal Zone Management program goals.	• Generally consistent with Coastal Zone Management program goals.	• Generally consistent with Coastal Zone Management program goals.	• No significant impacts with mitigation
4.19	Indirect/ Cumulative Impacts	• Little direct contribution to indirect or cumulative effects, though adverse effects of increasing congestion and delay on the community may have some contribution.	• Minimal direct contribution to indirect or cumulative effects though adverse effects of increasing congestion and delay on the community may have some contribution	• Indirect effects from induced growth, though growth is occurring independently of project. • Indirect effects from induced traffic from congestion reduction • Cumulative effects on vegetation, wildlife, aesthetics, natural/cultural resources, community cohesion, past right-of-way impacts	• Indirect effects from induced growth, though growth is occurring independently of project. • Indirect effects from induced traffic from congestion reduction • Cumulative effects on vegetation, wildlife, aesthetics, natural/cultural resources, community cohesion, past right-of-way impacts	• Indirect effects from induced growth, though growth is occurring independently of project. • Indirect effects from induced traffic from congestion reduction • Cumulative effects on vegetation, wildlife, aesthetics, natural/cultural resources, community cohesion, past right-of-way impacts	• No significant impacts with mitigation. Mitigation for these varied effects discussed elsewhere in this table

CHAPTER 5: SECTION 4(F) EVALUATION

Section 4(f) of the Department of Transportation Act of 1966, 49 USC 303(c), requires that, prior to the use of any of the land types listed below, it must be determined that there are no prudent and feasible alternatives which avoid such use and that the project includes all possible planning to minimize harm to such resources:

- A publicly owned park
- A publicly owned recreation area
- A publicly owned wildlife or waterfowl refuge
- Land from an historic property that is on or eligible for inclusion in the National Register of Historic Places (NRHP or "National Register")
- Archaeological sites that will be preserved in place

According to FHWA regulations, a "use" can be either (1) direct, (2) constructive, or (3) temporary. [See 23 CFR 771.135(p)]

- A direct use occurs when land from a Section 4(f) resource is permanently incorporated into a transportation project
- A constructive use occurs when the proximity impacts of the project are so severe that they substantially impair the protected activities, feature, or attributes that qualify the resource for Section 4(f) protection
- A temporary use occurs when there is a temporary occupancy of the Section 4(f) property that is adverse in terms of the statute's preservation purposes

In order for a park, recreation area, or wildlife/waterfowl refuge to qualify for protection under Section 4(f) it must be publicly owned and officially designated as a park, recreational area, or wildlife or waterfowl refuge. Historic resources that are listed in, or eligible for listing in, the NRHP are not required to be publicly owned in order to be protected under Section 4(f). Archaeological sites must also be on or eligible for the National Register and important for 'preservation in place' in order to be considered a Section 4(f) resource.

As noted in **Section 4.10: Parks and Recreational Resources**, there are no recreational facilities affected in any way by the project. The Hawaiʻi County Department of Parks and Recreation has investigated the concept of a park along Keaʻau-Pāhoa Road adjacent to the new Pāhoa Fire Station. However, at the present time, the county has not programmed or produced any long-term plans for a park on this site, and no conceptual design plans have been produced to date. (Personal Communication, Robert Fitzgerald, County of Hawaiʻi Director of Parks and Recreation, 11/12/09). Therefore, Section 4(f) would not apply to impacts upon this property.

There are two historic resources that were identified in the Archaeological Inventory Survey for this project that would be covered by Section 4(f), a historic 1930s-era concrete bridge and the Sacred Heart Church Cemetery. The bridge and cemetery have been discussed in detail in **Section 3.9.3: Historic Resources** and **Section 4.9.2: Historic Resources** and the reader is

suggested to refer to those sections for more information. The discussion that follows focuses on the Section 4(f) implications of these properties and project impacts.

5.1 Proposed Action

5.1.1 Project Description

HDOT proposes to improve 9.5 miles of Keaʻau-Pāhoa Road (State Route 130), from the terminus of the existing four-lane Keaʻau Bypass to its intersection with Pāhoa-Kapoho Road as shown in **Figure 1-1: Project Study Area**. State Route 130 is the only roadway that connects the study area with the Hilo area and is the primary conduit for emergency services to access local properties.

The project's purpose is to improve safety, increase capacity, and modernize State Route 130 between Keaʻau and Pāhoa. Currently, Keaʻau-Pāhoa Road is heavily congested during peak hours. The study area is only a quarter built-out, but it is expected that over the next 20-30 years, population will double, exacerbating an already-congested situation if improvements are not made. Safety for both motorists and non-motorists is a paramount concern, as the roadway serves motor vehicles, the county's Hele-On bus routes, bicyclists, and pedestrians. Vehicle conflict points, at the intersections and numerous driveways, contribute to an accident rate much higher than the statewide average.

