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November 28, 2006

TPD06-00591

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CITY CLERK
HONOLULU, HAWAII

The Honorable Donovan Dela Cruz, Chair
and Members of the City Council
Honolulu City Council
530 South King Street, Room 202
Honolulu, Hawaii 96813

Dear Chair Dela Cruz and Councilmembers:

Subject: Honolulu High-Capacity Transit Corridor Project

This transmits 15 copies of the Examination of Proposed Fixed Guideway Alignment Alternative (November 24, 2006), prepared for the Kapolei-Iwilei alignment described in Bill 79, (2006) CD1.

We are also transmitting three (3) copies of the Draft Model Honolulu High-Capacity Transit Corridor Project Alternatives Analysis/Draft Environmental Impact Statement/Section 4(f) Evaluation (November 14, 2006), which was requested by Council Vice-Chair Ann Kobayashi.

Should you have any questions regarding this matter, please contact Mr. Toru Hamayasu, at Local 8344.

Sincerely,

MELVIN N. KAKU
Director

Enclosures

APPROVED:

Wayne M. Hashiro, P.E.
Managing Director

Dept. Com. No. 0955
TP

Examination of Proposed Fixed Guideway Alignment Alternative

Background

Bill 79, CD1 identifies a Fixed Guideway Alignment Alternative not examined in the Alternatives Analysis Report. The alternative is described as:

> A fixed guideway system between Kapolei and Iwilei, starting at or near the intersection of Kapolei Parkway and Kalaeloa Boulevard until the Iwilei area at or near either Ka'aahi Street or the intersection of North King Street and Liliha Street, with an alignment comprised of various section alignments that will be designated by the council from among those evaluated in the AA. This alignment is generally described as the Kapolei–Iwilei alignment.

Since Bill 79, CD 1 does not specify the alignment by section, two options have been examined. The first would link the following series of alignments through the study corridor: Saratoga Avenue/North-South Road to Farrington Highway/Kamehameha Highway to Salt Lake Boulevard to North King Street, terminating at the N. King Street & Liliha Street Station. It is referred to herein as the Kapolei–Iwilei, via Salt Lake/North King alignment.

The second would link the following series of alignments through the study corridor: Saratoga Avenue/North-South Road to Farrington Highway/Kamehameha Highway to Aolele Street to Dillingham Boulevard, terminating at the Ka'aahi Station. It is referred to herein as the Kapolei–Iwilei, via Airport/Dillingham alignment.

Capital Cost Estimates

As shown below, the capital costs of implementing the Kapolei–Iwilei alignments would be approximately $3.3 billion and $3.4 billion in 2006 dollars, respectively. The Salt Lake/North King alignment is shorter in length, approximately 22 miles, and would cost less than the Airport/Dillingham alignment, which is approximately 23 miles in length. Both are less expensive than the 20-mile alignment because they would include at-grade sections through Kalaeloa which would be less expensive than the 20-mile alignment's elevated section from Downtown to Ala Moana Center.

Alignment	Major Investment Facility Capital Costs [1] (millions of 2006 dollars)
Kalaeloa – Salt Lake – North King – Hotel	4,730
Kamokila – Airport – Dillingham – King with a Waikīkī Branch	5,510
Kalaeloa – Airport – Dillingham – Halekauwila	4,620
20-mile Alignment East Kapolei to Ala Moana Center	3,600
Kapolei – Iwilei via Salt Lake/North King	**3,280**
Kapolei – Iwilei via Airport/Dillingham	**3,420**

[1] Finance charges are not included.

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Transit Vehicle Requirements

As shown below, both Kapolei–Iwilei alignments would require more buses than any of the other Fixed Guideway alignments. This is because the alignments terminate 'Ewa of Downtown Honolulu so most transit patrons destined for Downtown Honolulu or points further than Koko Head would need to transfer to a bus to complete their journey. Because many of the bus routes available for these transfers would be loaded with bus-only patrons, additional bus trips would need to be added.

Alignment	Bus	Fixed Guideway
Kalaeloa – Salt Lake – North King – Hotel	529	90
Kamokila – Airport – Dillingham – King with a Waikīkī Branch	522	90
Kalaeloa – Airport – Dillingham – Halekauwila	540	90
20-mile Alignment East Kapolei to Ala Moana Center	596	70
Kapolei – Iwilei via Salt Lake/North King	**635**	**76**
Kapolei – Iwilei via Airport/Dillingham	**604**	**78**

Estimated Year 2030 Annual Transit Operating and Maintenance Costs

As shown below, both Kapolei–Iwilei alignments would have higher transit O&M costs, in year 2030, than any of the other Fixed Guideway alignments. This is because of higher bus O&M costs due to the need for additional bus service, described above.

Alignment	Bus O&M Cost	Fixed Guideway O&M Cost	Total O&M Cost[1]
	(millions of 2006 dollars)		
Kalaeloa – Salt Lake – North King – Hotel	169.3	78.9	248.2
Kamokila – Airport – Dillingham – King with a Waikīkī Branch	168.7	79.9	248.6
Kalaeloa – Airport – Dillingham – Halekauwila	173.0	83.1	256.1
20-mile Alignment East Kapolei to Ala Moana Center	189.2	61.4	250.6
Kapolei – Iwilei via Salt Lake/North King	**202.2**	**62.4**	**264.6**
Kapolei – Iwilei via Airport/Dillingham	**195.7**	**65.8**	**261.5**

[1] Handi-Van O&M costs are not included.

Estimated Year 2030 Daily Transit Ridership

As shown below, both Kapolei–Iwilei alignments would have fewer transit trips, on fixed guideway and in total, than any of the other Fixed Guideway alignment. This is due to the need for most transit patrons destined for Downtown Honolulu or points further than Koko Head to transfer to a bus, entailing additional travel time and inconvenience, to complete their journey.

Alignment	Fixed Guideway Trips	Total Transit Trips	Total Transit Boardings
Kalaeloa – Salt Lake – North King – Hotel	128,500	293,600	468,800
Kamokila – Airport – Dillingham – King with a Waikīkī Branch	122,500	287,800	449,300
Kalaeloa – Airport – Dillingham – Halekauwila	123,700	294,100	468,300
20-mile Alignment East Kapolei to Ala Moana Center	95,000	281,900	455,300
Kapolei – Iwilei via Salt Lake/North King	**77,700**	**276,400**	**441,100**
Kapolei – Iwilei via Airport/Dillingham	**78,300**	**277,200**	**440,000**

FTA Cost-Effectiveness Calculations – Transportation System Costs and Transit User Benefits Compared to TSM

As shown below, both Kapolei–Iwilei alignments would be less cost-effective compared to the TSM Alternative, i.e. higher cost per user benefit, than all but one other Fixed Guideway alignment. Cost-Effectiveness values compared to the TSM Alternative is one of the criteria used by FTA in evaluating projects seeking New Starts funds (FTA measures cost-effectiveness of the proposed New Start project against a "Baseline" alternative which is typically similar to or identical to the TSM Alternative examined in Alternatives Analysis). Any proposed New Start project receiving a "Medium-Low" or "Low" rating for cost-effectiveness will not be recommended for funding by FTA. Thus neither Kapolei–Iwilei alignment nor the Kamokila – Airport – Dillingham – King with a Waikīkī Branch Full-corridor Alignment would receive FTA's recommendation.

Measure	TSM Alternative	Kalaeloa - Salt Lake - North King - Hotel		Kamokila - Airport - Dillingham - King with a Waikīkī Branch		Kalaeloa - Airport - Dillingham - Halekauwila		20-mile Alignment East Kapolei to Ala Moana Center		Kapolei – Iwilei via Salt Lake/ North King		Kapolei – Iwilei via Airport/ Dillingham	
		Value	Incremental Change	Value	Incremental Change	Value	Incremental Change	Value	Incremental Change	Value	Incremental Change	Value	Incremental Change
Annualized Capital Cost (Millions of 2006 Dollars)	$59.80	$387.31	$327.52	$445.73	$385.94	$380.66	$320.86	$308.23	$248.43	$287.91	$228.11	$296.16	$236.36
Year 2030 Systemwide O&M Cost (Millions of 2006 Dollars)	$234.20	$248.20	$14.00	$248.60	$14.40	$256.10	$21.90	$250.60	$16.40	$264.60	$30.40	$261.50	$27.30
Total 2030 Annualized Cost (Millions of 2006 Dollars)	$294.00	$635.51	$341.52	$694.33	$400.34	$636.76	$342.76	$558.83	$264.83	$552.51	$258.51	$557.66	$263.66
Year 2030 Incremental User Benefits (Hours of Benefit)	N/A	N/A	15,633,300	N/A	13,723,300	N/A	15,504,500	N/A	11,638,500	N/A	9,834,200	N/A	10,107,500
Cost-Effectiveness (Cost per User Benefit)	N/A	N/A	$21.85	N/A	$29.17	N/A	$22.11	N/A	$22.75	N/A	$26.29	N/A	$26.09
FTA Cost-Effectiveness Rating	N/A	N/A	Medium	N/A	Low [1]	N/A	Medium	N/A	Medium	N/A	Medium–Low [1]	N/A	Medium–Low [1]

N/A = Not Applicable. Transit user benefits are calculated relative to the performance of the TSM Alternative.

[1] Any proposed New Start project receiving a "Medium-Low" or "Low" rating for cost-effectiveness will not be recommended for funding by FTA.

Conclusion

While both the Kapolei–Iwilei, via Salt Lake/North King alignment and the Kapolei–Iwilei, via Airport/Dillingham alignment would have lower initial project implementation costs than the 20-mile Alignment East Kapolei to Ala Moana Center, both would have higher ongoing O&M costs and neither would attract as many transit riders. Neither Kapolei–Iwilei alignment would meet FTA's under-$23 threshold for receiving a necessary "Medium" or better cost-effectiveness rating. For these reasons, the East Kapolei to Ala Moana Center 20-mile Alignment remains the optimum lesser-cost Fixed Guideway alternative.

Draft Model
Honolulu High-Capacity Transit Corridor Project Alternatives Analysis / Draft Environmental Impact Statement / Section 4(f) Evaluation

This model document was produced outside of the NEPA and Chapter 343 processes; therefore, it is not intended as the official document that meets the requirements for environmental approval

November 14, 2006

Prepared for:
City and County of Honolulu

Prepared by:
Parsons Brinckerhoff

ENCL TO D 0955

Honolulu High-Capacity Transit Corridor Project

City and County of Honolulu, Oahu, Hawaii

Alternatives Analysis/Draft Environmental Impact Statement/Section 4(f) Evaluation

Submitted pursuant to Section 42 U.S.C. 4332 (2) (c), 49 U.S.C 1601 eq. seq., 23 C.F.R. Part 771 and Chapter 343 Hawaii Revised Statutes.

by the

U.S. Department of Transportation, Federal Transit Administration
and the City and County of Honolulu

in cooperation with the

U.S. Department of Transportation, Federal Highway Administration
and State of Hawaii Department of Transportation

(Date of Approval)

Director, Department of Transportation Services
City and County of Honolulu

(Date of Approval)

Regional Administrator
U.S. Department of Transportation,
Federal Transit Administration

The following persons may be contacted for additional information concerning this document:

In compliance with the National Environmental Policy Act (NEPA), this Alternatives Analysis (AA)/Draft Environmental Impact Statement (DEIS)/Section 4(f) Evaluation describes the alternatives evaluated, transportation effects, environmental consequences, and financial implications of the construction and operation of a high-capacity transit system on the Island of Oahu.

Copies of this document may be purchased for $XX, which does not exceed the cost of reproduction. Comments are requested by XXXX, 2007 and should be returned to:

Context of the Alternatives Analysis/Draft Environmental Impact Statement

This Alternatives Analysis/Draft Environmental Impact Statement (AA/DEIS) supports the selection of a locally preferred transit alternative for the City and County of Honolulu consistent with the planning and project development process defined by the U.S. Department of Transportation Federal Transit Administration (FTA). The first step of the process was systems planning, which culminated with the O'ahu Metropolitan Planning Organization (OMPO) including a fixed guideway transit system in the *2030 O'ahu Regional Transportation Plan* (OMPO, 2006a).

The Honolulu City Council will select a locally preferred alternative (LPA) based on the findings of this AA/DEIS. Subsequently, design options within the LPA will be evaluated and a Final Environmental Impact Statement (EIS) will be prepared according to the National Environmental Policy Act (NEPA) as part of the Preliminary Engineering phase. Final Design, construction, and operation of the LPA will follow.

Purpose of the Alternatives Analysis/Draft Environmental Impact Statement

The purpose of this report is to provide the Honolulu City Council with the information necessary to select a mode and general alignment alternative for high-capacity transit service on O'ahu. The primary project study area is the travel corridor between Kapolei and the University of Hawai'i at Mānoa. The report summarizes the results of an AA that followed FTA planning guidance and provides information on the costs, benefits, and impacts of four alternatives:

- No Build Alternative
- Transportation System Management Alternative
- Managed Lane Alternative
- Fixed Guideway Alternative.

The goal of the AA process is to reach a broad consensus regarding which alternative best meets the goals and objectives for the study corridor. The analysis in the AA is defined by the need to make an intelligent selection of a preferred mode and general alignment. After public release of this report, the City Council will conduct public hearings to solicit community views on the evaluated alternatives. Considering both the technical information provided in the AA and the comments from the public, the Council will select an LPA to provide improved transit service in the study corridor. After selection of the LPA, the City and County of Honolulu Department of Transportation Services (DTS) will apply to FTA for permission to begin Preliminary Engineering.

Organization of the Alternatives Analysis/Draft Environmental Impact Statement

This report is organized into a summary followed by seven chapters. Chapter 1 provides the context for the study, including a description of the corridor and the existing transportation system, planned growth and improvements in the corridor, and the need for an improved transit system, and a definition of the purpose of the alternatives evaluated. Chapter 2 describes the alternatives being evaluated and how they were selected through both technical review and public comment.

Chapters 3 through 5 evaluate the technical merits and consequences of the alternatives. Chapter 3 presents the effects that the alternatives would have on the transportation system. The physical and social environment that would be affected by the alternatives and the effects on that environment are described in Chapter 4. Chapter 5 presents the financial evaluation of the alternatives, including their costs and how their implementation and long-term operation would be funded.

Chapter 6 summarizes all of the technical findings and describes how each alternative would meet the goals and objectives established for the project. It also compares the trade-offs among the alternatives. The final chapter, Chapter 7, describes the public involvement and agency coordination that has been conducted to include the concerns of affected parties in the planning process.

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Acronyms Used in this Document

AA	Alternatives Analysis
ADA	Americans with Disabilities Act
BMPs	Best Management Practices
BRT	Bus Rapid Transit
CO	Carbon Monoxide
dBA	A-weighted Decibels
DTS	Department of Transportation Services
EIS	Environmental Impact Statement
EJ	Environmental Justice
FTA	Federal Transit Administration
FY	Fiscal Year
GET	General Excise and Use Tax
GO	General Obligation
HDOH	Hawai'i Department of Health
HDOT	Hawai'i Department of Transportation
L_{dn}	Day/Night Sound Level
L_{eq}	Equivalent Sound Level
LOS	Level-of-Service
LOTMA	Leeward O'ahu Transportation Management Association
LPA	Locally Preferred Alternative
LRT	Light Rail Transit
MAGLEV	Magnetic Levitation
NAC	Noise Abatement Criteria
NEPA	National Environmental Policy Act
O&M	Operation and Maintenance
NO_x	Nitrogen Oxides
OR&L	O'ahu Railway and Land
OMPO	O'ahu Metropolitan Planning Organization
ORTP	O'ahu Regional Transportation Plan
OTS	O'ahu Transit Services, Inc.
PE	Preliminary Engineering
PEEP	Preliminary Engineering and Evaluation Program
PM	Particulate Matter
PUC	Primary Urban Center
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act
SCC	Standard Cost Categories
SHPD	State Historic Preservation Division
SOBA	Southern O'ahu Basal Aquifer
TAA	Transportation Analysis Area
TDM	Transportation Demand Management
TSM	Transportation System Management
UH	University of Hawai'i
UMTA	Urban Mass Transportation Administration
USC	United States Code
V/C	Volume-to-Capacity Ratio

Acronyms Used in this Document (continued)

VdB	Vibration Decibels
VHD	Vehicle Hours of Delay
VOC	Volatile Organic Compounds
YOE	Year of Expenditure

Summary

The City and County of Honolulu Department of Transportation Services (DTS), in coordination with the U.S. Department of Transportation Federal Transit Administration (FTA), has carried out an Alternatives Analysis (AA) to evaluate alternatives that would provide high-capacity transit service on O'ahu. The primary project study area is the travel corridor between Kapolei and the University of Hawai'i at Mānoa (UH Mānoa) (Figure S-1). This corridor includes the majority of housing and employment on O'ahu. The east-west length of the corridor is approximately 23 miles. The north-south width of the corridor is at most four miles, as much of the corridor is bounded by the Ko'olau and Wai'anae Mountain Ranges to the north and the Pacific Ocean to the south.

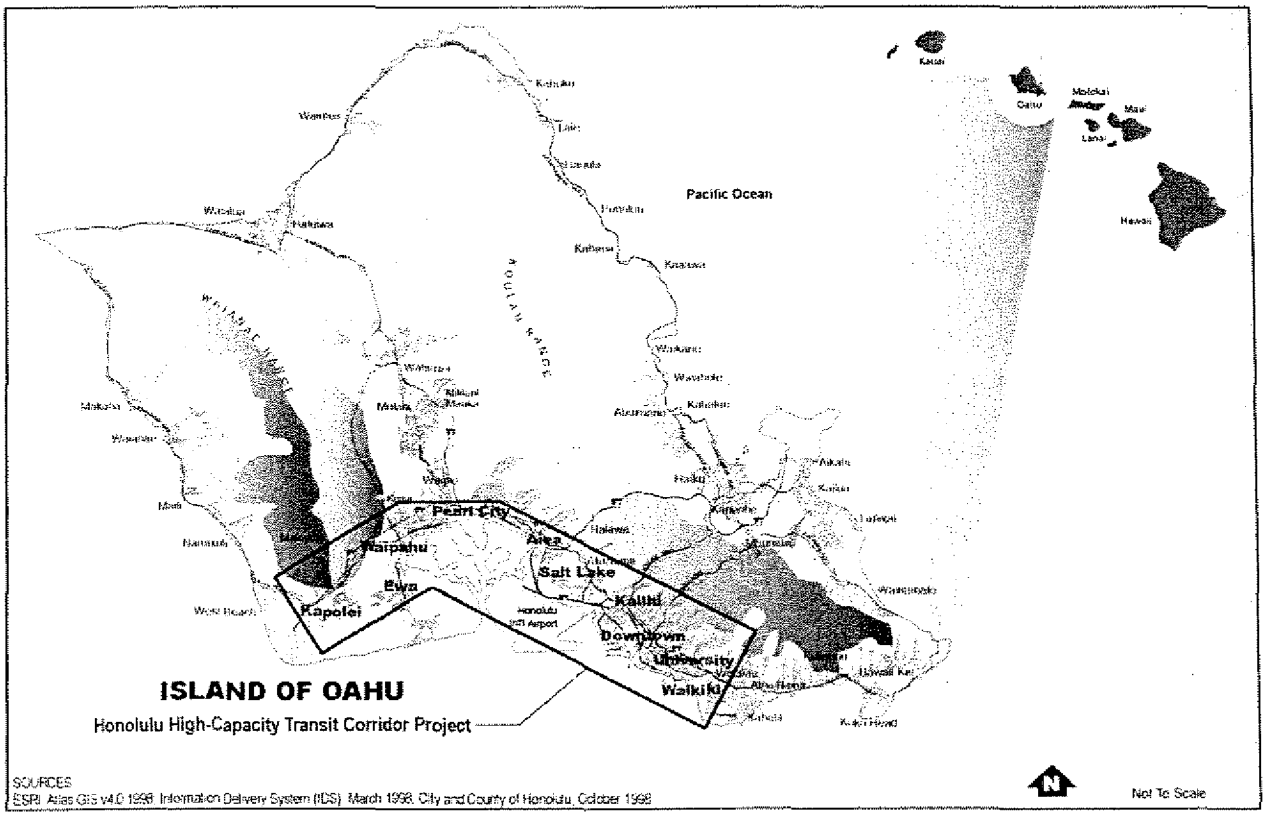

Figure S-1. Project Vicinity

Purpose of and Need for Transportation Improvements

The purpose of the Honolulu High-Capacity Transit Corridor Project is to provide improved mobility for persons traveling in the highly congested east-west transportation corridor between Kapolei and UH Mānoa. System planning for the corridor culminated in the *2030 O'ahu Regional Transportation Plan* (OMPO, 2006a).

The O'ahu Metropolitan Planning Organization (OMPO) concluded that the existing transportation infrastructure in this corridor is overburdened handling current levels of travel demand. Motorists experience substantial traffic congestion and delay at most times of the day during both the weekdays and weekends. Currently, transit is caught in the same congestion. As roadways become more congested, they become more susceptible to substantial delays caused by incidents such as traffic accidents or heavy rain. Current travel times are not reliable for either transit or automobile trips.

The highest population growth rates for the island, consistent with the General Plan for the City and County of Honolulu, are projected in the 'Ewa Development Plan area. Many lower-income and minority workers live in the corridor outside of the urban core and commute to work in the Primary Urban Center Development Plan area. Many lower-income workers also rely on transit because of its affordability.

Alternatives Considered

Four alternatives are evaluated in this report. They were developed through a screening process that considered alternatives identified through previous transit studies, a field review of the study corridor, an analysis of current population and employment data for the corridor, a literature review of technology modes, work completed by the O'ahu Metropolitan Planning Organization (OMPO) for its *2030 O'ahu Regional Transportation Plan (OMPO, 2006a)*, and public and agency comments received during a formal project scoping process. The four alternatives are described in detail in the *Honolulu High-Capacity Transit Corridor Project Alternatives Analysis Detailed Definition of Alternatives (DTS, 2006a)*. The alternatives evaluated are as follows:

- No Build Alternative
- Transportation System Management Alternative
- Managed Lane Alternative
- Fixed Guideway Alternative.

Two operational options were studied for the Managed Lane Alternative. Several alignments were studied for the Fixed Guideway Alternative, including a shorter 20-mile Alignment.

Transportation Impacts and Benefits

In the year 2030, the only alternative that is expected to significantly affect transit mode share and attract additional transit riders is the Fixed Guideway Alternative. Many Fixed Guideway alignment options were evaluated and the Kalaeloa - Airport - Dillingham - Halekauwila alignment combination is projected to attract the highest number of daily transit trips systemwide.

In regards to serving existing and future transit markets, the Fixed Guideway Alternative does the best job in accommodating both longer corridor transit trips, as well as the increase in work commute trips to West O'ahu, which is expected to become much more pronounced in the future. Two operational concepts for the Managed Lane Alternative were evaluated, and the Two-direction Option best serves the increase in work commute trips to West O'ahu.

The Fixed Guideway Alternative most consistently results in improved transit travel times between key corridor origins and destinations. In many cases these travel times are equivalent to, or faster than, the same trip time made by private vehicle under No Build conditions, especially when considering the use of park-and-ride trips. The Fixed Guideway Alternative would produce the most reliable travel times because the vehicles would operate in their own right-of-way separate from roadways and associated congestion. The Managed Lane Alternative would provide some travel time improvements between selected origins and destinations that are well served by the facility, but in many cases the travel time savings experienced is offset by the increased congestion experienced before entering and upon exiting the facility.

Traffic congestion on key corridor facilities is expected to continue to exist under all alternatives, particularly during peak travel periods. Systemwide vehicle hours of delay (VHD) are projected to be substantially lower for the Fixed Guideway Alternative as compared to all other alternatives. While all other alternatives have a minimal to negligible impact on peak-period traffic volumes in the corridor (in fact, the Managed Lane options are expected to increase vehicle peak-hour volumes in the corridor), the Fixed Guideway Alternative is projected to reduce peak traffic volumes that cross Kalauao Stream and Kapālama Canal by three to seven percent. Most importantly, however, the Fixed Guideway Alternative would provide a mobility option that the other alternatives do not. It gives users the opportunity to bypass the congestion that will occur on roadways throughout the study corridor.

Environmental Impacts and Benefits

The No Build and TSM Alternatives would generate minimal environmental impacts; however, they also would not generate environmental benefits.

The Managed Lane Alternative would require a moderate number of displacements and would affect a moderate number of potentially historic structures and one recreational facility. It would generate the greatest amount of air pollution, require the greatest amount of energy for transportation use, and would result in the largest number of transportation noise impacts. It would provide little community benefit, as it would not provide substantially improved transit access to the corridor.

Compared to the other alternatives, the Fixed Guideway Alternative would require more acquisitions and affect more potentially historic structures, as well as three park or recreational facilities. It would result in fewer transportation noise impacts than the Managed Lane Alternative.

Visual impacts for the Fixed Guideway Alternative would be less than those for the Managed Lane Alternative in areas where both alternatives would include structures, but the Fixed Guideway Alternative would extend beyond the area of the Managed Lane Alternative. The visual impacts of the 20-mile Alignment would be less than that for the 28-mile Full-corridor Alignment because the area of effect would be less.

The Fixed Guideway Alternative would generate the least air pollution and require the least energy for transportation. It would provide improved connections between communities, employment, and services in the corridor. The benefits of the Full-corridor Alignment would be somewhat greater than those for the 20-mile Alignment.

Financial Feasibility

Capital Costs

Capital costs for the No Build and TSM Alternatives would be $660 and $856 million, respectively, which accounts for bus replacement and system expansion. Total capital costs for the Managed Lane Alternative would range between $3.6 and $4.7 billion, of which $2.6 to $3.8 billion would be for construction of the managed lanes. Capital costs for the Fixed Guideway Alternative, including bus system costs, would range between $5.2 and $6.1 billion for the Full-corridor Alignments, of which $4.6 to $5.5 billion would be for the fixed guideway system. The costs would be $4.2 billion for the 20-mile Alignment, of which $3.6 billion would be for the fixed guideway system.

Operating and Maintenance Costs

Operating costs in 2030 for the No Build Alternative, in 2006 dollars, would be approximately $192 million. Operating costs for the TSM Alternative would be approximately $42 million greater than for the No Build Alternative. Transit operating costs for the Managed Lane Alternative would range between approximately $251 and $261 million as a result of additional buses that would be put in service under that alternative. These costs do not include the cost of maintaining the managed lane facility. The total operating costs for the Fixed Guideway Alternative, including the bus and fixed guideway, would range between approximately $248 and $256 million.

Funding Options

Funding sources for capital investments include a State General Excise and Use Tax (GET) surcharge, City general obligation bonds, and FTA funds. Only the Fixed Guideway Alternative could be funded with the GET surcharge. The No Build and TSM Alternatives are a continuation of existing bus services and system costs reflect ongoing operations with current funding sources.

With the Managed Lane Alternative, toll revenues would pay for ongoing operation and maintenance; remaining revenues would be used to contribute to repaying debt incurred to construct the system. Projections identify a funding deficit of $2.3 billion in 2006 dollars. Other funding sources would need to be identified to provide the remaining funding. Toll revenues would pay for less than one-quarter of debt service; other city funds would be needed for the remaining three-quarters.

For the Fixed Guideway Alternative, the GET surcharge is expected to yield between $2.6 and $3.2 billion in 2006 dollars. The 20-mile Alignment would require between $0.7 and $1.2 billion in 2006 dollars in funds from FTA New Starts or other sources. The Full-corridor Alignment would require between $1.7 and $2.2 billion in 2006 dollars in funds from FTA New Starts or other sources.

Evaluation of Alternatives

The alternatives were compared regarding their ability to improve corridor mobility, support smart growth and economic development, provide a cost-effective and equitable transportation solution, be constructible, minimize community and environmental impacts, and be consistent with other planning efforts.

The relative merits of two operational options were evaluated for the Managed Lane Alternative, and one was determined to be more effective than the other. Similarly, the Fixed Guideway Alternatives were evaluated and an optimal option of the alignments was selected. Because the performance differences between the two Managed Lane options would be small, the less costly Reversible Option would offer a better benefit-to-cost ratio; therefore, it would be the best option for the Managed Lane Alternative. The Kalaeloa - Airport - Dillingham - Halekauwila combination is the optimal Fixed Guideway alignment for the entire corridor. A 20-mile portion of that alignment from East Kapolei to Ala Moana Center provides a lower-cost option within the Fixed Guideway Alternative.

The Fixed Guideway Alternative performs the best when considering the goal of improving corridor mobility. The Full-corridor Alignment provides greater transportation benefits than the 20-mile Alignment. Although less effective than the full-corridor system, the 20-mile Alignment is still more effective at providing improved mobility than any of the other three alternatives.

In relation to encouraging patterns of smart growth and economic development, the No Build, TSM, and Managed Lane Alternatives generally maintain existing transit service patterns and methods. None of these alternatives would provide a high level of transit service that would serve as a nucleus for transit-oriented development. The Fixed Guideway Alternative would include new stations providing reliable high-capacity transit at locations zoned for new development or suitable for redevelopment. The Full-corridor Alignment would provide the greatest opportunity for smart growth, but considerable opportunities also would occur with the 20-mile Alignment.

The Fixed Guideway Alternative is substantially more cost-effective than the Managed Lane Alternative when the respective transit user benefits per dollar of cost relative to the TSM Alternative are compared.

The Fixed Guideway Alternative best meets the goal of providing equitable solutions. The Full-corridor Alignment would best serve transit-dependent populations, but the 20-mile Alignment would serve the majority of those served by the Full-corridor Alignment.

The No Build and Fixed Guideway Alternatives are financially feasible considering reasonably certain funding sources. The No Build Alternative would continue bus service using existing funding sources. The TSM Alternative would require a limited amount of additional funds, which could be from existing funding sources. Because the implementing legislation prohibits the GET surcharge from being used to fund existing transit systems, it would not be available to fund the TSM Alternative. The Managed

Lane Alternative has no defined funding source. Because it would be open to general purpose vehicles, including single-occupancy vehicles (cars carrying only the driver), neither the GET surcharge nor FTA funds could be used for its construction. The 20-mile Alignment for the Fixed Guideway Alternative could be funded with a combination of expected GET revenues and FTA New Starts funds. There is more uncertainty in funding of the Full-corridor Alignment. Either a larger share of FTA funds would be needed or other sources would need to be tapped.

The alternatives range widely in relation to community and environmental impacts. The No Build and TSM Alternatives would have little direct effect on existing resources; however, they also would not offer community or environmental benefits. The Managed Lane Alternative would require acquisition of private property, generate the highest levels of air and water pollution, consume the greatest amount of energy for transportation uses, and create the greatest number of noise impacts. The Fixed Guideway Alternative would require the greatest number or property acquisitions and have the greatest number of utility conflicts during construction, but it would also provide a new safe transportation connection between communities in the corridor. It would provide the greatest environmental benefits related to air and water pollution and energy consumption.

All alternatives are generally consistent with Local, District, and State plans. The Fixed Guideway Alternative best serves the areas of O'ahu that are designated for future growth and development. The Fixed Guideway Alternative is the only alternative that is consistent with regional transportation system planning defined in the *2030 O'ahu Regional Transportation Plan* (OMPO, 2006a).

Residents' Alternatives Preferences

The residents of Honolulu are very concerned about transportation. In the *Honolulu Advertiser* Hawai'i Poll conducted in June 2006, traffic was identified by most respondents as the most important issue currently facing Hawai'i (*Honolulu Advertiser*, 2006). While preparing the *2030 O'ahu Regional Transportation Plan*, OMPO conducted a telephone survey of O'ahu residents to gauge public reaction to transportation solutions (OMPO, 2006b). More than 50 percent of the respondents said that they would use rapid transit regularly or occasionally.

Scoping conducted for the Honolulu High-Capacity Transit Corridor Project also indicated broad interest and a majority of support for transportation improvements in the corridor. The majority of comments received during scoping related to a preference for one of the alternatives or a proposed modification to one of the alternatives. As a result of public comments, moderating the growth in traffic congestion was added to the purpose and need, a second Managed Lane option was added, and the presentation of the Fixed Guideway Alternative was changed. There continues to be both organized support for and opposition to the Managed Lane and Fixed Guideway Alternatives.

Issues to be Resolved

This AA/DEIS supports the selection of an LPA by the Honolulu City Council. Subsequently, a Final Environmental Impact Statement (EIS) will be prepared and preliminary engineering will be completed for the selected alternative. While the AA defines the alternatives under consideration, many issues have to be resolved, beginning with selection of the LPA. Many of the other issues will be resolved as the project is refined during the environmental and preliminary engineering phases. The following outstanding issues have been identified:

- Selection of mode, alignment, and limits (this will be defined in selection of the Locally Preferred Alternative)
- Selection of transit technology for the Fixed Guideway Alternative (if selected)
- Development of a financial plan to provide project funding
- Opportunities for public-private partnership to enhance the project that can be delivered with limited public funds
- Environmental commitments.

Substantive Comments Received During Scoping

The *Honolulu High-Capacity Transit Corridor Project Scoping Report (*DTS, 2006d) is incorporated into this AA/DEIS by reference. All substantive comments received during scoping are included in that report.

Purpose of the Project

The purpose of the Honolulu High-Capacity Transit Corridor Project is to provide improved mobility for persons traveling in the highly congested east-west transportation corridor between Kapolei and UH Mānoa, confined by the Wai'anae and Ko'olau Mountain Ranges to the north and the Pacific Ocean to the south. The project would provide faster, more reliable public transportation services in the corridor than those currently operating in mixed-flow traffic. The project would also provide an alternative to private automobile travel and improve linkages between Kapolei, the urban core, UH Mānoa, Waikīkī, and urban areas in between. Implementation of the project, in conjunction with other improvements included in the 2030 O'ahu Regional Transportation Plan (ORTP), would moderate anticipated traffic congestion in the corridor. The project also supports the goals of the O'ahu General Plan and the ORTP by serving areas designated for urban growth.

Need for Transportation Improvements

Improved mobility for travelers facing increasingly severe traffic congestion.

The existing transportation infrastructure in the corridor between Kapolei and UH Mānoa is overburdened handling current levels of travel demand. Motorists experience substantial traffic congestion and delay at most times of the day during both the weekdays and weekends. Average weekday peak-period speeds on the H-1 Freeway are currently less than 20 mph in many places and will degrade even further by 2030. Transit vehicles are caught in the same congestion. Travelers on O'ahu's roadways currently experience 51,000 vehicle hours of delay, a measure of how much time is lost daily by travelers stuck in traffic, on a typical weekday. This is projected to increase to more than 71,000 daily vehicle hours of delay by 2030, assuming implementation of all of the planned improvements listed in the ORTP (except for a fixed guideway system). Without these improvements, the ORTP indicates that daily vehicle-hours of delay could increase to as much as 326,000 vehicle hours.

Current a.m. peak-period travel times for motorists from West O'ahu to Downtown average between 45 and 81 minutes. By 2030, after including all of the planned roadway improvements in the ORTP, this travel time is projected to increase to between 53 and 83 minutes. Average bus speeds in the system have been decreasing steadily as congestion has increased. Currently, express bus travel times from 'Ewa Beach to Downtown range from 45 to 76 minutes and local bus travel times from 'Ewa Beach to Downtown range from 65 to 110 minutes during the peak period. By 2030, these travel times are projected to increase by 20 percent on an average weekday. Within the urban core, most major arterial streets will experience increasing peak-period congestion, including Ala Moana Boulevard, Dillingham Boulevard, Kalākaua Avenue, Kapi'olani Boulevard, King Street, and Nimitz Highway. Expansion of the roadway system between Kapolei and UH Mānoa is constrained by physical barriers and by dense urban neighborhoods that abut many existing roadways. Given the current and increasing levels of congestion, a need exists to offer an alternative way to travel within the corridor independent of current and projected highway congestion.

Improved transportation system reliability.

As roadways become more congested, they become more susceptible to substantial delays caused by incidents, such as traffic accidents or heavy rain. Even a single driver unexpectedly braking can have a ripple effect delaying hundreds of cars. Because of the operating conditions in the study corridor, current travel times are not reliable for either transit or automobile trips. To get to their destination on time, travelers must allow extra time in their schedules to account for the uncertainty of travel time. This is inefficient and results in lost productivity. Because the bus system primarily operates in mixed-traffic, transit users experience the same level of travel time uncertainty as automobile users. A need exists to reduce transit travel times and provide a more reliable transit system.

Accessibility to new development in ʻEwa/Kapolei/Makakilo as a way of supporting policy to develop the area as a second urban center.

Consistent with the General Plan for the City and County of Honolulu, the highest population growth rates for the island are projected in the ʻEwa Development Plan area (comprised of the ʻEwa, Kapolei and Makakilo communities), which is expected to grow by 170 percent between 2000 and 2030. This growth represents nearly 50 percent of the total growth projected for the entire island. The Waiʻanae, Wahiawā, North Shore, Windward, Waimānalo, and East Honolulu areas will have population growth of between zero and 16 percent because of this policy. This keeps the country country. Kapolei, which is developing as a "second city" to Downtown Honolulu, is projected to grow by nearly 600 percent to 81,100 people, the ʻEwa neighborhood by 100 percent, and Makakilo by 125 percent between 2000 and 2030. Accessibility to the overall ʻEwa Development Plan area is currently severely impaired by the congested roadway network, which will only get worse in the future. This area is less likely to develop as planned unless it is accessible to Downtown and other parts of Oʻahu; therefore, the ʻEwa, Kapolei, and Makakilo area needs improved accessibility to support its future growth as planned.

Improved transportation equity for all travelers.

Many lower-income and minority workers live in the corridor outside of the urban core and commute to work in the Primary Urban Center Development Plan area. Many lower-income workers also rely on transit because of its affordability. In addition, daily parking costs in Downtown Honolulu are among the highest in the United States (Colliers, 2005), further limiting this population's access to Downtown. Improvements to transit capacity and reliability will serve all transportation system users, including low-income and under-represented populations.

Description of the Corridor

The study corridor extends from Kapolei in the west (Waiʻanae or ʻEwa direction) to the University of Hawaiʻi at Mānoa (UH Mānoa) in the east (Koko Head direction), and is confined by the Wai'anae and Ko'olau Mountain Ranges to the north (mauka direction) and the Pacific Ocean to the south (makai direction). Between Pearl City and 'Aiea, the corridor's width is less than one mile between the Pacific Ocean and the base of the Ko'olau Mountains.

The General Plan for the City and County of Honolulu directs future population and employment growth to the 'Ewa and Primary Urban Center Development Plan areas and the Central O'ahu Sustainable Communities Plan area. The largest increases in population and employment are projected in the 'Ewa, Waipahu, Downtown, and Kaka'ako districts, which are all located in the corridor (Figure 1-1). Major activity centers in the corridor are shown in Figure 1-2.

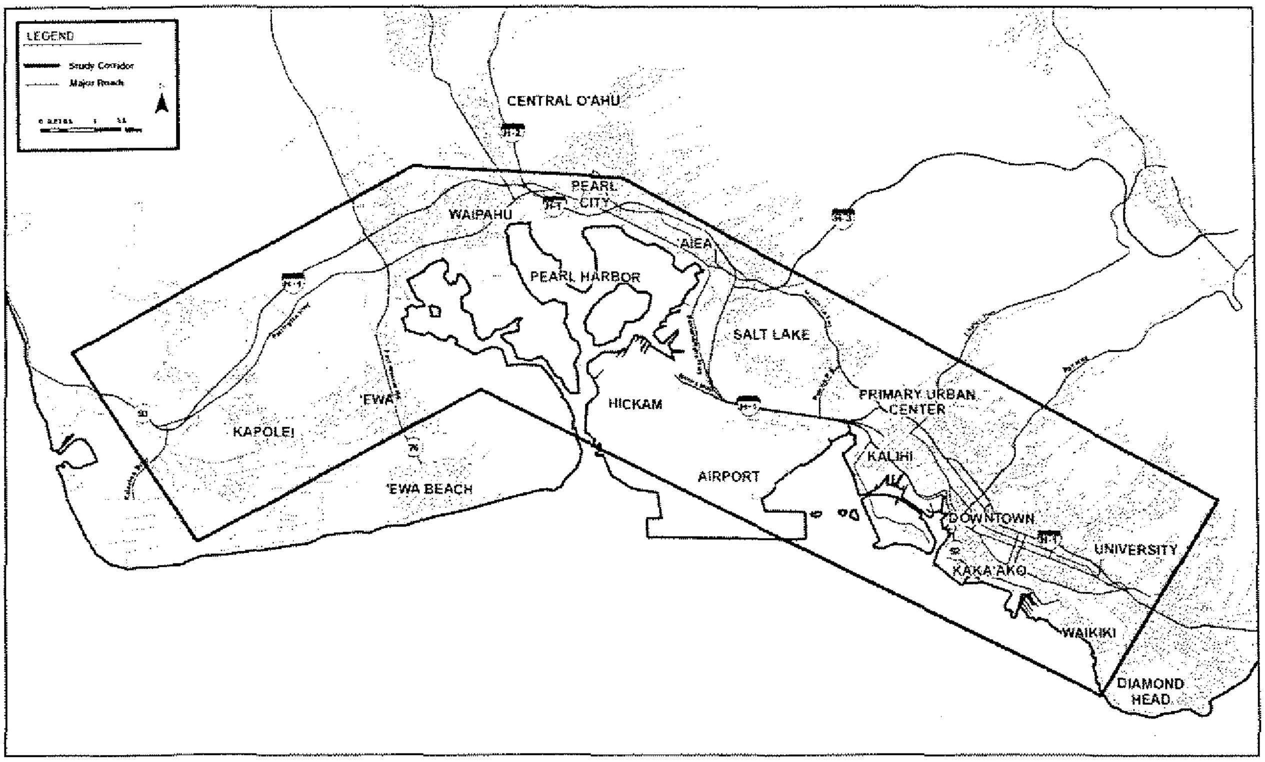

Figure 1-1. Areas and Districts in the Study Corridor

Currently, 63 percent of the population of 876,200 and 81 percent of the employment of 499,300 on O'ahu are located within the study corridor. By 2030 this distribution will increase to 69 percent of the population and 84 percent of the employment as development continues to be concentrated into the Primary Urban Center (PUC) and 'Ewa Development Plan areas. These trends are shown in two figures, Figure 1-3 and Figure 1-4, which illustrate existing and year 2030 projected population of 1,117,300 and employment of 632,900, respectively, by transportation analysis area.

Kapolei is the center of the 'Ewa Development Plan area and has been designated O'ahu's "second city." City and State government offices have opened in Kapolei and the University of Hawai'i is developing a master plan for a new West O'ahu campus there. The Kalaeloa Community Development District (formerly known as Barbers Point

Naval Air Station) covers 3,700 acres adjacent to Kapolei and is planned for redevelopment. The Department of Hawaiian Home Lands is also a major landowner in the area and has plans for residential and retail development. In addition, developers have several proposals to continue the construction of residential subdivisions.

Continuing Koko Head, the corridor follows Farrington and Kamehameha Highways through a mixture of low-density commercial and residential development. This part of the corridor passes through the makai portion of the Central O'ahu Sustainable Communities Plan area.

Farther Koko Head, the corridor enters the Primary Urban Center Development Plan area, which is bounded by commercial and residential densities that begin to increase in the vicinity of Aloha Stadium. The Pearl Harbor Naval Reserve, Hickam Air Force Base, and Honolulu International Airport border the corridor on the makai side. Military and civilian housing are the dominant land uses mauka of Interstate Route H-1 (the H-1 Freeway), with a concentration of high-density housing along Salt Lake Boulevard.

As the corridor continues Koko Head across Moanalua Stream, the land use becomes increasingly dense. Industrial and port land uses dominate along the harbor, shifting to primarily commercial uses along Dillingham Boulevard, a mixture of residential and commercial uses along North King Street, and primarily residential use mauka of the H-1 Freeway.

Koko Head of Nu'uanu Stream, the corridor continues through Chinatown and Downtown. The Chinatown and Downtown areas, with 62,300 jobs, have the highest employment density in the corridor. The Kaka'ako and Ala Moana neighborhoods, comprised historically of low-rise industrial and commercial uses, are being revitalized with several high-rise residential towers currently under construction. Ala Moana Center, both a major transit hub and shopping destination, is served by more than 2,000 weekday bus trips and visited by more than 56 million shoppers annually.

The corridor continues to Waikīkī and through the McCully neighborhood to the University of Hawai'i. Today, Waikīkī has more than 20,000 residents and provides more than 44,000 jobs. It is one of the densest tourist areas in the world, serving approximately 72,000 visitors daily (DBEDT, 2003). UH Mānoa is the other major destination at the Koko Head end of the corridor. It has an enrollment of more than 20,000 students and approximately 6,000 staff (UH, 2005). Approximately 60 percent of students do not live within walking distance of campus (UH, 2002) and must travel by vehicle or transit to attend classes.

Travel Patterns in the Corridor

The vast majority of trips made on the island occur within the study corridor. Currently, morning travel patterns in the corridor are heavily directional. Morning town-bound (Koko Head direction) traffic volumes through the Waipahu and 'Aiea areas are more than twice the volume traveling in the 'Ewa direction. Afternoon flows are less directional with 'Ewa-bound traffic volumes about 50 percent greater than town-bound (Koko Head-bound) traffic.