5.1.2 Project Purpose and Need

Chapter 1: Purpose and Need for Project provides a detailed discussion of the need for this project. The Purpose and Need can be summarized as follows:

- Improve Safety. The foremost purpose of the proposed action is to increase safety for all travelers between Keaʻau and Pāhoa. The design of the project from a geometric and traffic safety standpoint should address vehicle conflict points along the highway, including intersections and turning points.

- Provide Mobility and Relieve Congestion. Another primary purpose of this project involves improving regional mobility, local mobility and access, and reducing traffic congestion within the Puna District.

- Improve Travel for Alternative Modes. An important purpose of this project is to accommodate the transit system, bicyclists and pedestrians, to provide a more balanced transportation system.

- Address Future Traffic Increases. Improvements that increase accessibility, mobility and safety for local and regional traffic, including vehicular and non-vehicular modes of travel should be adequate for the next 20 to 30 years.

- Support Future Land Use Objectives. The Puna Community Development Plan (PCDP), adopted in 2008, and the Puna Regional Circulation Plan (PRCP), adopted in 2005, both envision a future land use concept concentrating future development into village and town centers to serve the local Puna community and address past sprawl and Hilo-centric patterns of travel.

- Enable Civil Defense, Emergency Travel, and Evacuations. Until an alternate parallel route to Keaʻau-Pāhoa Road can be constructed, for now, it provides the only route into and out of Lower Puna. This means that it would serve as the primary evacuation route for Civil Defense needs and it also is the primary route first responders use to reach local subdivisions and transport people to Hilo Medical Center, the region's only hospital.

5.1.3 Project Alternatives

Chapter 2: Alternatives provides a detailed discussion of the alternatives under consideration, including alternatives that were eliminated from analysis in the Environmental Assessment. To summarize, alternatives under consideration include:

- A "No-Build" alternative (Alternative 1), which only includes currently programmed actions
- A Transportation Systems Management (TSM) alternative (Alternative 2), which would make lower-cost improvements along the corridor, including signalizing intersections, access management, and transit improvements but not entail major construction
- Alternative 3, which could incorporate some or all of the TSM improvements above, plus widen Keaʻau-Pāhoa Road to four lanes between Keaʻau Bypass and Ainaloa Boulevard, and retain the two lane cross-section between Ainaloa Boulevard and Pāhoa-Kapoho Road. This alternative includes improved shoulders/bikeway areas, bus pull-outs,, and median treatments.
- Alternative 4, which could incorporate some or all of the TSM improvements above, plus widen Keaʻau-Pāhoa Road to four lanes between Keaʻau Bypass and Pāhoa-Kapoho Road. This alternative includes improved shoulders/bikeway areas, bus pull-outs, and median treatments.
- Alternative 5, which could incorporate some or all of the TSM improvements above, plus widen Keaʻau-Pāhoa Road to six lanes between Keaʻau Bypass and Paradise Drive, four lanes between Paradise Drive and Kahakai Boulevard, and retain the two lane cross-section between Kahakai Boulevard and Pāhoa-Kapoho Road. This alternative includes improved shoulders/bikeway areas, bus pull-outs, and median treatments.

5.2 1930s Era Concrete Bridge

5.2.1 Section 4(f) Property

An abandoned concrete bridge and associated asphalt-paved roadway are located adjacent and parallel to the southwestern edge of the existing Keaʻau-Pāhoa Road. The SIHP# 50-10-44-26874 bridge is located approximately 630 meters (2,067 feet) northwest of the intersection of Pōhaku/Shower Drives and Keaʻau-Pāhoa Road. The bridge is constructed across an intermittent unnamed stream (also called Waipāhoehoe Stream, see **Section 3.7.1: Surface and Groundwater**) which was dry during the current survey. The bridge measures 28.2 meters (92.5 feet) long by 5.8 meters (19.0 feet) wide with an approximate height of 2.8 m (9.1 feet) from the surface of the dry streambed. The bridge is constructed of four angled concrete supports bearing a solid concrete slab measuring approximately 40 cm (16 inches) thick. The bridge is constructed on solid bedrock with pipe and rail posts inset into both the southwestern and northeastern sides of the bridge. Thick vegetation has obscured the northwest end of the bridge as well as the northwestern extension of the associated asphalt-paved roadway. No date or inscriptions were observed on any surface of the bridge. The associated roadway was observed to extend from the southeastern end of the bridge and continue southeast to become an unnamed paved subdivision road that is currently in use. This subdivision road continues southeast to nearly reconnect with Keaʻau-Pāhoa Road but has been blockaded at its southeastern end.