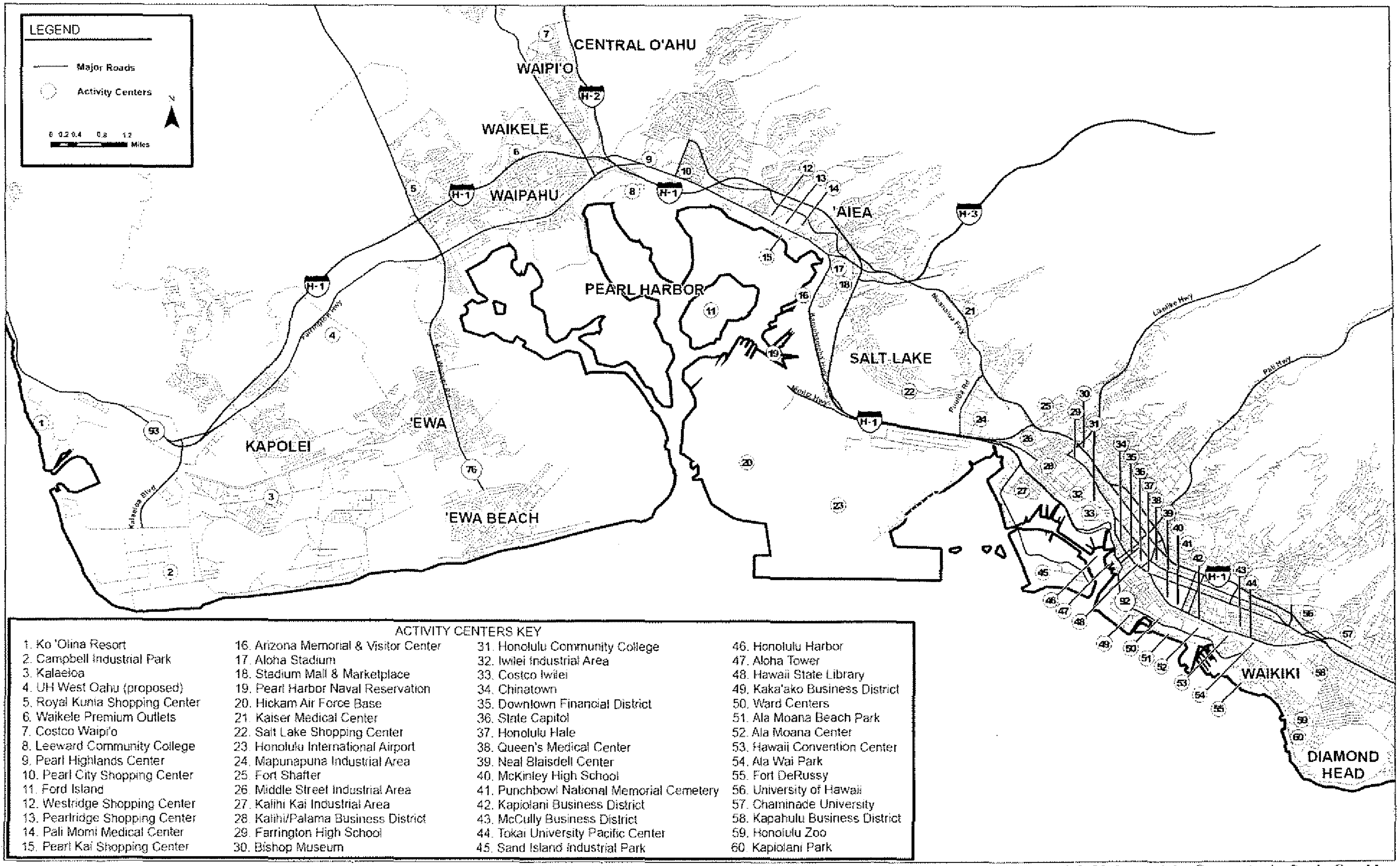

Figure 1-2. Major Activity Centers in the Study Corridor

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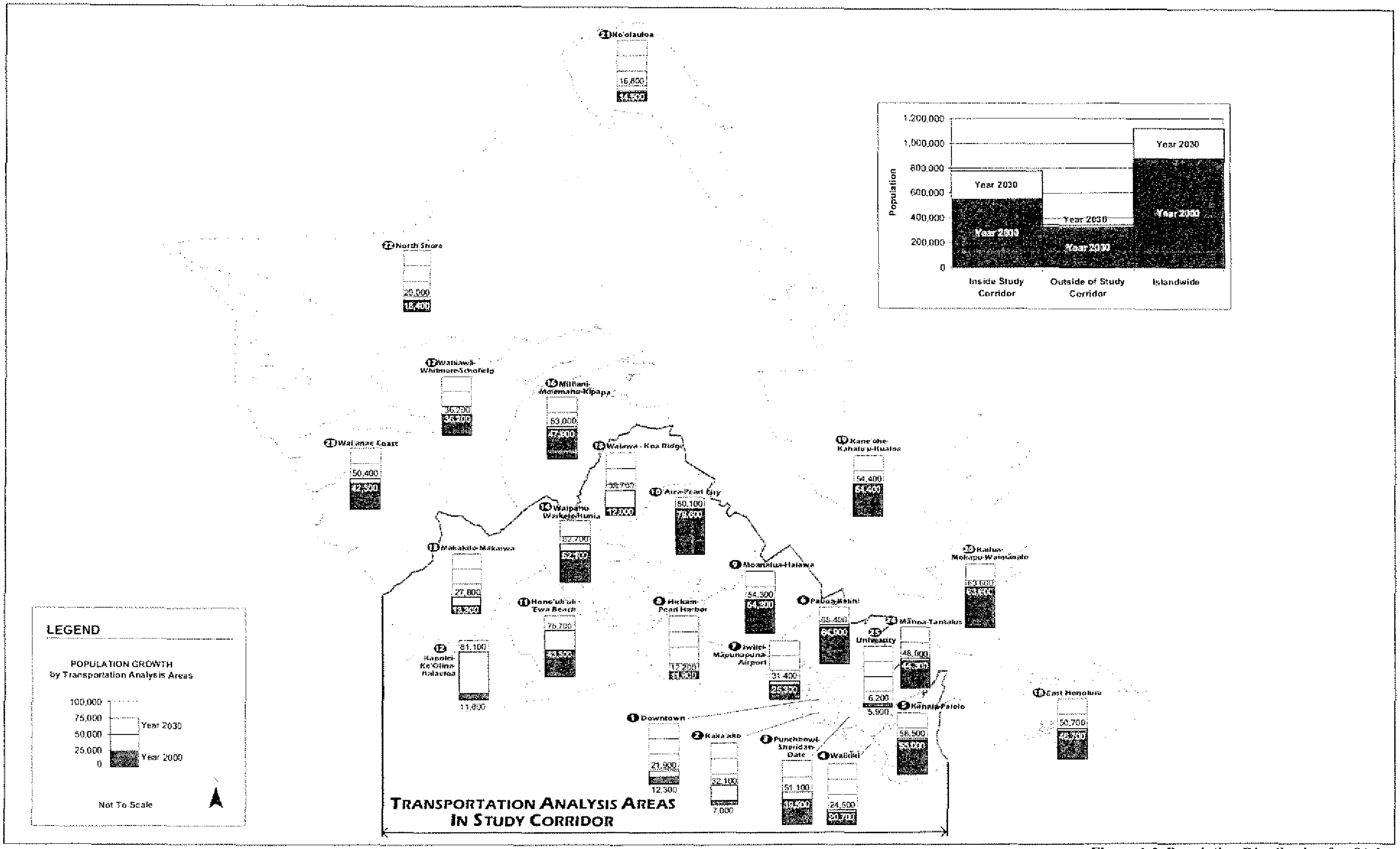

Figure 1-3. Population Distribution for O'ahu

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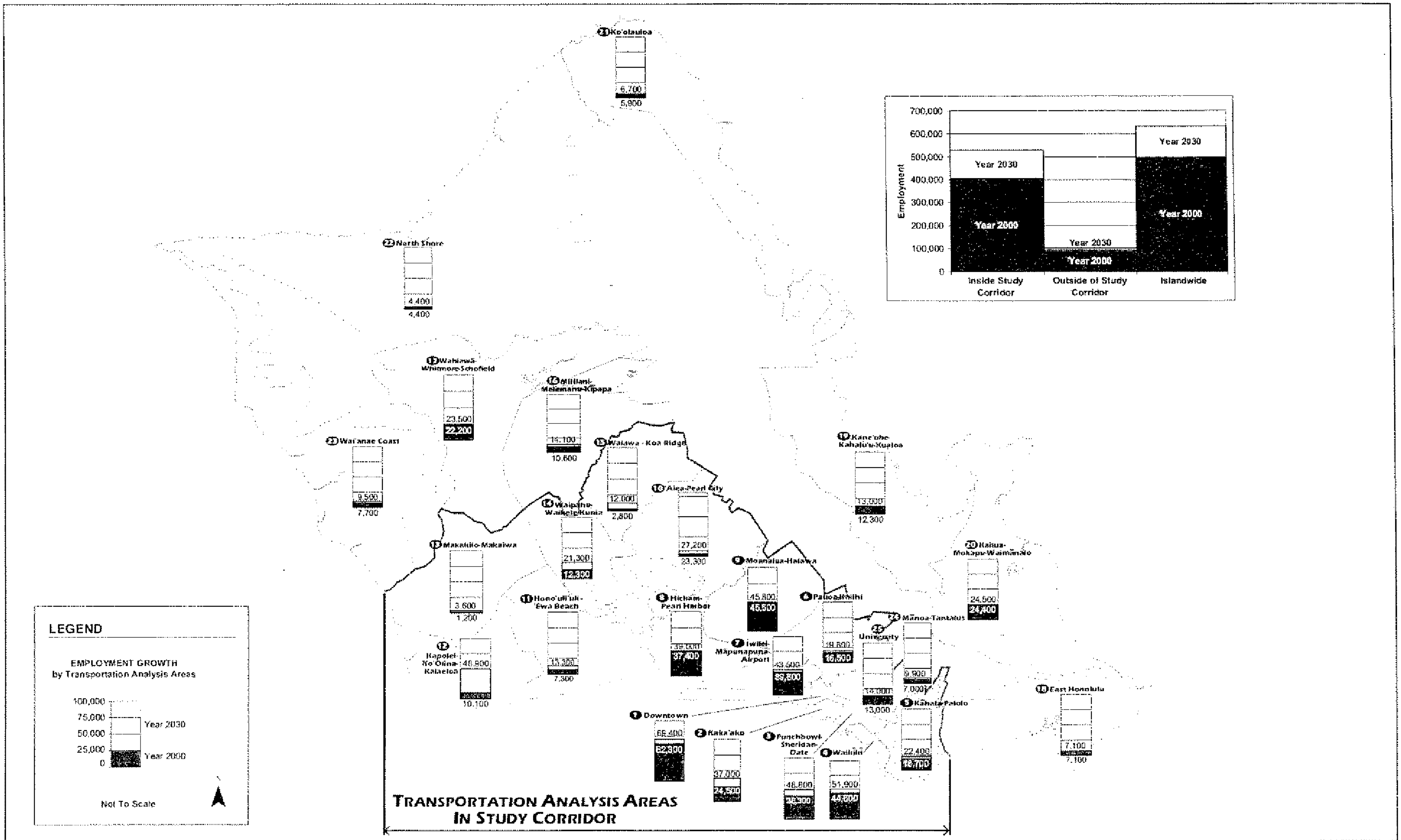

Figure 1-4. Employment Distribution for O'ahu

Trip origins correlate closely with the level of population in a given area, while trip destinations correlate to a high degree with the level of employment. Based on these data, 1,826,000 or 68 percent of the 2,698,000 islandwide daily trips and 335,000, or 64 percent of the 523,000 peak-period work-related trips are currently generated within the study corridor. The study corridor attracts an even higher percentage of islandwide trips with 2,092,000, or 78 percent of daily trips and 424,000 or 82 percent of peak-period work-related trips having destinations within the study corridor.

More trips will originate and remain within the Primary Urban Center in 2030 than they do today. However, the greatest increases in trips will be to and from the 'Ewa Development Plan area. These patterns illustrate the continued transportation importance of the study corridor with peak-period travel becoming less directional and more work trips destined for Kapolei.

Transit Travel Patterns

An on-board transit survey was conducted on all of TheBus routes in December 2005 and January 2006. Information obtained from the survey included the origins and destinations of current transit bus users across a variety of trip purposes for both the 178,400 total daily trips and the 57,000 peak-period work trips. These survey data indicate that the substantial majority of trips made by transit on the island occur within the study corridor.

When compared to total travel, the current number of transit trips within the corridor as a percentage of total islandwide transit trips is even more pronounced. Based on the survey data, 83 percent of both islandwide daily and peak-period work-related trips originate within the study corridor; while the study corridor attracts 90 percent of total islandwide daily trips and 94 percent of peak-period work-related trips.

Daily Transit Trips

The major destinations for weekday bus riders are Downtown (20 percent) and the Punchbowl-Sheridan-Date area (18 percent). Downtown contains the region's highest concentration of jobs. Punchbowl-Sheridan-Date also contains a high number of jobs, as well as Ala Moana Center, the state's largest shopping complex.

Overall, the largest share of TheBus riders' trips originates in Waikīkī (16.5 percent). The major destinations for these trips are Downtown (24 percent) and Punchbowl-Sheridan-Date (27 percent). In addition to Waikīkī, Punchbowl-Sheridan-Date (9 percent), Kāhala-Pālolo (8 percent), and Pauoa-Kalihi (9 percent) are the origins of a large number of trips. These areas are densely populated, with relatively high concentrations of transit-dependent households (Figure 1-5).

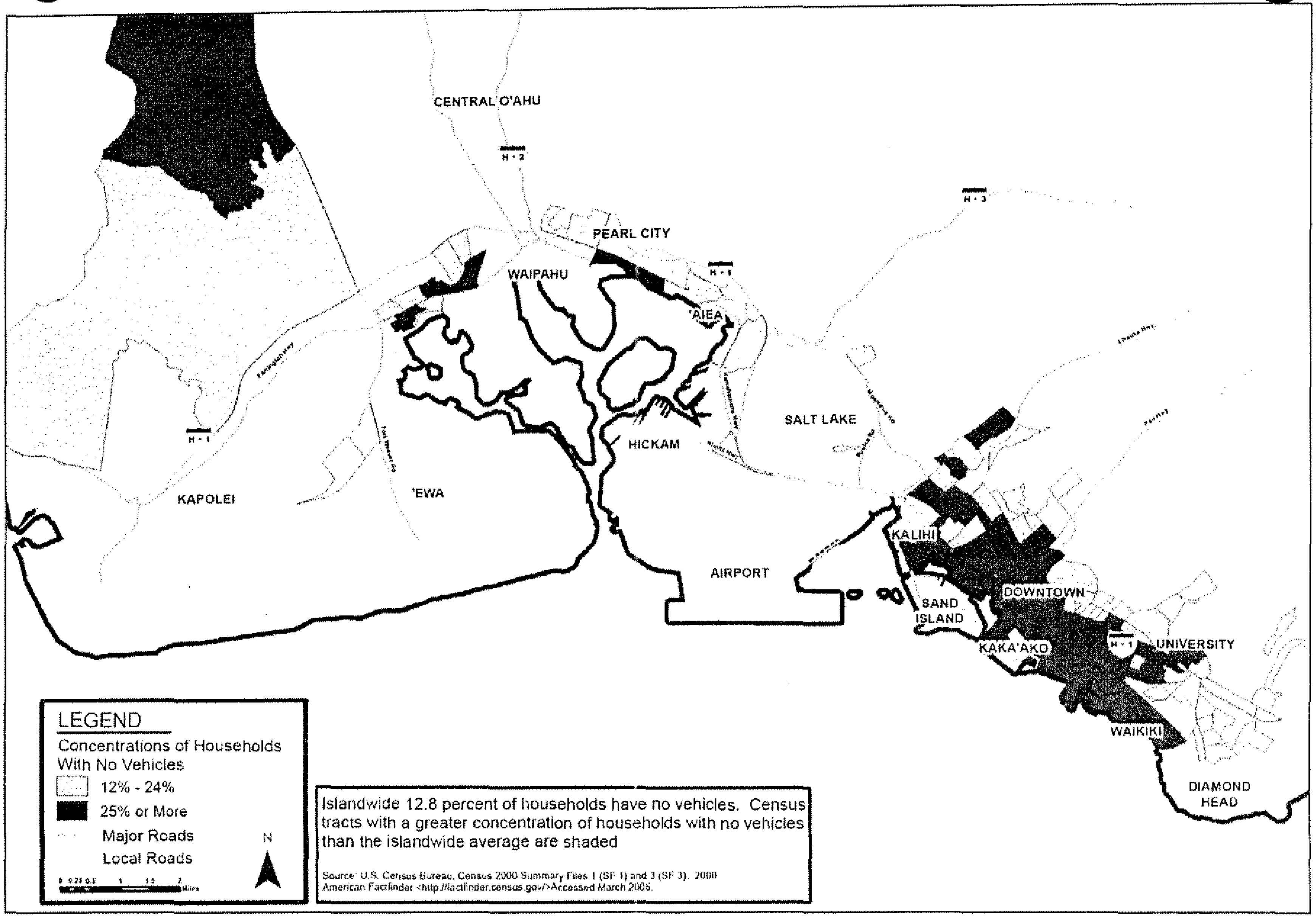

Figure 1-5. Concentrations of Transit-dependent Households

Peak-Period Transit Work Trips

Nearly 34 percent of all peak-period work trips are destined to Downtown, while Punchbowl-Sheridan-Date and Waikīkī each are destinations for about 12.5 percent of trips. Combined, these areas are the destinations of approximately 60 percent of the islandwide peak-period home-based work trips. Waikīkī, Punchbowl-Sheridan-Date, Pauoa-Kalihi, Waipahu-Waikele-Kunia, and Kāhala-Pālolo together account for about 50 percent of the home-based origins for work trips taken during the peak period on TheBus.

Existing Transportation Facilities and Services in the Corridor

The study corridor is currently served by roadway and transit systems, parking facilities, and pedestrian and bicycle facilities. Existing development throughout the study corridor combined with the previously described geographic boundaries limits the potential for new roadways or expansion of existing facilities.

Street and Highway System

The study corridor is served primarily by the H-1 Freeway, Farrington Highway, Kamehameha Highway, Nimitz Highway, and Moanalua Road (Route H201). The H-2 Freeway provides access to the corridor from Central O'ahu, and the H-3 Freeway provides access to the corridor from the Windward side. Because of the constraints posed by geography and existing development, the expansion of existing roadways or the addition of new roadways in many sections of the corridor would be extremely difficult and/or expensive. As a result, some sections of the corridor are served by a relatively small number of facilities, and the lack of redundancy in the system at these locations can cause severe traffic problems should any of the facilities become overly congested or incapacitated. An example of this is in Pearl City where only three primary roadways, H-1 Freeway, Moanalua Road, and Kamehameha Highway, serve the high volume of traffic traversing this area. Of these roadways, the H-1 Freeway carries 70 to 75 percent of the a.m. and p.m. peak-hour traffic. Hence, when traffic is congested on H-1 through this location, traffic is affected for miles along the adjacent corridor segments.

To better utilize the existing roadway facilities, both the Hawai'i Department of Transportation (HDOT) and the City and County of Honolulu have implemented a number of roadway management strategies, including the use of contraflow lanes and high-occupancy vehicle (HOV) lanes. A contraflow lane is a strategy wherein a lane that typically provides vehicular travel in one direction is reversed during certain times of the day. Current contraflow lanes operate on the H-1 Freeway, Nimitz Highway, Kapi'olani Boulevard, Ward Avenue, Atkinson Drive, and Wai'alae Avenue during the a.m. peak period. During the p.m. peak period, contraflow lanes operate on Kapi'olani Boulevard.

HOV lanes are freeway or surface street lanes designated for exclusive use by buses, carpools, and vanpools. HDOT operates HOV lanes on several state highways during certain times of the day. HOV lanes currently operate on the H-1 and H-2 Freeways, the Moanalua Road, the H-1 Zipper Lane and Shoulder Express Lane, and Nimitz Highway.

Public Transit System

O'ahu Transit Services, Inc. (OTS) operates the public transit system (TheBus) on the island of O'ahu under contract to the City and County of Honolulu. TheBus system serves more than 80 percent of the developed areas of the island and carries approximately 73 million passengers per year and experiences about 236,600 boardings on an average weekday. Annual transit passenger miles per-capita is higher in Honolulu than in all other major U.S. cities without a fixed guideway transit system.

Parking

Downtown Honolulu parking rates are high; however, many employers subsidize parking for their employees. Daily parking rates are the third-highest in the United States behind New York and Boston, while monthly parking rates are in the top 15 (Colliers, 2005). Downtown parking availability is considered limited, and garages have an average waiting list of three months for monthly parking. Parking availability also is limited in Waikīkī and near UH Mānoa.

Performance of the Existing Transportation System

Traffic Volumes

The highest daily traffic volumes occur near Downtown Honolulu. More than 398,000 vehicles cross Nu'uanu Stream daily on a total of nine roadways. During the a.m. and p.m. peak hours, more than 26,000 vehicles cross Nu'uanu Stream each hour.

At the facility level, the Interstate Freeway system carries a considerable amount of the island's traffic, with the H-1 being the most heavily traveled freeway on O'ahu. At the Kalauao Stream screenline in Pearl City, approximately 20,000 and 17,000 vehicles currently travel on H-1 (both directions combined) during the a.m. and p.m. peak hours, respectively. Approximately 245,000 vehicles travel through this section of H-1 daily.

Traffic Operating Conditions

The operating conditions of a roadway can be represented by a variety of measures, including the volume-to-capacity (V/C) ratio, operating speeds, and the density of traffic on the facility. These measures can be used to determine level-of-service (LOS). A roadway's V/C ratio compares the volume of traffic traveling on the roadway to the physical capacity of the roadway. Speeds are typically a reflection of the amount of congestion on a roadway or its geometric design characteristics. Traffic density is measured in terms of vehicles per mile per lane and is a function of both volumes and speeds. LOS is a grading scale from A through F for roadway operation; LOS A represents the best condition and LOS F represents more vehicles attempting to use a roadway than the capacity is able to accommodate.

In general, congested conditions (e.g., LOS E or F) occur during the a.m. and p.m. peak hours on many of the major roadways, particularly on segments of the H-1 Freeway from the Waiawa Interchange to the UH Mānoa area, where stop-and-go conditions are typical. Signalized routes, such as Nimitz Highway, require more than one traffic signal cycle to clear intersections during peak periods. To avoid peak-hour congestion, motorists have changed their time of travel, resulting in extended peak traffic conditions. Weekday a.m. and p.m. peak traffic conditions generally last three to four hours each. Weekend traffic during the mid-day also resembles weekday peak-period conditions.

Recent traffic counts for the corridor indicate that existing travel conditions are congested during the a.m. peak hour for Koko Head-bound traffic crossing the Kalauao Stream in Pearl City (V/C ratio of 1.06 [LOS F]) and the Kapālama Canal closer to Downtown (V/C 1.04 [LOS F]). These conditions are also indicated by estimated travel speeds along H-1 in the corridor, as shown in Table 1-1. The table indicates that existing speeds between the Waiawa Interchange and Downtown in the general purpose lanes range from 14 to 20 mph (LOS F) and will generally get worse by the year 2030 despite many planned roadway improvements.. The only location where speeds in the corridor on H-1 are predicted to increase in 2030 as compared to today is east of the Middle Street merge, where the addition of a lane is expected to result in an average a.m. peak period speed of 24 mph, which still indicates LOS F at this location.

Table 1-1. Existing and 2030 No Build Alternative A.M. Peak Period Speeds and Level-of-Service on H-1

Location	2005 Speed (mph)	2005 Level-of-Service[1]	2030 Speed (mph)	2030 Level-of-Service
Waiawa Interchange - Koko Head Bound				
General Purpose Traffic	19	F	12	F
HOV Lane Traffic	24	F	14	F
Zipper Lane Traffic	39	F	37	F
Kalauao Stream - Koko Head Bound				
General Purpose Traffic	20	F	15	F
HOV Lane Traffic	46	E	24	F
Zipper Lane Traffic	37	F	36	F
East of Middle Street Merge - Koko Head Bound				
General Purpose Traffic	14	F	24	F
Liliha Street - Koko Head Bound				
General Purpose Traffic	19	F	12	F
East of Ward Avenue - ʻEwa Bound				
General Purpose Traffic	21	F	18	F
West of University Avenue - ʻEwa Bound				
General Purpose Traffic	36	F	34	F

[1]Level-of-Service is calculated based on vehicle density, a function of traffic volume and speed.

Based on recent traffic counts as well as field observations, the p.m. peak period is also experiencing a high level of congestion in the corridor. Analysis of operations at Kalauao Stream and Kapālama Canal show p.m. peak-hour levels-of-service of E for each; however, H-1 itself is over capacity and operating at LOS F.

Transit Operating Conditions

The public transit system, TheBus, uses the general roadway network described above. The major factors influencing bus operating conditions are the traffic conditions under which the service operates, passenger loading time, and bus-stop spacing. Honolulu has substantial traffic congestion, high ridership and load factors, and closely spaced bus stops. Combined, these factors result in declining bus operating speeds over recent years, which are not competitive with the private automobile. Between 2002 and 2006, islandwide average bus speeds decreased four percent to 13.4 miles per hour. Because congestion in the study corridor is greater than in other parts of O'ahu, the decrease in average bus speed in the corridor is greater than the islandwide average. To account for the congestion, OTS has lengthened the peak-period scheduled trip lengths by between nine and 26 percent for several routes operating in the study corridor. Trip lengths for these typical routes serving various parts of O'ahu are shown in Figure 1-6.

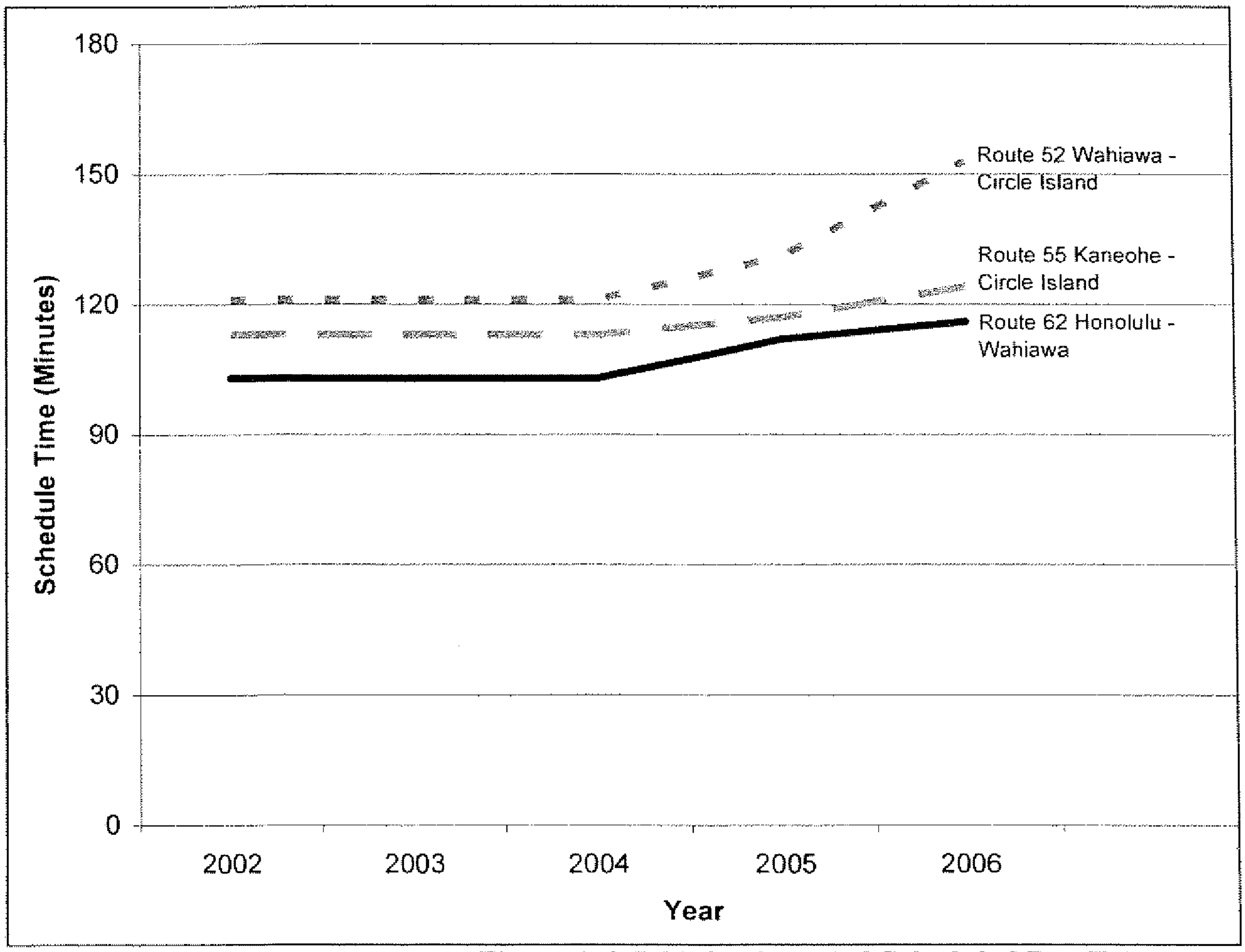

Figure 1-6. P.M. Peak-period Scheduled Bus Trip Times

Implementation of peak-period HOV lanes on H-1 and H-2, as well as the addition of the H-1 a.m. peak zipper lane, were intended to provide higher priority and mobility to buses and other high-occupancy vehicles. However, with a minimum eligibility requirement of only two persons per vehicle, these special lanes are often just as congested as the adjacent general purpose lanes (Table 1-1), thus negating much of the travel time advantage for transit buses.

As roadways become more congested, they become more susceptible to substantial delays caused by incidents such as traffic accidents or heavy rain. As a result, current transit schedules in the corridor are not reliable. Recent statistics from TheBus indicate that on a systemwide basis 27 percent of all buses were more than five minutes late. During the a.m. peak period, express buses were more than five minutes late 38 percent of the time (OTS, 2006).

Transit speed and reliability with mixed-traffic operations will continue to diminish in the corridor as the number of transit passengers increases and traffic volumes approach roadway capacity on more streets.

Potential Transit Markets

A comparison of the location and number of new employment opportunities in relation to population growth shows that many workers will still be required to travel to the Primary Urban Center for work (Figure 1-4). Despite the large growth of employment opportunities in the Kapolei area, population is projected to outpace and exceed the available employment in the area. Additionally, there will be a bidirectional flow of traffic throughout the day as more City and County administrative offices move their daily operations to Kapolei and other employment grows in the area. Both of these factors point to increased travel on the transportation system between Kapolei and the Primary Urban Center and represent an important potential future transit market.

Relatively large areas within the corridor are transit-dependent because they contain a large number of zero-car households relative to other parts of O‘ahu. Persons living in zero-car households are much more likely to use transit than other residents. These concentrations of zero-car household areas include much of the Primary Urban Center (including the Central Business District, Chinatown, Kaka‘ako, Kalihi-Pālama, and Iwilei) and some Waipahu neighborhoods as indicated in Figure 1-5. These areas represent a robust transit market because they already rely on existing transit and are likely to use an improved system.

Finally, although the primary market for the transit corridor improvements are for the residents, the visitor industry and location of visitor attractions within the corridor combine to create a transit market for visitors traveling within the corridor. O‘ahu hosts more than 4.4 million visitors annually (DBEDT, 2005). Many of these visitors stay in the Waikīkī area and travel to points of interest outside of Waikīkī, including many of the activity centers in the corridor (Figure 1-2).

History of the Project

During the summer of 2005, the State legislature recognized the need and public support for a high-capacity transit system on O‘ahu and passed Act 247. Act 247 authorized the County to levy a general excise tax surcharge to construct and operate a mass transit project serving O‘ahu. The City Council subsequently adopted Ordinance 05-027 to levy a tax surcharge to fund public transportation. With secure local funding established for the first time, the City began the AA process to analyze the feasibility of a high-capacity transit system in the corridor between Kapolei and UH Mānoa. A range of alternatives was evaluated and screened to select alternatives that would provide the most improvement to person-mobility and travel reliability in the study corridor. FTA published a Notice of Intent to Prepare an AA and an EIS in the *Federal Register* on December 7, 2005, and DTS published an EIS Preparation Notice in the State of Hawai'i *Environmental Notice* on December 8, 2005. The public was asked to comment on the proposed alternatives, the purpose and need for the project, and the range of issues to be evaluated at a series of scoping meetings in December 2005.

Goals and Objectives

Seven project goals were developed to address the transportation needs identified in the study corridor. The project has several objectives related to each of the project goals (Table 1-2).

Table 1-2. Project Goals and Objectives

Goal	Objectives
Improve Corridor Mobility	Reduce corridor travel times
	Improve corridor travel time reliability[1]
	Provide convenient, attractive, and effective transit service within the corridor
	Provide transit corridor travel times competitive with auto travel times
	Connect major trip attractors/generators within the corridor[1]
	Maximize the number of persons within convenient access range of transit
	Provide safe and convenient access to corridor transit stations[1]
Encourage Patterns of Smart Growth and Economic Development	Encourage transit-oriented development in existing and new growth areas
	Utilize corridor land use policies/opportunities related to economic development
	Support economic development of major regional economic centers
Find Cost-Effective Solutions	Provide solutions with benefits commensurate with their costs
	Provide solutions that meet the project purpose and needs while minimizing total costs
	Improve transit operating efficiency
Provide Equitable Solutions	Distribute costs and benefits fairly across different population groups[1]
	Avoid disproportionate impacts on low income and minority population groups
	Provide effective transit options to transit-dependent communities
Develop Feasible Solutions	Ensure the cost of building, operating, and maintaining the alternative is within the range of likely available funding
	Develop a feasible alternative in terms of constructability and ROW availability
Minimize Community and Environmental Impacts	Minimize impacts on natural and cultural resources
	Minimize the effect on homes and businesses
	Minimize disruption to traffic operations[1]
	Minimize conflicts with utilities
	Minimize construction impacts
	Minimize impacts to the community and community amenities
	Reduce energy consumption
	Minimize impacts to future development
Achieve Consistency with Other Planning Efforts	Achieve consistency with adopted community, regional, and state plans

[1]This objective was considered during project development, but is not evaluated in the comparison of alternatives.

Chapter 2 Alternatives Considered

Screening and Selection Process

During the fall of 2005 and winter of 2006, the City and County of Honolulu conducted an alternatives screening that is documented in the *Honolulu High-Capacity Transit Corridor Project Alternatives Screening Memorandum* (DTS, 2006b). The alternatives screening was approached through a top-down analysis completed in five major steps. The first step was to gather input needed for the analysis. The input included the purpose and need for the project, past studies and their recommendations, requirements of the FTA process, adopted community and area plans, and a visual assessment of the entire corridor as it currently exists. The second step used the information gathered to identify a comprehensive list of potential alternatives. The third step included developing screening criteria and undertaking the initial screening of all potential alternatives to identify those that address the needs of the corridor and do not have any "fatal flaws." Those surviving alternatives were then presented to the public and interested public agencies and officials for comment through a scoping process in the fourth step. Finally, input from the scoping process was collected and analyzed, and refinements were made to the alternatives. Once the evaluations were completed, the modal, technology, and alignment options were matched to create the alternatives that are carried forward into this AA.

Alternatives Considered

Multiple sources were accessed for input to determine the initial options screened. The goal was to screen as broad a range of feasible alternatives as possible to ensure that the best solutions for the corridor would be considered. A long list of alternatives was developed based on these previous studies, a field review of the study corridor, an analysis of current population and employment data for the corridor, and a literature review of modal technologies.

The alternatives considered during screening included a No Build Alternative, a Transportation System Management Alternative, and a number of "build" alternatives. Transit technologies that were examined included conventional bus, guided bus, light rail transit, personal rapid transit, people mover, monorail, magnetic levitation, rapid rail, commuter rail, and waterborne ferry service. Several highway improvements considered during OMPO's 2030 ORTP planning process also were reviewed for their ability to improve transit capacity and reliability, including a bridge or tunnel crossing of Pearl Harbor to connect 'Ewa with the PUC and the construction of a two-lane elevated structure from the Waiawa Interchange to Iwilei, which would be used by transit vehicles and potentially carpools and single-occupant vehicles willing to pay a congestion-based toll. In addition, 75 Fixed Guideway alignment options were screened.

Alternatives Considered but Rejected

All of the alternatives considered are detailed in the *Honolulu High-Capacity Transit Corridor Project Alternatives Screening Memorandum* (DTS, 2006b). The following alternatives were eliminated before undertaking this AA.

The tunnel crossing of Pearl Harbor was rejected because it would not provide an alternative to private automobile use or improve linkages within the study corridor, as it would bypass much of the corridor and not provide any new connections within the remainder of the corridor.

Waterborne ferry service was eliminated as a primary transit system because its capacity and travel times were not competitive with other alternatives. This alternative is being studied as an augmentation to the existing transit system in a separate effort from this project.

Several transit technologies were eliminated for various reasons. Diesel multiple unit was eliminated based on technical maturity, supplier competition, and environmental performance. Personal rapid transit was eliminated based on lack of technical maturity and line capacity. Commuter rail was eliminated because it is not suited for short station spacing and is not competitive without existing freight tracks being available. Also, emerging rail concepts were eliminated because of their lack of technical maturity and the rapid implementation schedule for the project.

For the Fixed Guideway Alternative screening analysis, the corridor was divided into eight sections. (Following the screening analysis, the eight sections were combined into a set of five sections.) Within each of the sections, the alignments that demonstrated the best performance related to mobility and accessibility, supporting smart growth and economic development, constructability and cost, community and environmental quality, and planning consistency were retained for evaluation in the AA.

Alternatives Evaluated in this Alternatives Analysis

Four alternatives are evaluated in this AA/DEIS. They were developed through a screening process that considered alternatives identified through previous transit studies, a field review of the study corridor, an analysis of current population and employment data for the corridor, a literature review of technology modes, work completed by the O'ahu Metropolitan Planning Organization (OMPO) for its *2030 O'ahu Regional Transportation Plan* (OMPO, 2006a), and public and agency comments received during a formal project scoping process held that would satisfy the requirements of the National Environmental Policy Act (NEPA) and the Hawai'i EIS Law (Chapter 343). The four alternatives are described in detail in the *Honolulu High-Capacity Transit Corridor Project Alternatives Analysis Detailed Definition of Alternatives* (DTS, 2006a). The alternatives evaluated are as follows:

- No Build Alternative
- Transportation System Management Alternative
- Managed Lane Alternative
- Fixed Guideway Alternative.

Alternative 1: No Build

The No Build Alternative includes existing transit and highway facilities and committed transportation projects anticipated to be operational by 2030. Committed transportation projects are those programmed in the *2030 O'ahu Regional Transportation Plan* prepared by OMPO. The committed highway elements of the No Build Alternative are also included in the build alternatives.

The No Build Alternative's transit component would include an increase in fleet size to accommodate the anticipated growth in population, while allowing service frequencies to remain the same as today. Bus fleet requirements are listed in Table 2-1.

Table 2-1. Transit Vehicle Requirements

Alternative	Bus		Fixed Guideway	
	Peak	Fleet	Peak	Fleet
2005 Existing Conditions				
Existing Conditions	409	525	0	0
Alternative 1: 2030 No Build				
No Build Alternative	511	614	0	0
Alternative 2: 2030 Transportation System Management				
TSM Alternative	638	765	0	0
Alternative 3: 2030 Managed Lane				
Two-Direction Option	705	846	0	0
Reversible Option	755	906	0	0
Alternative 4: 2030 Fixed Guideway				
Kalaeloa - Salt Lake - North King - Hotel	441	529	72	90
Kamokila - Airport - Dillingham - King with a Waikīkī Branch	435	525	68	90
Kalaeloa - Airport - Dillingham - Halekauwila	448	540	74	90
20-mile Alignment East Kapolei to Ala Moana Center	497	596	54	70

Alternative 2: Transportation System Management

The Transportation System Management (TSM) Alternative would provide an enhanced bus system based on a hub-and-spoke route network, conversion of the present a.m. peak-hour-only zipper-lane to both a morning and afternoon peak-hour zipper-lane operation, and relatively low-cost capital improvements on selected roadway facilities to give priority to buses. Bus fleet requirements are listed in Table 2-1. The TSM Alternative includes the same committed highway projects as assumed for the No Build Alternative.

Alternative 3: Managed Lane

The Managed Lane Alternative would include construction of a two-lane, grade-separated facility between Waipahu and Downtown Honolulu (Figure 2-1 and Figure 2-2) for use by buses, paratransit vehicles, and vanpool vehicles. The managed lane facility would integrate with HDOT's proposed Nimitz Flyover project that is included in the *2030 O'ahu Regional Transportation Plan* (OMPO, 2006a). HOV and toll-paying, single-occupant vehicles also would be allowed to use the facility provided that sufficient capacity would be available to maintain free-flow speeds for buses and the above-noted paratransit and vanpool vehicles. Variable pricing strategies for single-occupant vehicles would be implemented to maintain free-flow speeds for transit and HOVs. Two design and operational variations of the Managed Lane Alternative are evaluated: a Two-direction Option (one lane in each direction) and a two-lane Reversible Option. For both options, access to the facility in West O'ahu would be via ramps from the H-1 and H-2 Freeways just prior to the Waiawa Interchange. Both options would require modification to the Nimitz Flyover project's design and would terminate with ramps tying into Nimitz Highway at Pacific Street. The H-1 zipper lane would be maintained in the Two-direction Option but discontinued in the Reversible Option.

An intermediate bus access point would be provided in the vicinity of Aloha Stadium. Bus service using the managed lane facility would be restructured and enhanced, providing additional service between Kapolei and other points 'Ewa of the Primary Urban Center, and Downtown Honolulu and UH Mānoa.

Characteristics of the Managed Lane Alternative

The Two-direction Option would serve express buses operating in both directions during the entire day. The Reversible Option would serve peak-direction bus service, while reverse-direction service would use H-1. Twenty-nine bus routes, with approximately 93 buses per hour, would use the managed lane facility during peak hours for either option. One limited-stop route and one local route would continually operate in the managed lane. A total of 27 peak-period express routes would operate in the peak direction using the managed lane facility. Of these, three are new express routes serving developing areas and nine are new routes developed for exclusive use of the managed lane. The nine new managed lane express bus system routes originate from Kalaeloa, Kapolei, or Central O'ahu and terminate at the Alapa'i Transit Center, Waikīkī, or UH Mānoa. Other peak-period, local and limited-stop routes follow a route similar to the current structure but will use the managed lane for the line-haul portion of the route.

A toll structure has been developed that ensures that the managed lane facility would operate to maintain free-flow speeds for buses. To maintain free-flow speeds in the Two-direction Option, it may be necessary to charge tolls to manage the number of HOVs using the facility. For the Reversible Option, three-person HOVs would be allowed to use the facility for free, while single-occupant and two-person HOVs would have to pay a toll.

Optimum Managed Lane Option

The two Managed Lane options discussed above are evaluated in the following chapters of this report in relation to transportation benefits, environmental and social consequences, and costs. The findings within each of these topics are synthesized at the beginning of Chapter 6 (Comparison of Alternatives) where it is determined that the Reversible Option is optimal.

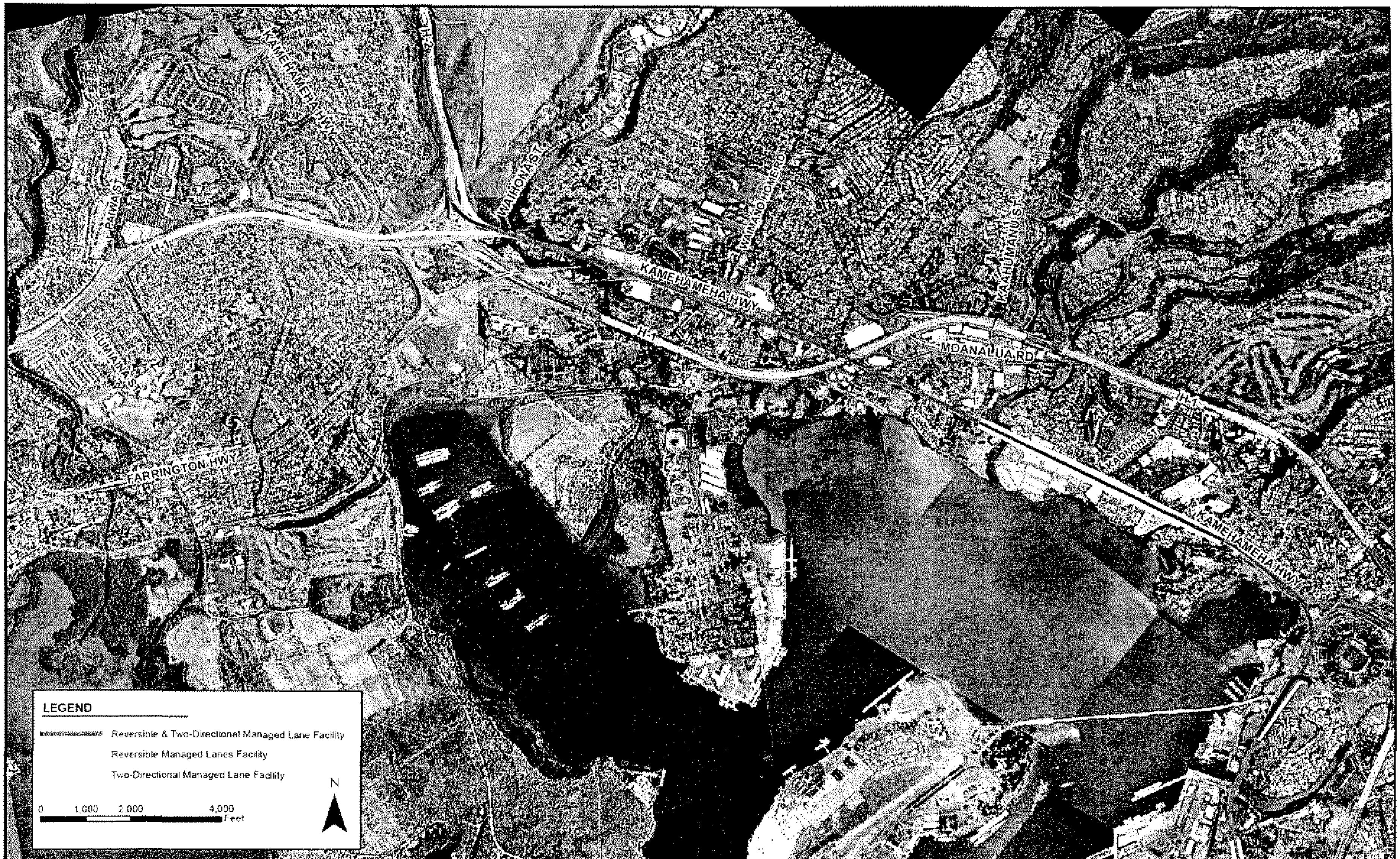

Figure 2-1. Managed Lane Alternative ('Ewa Section)

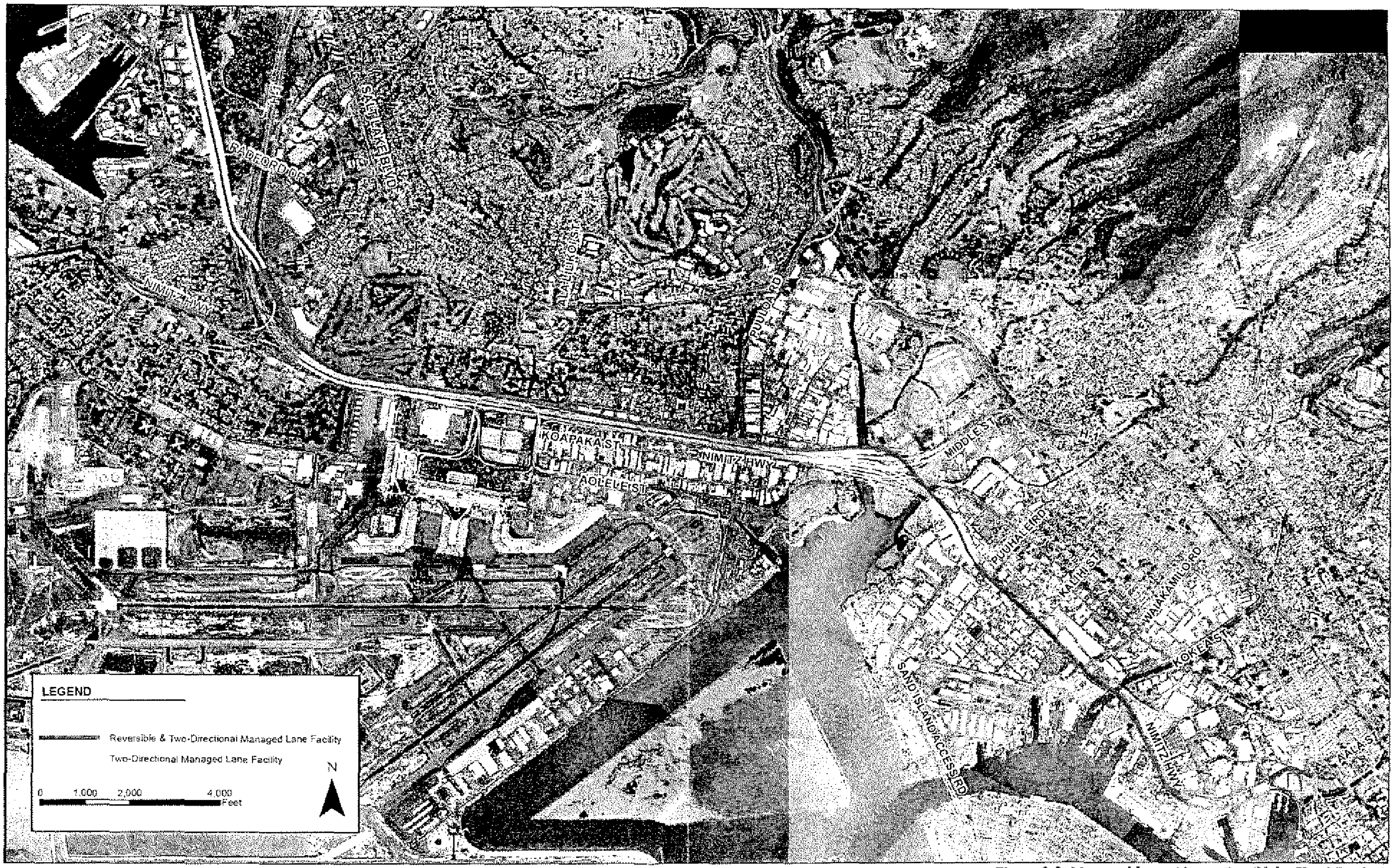

Figure 2-2. Managed Lane Alternative (Koko Head Section)

Alternative 4: Fixed Guideway

The Fixed Guideway Alternative would include the construction and operation of a fixed-guideway transit system between Kapolei and UH Mānoa. The system could use any of a range of fixed-guideway transit technologies that meet performance requirements and could be either automated or employ drivers.

The study corridor for the Fixed Guideway Alternative is evaluated in five sections to simplify the analysis and facilitate evaluation in this report (Figure 2-3 through Figure 2-7). Detailed alignment drawings are available in the *Honolulu High-Capacity Transit Corridor Project Alignment Plans and Profiles* (DTS, 2006e). Each alignment has distinctive characteristics and environmental impacts, as well as providing different service options. Therefore, each alignment is evaluated individually and compared to the other alignments in that section. The sections, the alignments within each section, and the number of stations considered for each alignment are listed in Table 2-2.