The bridge and associated roadway likely functioned as an older alignment of the highway. The stretch of former roadway would have extended approximately 487 meters (1,598 feet) connecting to the present Keaʻau-Pāhoa Road at both ends.

A quick review of maps including the 1928 Hawaiʻi Territory map, the 1944 Hawaiʻi Island map and the Tax Map Key Zone map does not show the paved roadway adjacent to Keaʻau-Pāhoa Road. However, TMK 1-6-04, dated "March 1935, Revised January 27, 1959 and August 6, 1964" shows a bypass identified as State PAR. 30A [4.853 Ac.] in the location of SIHP # 50-10-44-26874. A Geographic Information Systems (GIS) review of the portion of Keaʻau-Pāhoa Road containing SIHP # 50-10-44-26874, indicates that the bypass containing the bridge and Keaʻau-Pāhoa Road itself are within the same parcel. The associated asphalt-paved roadway and unnamed paved subdivision road that it becomes is visible on an aerial photograph of the project area. The bridge is not listed in the Historic Bridge Inventory and Evaluation (Alvarez 1987) for the island of Hawaiʻi, nor is it in the State of Hawaii Historic Bridge Inventory and Evaluation (Spencer Mason Architects 1996), but the bridge is constructed in a style that is similar to 1930s concrete slab bridges.

The 1930s era concrete bridge is recommended eligible for the Hawaiʻi and National Registers under Criterion D.

5.2.2 Impacts on 1930s Era Concrete Bridge

This bridge will be demolished as part of the separate Shoulder Lane Conversion project described in **Section 1.2.2.1: The Kea'au-Pāhoa Road Shoulder Lane Conversion Project**, and therefore the bridge will no longer be present at the time that the project covered in this EA is constructed. Thus, none of the alternatives in this project will have any direct impact on this bridge. The bridge has been recommended for demolition as it impedes stream flow and would cause drainage problems during heavy rain events.

The recommendation being made to the SHPD specific effect recommendation is "no effect" as the bridge will have been demolished at the time this project is constructed.

Therefore, while this resource is present in the corridor at the present time, since it will have been demolished prior to construction of the Kea'au-Pāhoa Road Improvements Project, the project will not result in:

- A direct use of this Section 4(f) resource,
- A constructive use of this Section 4(f) resource, or
- A temporary use of this Section 4(f) resource.

5.2.3 Avoidance Alternatives

None of the alternatives for this project have any effect on this bridge.

5.2.4 Measures to Minimize Harm

To mitigate the impact of demolishing this bridge, data recovery in the form of Historic American Building Survey and Historic American Engineering Record (HABS/HAER) documentation of the bridge has been recommended as part of the Shoulder Lane Conversion project and by the project team on this project as well. Consultation with and the approval of the SHPD with the mitigation proposed above is recommended prior to any proposed alteration to SIHP # 50-10-44-26874.

5.2.5 Coordination

Coordination with SHPD has occurred on this project and will continue throughout the EA process and into the final design and construction process as is needed.

5.3 Sacred Heart Church Cemetery

5.3.1 Section 4(f) Property

A cemetery associated with the Sacred Heart Catholic Church in Pāhoa abuts the current right-of-way limits, at the intersection of the Pāhoa Bypass and Pāhoa-Kapoho Road (Old Pāhoa Road). The Sacred Heart Catholic Church and its cemetery are components of the Pāhoa Historic and Commercial District, SIHP # 50-10-55-7388 (Department of Transportation

1979:F1). Original documentation describes the church building that was constructed in 1898. Other buildings are briefly described as, "an outhouse and the rectory". The only description of the cemetery is, "A small graveyard is located in the rear" [of the lot] (Department of Transportation 1979:F-3).

A "path of meditation" was noted within 16 meters (52.5 feet) from the edge of the asphalt of the existing Keaʻau-Pāhoa Road at the intersection with Old Pāhoa Road. This path of meditation includes landscaped areas containing basalt stone alignments, basalt pebble pavement, cement and basalt constructions, wooden crosses, and at least one wooden placard inscribed with family names. No burials are believed to be associated with this path of meditation. A miniature replica of Sacred Heart Catholic Church is found on the eastern edge of the church property. The church property improvements and amenities do not extend into the existing or future anticipated highway right-of-way limits but the path of meditation landscaping extends to the edge of the existing highway right-of-way.

The Sacred Heart Catholic Church cemetery is a component of the Pāhoa Historic and Commercial District, and is recommended eligible for the Hawaiʻi and National Registers under Criterion D.

5.3.2 Impacts on Sacred Heart Church Cemetery

As noted in **Section 4.9.2: Historic Resources**, the Sacred Heart Church Cemetery is outside of the Area of Potential Effect of the project. It borders on both the existing and future project right-of-way.

There will be no direct impacts upon the Sacred Heart Church Cemetery property by any alternative. The No-Build Alternative and TSM Alternative will not involve any reconstruction in the vicinity of Sacred Heart Church Cemetery. Alternatives 3 and 5 would retain the existing two-lane cross-section in the vicinity of the cemetery. Alternative 4 would construct a four-lane cross-section in the vicinity of the cemetery. All project alternatives will remain within the existing right-of-way limits.

There will be no constructive use of this property. It is currently in close proximity to the existing highway, and will remain so in the future under all build alternatives. Usage of the cemetery will not be altered or affected by the project.

No temporary use of the cemetery property is anticipated.

5.3.3 Avoidance Alternatives

The No-Build and TSM Alternatives would not require any construction in this area, but neither meets the Purpose and Need for this project.

All Build Alternatives would reconstruct Keaʻau-Pāhoa Road in this area. There is no alternative alignment under consideration that would enable the area to be totally avoided by the project. The project terminates at the existing Pāhoa-Kapoho Road intersection, and therefore, it would

not be possible to shift the alignment to the makai side of the roadway away from the cemetery as it would then not line up with this intersection.

5.3.4 Measures to Minimize Harm

The design of the facility in this area will ensure that no direct impacts on the cemetery are anticipated.

The institution of interim protection measures just prior to and during any project related work in the immediate vicinity is recommended. Specifically, the erection of continuous, orange-web "event fencing" or some similar barrier is recommended prior to any project related work within 50 feet of the Sacred Heart Catholic Church property. This interim protection could be carried out and documented under monitoring archaeologist supervision.

5.3.5 Coordination

Coordination has taken place with the State Historic Preservation Division as part of the Archaeological Impact Survey and Cultural Impact Assessment for this project. This coordination will continue through the rest of the Environmental Assessment process

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CHAPTER 6: ANTICIPATED DETERMINATION

To determine whether a proposed action may have a significant effect on the environment under Hawaiʻi Administrative Rules (HAR) Title 11, Chapter 200, the Approving Agency needs to consider every phase of the action, the expected primary and secondary consequences, cumulative effect, and the short- and long-term effects. The Approving Agency's review and evaluation of the proposed action's effect on the environment would result in a determination whether: 1) the action would have a significant effect on the environment, and an Environmental Impact Statement Preparation Notice should be issued, or 2) the action would not have a significant effect warranting a Finding of No Significant Impact (FONSI).

This chapter discusses the results of the environmental assessment conducted of the proposed Keaʻau-Pāhoa Road Improvements Project in relation to the 13 Significance Criteria prescribed under the State Department of Health's Administrative Rules Title 11, Chapter 200. The purpose of this assessment was to consider the "significance" of potential environmental effects which includes the sum of effects on the quality of the environment along with the overall and cumulative effects. The resulting findings are discussed below for each criterion.

Since a Preferred Alternative has not been selected at this time, the analysis below considers all alternatives under consideration other than the No-Build Alternative.

While the analysis that follows is specific to fulfilling the requirements under HAR Chapter 11-200, it also demonstrates a lack of significant impacts that would be regulated under the National Environmental Policy Act (NEPA).

6.1 Preliminary Findings

This section discusses the in relation to the 13 Significance Criteria prescribed under the State Department of Health's Administrative Rules Title 11, Chapter 200.

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

Neither the TSM Alternative (Alternative 2) nor the Build Alternatives (Alternatives 3, 4, and 5) will have impacts on natural or cultural resources of any significance after mitigation. As noted above in **Chapter 4: Environmental Impacts and Mitigation Measures**, the corridor is generally highly disturbed from both the existing roadway environment and from the high level of development that has taken place in the properties adjoining the corridor. Vegetation consists in large part of alien species, and even in those portions of the corridor where natural vegetation is found, the natural community has been degraded from its original state. There were minimal impacts anticipated on wildlife in the corridor for similar reasons. No threatened or endangered species are anticipated to inhabit the corridor.