Station and supporting facility locations also are considered. Supporting facilities include a vehicle maintenance facility and park-and-ride lots. Some bus service would be reconfigured to bring riders on local buses to nearby fixed-guideway transit stations. To support this system, the bus fleet would increase or remain as today, as shown in Table 2-1.

Although this alternative would be designed to be within existing street or highway rights-of-way as much as possible, property acquisition at various locations would be required. Future extensions of the system to Central O'ahu, East Honolulu, or within the corridor are possible, but are not being addressed in detail in this AA.

Combination of Fixed Guideway Alternative Alignment Options

For ease of comparison to Alternatives 1 through 3, three alignment combinations are presented in this report. The combinations were selected considering initial information about performance of the various alignment options in each of the corridor sections. While the presented combinations include the alignments with the best performance characteristics in each section, they do not preclude a different combination of alignments from being selected. The three combinations presented are as follows:

- Kalaeloa - Salt Lake - North King - Hotel. This combination would link the following series of alignments through the study corridor: Saratoga Avenue/North-South Road to Farrington Highway/Kamehameha Highway to Salt Lake Boulevard to North King Street to Hotel Street/Kawaiaha'o Street/Kapi'olani Boulevard.
- Kamokila -- Airport - Dillingham - King with a Waikīkī Branch. This combination would link the following series of alignments through the study corridor: Kamokila Boulevard/Farrington Highway to Farrington Highway/Kamehameha Highway to Aolele Street to Dillingham Boulevard to King Street/Waimanu Street/Kapi'olani Boulevard with a Waikīkī Branch.
- Kalaeloa - Airport - Dillingham - Halekauwila. This combination would link the following series of alignments through the study corridor: Saratoga Avenue/North-South

Road to Farrington Highway/Kamehameha Highway to Aolele Street to Dillingham Boulevard to Nimitz Highway/Halekauwila Street/Kapiʻolani Boulevard.

Table 2-2. Fixed Guideway Alternative Analysis Sections and Alignments

Section	Alignments Being Considered	Number of Stations
I. Kapolei to Fort Weaver Road	Kamokila Boulevard/Farrington Highway	5
	Kapolei Parkway/North-South Road	6
	Saratoga Avenue/North-South Road	9
	Geiger Road/Fort Weaver Road	7
II. Fort Weaver Road to Aloha Stadium	Farrington Highway/Kamehameha Highway	5
III. Aloha Stadium to Middle Street	Salt Lake Boulevard	2
	Mauka of the Airport Viaduct	3
	Makai of the Airport Viaduct	4
	Aolele Street	4
IV. Middle Street to Iwilei	North King Street	3
	Dillingham Boulevard	4
V. Iwilei to UH Mānoa	Beretania Street/South King Street	7
	Hotel Street/Kawaiaha'o Street/Kapi'olani Boulevard	11
	King Street/Waimanu Street/Kapi'olani Boulevard	7
	Nimitz Highway/Queen Street/Kapi'olani Boulevard	9
	Nimitz Highway/Halekauwila Street/ Kapi'olani Boulevard	9
	Waikīkī Branch	3

Characteristics of the Fixed Guideway Alternative

The fixed guideway system is planned to operate between 4 a.m. and midnight, with a train arriving in each direction at each station between every three and six minutes (Table 2-3). The system is planned to operate with a unified fare structure with TheBus, with transfers and passes usable on both systems. A possible fare-collection system would include one that operates on an honor basis. No gates or fare inspection points would be used in the stations. Fare machines would be available at all stations and standard fare boxes would be used on buses. Fare inspectors would ride the system and check that passengers have valid tickets or transfers. Violators would be cited and fined.

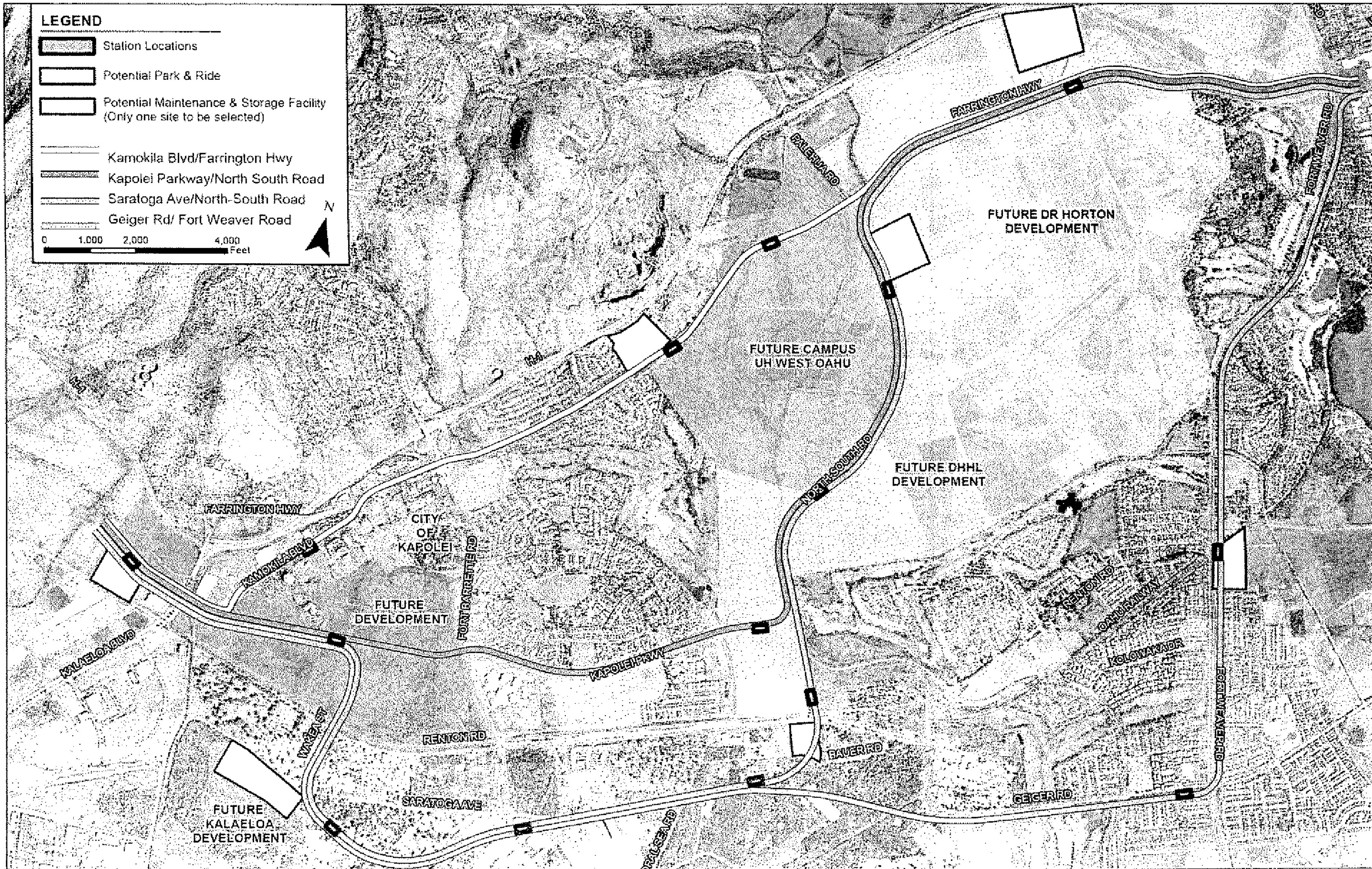

Figure 2-3. Fixed Guideway Alternative Section I

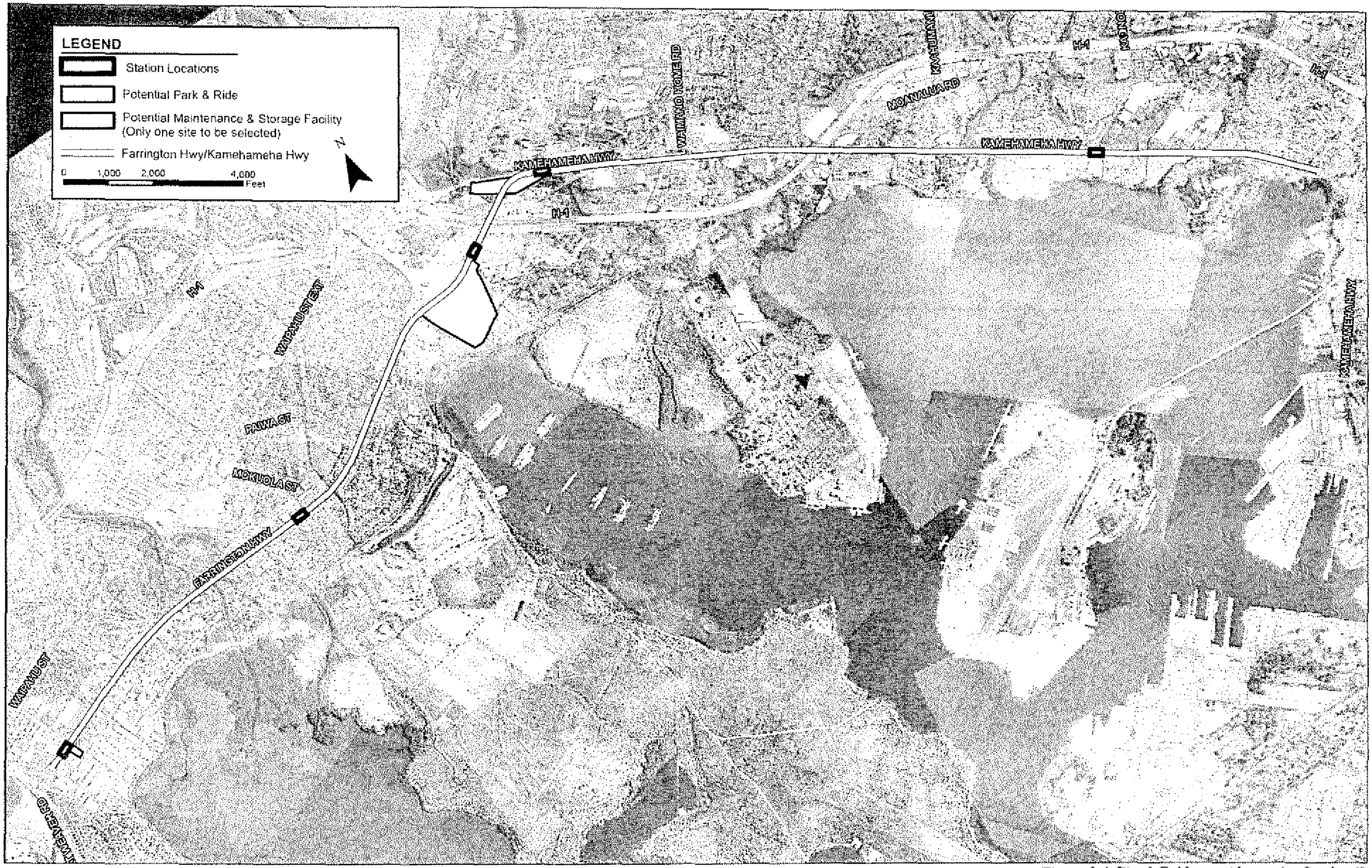

Figure 2-4. Fixed Guideway Alternative Section II

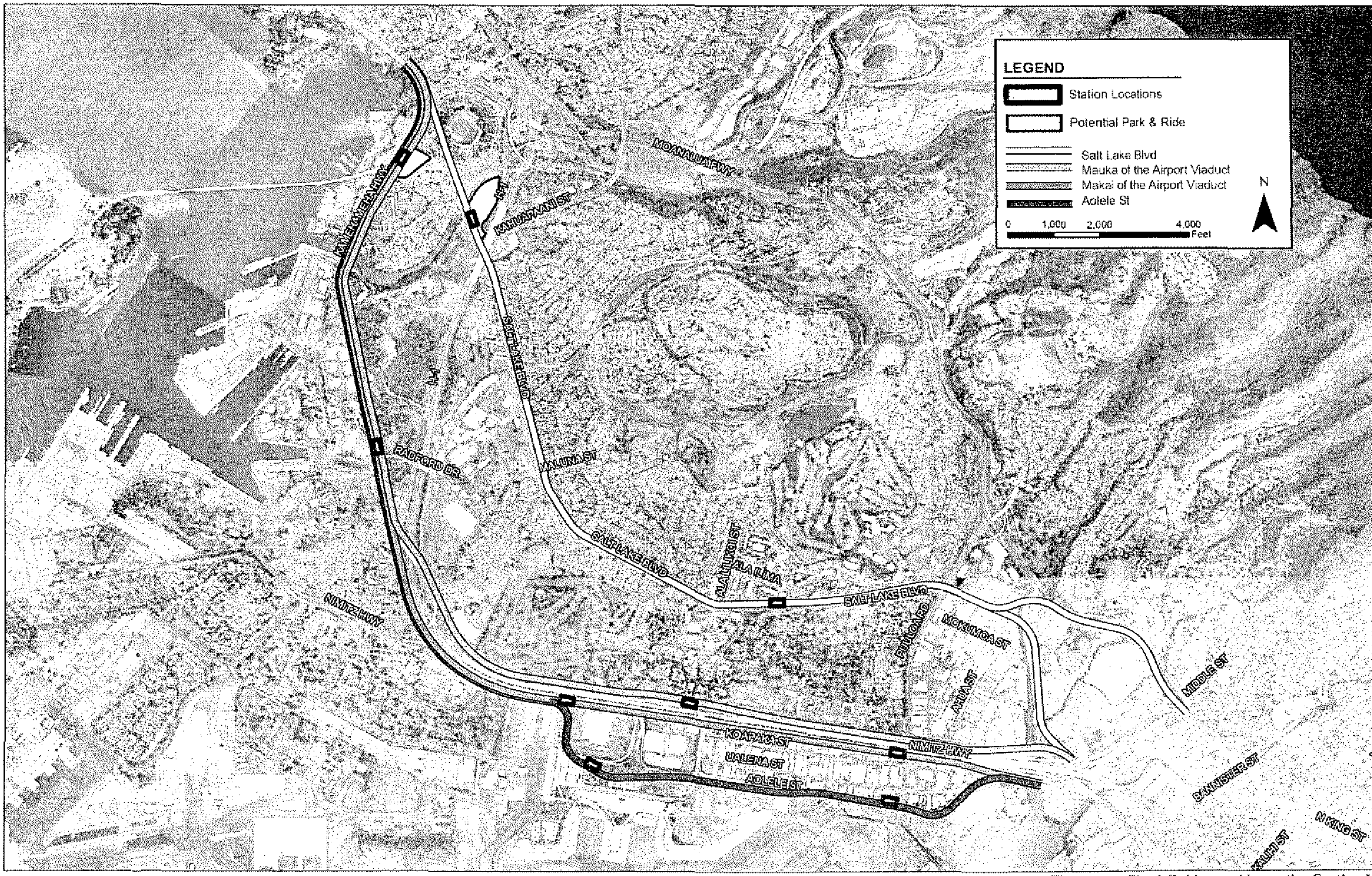

Figure 2-5. Fixed Guideway Alternative Section III

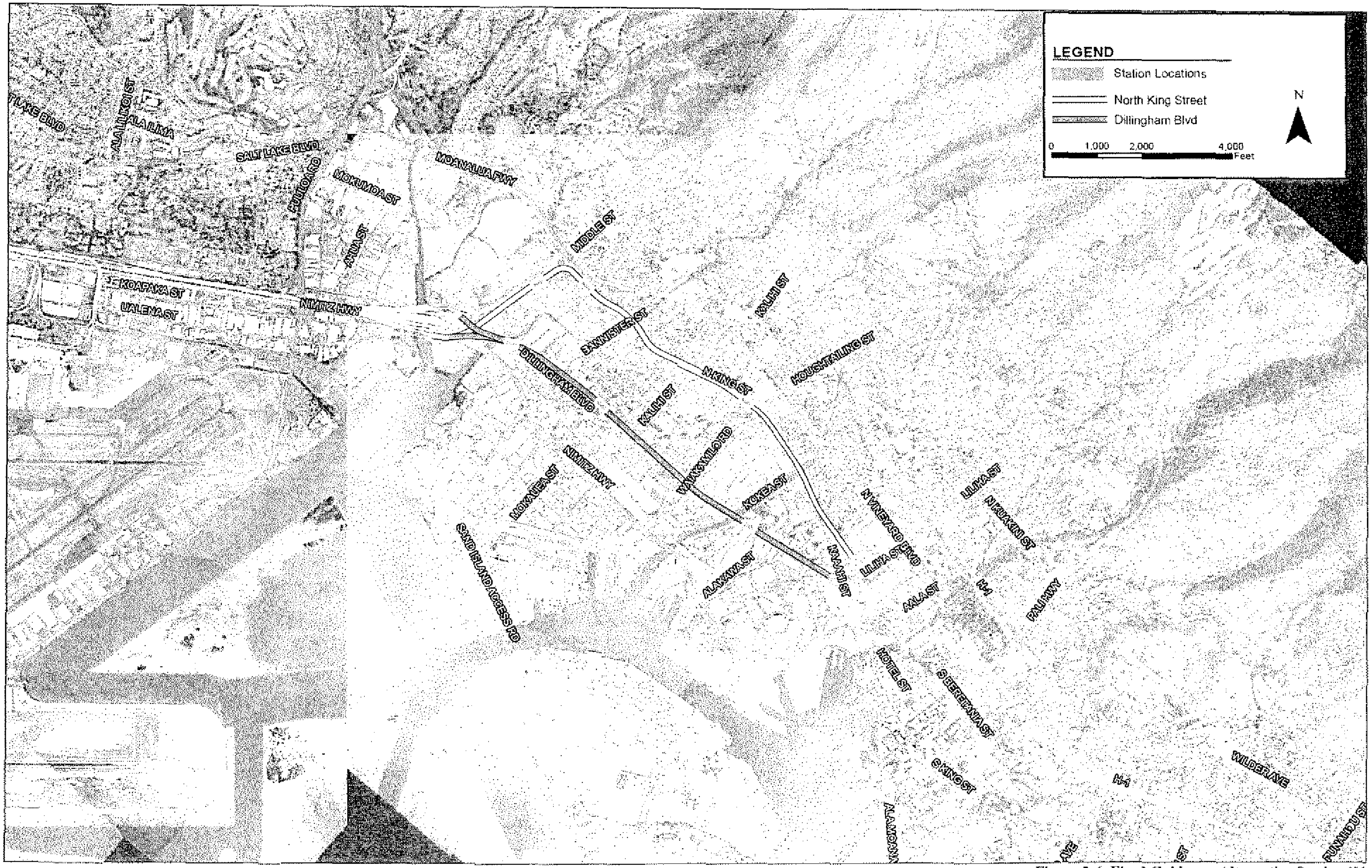

Figure 2-6. Fixed Guideway Alternative Section IV

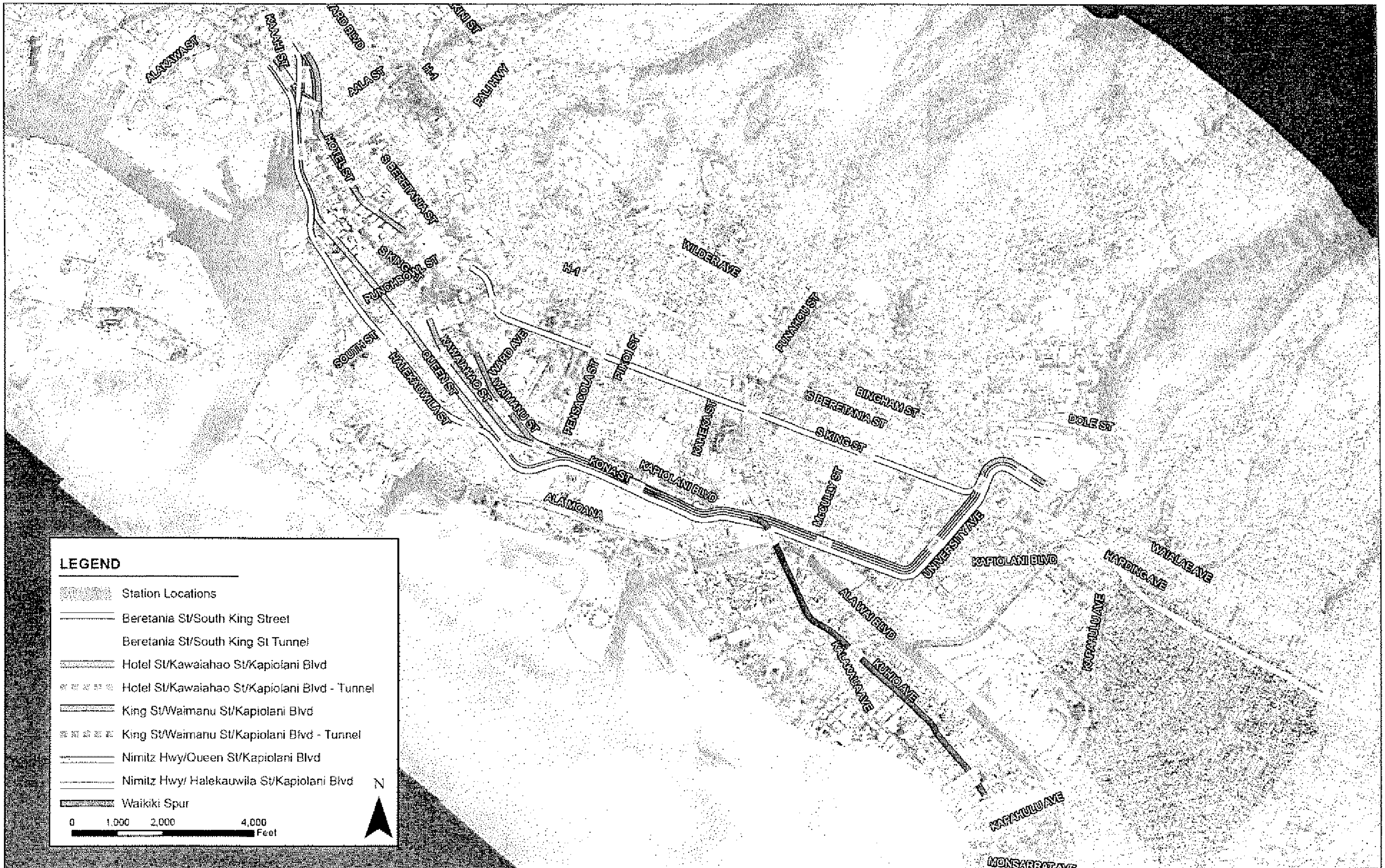

Figure 2-7. Fixed Guideway Alternative Section V

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Table 2-3. Fixed Guideway Alternative Operating Assumptions

Time of Day[1]	System Headway[2]
4 a.m. to 6 a.m.	6 minutes
6 a.m. to 9 a.m.	3 minutes
9 a.m. to 3 p.m.	6 minutes
3 p.m. to 6 p.m.	3 minutes
6 p.m. to 8 p.m.	6 minutes
8 p.m. to 12 a.m.	10 minutes

[1]System is closed from 12 a.m. to 4 a.m.
[2]With Waikīkī Branch, branch-line headway to Waikīkī and UH Mānoa would be twice that of the main line.

A vehicle loading standard of one standee per 2.7 square feet of floor space has been used. The system is planned to operate with multicar or articulated trains approximately 175 to 200 feet in length, with each train able to carry a minimum of 300 passengers. This would provide a peak capacity of at least 6,000 passengers per hour per direction. The number of vehicles required to provide this service is listed in Table 2-1, assuming two vehicles per train. With the exception of the Hotel Street alignment, the system would be expandable to longer trains of up to 300 feet in the future to increase capacity by 50 percent. Also, the system could be operated with shorter headways to increase peak capacity.

Optimum Fixed Guideway Alignment

Each of the Fixed Guideway alignment options discussed above is evaluated in the following chapters of this report in relation to transportation benefits, environmental and social consequences, and costs. The findings within each of these topics are synthesized at the beginning of Chapter 6 (Comparison of Alternatives) to determine the optimal combination of alignments. The comparison results in an optimal alignment of Saratoga Avenue/North-South Road to Farrington Highway/Kamehameha Highway to Aolele Street to Dillingham Boulevard to Nimitz Highway/Halekauwila Street/Kapiʻolani Boulevard, which is the Kalaeloa - Airport - Dillingham - Halekauwila combination Figure 2-8.

Twenty-mile Alignment

To provide an alternative with lower cost than the Full-corridor Alignments, a 20-mile Alignment was identified for evaluation. The 20-mile Alignment provides a substantial benefit to users with a lower capital cost.

Several portions of the corridor could be selected within the range of sections and alignments considered for the Fixed Guideway Alternative; however, the optimum shortened alignment should be able to provide substantial benefit to transit users independent of the remainder of the system under long-range consideration. As indicated by the financial analysis presented in Chapter 5, there is a substantial level of uncertainty in development of a fixed guideway system for the entire length of the study corridor (Kapolei to UH Mānoa) with known available funds from tax sources, combined with a reasonable projection of Federal funds. With this in mind, the following items were considered in defining possible shortened alignments from the alignments considered for the entire length of the study corridor.

- The alignment must, at minimum, reach Downtown Honolulu
- The alignment should serve as much of the study corridor as practical
- The alignment selected in each section should provide the greatest user benefit while considering the cost of the alignment.

The 20-mile Alignment evaluated in Chapter 6 (Comparison of Alternatives) could be constructed and operated within the funding assumptions that are established in Chapter 5. When the additional future funding sources become more certain over the course of project development, the 20-mile Alignment could be modified to accommodate the changed condition. The 20-mile Alignment includes the portion of the Optimum Fixed Guideway Alignment discussed above that would begin makai of UH West Oʻahu and continue to Ala Moana Center. In its entirety, the 20-mile Alignment would begin at one station Waiʻanae of UH West Oʻahu near Kapolei Parkway and North-South Road. The alignment would include a design variation to serve UH West Oʻahu and cross D.R. Horton land to Farrington Highway then continue Koko Head following Kamehameha Highway to Aolele Street and Dillingham Boulevard, and then continue elevated following Nimitz Highway and Halekauwila Street to Ala Moana Center (Figure 2-9).

Costs of the Alternatives

The costs for each alternative are detailed in Chapter 5. They are summarized in this section to provide a comparison among the alternatives.

Capital Costs

Capital costs for the No Build and TSM Alternatives would be $660 and $856 million, respectively, which accounts for bus replacement and system expansion. Total capital costs for the Managed Lane Alternative would range between $3.6 and $4.7 billion, of which $2.6 to $3.8 billion would be for construction of the managed lanes. Capital costs for the Fixed Guideway Alternative, including bus system costs, would range between $5.2 and $6.1 billion for the Full-corridor Alignments, of which $4.6 to $5.5 billion would be for the fixed guideway system. The costs would be $4.2 billion for the 20-mile Alignment, of which $3.6 billion would be for the fixed guideway system.

Operating and Maintenance Costs

Operating costs in 2030 for the No Build Alternative, in 2006 dollars, would be approximately $192 million. Operating costs for the TSM Alternative would be approximately $42 million greater than for the No Build Alternative. Transit operating costs for the Managed Lane Alternative would range between approximately $251 and $261 million as a result of additional buses that would be put in service under that alternative. These costs do not include the cost of maintaining the managed lane facility. The total operating costs for the Fixed Guideway Alternative, including the bus and fixed guideway, would range between approximately $248 and $256 million.

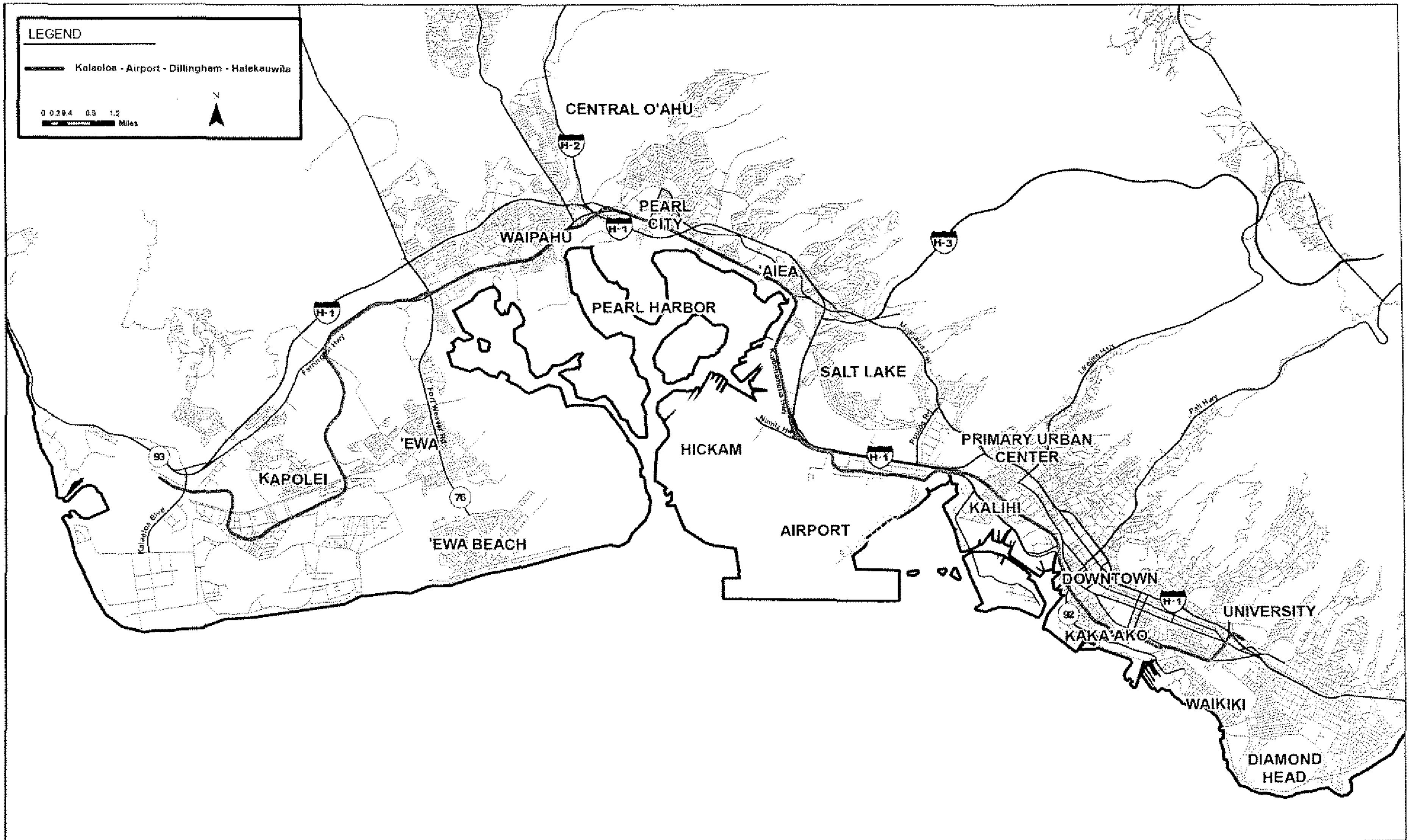

Figure 2-8. Kalaeloa - Airport - Dillingham - Halekauwila Combination (Twenty-eight-mile Alignment)

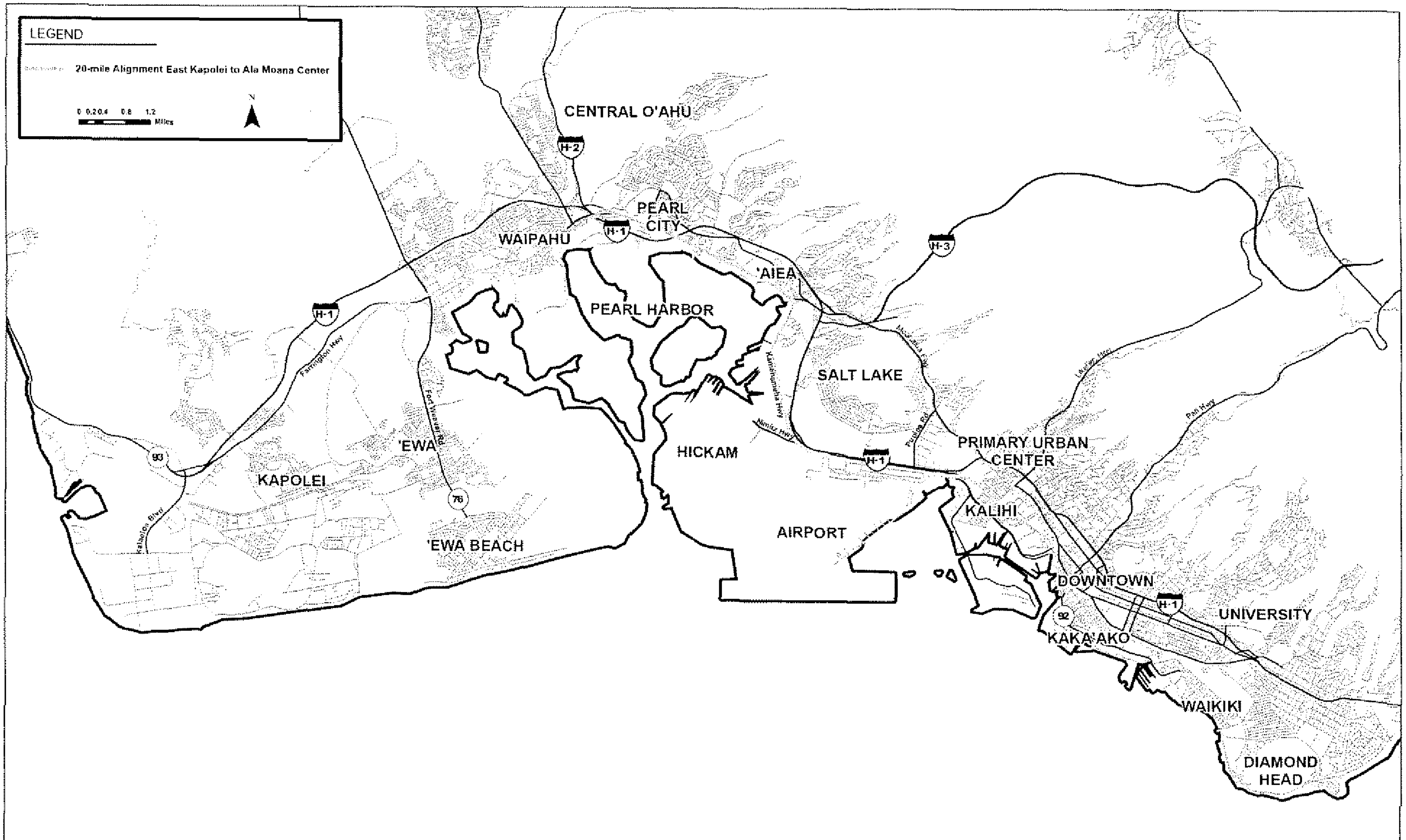

Figure 2-9. Twenty-mile Alignment

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Schedule

Projects developed through the FTA New Starts process progress through many stages from system planning to operation of the project. The Honolulu High-Capacity Transit Corridor Project is currently in the Alternatives Analysis phase, which includes defining and evaluating specific alternatives to address the purpose of and needs for the project discussed in Chapter 1. The anticipated project development schedule for completion of the 20-mile Alignment is shown in Figure 2-10.

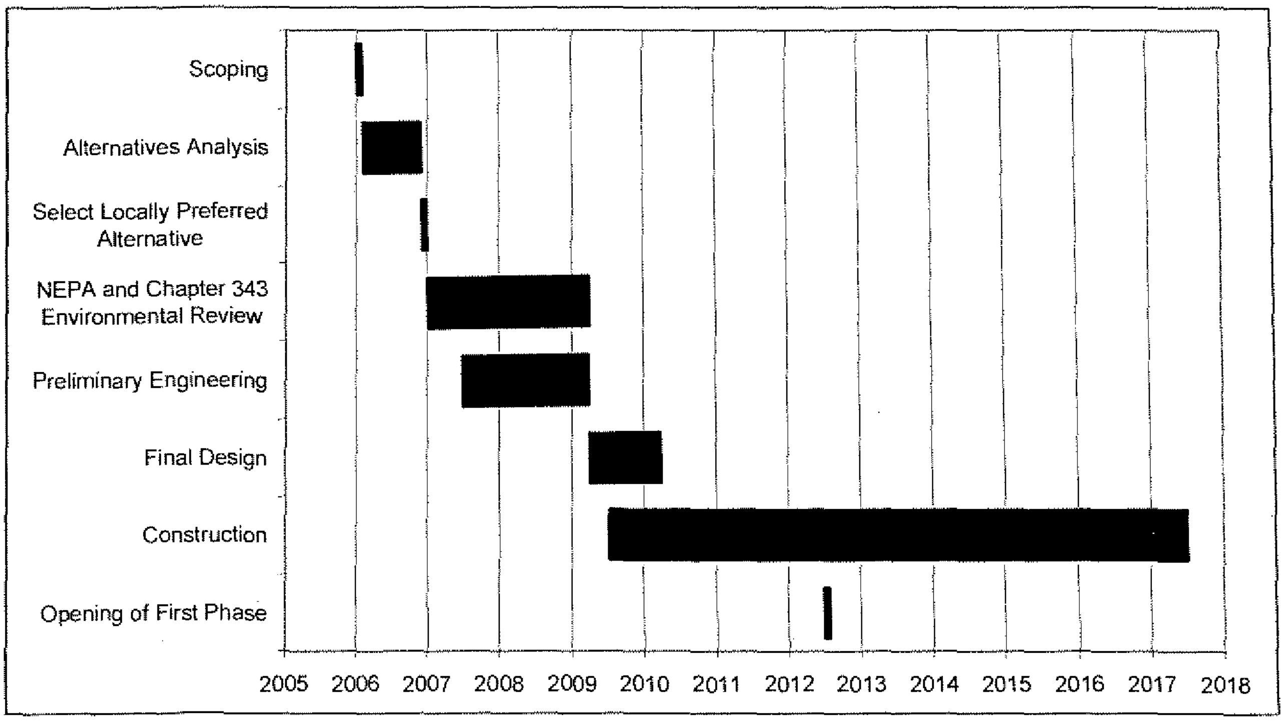

Figure 2-10. Project Schedule

Chapter 3 Transportation Benefits and Impacts

This chapter discusses, for each of the alternatives, the 2030 transportation system conditions; the service characteristics; performance; and transportation impacts. The chapter first presents the projected future travel demand patterns in comparison with existing conditions. The performance of the future alternatives is then compared in terms of transit performance, traffic impacts, non-motorized traffic impacts, and construction impacts. Finally, a summary is presented highlighting key differences among the alternatives.

Transportation Demand and Travel Patterns

This section compares year 2030 projected transportation demand for each alternative to existing travel patterns. To characterize travel patterns within the corridor and islandwide, current and future daily total and peak-period home-based work trips are assessed, along with the projected modes that travelers will use in the future.

Table 3-1 and Table 3-2 show the breakdown of where resident trips originate from and are destined to by the 25 Transportation Analysis Areas that are depicted in Figure 1-3 and Figure 1-4. Table 3-1 compares daily trips for all trip purposes for the year 2030 against those for the year 2005, while Table 3-2 makes a similar comparison for peak-period home-based work trips. Note that these tables represent O'ahu resident trips and do not include visitor trips. The year 2030 trip distribution patterns and average trip lengths are the same for all of the future year alternatives being studied. The mode choice projections vary by alternative and can indicate how effective the transit system is relative to the other alternatives.

Based on Table 3-1 and Table 3-2, an islandwide increase in daily all-purpose trips of 27 percent and an increase of 21 percent for peak period home-based work trips are expected between 2005 and 2030.

A comparison of daily all-purpose trips between 2005 and 2030 indicates that travel patterns will shift in response to the areas of expected growth, both islandwide and within the corridor. Trips to and from the Primary Urban Center areas of Downtown, Kaka'ako, and Punchbowl-Sheridan-Date will show significant increases. The areas of Honouliuli-'Ewa Beach and Kapolei-Ko 'Olina-Kalaeloa are projected to also have large increases in trips both generated and attracted. Kapolei-Ko 'Olina-Kalaeloa shows the greatest increase by far of any area. Other areas 'Ewa of the Primary Urban Core are also projected to have large increases in trips, including 'Aiea-Pearl City, Waipahu-Waikele-Kunia, and Waiawa-Koa Ridge. These projections indicate that more trips will be made to and from the Leeward side of the island and suggest that not only will there be more travel demand in the study corridor, but also that travel directionality in the corridor will change as more jobs are created in Leeward areas. The Wai'anae, Wahiawā, North Shore, Windward, Waimānalo, and East Honolulu areas show little to no increase in peak-period trips.

Table 3-1. Year 2030 Daily Compared to Existing Daily Trips by Transportation Analysis Area, All Modes

Transportation Analysis Area		2005 Daily Trips, All Purposes				2030 Daily Trips, All Purposes					
		Origin		Destination		Origin			Destination		
		Trips[1]	% of Total	Trips[1]	% of Total	Trips[1]	% of Total	Change from 2005	Trips[1]	% of Total	Change from 2005
1*	Downtown	97,000	3.6	224,000	8.3	138,000	4.0	41,000	255,000	7.4	31,000
2*	Kaka'ako	60,000	2.2	125,000	4.6	142,000	4.1	82,000	166,000	4.8	41,000
3*	Punchbowl-Sheridan-Date	156,000	5.8	184,000	6.8	200,000	5.8	44,000	229,000	6.7	45,000
4*	Waikīkī	87,000	3.2	143,000	5.3	100,000	2.9	13,000	160,000	4.7	17,000
5*	Kāhala-Pālolo	167,000	6.2	146,000	5.4	182,000	5.3	15,000	172,000	5.0	26,000
6*	Pauoa-Kalihi	158,000	5.9	113,000	4.2	171,000	5.0	13,000	136,000	4.0	23,000
7*	Iwilei-Māpunapuna-Airport	108,000	4.0	195,000	7.2	126,000	3.7	18,000	216,000	6.3	21,000
8*	Hickam-Pearl Harbor	65,000	2.4	155,000	5.7	69,000	2.0	4,000	168,000	4.9	13,000
9*	Moanalua-Hālawa	168,000	6.2	211,000	7.8	173,000	5.0	5,000	231,000	6.7	20,000
10*	'Aiea-Pearl City	237,000	8.8	180,000	6.7	257,000	7.5	20,000	232,000	6.7	52,000
11*	Honouliuli-"Ewa Beach	119,000	4.4	57,000	2.1	236,000	6.9	117,000	106,000	3.1	49,000
12*	Kapolei-Ko 'Olina-Kalaeloa	50,000	1.9	72,000	2.7	210,000	6.1	160,000	252,000	7.3	180,000
13*	Makakilo-Makaīwa	35,000	1.3	11,000	0.4	60,000	1.8	25,000	19,000	0.6	8,000
14*	Waipahu-Waikele-Kunia	143,000	5.3	110,000	4.1	171,000	5.0	28,000	156,000	4.5	46,000
15*	Waiawa-Koa Ridge	36,000	1.3	27,000	1.0	113,000	3.3	77,000	71,000	2.1	44,000
16	Mililani-Melemanu-Kīpapa	150,000	5.6	88,000	3.3	162,000	4.7	12,000	110,000	3.2	22,000
17	Wahiawā-Whitmore-Schofield	95,000	3.5	100,000	3.7	100,000	2.9	5,000	114,000	3.3	14,000
18	East Honolulu	131,000	4.9	60,000	2.2	139,000	4.0	8,000	67,000	2.0	7,000
19	Kāne'ohe-Kahalu'u-Kualoa	145,000	5.4	91,000	3.4	150,000	4.4	5,000	101,000	2.9	10,000
20	Kailua-Mokapu-Waimānalo	165,000	6.1	134,000	5.0	169,000	4.9	4,000	146,000	4.3	12,000
21	Ko'olauloa	36,000	1.3	37,000	1.4	43,000	1.3	7,000	45,000	1.3	8,000
22	North Shore	49,000	1.8	31,000	1.1	55,000	1.6	6,000	35,000	1.0	4,000
23	Wai'anae Coast	98,000	3.6	66,000	2.4	118,000	3.4	20,000	83,000	2.4	17,000
24*	Mānoa-Tantalus	117,000	4.3	66,000	2.4	129,000	3.8	12,000	83,000	2.4	17,000
25*	University	23,000	0.9	73,000	2.7	25,000	0.7	2,000	82,000	2.4	9,000
	Total[2]	2,698,000	100	2,698,000	100	3,436,100	100	738,100	3,436,100	100	738,100

*Transportation Analysis Area is within the Study Corridor.
[1]Values include resident trips only.
[2]Values may not add exactly to the total because of rounding.

Table 3-2. Year 2030 Compared to Existing Peak-Period Work Trips by Transportation Analysis Area, All Modes

Transportation Analysis Area		2005 Peak-Period Home-Based Work Trips				2030 Peak-Period Home-Based Work Trips					
		Origin		Destination		Origin			Destination		
		Trips[1]	% of Total	Trips[1]	% of Total	Trips[1]	% of Total	Change from 2005	Trips[1]	% of Total	Change from 2005
1*	Downtown	10,000	1.9	69,000	13.2	17,000	2.7	7,000	76,000	12.0	7,000
2*	Kaka'ako	6,000	1.1	28,000	5.4	24,000	3.8	18,000	34,000	5.3	6,000
3*	Punchbowl-Sheridan-Date	28,000	5.4	38,000	7.3	35,000	5.5	7,000	45,000	7.1	7,000
4*	Waikīkī	16,000	3.1	47,000	9.0	17,000	2.7	1,000	51,000	8.1	4,000
5*	Kāhala-Pālolo	34,000	6.5	19,000	3.6	34,000	5.4	0	22,000	3.5	3,000
6*	Pauoa-Kalihi	34,000	6.5	17,000	3.3	35,000	5.5	1,000	19,000	3.0	2,000
7*	Iwilei-Māpunapuna-Airport	13,000	2.5	38,000	7.3	15,000	2.4	2,000	42,000	6.7	4,000
8*	Hickam-Pearl Harbor	5,000	1.0	39,000	7.5	5,000	0.8	0	42,000	6.7	3,000
9*	Moanalua-Hālawa	29,000	5.5	43,000	8.2	27,000	4.3	-2,000	45,000	7.1	2,000
10*	'Aiea-Pearl City	48,000	9.2	23,000	4.4	47,000	7.4	-1,000	30,000	4.7	7,000
11*	Honouliuli-'Ewa Beach	28,000	5.4	7,000	1.3	52,000	8.2	24,000	14,000	2.1	7,000
12*	Kapolei-Ko 'Olina-Kalaeloa	8,000	1.5	16,000	3.1	34,000	5.4	26,000	48,000	7.7	32,000
13*	Makakilo-Makaīwa	9,000	1.7	1,000	0.2	14,000	2.2	5,000	3,000	0.5	2,000
14*	Waipahu-Waikele-Kunia	28,000	5.4	13,000	2.5	31,000	4.9	3,000	21,000	3.3	8,000
15*	Waiawa-Koa Ridge	8,000	1.5	6,000	1.1	24,000	3.8	16,000	13,000	2.1	7,000
16	Mililani-Melemanu-Kīpapa	33,000	6.3	11,000	2.1	33,000	5.2	0	14,000	2.2	3,000
17	Wahiawā-Whitmore-Schofield	18,000	3.4	24,000	4.6	17,000	2.8	-1,000	26,000	4.0	2,000
18	East Honolulu	32,000	6.1	7,000	1.3	32,000	5.0	0	7,000	1.1	0
19	Kāne'ohe-Kahalu'u-Kualoa	32,000	6.1	12,000	2.3	32,000	5.0	0	13,000	2.0	1,000
20	Kailua-Mokapu-Waimānalo	34,000	6.5	25,000	4.8	33,000	5.1	-1,000	26,000	4.1	1,000
21	Ko'olauloa	7,000	1.3	6,000	1.1	8,000	1.2	1,000	6,000	1.0	0
22	North Shore	11,000	2.1	4,000	0.8	11,000	1.8	0	4,000	0.7	0
23	Wai'anae Coast	21,000	4.0	8,000	1.5	24,000	3.8	3,000	9,000	1.4	1,000
24*	Mānoa-Tantalus	29,000	5.5	7,000	1.3	30,000	4.8	1,000	9,000	1.5	2,000
25*	University	2,000	0.4	13,000	2.5	2,000	0.3	0	14,000	2.2	1,000
	Total[2]	523,000	100	523,000	100	632,200	100	109,200	632,200	100	109,200

* Transportation Analysis Area is within the Study Corridor.
[1]Values include resident trips only.
[2]Values may not add exactly to the total because of rounding.