There were no archaeological resources identified in the project corridor during the field survey. One affected historic property, a 1930s-era concrete bridge, will be demolished as a result of an earlier project in the corridor. The specific effect recommendation being made to the SHPD is "effect, with proposed mitigation measures." The recommended mitigation

measures, data collection (which has already taken place) will reduce any impacts on this property and bring them down below the level of a significant impact.

As noted above in **Section 3.9.4: Cultural Practices**, the Cultural Impact Assessment (CIA) found that the Build Alternatives (Alternatives 3, 4, and 5) would create no impact to traditional cultural practices along the corridor, with the potential exception of the activities that are ongoing at the Maku'u Farmers Market Association site. As described above in **Section 4.9.3: Cultural Practices**, the design of the roadway in the vicinity of this site has been focused on avoiding impacts on the site to the greatest degree possible. Under Alternatives 2, 3, 4, and 5, a bus stop and bus pullout area will help improve accessibility of the site to transit-dependent persons but will affect a narrow strip of the property immediately next to Keaʻau-Pāhoa Road. Alternative 3 will not increase the number of lanes in this area and is anticipated to have no impact with the exception of the bus stop and bus pullout area. If a four-lane cross-section is constructed under Alternatives 4 and 5, impacts will be limited to the need to relocate power poles in the area and to provide the bus stop and pullout area.

Section 4.9.3: Cultural Practices also recommends other measures for mitigating cultural effects of the project below a level of significance.

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

Neither the TSM Alternative (Alternative 2) nor the Build Alternatives (Alternatives 3, 4, and 5) will curtail the range of beneficial uses of the environment after mitigation. As the project intends to improve an existing roadway, the areas of impact are generally highly disturbed. The project is consistent with plans for the area and will enhance beneficial uses of the environment by providing improved opportunities for increased multi-modal travel in the corridor, specifically transit, bicycling, and pedestrian use.

3. *Conflicts with the state's long-term environmental policies or goals and guidelines as expressed in chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders;*

HRS Chapter 344 states that its purpose is to establish a state policy which will encourage productive and enjoyable harmony between people and their environment, promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, and enrich the understanding of the ecological systems and natural resources important to the people of Hawaii.

All Alternatives covered in this EA other than the No-Build Alternative will receive mitigation for impacts on land, water, mineral, visual, air and other natural resources to ensure that there are no significant adverse impacts consistent with Chapter 344.

Section 3(2)(C) of Chapter 344 calls for establishing communities which provide a sense of identity, wise use of land, efficient transportation, and aesthetic and social satisfaction in harmony with the natural environment which is uniquely Hawaiian. The Context Sensitive Solutions (CSS) process followed for this project resulted in the Build Alternatives studied in this EA with the overall goal of aspiring to meet the ideals espoused in Section 3(2)(C).

4. *Substantially affects the economic welfare, social welfare, and cultural practices of the community or State;*

With the exception of the No-Build Alternative, none of the Alternatives will have a substantial negative effect on the economic or social welfare of the community or state. The lower Puna region has been underserved by community services historically, including transportation and emergency services. Deficiencies along existing Keaʻau-Pāhoa Road have resulted in a facility with a high accident rate, and high levels of congestion that result in long commute times, all of which have adverse social effects on the community. The project will increase mobility of the residents of lower Puna, and improve accessibility to school, jobs, and other life activities. The project will also create construction jobs.

5. *Substantially affects public health;*

The Build Alternatives are anticipated to have a net positive effect on public health, particularly in improving access to the region's hospital in Hilo. Effects on air quality, water quality, and noise levels, are expected to be only minimal in magnitude. Improved safety for pedestrians, bicyclists and motorists and a lower accident rate are expected. The mitigative measures proposed in this EA will abide by all applicable state and county standards and rules. Improved opportunities for transit, pedestrians, and bicycles in the corridor will support modes of transportation that encourage physical activity and benefit public health.

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

The lower Puna area has been confronting challenges that originated when the large non-conforming subdivisions flanking Keaʻau-Pāhoa Road were created in the 1950s through early 1970s. The rapid growth that has taken place in these subdivisions and the large number of available lots for additional development spread over a vast area will create an unsustainable future condition unless action is taken to direct growth in Puna in a more concentrated, strategic manner. Furthermore, the area is dependent on longer-distance trips to Hilo as a center of employment, education, and other services. The Puna Community Development Plan (PCDP) attempts to address these problems through a directed land-use strategy of village and town centers.

In many ways, the Keaʻau-Pāhoa Road improvements are a response to rapid growth. They are consistent with the PCDP's vision for the corridor. While there is potential for additional growth to be induced by the increased mobility offered by improvements to Keaʻau-Pāhoa Road, the implementation of the PCDP will intend to direct the growth in a concentrated, planned manner by way of the village and town centers. Improved regional access to the village and town centers from an improved Keaʻau-Pāhoa Road will strengthen the viability of those areas to serve the greater Puna community by encouraging employment and services that are not present today.

7. *Involves a substantial degradation of environmental quality;*

None of the Alternatives under consideration would result in a substantial degradation of environmental quality. While there would be temporary construction effects and long-term

effects from conversion of non-highway property to a transportation use, impacts will be mitigated in accordance with federal, state, and county regulations and permit conditions to avoid substantial degradation of environmental quality.

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

As discussed in greater detail in **Section 4.19.2: Cumulative Impacts**, there will be some cumulative effects from the Build Alternatives, but these are not significant effects. The effects of the project will generally be mitigated in accordance with federal, state, and county regulations and permit conditions to avoid a cumulative effect resulting from this project in conjunction with other past, present, and reasonable foreseeable future actions.

The No-Build Alternative will create impacts, not mitigated, that will contribute to a cumulative effect on the social environment as traffic congestion, accidents, and reduced mobility compromise Puna's quality of life.

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

Botanical and faunal studies were conducted for this EA. Overall, the Keaʻau-Pāhoa corridor is highly disturbed and as described in **Section 4.6.2: Fauna**, there are minimal resources of importance. No significant impacts are anticipated to rare, threatened/endangered species or critical habitat with the mitigative measures proposed for this project.

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

The project will not result in an exceedance of federal or state air quality standards, and the overall regional benefit to air quality will be positive with a reduction in congestion and idling vehicles in the corridor. The project will also encourage alternative modes of travel, specifically transit, bicycling, and pedestrian activity, and increasing these modes in the corridor will have a beneficial effect on air quality as well. There will be some short-term impacts to air quality associated with construction activities, but these impacts will be mitigated through Best Management Practices.

Water quality in and around the corridor will not deteriorate as compliance with federal, state, and county regulations will prevent adverse impacts, both during and after construction.

Traffic noise levels are already generally high and will increase substantially by 2038 even under the No-Build Alternative. Future increases in noise specifically associated with the project compared to the No-Build Alternative would generally be imperceptible. Nonetheless, the project will result in exceedances of the FHWA/HDOT Noise Abatement Criteria. As noted in **Section 4.5.2: Mitigation of Project-Related Noise**, noise mitigation was evaluated, but the potential for noise barriers is limited because of the large number of driveways in the corridor. Noise mitigation for individual properties will be Implemented where reasonable and feasible, to reduce impacts to affected properties. Potential short-term construction noise impacts are possible during the project construction period. However, noise impacts would be minimized with the use of standard curfew periods, properly muffled equipment, administrative controls, and construction barriers as required.

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

The project site is not located within a tsunami zone, erosion prone area, or near coastal waters.

An unnamed intermittent stream (referred by some as Waipāhoehoe Stream) is crossed by the current Kea'au-Pāhoa Road. The bridge over this stream may need to be widened depending upon the alternative selected and design. Demolition of a nearby unused bridge structure will take place as part of the Shoulder Lane Conversion project that precedes this project as described in **Section 1.2.2.1: The Kea'au-Pāhoa Road Shoulder Lane Conversion Project**. That demolition is anticipated to improve the drainage of this stream. The stream is not directly connected hydrologically to the ocean and is not anticipated to be a Water of the United States. Impacts on this stream will be mitigated through compliance with federal, state, and county regulations. Best Management Practices during construction will prevent erosion and sedimentation.

The project corridor, and for that matter, all of the Puna District is threatened by volcanic hazards from Kīlauea volcano as well as earthquakes, but the corridor is not unusually sensitive to these hazards compared to other areas in the vicinity. There are numerous lava tubes that underlie this part of Puna, including the Kazumura Lava Tube Cave and Pāhoa Cave. **Sections 4.9.1: Archaeological Resources** and **4.9.2: Historic Resources** discuss measures for archaeological monitoring of the corridor to avoid or minimize effects on lava tubes.

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

The project corridor is already affected by the existing roadway and by the highly developed nature of much of the adjoining land use. The Build Alternatives will not block scenic vistas or viewplanes identified in county or state plans or studies. The project has followed a Context Sensitive Solutions (CSS) process in order to involve the community in the planning for the project to ensure a facility that is appropriate for the context of the lower Puna District. Landscaping and design decisions in final design will strive for a facility that is complementary to the adjoining properties and community at large.