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The home-based work data illustrate patterns similar to daily trips and provides additional evidence of increasing employment opportunities outside the Primary Urban Center with a shift to the Leeward areas. Honouliuli-'Ewa Beach and Kapolei-Ko 'Olina-Kalaeloa are projected to post the largest increases in origin trips, and Kapolei-Ko 'Olina-Kalaeloa the largest increase in destination trips. The Downtown area remains the single highest destination for peak-period home-based work trips.

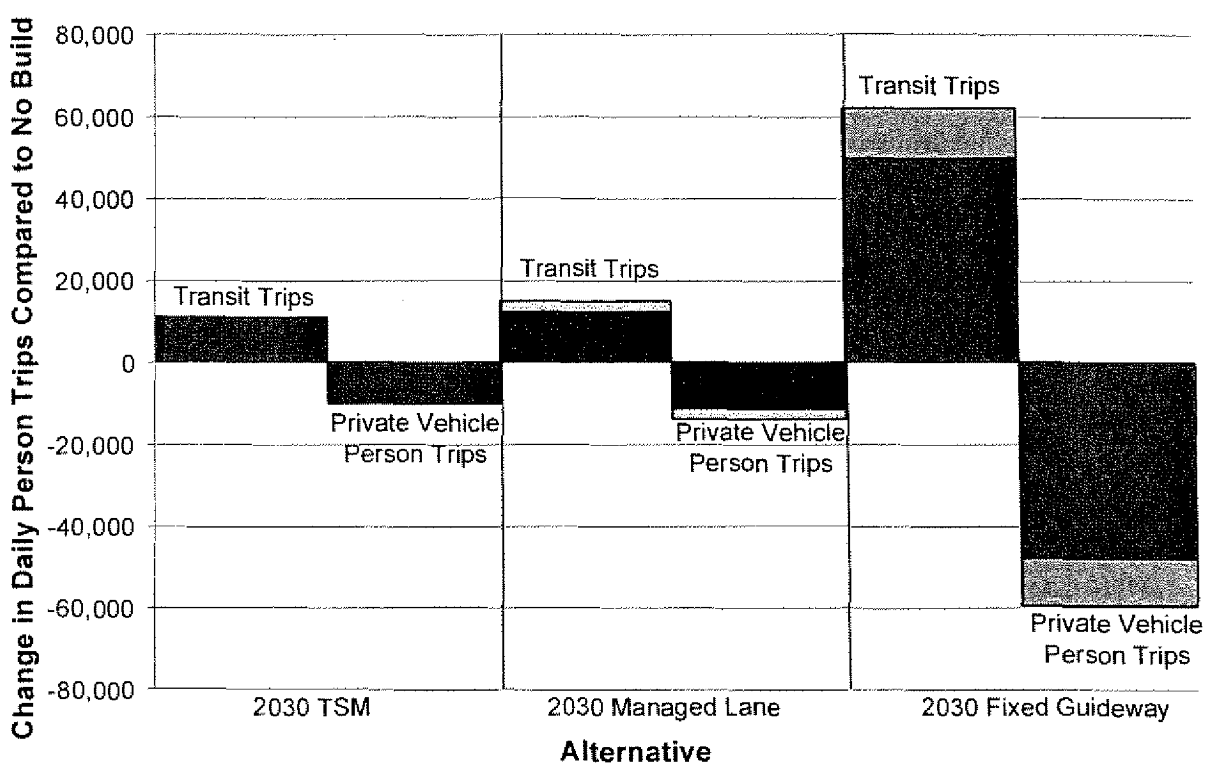
Systemwide Travel by Mode

Figure 3-1 compares the alternatives estimated average weekday trips by mode to the No Build Alternative for year 2030. Table 3-4 shows the estimated transit mode share of home-based work trips. These trips are typically more representative of peak travel periods. The following sub-sections discuss the results for each alternative. Figure 3-1 compares the changes from the No Build Alternative in daily transit trips and private vehicle trips for the TSM, Managed Lane, and Fixed Guideway Alternatives.

Table 3-3. Total Daily Person Trips by Mode

Alternative	Transit Trips	Vehicle Trips	Bicycle/Walk Trips	Total Trips[1]
2005 Existing Conditions				
Existing Conditions	178,400	2,370,000	450,100	2,998,500
% Mode Share	*5.9%*	*79.0%*	*15.0%*	*100%*
Alternative 1: 2030 No Build				
No Build Alternative	232,100	3,022,100	547,300	3,801,500
% Mode Share	*6.1%*	*79.5%*	*14.4%*	*100%*
Alternative 2: 2030 Transportation System Management				
TSM Alternative	243,100	3,011,900	546,600	3,801,600
% Mode Share	*6.4%*	*79.2%*	*14.4%*	*100%*
Alternative 3: 2030 Managed Lane				
Two-direction Option	247,000	3,008,200	546,500	3,801,700
% Mode Share	*6.5%*	*79.1%*	*14.4%*	*100%*
Reversible Option	244,400	3,010,700	546,700	3,801,800
% Mode Share	*6.4%*	*79.2%*	*14.4%*	*100%*
Alternative 4: 2030 Fixed Guideway				
Kalaeloa - Salt Lake - North King - Hotel	293,600	2,962,100	546,300	3,802,000
% Mode Share	*7.7%*	*77.9%*	*14.4%*	*100%*
Kamokila - Airport - Dillingham - King with a Waikīkī Branch	287,800	2,968,700	546,500	3,803,000
% Mode Share	*7.6%*	*78.1%*	*14.4%*	*100%*
Kalaeloa - Airport - Dillingham - Halekauwila	294,100	2,962,500	546,000	3,802,600
% Mode Share	*7.7%*	*77.9%*	*14.4%*	*100%*
20-mile Alignment East Kapolei to Ala Moana Center	281,900	2,974,100	546,200	3,802,200
% Mode Share	*7.4%*	*78.2%*	*14.4%*	*100%*

[1]Includes resident transit trips, visitor transit, resident vehicle, and non-motorized trips.



The range between the maximum and minimum number of trips for each alternative depends on the option selected.

Figure 3-1. Change in Islandwide 2030 Daily Person Trips by Mode Compared to No Build

Table 3-4. Transit Mode Share for Home-based Work Trips by Alternative

Alternative	% Transit Mode Share
2005 Existing Conditions	
Existing Conditions	10.9%
Alternative 1: 2030 No Build	
No Build Alternative	11.2%
Alternative 2: 2030 Transportation System Management	
TSM Alternative	12.1%
Alternative 3: 2030 Managed Lane	
Two-direction Option	12.6%
Reversible Option	12.3%
Alternative 4: 2030 Fixed Guideway	
Kalaeloa - Salt Lake - North King - Hotel	16.2%
Kamokila - Airport - Dillingham - King with a Waikīkī Branch	15.7%
Kalaeloa - Airport - Dillingham - Halekauwila	16.2%
20-mile Alignment East Kapolei to Ala Moana Center	15.2%

Alternative 1: No Build

As compared to year 2005, total systemwide daily person trips are projected to increase by about 27 percent for the No Build Alternative in 2030, keeping pace with the projected growth in population between 2005 and 2030. Transit mode share for total daily trips as well as home-based work trips (Table 3-4) is expected to increase slightly over the current mode share. The enhancement of the HOV and zipper-lane systems provides some additional benefits, and hence, attractiveness, to the transit mode.

Alternative 2: Transportation System Management (TSM)

As shown in Table 3-3 and Table 3-4, the TSM Alternative, as a result of its enhanced bus service, results in a slightly higher transit mode share, at 6.4 percent (daily trips) and 12.1% (home-based work trips), than the No Build Alternative. Private vehicle trips and non-motorized trips are projected to decrease slightly in comparison to the No Build Alternative as more people are attracted to transit (Figure 3-1).

Alternative 3: Managed Lane

Both Managed Lane Alternative options, as shown in Table 3-3 and Table 3-4, are expected to result in a slightly higher transit mode share for daily trips (6.4 to 6.5 percent) as well as for home-based work trips (12.3 to 12.6 percent) than either the No Build or TSM Alternatives. The projected increase in transit trips and decrease in private vehicle trips is similar to that of the TSM Alternative (Figure 3-1).

Alternative 4: Fixed Guideway

All of the Fixed Guideway Alternative options are expected to experience significantly higher systemwide daily transit ridership and mode share in comparison with all of the other alternatives, as shown in Table 3-3. The three alignment combination options are expected to result in transit mode shares of 7.6 to 7.7 percent for daily trips and up to 16.2% for home-based work trips (Table 3-4). The Fixed Guideway options also see an increase in total daily transit trips over the No Build Alternative by 55,700 to 62,000 trips (Figure 3-1). The vast majority of these trips are drawn away from the highway mode as automobile travel is expected to decrease by 53,400 to 60,000 trips. Of the three combination options, the Kalaeloa - Airport - Dillingham - Halekauwila combination is projected to experience the highest transit ridership with 294,100 trips. The 20-mile Alignment is expected to result in a transit mode share of 7.4 percent and an increase over the No Build Alternative of more than 46,000 transit trips (Figure 3-1). The transit mode share for home-based work trips for the 20-mile Alignment, 15.2 percent, is comparable with those of the Full-corridor Alignments. Similar to the Full-corridor Alignments, the bulk of these trips are expected to be drawn from the highway mode as automobile travel is projected to decrease by 44,600 trips in comparison to the No Build Alternative, by 33,000 as compared to the TSM Alternative, and by 28,000 to 29,000 trips as compared to the Managed Lane Alternative options.

Transit

This section presents data for transit performance for each alternative. Characteristics of transit service, transit ridership, and user benefits have been identified as the major performance indicators of transit.

Transit Service

Description of Service Plan

Significant characteristics of the proposed bus transit service plan for each of the alternatives are discussed in this section. Table 2-1 compares bus fleet size requirements for the proposed plans for each of the alternatives with year 2005 requirements.

Alternative 1: No Build
In anticipation of increased roadway congestion and slower overall bus transit speeds, the No Build Alternative's transit component would include an increase in fleet size to allow service frequencies to remain close to what they are today. It would also include new bus service to serve proposed growth areas (e.g., Kapolei), and restructured "hub-and-spoke" service to serve the regional transit centers.

The No Build Alternative includes a small increase in the number of buses required for the time period of analysis. The number of additional buses purchased would need to be adequate to support increasing demand while maintaining the current level of service. Given this assumption, TheBus fleet would need to be increased by 89 vehicles, from an existing fleet size of 525 buses to 614 buses in the year 2030 (Table 2-1).

Alternative 2: Transportation System Management (TSM)
Three types of service modifications have been identified for the TSM Alternative to provide the best mobility without a major capital project to serve the population and employment growth in the project corridor. The first includes frequency adjustments, primarily during peak periods to serve work trip demands. Frequency adjustments involve adding trips to community circulators, limited-stop express routes, and ferry services.

The second modification is the addition of three peak-period bus express routes to serve the corridor and Downtown from developing areas such as Royal Kunia, Koa Ridge, and Waiawa.

The third modification is the restructuring of bus services in Pearl City and ʻAiea to focus on the new transit center proposed there and the extension of some urban Honolulu bus routes farther into local neighborhoods.

The TSM Alternative would require a fleet increase from 525 buses to 765 buses (Table 2-1). The increase in buses would accommodate future projected growth. Additionally, the following park-and-ride lots would be added:

- Kapolei Parkway/Hanua Street - 1,200 parking stalls
- UH West Oʻahu off of North-South Road - 1,700 parking stalls

- Ka Uka Road/H-2 - 1,000 parking stalls
- Aloha Stadium - 1,300 parking stalls.

The park-and-ride facilities would be located to intercept vehicles prior to the major choke points of the freeway system, such as occurs at the Waiawa Interchange of H-1 with H-2. The location for Central O'ahu residents would be near Ka Uka Boulevard and H-2. Residents would drive to the park-and-ride facility to access buses for their trip to town. Buses during the peak travel period would depart approximately every five minutes.

Wai'anae Coast and West Kapolei residents would be able to use the Kapolei Parkway and Hanua Street park-and-ride facility.

Alternative 3: Managed Lane

The bus network would be structured to support access to the managed lane via bus transfers at park-and-ride locations as well as by the addition of express bus routes using the Managed Lane viaduct. The two design variations for the Managed Lane Alternative offer a limited number of access points in order to maintain free-flowing lane operations. Bus operations for the managed lane facility would be staged from park-and-ride facilities to serve Central and Leeward O'ahu residents. As in the TSM Alternative, new park-and-ride lots would be located at the following sites:

- Kapolei Parkway/Hanua Street - 1,200 parking stalls
- UH West O'ahu off of North-South Road - 1,700 parking stalls
- Ka Uka Road/H-2 - 1,000 parking stalls
- Aloha Stadium - 1,300 parking stalls.

The park-and-ride planned at the intermediate access point at Aloha Stadium would be within the stadium's parking lot adjacent to the managed lane's on- and off-ramps. The lot would be integrated with the managed lane access ramps so transit riders could access the bus system via this intermediate access point.

The enhanced bus system would include an increase in fleet size (Table 2-1). Based on the redesigned bus network for the Managed Lane Alternative, it is estimated that 321 new buses beyond the existing fleet would need to be added for the two-direction Managed Lane facility and 381 new buses would need to be added for the reversible Managed Lane facility to provide a sufficient fleet to perform operations as planned. These additional buses would create a fleet size of 846 buses for the two-direction facility and 906 buses for the reversible facility. In addition, the normal schedule of bus replacement every 12 years would be executed.

All supporting maintenance facilities and services included in the TSM Alternative are also included in the Managed Lane Alternative. In addition, the Managed Lane Alternative includes additional express bus services dedicated to utilize the managed lane.

Alternative 4: Fixed Guideway

Multiple alignment options through most sections of the corridor were analyzed for the Fixed Guideway Alternative. As a result of these analyses, three Full-corridor Alignment combinations were selected for thorough analysis and presentation in this report along with one 20-mile Alignment option.

Most of the changes to the transit network for the Fixed Guideway Alternative result from adjustments to provide access to the fixed guideway stations. The fixed guideway system allows many of the existing and planned future express long-haul routes to be shortened or rerouted where the fixed guideway provides improved service. Local buses and community circulators would provide increased service frequency and would include stops at nearby fixed guideway stations to provide access to the fixed guideway system. The reduced requirement for long-haul express buses and the increased frequency of the local and community circulator buses create a large improvement in the overall performance of the bus transit network while not requiring a significant number of new buses for the greatly improved service.

Service from areas outside of the corridor would be modified to provide the most convenient access to the fixed guideway stations. For example, express buses from the Wai'anae area would provide direct access to the fixed guideway stations at Hanua Street and the Kapolei Transit Center. Express buses from Central O'ahu would provide access to the Pearl Highlands Station. Express routes that deviate more than five minutes from the Fixed Guideway alignments would not be revised and would continue to serve their routes as planned. This would ensure a continuity of express service for those who cannot take advantage of the fixed guideway.

Community circulator buses would provide service at shorter headways than are currently operating. This would improve service within communities and provide more opportunities for people to use transit.

Park-and-ride lots proposed to support the Fixed Guideway Alternative options are listed in Table 3-5. The park-and-ride facilities would be located to provide an opportunity for parking vehicles prior to the major choke points of the freeway system. Wai'anae Coast and West Kapolei residents would be able to use the Kapolei Parkway and Hanua Street park-and-ride facility. 'Ewa Beach residents could use either the lot at Saratoga Avenue /North-South Road or UH West O'ahu (either the one on North-South Road or on Farrington Highway) depending on the Fixed Guideway alignment.

Central O'ahu residents could use either the Ka Uka Boulevard and H-2 facility or drive directly to the Pearl Highlands Station (Kamehameha Highway and Kuala Street) to use the proposed facility there. A new ramp from H-2 is proposed to allow both transit vehicles and park-and-ride automobiles direct access into the proposed Pearl Highlands Station park-and-ride lot.

Another park-and-ride is planned near Aloha Stadium. For the Kamokila - Airport - Dillingham - King with a Waikīkī Branch and Kalaeloa - Airport - Dillingham - Halekauwila combinations, as well as the 20-mile Alignment, this facility would be within the Aloha Stadium parking lot adjacent to the fixed guideway station. For the Kalaeloa - Salt Lake - North King - Hotel combination, the lot would be located at Salt Lake Boulevard and Kahuapa'ani Street. The proposed size of the facilities as indicated in Table 3-5 reflects the expected demand for their use as determined by the travel demand forecasting model.

Table 3-5. Park-and-Ride Lot Locations and Size for the Fixed Guideway Alternative Alignment Combinations

Park-and-Ride Location	Kalaeloa - Salt Lake - North King - Hotel	Kamokila - Airport - Dillingham - King with a Waikīkī Branch	Kalaeloa - Airport - Dillingham - Halekauwila	20-mile Alignment East Kapolei to Ala Moana Center
Kapolei Parkway /Hanua Street	1,200 stalls	1,200 stalls	1,200 stalls	n/a
Saratoga Avenue/Renton Road/North-South Road	1,650 stalls	1,650 stalls	1,650 stalls	n/a
UH West O'ahu at North-South Road, south of Farrington Highway	1,700 stalls	n/a	2,100 stalls	1,700 stalls
UH West O'ahu at Farrington Highway and Kapolei Golf Course Road	n/a	1,700 stalls	n/a	n/a
Ka Uka Boulevard and H-2 Freeway	1,000 stalls	1,000 stalls	1,000 stalls	1,000 stalls
Pearl Highlands (Kamehameha Highway/Kuala Street)	1,500 stalls	1,500 stalls	1,500 stalls	1,500 stalls
Aloha Stadium	n/a	1,300 stalls	1,500 stalls	1,500 stalls
Salt Lake Boulevard/ Kahuapa'ani Street	1,300 stalls	n/a	n/a	n/a

The supporting bus system would represent a 12 to 15 percent decrease in required fleet size as compared to the No Build Alternative, but would be similar to or a slight increase over the current bus fleet size (Table 2-1). This is in major contrast to both the TSM and Managed Lane Alternatives, which would require significant increases in bus fleet size.

Transit Travel Times

Table 3-6 shows the future estimated transit travel times between 10 selected study corridor location pairs, as well as for the existing year 2005. For added context, estimated single-occupant auto travel times for the existing year 2005 as well as the year 2030 No Build Alternative are also presented. The locations of the origins and destinations comprising the travel routes for which times are estimated are shown in Figure 3-2.

Table 3-6. A.M. Peak-hour Transit Travel Times by Alternative (in minutes)

Alternative	From Wai'anae To Downtown	From Kapolei To Downtown	From 'Ewa To Downtown	From Waipahu To Downtown	From Mililani Mauka To Downtown	From Pearlridge Center To Downtown	From Downtown To Ala Moana Center	From Downtown To Waikīkī	From Downtown To UH Mānoa	From Airport To Waikīkī
	Travel origin and destination									
2005 Existing Conditions										
Walk to Transit	87	65	68	53	90	46	18	32	31	70
Drive to Transit*	N/A	N/A	N/A	N/A	67	N/A	N/A	N/A	N/A	N/A
Auto Travel Time	81	58	60	45	60	33	17	23	21	36
Alternative 1: 2030 No Build										
Walk to Transit	79	68	67	69	78	51	18	34	41	72
Drive to Transit	N/A	N/A	N/A	N/A	67	N/A	N/A	N/A	N/A	N/A
Auto Travel Time	83	62	70	53	60	35	17	24	22	38
Alternative 2: 2030 Transportation System Management										
Walk to Transit	79	67	67	57	61	46	15	33	31	72
Drive to Transit	68	57	59	N/A	57	41	N/A	N/A	N/A	N/A
Alternative 3: 2030 Managed Lane										
Two-direction Option										
Walk to Transit	87	70	70	52	61	40	19	33	35	68
Drive to Transit	74	63	65	N/A	53	N/A	N/A	N/A	N/A	N/A
Reversible Option										
Walk to Transit	89	72	72	56	66	41	20	33	35	69
Drive to Transit	75	65	67	N/A	58	N/A	N/A	N/A	N/A	N/A
Alternative 4: 2030 Fixed Guideway										
Kalaeloa - Salt Lake - North King - Hotel										
Walk to Transit	79	51	59	34	55	29	13	28	24	63
Drive to Transit	63	43	45	32	38	29	N/A	N/A	N/A	N/A
Kamokila - Airport - Dillingham - King with a Waikīkī Branch										
Walk to Transit	79	54	72	39	59	33	15	21	28	31
Drive to Transit	63	47	49	36	43	31	N/A	N/A	N/A	N/A
Kalaeloa - Airport - Dillingham - Halekauwila										
Walk to Transit	85	55	66	41	61	35	17	40	28	42
Drive to Transit	70	49	51	39	45	33	N/A	N/A	N/A	N/A
20-mile Alignment East Kapolei to Ala Moana Center										
Walk to Transit	85	65	63	41	61	35	17	33	31	42
Drive to Transit	66	49	50	39	45	33	N/A	N/A	N/A	N/A

* A drive to transit trip indicates a trip where the transit user drove to a park-and-ride lot to access transit.

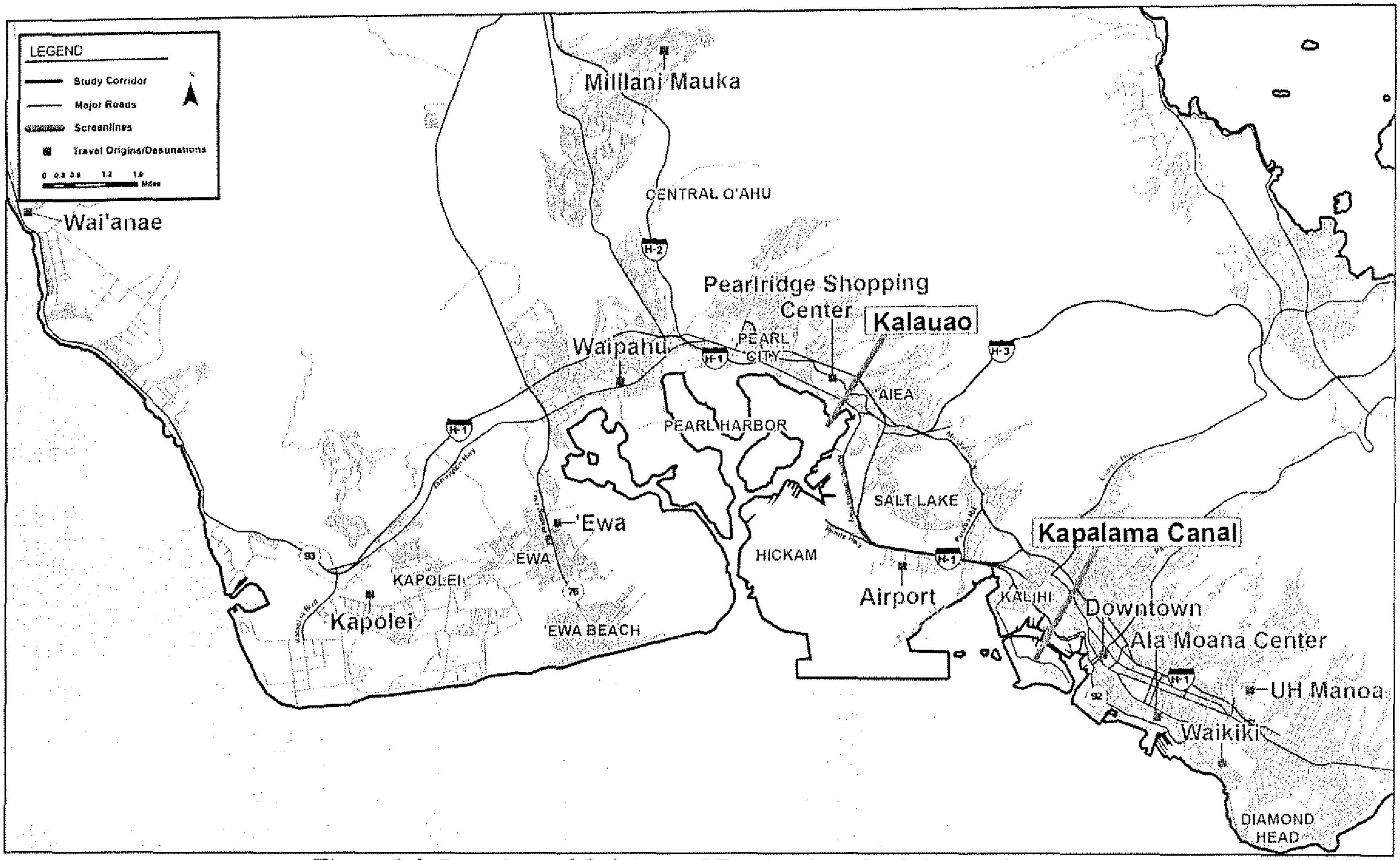


Figure 3-2. Locations of Origins and Destinations for Selected Travel Time Routes and Screenlines

Alternative 1: No Build

As shown in Table 3-6, auto travel times for the No Build Alternative are either the same or longer than existing conditions between all origins and destinations selected, despite the fact that the "No Build" Alternative includes $3 billion of roadway improvements that are included in the ORTP. However, the No Build Alternative also results in longer travel times for transit trips for many of the selected pairs. Some transit travel times, such as from Wai'anae to Downtown and from Mililani Mauka to Downtown, are projected to improve in the 2030 No Build Alternative. This is because these trips are able to take advantage of the extended HOV lanes on H-1; the improved operations of the zipper lane, which is assumed to be limited to three or more occupant vehicles by the year 2030; and/or the proposed Nimitz Flyover facility, which will give priority to HOVs and transit vehicles. Additionally, the transit travel time from Mililani Mauka to Downtown improves because it is assumed that bus service will be extended farther into the neighborhood, hence shortening walk access time.

Alternative 2: Transportation System Management (TSM)

Transit travel times for the year 2030 TSM Alternative are expected to generally improve over the No Build Alternative (Table 3-6). In most cases, the savings are due to the higher frequency of service and the shorter wait times for riders. Some locations experience larger travel time benefits due to new express routes added for this alternative. The TSM Alternative also has a number of additional park-and-ride lots, and travel times would improve for those riders using these lots.

In general, travel time benefits are moderate at best for the TSM Alternative as compared to the No Build. Table 3-6 shows that even by optimizing the bus system, only a marginal benefit in travel time would be gained because more buses on the road would not improve travel times in a majority of cases.

Alternative 3: Managed Lane

Table 3-6 shows that the Managed Lane Alternative options provide some transit travel time benefit for selected trips in comparison with the No Build and TSM Alternatives, but the majority of travel times either stays the same or gets worse. The Managed Lane Alternative options are projected to improve transit travel times for some origins and destination pairs that are particularly well served by the managed lane (e.g., Waipahu Transit Center to Downtown and Mililani to Downtown). In general however, the two Managed Lane options would increase traffic on the overall roadway system and create more delay for buses. While bus speeds on the managed lanes are projected to be relatively high, the H-1 freeway leading up to the managed lanes is projected to become more congested when compared to the other alternatives, because cars accessing the managed lanes would increase traffic volumes in those areas. Additionally, significant congestion is anticipated to occur where the managed lanes connect to Nimitz Highway at Pacific Street near Downtown. Nimitz Highway is already projected to be over capacity at this point, and the addition of high volumes of traffic exiting and entering the managed lanes would create increased congestion and high levels of delay for all vehicles using the facility, including buses. Hence, much of the time saved on the managed lane itself would be negated by the time spent in congestion leading up to the managed lane as well as exiting the lanes at their Downtown terminus. These impacts are more pronounced with the Reversible Option as compared to the Two-direction Option because it accommodates a higher volume of traffic in the peak direction and thus experiences greater congestion. Additionally, areas that are not directly served by the managed lane, such as from the Airport to Waikīkī, would not experience much change from the No Build or TSM Alternative projections. Hence, although the Managed Lane Alternative would provide some travel-time improvement for certain areas, it has significant limitations with regard to improving travel times or transit service for a broader customer base.

Alternative 4: Fixed Guideway

In general, the four Fixed Guideway options provide the fastest transit travel times of all the alternatives and are often either as fast as, or faster than, projected auto travel time for the No Build Alternative (Table 3-6). In particular, "drive-to-transit" trips (i.e., park-and-ride transit trips) provide significant savings from several locations (e.g., Wai'anae, 'Ewa, and Mililani).

Among the Fixed Guideway Alternative options, the Kalaeloa - Salt Lake - North King - Hotel combination would result in slightly faster travel times from the Leeward side to Downtown because of a shorter alignment through the Salt Lake community - as opposed to traveling past the Airport - and a more central location Downtown (i.e., Hotel Street rather than Halekauwila Street). However, trips from the Airport would be significantly longer for this option as compared to the others.

The Kamokila - Airport - Dillingham - King with a Waikīkī Branch combination, in general, shows similar benefits for transit as the Kalaeloa - Salt Lake - North King - Hotel combination, although it is a few minutes slower for many trips because of the longer alignment that serves the Airport. However, since this alignment provides direct service to Waikīkī, transit travel times to and from Waikīkī are expected to be much faster than all other alternatives and options.

The Kalaeloa - Airport - Dillingham - Halekauwila combination also has similar patterns to the other combinations. However, because of the longer alignment makai into Kalaeloa along Saratoga Avenue, as well as the location of stations on the edge of Downtown (e.g., Nimitz Highway/Fort Street and South Street/Halekauwila Street) rather than in the center of Downtown, walk-to-transit travel times from Wai'anae would be longer than transit travel times for the No Build Alternative; however, drive-to-transit travel times are shorter.

Other than the Kapolei to Downtown walk-to-transit travel time, which is 10 to 14 minutes longer, the Fixed Guideway 20-mile Alignment generally shows the same pattern as the other Fixed Guideway Alternative combinations. Even with a shorter overall service length and some longer travel times as compared to the Full-corridor Alignments, the 20-mile Alignment provides transit travel times that compare favorably to the other alternatives, and are competitive with the 2030 auto travel times in most cases.

Transit Ridership

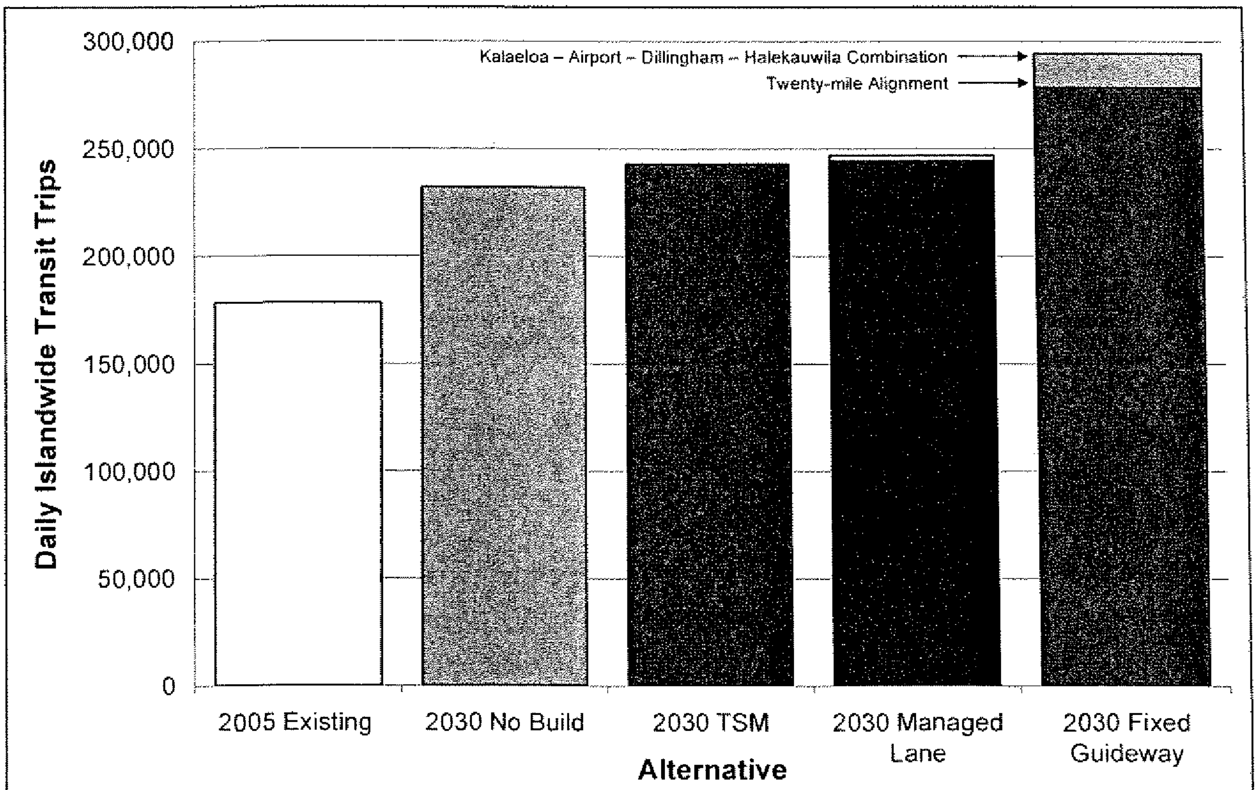
Table 3-7 and Figure 3-3 present daily transit ridership for year 2005 as well as estimated transit ridership for each of the year 2030 alternatives, and Table 3-8 shows estimated a.m. peak two-hour ridership. The ridership numbers are presented in terms of bus or fixed guideway trips, as well as in terms of total boardings. Note that the number of transit vehicle boardings is higher than the number of total trips because of transfers.

Table 3-7. Daily Transit Ridership

Alternative	Fixed Guideway Trips	Total Transit Trips	Total Transit Boardings
2005 Existing Conditions			
Existing Conditions	NA	178,400	243,100
Alternative 1: No Build			
No Build Alternative	NA	232,100	330,600
% Change from Existing Conditions	--	30%	36%
Alternative 2: Transportation System Management			
TSM Alternative	NA	243,100	354,200
% Change from No Build Alternative	--	4.7%	7.1%
Alternative 3: Managed Lane			
Two-direction Option	NA	247,000	363,700
% Change from No Build Alternative	--	6.4%	10%
Reversible Option	NA	244,400	363,700
% Change from No Build Alternative	--	5.3%	10%
Alternative 4: Fixed Guideway			
Kalaeloa - Salt Lake - North King - Hotel	128,500	293,600	468,800
% Change from No Build Alternative	--	27%	42%
Kamokila - Airport - Dillingham - King with a Waikīkī Branch	122,500	287,800	449,300
% Change from No Build Alternative	--	24%	36%
Kalaeloa - Airport - Dillingham - Halekauwila	123,700	294,100	468,300
% Change from No Build Alternative	--	27%	42%
20-mile Alignment East Kapolei to Ala Moana Center	95,000	281,900	455,300
% Change from No Build Alternative	--	21%	38%

Alternative 1: No Build

The No Build Alternative is forecast to have the lowest ridership of any of the alternatives, as shown in Table 3-7 and Table 3-8. The No Build Alternative is expected to keep pace with population growth and increase over the 2005 existing conditions by 30 percent. Transit boardings are projected to increase at a slightly higher pace, primarily reflecting additional transfers in the system (about 4.5% more) that would result from route restructuring to focus on transit hubs throughout the network. The majority of the a.m. peak-period transit trips are relatively short and stay within the same community area they originate in, or else terminate in the adjacent community area. This suggests that transit for the No Build Alternative is not conducive to longer trips because of the slow travel times experienced as a result of the congested roadway network.



The range between the maximum and minimum number of trips for each alternative depends on the option selected.

Figure 3-3. Islandwide Daily Transit Trips for All Alternatives

Table 3-8. A.M. Peak Two-hour Transit Ridership

Alternative	Transit Trips	% Change from No Build
2005 Existing Conditions		
Existing Conditions	29,110	N/A
Alternative 1: 2030 No Build		
No Build Alternative	37,970	N/A
Alternative 2: 2030 Transportation System Management		
TSM Alternative	40,220	5.9%
Alternative 3: 2030 Managed Lane		
Two-direction Option	41,220	8.6%
Reversible Option	40,600	6.9%
Alternative 4: 2030 Fixed Guideway		
Kalaeloa - Salt Lake - North King - Hotel	50,730	34%
Kamokila - Airport - Dillingham - King with a Waikīkī Branch	49,280	30%
Kalaeloa - Airport - Dillingham - Halekauwila	50,600	33%
20-mile Alignment East Kapolei to Ala Moana Center	48,110	27%

Alternative 2: Transportation System Management (TSM)
Transit ridership for the TSM Alternative is expected to increase over the No Build Alternative by 4.7 percent in terms of transit trips and by 7.1 percent in terms of boardings, as shown in Table 3-7. The increase in transit trips is a reflection of the enhanced transit service provided by the alternative, whereas the slightly higher increase in boardings reflects a higher number of transfers that would likely result from the increased use of transit hubs. The TSM Alternative results in an increase of 2,250 a.m. peak-period trips, or 5.9 percent compared to the No Build Alternative (Table 3-8). The largest increase in absolute numbers of trips is in the ʻEwa and Kapolei areas. Similar to the pattern exhibited in the No Build Alternative, these trips are primarily short trips with destinations either within the same area of origin or immediately adjacent to it.

Alternative 3: Managed Lane
Transit ridership for the Managed Lane Alternative options is expected to increase over the No Build Alternative by 12,300 to 14,900 daily transit trips or approximately 5.3 to 6.4 percent, as shown in Table 3-7. This is a very small increase (0.5 to 1.6 percent) over the ridership projected for the TSM Alternative. Regarding the change in a.m. peak-period transit trips, the Managed Lane Alternative options show an increase in overall trips of 3,250 (8.6 percent) and 2,610 (6.9 percent) as compared to the No Build Alternative for the Two-direction Option and Reversible Option, respectively. These increases are slightly more than the increase exhibited by the TSM Alternative. The Managed Lane Alternative tends to do a better job of facilitating longer transit trips than either the No Build or TSM Alternatives; for example Waikīkī is experiencing a relatively high number of additional transit trips to it from places such as Honouliuli-'Ewa Beach and Waiawa-Koa Ridge.

Alternative 4: Fixed Guideway
Daily transit ridership for the Fixed Guideway Alternative is expected to increase over the No Build Alternative by approximately 24 to 27 percent for the Full-corridor Alignments and by 21 percent for the 20-mile Alignment, as shown in Table 3-7. This is a substantially greater increase in ridership as compared to either the TSM or Managed Lane Alternatives. Of the three combination alignment options, Kalaeloa - Airport - Dillingham - Halekauwila is projected to have the most systemwide daily transit trips at 294,100. Total daily transit boardings increase by 36 to 42 percent compared to the No Build Alternative. Note that even the 20-mile Alignment attracts significantly more transit trips and boardings than any of the non-Fixed Guideway alternatives.

The fixed guideway system would provide the greatest benefit to transit users in terms of overall a.m. peak-period transit use and connectivity within the study corridor. In particular, across all of the Fixed Guideway combinations, there is a large increase in the number of long-distance transit trips made. Transit trips made to Downtown and Waikīkī increase by two times or more from the areas of ʻAiea - Pearl City, ʻEwa - Honouliuli, Kapolei - Ko ʻOlina - Kalaeloa, and Waiawa - Koa Ridge. These areas are high-demand destinations for the transit market in the non-Fixed Guideway alternatives as well. With the fixed guideway, however, transit is used to access these destinations from much farther distances. Access to UH Mānoa from points west is also greatly increased, particularly from ʻEwa - Honouliuli and Kapolei - Ko ʻOlina - Kalaeloa. There is also a large increase in transit trips from all areas to Kapolei - Ko 'Olina - Kalaeloa, which illustrates that the fixed guideway would support the increase in commute trips within the corridor destined for West O'ahu.

The greatest impact of the transit system on the overall transportation network is during the peak commuter travel periods. It is during this period that attracting more travelers to transit will pay the largest dividends in terms of increased system mobility. In comparison to the non-Fixed Guideway alternatives, the Fixed Guideway Alternative combinations show the largest increase in total a.m. peak-period transit trips over the No Build Alternative by a significant margin (Table 3-8). The Full-corridor Alignments show increases ranging from 11,310 to 12,760 transit trips, which are 30 to 34 percent increases. The 20-mile Alignment option is also expected to attract a significant number of a.m. peak-period trips (10,140) over the No Build Alternative, representing a 27 percent increase.

Table 3-9 shows projected daily fixed guideway boardings by station for each of the Fixed Guideway alignment options, as well as the 20-mile Alignment. Stations expected to experience a relatively high level of boardings include the terminus stations, those stations with major park-and-ride facilities, and those stations with major bus interface activity. Of the three full-corridor alignments, all have comparable projected boardings in the Kapolei, 'Ewa, Waipahu, Pearl City and 'Aiea areas. The Kalaeloa - Airport - Dillingham - Halekauwila alignment is projected to have higher ridership through the Salt Lake, Airport and Kalihi areas; while the Kalaeloa - Salt Lake - North King - Hotel alignment is expected to have the highest ridership through the Downtown and Kaka'ako areas. The latter result is due primarily to the Hotel Street alignment being more central to many Downtown destinations in comparison to the Nimitz - Halekauwila alignment, as well as its having more proposed stations through Downtown.

Roadway Traffic

Systemwide Travel Statistics

This section describes the expected future islandwide roadway travel conditions resulting from each of the study alternatives. Measures assessed include systemwide vehicle miles traveled (VMT), vehicle hours traveled (VHT), and vehicle hours of delay (VHD). Results are presented in Table 3-10. The change in systemwide vehicle hours of delay is also shown graphically in Figure 3-4. VMT and VHT are indicators of how much people are using their private automobiles for travel. Lower values for these measures indicate a more efficient and environmentally friendly transportation system. VHD is a measure that reflects the amount of congestion present in the system. Lower VHD values indicate less congestion on the transportation network.

Table 3-9. Year 2030 Fixed Guideway Forecast Daily Boardings[1]

Station	Combination Alignment: Kalaeloa - Salt Lake - North King - Hotel	Combination Alignment: Kamokila - Airport - Dillingham - King with a Waikīkī Branch	Combination Alignment: Kalaeloa - Airport - Dillingham - Halekauwila	20-mile Alignment East Kapolei to Ala Moana Center
Kapolei Parkway & Hanua Street	6,740	6,670	6,730	N/A[2]
Kamokila Blvd. & Wākea Street	N/A	4,410	N/A	N/A
Kapolei Pkwy & Wākea Street	3,530	N/A	3,210	N/A
Saratoga Avenue & Wākea Street	640	N/A	630	N/A
Farrington Hwy at UH West O'ahu	N/A	5,660	N/A	N/A
Saratoga Avenue & Fort Barrette Road	640	N/A	620	N/A
Kapolei Pkwy & North-South Road	4,510	N/A	5,430	5,860
North-South Road between Kapolei Parkway & Farrington Highway	1,580	N/A	1,730	N/A
Farrington Hwy & North-South Road	8,390	1,550	5,540	7,650
Farrington Hwy between North-South Road & Fort Weaver Road	1,110	3,350	1,750	3,610
Farrington Highway & Leokū Street	4,070	3,460	4,550	4,970
Farrington Hwy & Mokuola Street	2,990	3,610	2,990	2,710
Leeward Community College	1,530	1,380	1,490	1,500
Kamehameha Hwy & Kuala Street	9,600	9,800	9,540	9,200
Kamehameha Highway & Kaonohi Street	7,390	6,610	6,880	6,140
Aloha Stadium	N/A	4,340	4,390	4,400
Salt Lake Boulevard & Kahuapa'ani Street	9,230	N/A	N/A	N/A
Salt Lake Blvd. & Ala Inoi Place	4,540	N/A	N/A	N/A
Kamehameha Hwy & Radford Drive	N/A	5,230	5,800	5,330
Honolulu International Airport	N/A	3,710	3,870	3,830
Aolele Street & Lagoon Drive	N/A	3,420	3,010	1,990
Middle Street Transit Center	N/A	3,360	3,180	3,630
N. King Street & Owen Street	3,530	N/A	N/A	N/A
N. King Street & Waiakamilo Road	2,580	N/A	N/A	N/A
N. King Street at Liliha Street	4,750	N/A	N/A	N/A
Dillingham Blvd. & Mokauea Street	N/A	2,980	3,030	2,720
Dillingham Blvd. & Kōkea Street	N/A	2,540	2,340	1,970
Ka'aahi Street	N/A	3,480	4,370	3,390
King Street & Bethel Street	N/A	7,350	N/A	N/A
King Street & Punchbowl Street	N/A	6,330	N/A	N/A
Hotel Street & Kekaulike Street	1,000	N/A	N/A	N/A
Hotel Street & Nu'uanu Avenue	3,270	N/A	N/A	N/A
Hotel Street & Fort Street Mall	9,150	N/A	N/A	N/A
Honolulu Hale	2,210	N/A	N/A	N/A
Nimitz Highway & Kekaulike Street	N/A	N/A	2,390	1,650
Nimitz Highway & Fort Street Mall	N/A	N/A	5,800	3,670
Waimanu Street & Cummins Street	N/A	3,190	N/A	N/A
Kawaiaha'o Street & Cooke Street	4,190	N/A	N/A	N/A
Halekauwila Street & South Street	N/A	N/A	3,870	5,700
Halekauwila Street & Ward Avenue	N/A	N/A	2,910	2,240
Ala Moana Center	5,140	5,200	9,780	12,990
Kapi'olani Blvd. & McCully Street	11,360	1,110	4,450	N/A
University Avenue & Date Street	3,580	2,460	3,010	N/A
University Avenue & S. King Street	4,280	3,240	4,200	N/A
UH Lower Campus	6,930	5,490	6,180	N/A
Waikīkī Branch				
Convention Center from Kalākaua Avenue	N/A	2,630	N/A	N/A
Kūhiō Avenue & Kālaimoku Street	N/A	4,220	N/A	N/A
Kūhiō Avenue & Lili'uokalani Avenue	N/A	5,760	N/A	N/A
Total Daily Boardings[1]	**128,460**	**122,540**	**123,670**	**94,970**

[1]Boardings are a count of individual passengers entering a transit vehicle.
[2]N/A = Not applicable, as this station would not exist for this alternative.

Table 3-10. Systemwide Daily Travel Statistics by Alternative

Alternative	Vehicle Miles Traveled	Vehicle Hours Traveled	Vehicle Hours of Delay
2005 Existing Conditions			
Existing Conditions	11,206,000	305,000	57,000
Alternative 1: 2030 No Build			
No Build Alternative	13,971,000	395,000	82,000
% Change from Existing Conditions	*25%*	*30%*	*44%*
Alternative 2: 2030 Transportation System Management			
TSM Alternative	13,874,000	390,000	80,000
% Change from No Build Alternative	*-0.7%*	*-1.3%*	*-2.4%*
Alternative 3: 2030 Managed Lane			
Two-direction Option	14,002,000	384,000	78,500
% Change from No Build Alternative	*0.2%*	*-2.8%*	*-4.3%*
Reversible Option	14,034,000	397,000	82,500
% Change from No Build Alternative	*0.5%*	*0.5%*	*0.6%*
Alternative 4: 2030 Fixed Guideway			
Kalaeloa - Salt Lake - North King - Hotel	13,464,000	365,000	65,000
% Change from No Build Alternative	*-3.6%*	*-7.6%*	*-21%*
Kamokila - Airport - Dillingham - King with a Waikīkī Branch	13,512,000	367,000	65,000
% Change from No Build Alternative	*-3.3%*	*-7.1%*	*-21%*
Kalaeloa - Airport - Dillingham - Halekauwila	13,500,000	367,000	67,000
% Change from No Build Alternative	*-3.4%*	*-7.1%*	*-18%*
20-mile Alignment East Kapolei to Ala Moana Center	13,539,000	376,000	73,500
% Change from No Build Alternative	*-3.1%*	*-4.8%*	*-11%*

Alternative 1: No Build

Table 3-10 shows that all three systemwide travel measures are expected to increase significantly between 2005 and the 2030 No Build Alternative. However, while VMT and VHT are expected to increase by an amount approximating expected population growth between 2005 and 2030 (i.e., 25 percent and 30 percent, respectively), VHD is projected to increase at a substantially higher rate of nearly 44 percent. This is because much of the roadway system is currently operating at or over capacity for many hours of the day, and it only takes a small increase in additional traffic to create a large amount of additional congestion and delay under these conditions.

Alternative 2: Transportation System Management (TSM)

The TSM Alternative is expected to result in a minimal decrease in the three systemwide travel measures as compared to the No Build Alternative (Table 3-10), indicating that it would have only a slight impact islandwide on how much people use their private automobiles and how much congestion is experienced.