Implementation of roundabouts, if pursued, will provide landscaping and aesthetic opportunities in the middle of the roundabout.

13. Requires substantial energy consumption.

The project will require an expenditure of energy during construction of the project, and street lights and traffic signals will consume energy after construction is completed. However, these minor outlays of energy will be greatly compensated for many times over by the great improvement in traffic operations, which will reduce congestion and wasted fuel.

6.2 Anticipated Determination

Based upon the information and results of the assessments conducted for the project site; it is anticipated that a Finding of No Significant Impact (FONSI) determination will be warranted for the Keaʻau-Pāhoa Road Improvements Project under any alternative selected. No Environmental Impact Statement would be required. The findings supporting this anticipated determination are based upon the previous discussion of the project's effect on the environment in relation to the 13 Significance Criteria.

CHAPTER 7: PUBLIC INVOLVEMENT

7.1 Community Participation and CSS Process

HDOT and the consultant team have been conducting a rigorous community participation program for the proposed project.

The use of the Context Sensitive Solutions, or CSS, approach was fundamental in designing and implementing the community participation program. The core principles of CSS apply to transportation processes, outcomes and decision making, and include:

- Strive towards a shared stakeholder vision to provide a basis for decisions,
- Demonstrate a comprehensive understanding of contexts,
- Foster continuing communication and collaboration to achieve consensus, and
- Exercise flexibility and creativity to shape effective transportation solutions, while preserving and enhancing community and natural environments.

Project team efforts to engage minority and low income groups in the planning and alternatives development for the proposed project are discussed in **Section 3.3.2.3: Incorporation of Title VI and Environmental Justice Requirements into the Proposed Project**.

Highlights of the community participation program that has occurred thus far are described below.

7.1.1 Kea'au-Pāhoa Road Advisory Group (KPAG)

Development of the proposed project included a representative group of community leaders in the KPAG. Further, it also means that a portion of the community was aware of the project processes due to the networks of members of the KPAG.

Between August 2008 and October 2009, KPAG and the project team held eight meetings, one of which occurred over a two-day period. An additional KPAG meeting is expected immediately prior to the issuance of this Draft EA.

The following issues were discussed at the KPAG meetings. Meeting summaries, comments received, and accompanying materials are available upon request from HDOT. All meetings offered the public opportunity for questions and comments.

- Meeting 1, held on August 26, 2008, introduced the new KPAG and discussed the Context Sensitive Solutions concept. KPAG members were given workbooks and disposable cameras to establish the context of the region and a sense of place.
- Meeting 2, held on September 22, 2008, provided an overview of the environmental review process, and further discussed the CSS process. It also included a work session for formulating the project's Purpose and Need.

- Meeting 3, held on October 27, 2008, provided a status report on the County's Transit System and Puna Community Development Plan, had breakout groups develop a "Universe of Alternatives" for the project, and presented traffic forecasts.
- Meeting 4 was held on two days, December 8 and December 9, 2008. Day one completed the KPAG's Purpose and Need statement with a voting effort, refined and confirmed the "Universe of Alternatives", and provided technical discussion on intersection treatments and roundabouts. Day two confirmed the results of the Purpose and Need voting, discussed traffic forecasts and Level of Service, discussed accident data, provided an overview of highway design guidelines, and three breakout groups screened a reasonable set of alternatives from the "Universe of Alternatives."
- Meeting 5, held on January 26, 2009, reviewed the reasonable set of alternatives from Meeting 4. KPAG members voted on the types of evaluation criteria identified for the reasonable set of alternatives. A brief discussion of intersections and roundabouts took place. KPAG members helped plan future Public Informational Meetings.
- Meeting 6, held on March 30, 2009, went into detail on existing and anticipated traffic conditions and Level of Service, along with corridor access management strategies. The KPAG approved the prioritization of evaluation criteria from the preceding meeting. A review of the Environmental Assessment process was provided. Further planning for two Public Informational Meetings on April 29 and 30, 2009 was discussed.
- Meeting 7, held on September 28, 2009, provided an overview of the Environmental Process and its timeline. The designs of the five alternatives discussed in this EA were discussed. A discussion of some of the soon-to-be-completed environmental studies (botany, fauna, aquatic resources, hydrology, archaeology, and cultural impacts) were provided to the group.
- Meeting 8, held on October 21, 2009, included a group field trip out to the corridor to consider the issues affecting the improvements to the main intersections. The issues of connectivity, village centers, and the potential to create access-management improvements were discussed. A special presentation by a national expert on roundabouts comprised a substantial amount of the meeting.
- Meeting 9, held on April 5, 2010, included an overall summary of the Draft Environmental Assessment and explained the process for releasing the Draft Environmental Assessment to the public. The public comment period and public hearing were discussed.