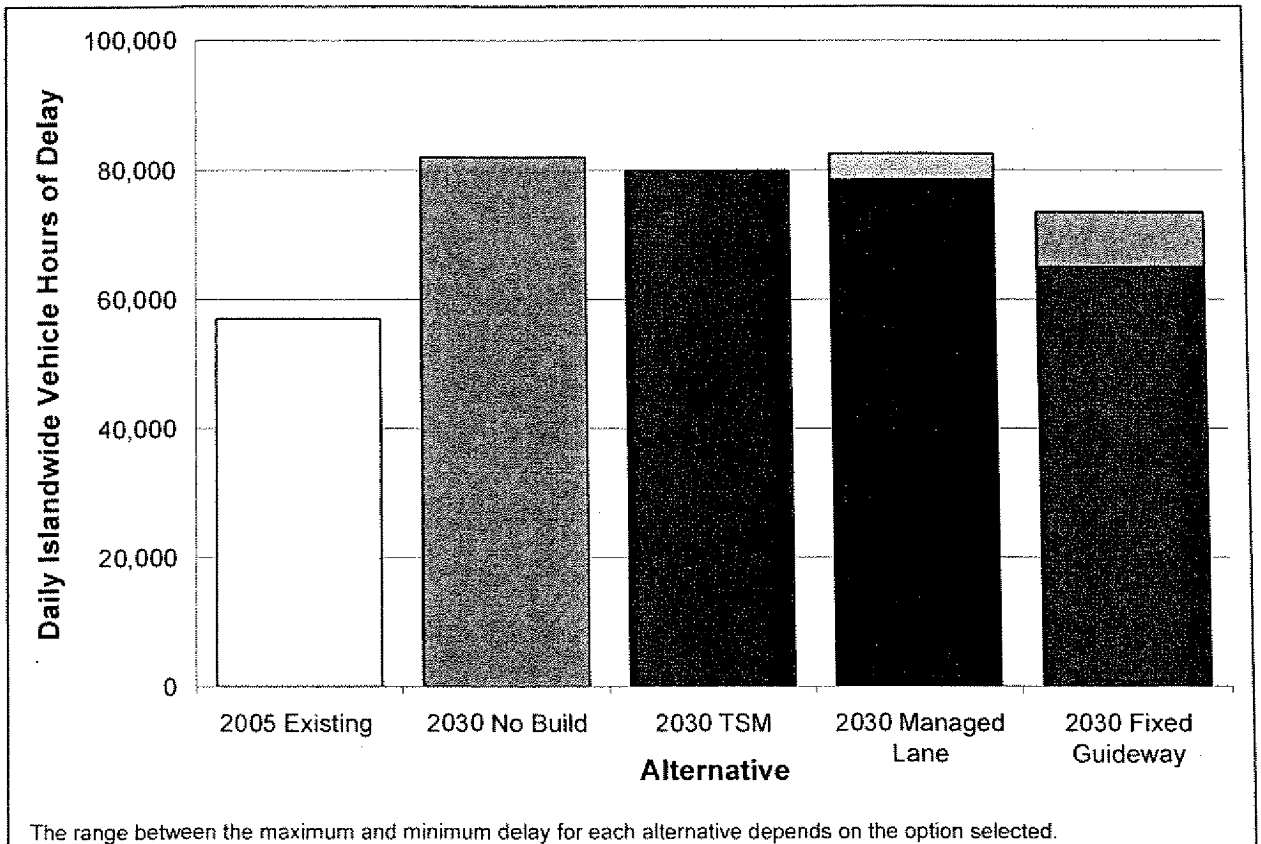


Figure 3-4. Islandwide Daily Vehicle Hours of Delay for All Alternatives

Alternative 3: Managed Lane

Table 3-10 shows that, compared to the No Build Alternative, the Two-direction Option would have a negligible impact on VMT, and a slightly positive impact on VHT and VHD, which decrease by 2.8 percent and 4.3 percent, respectively, due to the faster speeds provided by the managed lane facility.

The Reversible Option is projected to have an increase in the three measures, indicating that it would encourage more people to drive private automobiles and would therefore result in more congestion.

Alternative 4: Fixed Guideway

The Fixed Guideway Alternative is projected to have the most significant impact of all the alternatives on these three travel measures (Table 3-10). The Full-corridor Alignments show a 3.3 to 3.6 percent decrease in VMT, a 7.1 to 7.6 percent decrease in VHT, and an 18 to 21 percent decrease in VHD. This indicates that the fixed guideway system would attract more riders to transit; therefore, reducing the use of private autos. It also would result in less congestion on the roadway system than any of the alternatives.

The 20-mile Alignment option shows similar results as the Full-corridor Alignments, although to a lesser degree. This option is projected to reduce VMT by 3.1 percent, VHT by 4.8 percent, and VHD by 11 percent in comparison to the No Build Alternative.

Traffic Volumes and Level-of-Service

This section discusses projected roadway network operations for each of the alternatives as indicated by the level of peak-hour traffic volumes and corresponding operational level-of-service (LOS) in the study corridor. For the purpose of this discussion, traffic volumes are grouped together by screenlines (Figure 3-2). Screenlines are imaginary lines drawn across the road network. LOS is a grading scale from A through F for roadway operation; LOS A represents the best condition and LOS F represents more vehicles attempting to use a roadway than the capacity is able to accommodate. Existing traffic volumes were extracted from historical State files at points where the lines intersect the road network and totaled for all of the individual facilities that cross each screenline. Year 2030 volumes were developed through the use of the travel demand forecasting model.

Table 3-11 shows a.m. and p.m. peak-hour volumes for existing conditions (year 2003) and all of the year 2030 alternatives for two key screenlines in the study corridor: Kalauao Stream in Pearl City and the Kapālama Drainage Canal just ‘Ewa of Downtown. The locations of these two screenlines are shown in Figure 3-2. Table 3-12 and Table 3-13 present estimated LOS for these two screenlines and the individual roadways comprising them for the a.m. and p.m. peak hours, respectively, in the peak traffic direction.

Alternative 1: No Build

Both the Kalauao Stream and Kapālama Canal screenlines experience high volumes and significant congestion under existing conditions. The existing screenline is estimated at LOS F in the a.m. peak hour for Koko Head direction travel across both screenlines, with the H-1 general purpose lanes operating at LOS F as well (Table 3-12). Screenline operations are estimated to be LOS E (i.e., at capacity) in the p.m. peak hour in the ‘Ewa-bound direction (Table 3-13), but LOS F for general purpose traffic on H-1 itself. These conditions are expected to worsen considerably under the 2030 No Build Alternative as peak-hour volumes are projected to increase by 25 to 48 percent at the Kalauao Stream screenline and by 11 to 21 percent at the Kapālama Canal, resulting in extreme LOS F conditions with a V/C ratio of 1.54 at the Kalauao Stream screenline and 1.12 at the Kapālama Canal (note that this latter screenline is still projected to be at LOS F despite the addition of a traffic lane in the peak direction as proposed in the ORTP).

Alternative 2: Transportation System Management (TSM)

As shown in Table 3-11, the TSM Alternative results in only a small decrease (zero to one percent) in peak-hour volumes across the two key corridor screenlines as compared to the No Build Alternative. Consequently, projected peak-hour peak-direction LOS at these two screenlines is projected to remain at LOS F.

Table 3-11. Selected Screenline Peak-hour Volumes by Alternative

Alternative	Screenline			
	Kalauao Stream		Kapālama Canal	
	A.M.	P.M.	A.M.	P.M.
Existing Conditions (2003)				
'Ewa Bound	7,640	15,340	11,370	14,510
Koko Head Bound	18,870	8,970	15,040	12,660
Total	26,510	24,310	26,410	27,170
Alternative 1: 2030 No Build				
'Ewa Bound	9,580	20,270	13,390	16,130
% Change from Existing Conditions	25%	32%	18%	11%
Koko Head Bound	28,020	11,470	18,190	14,540
% Change from Existing Conditions	48%	28%	21%	15%
Total	37,600	31,740	31,580	30,670
% Change from Existing Conditions	42%	31%	20%	13%
Alternative 2: 2030 Transportation System Management				
'Ewa Bound	9,530	20,090	13,340	16,030
% Change from No Build	-1%	-1%	0%	-1%
Koko Head Bound	27,690	11,400	18,070	14,480
% Change from No Build	-1%	-1%	-1%	0%
Total	37,220	31,490	31,410	30,510
% Change from No Build	-1%	-1%	-1%	-1%
Alternative 3: 2030 Managed Lane				
Two-direction Option				
'Ewa Bound	10,620	19,890	15,400	16,210
% Change from No Build	11%	-2%	15%	0%
Koko Head Bound	28,800	11,230	20,110	14,740
% Change from No Build	3%	-2%	11%	1%
Total	39,420	31,120	35,510	30,950
% Change from No Build	5%	-2%	12%	1%
Reversible Option				
'Ewa Bound	10,570	19,860	15,520	16,190
% Change from No Build	10%	-2%	16%	0%
Koko Head Bound	28,730	12,260	20,540	14,190
% Change from No Build	3%	7%	13%	-2%
Total	39,300	32,120	36,060	30,380
% Change from No Build	5%	1%	14%	-1%

Table 3-11. Selected Screenline Peak-hour Volumes by Alternative (continued)

Alternative	Screenline			
	Kalauao Stream		Kapālama Canal	
	A.M.	P.M.	A.M.	P.M.
Alternative 4: 2030 Fixed Guideway				
Kalaeloa - Salt Lake - North King - Hotel				
ʻEwa Bound	9,090	18,930	13,040	15,320
% Change from No Build	-5%	-7%	-3%	-5%
Koko Head Bound	25,810	10,970	16,860	14,080
% Change from No Build	-8%	-4%	-7%	-3%
Total	34,900	29,900	29,900	29,400
% Change from No Build	-7%	-6%	-5%	-4%
Kamokila - Airport - Dillingham - King with a Waikīkī Branch				
ʻEwa Bound	9,100	18,970	12,990	15,390
% Change from No Build	-5%	-6%	-3%	-5%
Koko Head Bound	25,950	11,000	17,000	14,110
% Change from No Build	-7%	-4%	-7%	-3%
Total	35,050	29,970	29,990	29,500
% Change from No Build	-7%	-6%	-5%	-4%
Kalaeloa - Airport - Dillingham - Halekauwila				
ʻEwa Bound	9,090	18,960	12,980	15,500
% Change from No Build	-5%	-6%	-3%	-4%
Koko Head Bound	25,930	10,990	17,000	14,040
% Change from No Build	-7%	-4%	-7%	-3%
Total	35,020	29,950	29,980	29,540
% Change from No Build	-7%	-6%	-5%	-4%
20-mile Alignment East Kapolei to Ala Moana Center				
ʻEwa Bound	9,100	19,090	12,960	15,280
% Change from No Build	-5%	-6%	-3%	-5%
Koko Head Bound	26,100	11,000	17,070	14,170
% Change from No Build	-7%	-4%	-6%	-3%
Total	35,200	30,090	30,030	29,450
% Change from No Build	-6%	-5%	-5%	-4%

Table 3-12. A.M. Peak-hour Screenline Volumes and Level of Service (LOS)

												2030 Managed Lane Alternative						2030 Fixed Guideway Alternative											
	Existing Conditions (2003)				2030	2030 No Build Alternative			2030 TSM Alternative			Two-direction Option			Reversible Option			Kalaeloa - Salt Lake - North King - Hotel			Kamokila - Airport - Dillingham - King with a Waikiki Branch			Kalaeloa - Airport - Dillingham - Halekauwila			20-mile Alignment East Kapolei to Ala Moana Center		
SCREENLINE / FACILITY	Facility Capacity (vph)	Observed Volume (vph)	Volume/ Capacity Ratio	Level of Service	Facility Capacity (vph)	Forecast Volume (vph)	Volume/ Capacity Ratio	Level of Service	Forecast Volume (vph)	Volume/ Capacity Ratio	Level of Service	Forecast Volume (vph)	Volume/ Capacity Ratio	Level of Service	Forecast Volume (vph)	Volume/ Capacity Ratio	Level of Service	Forecast Volume (vph)	Volume/ Capacity Ratio	Level of Service	Forecast Volume (vph)	Volume/ Capacity Ratio	Level of Service	Forecast Volume (vph)	Volume/ Capacity Ratio	Level of Service	Forecast Volume (vph)	Volume/ Capacity Ratio	Level of Service
Kalauao Stream Koko Head bound																													
H-1 Fwy	9,500	10,960	1.15	F	9,500	18,049	1.90	F	17,897	1.88	F	18,327	1.93	F	18,419	1.94	F	17,322	1.82	F	17,414	1.83	F	17,198	1.81	F	17,209	1.81	F
H-1 Fwy (HOV)[1]	1,900	1,600	0.84	D	1,900	3,014	1.59	F	2,959	1.56	F	2,882	1.52	F	2,769	1.46	F	2,756	1.45	F	2,701	1.42	F	2,898	1.53	F	2,740	1.44	F
H-1 Fwy (Zipper)[1]	1,900	1,700	0.89	D	1,900	2,444	1.29	F	2,398	1.26	F	1,677	0.88	D	NA	NA	NA	2,120	1.12	F	2,154	1.13	F	2,147	1.13	F	2,241	1.18	F
Moanalua Rd	1,700	1,650	0.97	E	1,700	1,018	0.60	B	1,006	0.59	A	918	0.54	A	966	0.57	A	722	0.42	A	756	0.44	A	709	0.42	A	853	0.50	A
Kamehameha Hwy	3,450	2,960	0.86	D	3,450	3,498	1.01	F	3,431	0.99	E	3,226	0.94	E	3,121	0.90	E	2,891	0.84	D	2,923	0.85	D	2,974	0.86	D	3,059	0.89	D
Managed Lane	NA	NA	NA	NA	2,200	NA	NA	NA	NA	NA	NA	1,769	0.80	D	3,457	0.79	C[2]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total General Purpose Traffic	14,650	15,570	1.06	F	14,650	22,565	1.54	F	22,334	1.38	F	22,471	1.39	F	22,507	1.39	F	20,936	1.30	F	21,093	1.31	F	20,881	1.29	F	21,120	1.31	F
Total HOV Traffic	3,800	3,300	0.87	D	3,800	5,458	1.44	F	5,357	1.41	F	4,559	1.20	F	2,769	1.46	F	4,876	1.28	F	4,855	1.28	F	5,045	1.33	F	4,980	1.31	F
Total Managed Lane Traffic	NA	NA	NA	NA	2,200	NA	NA	NA	NA	NA	NA	1,769	0.80	D	3,457	0.79	C[2]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kapālama Canal Koko Head bound																													
Nimitz Hwy	2,700	3,670	1.36	F	2,700	4,723	1.75	F	4,824	1.79	F	4,939	1.83	F	4,353	1.61	F	4,348	1.61	F	4,410	1.63	F	4,488	1.66	F	4,463	1.65	F
Nimitz Flyover/Managed Lane	NA	NA	NA	NA	2,900	1,237	0.43	A	1,298	0.45	A	2,852	0.65	B[2]	3,900	0.89	D[2]	1,169	0.40	A	1,151	0.40	A	1,154	0.40	A	1,204	0.42	A
Dillingham Blvd	1,700	1,730	1.02	F	1,600	1,325	0.83	D	1,329	0.83	D	1,501	0.94	E	1,482	0.93	E	1,329	0.83	D	1,270	0.79	C	1,260	0.79	C	1,327	0.83	D
N King St	1,700	1,490	0.88	D	1,800	1,493	0.83	D	1,481	0.82	D	1,503	0.83	D	1,447	0.80	C	1,287	0.71	C	1,334	0.74	C	1,315	0.73	C	1,335	0.74	C
H-1 Fwy	6,800	6,860	1.01	F	7,600	8,008	1.05	F	7,717	1.02	F	7,879	1.04	F	8,000	1.05	F	7,500	0.99	E	7,578	1.00	E	7,509	0.99	E	7,420	0.98	E
School St	1,600	1,290	0.81	C	1,600	1,402	0.88	D	1,418	0.89	D	1,436	0.90	D	1,360	0.85	D	1,227	0.77	C	1,259	0.79	C	1,275	0.80	C	1,339	0.84	D
Total General Purpose Traffic	14,500	15,040	1.04	F	15,300	16,952	1.11	F	16,769	1.10	F	17,258	1.13	F	16,642	1.09	F	15,691	1.03	F	15,851	1.04	F	15,847	1.04	F	15,886	1.04	F
Total HOV Traffic	NA	NA	NA	NA	2,900	1,237	0.43	A	1,298	0.45	A	NA	NA	NA	NA	NA	NA	1,169	0.40	A	1,151	0.40	A	1,154	0.40	A	1,204	0.42	A
Total Managed Lane Traffic	NA	NA	NA	NA	4,400	NA	NA	NA	NA	NA	NA	2,852	0.65	B	3,900	0.89	D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

[1]Separate HOV lane and Zipper lane counts are not available at this location; hence HOV and Zipper lane traffic volumes are estimated at this location.
[2]Managed lane facility capacity estimated at 2,200 vehicles per lane per hour.

Table 3-13. P.M. Peak-hour Screenline Volumes and Level of Service (LOS)

												2030 Managed Lane Alternative						2030 Fixed Guideway Alternative											
	Existing Conditions (2003)				2030	2030 No Build Alternative			2030 TSM Alternative			Two-direction Option			Reversible Option			Kalaeloa - Salt Lake - North King - Hotel			Kamokila - Airport - Dillingham - King with a Waikiki Branch			Kalaeloa - Airport - Dillingham - Halekauwila			20-mile Alignment East Kapolei to Ala Moana Center		
SCREENLINE / FACILITY	Facility Capacity (vph)	Observed Volume (vph)	Volume/ Capacity Ratio	Level of Service	Facility Capacity (vph)	Forecast Volume (vph)	Volume/ Capacity Ratio	Level of Service	Forecast Volume (vph)	Volume/ Capacity Ratio	Level of Service	Forecast Volume (vph)	Volume/ Capacity Ratio	Level of Service	Forecast Volume (vph)	Volume/ Capacity Ratio	Level of Service	Forecast Volume (vph)	Volume/ Capacity Ratio	Level of Service	Forecast Volume (vph)	Volume/ Capacity Ratio	Level of Service	Forecast Volume (vph)	Volume/ Capacity Ratio	Level of Service	Forecast Volume (vph)	Volume/ Capacity Ratio	Level of Service
Kalauao Stream 'Ewa bound																													
H-1 Fwy	9,500	9,220	0.97	E	9,500	12,445	1.31	F	12,288	1.29	F	12,278	1.29	F	12,274	1.29	F	11,820	1.24	F	11,713	1.23	F	11,797	1.24	F	11,802	1.24	F
H-1 Fwy (HOV)	1,900	1,600	0.84	D	1,900	2,086	1.10	F	2,111	1.11	F	1,505	0.79	C	1,572	0.83	D	1,861	0.98	E	1,989	1.05	F	1,908	1.00	F	2,006	1.06	F
H-1 Fwy (Zipper)	NA	NA	NA	NA	1,900	845	0.44	A	833	0.44	A	573	0.30	A	NA	NA	NA	779	0.41	A	790	0.42	A	797	0.42	A	778	0.41	A
Moanalua Rd	1,700	1,820	1.07	F	1,700	1,959	1.15	F	1,930	1.14	F	1,584	0.93	E	1,706	1.00	F	1,715	1.01	F	1,716	1.01	F	1,719	1.01	F	1,783	1.05	F
Kamehameha Hwy	3,450	2,700	0.78	C	3,450	2,933	0.85	D	2,923	0.85	D	2,712	0.79	C	2,750	0.80	D	2,753	0.80	D	2,762	0.80	D	2,735	0.79	C	2,722	0.79	C
Managed Lane	NA	NA	NA	NA	2,200	NA	NA	NA	NA	NA	NA	1,234	0.56	A	1,562	0.36	A[2]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total General Purpose Traffic	14,650	13,740	0.94	E	14,650	17,337	1.18	F	17,141	1.17	F	16,574	1.13	F	16,729	1.14	F	16,288	1.11	F	16,191	1.11	F	16,251	1.11	F	16,307	1.11	F
Total HOV Traffic	1,900	1,600	0.84	D	3,800	2,931	0.77	C	2,944	0.77	C	2,078	0.55	A	1,572	0.83	D	2,640	0.69	B	2,779	0.73	B	2,705	0.71	C	2,784	0.73	C
Total Managed Lane Traffic	NA	NA	NA	NA	2,200	NA	NA	NA	NA	NA	NA	1,234	0.56	A	1,562	0.36	A[2]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kapālama Canal 'Ewa bound																													
Nimitz Hwy	2,700	3,400	1.26	F	2,700	3,115	1.15	F	3,128	1.16	F	3,058	1.13	F	2,402	0.89	E	2,836	1.05	F	2,893	1.07	F	2,858	1.06	F	2,914	1.08	F
Nimitz Flyover/Managed Lane	NA	NA	NA	NA	2,900	608	0.21	A	518	0.18	A	1,199	0.27	A[2]	2,041	0.46	A[2]	521	0.18	A	578	0.20	A	545	0.19	A	582	0.20	A
Dillingham Blvd	1,700	1,490	0.88	D	1,600	1,641	1.03	F	1,630	1.02	F	1,681	1.05	F	1,626	1.02	F	1,608	1.01	F	1,621	1.01	F	1,633	1.02	F	1,590	0.99	E
N King St	1,700	1,340	0.79	C	1,800	1,485	0.82	D	1,422	0.79	C	1,463	0.81	D	1,257	0.70	C	1,286	0.71	C	1,338	0.74	C	1,323	0.74	C	1,366	0.76	C
H-1 Fwy	7,200	7,520	1.04	F	7,200	8,394	1.17	F	8,451	1.17	F	8,055	1.12	F	8,066	1.12	F	8,248	1.15	F	8,130	1.13	F	8,298	1.15	F	7,954	1.10	F
School St	1,600	760	0.48	A	1,600	892	0.56	A	684	0.55	A	754	0.47	A	801	0.50	A	824	0.52	A	835	0.52	A	842	0.53	A	870	0.54	A
Total General Purpose Traffic	14,900	14,510	0.97	E	14,900	15,526	1.04	F	15,514	1.04	F	15,010	1.01	F	14,152	0.95	E	14,802	0.99	E	14,816	0.99	E	14,954	1.00	F	14,695	0.99	E
Total HOV Traffic	NA	NA	NA	NA	2,900	608	0.21	A	518	0.18	A	NA	NA	NA	NA	NA	NA	521	0.18	A	578	0.20	A	545	0.19	A	582	0.20	A
Total Managed Lane Traffic	NA	NA	NA	NA	4,400	NA	NA	NA	NA	NA	NA	1,199	0.27	A	2,041	0.46	A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

[1]Separate HOV lane and Zipper lane counts are not available at this location; hence HOV and Zipper lane traffic volumes are estimated at this location.
[2]Managed lane facility capacity estimated at 2,200 vehicles per lane per hour.

Alternative 3: Managed Lane

The two Managed Lane Alternative options are expected to increase the volume of peak-hour vehicles across the two key corridor screenlines in the a.m. peak hour and have a negligible impact in reducing the volume in the p.m. peak hour (Table 3-11) as compared to the No Build Alternative. As such, the peak-hour peak-direction LOS for the two screenlines is projected to remain at LOS F under this alternative for general purpose traffic except at the Kapālama Canal screenline in the p.m. peak hour which is projected to improve to LOS E. The managed lanes themselves are projected to be operating at levels of service ranging from LOS B to LOS D in the a.m. peak hour, and LOS A during the p.m. peak hour. The Two-direction Option is projected to result in a large decrease in both the a.m. and p.m. peak hour HOV volumes in the Zipper Lane due to a shift of this traffic to the managed lane. Both managed lane options are expected to result in lower volumes in the median HOV lane in the p.m. peak hour as compared to the No Build Alternative; hence improving HOV lane operations.

Alternative 4: Fixed Guideway

Table 3-11 shows that all of the Fixed Guideway Alternative options, including the 20-mile Alignment, are expected to reduce the number of vehicles crossing these two key screenlines in the peak hours by anywhere from three to seven percent as compared to the No Build Alternative. While this amount of volume decrease is significant and would reduce the V/C ratios and hence the degree of congestion, due to the very high volumes anticipated for the corridor this reduction would not result in an improvement in the overall LOS in the a.m. peak hour. However, in the p.m. peak hour, LOS is projected to improve to LOS E at the Kapālama Canal screenline for three of the four fixed guideway options.

Measures Taken to Minimize Uncertainties Associated with Transportation Analysis

Potential risks associated with the transportation analysis have been identified and a number of measures to minimize them have been taken. The primary risk relates to the accuracy of the ridership forecasts. The level of projected ridership is key to whether a proposed project is viable from both a financial and political perspective. A commonly considered risk is that the projected levels of ridership will not be attained in reality. Factors that can influence this include the robustness of the travel demand forecasting process and the accuracy of the data input into the model—particularly the projections of the amount and location of future population and employment. Both of these factors have been considered and the following steps to minimize related risks have been taken:

- The travel demand forecasting model has been reviewed and updated for use on the project. This includes incorporating guidelines and standards mandated by the FTA that have been implemented to produce reasonable and conservative ridership forecasts. One critical component of the model that was updated was the mode choice sub-model, which estimates which mode travelers will choose to use for a given trip in the future. The revision of the model and the resulting forecast methodology have been reviewed and approved by FTA.

- A comprehensive on-board transit survey was undertaken covering the entire TheBus system to obtain the most up-to-date information regarding how many people are currently using transit on O'ahu, who they are, and why they use it. This information is critical in assessing future transit use on the island.
- The population and employment forecasts are official OMPO projections. These forecasts were reviewed and updated specifically for this project to make certain that the most recent knowledge regarding development on the island is incorporated into the model.

After taking these steps, the biggest single risk that could affect the accuracy of the ridership forecasts is the accuracy of the population and employment projections. External factors, such as a downturn in the economy, could affect whether the island will develop as planned.

Conclusions Regarding Transportation

Table 3-14 summarizes and compares the results for key measures for each of the alternatives analyzed in this chapter. The results can be summarized as follows.

The only alternative that is expected to significantly affect transit mode share and attract additional transit riders is the Fixed Guideway Alternative. Of the Fixed Guideway options, the Kalaeloa - Airport - Dillingham - Halekauwila alignment option is projected to attract the highest systemwide transit ridership.

In regards to serving existing and future transit markets, the Fixed Guideway Alternative does the best job in accommodating both longer corridor transit trips, as well as the increase in commute trips to West O'ahu, which is expected to become much more pronounced in the future. Of the two Managed Lane options, the Two-direction Option best serves the increase in commute trips to West O'ahu.

The Fixed Guideway Alternative most consistently results in improved transit travel times between key corridor origins and destinations. In many cases these travel times are equivalent to, or faster than, the same trip time made by private auto under No Build conditions—especially when considering park-and-ride trips. The Fixed Guideway Alternative also is expected to produce the most reliable travel times because the guideway would be in its own right-of-way separate from roadways and associated congestion. The managed lane options provide some travel-time improvements for selected origins and destinations well served by the facility, but in most cases the travel time savings experienced on the facility itself is offset by the increased congestion experienced accessing and egressing the facility.

Traffic congestion on key corridor facilities is expected to continue to exist under all alternatives, particularly during the peak travel periods. However, systemwide vehicle hours of delay is projected to be significantly lower for the Fixed Guideway Alternative as compared to all other alternatives. The Managed Lane Alternative may reduce congestion somewhat along the managed lane facility itself, but it creates additional congestion because of the volume of traffic increase wanting to access it; hence, very little positive change in systemwide vehicle hours of delay is projected. In addition, while all other alternatives have a minimal to negligible impact on peak-period traffic volumes in the corridor (in fact the managed lane options are expected to increase vehicle peak-hour volumes in the corridor), the Fixed Guideway Alternative is projected to reduce peak traffic volumes up to seven percent in some areas. Most importantly, however, the Fixed Guideway Alternative provides a mobility option that the other alternatives do not, in that it gives users the opportunity to bypass the congestion that will occur on roadways throughout the study corridor.

Table 3-14. Summary of Transportation Effects

Alternative	Measure: Transit Mode Share (Table 3-3 and Table 3-4)	Transit Ridership (Table 3-7)	Ability to Serve Transit Markets	Transit Travel Times (Table 3-6)	Roadway Impacts (Table 3-10 to Table 3-13)
Alternative 1: 2030 No Build					
No Build Alternative	Little change from existing	Keeps pace with projected population growth	Primarily attracts/serves shorter trips and transit-dependent trips. Does not serve increased commute to West O'ahu well	Transit travel times increase over existing, although HOV facility improvements reduce some travel times to the Leeward side.	Significant increase in peak-hour volumes over existing (11 to 48%). Key corridor screenlines at LOS F. 44% increase over existing VHD.
Alternative 2: 2030 TSM					
TSM Alternative	Small increase over No Build	Small increase (4.7%) over No Build	Primarily attracts/serves shorter trips and transit-dependent trips. Does not serve increased commute to West O'ahu well	Some improvement in times over the No Build due to increased bus frequency.	Negligible change in key screenline peak-hour volumes. Screenlines at LOS F. Slight decrease in VHD (2.4%) from No Build.
Alternative 3: 2030 Managed Lane					
Two-direction Option	Small increase over No Build	Small increase (6.4%) over No Build	While serving slightly longer trips in comparison to No Build and TSM, both options still primarily attract/ serve shorter trips and transit-dependent trips. The Reversible Option does not serve increased commute to West O'ahu well	Selected areas well served by managed lanes experience improved times, other areas stay the same or experience increased times.	Peak-hour corridor volumes increase for a.m. peak hour as compared to No Build. Key screenlines at LOS E or F. Slight VHD decrease (4.3%) from No Build for Two-Direction, negligible change for Reversible. Diversion of HOV traffic to the managed lanes results in some improvement in HOV and Zipper Lane operations.
Reversible Option	Small increase over No Build	Small increase (5.3 %) over No Build			
Alternative 4: 2030 Fixed Guideway					
Kalaeloa - Salt Lake - North King - Hotel	Substantial increase over No Build, especially for work trips	Substantial increase (27%) over No Build	Serves both long and short trips. Provides mobility around corridor "pinch points." Accommodates increased commute to West O'ahu	Transit travel times between most key corridor locations improve. Travel time reliability is greatly improved due to use of separate right-of-way from the roadway system.	Peak hour volumes decrease up to 7% in both peak periods, both directions. While volume reduction will provide some relief (particularly for the shoulder peak), peak-hour peak-direction conditions will still be at LOS E or F for key corridor screenlines. However, substantial decrease in VHD (18-21%) from No Build for Full-corridor Alignments, significant decrease (9%) for 20-mile Alignment East Kapolei to Ala Moana Center.
Kamokila - Airport - Dillingham - King with a Waikīkī Branch	Substantial increase over No Build, especially for work trips	Substantial increase (24%) over No Build			
Kalaeloa - Airport - Dillingham - Halekauwila	Substantial increase over No Build, especially for work trips	Substantial increase (27%) over No Build			
20-mile Alignment East Kapolei to Ala Moana Center	Substantial increase over No Build, especially for work trips	Substantial increase (21%) over No Build			

Chapter 4 Environmental Consequences

This chapter discusses the current natural and social environment in the Honolulu High-Capacity Transit Corridor Project's study area, and addresses the effects that the proposed alternatives would have on the environment. This analysis focuses on environmental elements that provide the greatest differentiation between these alternatives. It does not provide a comprehensive listing of all environmental changes anticipated in the study corridor area.

Land Use and Economic Activity

The project corridor's existing land use pattern on the southern shore of O'ahu is well established. Most of the project corridor lies between the foot of the Wai'anae and Ko'olau Mountains and the Pacific Ocean, and is virtually built out from Waipahu to Waikīkī. This narrow, geographically constrained corridor is where most O'ahu's residents live and work, and it is served by the island's major transportation facilities. The highest density development (e.g., office, retail, government, residential, and hotel towers) is located between Downtown Honolulu and Waikīkī. This area is experiencing major redevelopment and construction for even higher densities.

The lowest-density development in the project corridor (e.g., single-family detached housing, low-rise office parks, free-standing shopping centers, and big-box retail stores) is farther Wai'anae in 'Ewa and Kapolei. These West O'ahu areas are rapidly developing, but still include areas of open space, agricultural use, and Kalaeloa (formerly known as Barbers Point Naval Air Station). The moderately dense built-up area between Waipahu and Downtown Honolulu is relatively stable, with little major new construction evident.

Background, Studies, and Coordination

The State of Hawai'i Land Use Law (Chapter 205, Hawai'i Revised Statutes, 1961, amended 1985) establishes an overall framework for land use management, where all state land is classified into one of four districts: Urban, Rural, Agricultural, and Conservation. The City and County of Honolulu has planning and zoning authority over all of the Island of O'ahu. The General Plan for the City and County of Honolulu was first adopted in 1987 and has been updated through 1991 in the Revised 1992 Edition. This General Plan, required by City Charter, is a statement of long-range social, economic, environmental, and design objectives for the people of O'ahu's general welfare and prosperity. It is also a statement of broad policies that facilitate the Plan's objectives. Future development in the project corridor is guided by community comprehensive plans prepared and adopted by the City and County of Honolulu. The following community plans are applicable to the project corridor: 'Ewa Development Plan, Central O'ahu Sustainable Communities Plan, and Primary Urban Center (PUC) Development Plan: West, Central, and East.

Economic activity may be affected by the project in many ways; however, long-term employment on O'ahu has been assumed to remain consistent with projections in the 2030 O'ahu Regional Transportation Plan (ORTP). Given this assumption, the greatest direct economic affect of the project would be on employment during construction. Construction generates employment in three ways:

1. Direct employment (on-site construction job growth attributable to new projects)
2. Indirect employment (off-site employment, including manufacturing and preparing supplies and equipment)
3. Induced employment (employment generated to fulfill newly employed households' demands for goods and services)

The number of jobs generated is proportional to a project's size. For Hawaii, the Department of Business, Economic Development, and Tourism (DBEDT) has calculated that 23.73 person-years of employment are generated for each million dollars of heavy construction undertaken (DBEDT, 2002).

Impacts

The general future land use pattern of the project corridor is shown in the City and County of Honolulu's community-level comprehensive plans. Most of the project corridor between Waipahu and Waikīkī contains no undeveloped land. Redevelopment in this area will be the key to future land use, and is highly dependent on market demand and the availability of suitable vacant and underdeveloped land near the proposed project alternatives. The greatest potential for continued high-density development (e.g., office, retail, and possibly government, residential, and hotel uses) is between Downtown Honolulu and Waikīkī (Table 4-1.). The greatest potential for lower- to medium-density new development in the project corridor (e.g., single-family detached housing, low-rise office parks, free-standing shopping centers, and big-box retail stores) is farther 'Ewa. These more suburban and rural areas are planned for development, including Kalaeloa. The moderately dense, built-up areas between Waipahu and Downtown Honolulu and along South King Street and University Avenue to the University of Hawai'i (UH) at Mānoa are relatively stable, with few vacant parcels. In the future as transit and market demand develops, redevelopment of key underused parcels is likely.

The project alternatives' land use impacts are consistent with the regional plan's broad policies. For example, the General Plan for the City and County of Honolulu establishes a policy to redistribute O'ahu's future population by 2025 so 17 percent is in 'Ewa, 13 percent is in Central O'ahu, and 46 percent is in the PUC. To accomplish this, new planned developments in Kapolei and Kalaeloa in the 'Ewa Development Area are consistent with this policy.

Table 4-1. Project Access, Connectivity, Land Use, and Development Potential

Alternative	Connections to major activity centers	2030 employment within ½ mile of stations	2030 population within ½ mile of stations	Potential for Transit-Oriented Development	Compatible with land use regulations (zoning)	Potential for increased development in station area
No Build Alternative	N/A	N/A	N/A	N/A	N/A	N/A
TSM Alternative	N/A	N/A	N/A	N/A	N/A	N/A
Alternative 3: Managed Lane (by section)						
3a. Two-Direction Option						
Waiawa IC to Hālawa Stream	1	7,640	5,780	Low	N/A	N/A
Hālawa Stream to Pacific Street	1	5,150	1,110	Low	N/A	N/A
3b. Reversible Option						
Waiawa IC to Hālawa Stream	1	0	0	Low	N/A	N/A
Hālawa Stream to Pacific Street	1	0	0	Low	N/A	N/A
Alternative 4: Fixed Guideway (by section)						
I. Kapolei to Fort Weaver Road						
Kamokila Boulevard/Farrington Highway	1	18,900	30,600	High	No	Yes
Kapolei Parkway/North-South Road	1	21,100	42,700	High	No	Yes
Saratoga Avenue/North-South Road	1	23,000	44,300	High	Yes	No
Geiger Road/Fort Weaver Road	1	17,400	35,300	High	Yes	No
II. Fort Weaver Road to Aloha Stadium						
Farrington Highway/Kamehameha Highway	1	20,000	28,600	Low	Yes	No
III. Aloha Stadium to Middle Street						
Salt Lake Boulevard	1	4,900	19,500	Low	Yes	No
Mauka of the Airport Viaduct	2	16,500	8,100	High	No	Yes
Makai of the Airport Viaduct	1	20,700	9,400	Low	Yes	No
Aolele Street	2	22,900	7,500	High	No	Yes
IV. Middle Street to Iwilei						
North King Street	1	23,000	33,600	Low	Yes	No
Dillingham Boulevard	1	40,300	28,200	Low	Yes	No
V. Iwilei to UH Mānoa						
Beretania Street/South King Street	2	223,600	193,300	Low	No	No
Hotel Street/Kawaiaha'o Street/Kapi'olani Boulevard	6	432,400	283,700	High	Yes	Yes
King Street/Waimanu Street/Kapi'olani Boulevard	6	276,600	211,900	High	Yes	Yes
Nimitz Highway/Queen Street/Kapi'olani Boulevard	6	322,100	234,000	Medium	Yes	Yes
Nimitz Highway/Halekauwila Street/Kapi'olani Blvd.	4	337,600	255,800	Medium	Yes	Yes
Waikīkī Branch	8	80,100	56,300	High	Yes	Yes

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This development policy may conflict with policy established in the State of Hawai'i Land Use Law to maintain the viability of agriculture on O'ahu, specifically in 'Ewa and Central O'ahu. The community plans are somewhat in conflict with this policy, because some agricultural lands in these areas are planned for urban uses. The Central O'ahu and 'Ewa Plans are more supportive of the land use impacts of the project alternatives than they are of continued agricultural use. These community-level policies are consistent with the regional policy to reduce speculation in land and housing, because these plans clearly indicate where development is encouraged and discouraged.

Alternative 1: No Build Alternative

Substantial changes in land use impacts are not expected with the No Build Alternative.

Alternative 2: TSM Alternative

Substantial changes in land use impacts would not be expected with the Transportation System Management (TSM) Alternative.

Construction associated with the minor capital improvements that would be completed for the TSM Alternative would generate approximately 950 person-years of direct, indirect, and induced employment over the course of project completion (Table 4-2).

Table 4-2. Person-Years of Employment Generated by Project Construction

Alternative	Project Construction Cost (millions 2006 $)	Person-Years of Employment Generated
Alternative 1: No Build		
No Build Alternative	$0	none
Alternative 2: Transportation System Management		
TSM Alternative	$40	950
Alternative 3: Managed Lane		
3a: Two-Direction	$3,780	89,700
3b: Reversible	$2,570	61,000
Alternative 4: Fixed Guideway		
Kalaeloa – Salt Lake – North King – Hotel	$4,880	115,800
Kamokila – Airport – Dillingham – King with a Waikīkī Branch	$6,140	145,700
Kalaeloa – Airport – Dillingham – Halekauwila	$4,630	109,900
20-mile Alignment	$3,550	84,200

Alternative 3: Managed Lane Alternative

The most likely impact of the Managed Lane Alternative would be induced or indirect development farther mauka and 'Ewa than its termini on Interstate Route H-1 (H-1) and H-2. Shorter travel times from Central O'ahu and Kapolei to Honolulu, for example, would enable commuters to live in less expensive and larger housing farther from employment centers. Little or no land use impacts would be expected within the Koko Head section of the Managed Lane corridor, because virtually no access to adjacent parcels exists.

Construction associated with the Managed Lane Alternative would generate between approximately 61,000 and 89,700 person-years of direct, indirect, and induced employment over the course of project completion (Table 4-2).

Alternative 4: Fixed Guideway Alternative

Construction of the Fixed Guideway Alternative for the full length of the corridor would generate between approximately 109,900 and 145,700 person-years of direct, indirect, and induced employment over the course of project completion (Table 4-2). Construction of the 20-mile Alignment would generate approximately 84,200 person-years of employment.

Land use impacts could be substantial within one-half mile of certain station locations along the four alignment options being considered for the Fixed Guideway Alternative. This radius is within walking distance to a station, and the new transit service would increase mobility and accessibility. These changes would affect land values and increase the potential for real estate development investments. The potential for transit-supportive development (TSD) and transit-oriented development (TOD) are described in this section. TSD would include land uses such as office space and multi-story residential buildings near transit stations. Office uses generate more transit riders than any other land use. TOD includes the following elements:

- Moderate- to higher-density uses
- Within easy walking distance to and from the station
- A mix of uses
- Pedestrian-oriented
- New construction or redevelopment
- Generates transit ridership.

For successful TOD to occur, the following has to be present: an excellent transit system, strong market demand, available parcels close to the station, and a consistent TOD land use planning policy. The following sections describe the probable land use impacts of the Fixed Guideway Alternative in the five project sections described in Chapter 2 of the *Alternatives Analysis Report*.

Section I. Kapolei to Fort Weaver Road

The Kamokila Boulevard/Farrington Highway alignment option would have the best potential for TOD of the four optional alignments in this section, because of the planned locations of Downtown Kapolei and UH West O'ahu. The station sites along Kamokila Boulevard and Farrington Highway would serve large concentrations of employees, shoppers, students, faculty, and staff. This alignment would also be the shortest of the four. The Kapolei Parkway/North-South Road alignment has the second-best potential for TOD and TSD for the same reasons, and would be more central to planned residential areas. However, this alignment is a bit longer. The future orientation of the densest uses in Downtown Kapolei and UH West O'ahu could shift toward stations along Kapolei Parkway and North-South Road. The Saratoga Avenue/North-South Road and the Geiger Road/Fort Weaver Road alignments would have the least potential for TSD or TOD, because they are located in planned and existing residential areas with little commercial and no apartment zoning. These two alignment options are also the longest of the four being considered.

Section II. Fort Weaver Road to Aloha Stadium
Although there is only one alignment option in this section and so no comparison of alignments can be made, all four stations offer some potential for TSD or TOD. All TSD areas adjacent to these four stations could generate ridership, but strong pedestrian connections would be needed between these areas and the stations. The potential for TOD would be limited over the short-term, but more probable with long-range redevelopment.

Section III. Aloha Stadium to Middle Street
The Salt Lake Boulevard alignment has limited TOD potential because of built-up land around station areas. In addition, this alignment would not serve Honolulu International Airport (HNL), a major generator of potential riders. The Mauka Side of the Airport Viaduct has no TOD potential and would not serve the airport well with a pedestrian connection. The Makai Side of the Airport Viaduct has little TOD potential but would serve the airport. The Aolele Street alignment would have the greatest TOD potential.

Section IV. Middle Street to Iwilei
Neither alignment is a strong candidate for TOD and TSD in this area, because of its built-up industrial and commercial nature. With redevelopment, the North King Street alignment may be a slightly stronger candidate because it contains more residential uses likely to be occupied by a highly transit-dependent population.

Section V. Iwilei to UH Mānoa
The more makai alignments along Hotel Street and Nimitz Highway have stronger TOD potential than the alignment along South King Street, because the former two are located in developing areas and closer to activity centers. Of the two, the Hotel Street-Kapi'olani alignment is the most central to the major shopping, business, and governmental districts of Downtown Honolulu. South King Street is farthest from the major activity centers and in a low-density residential and commercial area in this section of the project corridor. The Waikīkī Branch has a high potential to attract even more redevelopment in this densely built-up area.

Mitigation

The City and County of Honolulu has traditionally addressed development issues through the administration of land use regulations (zoning, site plan, and subdivision regulations) that are usually based on local master plans. The responsibility for mitigating the effects of ongoing growth, regardless of the project, rests with local governments that have jurisdiction over land use and with developers who carry out development projects. For example, the City and County of Honolulu could work with affected communities to help implement the regional vision described in the General Plan. Potential measures to mitigate the effects of growth on the environment include:

- Revising local community master plans to accommodate even higher densities than planned and to use less land
- Updating zoning districts to increase densities near the project and add the planned community zone
- Encouraging TOD where feasible
- Acquiring open space and protecting farmland
- Engaging in more aggressive regional planning efforts.

Neighborhoods and Communities

Affected Environment

Communities along the project corridor include Kapolei, the ʻEwa area, Waipahu, Pearl City, Salt Lake, Kalihi, Downtown Honolulu, Kakaʻako, McCully, the University District, and Waikīkī. Kapolei is located in a plain of former sugar cane fields. The agricultural land is rapidly developing, and the area has been designated as Oʻahu's "second city." As the corridor extends Koko Head, land uses become more urbanized. The corridor traverses through sugar plantation worker communities that date from the late 19th century; single-family bedroom communities; suburban cities with low-rise mixed residential and commercial/industrial uses; and ultimately, the dense high-rise residential apartment, condominium, commercial, and office developments of Downtown Honolulu. Major institutions include several military bases and associated enlisted-persons housing, Aloha Stadium, several regional retail and commercial shopping centers, Honolulu International Airport, and major industrial and port businesses. The corridor includes Waikīkī, one of the densest tourist areas in the world and the University of Hawaiʻi Mānoa, with an enrollment of over 20,000 students.

The Island of Oʻahu's population was over 876,000 in 2000 according to the U.S. Census Bureau – an increase of 4.8 percent over the previous decade. The fastest growing areas were suburban communities where residents could find more affordable housing. Between 2000 and 2030, the Island's population is expected to increase 28 percent to over 1.1 million. Based on local land use planning policies, this future population growth will be focused in the ʻEwa and PUC areas.

Like many of Hawaii's largest metropolitan areas, O'ahu's demographic characteristics are increasingly more diverse, particularly as a result of the Native Hawaiians and Polynesians originally inhabiting the island. In 2000, 79 percent of the population was non-White, with 46 percent Asian. Key racial groups included Native Hawaiians, Filipinos, Samoans, Japanese, and Chinese. Large concentrations of White and Black persons were in close proximity to the military bases, which is typical of temporarily stationed military personnel.

The median income in 1999 was $52,280, but this number represents limited purchasing power because of Hawaii's high cost of living. Ten percent of the population had an income below the poverty level. Neighborhoods with concentrations of residents below the poverty level included Downtown Honolulu, Kalihi-Pālama, and Kalihi Valley, which contain low-income housing, a disproportionate number of elderly, and many new immigrants. Seven percent of the households received public assistance and 22 percent and 27 percent receive income from retirement and social security, respectively. Only 49 percent of dwellings are owner-occupied, but 55 percent are single-family residences.

Honolulu, the state capitol, is the center of commerce for all of Hawai'i and Polynesia and a world-renowned tourist destination that contributes considerably to the local economy. The metropolitan area provides regional medical services, shopping, and education. This area has several military bases, substantial industrialized maritime business activity, and an international airport. The project corridor encompasses many outlying communities where old sugar refineries have been converted to shopping centers and industrial parks in the past 10 to 15 years. These suburban communities have smaller commercial areas and neighborhood shopping districts that meet the everyday needs of both residents and visitors.

Major employment centers along the project corridor include the following:

- Pearl Harbor and the nearby industrial area
- Pearlridge Center
- Honolulu International Airport and supporting businesses
- Industrial districts in Hālawa Valley, Māpunapuna, Kalihi, Iwilei, and Kaka'ako
- Downtown Honolulu and the Capital District
- Ala Moana Center and the surrounding area
- Waikīkī
- University of Hawai'i (UH) at Mānoa.

Many public services and community facilities are located in the project corridor, including fire, police, and emergency medical services. Public health clinics, hospitals, senior centers, schools, colleges, universities, libraries, religious institutions, and cemeteries are also present. Together, they support the community's social fabric.

Despite the urban character of much of the project corridor, natural areas, parks, and other types of recreational amenities are numerous. These include regional recreation areas for picnicking and hiking, ocean beaches, developed facilities such as recreation centers and golf courses, neighborhood parks for local residents and children's organized sports programs, and small urban parks. Meandering pedestrian and bicycle trails are also present. Major facilities include the Hawai'i Raceway Park, Hawaiian Waters Adventure Park, Ke'ehi Lagoon Beach Park, Ala Moana Regional Park, Stadium Park, and the UH Stan Sheriff Sports Center. These amenities provide a variety of recreational opportunities.