7.1.2 Public Information Meetings

A public meeting was held at the onset of the project in April, 2008 at the Kea'au Community Center. The project approach was presented, including the process for developing alternatives, the use of the Context Sensitive Solutions approach in project development, and the overall public involvement program that included the KPAG.

Two public meetings were held in April 2009 at the Pāhoa Intermediate/High School and Kea'au Elementary School to present the findings of the KPAG process to date.

A public hearing will be held during the public review period for this Draft EA.

7.1.3 Project Website

A project website, http://www.keaau-pahoa.com/ provides:

- An overview of the project,
- Notices about KPAG meetings
- Notices about Public Information Meetings and Public Hearings, and
- An opportunity for the public to comment or make inquiries about issues related to the project.

7.2 Pre-Assessment Consultation

Consultation with various Federal, State and County government agencies was conducted to obtain their comments and concerns associated with the project as part of the environmental assessment process.

Letters providing project information along with a preliminary site plan were sent to 57 consulted parties dated May 1, 2009 to solicit their initial comments and concerns associated with the project as part of the preparation of this Draft EA. Two letters, one to a house of worship in the corridor and one to a community organization, were returned as undeliverable.

A listing of agencies and organizations for which consultation letters were sent is provided below. Those providing written response are identified with a "**»**" symbol. Copies of written comments received along with written responses are included in **Appendix B: Pre-Consultation Comments Received**. Comments received have been addressed in the appropriate sections of this Draft EA.

FEDERAL AGENCIES

» U.S. Department of Agriculture
» U.S. Army Engineer Division, Department of the Army
» U.S. Department of the Interior, Fish and Wildlife Service
- U.S. Department of the Interior, National Park Service
- U.S. Department of Transportation

STATE OF HAWAI'I AGENCIES

» Department of Accounting and General Services
- Department of Agriculture
  Department of Business, Economic Development and Tourism

- » Department of Civil Defense
- » Department of Education
- Department of Education, Kau - Keaʻau-Pāhoa Complex Area Superintendent
- » Department of Land and Natural Resources
- Department of Land and Natural Resources, Land Division
- Department of Aquatic Resources
- Department of Engineering Division
- Department of Land Division - Hawaiʻi District
- Department of Land and Natural Resources, Historic Preservation Division
- Department of Hawaiian Home Lands
- Land Use Commission, Department of Business, Economic Development & Tourism
- » Office of Hawaiian Affairs
- » Office of Planning, Department of Business, Economic Development & Tourism
- Department of Health, Environmental Planning Office

COUNTY OF HAWAIʻI AGENCIES

- County of Hawaiʻi, Mayor
- Hawaiʻi County Council, Honorable J. Yoshimoto
- Department of Civil Defense
- » Department of Environmental Management
- » Hawaiʻi Fire Department
- Mass Transit Agency
- Office of the Aging
- Department of Parks and Recreation
- » Department of Water Supply
- » Hawaiʻi Police Department
- » Planning Department
- Department of Public Works
- Department of Research and Development
- Hawaiʻi County Council, Honorable Emily Naeole, 5th District

ORGANIZATIONS AND INDIVIDUALS

- 4th Representative District, Faye Hanohano
- 3rd Representative District, Clift Tsuji
- 2nd Senatorial District, Russell Kokubun
- Ainaloa Community Association
- » Hawaiian Shores Community Association

- Hawaiian Paradise Park Association
- Leilani Estates Community Association
- Orchidland Community Association
- Hawaiian Acres Community Association
- Nanawale Community Association
- Malama O Puna
- Friends of Puna Future
- ʻŌlaʻa Community Center
- Church on a Sure Foundation
- Iglesia Ni Cristo
- Main Street Pāhoa Association

UTILITY COMPANIES

- Hawaiian Electric Light Company
» Hawaiian Telecom
- The Gas Company
- Oceanic Time Warner Cable

RETURNED TO SENDER AS UNDELIVERABLE

- Church of Jesus Christ of Latter Day Saints
- Neighborhood Place of Puna

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CHAPTER 8: LIST OF PREPARERS

This Draft Environmental Assessment Report has been prepared by SSFM International, Inc. 99 Aupuni Street, Suite 202, Hilo HI 96720.

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CHAPTER 9: REFERENCES

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