A substantial portion of the proposed project corridor encompasses urban areas served by a number of different utilities, including electric, water, sewer, stormwater, telephone, cable, and fiber optics. No underground natural gas lines exist, but there are fuel lines to the military bases and airport. Most of these facilities include buried cables, conduits, or pipelines, either in the public right-of-way or on separate rights-of-ways or easements. Facilities with buried or above-ground structures such as electric substations or telephone switching stations also exist. A number of major high-voltage power lines are also located in the project corridor.

Cohesion is provided by many social settings and activities in the project corridor. In the 'Ewa end of the corridor, sugar plantation history is an important part of the community's cultural history and present social fabric. This area includes historic Hawaiian and Filipino enclaves and communities of recent immigrants from throughout the Pacific, the Philippines, and Southeast Asia. Downtown Honolulu contains the long-established Chinatown District. At the State Capitol, a special Hawaiian lei draping ceremony takes place for Father Damien's Birthday and Lili'uokalani's birthday. The 'Iolani Palace hosts commemorative gatherings for the Native Hawaiian community. Certain neighborhoods and communities celebrate special cultural events such as the Prince Lot Hula Festival. Large cultural institutions provide a community focus, such as the Bishop Museum of Hawaiian artifacts and royal family heirlooms and the annual "Salute the Troops" celebration for Hawaii's armed services. Other social activities include ethnic rituals, including the Japanese and Okinawan ritual Bon dances to commemorate the dead and special community holiday events, such as the annual Kalihi Christmas parade. Multi-cultural celebrations for Mardi Gras, the Chinese New Year, and St. Patrick's Day also take place. Community gathering places include low-key neighborhood farmers' markets and movie nights at local beaches. Community identity is strengthened by the many cultural practices, such as special ethnic food preparation, dance studios, traditional arts, languages, and family-oriented ceremonies provided by local neighborhood businesses. All of these attributes contribute to neighborhood and community cohesion along the project corridor.

Impacts

Alternative 1: No Build Alternative

The No Build Alternative would not include construction of a new transit system, so neighborhoods and communities would not be affected. It would not cause displacements, provide new access, or affect parklands, utilities and services in the corridor. Long-term impacts would include increased congestion on surface streets, which would impact the operating environment for fire, police, and emergency medical service vehicles and access to some community facilities. General public service vehicles such as school buses and solid waste collection trucks would also experience delays caused by increased congestion.

Alternative 2: TSM Alternative

Community Cohesion

Communities would be served by the enhanced bus system. No impacts on population or demographics would be expected.

Displacements and Relocations

With this alternative, the existing bus system would be enhanced. These enhancements would involve changing existing operations and frequencies of service, and would not require additional right-of-way. Additional right-of-way requirements for new transit centers, Park-and-Ride lots and bus maintenance facilities have not yet been identified, but would be less than the requirements for Alternatives 3 and 4.

Services, Utilities and Public Safety
Compared to the No Action Alternative, the limited transportation improvements and enhanced bus system associated with Alternative 2 would improve transit service. These improvements would have a small effect on community facilities by increasing accessibility. Impacts on utilities and community cohesion would be expected to be minor.

Parklands
No impacts to parklands have been identified.

Alternative 3: Managed Lane Alternative

Community Cohesion
The Managed Lane Alternative would provide additional vehicular through-capacity in an existing transportation corridor. It is not expected to have a substantial additional impact on the overall population or demographic characteristics in adjacent census tract areas, because these areas are already separated by a four-lane or wider highway. The facility would largely be constructed within an existing highway right-of-way. The effects of the Two-Direction and Reversible options would be the same.

Displacements and Relocations
Up to 49 adjacent parcels could be affected by parcel acquisition under this option (Table 4-3). Of this total, two parcels have been identified as residential, and up to 47 parcels with commercial/office and other uses would be affected. Where buildings are located on the affected parcels, displacements could occur.

Two parcels where residential uses occur would be affected by right-of-way acquisition for both of the options for this alternative. Parcels affected by right-of-way acquisition may include condominium or apartment buildings where multiple dwelling units could be affected, as well as single-family homes. Therefore, this alternative may result in a slight reduction in housing in the project area.

Table 4-3. Numbers of Parcels Affected (Full and Partial Acquisitions)

Alternative	Parcels of All Types[1]	Residential Parcels	Commercial/Office Parcels
Alternative 1: No Build			
No Build Alternative	0	0	0
Alternative 2: Transportation System Management			
TSM Alternative	None identified		
Alternative 3: Managed Lane (by section)			
3a.Two-Direction Option			
Waiawa IC to Hālawa Stream	11	2	4
Hālawa Stream to Pacific St.	38	0	26
3b. Reversible Option			
Waiawa IC to Hālawa Stream	9	2	3
Hālawa Stream to Pacific St.	35	0	26
Alternative 4: Fixed Guideway (full-length system by section)			
I. Kapolei to Fort Weaver Road			
Kamokila Blvd./Farrington Hwy.	22	0	3
Kapolei Pwy./North-South Rd.	19	0	0
Saratoga Ave./North-South Rd.	35	0	0
Geiger Rd./Fort Weaver Rd.	28	0	4
II. Fort Weaver Road to Aloha Stadium			
Farrington Hwy./Kamehameha Hwy.	14	2	4
III. Aloha Stadium to Middle Street			
Salt Lake Blvd.	24	1	12
Mauka of the Airport Viaduct	33	0	20
Makai of the Airport Viaduct	49	0	37
Aolele St.	15	0	1
IV. Middle Street to Iwilei			
North King St.	37	2	6
Dillingham Blvd.	39	1	22
V. Iwilei to UH Mānoa			
Beretania St./South King St.	36	3	22
Hotel St./Kawaiaha'o St./Kapi'olani Blvd.	83	11	58
King St./Waimanu St./Kapi'olani Blvd.	36	9	62
Nimitz Hwy./Queen St./Kapi'olani Blvd.	63	8	47
Nimitz Hwy./Halekauwila St./Kapi'olani Blvd.	77	9	51
Waikīkī Branch	16	1	10
Total for 20-mile Alignment	139	7	72

[1]Parcels of all types is greater than the sum of the other columns because it also includes parcels with governmental or utility company ownership that are not currently transportation right-of-way.

Services and Public Safety

Table 4-4 shows the parcels that support community and utility facilities that would be directly affected. Overall, introduction of a two-lane grade-separated facility between Waipahu and Downtown Honolulu would have effects similar to the Fixed Guideway Alternative. However, the scale and intensity of impacts would be less.

Table 4-4. Numbers of Community and Utility Facilities Affected

Alternative	Number and Type of Community Facilities	Number and Type of Utility Facilities	Total Number of Community and Utility Parcels
Alternative 1: No Build			
No Build Alternative	0	0	0
Alternative 2: Transportation System Management			
TSM Alternative	None identified		
Alternative 3: Managed Lane			
Managed Lane Alternative	0	1-Refuse 1-Electrical	2
Alternative 4: Fixed Guideway (full-length system by section)			
I. Kapolei to Fort Weaver Road			
Kamokila Boulevard/Farrington Highway	1-Health Service	2-Water	3
Kapolei Parkway/North-South Road	1-Health Service	2-Water	3
Saratoga Avenue/North-South Road	1-Health Service	2-Water	3
Geiger Road/Fort Weaver Road	None	1-Sewer	1
II. Fort Weaver Road to Aloha Stadium			
Farrington Highway/Kamehameha Highway	2-Educational Services 1-Religious Institution	None	3
III. Aloha Stadium to Middle Street			
Salt Lake Boulevard	None	1-Refuse 1-Water 1-Sewer	3
Mauka of the Airport Viaduct	None	1-Refuse	1
Makai of the Airport Viaduct	1-Social/Charitable	None	1
Aolele Street	1-Social/Charitable	None	1
IV. Middle Street to Iwilei			
North King Street	1-Educational Service 2-Religious Institutions	None	3
Dillingham Boulevard	1-Health Services 1-Educational Service	1-Electric	3
V. Iwilei to UH Mānoa			
Beretania Street/South King Street	1-Police Station 2-Educational Services	1-Electric	4
Hotel Street/Kawaiaha'o Street/ Kapi'olani Boulevard	1-Cultural Activity 1-Health Service 1-Educational Service	2-Electric	5
King Street/Waimanu Street/ Kapi'olani Boulevard	1-Cultural Activity 1-Health Service 1-Educational Service	2-Electric	5
Nimitz Hwy./Queen St./Kapi'olani Blvd.	1-Educational Service	1-Electric	2
Nimitz Hwy/Halekauwila St./Kapi'olani Blvd.	1-Educational Service	1-Electric 1-Sewer	3
Waikīkī Spur	1-Social/Charitable	None	1
Total for 20-mile Alignment	1-Health Services 2-Educational Service 2-Religious Institutions	2-Electric 1-Sewer	8

Parklands

The Managed Lane Alternative is anticipated to affect one public park, Waiawa District Park, and one recreational facility, Aloha Stadium (Table 4-5). It is anticipated that the proposed project improvements would require additional right-of-way at the Waiawa District Park and Aloha Stadium. However, it is not anticipated that these resources would be required to be relocated. Access to the facilities would be maintained. Parking may be permanently acquired at the Aloha Stadium. The Navy-Marine Golf Course would also be impacted through partial acquisition by the proposed project, but this facility is not considered a public resource.

Table 4-5. Affected Public Parklands, Recreation Areas, and Refuges

Alternative	Parklands	Sports and Recreation Areas	Wildlife and Waterfowl Refuges	Total
Alternative 1: No Build				
No Build Alternative	0	0	0	0
Alternative 2: Transportation System Management				
TSM Alternative	None identified			
Alternative 3: Managed Lane				
3a. Two-Direction Option	1	1	0	2
3b. Reversible Option	1	1	0	2
Alternative 4: Fixed Guideway (full-length system by section)				
I. Kapolei to Fort Weaver Road				
Kamokila Boulevard/Farrington Highway	1	0	0	1
Kapolei Parkway/North-South Road	1	0	0	1
Saratoga Avenue/North-South Road	1	0	0	1
Geiger Road/Fort Weaver Road	0	0	0	0
II. Fort Weaver Road to Aloha Stadium				
Farrington Highway/Kamehameha Highway	0	0	0	0
III. Aloha Stadium to Middle Street				
Salt Lake Boulevard	0	1	0	1
Mauka of the Airport Viaduct	0	1	0	1
Makai of the Airport Viaduct	1	1	0	2
Aolele Street	1	1	0	2
IV. Middle Street to Iwilei				
North King Street	0	0	0	0
Dillingham Boulevard	0	0	0	0
V. Iwilei to UH Mānoa				
Beretania Street/South King Street	0	0	0	0
Hotel Street/Kawaiaha'o Street/ Kapi'olani Boulevard	2	0	0	2
King Street/Waimanu Street/Kapi'olani Boulevard	0	0	0	0
Nimitz Highway/Queen Street/Kapi'olani Boulevard	0	0	0	0
Nimitz Highway/Halekauwila Street/Kapi'olani Boulevard	1	0	0	1
Waikīkī Branch	1	0	0	1
Total for 20-mile Alignment	2	1	0	3

Alternative 4: Fixed Guideway Alternative

Community Cohesion

Long-Term Impacts

The introduction of a fixed guideway transit system could both increase and decrease access through neighborhoods. Access to community services and businesses could be enhanced around stations. Overall adverse effects on community cohesion and social interaction would be low, because most of the proposed improvements would occur in existing major transportation corridors that already act as physical barriers between neighborhoods.

Experience in other cites with fixed guideway transit systems has shown that under appropriate market and regulatory conditions, a fixed guideway system can stimulate greater incentive for investment by property owners, especially in station areas. Transit-oriented development (TOD) is pedestrian-friendly, and concentrations of pedestrian-oriented businesses and services can increase social interaction within communities. Faster, more reliable, more frequent transit service can also increase access to community facilities and employment opportunities, benefiting all communities along the route.

Construction Impacts

Temporary physical barriers to isolate construction sites from traffic lanes would likely restrict access across roadways. Some streets would also be partially or fully closed during certain phases of construction, hindering access and temporarily reducing community cohesion within neighborhoods.

Displacements and Relocations

The parcels that would be affected by Alternative 4 would vary according to the alignment selected within each section (Table 4-3). Displacement and relocation issues for the five corridor sections are discussed in the following sections.

Section I. Kapolei to Fort Weaver Road

This portion of the route would affect up to 35 adjacent parcels. None of these parcels would require full acquisition. The Saratoga Avenue/North-South Road alignment would affect the most parcels, but many of the parcels that would be affected are currently vacant and planned for redevelopment as part of the Hawai'i Community Development Authority's Kalaeloa Master Plan. The Kapolei Parkway/North-South Road alignment would affect the fewest number of parcels. .

Section II. Fort Weaver Road to Aloha Stadium

Fourteen parcels would be affected along this portion of the corridor. Five of these parcels would be acquired in full and could include building displacements.

Section III. Aloha Stadium to Middle Street

Up to 49 parcels would be affected along this portion of the corridor. The greatest number of affected parcels would occur along the Makai of the Airport Viaduct alignment, and the fewest along the Aolele Street alignment. One of these parcels would likely be acquired in full and could include building displacements.

Section IV. Ke'ehi Interchange to Iwilei

Thirty-nine parcels could be affected by one alignment or another along this portion of the corridor. The Dillingham Boulevard alignment would affect the most adjacent parcels, as a result of widening to accommodate the fixed guideway structure. As many as 25 of these parcels would be acquired in full and could include building displacements.

Section V. Iwilei to UH Mānoa

Up to 83 parcels could be affected by one alignment or another along this portion of the corridor. The greatest number of parcels affected within this section would occur along the King Street/ Kawaiaha'o Street/Kapi'olani Boulevard alignment. The fewest affected parcels would occur along the Beretania Street/South King Street alignment. As many as 39 of the affected parcels would be acquired in full and could include building displacements.

The Waikīkī Branch would affect up to 17 parcels. No full acquisitions would occur.

20-mile Alignment

Up to 139 parcels could be affected along this alignment. As many as 25 of the affected parcels would be acquired in full and could include building displacements. The 20-mile Alignment would affect seven residential parcels.

Services and Public Safety

Long-Term Impacts

Long-term impacts could involve either the physical placement of the project on or adjacent to a public service or community facility, or a change in a public service or community facility's operating environment. The number of parcels supporting community facilities that would be directly affected by physical placement is shown in Table 4-4, which is organized by section with the number of affected parcels listed for each alignment option.

Overall, Alternative 4 would increase mobility and accessibility within the project corridor. It could limit or impede local access to specific public services (e.g., police, fire, or emergency medical services) in areas where access would be limited by installation of raised medians. Community facilities could be adversely affected if access to these facilities is viewed as restricted and less desirable or travel times are extended. These effects would be minor and would vary little between the alignments. To the extent that community facilities function as places of social interaction, the displacement of a substantial number of these facilities could change the way that some residents gather socially. However, as shown in Table 4-4, few community facilities would be directly affected by the Fixed Guideway Alternative.

Construction Impacts

For public services, some traffic rerouting or delays could affect fire, police, and emergency medical service vehicles during construction, and some cross streets could be temporarily closed to complete construction work. In some cases, construction requiring temporary road closures would be conducted at night or during off-peak hours to minimize traffic impacts. Construction of at-grade and elevated guideway sections in high-volume traffic and pedestrian areas could require additional police support services to direct and control traffic and pedestrian movements. Traffic rerouting or delays could also affect school bus routes and solid waste collection.

Access to community facilities near construction sites may be impeded by traffic restrictions and detours, displacement of parking or loading areas, and road closures for project construction and utility relocation. Permanent relocation of some facilities may be necessary, although the magnitude of this impact would vary between alignment options.

Utilities

Long-Term Impacts

Long-term impacts on utility services and systems are expected to be minimal. Indirectly, the increased densities that may occur around station locations could decrease siting costs for new utilities, because a compact growth pattern would be easier to serve than a more dispersed development pattern. The number of parcels supporting utility facilities that would be directly affected is shown in Table 4-4.

Construction Impacts

Multiple physical utilities are located within, adjacent to, or traverse the project corridor roadways, including electric, water, sewer, stormwater, telephone, cable, and fiber optics. These utilities may or may not be affected during construction, depending on their depth below grade, soil conditions, the excavation limits, the exact location of the guideway, and other factors.

Underground utilities would be relocated or otherwise protected to allow for excavation and minimize potential load impacts on existing utilities. Numerous utility poles that support overhead lines may also require relocation. Some of these impacts may be significant to some utility service providers in terms of relocation costs incurred, staff time and resources, and temporary loss of existing access to utilities.

Cut-and-cover construction (which is being considered for the Hotel Street/Kawaiaha'o Street/ Kapi'olani Boulevard Alignment) followed by at-grade construction would generally have the greatest impact on utility infrastructure. This is because these methods would require more relocation of underground piles and above-ground utility poles for guideways, stations, and right-of-way acquisitions. Construction of elevated sections could also require relocation of utilities. However, elevated supports can often be placed to avoid conflicts with major underground utilities and could straddle crossing roadways. This would help avoid having utilities run beneath them. Bored tunnel sections would generally pass beneath most underground utilities and would not require relocation. Protection of these utilities in some cases (typically deeper sewer pipes) may be required. Disruptions to utility service during utility relocations would likely be minimal, because temporary connections to customers would typically be established before relocating utility conveyances.

Parklands

Long-term impacts could involve either the physical placement of the project on or adjacent to a public park or recreational use, or a change in a public service or community facility's operating environment. The number of parcels supporting park or recreation uses that would be directly affected by physical placement of the project is shown in Table 4-5, organized by section with the number of affected parcels listed for each alignment option. It is anticipated that the proposed transit project would require additional right-of-way at the parks and recreational resources. However, it is not anticipated that any of these resources would require permanent relocation.

Mitigation

Where relocations would occur, compensation would be provided to affected businesses or residents. Compensation for parcel acquisitions, including buildings and structures, would be provided at fair market value and comply with the Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended. These regulations provide for relocation services for businesses and residences and include measures for providing assistance in locating suitable replacement housing and business sites. If residences are displaced, housing relocation assistance would be provided to displaced persons.

Federal laws require that no person be required to move from a residence unless comparable replacement property is available within that person's financial means. In addition, no displaced person, business, or organization would be required to move from any dwelling or business facility without being given a written notice at least 90 days prior to the earliest date that they could be required to move. Relocation services would be provided to all affected property owners and tenants without discrimination.

Environmental Justice

Executive Order 12898 requires that federal agencies identify and not disproportionately affect minority and low-income populations. For this project, environmental justice communities have been expanded to include areas with high proportions of linguistically isolated households, in order to more broadly define communities of concern to fit O'ahu's diverse ethnic make-up. This section identifies environmental justice populations, discusses outreach made to these populations, and analyzes effects on these populations. Effects evaluated include land acquisitions, distribution of transportation benefits, and construction impacts.

Alternative 1: No Build Alternative

With the No Build Alternative, the proposed project would have no disproportionately high or adverse impacts on low-income and/or minority communities. This is because there would be no new construction other than what has already been planned and approved. Projects included under the No Build Alternative would undergo planning and environmental review as part of their individual project development process.

Alternative 2: TSM Alternative

Long-Term Impacts

The TSM Alternative would provide an enhanced bus system based on a hub-and-spoke route network, conversion of the present morning peak-hour-only zipper-lane to a morning and afternoon peak-hour zipper-lane operation, and other relatively low-cost bus priority capital improvements on selected roadway facilities. It would also include completion of projects defined in the O'ahu Regional Transportation Plan, which are also included in the No Build Alternative. The limited transportation improvements and enhanced bus system associated with Alternative 2 would improve traffic operations on corridor roadways. These improvements would benefit low-income and/or minority communities by increasing accessibility to these communities.

Construction Impacts

Construction of bus enhancement facilities could affect low-income and/or minority communities if such facilities are located in or adjacent to those communities. However, impacts such as noise or dust from construction activities would be temporary and would be minimized and monitored by using Best Management Practices (BMPs) such as construction scheduling or dust control measures, if necessary. Traffic impacts during construction would be managed through implementation of Traffic Management Plans.

Alternative 3: Managed Lane Alternative

Long-Term Impacts

The acquisition of commercial and residential uses may have a disruptive influence on a community. According to Table 4-6, within potential low-income or minority communities, approximately 21 parcels (including one parcel where a residential use occurs) may be potentially affected by right-of-way acquisition for the Two-Direction Option for the Managed Lanes Alternative. Approximately 17 parcels, including one residential use, may be affected by right-of-way acquisition for the Reversible Option. This impact would result in a slight reduction in commercial and residential uses for these communities. The Two-Direction Option provides more opportunity to connect communities, because two stations are associated with this option. The Reversible Option would only connect communities near the ends of the facility (Ewa of Waiawa Interchange or Koko Head of Pacific Street) and near the Salt Lake neighborhood (from the Salt Lake Boulevard ramps).

Table 4-6. Numbers of Parcels Directly Affected by Each Alternative within Communities of Concern

Alternative	Parcels Directly Affected in Communities of Concern (EJ)	
	Total*	**Residential**
Alternative 1: No Build		
No Build Alternative	N/A	N/A
Alternative 2: Transportation System Management		
TSM Alternative	N/A	N/A
Alternative 3: Managed Lane		
3a. Two-Direction Option	21	1
3b. Reversible Option	17	1
Alternative 4: Fixed Guideway (by section)		
I. Kapolei to Fort Weaver Road		
Kamokila Boulevard/Farrington Highway	3	0
Kapolei Parkway/North-South Road	2	0
Saratoga Avenue/North-South Road	2	0
Geiger Road/Fort Weaver Road	5	0
II. Fort Weaver Road to Aloha Stadium		
Farrington Highway/Kamehameha Highway	2	0
III. Aloha Stadium to Middle Street		
Salt Lake Boulevard	5	1
Mauka of the Airport Viaduct	15	0
Makai of the Airport Viaduct	8	0
Aolele Street	8	0
IV. Middle Street to Iwilei		
North King Street	29	2
Dillingham Boulevard	23	0
V. Iwilei to UH Manoa		
Beretania Street/South King Street	21	3
Hotel Street/Kawaiaha'o Street/ Kapi'olani Boulevard	10	1
King Street/Waimanu Street/Kapi'olani Boulevard	39	1
Nimitz Highway/Queen Street/Kapi'olani Boulevard	22	0
Nimitz Highway/Halekauwila Street/Kapi'olani Boulevard	25	1
Waikīkī Branch	14	1
Total for 20-mile Alignment	54	1

*Includes City-owned, negotiated, or donated parcels

Construction Impacts

Short-term construction impacts would potentially include increased congestion on surface streets, noise, and dust during construction activities. Temporary construction easements may be required for properties adjacent to the proposed alignment. Short-term noise and dust from construction activities would be minimized and monitored through the use of BMPs such as construction scheduling or dust control measures, if necessary. Traffic impacts during construction would be managed through the implementation of Traffic Management Plans.

Alternative 4: Fixed Guideway Alternative

Long-Term Impacts

The relocation or acquisition of commercial and residential uses may have a disruptive influence on a community (Table 4-6). Impacts to services such as schools, community and social facilities, and public services can have a disruptive affect on communities. In Section I, no residential uses would be acquired. Kapolei Parkway/North-South Road alignment and Saratoga Avenue/North-South Road alignment would have the least acquisitions (two parcels). Geiger would potentially have the greatest disruption with approximately five parcels to be fully or partially acquired. In Section II, Farrington Highway/Kamehameha would potentially impact two parcels within low-income or minority communities. In Section III, the Salt Lake Boulevard alignment would have the least impact, with five parcels fully or partially acquired, but one residential use would be impacted. The Mauka of Airport Viaduct alignment would potentially acquire 15 parcels within low-income or minority communities, with no impact to residential uses. In Section IV, North King Street alignment would have the greatest impact, with a potential impact to 29 parcels where two residential uses occur. In Section V, the Hotel Street/Kawaiahao Street/Kapiolani Boulevard would have the least impact to parcels that occur within low-income or minority communities (ten parcels including one residential). The King Street/Waimanu Street/Kapiolani Boulevard alignment would have the greatest impact, with approximately 39 full or partial acquisitions, including one residential use. Residential-use parcels may include condominium and/or apartment units as well as single-family residences.

Construction Impacts

Short-term construction impacts could potentially include increased congestion on surface streets, noise, and dust during construction activities. Temporary construction easements may be required for properties adjacent to the proposed alignment. Short-term noise and dust from construction activities would be minimized and monitored through the use of BMPs such as construction scheduling or dust control measures, if necessary. Traffic impacts during construction would be managed through implementation of Traffic Management Plans.

Mitigation

Where relocations would occur, compensation would be provided to affected businesses or residents. Compensation for parcel acquisitions, including buildings and structures, would be provided at fair market value and comply with the Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended. These regulations provide for relocation services for businesses and residences and include measures for providing assistance in locating suitable replacement housing and business sites. If residences are displaced, housing relocation assistance would be provided to displaced businesses, persons, and organizations.

Federal laws require that no person be required to move from a residence unless comparable replacement property is available within that person's financial means. In addition, no displaced person, business or organization would be required to move from any dwelling or business facility without being given a written assurance at least 90 days prior to the earliest date that they could be required to move. Relocation services would be provided to all affected property owners and tenants without discrimination.

Public outreach to affected communities would occur during the project's planning and construction phases. Where identified, multilingual publications would be produced for communities with language barriers. Interpreters would be also be available and provided upon request.

Farmlands

The 'Ewa Plain was once a major agricultural area primarily used to cultivate sugarcane. However, sugarcane has not been cultivated in 'Ewa since 1995. Despite recent rapid urbanization, much of the 'Ewa Plain is still classified and/or zoned for agricultural use by the State of Hawai'i and City and County of Honolulu. In particular, the State of Hawai'i still designates much of 'Ewa that is not urbanized to be "prime" and "unique" farmlands, under the "Agricultural Lands of Importance to the State of Hawai'i" (ALISH) land classification system. The remainder of the project corridor does not contain known agricultural uses or lands designated as "prime" or "unique."

Although currently designated as "prime" or "unique" farmland according to ALISH, some areas in 'Ewa have existing or planned land uses for development. For example, East Kapolei is designated "prime" land and is still actively farmed, but long-term plans for East Kapolei do not include agricultural use. All of East Kapolei is slated (zoned or planned) for development, along with the rest of the 'Ewa/Kapolei region, in accordance with the City's General Plan and the 'Ewa Development Plan. The University of Hawai'i (UH) has already begun planning its UH West O'ahu campus on a site along the west side of North-South Road (see Chapter 1 of the *Alternatives Analysis/Draft Environmental Impact Statement*). Tenant farms in East Kapolei are on short-term leases with the Estate of James Campbell or the Department of Land and Natural Resources (DLNR), with the understanding that these lands are not intended for indefinite agricultural use.

In the more urbanized corridor along Farrington Highway and Kamehameha Highway in Waipahu and Pearl City, some limited areas are still designated as "prime" or "unique." Part of the City's Waipahu Cultural Garden Park, located slightly mauka of Farrington Highway in the heart of Waipahu, is designated "unique" land. Makai of Kamehameha Highway in Pearl City, active cultivation of taro and potentially other crops is occurring on coastal property along Pearl Harbor, directly 'Ewa of the Hawaiian Electric Company (HECO)'s Waiau Power Plant.

Impacts

Alternatives 1 and 2

No direct impacts to farmlands would result from the No Build Alternative (Alternative 1) or the TSM Alternative (Alternative 2).

Alternative 3: Managed Lane Alternative

The Managed Lane Alternative would have no direct footprint impacts on farmlands. Although some "prime" and "unique" agricultural lands lie adjacent to or near H-1, H-2, and Kamehameha Highway through the Waiawa/Pearl City area, the elevated structure would have no appreciable impact on any farmland operations because this alternative stays largely within existing rights-of-way.

Alternative 4: Fixed Guideway Alternative

Three of the four alignments in Section I of the Fixed Guideway Alternative would affect lands in the 'Ewa area that are currently leased and used by active farms. These areas, which are currently under crop production, may be developed by the time this project would be ready for implementation. Therefore, lands are expected to be lost to agricultural production by 2030 with or without the project. Only the Geiger Road/Fort Weaver Road alignment option would not impact existing agricultural operations. If agricultural activities in the 'Ewa Plain remain stable, only a very limited amount of farmland would be lost as a result of the project, which would be largely within existing roadway right-of-way.

The Fixed Guideway Alternative would not cause any other direct impacts to farmlands. Other lands in the Kapolei/'Ewa and Waipahu/Pearl City areas are categorized as "prime" or "unique" lands under ALISH, but these areas are either already developed, plans exist for their development, and/or they would become part of roadway right-of-way under future development plans, such as in the City of Kapolei. Moreover, most of the remainder of the Fixed Guideway Alternative alignments would be within existing roadway right-of-way, such as on Kamehameha Highway through Pearl City.

Visual and Aesthetic Resources

This section concentrates on viewshed impacts, shading, and any impacts to light and glare that the project would create.

Methodology

The study of visual and aesthetic resources included a review of related studies previously conducted within the study corridor, consultation with agencies and special interest groups, and field surveys to verify literature review findings. The City and County of Honolulu Department of Planning and Permitting (DPP) and the Outdoor Circle were also consulted to obtain additional data, refine the focus for the visual analysis, and elicit the most pertinent concerns that stakeholders had regarding safeguarding the aesthetic environment. Comments received during public scoping meetings for this project were reviewed, to gain perspective on the concerns and ideas that communities, organizations, and businesses have regarding the proposed project's aesthetic impact.

Field surveys were conducted to develop a baseline condition and document existing conditions for view corridors protected by policy. The field and view corridor surveys helped define the Area of Visual Affect (AVE) and identify representative viewpoints.

The surveys also helped identify viewer groups that would be exposed to project changes on a regular basis. Visual impacts are a combination of effects on the AVE and important resources, as well as response of persons viewing the impacts. Viewer response involves viewer sensitivity and viewer exposure.

An assessment of visual impacts was conducted using criteria based on state and federal preservation requirements and simulations for the representative viewpoints. Impacts were evaluated for the short-term, the construction period, and the long-term operational period.

Affected Environment

The island has maintained most of its natural open space and scenic resources through preservation and enhancement policies. These policies generally reflect the community's desire to preserve the island's historic character, design projects that fit the local setting's character, maintain proper scale and balance between the built environment and its surrounding setting, and limit impacts to scenic resources. The following policy documents govern the study area and identify scenic resources:

- O'ahu General Plan (Revised 2002)
- 'Ewa Sustainable Communities Plan (August 1997)
- Central O'ahu Sustainable Communities Plan (December 2002)
- Primary Urban Center Development Plan (Draft June 2004)
- Aiea-Pearl City Livable Communities Plan (May 2004)
- Waipahu Livable Communities Initiative (May 1998)
- Waipahu Town Plan (December 1995)
- Revised Ordinance of Honolulu 1990

'Ewa, which has a generally open and rural agricultural nature, is slowly transitioning to a more urbanized context with new growth and development, supporting the City and County of Honolulu's vision for this area as a second urban center. Similarly, Central O'ahu, previously in extensive agricultural use, is growing into a more suburban area. The Primary Urban Center (PUC) encompasses a wide range of land uses and neighborhoods as it extends from Pearl City at the Ewa end to Waialae and Kahala at the Koko Head end. Pearl Harbor, Honolulu International Airport, Downtown, and Waikiki are located within the PUC. Although densely developed, the PUC still supports several parks, beaches, and streams that offer recreational and open space opportunities for its community members.

Scenic resources within the study area include landmarks, significant views and vistas, and view corridors. Table 4-7 is a list of the National Historic Landmarks and views located within the study corridor. They are protected by policy and considered to be significant scenic resources based on their scale and prominence within the visual environment.

Table 4-7. Identified Resources

Class of Resource	Resources
National Historic Landmarks	Pearl Harbor
	Pearl Harbor Naval Base
	Diamond Head
	Puowaina Crater (Punchbowl)
Significant Views and Vistas	Waianae and Koolau Mountains
	Pacific Shoreline
	Downtown Skyline
	Pearl Harbor
	Diamond Head

View Corridors

View corridors were reviewed, and either considered to be unaffected by the proposed project alignments or located within the study area and possibly affected. Photographs were taken to document existing conditions at each view corridor that could be affected.

Viewpoints

The visual quality of 23 representative viewpoints within the study corridor was rated as high, moderate or low depending on how well an image, as seen from the viewpoint, met visual excellence and visual quality criteria as defined by U.S. Department of Transportation (DOT). Visual excellence was measured based on *vividness* (the memorability of the view), *intactness* (freedom from encroaching elements), and *unity* (the cohesiveness of an image) as evaluative criteria. If all three criteria were met, an image was rated high for visual quality. If two criteria were met, the viewpoint was rated as moderate for visual quality. If none or only one of the criteria were met, the viewpoint was rated low for visual quality.

Impacts

Impacts were evaluated based on the following parameters:

- Physical changes to the visual environment;
- Removal, alteration, or obstruction of scenic, cultural, or historic resources;
- Changes in visual quality from existing conditions to modified conditions;
- Viewer response to modified conditions;
- Changes in the light environment, which consists of sources of light, glare, shade, and shadow patterns; and
- Inconsistency with aesthetic goals outlined in policy documents governing the study area.

Construction impacts that would be similar for all build alternatives affecting the visual environment include the following:

- removal of vegetation during clearing and grubbing operations;
- placement of barriers, signage, and screening materials during construction for traffic control;
- safety, privacy, and noise abatement; and
- storage of large equipment and construction materials.

These elements are a component of construction operations and would temporarily affect the existing landscape by changing visual aesthetics within and surrounding the construction site.

Alternative 1: No Build

No construction would occur under the No Build Alternative; so no impacts to visual resources or the existing visual environment would occur. Since no visual impacts would occur, Alternative 1 would be consistent with policies protecting the aesthetic environment.

Alternative 2: Transportation System Management

Alternative 2 consists primarily of operational improvements to the existing bus system, such as bus network and zipper-lane improvements. It would also include some capitol improvements that give priority to buses. These improvements would not permanently affect visual resources. The TSM Alternative also includes construction of new transit centers and bus maintenance facilities. Visual effects would be minor and limited to the area surrounding the new facilities.

Alternative 3: Managed Lane Alternative

Long-Term Impacts

Physical Change to Visual Environment

The Managed Lane Alternative would add an elevated roadway structure into the visual environment between the Waiawa Interchange and Iwilei.

Change in Visual Quality

Changes in visual quality for the Two-Direction and Reversible options were based on the following criteria:

- Potential for impacts to exceptional trees, historic sites, or cultural resources as a result of property acquisition
- Introduction of project elements that would be out of scale or character with the existing visual environment
- Introduction of new sources of light, glare, shade, or shadow patterns
- Viewer response to physical changes, and
- Whether proposed changes or affects on scenic resources would be consistent with policy documents.

Both options have the potential for impacts under all of the above criteria. The Two-Direction Option would result in greater impacts than the Reversible Option because of the proposed structure's increased width. Operational effects for this option would be moderate to high (Table 4-8). The Reversible Option would result in moderate effects.

Construction Impacts

The Managed Lane Alternative would have a fairly large construction footprint and construction is anticipated to last several years. During that time, the elements and conditions of construction would cause a change in the existing landscape's character that would be visible to the public.

Construction of a grade-separated structure would require additional equipment that would be much larger and more visible from a distance. The Managed Lane Alternative would also require additional staging and storage areas. Construction activities could occur 24 hours a day, 7 days a week to minimize overall project costs and shorten the build-out period. Continuous construction operations would require night-time lighting equipment that would introduce new sources of light and glare in rural areas that have limited light sources and in residential areas with low lighting.

Table 4-8. Summary of Visual Impacts and Benefits

Alternative	Operational Effects
Alternative 1: No Build	
No Build Alternative	None
Alternative 2: Transportation System Management	
TSM Alternative	Low
Alternative 3: Managed Lane (by section)	
3a. Two-Direction Option	
Waiawa IC to Halawa Stream	Moderate
Halawa Stream to Pacific Street	Moderate - High
3b. Reversible Option	
Waiawa IC to Halawa Stream	Moderate
Halawa Stream to Pacific Street	Moderate
Alternative 4: Fixed Guideway (by section)	
I. Kapolei to Fort Weaver Road	
Kamokila Boulevard/Farrington Highway	Moderate - High
Kapolei Parkway/North-South Road	Moderate - High
Saratoga Avenue/North-South Road	Moderate - High
Geiger Road/Fort Weaver Road	Moderate - High
II. Fort Weaver Road to Aloha Stadium	
Farrington Highway/Kamehameha Highway	Moderate - High
III. Aloha Stadium to Middle Street	
Salt Lake Boulevard	Moderate
Mauka of the Airport Viaduct	Low - Moderate
Makai of the Airport Viaduct	Low - Moderate
Aolele Street	Low - Moderate
IV. Middle Street to Iwilei	
North King Street	Moderate - High
Dillingham Boulevard	Low - Moderate
V. Iwilei to UH Manoa	
Beretania Street/South King Street	Moderate - High
Hotel Street/Waimanu Street/Kapi'olani Boulevard	Low - Moderate
Hotel Street/Kawaiaha'o Street/Kapi'olani Boulevard	Low - Moderate
King Street/Waimanu Street/Kapi'olani Boulevard	Low - Moderate
Nimitz Highway/Queen Street/Kapi'olani Boulevard	Low - Moderate
Nimitz Highway/Halekauwila Street/Kapi'olani Boulevard	Low - Moderate
Waikīkī Branch	Low - Moderate

Alternative 4: Fixed Guideway

Long-Term Impacts

Physical Change to Visual Environment

The Fixed Guideway Alternative would add a mostly elevated fixed guideway into the visual environment between Kapolei and UH Manoa. The structure would be narrower than the roadway structure for the Managed Lane Alternative, but would extend a greater distance.

Change in Visual Quality

All of the alignments proposed under the Fixed Guideway Alternative would have the potential for impacts to exceptional trees, historic and cultural resources, the existing aesthetic environment's character, the existing light environment, viewer groups, and aesthetic policies.

Operational effects for each alignment are shown in Table 4-8. Operational effects were based on what level of effect (high, moderate, low) an alignment would have on visual quality, what the viewer groups' level of sensitivity, and the level of impact an alignment would have on light, glare, shade, shadow, and aesthetic policies. A percentage scale was used to determine the level of impact (high, moderate, low) for change in light, glare, shade, shadow and policy consistency. This was based on the number of elements introduced (light, glare, shade, shadow) and the number of policy documents with which the alignment would be inconsistent. Introduction of 0 to 1 new light conditions was considered low, 2 new conditions was considered moderate, and 3 to 4 new conditions was considered high. Inconsistency with 0 to 2 policy documents was considered low, 3 to 5 policy documents was moderate, and 6 to 8 policy documents was high.

The elevated guideway structure has the potential to be out of scale or character in settings that are more historic, pedestrian-oriented, and low-profile or open. Among the five sections, Section I would have higher operational effects because of the low-profile, open character of the Ewa-Kapolei area. On the other hand, impacts within Section V would be lower because of the existing density and number of high-rise structures in the Downtown and Waikiki areas.

Construction Impacts

The Fixed Guideway Alternative would have a fairly large construction footprint, with construction anticipated to last several years. During that time, the elements and conditions of construction would cause a change in the character of the existing landscape that would be visible to the public.

Construction of a grade-separated structure would require additional equipment that would be much larger and more visible from a distance. The Fixed Guideway Alternative would also require additional staging and storage areas. Construction activities could occur 24 hours a day, 7 days a week to minimize overall project costs and shorten the build-out period. Continuous construction operations would require nighttime lighting equipment that introduce new sources of light and glare in rural areas that have limited light sources and residential areas with low lighting.

Mitigation

Alternative 1: No Build

No construction would occur under the No Build Alternative, so no impacts to the visual environment would occur. No mitigation would be required.

Alternative 2: Transportation System Management

Construction would be localized to a small area, and the use of context-sensitive design would integrate the transit facilities into the existing environment. Consideration of basic design principles would mitigate impacts to less than substantial.

Alternative 3: Managed Lane

Impacts associated with the Managed Lane Alternative would include:

- Potential removal or relocation of exceptional trees
- Changes in the setting of an historic or cultural site or Section 4(f) resource
- Alteration of mauka-makai views
- Introduction of project components that are out of scale or character with their setting
- Moderate to high viewer response to project changes
- Introduction of new light sources in sensitive areas, and
- Inconsistency with policy documents.

The following design principles should be considered to help minimize, reduce, or mitigate these impacts:

- Integrate landscaping and artwork to improve the project's visual quality.
- Project design should consider a contextual approach, so project elements are functional as well as aesthetically appropriate to their setting.
- Consider alignments that better support the construction of large-scale, elevated components.
- Consult with a multi-disciplinary advisory committee regarding an appropriate design theme.
- Use project components to define spaces and create a "sense of place" that is appropriate in scale and character to its setting.
- Consider design components that help create a human-scale and pedestrian-friendly environment.
- Create opportunities for appropriate and sensitive "showcasing" of project components that are too large-scale to apply minimizing techniques.
- In highly sensitive settings, use design features with materials and shapes that fit the topography and visual setting.
- Look for opportunities to use materials that reflect the Hawai'ian culture and minimize the potential for vandalism.
- Incorporate appropriate consultation, monitoring, preservation, and documentation measures to minimize impacts to Section 4(f), historic, cultural, and vegetative resources.

- Pursue cooperative agreements with adjacent property owners to finance and maintain landscaping, artwork, or other design features that would improve the project's visual quality.

Alternative 4: Fixed Guideway

Mitigation for impacts related to Alternative 4 would be similar to those discussed for Alternative 3.

Air Quality and Energy

The island of O'ahu is in attainment with all national ambient air quality standards. Air pollutants related to motor vehicles are relevant to the evaluation of project impacts. These pollutants include carbon monoxide (CO), volatile organic compounds (VOC), nitrogen oxides (NO_x), particulate matter (PM_{10} and $PM_{2.5}$), and Mobile Source Air Toxics. Emissions of Mobile Source Air Toxics are not calculated, because initial transportation data indicate that the project alternatives would not substantially increase their emission. They would vary among the alternatives, similar to the other air pollutants.

Air pollutant emissions from transportation sources are related to vehicle miles traveled (VMT) and the average network speed for each alternative. Regional air pollutant emissions would be between 0 and 4 percent less (depending on the pollutant of interest) for the TSM and Fixed Guideway Alternatives compared to the No Build Alternative. Pollutant emissions with the Managed Lane Alternative would be between 0 and 4 percent greater compared to the No Build Alternative (Table 4-9). The total transportation energy demand for roadway and fixed guideway transit vehicles would be lowest for the Fixed Guideway and TSM Alternatives and highest for the Managed Lane Alternative.

Table 4-9. Daily Air Pollution Emissions and Energy Consumption

Alternative	Air Pollutant Emissions (kg/day)[1]					Energy Consumption (MBTUs)[2]
	VOC	CO	NO_x	PM_{10}	$PM_{2.5}$	
Alternative 1: No Build						
2030 No Build	8,040	143,000	4,780	424	203	92,310
Alternative 2: Transportation System Management						
2030 TSM	7,980	142,000	4,750	420	201	91,600
Alternative 3: Managed Lane						
2030 Two-Direction Option	8,030	143,500	4,800	424	203	94,860
2030 Reversible Option	8,340	147,000	4,930	438	210	95,360
Alternative 4: Fixed Guideway						
2030 Fixed Guideway – Minimum	7,760	139,000	4,640	410	196	91,200
2030 Fixed Guideway – Maximum	7,800	139,700	4,670	412	197	92,100

[1]Kilograms per day
[2]Million British Thermal Units

Energy is consumed during construction and operation of transportation projects. It is used during construction to manufacture materials, transport materials, and operate construction machinery. Energy used during project operation includes fuel consumed by vehicles on O'ahu, electricity used to power transit vehicles, and a negligible amount of energy for signals, lighting, and maintenance. Total transportation energy consumption with the Managed Lane Alternative would be approximately 3 percent greater than with the No Build Alternative. Total transportation energy consumption would be less for the Fixed Guideway Alternative than for the No Build Alternative.

The project's construction-related air quality effects would be limited to short-term increased fugitive dust and mobile-source emissions. Construction of the Managed Lane Alternative would require between 2,990,000 and 4,160,000 million BTUs of energy. Construction of the Fixed Guideway Alternative would require between 3,700,000 and 4,900,000 million BTUs of energy.

Noise and Vibration

Noise and vibration effects were evaluated using Federal Transit Administration (FTA) noise and vibration impact criteria. The impact criteria include transit-specific criteria that vary depending on the existing sound environment, and an adoption of Federal Highway Administration (FHWA) highway noise criteria for roadway noise sources. The State of Hawai'i Highway Department of Transportation (HDOT) Noise Analysis and Abatement Policy, which is the local adaptation of the FHWA criteria, was used to evaluate potential noise impacts for the Managed Lane Alternative. The transit-specific criteria were used to evaluate the Fixed Guideway Alternative.

Background, Studies, and Coordination

A general discussion of the science and policy of transportation noise and vibration is provided in the *Honolulu High-Capacity Transit Corridor Project Noise and Vibration Technical Report*. The impact criteria considered are described in this section.

FTA Noise Criteria

The amount that a transit project is allowed to change the overall noise environment is reduced with increasing levels of existing noise. The FTA noise impact criteria group noise-sensitive land uses into the following three categories:

Category 1: Buildings or parks where quiet is an essential element of their purpose.

Category 2: Residences and buildings where people normally sleep. This includes residences, hospitals, and hotels where nighttime sensitivity is assumed to be of utmost importance.

Category 3: Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, churches, office buildings, and other commercial and industrial land use.

L_{dn} is a measure of the average noise level over a 24-hour day. It is used to characterize noise exposure for residential areas (Category 2). The maximum 1-hour L_{eq} is used for other noise-sensitive land uses such as school buildings (Categories 1 and 3). Two levels of impact are included in the FTA criteria. The interpretations of these two levels of impact are summarized below:

Severe Impact: Severe noise impacts are considered "significant". This term is used in the National Environmental Policy Act (NEPA) and implementing regulations. Noise mitigation will normally be specified for severe impact areas unless there is no practical method of mitigating the noise.

Moderate Impact: In this range, other project-specific factors must be considered to determine the magnitude of the impact and the need for mitigation. These other factors can include the predicted increase over existing noise levels, the types and number of noise-sensitive land uses affected, existing outdoor-indoor sound insulation, and the cost effectiveness of mitigating noise to more acceptable levels.

FTA Vibration Criteria

The FTA has developed impact criteria for acceptable levels of vibration. Ground-borne vibration from transit vehicles is characterized in terms of the RMS vibration velocity amplitude. The threshold of vibration perception for most people is around 65 "vibration" decibels (VdB). Levels in the 70 to 75 VdB range are often noticeable but acceptable, and levels over 80 VdB are often considered unacceptable. For urban transit systems with 10 to 20 buses per hour throughout the day, limits for acceptable levels of residential ground-borne vibration are usually between 70 and 75 VdB.

FHWA/HDOT Noise Criteria

HDOT's Noise Analysis and Abatement Policy implements the requirements of the FHWA regulations on noise impacts (23 CFR 772). The policy requires that a noise analysis be performed whenever potentially affected receptors exist in the study area, either as developed lands or lands that are planned, designed, or programmed for future use.

Under HDOT policy, a noise impact occurs when predicted traffic noise levels approach or exceed FHWA's Noise Abatement Criteria (NAC), or when predicted traffic noise levels substantially exceed existing noise levels. FHWA's NAC for residential and other noise-sensitive land uses is 67 A-weighted decibels (dBA) L_{eq}(h). This criterion applies to most land uses considered Category 1 or 2 under the FTA noise impact criteria.

Affected Environment

To establish the existing baseline noise levels, a series of noise measurements were taken at representative locations along the proposed alignment corridor. This section provides details on the existing noise levels used to establish baseline conditions.

Noise measurements were taken at 43 noise-sensitive locations along the study corridor. These locations provide a good representation of all noise-sensitive land uses along the corridor. Thirty long-term (24-hour) noise measurements and 13 short-term (15-minute) measurements were taken at the locations shown in Figure 4-1 and Figure 4-2 for Alternative 3 and in Figure 4-3 through Figure 4-7 for Alternative 4. The measurement data are summarized in Table 4-10and Table 4-11. L_{dn} (24-hour) noise measurements are used to assess transit noise in locations where people sleep, and peak-hour L_{eq} noise levels are used to assess roadway noise in all locations and transit noise in locations with daytime use only. To determine the peak noise hour L_{eq}, each short-term measurement was compared to the closest 24-hour data at the same hour of the day. The short-term measured levels in Table 4-11 were adjusted relative to the 24-hour samples to develop a peak L_{eq} for each of the short-term measurement locations.

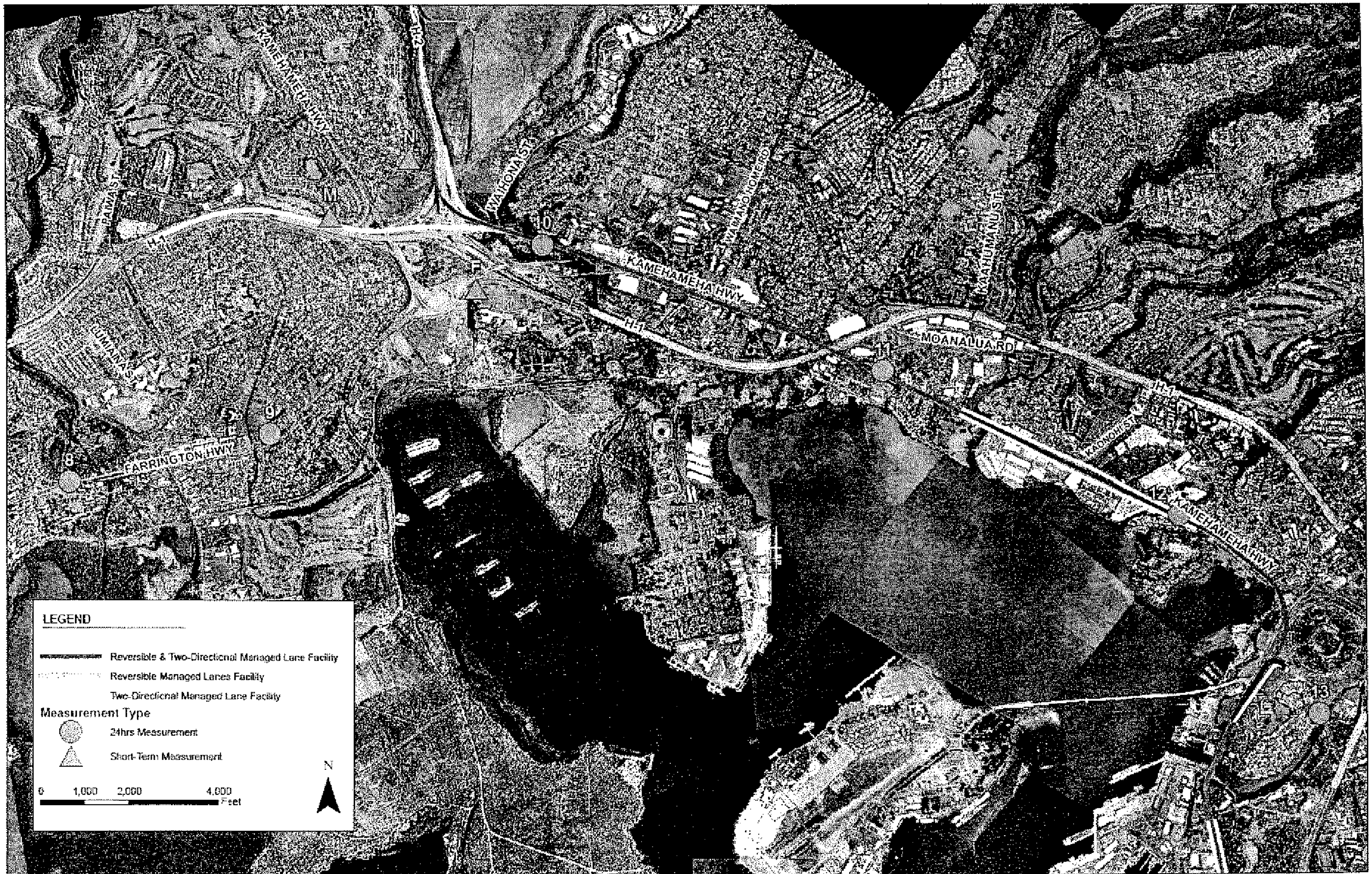

Figure 4-1. Noise Monitoring and Assessment Locations for the Managed Lane Alternative ('Ewa Section)

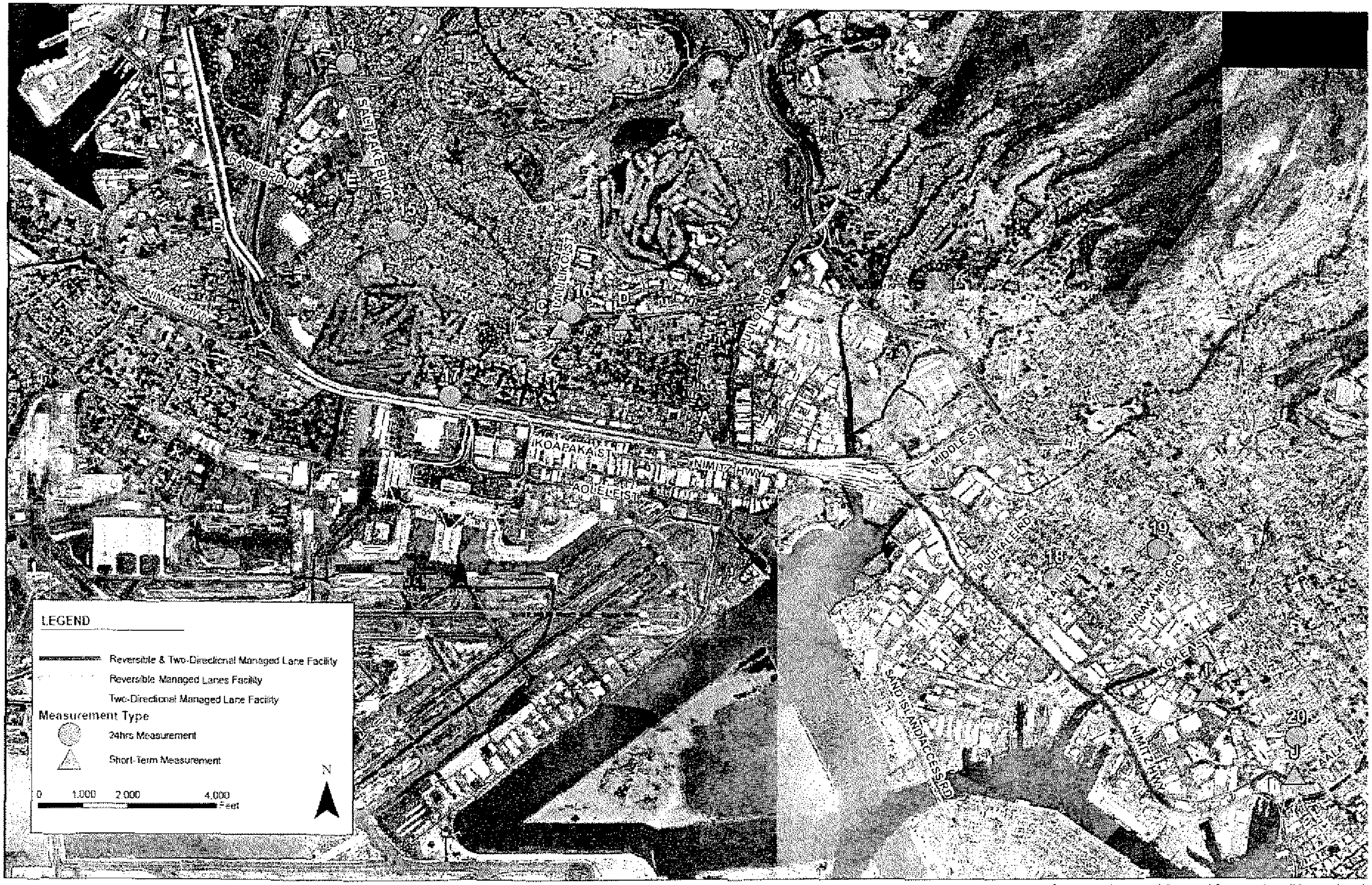

Figure 4-2. Noise Monitoring and Assessment Locations for the Managed Lane Alternative (Koko Head Section)

AR00071108

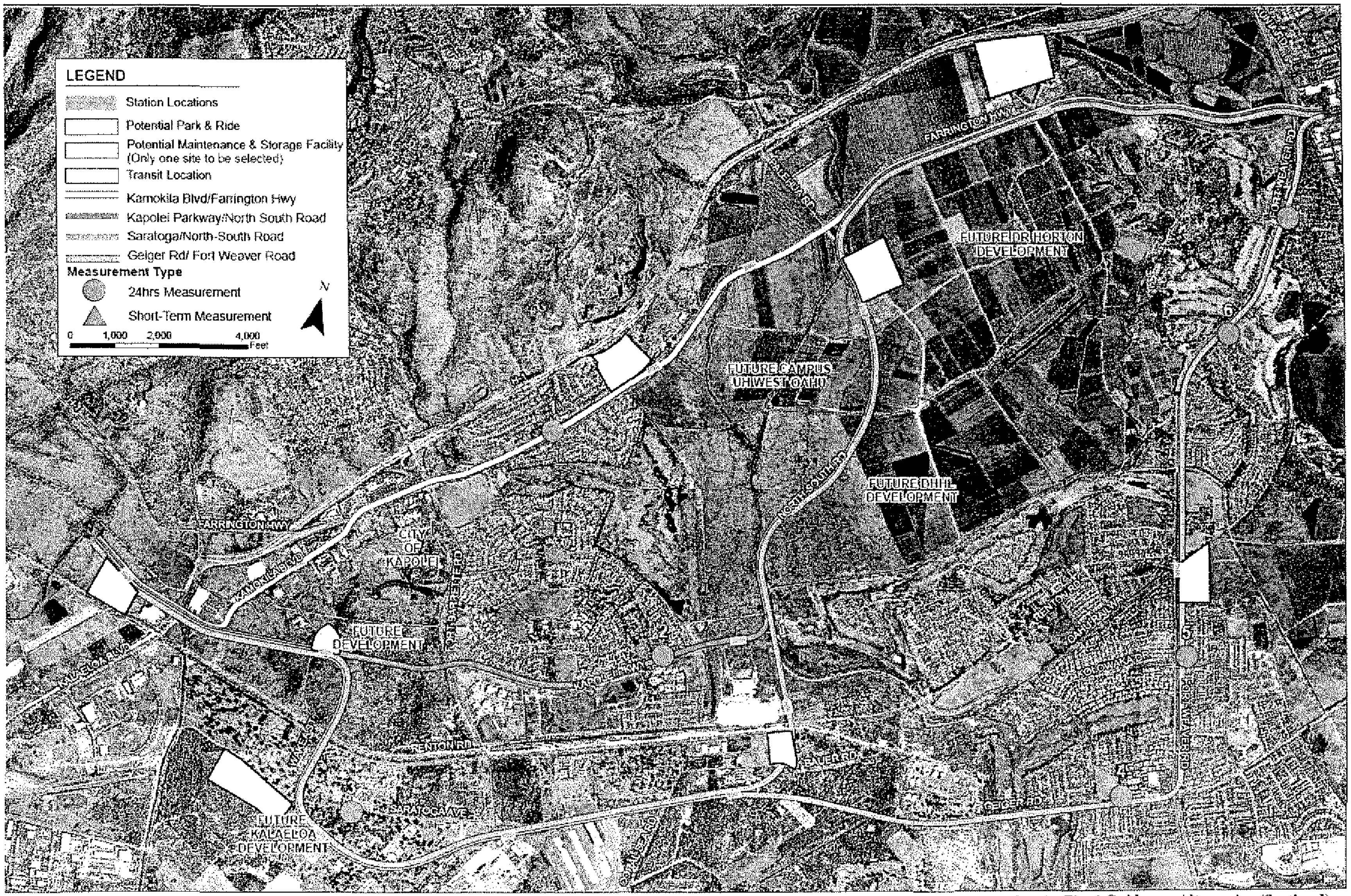

Figure 4-3. Noise Monitoring and Assessment Locations for the Fixed Guideway Alternative (Section I)

AR00071109

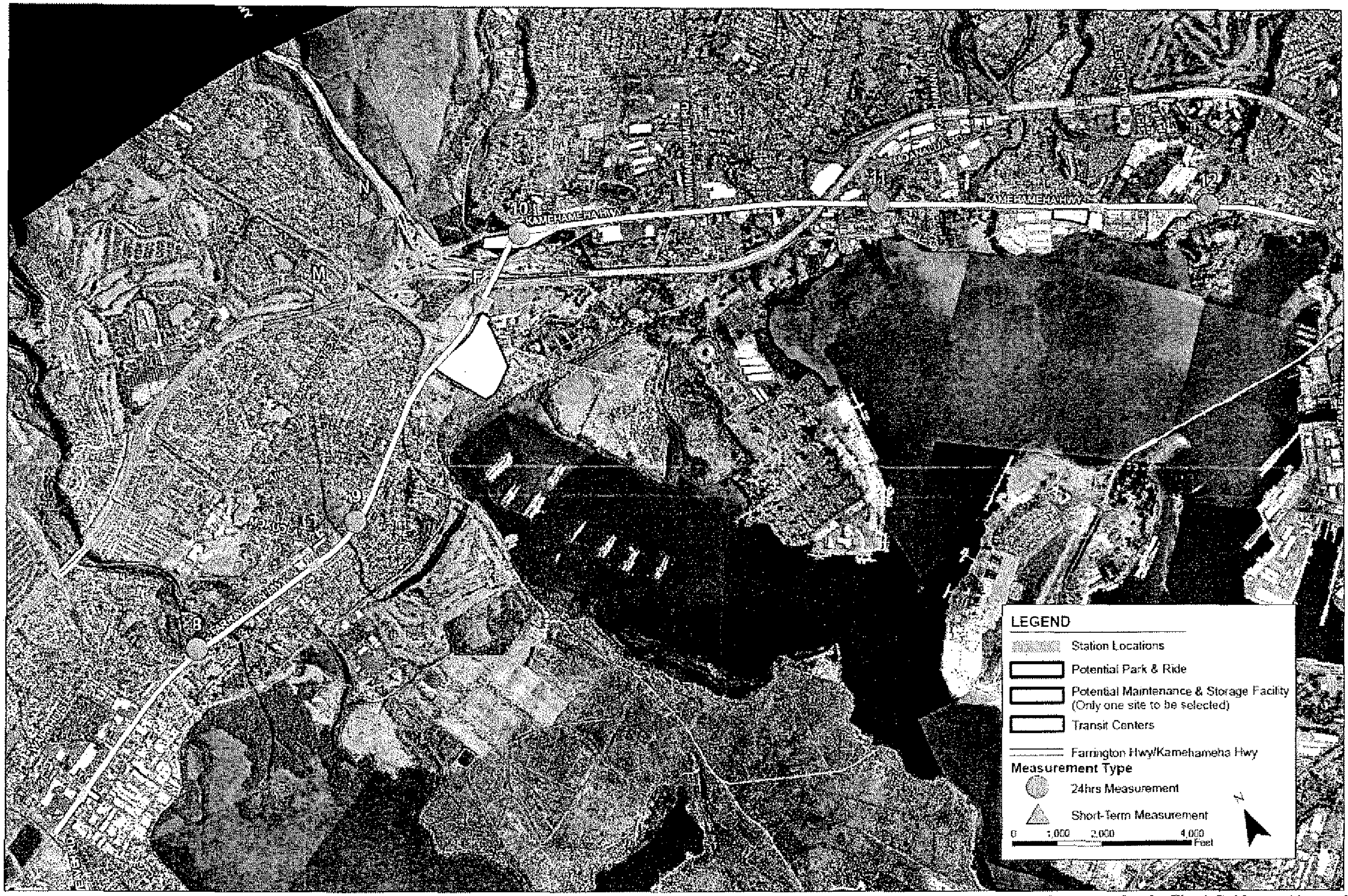

Figure 4-4. Noise Monitoring and Assessment Locations for the Fixed Guideway Alternative (Section II)

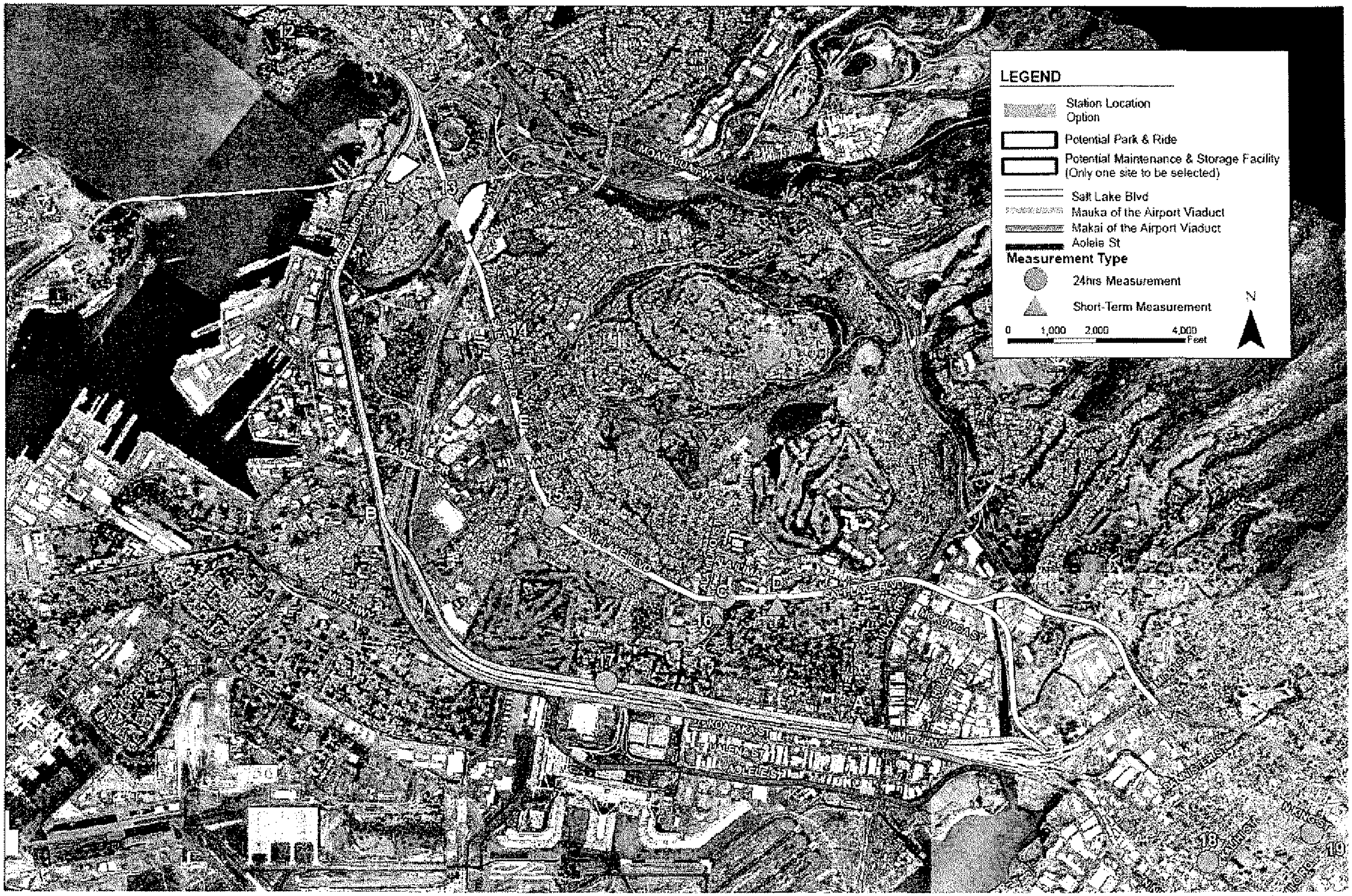

Figure 4-5. Noise Monitoring and Assessment Locations for the Fixed Guideway Alternative (Section III)

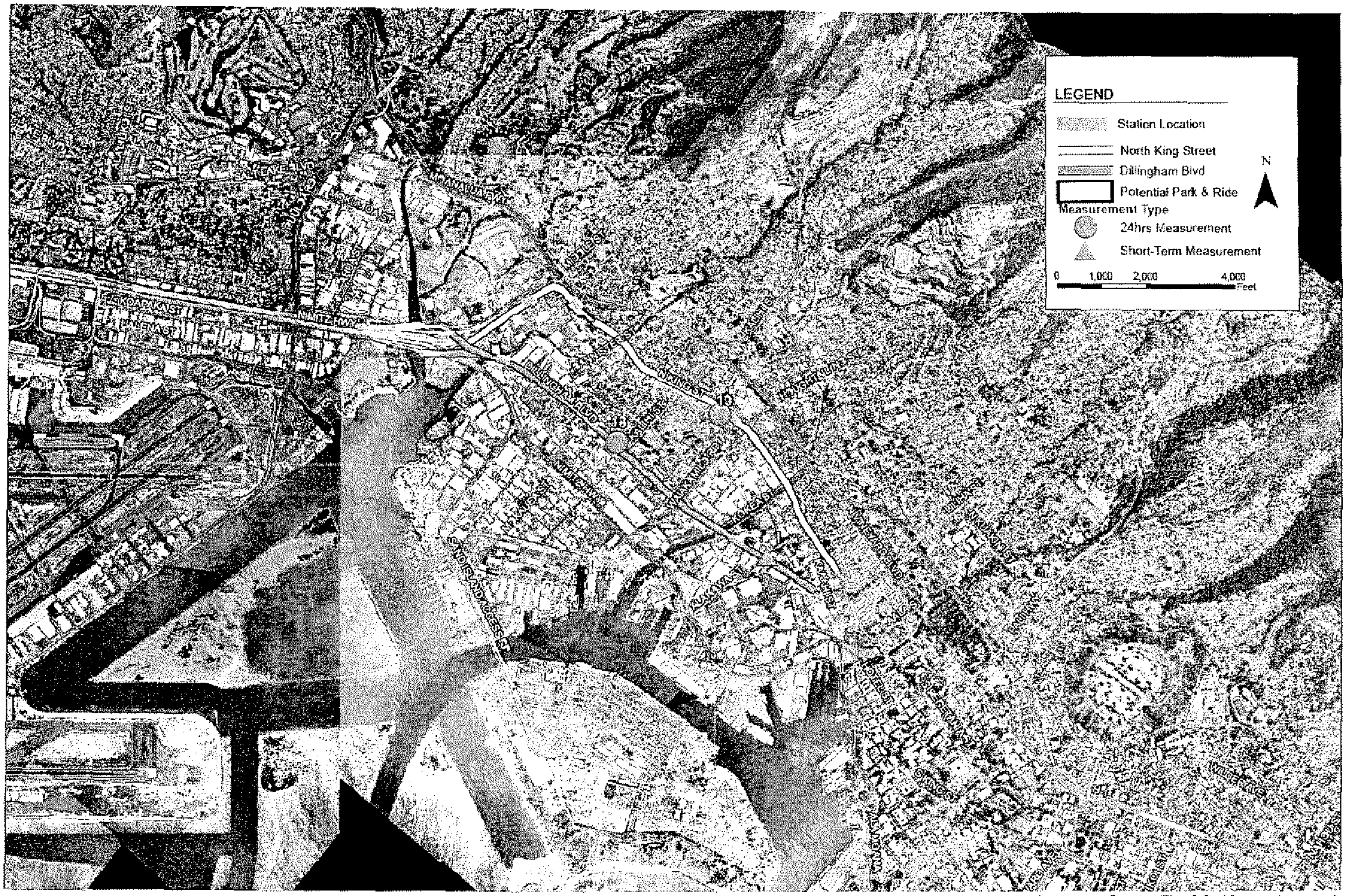

Figure 4-6. Noise Monitoring and Assessment Locations for the Fixed Guideway Alternative (Section IV)

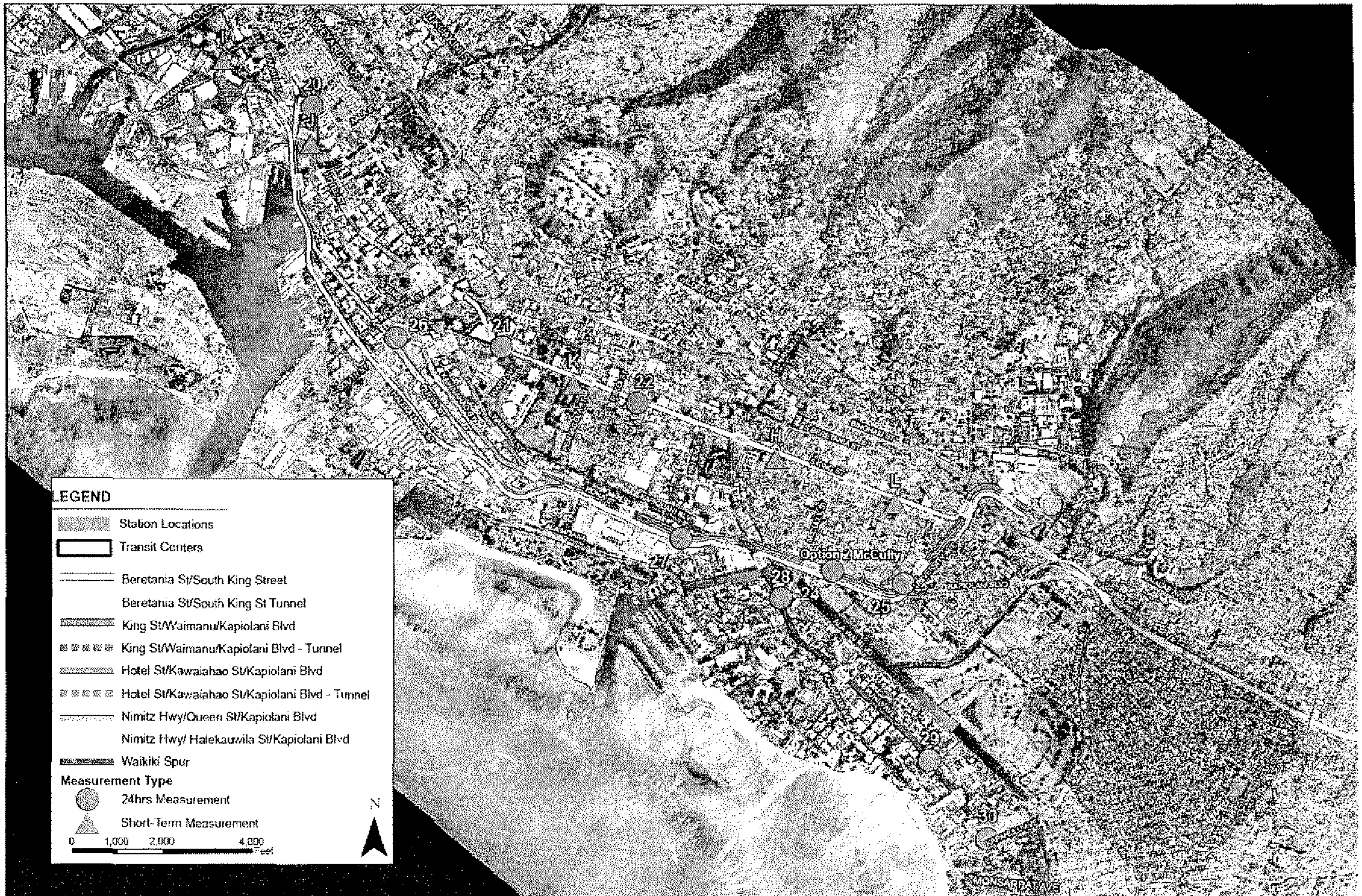

Figure 4-7. Noise Monitoring and Assessment Locations for the Fixed Guideway Alternative (Section V)

Where the short-term measurements were taken at hotels/motels or residential land uses (Sites A, B, D, E, and J), the 15-minute noise measurement was used to estimate an L_{dn} level by comparison to the nearest 24-hour measurement location at the same hour of the day. Traffic on local streets is the primary cause of existing noise levels. The 24-hour L_{dn} noise levels range from 59 dBA to 77 dBA, and peak one-hour noise levels range from 58 dBA to 72 dBA (Table 4-10 and Table 4-11).

Ambient vibration levels were not measured as part of this study. The FTA vibration impact criteria were used to identify locations where potential impacts may occur based on existing land use activities. If needed, these locations would be surveyed for ambient vibration levels at a later time as part of the final engineering design. No buildings with special ground-borne vibration concern were identified.

Impacts

Alternative 1: No Build Alternative

No traffic noise impacts are predicted to result from the No Build Alternative.

Alternative 2: TSM Alternative

No traffic noise impacts are predicted to result from the TSM Alternative.

Alternative 3: Managed Lane Alternative

Long-Term Impacts

Traffic noise levels, including the effects of the Managed Lane Alternative, would exceed the FHWA/HDOT noise abatement criteria at approximately 250 first-row residences along the corridor, as shown in Table 4-12.

The existing peak-hour L_{eq} at location M of 66 dBA is already above the NAC. Therefore, an increase of 1 dBA would cause traffic noise impacts at the 77 first-row residences (Table 4-12). Sites 10, 11, and 12 represent 67 sensitive receivers. An increase of 3 dBA would increase the peak-hour noise levels to above 75 dBA at these sites, which would be a severe impact under FHWA/HDOT criteria. The 35 first-row residential units along Kamehameha Highway from Salt Lake Boulevard to the Airport Viaduct are represented by Site B. The existing peak-hour noise level, at 67 dBA, is above the NAC, so a 3 dBA noise increase would cause a noise impact to 35 residential units (Table 4-12). Since the existing peak-hour Leq at locations 17 and A, 70 and 71 dBA (respectively) are already above the NAC, an increase of 1 dBA would result in traffic noise impacts at 82 first-row residences (Table 4-12).

Construction Impacts

Noise impacts from project construction would be generated by heavy equipment used during major construction periods as close as 50 feet from existing structures along the alignment. Common vibration-producing equipment used during at-grade construction activities includes jackhammers, pavement breakers, hoe rams, augur drills, bulldozers, and backhoes. Pavement breaking and soil compaction would probably produce the highest levels of vibration. These noise levels would be bothersome to nearby residents, but would be temporary and would not create long-term adverse effects.

Table 4-10. Existing 24-hour Noise Measurements

Noise Measurement Site		Activity or Land Use Category[1]	Measured L_{dn}[2] (dBA)	Peak-Hour L_{eq} (dBA)	Noise Source
1	91-1001 Pa'aoloulu Way	2	69	67	Farrington Highway
2	91-1027 C Wa'a'ula Street	2	62	63	Kapolei Parkway
3	Saratoga Avenue at Franklin Street	2	59	60	Saratoga Avenue
4	91-275 Hanapouli Circle	2	70	68	Geiger Road
5	91-1005 Niolo Street	2	67	71	Fort Weaver Road
6	91-1042 Hamoula Street	2	63	66	Fort Weaver Road
7	91-102 Aha Way	2	71	69	Fort Weaver Road
8	94-508 Farrington Highway	2	72	69	Farrington Highway
9	94-979 Kahuamoku Place	2	78	79	Farrington Highway
10	96-165 Kamehameha Highway	2(B)	75	73	Kamehameha Highway
11	98-5 Kuleana Place	2(B)	74	72	Kamehameha Highway
12	98-124B Kihale Street	2(B)	74	72	Kamehameha Highway
13	99-259 Ohialomi Place	2	60	63	Salt Lake Boulevard
14	4335 La'akea Street	2	59	57	Salt Lake Boulevard
15	3760 Salt Lake Boulevard	2	69	69	Salt Lake Boulevard
16	827 Ala Liliko'i Street	2	61	65	Salt Lake Boulevard
17	2200-B Hupua Loop	2(B)	72	70	Kamehameha Highway and H-1 on Viaduct
18	1746 Dillingham Boulevard	2	75	74	Dillingham Boulevard
19	1507 Haka Drive	2	68	70	North King Street
20	404 North King Street	2	77	76	North King Street and Beretania Street
21	818 South King Street	2	70	75	South King Street
22	1239 South King Street	2	71	70	South King Street
24	2148 Kapi'olani Boulevard	2	74	72	Kapi'olani Boulevard
25	630 University Avenue	2	68	67	University Avenue
26	550 Queen Street	2	73	73	Queen Street
27	410 Atkinson Drive	2	72	71	Kona Street
28	1880 Kalākaua Avenue	2	73	73	Kalākaua Avenue
29	2406 Kūhiō Avenue	2	77	76	Kūhiō Avenue
30	2588 Kūhiō Avenue	2	73	72	Kūhiō Avenue

Notes: [1] Land use or activity category descriptors: B = FHWA land use category B. 1, 2, or 3 = FTA land use category.
[2] L_{dn} is used for land uses with nighttime sensitivity to noise and for residential areas where FTA rather than FHWA noise procedures are applicable.

Table 4-11. Existing Short-Term Noise Measurements

Noise Measurement Site	Activity or Land Use Category[1]	Measured L_{eq}[2] (dBA)	Estimated L_{dn}[3] (dBA)	Peak-Hour L_{eq} (dBA)	Noise Source
A 1653 Plumpago Court	2(B)	65	73	71	Kamehameha Highway and H-1 Viaduct
B 1086 Fisler Court	2(B)	69	69	67	Kamehameha Highway
C Āliamanu Elementary School	3	60	NA	60	Salt Lake Boulevard
D 760 Moore Street	2	58	59	58	Salt Lake Boulevard
E 4034 Salt Lake Boulevard	2	68	69	68	Salt Lake Boulevard
F Leeward Community College	3	65	NA	65	Farrington Highway Kamehameha Highway
H Washington Middle School	3	66	NA	66	South King Street
I Honolulu Community College	3	72	NA	72	Dillingham Boulevard
J 215 N. King Street	2	72	73	72	North King Street
K McKinley High School	3	61	NA	61	South King Street
L Old Stadium Park	3	64	NA	64	South King Street
M 94-1121 Lelehu Street	B	66	NA	66	H-1
N 94-1033 Lumipolu Street	B	59	NA	60	H-2

Notes: [1] Land use activity or category descriptors: B = FHWA land use category B. 1, 2, or 3 = FTA land use category.
[2] Each 15-minute noise measurement is compared to the closest 24-hour measurement site at the same hour of the day. The 15-minute noise levels are then adjusted relative to the 24-hour levels to develop a peak Leq and Ldn for each of the 15-minute measurement locations.
[3] L_{dn} is used for land uses with nighttime sensitivity to noise and for residential areas where FTA rather than FHWA noise procedures are applicable.
NA= Not Applicable. These sites do not have sleep activity or would only be affected by the Managed Lane Alternative. Ldn existing noise levels are not applicable at these sites.

Table 4-12. Summary of Noise Impacts for the Managed Lane Alternative

Location	Representative Noise Site(s)	Noise Impacts
H-1	M	Impacts at 77 receivers
H-2	N	None
H-1 to Waimano Home Road	10	Impacts at 8 receivers
Waimano Home Road to Ka'ahumanu Street	11	Impacts at 27 receivers
Ka'ahumanu Street to Kalauao Bridge	12	Impacts at 32 receivers
Kalauao Bridge to Salt Lake Boulevard	None	None
Salt Lake Boulevard to Radford Drive	B	Impacts at 35 receivers
Radford Drive to Kalihi Street	17, A	Impacts at 82 receivers

Alternative 4: Fixed Guideway Alternative

Long-Term Impacts

The potential noise impacts associated with the Fixed Guideway Alternative are shown by section, alignment, and transit technology in Table 4-13. These values do not consider the effects of mitigation that could be used to reduce transit noise levels. The LRT and Rapid Rail technologies would have the largest number of potential noise impacts, with up to 440 moderate and 140 severe noise impacts (Table 4-13).

Table 4-13. Summary of Noise Impacts for the Fixed Guideway Alternative

Section and Alignment	Representative Noise Site(s)	Technology		
		LRT and Rapid Rail	Monorail	Maglev
I. Kapolei to Fort Weaver Road				
Kamokila Boulevard/ Farrington Highway	1	Moderate impact at 77 receivers	No Impact	No Impact
Kapolei Parkway/ North-South Road	2	Severe impact at 78 receivers	Moderate impact at 78 receivers	No Impact
Saratoga Avenue/ North-South Road	3	Moderate impact at 20 receivers	Moderate impact at 20 receivers	No Impact
Geiger Road/Fort Weaver Road	4, 5, 6, 7	Moderate impact at 138 receivers	No Impact	No Impact
II. Fort Weaver Road to Aloha Stadium				
Farrington Highway/ Kamehameha Highway	8, 9 ,F, 10, 11, 12	Moderate impact at 153 receivers	No Impact	No Impact
III. Aloha Stadium to Middle Street				
Salt Lake Boulevard	13, 14, E, 15, C, 16, D	Severe impact at 55 receivers and moderate impact at 207 receivers	Moderate impact at 262 receivers	No Impact
Mauka of the Airport Viaduct	B, 17, A	No Impact	No Impact	No Impact
Makai of the Airport Viaduct	B, 17, A	No Impact	No Impact	No Impact
Aolele Street	None	No Impact	No Impact	No Impact
IV. Middle Street to Iwilei				
North King Street	19, 20, J	Moderate impact at 52 (45*) receivers	Moderate impact at 7 receivers	No Impact
Dillingham Boulevard	18, I, 20, J	Moderate impact at 17 receivers	No Impact	No Impact
V. Iwilei to UH Mānoa				
Beretania Street/ South King Street	21,K,22,H,L	Moderate impact at 10 receivers	No Impact	No Impact
Hotel Street/Kawaiaha'o Street/ Kapi'olani Boulevard	27,24,25	No Impact	No Impact	No Impact
King Street/Waimanu Street/Kapi'olani Boulevard	27,24,25	No Impact	No Impact	No Impact
Nimitz Highway/Queen Street/ Kapi'olani Boulevard	26,27,24,25	Moderate impact at 3 receivers	No Impact	No Impact
Nimitz Highway/Halekauwila Street/Kapi'olani Boulevard	27,24,25	No Impact	No Impact	No Impact
Waikīkī Branch	28,29	Moderate impact at 23 receivers	No Impact	No Impact

*Noise impacts for the North King Street Alignment would be reduced to 45 receivers if connecting to Nimitz Highway.

The greatest number of noise impacts would occur on the Salt Lake Boulevard Alignment. The alignments ranked highest to lowest by noise impacts for the LRT and Rapid Rail technologies follow (alignments not listed would not cause noise impacts):

- Salt Lake Boulevard – 55 severe noise impacts, 207 moderate noise impacts
- Kapolei Parkway/North South Road – 78 severe noise impacts
- Farrington Highway/Kamehameha Highway – 153 moderate noise impacts
- Geiger Road/Fort Weaver Road – 138 moderate noise impacts
- Kamokila Boulevard/Farrington Highway – 77 moderate noise impacts
- North King Street – 52 moderate noise impacts (45 if connecting to Nimitz Highway in Section V)
- Waikīkī Branch – 23 moderate noise impacts
- Saratoga Avenue/North South Road – 20 moderate noise impacts
- Dillingham Boulevard – 17 moderate noise impacts
- Beretania Street/South King Street – 10 moderate noise impacts
- Nimitz Highway/Queen Street/Kapi'olani Boulevard – 3 moderate noise impacts

Monorail technology would cause up to 333 moderate noise impacts. The alignments ranked highest to lowest by noise impacts for the monorail technology are listed below. Alignments not listed would not cause any noise impacts.

- Salt Lake Boulevard – 262 moderate noise impacts
- Kapolei Parkway/North South Road – 78 moderate noise impacts
- Saratoga Avenue/North South Road – 20 moderate noise impacts
- North King Street to Beretania Street/South King Street tunnel – 7 moderate noise impacts

Maglev technology would cause no noise impacts.

Ground vibration levels from the LRT and Rapid Rail cars would be the highest among the technologies. The highest vibration level for the LRT and Rapid Rail of 62 VdB would occur at Site 20. This level would not exceed the FTA criteria of 72 VdB for residential buildings and other structures where people normally sleep (Category 2). Because no land use along the alignment has vibration-sensitive equipment that would be subject to lower vibration impact criteria, no vibration impacts are projected.

Construction Impacts

Noise impacts from project construction would be generated by heavy equipment used during major construction periods as close as 50 feet from existing structures along the alignment. Common vibration-producing equipment used during at-grade construction activities includes jackhammers, pavement breakers, hoe rams, augur drills, bulldozers, and backhoes. Pavement breaking and soil compaction would probably produce the highest levels of vibration. These noise levels would be bothersome to nearby residents, but would be temporary and would not create long-term adverse effects.

Mitigation

Alternative 3: Managed Lane Alternative

Mitigation of Long-Term Impacts

Noise barriers at the right-of way or at the top of the slope of H-1 ʻEwa of the Waiawa Interchange could reduce noise levels by at least 5 dBA and eliminate traffic noise impacts in this area.

Noise barriers would not be feasible to provide noise abatement for receivers along Kamehameha Highway for two reasons. First, noise barriers placed on the elevated managed lane structure would only reduce traffic noise by 1 to 3 dBA (a 5 dBA noise reduction is needed for a noise barrier to be feasible). Second, the managed lane structure's height would make ground-level walls ineffective, because they would not break the line of sight. The Managed Lane Alternative would add 3 dBA to the current noise level. Noise barriers at ground level would need to provide at least 8 dBA noise reduction from the noise level of the at-grade section of Kamehameha Highway.

Other forms of noise mitigation along Kamehameha Highway would need to be analyzed during the preliminary engineering and environmental review phase if this alternative is selected as the preferred alternative.

Noise barriers placed on the edges of the elevated viaduct along Nimitz Highway Koko Head-bound between Radford Drive and Kalihi Street could reduce noise levels at Sites 17 and A by at least 5 dBA. However, traffic under the viaduct is the major noise source in the area, so overall noise levels would only be reduced by 1 to 2 dBA. To be effective, noise barriers must block the direct view of the noise source and must be solid with minimal openings. A ground-level noise barrier would not block the line of sight to or from the elevated section of the viaduct, and the length of noise barrier needed to provide at least a 5-dBA noise reduction would cause the barriers to block local cross-street traffic.

Mitigation of Construction Impacts

Noise control measures would be required during construction to minimize impacts on existing noise-sensitive land uses. All construction activities must comply with State of Hawaiʻi Department of Health noise regulations.

Alternative 4: Fixed Guideway Alternative

Mitigation of Long-Term Impacts

Placement of a solid 3- to 5-foot barrier on the guideway structure at locations with noise impacts could reduce noise levels by at least 5 dBA. The placement of the barriers as noise mitigation would eliminate all moderate noise impacts from the LRT and Rapid Rail technologies and reduce severe noise impacts. This would moderate impacts for the Salt Lake Boulevard and Kapolei Parkway alignments.

Noise barriers for monorail technology are not feasible, but monorail vehicles with skirts that wrap around the guideway beam would be quieter than the modeled levels. Further study would be conducted if this technology is selected.

Because no noise impacts are predicted for the maglev technology, no noise mitigation is proposed.

Mitigation of Construction Impacts

Noise control measures would be required during construction to minimize impacts on existing noise-sensitive land uses. All construction activities must comply with the State of Hawai'i Department of Health noise regulations.

Water Resources

Several federal and state agencies are authorized to regulate inland surface waters, tidal waters and wetlands (collectively, "waters of the United States"). This authority derives primarily through the Clean Water Act, the Rivers and Harbors Act, and associated state rules for water quality standards.

Affected Environment

Many streams, including navigable waters, are located within the study corridor. Most of these stream channels have been altered in the lower reaches and are not of high ecological quality. The overall water quality in these urban streams is poor and many are included on the 303(d) List of Impaired Waters by the Hawai'i Department of Health (HDOH). Many streams in the state are not listed because data collection is ongoing. Tributaries to water bodies that appear on the 303(d) list may also be considered impaired for regulatory purposes and permits.

Wetland complexes within the study area from Kapolei to Waikīkī are associated with riverine, tidal, and spring systems in three areas: Pearl Harbor, Salt Lake, and Waikīkī. Over time, land development has altered or destroyed most of these wetlands, leaving only a few remnants. All streams within low-lying areas, and especially at road crossings, have been altered through channelization, lining, dredging, or other alteration (Hawai'i Cooperative Park Service Unit, 1990).

The following large coastal (marine) surface water bodies are located within or adjacent to the transit corridor:

- Pearl Harbor
- Ke'ehi Lagoon
- Honolulu Harbor
- Kewalo Basin
- Ala Wai Canal and Boat Harbor

These five water bodies are all highly urbanized and/or altered from their natural state. They are all listed by HDOH as "Water Quality-Limited Segments."

Within the proposed project corridor, coral reefs and eroded volcanic material have formed a wedge of sedimentary rock and sediments referred to as *caprock*, which rests on the underlying volcanic rock. Caprock is composed predominantly of coral-algal limestone, interlaid with terrigenous clay and mud. Volcanic ash from the Honolulu volcanic series is often found in caprock. The caprock ranges between approximately zero and 1,000 feet thick in the project corridor (Wentworth, 1951).

The Southern O'ahu Basal Aquifer (SOBA) occurs as a basal freshwater lens floating on saline groundwater. It is recharged by rainfall that falls on the Leeward Coast and the mauka area of Honolulu. The caprock overlies the SOBA and impedes the escape of groundwater from this basaltic aquifer. Water in the caprock is brackish and not potable. The caprock is less permeable than water-bearing lava flows near the Ko'olau Range and constitutes a barrier that retards the seaward flow of groundwater.

Impacts

The Managed Lane and Fixed Guideway Alternatives would have similar impacts on water resources. Both would include construction of an elevated structure. The Managed Lane viaduct would not be as long as the structure proposed for the Fixed Guideway, so impacts would be less widespread. To simplify the comparison of the alternatives including the various alignments for the Fixed Guideway Alternative, Table 4-14 lists the types of stream and river crossings for each alignment. The Managed Lane Alternative would cross 20 water resources. The Fixed Guideway Alternative would cross between 30 and 37 water resources. At each crossing, there would be a need for a Coast Guard permit if the water body is considered navigable. If building the bridge would require dredging or soil or other fill material in the river/stream or associated wetland, an Army Corps of Engineers permit would be required in addition to permits from other state agencies. If the water body has been listed as impaired by HDOH, additional permits may be required.

The viaduct structure for both the Managed Lane and Fixed Guideway Alternatives would be supported on piers or columns drilled or driven into the subsurface. Because the underlying aquifer is a prime source of drinking water for O'ahu (referred to as a *Sole Source Aquifer*), construction that could pollute the aquifer (i.e., when piers penetrate into the caprock) will be evaluated in a Groundwater Impact Assessment as required by Section 1424(e) of the Clean Water Act.

Building the elevated structure would also likely require dewatering in order to pour concrete. Although disposal of the water can be permitted through the Clean Water Act, some water may be contaminated with petroleum and other hazardous chemicals. Treatment of the contaminated water would need to occur before its discharge into nearby storm sewers, streams, or marine waters. Similarly, soil removed to build the piers may be contaminated. When exposed to rain, contaminated soil may run off into surface water bodies.

Dewatering can also cause subsidence as water is removed from the ground and soils compact in the area requiring dewatering. Walls, buildings, roads, and other infrastructure may be damaged. Subsidence, water disposal, and drinking water protection are all issues common to the Managed Lane and Fixed Guideway Alternatives for construction of the required viaducts. These issues would also be of high importance in evaluating the impacts of the tunnels proposed as part of the Fixed Guideway Alternative.

Table 4-14. Water Resources Affected by the Project Alternatives

Alternative	Crossings of Navigable Water	Crossings of Riverine Wetlands	Crossings of Impaired Water Bodies
Alternative 1: No Build			
No Build Alternative	0	0	0
Alternative 2: Transportation System Management			
TSM Alternative	0	0	0
Alternative 3: Managed Lane			
Managed Lane Alternative	6	8	6
Alternative 4: Fixed Guideway (by section)			
I. Kapolei to Fort Weaver Road			
Kamokila Boulevard/Farrington Highway	0	1	0
Kapolei Parkway/North-South Road	0	0	0
Saratoga Avenue/North-South Road	0	0	0
Geiger Road/Fort Weaver Road	0	1	0
II. Fort Weaver Road to Aloha Stadium			
Farrington Highway/ Kamehameha Highway	1	10	4
III. Aloha Stadium to Middle Street			
Salt Lake Boulevard	2	2	3
Mauka/Makai of the Airport Viaduct	2	2	2
Aolele Street	2	2	2
IV. Middle Street to Iwilei			
North King Street	1	3	2
Dillingham Boulevard	2	2	2
V. Iwilei to UH Mānoa			
Beretania Street/South King Street	1	1	1
Hotel Street/Kawaiaha'o Street/ Kapi'olani Boulevard	1	1	3
King Street/Waimanu Street/ Kapi'olani Boulevard	1	1	3
Nimitz Highway/Queen Street/ Kapi'olani Boulevard	1	1	3
Nimitz Highway/Halekauwila Street/ Kapi'olani Boulevard	1	1	3
Waikīkī Branch	1	1	1

When the new transit system is operational, stormwater runoff would increase as a result of the additional pavement associated with the transit system. The Fixed Guideway Alternative would include a longer structure than the other alternatives, and additional transit stations and parking lots. As a result, it would cause a greater increase in stormwater runoff. Impacts to water quality would be greater under the Managed Lane Alternative because the number of vehicle miles traveled on O'ahu would be greater than with the other alternatives.

Mitigation

Sedimentation and turbidity caused by sediment suspended in stormwater runoff would be mitigated by a site-specific Best Management Practices (BMP) Plan. Current design standards would be followed in handling stormwater runoff from structures and parking lots after operation of the transit system begins.

Natural Resources

Impacts to natural resources, including vegetation, wildlife, threatened and endangered species, and wetlands are discussed in this section.

Affected Environment

Except for portions of the 'Ewa Plain, the study area consists of heavily urbanized environments. Birds are the most prominent wildlife in the project area, so the primary focus of field investigations was to document the species of birds and their population at count stations along the alignments being considered for the Managed Lane and Fixed Guideway alternatives.

Coordination with governmental agencies and a literature review indicated that no designated critical habitats are located within the proposed project area. Several protected species were reported as being present or potentially present in or near the proposed project area.

Impacts

Alternative 1: No Build Alternative

The No Build Alternative includes no new construction related to this project, but other projects defined in the 2030 ORTP would proceed as planned. Although the No Build Alternative would have no impacts on the project area, by 2030 the project corridor would be more urbanized than it is currently, especially in the 'Ewa and Kapolei areas. This would reduce the amount of farming, open space, and habitat for wildlife and plants.

Alternative 2: TSM Alternative

No major construction projects would be undertaken under the TSM Alternative. Because of the limited nature of actions proposed under this alternative, no major impacts on natural resources would be expected in the long or short term. Similar to the No Build Alternative, the project corridor would become more urbanized than it is currently, especially in the 'Ewa and Kapolei areas, reducing the amount of farming, open space, and habitat for wildlife and plants.

Alternative 3: Managed Lane Alternative

From a natural resources perspective, the primary difference between the two options of the Managed Lane Alternative is that the Two-Direction Option would require an approximately 50-foot-wide structure and the Reversible Lanes Option would require an approximately 40-foot-wide structure. In both cases, the bottom of the structure would average between 17 and 30 feet above ground level. Under both alternatives, an approximately 13-mile-long elevated structure would be constructed, extending from Waipahu to Downtown Honolulu, primarily above the median of existing roadways in heavily developed areas.

Impacts on natural resources caused by the Managed Lane Alternative would be minor and primarily affect vegetation, particularly street trees (Table 4-15). No direct impacts on natural resources, farmlands, or wildlife are anticipated. A possible indirect impact on farmland, street trees, and vegetation is the shade that would be produced by the managed-lane structure. Shadow impacts could occur at the Waiau Stream taro patch and the Sumida Watercress Farm on Kamehameha Highway. Possible direct impacts on street trees would likely include:

- Removal of the five notable monkeypod trees at the intersection of Nimitz Highway and Sand Island Access Road
- Removal, transplanting, or trimming of some trees on the Aloha Stadium property and inside the Pu'uwai Momi Apartments (low-income housing) property
- Transplanting fan palms and shower trees on Kamehameha Highway in the vicinity of the Arizona Memorial
- Effects on all 83 trees on the mauka side of Nimitz Highway between Kamehameha Highway and Middle Street
- Effects on some scrambled egg trees, coconut and Manila palms, shower trees, and kou trees in the median of Nimitz Highway east of Middle Street.

Impacts on street trees could result in secondary impacts on wildlife. Street trees with large canopies provide ideal roosting and nesting sites for white terns, a state threatened species. Although no white terns were observed along the Alternative 3 alignment during this study, the habitat is available and could be used in the future.

Alternative 4: Fixed Guideway Alternative

Because of its length and associated Park-and-Ride lots, maintenance facilities, and transit centers, the Fixed Guideway Alternative would result in a greater impact on natural resources than the other three alternatives. However, similar to the other alternatives, the Fixed Guideway Alternative is not expected to impact natural hazards.

The Fixed Guideway Alternative would impact farmlands and wildlife in the 'Ewa area, but all areas currently under cultivation or occupied by kiawe woodlands in the 'Ewa Plain may be developed in the near future whether or not this project proceeds. Also, as discussed previously for the Managed Lane Alternative, shadow impacts could occur at the Waiau Stream taro patch and the Sumida Watercress Farm.

Table 4-15. Natural Resources Affected by the Project Alternatives

Alternative	Geology and Natural Hazards	Wildlife	Botanical Resources Including Street Trees
Alternative 1: No Build			
No Build Alternative	None	Habitat for introduced birds would be lost to urbanization independent of the project	Loss of some vegetated open spaces to urbanization independent of the project
Alternative 2: Transportation System Management			
TSM Alternative	None	Same as No Build	Same as No Build
Alternative 3: Managed Lane			
3a. Two-Direction Option			
Waiawa IC to Hālawa Stream	None	No impact on common introduced birds; no sensitive species present	May impact Waiawa Stream vegetation; possible impact on trees at Aloha Stadium and Pu'uwai Momi Apartments. On Kamehameha Highway near Arizona Memorial, transplant fan palms and shower trees; transplant 10 queen palms on Nimitz Highway; remove five notable monkeypods on Nimitz Highway at Sand Island Access Road
Hālawa Stream to Pacific Street	None	White tern	
3b. Reversible Option			
Waiawa IC to Hālawa Stream	None	Same as Alternative 3a	Same as Alternative 3a
Hālawa Stream to Pacific Street	None	Same as Alternative 3a	
Alternative 4: Fixed Guideway (by section)			
Section I. Kapolei to Fort Weaver Road			
Kamokila Boulevard/ Farrington Highway	None	Same as No Build	Disturbance and loss of native and weedy species; Indian coral trees on Kapolei Parkway; transplant 76 kamani trees
Kapolei Parkway/ North-South Road	None	Same as No Build	Loss of weedy plant species; incidental take license needed for possible disturbance to *Abutilon menziesii* population; Indian coral trees on Kapolei Parkway; transplant 7 monkeypod trees
Saratoga Avenue/ North-South Road	None	Same as No Build	Loss of weedy and possible native species; incidental take license needed for possible disturbance to *Abutilon menziesii* population; other impacts undetermined; additional fieldwork necessary; possible impacts on canopy trees
Geiger Road/ Fort Weaver Road	None	Same as No Build	Loss and disturbance of weedy and possible native species; transplant all street trees in Fort Weaver Road median; remove one notable monkeypod; impacts undetermined in Kalaeloa; additional fieldwork necessary

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Alternative	Geology and Natural Hazards	Wildlife	Botanical Resources Including Street Trees
Section II. Fort Weaver Road to Aloha Stadium			
Farrington Highway/ Kamehameha Highway	None	No effect on common introduced species; no sensitive species present	Transplant all median landscaping on Farrington Highway in Waipahu
Section III. Aloha Stadium to Middle Street			
Salt Lake Boulevard	None	Same as Section II	Possible impact on trees at Aloha Stadium; remove a few Indian coral trees on Salt Lake Boulevard; pruning or other impact on two monkeypods on Kikowaena Street
Makai of the Airport Viaduct	None	Same as Section II	Possible impact on trees at Aloha Stadium and Pu'uwai Momi Apartments; on Kamehameha Highway near Arizona Memorial transplant fan palms and shower trees; pruning of shower trees on Nimitz Highway
Mauka of the Airport Viaduct	None	Same as Section II	Possible impact on trees at Aloha Stadium and Pu'uwai Momi Apartments; on Kamehameha Highway near Arizona Memorial transplant fan palms and shower trees; transplant 10 queen palms on Nimitz Highway
Aolele Street	None	Same as Section II	Possible impact on trees at Aloha Stadium and Pu'uwai Momi Apartments; transplant various trees on Aolele Street; possible impact on damaged Indian coral trees in Ke'ehi Lagoon Park
Section IV. Middle Street to Iwilei			
North King Street	None	Same as Section II	Transplant fiddlewoods on mauka side of North King Street; possibly transplant fiddlewoods on Middle Street
Dillingham Boulevard	None	Same as Section II	Several notable trees affected by widening Dillingham Boulevard – one monkeypod and 26 kamani trees; additional kamani tree impacts at Honolulu Community College transit stop; possibly transplant fiddlewoods on Middle Street

Alternative	Geology and Natural Hazards	Wildlife	Botanical Resources Including Street Trees
Section V. Iwilei to UH Mānoa			
Hotel Street/ Kawaiaha'o Street/ Kapi'olani Boulevard	None	Alteration or removal of mature trees may impact roosting/nesting of white terns	Transplant minor fiddlewoods on Hotel Street; removal of notable monkeypods on Kona Street possible; removal of some notable monkeypods on Kapi'olani Boulevard between Kalākaua Avenue and McCully Street; transplant 27 new shower tree plantings on University Avenue
King Street/Waimanu Street/ Kapi'olani Boulevard	None	Same as above	Possible impact on notable monkeypod at Waimanu Street and Ward Avenue; removal of notable monkeypods on Kona Street possible; removal of some notable monkeypods on Kapi'olani Boulevard between Kalākaua Avenue and McCully Street; transplant 27 new shower tree plantings on University Avenue
Nimitz Highway/ Queen Street/ Kapi'olani Boulevard	None	Same as above	Right-of-way needed may affect notable monkeypod on Queen Street; removal of notable monkeypods on Kona Street possible; removal of some notable monkeypods on Kapi'olani Boulevard between Kalākaua Avenue and McCully Street; transplant 27 new shower tree plantings on University Avenue
Nimitz Highway/ Halekauwila Street/ Kapi'olani Boulevard	None	Same as above	Remove/replace four notable monkeypods on makai side of Halekauwila Street; removal of notable monkeypods on Kona Street possible; removal of notable monkeypods on Kapi'olani Boulevard between Kalākaua Avenue and McCully Street; transplant 27 new shower tree plantings on University Avenue
Beretania Street/ South King Street	None	Same as above	Impacts depend on method of tunnel construction; tree impacts may occur at transit stations; pruning of shower, earpod, and banyan trees likely on King Street, but tree removal possible at transit stations
Waikīkī Branch	None	Same as above	Tree protection zones needed for exceptional mahogany trees on Kalākaua Avenue; pruning or removal/ replacement of several new plantings along Kūhiō Avenue

The Fixed Guideway Alternative would have limited impact on vegetation in open areas of the ‘Ewa Plain. Most of the area has been heavily disturbed by farming in the past, but a few native species are present, including ‘ilima, Uhaloa, Kooloaula (*Abutilon menziesii*), and Kauna‘oa pehu. *Abutilon menziesii* is an endangered species and known to be present at the southern end of North-South Road. A Habitat Conservation Plan for *A. menziesii* at Kapolei already exists.

Street trees would also be affected by the Fixed Guideway Alternative. Because this alternative would extend farther into the city of Honolulu, it would have more impacts on street trees than the Managed Lane Alternative. Street tree impacts would depend largely on the alignment selected.

Possible impacts on natural resources are discussed in the following sections, arranged according to the section of the project where they would occur.

Section I. Kapolei to Fort Weaver Road
The four alignments are similar in their potential impacts on natural resources, with the exception of the following alignment-specific impacts:

- The Kamokila Boulevard/Farrington Highway alignment would not impact the A. menziesii population but would impact some of the 294 street trees on Kamokila Boulevard.
- The Kapolei Parkway/North-South Road and the Saratoga Avenue/North-South Road alignments could impact the A. menziesii population.
- The Geiger Road/Fort Weaver Road alignment would not impact the A. menziesii population and is the only alignment that would not impact any active farmlands. However, some of the 286 street trees on Fort Weaver Road would be impacted, including the one notable banyan tree in the median near Old Fort Weaver Road.

Section II. Fort Weaver Road to Aloha Stadium
Possible impacts along the one alignment in this section include shading of farms, as discussed for the Managed Lane Alternative. Some impacts on street trees along the alignment would also likely occur. Many new plantings in the median of Farrington Highway in Waipahu would likely be affected, but few street trees exist along Kamehameha Highway and none are located in the median.

Section III. Aloha Stadium to Middle Street
The four alignments are similar in their potential impacts on natural resources, with the exception of the following alignment-specific impacts:

- The Salt Lake Boulevard alignment would result in the fewest number of impacts on street trees.
- The alignment makai of the airport viaduct could impact some street trees, but fewer trees than the mauka alignment. A few street trees along the makai alignment are potential nesting and roosting sites for white terns.

- The alignment mauka of the airport viaduct would impact more street trees than the makai alignment. A few street trees along this alignment are potential nesting and roosting sites for white terns.
- The Aolele Street alignment contains more street trees, but few are located in the median and some are Indian coral trees, which are already in poor condition as a result of gall wasp infestation. Some street trees along this alignment are potential nesting and roosting sites for white terns.

Section IV. Middle Street to Iwilei

The two alignments in this section would have similar potential impacts on natural resources. The North King Street alignment has more street trees, but only two are considered notable. The Dillingham Boulevard alignment has fewer trees, but most are considered notable. No street trees along either alignment are located in the median, but shoulder trees would be affected by road widening.

Section V. Iwilei to UH Mānoa

The five alignment options and the Waikīkī branch in this section of the Fixed Guideway Alternative would have similar impacts. All alignments would impact some street trees, and some street trees along all of the alignments are potential white tern roosting and nesting habitat. Specifics for each alignment are discussed below.

- The four alignments that include Kona Street (Ala Moana Center) would all have similar impacts. Ten notable monkeypod trees in the median of Kona Street, seven notable monkeypod trees in the median along Kapi'olani Boulevard, and several relatively new shower trees in the median of University Avenue would be affected. Some large trees planted on the shoulder along each alignment would also be affected, but probably to a lesser degree than trees planted in the medians.
- The Beretania Street/South King Street alignment contains more total trees and more notable trees than the other four alignments, but none are located in the median so impacts could be less.
- The Waikīkī Branch alignment contains more street trees than the other alignments in Section V, including 10 exceptional mahogany trees in the median of Kalākaua Avenue and many relatively new plantings in the median of Kūhiō Avenue.

Mitigation

No mitigation would be necessary for Alternatives 1 and 2. The following sections summarize general mitigation measures related to impacts that could result from Alternatives 3 and 4.

Wildlife

Suitable trees for white tern nesting and roosting are present throughout Downtown Honolulu. The relatively small number of trees that would be removed or trimmed as a result of the proposed project should not have a substantial impact on the terns, so no immediate or direct mitigation is needed. Street trees and plantings are discussed below.

Tree removal and trimming during construction and maintenance along the routes of the Managed Lane and Fixed Guideway alternatives would need to take into account the potential presence of roosting or nesting white terns. In areas of urban Honolulu east of Hickam Air Force Base to Waikīkī, mature street trees provide ideal nesting habitat for white terns. To prevent possible impacts on this state-listed threatened species, it is recommended that tree removal or trimming be conducted: (a) during fall and early winter when fewer white terns are nesting, (b) after the trees have been inspected for the presence of terns and none were found, and (c) after any white tern chicks present have fledged.

Vegetation

The only known threatened or endangered vegetation that could be affected by any of the alternatives is the population of kooloaula (*A. menziesii*) at the southern end of the North-South Road. This population would only be affected by the Kapolei Parkway/North-South Road and Saratoga Avenue/North-South Road alignments of the Fixed Guideway Alternative. If one of these alignments is selected, a Habitat Conservation Plan would be developed and followed.

As part of the environmental planning for North-South Road and a portion of Kapolei Parkway, a Habitat Conservation Plan for *Abutilon menziesii* at Kapolei was finalized in March 2004. Mitigation measures have already been specified for populations of *A. menziesii* related to construction of North-South Road. Two proposed alignments include North-South Road as an easement. Future construction on North-South Road for the proposed fixed guideway system should consider the impact it may have on the *A. menziesii* population, including possible shading of the population and secondary disturbance due to dust and debris from construction.

A landscaping plan would be prepared during final design to replace common weedy species with more aesthetically pleasing or native vegetation. The new vegetation would be designed to serve a number of purposes, including habitat restoration, erosion control, and beautification.

Street Trees

A Tree Preservation Plan would be developed to minimize and mitigate impacts on street trees. In general, healthy mature trees that are notable or otherwise distinctive would be kept in place where possible. Other trees may need to be removed (or transplanted, if viable) and replaced with new landscaping appropriate to the area and the elevated structure. Tree project zones would also be established during construction.

The landscaping plan for the project, discussed previously, would include planting new street trees in areas where existing trees would require removal and could not be transplanted.

Hazardous Materials

A hazardous material is any substance that may be hazardous to humans, animals, or plants and may include pesticides, herbicides, toxic metals and chemicals, volatile chemicals, explosives, and nuclear fuels or low-level radioactive wastes. O'ahu has a wide variety of industries and land uses that generate, use, store, or handle hazardous materials. Most of these sites are associated with industrial and commercial uses located throughout the island. For this assessment, potential contaminant sources were defined as facilities that treat, store, or dispose of hazardous waste; use hazardous substances; store petroleum products on site; or otherwise present a source of contamination to the project. Construction of the project may also be affected by potential contaminant sources located within the project footprint, or contaminants that may have migrated from an off-site source to an area involved in one or more of the project alternatives.

The hazardous waste/materials assessment was performed along the proposed alignments for the Build Alternatives and is summarized in Table 4-16. The Fixed Guideway Alternative has a larger number of potential hazardous waste/materials than the Managed Lane Alternative. This results from the longer length of the alignments and other footprint impacts. The potential for encountering contaminated materials is greater for the alternatives and alignments that are near a greater number of potentially or known contaminated sites.

For the Managed Lane Alternative, the Reversible Option would encounter fewer hazardous waste/materials sites (10 sites) than the Two-Direction Option (17 sites). For Section I of the Fixed Guideway Alternative, the Kapolei Parkway/North-South Road and Saratoga Avenue/North-South Road alignments would encounter no known hazardous waste/materials sites. The Kamokila Boulevard/Farrington Highway alignment would encounter 1 site and the Geiger Road/Fort Weaver Road would encounter 2 sites. For Section II of the Fixed Guideway Alternative, the Farrington Highway/Kamehameha Highway alignment would encounter 1 hazardous waste/materials site. For Section III of the Fixed Guideway Alternative, the Aolele Street alignment would encounter the fewest hazardous waste/materials sites (12 sites). For Section IV of the Fixed Guideway Alternative, the North King Street alignment would encounter the fewest hazardous waste/materials sites (5 sites). For Section V of the Fixed Guideway Alternative, the Beretania Street/South King Street alignment would encounter the fewest hazardous waste/materials sites (3 sites). The Waikīkī Branch would not encounter any known sites.

Table 4-16. Known Hazardous Materials Sites Near Each Alternative

Alternative	Number of Known Hazardous Waste/ Materials Sites that could be Affected
Alternative 1: No Build	
No Build Alternative	0
Alternative 2: Transportation System Management	
TSM Alternative	0
Alternative 3: Managed Lane (by section)	
3a. Two-Direction Option	
Waiawa IC to Hālawa Stream	4
Hālawa Stream to Pacific Street	13
3b. Reversible Option	
Waiawa IC to Hālawa Stream	4
Hālawa Stream to Pacific Street	6
Alternative 4: Fixed Guideway (by section)	
I. Kapolei to Fort Weaver Road	
Kamokila Boulevard/Farrington Highway	1
Kapolei Parkway/North-South Road	0
Saratoga Avenue/North-South Road	0
Geiger Road/Fort Weaver Road	2
II. Fort Weaver Road to Aloha Stadium	
Farrington Highway/Kamehameha Highway	1
III. Aloha Stadium to Middle Street	
Salt Lake Boulevard	14
Mauka of the Airport Viaduct	28
Makai of the Airport Viaduct	15
Aolele Street	12
IV. Middle Street to Iwilei	
North King Street	5
Dillingham Boulevard	13
V. Iwilei to UH Mānoa	
Beretania Street/South King Street	3
Hotel Street/Kawaiaha'o Street/Kapi'olani Boulevard	11
King Street/Waimanu Street/Kapi'olani Boulevard	15
Nimitz Highway/Queen Street/Kapi'olani Boulevard	10
Nimitz Highway/Halekauwila Street/Kapi'olani Boulevard	11
Waikīkī Branch	0

Cultural, Historic, and Archaeological Resources

Background, Studies, and Coordination

Cultural practices, as defined by the Hawai'i State Legislature in Act 50, Hawai'i Session Laws of 2002, were evaluated for the various alternatives. These practices were broadly defined as: (1) a traditional cultural practice that is being conducted in an urban setting, and (2) traditions, beliefs, practices, life ways, and societal history of a community and its traditions, arts, crafts, music, and related institutions. Cultural practices include such broad categories as food, dance, physical practices and health arts, museums, flora, religious practices and gathering places, cultural settings, and festivals and ceremonies. To gather information about the identification and impact of cultural resources within the study area, more than 400 letters were mailed to community members and organizations requesting comments related to cultural and ethnic practices and beliefs within the study area.

In regard to historic resources, this project must comply with Section 106 of the National Historic Preservation Act of 1966 (NHPA) and Section 4(f) of the Department of Transportation Act of 1966 because of federal participation in the project. The environmental analysis completed for this proposed project addresses the first steps in meeting the requirements of these two acts. A review of resources along the proposed alignments was conducted to determine if they are eligible for the National Register of Historic Places. Consultation and confirmation of resource eligibility have not been completed.

For archaeological resources, three general categories of resources were identified: burials, pre-contact archaeology, and historic archaeology. With few exceptions, the archaeological resources that could be affected by the project are subsurface features and deposits that have not been previously identified. Such impacts would occur during construction. Once negative impacts from construction (e.g., archaeological resource destruction) and positive impacts from construction (e.g., an increase in archaeological knowledge about O'ahu's south shore) have occurred, no long-term project-related impacts on archaeological resources are expected.

Cultural Resource Impacts

Approximately 1,120 cultural practices and resources were identified in the study area. The cultural practices varied from one-time annual events (e.g., the Aloha Week festival) to churches or community organizations where cultural activities are regularly held. Each cultural resource or practice was analyzed to assess the following:

- A finding of potential impact on the cultural practice
- Impacts on access to the practice during construction
- Potential impact to the cultural practice during operation or implementation of the project; or
- A finding of no impact.

Potential impacts identified may not be substantial, and may be avoided or minimized with mitigation. Table 4-17 summarizes cultural practices and resources that may be affected by each alternative. Generally, impacts to resources during construction would include temporary limits on access to resources, or the need to temporarily relocate or reroute resources or events such as parades. Impacts to major events could be avoided by coordinating construction activities around events such as the Kamehameha Day Parade.

The No Build Alternative includes existing transit and highway facilities and committed transportation projects expected to be operational by 2030. An independent cultural impact analysis would need to be conducted for each of these other projects. Accordingly, it was determined that there would be no long-term or construction-related impacts from the No Build Alternative on the identified cultural resources or practices.

Table 4-17. Cultural Practices and Resources in the Study Area

Alternative	Total Resources	Resources that May be Affected during Construction	Resources that May be Affected during Operation
Alternative 1: No Build			
No Build Alternative	1,120	Not identified	Not identified
Alternative 2: Transportation System Management			
TSM Alternative	1,120	Not identified	Not identified
Alternative 3: Managed Lane			
3a. Two-Direction Option	178	125	0
3b. Reversible Option	178	125	0
Alternative 4: Fixed Guideway (by section)			
I. Kapolei to Fort Weaver Road			
Kamokila Boulevard/Farrington Highway	48	43	0
Kapolei Parkway/North-South Road	15	12	0
Saratoga Avenue/North-South Road	3	3	2
Geiger Road/Fort Weaver Road	47	8	2
II. Fort Weaver Road to Aloha Stadium			
Farrington Highway/Kamehameha Highway	151	112	0
III. Aloha Stadium to Middle Street			
Salt Lake Boulevard	23	6	0
Mauka of the Airport Viaduct	23	11	0
Makai of the Airport Viaduct	23	11	0
Aolele Street	23	11	0
IV. Middle Street to Iwilei			
North King Street	88	43	2
Dillingham Boulevard	34	23	0
V. Iwilei to UH Mānoa			
Beretania Street/South King Street	159	128	0
Hotel Street/Kawaiaha'o Street/ Kapi'olani Boulevard	142	134	7
King Street/Waimanu Street/Kapi'olani Boulevard	148	42	2
Nimitz Highway/Queen Street/Kapi'olani Boulevard	49	45	0
Nimitz Highway/Halekauwila Street/Kapi'olani Boulevard	35	25	0
Waikīkī Branch	109	99	1

Similarly, Alternative 2, Transportation System Management, would include the same committed highway projects assumed for the No Build Alternative. Therefore, the determination was made that there would be no long-term or construction-related impacts from this alternative on the identified cultural resources or practices.

Alternative 3, Managed Lane, would include construction of a two-lane, grade-separated facility for use by buses, paratransit vehicles, and vanpools between Waipahu and Downtown Honolulu. Impacts on cultural resources would be the same for both options under this alternative (Two-Direction and Reversible). In general, no long-term impacts on cultural activities are expected under the Managed Lane Alternative. Along this route, 178 cultural resources were identified and one cultural resource would be directly affected, but not over the long term. Access to 125 of these resources (including the directly affected cultural resource) could be affected during construction (Table 4-17). Access to small ethnic food shops and cultural activities between Aloha Stadium and Ke'ehi Lagoon Beach Park, including fishing and canoe paddling events, could occur. Access to prominent features, such as the Arizona Memorial and USS Missouri, may be affected. However, there would be no long-term impacts on cultural resources under the Managed Lane Alternative.

In general, Alternative 4, Fixed Guideway, would have few long-term impacts on cultural resources or practices, except in the historic and culturally sensitive areas of Downtown – in particular Kawaiaha'o Church, the Mission Houses, and 'Iolani Palace. The greatest impact on cultural resources would occur during construction when access to resources (including ethnic food shops and religious sites where various ethnic and cultural groups gather) could be affected. The alignments that included a bored tunnel and those that avoid Chinatown and Downtown would cause fewer disruptions. However, some cultural resources and practices may be affected during construction and operation if the project displaces or eliminates a particular cultural practice or resource.

In Section I of Alternative 4, the Kapolei to Fort Weaver Road alignment, the Kamokila Boulevard/Farrington Highway alignment could impact the largest number of cultural resources and practices. Access to 43 cultural resources could be temporarily affected by construction, but no long-term impacts would occur. The Saratoga Avenue/North/South Road alignment would have the fewest impacts: a direct impact to one cultural practice would occur and access to three cultural resources could be affected by construction. Two resources could be impacted during operation.

For Section II of Alternative 4, Fort Weaver Road to Aloha Stadium, construction of the Farrington Highway/Kamehameha Highway alignment could temporarily impair access to 112 cultural resources, but no long-term impacts would occur.

Along Section III of Alternative 4, Aloha Stadium to Middle Street, construction of all four alignments could temporarily affect access to cultural resources, but there would be no long-term impacts during operation.

In Section IV of Alternative 4, Middle Street to Iwilei, the North King Street Alignment would have the greatest impact on cultural resources and practices. A direct impact to one cultural practice would occur and access to 43 cultural resources could be temporarily affected by construction. Two resources could be affected long-term.

For Section V of Alternative 4, Iwilei to UH Mānoa, the Hotel Street/Kawaiaha'o Street/Kapi'olani Boulevard Alignment would have the greatest impacts on cultural resources and practices. Direct impacts could affect 17 practices, and access to 134 cultural resources could be temporarily affected by construction. Seven resources could be affected long-term. The Nimitz Highway/Halekauwila Street/Kapi‘olani Boulevard Alignment would have the least impact on cultural resources and practices. Access to 25 cultural resources could be affected by construction, but no long-term impacts on cultural resources would occur during operation. The number of resources that would be affected by the Beretania Street/South King Street and King Street/Waimanu Street/Kapi‘olani Boulevard tunnel alignments would be reduced because they would be constructed using a tunnel boring machine, which would leave the surface undisturbed.

Cultural Resource Mitigation

Transit stations can enhance cultural practices and resources through appropriate interpretive signage in different ethnic languages. In the Kapolei area, transit centers could also provide a venue for traditional cultural stories about the area, including legends and Hawaiian place names. Coordination of construction activities would avoid impacts on traditional ceremonies and festivals, including the Kamehameha Day Parade.

Historic Resource Impacts

The City and County property record search identified approximately 1,000 pre-1965 tax map lots within the study corridor. These properties are not evenly distributed among the proposed transit corridor's various sections. The preliminary list was used to determine resources that were reviewed in previous studies and/or are already included in the State Historic Preservation Division (SHPD)'s State and National Register lists. Resources that had not been previously assessed were reviewed in a field survey. This survey identified buildings and structures that appear to possess distinctive characteristics of a type, period, or method of construction. The fewest pre-1965 resources are located in the Kapolei area, and the most in the Honolulu area (Table 4-18).

Alternative 1: No Build

No impacts to historic resources would occur as a result of project activities under the No Build Alternative. Transportation projects included in the 2030 O‘ahu Regional Transportation Plan would be evaluated individually as each project is developed.

Alternative 2: TSM

Similar to the No Build Alternative, no impacts to historic resources would occur as a result of project activities. Transportation projects included in the 2030 O‘ahu Regional Transportation Plan, and any other transit capital improvements, would be evaluated individually as each project is developed.

Alternative 3: Managed Lane

Both the Two-Direction and Reversible options under this alternative could impact the physical environment of 26 historic resources identified along this route. The impacts to historic resources, discussed below, would be the same for either option selected for implementation.

The various historic resources (districts, cemeteries, parks, buildings, bridges, stone paving, curbing, and other such objects) considered potentially eligible, potentially eligible pending further study, or already on the Register(s) along this alternative's alignment could face a loss of integrity of setting, feeling, and association. The loss of these aspects of integrity could result during project construction and operation (long-term impacts).

Long-Term Impacts
Impacts during project operation could include direct changes to physical features of a property's setting that contribute to its historic significance. Specific changes would include infrastructure that is visually incompatible and blocks the view of a historic resource (e.g., the scale of the infrastructure could overwhelm the resource's historic appearance).

Construction Impacts
Impacts during construction could include the following:

- Demolition or damage to historic objects
- Alterations (e.g., stabilization efforts/reinforcement, particularly to historic bridges) where such alterations would change the historic appearance
- Inadvertent collision of equipment and/or material into the resource
- Collision from overhead debris
- Construction vibration causing direct movement or resulting in ground displacement (which could cause settling and movement, resulting in structural damage to the resource)
- Dewatering from adjacent foundation excavations, creating settling and movement beneath historic resources
- Dewatering resulting in the rapid dry rot of any previously submerged timber piles when exposed to air
- High concentrations of dust that directly soils the exterior or infiltrates the interior and damages interior architectural features
- Construction noise altering the feeling of historic areas (particularly residential neighborhoods)

Alternative 4: Fixed Guideway

Long-Term Impacts
The Fixed Guideway Alternative could impact the physical environment of 209 historic resources identified along its various alignments (Table 4-18). As a means of comparing the relative degree of impact that the various alignments in each section would entail, each has been given a ranking from low to high in the far right column of Table 4-19.

Table 4-18. Historic Resources in the Study Area

Section and Alignment[1]	Pre-1965 Properties	Resources Determined Eligible	Potentially Eligible Resources [2]	Historic Districts (HD) Affected
Alternative 3: Managed Lane (by section)				
Waiawa IC to Hālawa Stream	78	0	9	1 (PH NHL[3])
Hālawa Stream to Pacific Street	63	2	19	1 (PH NHL[3])
Alternative 4: Fixed Guideway (by section)				
I. Kapolei to Fort Weaver Road (5)				
Kamokila Boulevard/Farrington Highway	0	0	2	0
Kapolei Parkway/North-South Road	1	0	1	0
Saratoga Avenue/North-South Road	1	0	3	0
Geiger Road/Fort Weaver Road	3	0	3	0
II. Fort Weaver Road to Aloha Stadium (9)				
Farrington Highway/Kamehameha Highway	173	0	9	0
III. Aloha Stadium to Middle Street (10)				
Salt Lake Boulevard	110	0	3	1 (Palm Circle NHL)
Mauka of the Airport Viaduct	9	0	8	1 (PH NHL[3])
Makai of the Airport Viaduct	21	0	8	1 (PH NHL[3])
Aolele Street	18	0	8	0
IV. Middle Street to Iwilei (44)				
North King Street	94	3	33	0
Dillingham Boulevard	49	2	12	0
V. Iwilei to UH Mānoa (141)				
Beretania Street/South King Street	126	16	56	2 (Chinatown HD, Hawai'i Capital HD)
Hotel Street/Kawaiaha'o Street/ Kapi'olani Boulevard	228	33	52	2 (Chinatown HD, Hawai'i Capital HD)
King Street/Waimanu Street/ Kapi'olani Boulevard	205	37	50	2 (Chinatown HD, Hawai'i Capital HD)
Nimitz Highway/Queen Street / Kapi'olani Boulevard	218	21	45	3 (Chinatown HD, Merchant St. HD, Hawai'i Capital HD)
Nimitz Highway/Halekauwila Street/ Kapi'olani Boulevard	186	15	33	2 (Chinatown HD, Merchant St. HD)
Waikīkī Branch	33	0	8	0
Total historic or potentially historic resources that may be affected by Alternative 4: 209				

Notes on table:

[1]The numbers in parentheses are the total number of resources that meet the 1965 cut-off date for each section. Because some resources are affected by multiple alignments, the numbers in parentheses are typically less than the total of the resources for each section in column two.

[2]Includes pre-1965 properties from the City and County database, plus other properties identified during field surveys.

[3]PH NHL = Pearl Harbor National Historic Landmark

In addition to the number of historic or potentially historic resources identified along each alignment, the rankings take into account several other weighting factors. These factors include the level of impact that would result from where the system is built in a particular area (above-grade, at-grade, and below-grade). For example, at-grade alignments were evaluated as posing less impact than elevated alignments, and tunneled alignments would pose less impact than at-grade alignments. The tunneled alignments were projected to cause the least amount of impact among these three types of alignments, because it is assumed that construction damage would be avoided or minimized and no historic resources adjacent to the tunneled alignments would be affected. The ranking also reflects how many of the resources are already on the National and/or State registers, and the path an alignment takes through a historic district. For example, a lower ranking is given when an alignment is adjacent to the outer boundary of a district, compared to an alignment that goes directly through it.

Of the four alignments within Section I, the Kapolei Parkway/North-South Road alignment has the least potential for impact to historic resources because it is adjacent to only one potentially historic resource. The other three alignments are adjacent to either two or three potentially historic resources. This section contains no properties already listed on the State or National registers and does not contain any historic districts. The system would also be elevated in this section. Therefore the various weighting factors do not affect the ranking of these alignments. The relative rankings for this section directly reflect the number of potentially historic resources identified in the survey.

Section II contains only one alignment, Farrington Highway/Kamehameha Highway, which is adjacent to nine potentially historic resources. Because no other alignments exist for comparison purposes, it was not given a ranking.

Four alignments exist in Section III, all of which are proposed to be elevated. The Salt Lake Boulevard alignment has the least potential for impact to historic resources because it is adjacent to only three historic or potentially historic resources. It passes adjacent to the outer boundary of the Palm Circle National Historic Landmark, but none of the landmark's resources are located near this boundary so its direct impact to historic resources in this area is insignificant. The three other alignments in Section III affect eight resources each. They also follow the Kamehameha Highway boundary of the Pearl Harbor National Historic Landmark, passing directly in front of some of its historic resources. These three alignments would result in more impacts to historic resources.

Of the two alignments in Section IV, the Dillingham Boulevard alignment has a lower potential for impacts to historic resources than the North King Street alignment. This is because the Dillingham Boulevard alignment is adjacent to 12 potentially historic resources (of which only one is on one of the registers), and the North King Street alignment is adjacent to 33 historic resources (of which 5 are on either the Hawai'i Register or Eligible for the National Register). Because neither of these alignments passes through or near any historic districts and both use elevated systems, the rankings are primarily based on the historic or potentially historic resources located along the alignments.

Table 4-19. Historic Resources Affected by the Fixed Guideway Alternative

Section and Alignment[1]	Number of Resources Eligible or Potentially Eligible along Alignment[2]	Historic Districts along Alignment	Relative Potential for Impact[3]
I. Kapolei to Fort Weaver Road (5)			
Kamokila Boulevard/Farrington Highway	2	0	◑
Kapolei Parkway/North-South Road	1	0	○
Saratoga Avenue/North-South Road	3	0	●
Geiger Road/Fort Weaver Road	3	0	●
II. Fort Weaver Road to Aloha Stadium (9)			
Farrington Highway/Kamehameha Highway	9	0	Not ranked; only one alignment
III. Aloha Stadium to Middle Street (10)			
Salt Lake Boulevard	3	1 (Palm Circle NHL)	○
Mauka of the Airport Viaduct	8	1 (PH NHL)	●
Makai of the Airport Viaduct	8	1 (PH NHL)	●
Aolele Street	8	1 (PH NHL)	●
IV. Middle Street to Iwilei (44)			
North King Street	33	0	●
Dillingham Boulevard	12	0	○
V. Iwilei to UH Mānoa (141)			
Beretania Street/South King Street	56	2 (Chinatown HD, Hawai'i Capitol HD)	●
Hotel Street/Kawaiaha'o Street/Kapi'olani Boulevard	52	2 (Chinatown HD, Hawai'i Capitol HD)	●
King Street/Waimanu Street/Kapi'olani Boulevard	50	2 (Chinatown HD, Hawai'i Capitol HD)	◑
Nimitz Highway/Queen Street/ Kapi'olani Boulevard	45	3 (Chinatown HD, Merchant St. HD, Hawai'i Capitol HD)	●
Nimitz Highway/Halekauwila Street/Kapi'olani Boulevard	33	2 (Chinatown HD, Merchant St. HD)	○
Waikīkī Branch	8	0	Not ranked
TOTAL: 209			

[1]Numbers in parentheses following segment titles are the total number of resources on the NR and/or HR, determined eligible, or evaluated as potentially eligible, that could be affected within each section. Because some resources are affected by multiple alignments, the numbers in parentheses are typically less than the total of the resources for each section in column two.

[2]Includes pre-1965 properties from the City and County database, plus other properties identified during field surveys.

[3]○ = Lowest Potential, ● = Highest Potential.

Of the five alignments in Section V, the Nimitz Highway/Halekauwila Street/Kapi'olani Boulevard alignment has the least potential for impacts to historic resources. This alignment avoids many areas with concentrated groups of resources (central Chinatown, South King Street), and also avoids the Hawai'i Capital Historic District, which has a number of high-profile resources. However, this alignment does not entirely avoid historic resources. Its elevated route goes through the makai side of the Chinatown Historic District where it is adjacent to 10 resources, and would further isolate that district from its historic connection with the waterfront. It also runs along the border of the Merchant Street Historic District.

The Nimitz Highway/Queen Street/Kapi'olani Boulevard alignment would have the same impacts as the Nimitz Highway/Halekauwila Street/Kapi'olani Boulevard alignment, but would also affect properties within the Hawai'i Capital Historic District (Post Office, Ali'iōlani Hale building, and Attorney General's building). It would also affect three National Register properties along Queen Street (C. Brewer, Alexander and Baldwin, and Royal Brewery buildings). This alignment is fully elevated – there are no tunnels proposed that would reduce the number of historic resources affected.

The Hotel Street/Kawaiaha'o Street/Kapi'olani Boulevard alignment would operate at grade on Hotel Street. This is in context with this street's history, because a streetcar historically ran along it (this precedence notably minimizes but does not eliminate the alignment's impact). This alignment would tunnel under the Hawai'i Capital Historic District, which reduces the number of resources affected to approximately the same number as found along the Nimitz Highway/Queen Street/Kapi'olani Boulevard alignment. Important resources along the Hotel Street alignment are 18 buildings in the Chinatown Historic District; the National Register-eligible Campbell, McCorriston, and Portland buildings; and five other National Register-listed resources (one Capitol District building, the Kawaiaha'o Church, the Mission Houses, Ala Wai Park Clubhouse, and Church of the Crossroads).

In Section V, the King Street/Waimanu Street/Kapi'olani Boulevard alignment would tunnel under the Chinatown Historic District and Hawai'i Capital Historic District and the National Register-eligible Honolulu Advertiser Building. Koko Head of Ward Avenue, the alignment is similar to the other alignments that would be elevated near the Ala Wai Park Clubhouse and Church of the Crossroads.

The Beretania Street/South King Street alignment within Section V has the highest number of historic resources, but because of the tunneling proposed along the Beretania Street portion of the alignment, fewer resources would actually be affected. Many potentially historic resources identified along South King Street are not listed on either the Hawai'i or National registers. Important resources along the South King Street alignment listed on the National Register are Thomas Square, McKinley High School, the Board of Agriculture and Forestry building, and Church of the Crossroads.

Construction Impacts

Impacts during construction could include:

- Ground displacement and movement of historic properties from tunneling, resulting in structural damage
- Inadvertent collision of equipment and/or material into the resource
- Collision from overhead debris
- Construction vibration, causing direct movement or ground displacement (resulting in settling and movement and possible structural damage to the resource)

- Dewatering from adjacent foundation excavations, creating settling and movement beneath historic resources
- Dewatering, resulting in the rapid dry rot of any previously submerged timber piles when exposed to air
- High concentrations of dust, soiling the exterior or infiltrating the interior and damaging interior architectural features
- Construction noise altering the feeling of historic areas (particularly residential neighborhoods)

Historic Resource Mitigation

Mitigation of Long-Term Impacts

Impacts to historic resources should be avoided and minimized where possible. Other mitigation methods, specifically documentation, should take place if avoiding and minimizing impacts are not practicable. Where the grade-separated roadway or selected fixed guideway alignment would pose a considerable negative impact on historic resources (in particular where the alignment is above grade and would block the primary façade or view), documentation of the resources prior to construction would be an appropriate method of mitigation. The format of this documentation could be either Historic American Buildings Survey or Historic American Engineering Record reports, as appropriate. If station locations cannot be located away from historic resources, interpretive signs could be installed in the stations located near the affected historic resources. These signs could provide historical and architectural information to transit users.

Mitigation of Construction Impacts

During construction, historic properties located near work areas would be protected from damage. This would include erecting barriers to prevent collision from machinery, equipment, and construction materials, and erecting overhead protection if construction is needed above the resource. Vibration from nearby construction should be monitored at historic resources to avoid damage either directly (e.g., from pile driving) or from ground displacement. Dewatering of the ground under historic resources should be prevented by using watertight excavation support systems (e.g., slurry walls) to ensure that water pumped from a construction site does not come from adjacent properties. Dust suppression measures should be used at construction sites. A monitoring program should be implemented during construction to evaluate the efficacy of protective measures and recommend new measures as needed.

Archaeological Resource Impacts

Alternative 1 (No Build0 and Alternative 2 (Transportation System Management) may involve construction that could impact archaeological resources. However, these impacts are not considered in this analysis, because these alternatives would undergo a separate environmental review as part of their planning and implementation. Most areas affected by Alternative 3, Managed Lane, would also be within the area affected by Alternative 4, Fixed Guideway. Depending on the alignment and construction methods chosen for the Fixed Guideway Alternative, the Managed Lane Alternative could result in fewer impacts on archaeological resources than the Fixed Guideway Alternative, because the Managed Lane Alternative would involve disturbance of a shorter corridor (Table 4-20).

The potential for encountering archaeological resources is dependent on the construction methods used. Construction of elevated structures requires soil disturbance at periodic intervals where columns are placed, but would not disturb areas between these columns. With tunnel construction, boring machines create deep tunnels below the layer where archeological resources are commonly found, so are not likely to disturb resources except near the ends of the tunnel. Cut-and-cover tunnel construction removes material from the surface, so any resources in the alignment are likely to be disturbed.

Alternative 3: Managed Lane

In relation to archaeological impacts, no differences exist between Managed Lane Alternative 3a (Two-Direction Option) and 3b (Reversible Option). For the section of the Managed Lane Alternative from the Waiawa Interchange to Hālawa Stream, the potential to impact burials is rated as low, and the potential to impact archaeological resources and historic resources is rated as medium. The section of the Managed Lane Alternative from Hālawa Stream to Pacific Street has a medium rating for impacts to all archaeological resource types.

Alternative 4: Fixed Guideway

For Section I of the Fixed Guideway Alternative, the potential for impacts to all three types of archaeological resources decreases in direct correlation with an alignment's distance from the coast. The most mauka alignment, Kamokila Boulevard/Farrington Highway, has the least potential to impact archaeological resources. All three mauka alignments (Kamokila Boulevard/Farrington Highway, Kapolei Parkway/North-South Road, and Saratoga Avenue/North-South Road) have a low impact potential for all archaeological resource types. The makai alignment, Geiger Road/Fort Weaver Road, has a medium impact potential for pre-contact archaeological resources and a low impact potential for burials and historic resources.

Table 4-20. Summary of Potential Impacts to Archaeological Resources

Alternative	Burials	Pre-Contact Archaeology	Historic Archaeology
Alternative 1: No Build			
No Build Alternative	N/A	N/A	N/A
Alternative 2: Transportation System Management			
TSM Alternative	N/A	N/A	N/A
Alternative 3: Managed Lane (by section)			
3a. Two-Direction Option			
Waiawa IC to Hālawa Stream	○	◑	◑
Hālawa Stream to Pacific Street	◑	◑	◑
3b. Reversible Option			
Waiawa IC to Hālawa Stream	○	◑	◑
Hālawa Stream to Pacific Street	◑	◑	◑
Alternative 4: Fixed Guideway (by section)			
I. Kapolei to Fort Weaver Road			
Kamokila Boulevard/Farrington Highway	○	○	○
Kapolei Parkway/North-South Road	○	○	○
Saratoga Avenue/North-South Road	○	○	○
Geiger Road/Fort Weaver Road	○	◑	○
II. Fort Weaver Road to Aloha Stadium			
Farrington Highway/Kamehameha Highway	○	◑	◑
III. Aloha Stadium to Middle Street			
Salt Lake Boulevard	○	○	○
Mauka of the Airport Viaduct	○	◑	◑
Makai of the Airport Viaduct	○	◑	◑
Aolele Street	○	◑	◑
IV. Middle Street to Iwilei			
North King Street	◑	◑	◑
Dillingham Boulevard	◑	◑	◑
V. Iwilei to UH Mānoa			
Beretania Street/South King Street	◑	◑	◑
Hotel Street/Kawaiaha'o Street/ Kapi'olani Boulevard	●●	●	●
King Street/Waimanu Street/ Kapi'olani Boulevard	●	●	●
Nimitz Highway/Queen Street/ Kapi'olani Boulevard	●	●	●
Nimitz Highway/Halekauwila Street/ Kapi'olani Boulevard	●	●	●
Waikīkī Branch	●	●	●

Notes:

○ = Low Potential, ● = High Potential

The highest potential for encountering burials would occur during cut-and-cover tunnel construction, which would be used on the Hotel Street/Kawaiaha'o Street alignment.

Only one alignment is being considered for Section II: Farrington Highway/Kamehameha Highway. This alignment has a low impact potential for burials and a medium impact potential for pre-contact archaeological and historic resources.

For Section III, the potential impact to burials is rated low for all four alignments. The potential to impact archaeological and historical resources along the mauka side of the Airport Viaduct, makai of the Airport Viaduct, and Aolele Street alignments is rated medium. For the Salt Lake Boulevard alignment, the potential impact rating for archaeological and historical resources is low, primarily because of the extensive land modification that has occurred in this area.

Both of the alignments for Section IV have medium impact potential for all archaeological resource types.

The alignments along Section V have the greatest potential to impact archaeological resources because of the area's intensive land use history through pre-contact and historic times. Of the six alignments, the most mauka alignment, Beretania Street/South King Street, has a medium impact rating for all archaeological resource types. All other alignments are rated as having a high impact potential for all archaeological resources. The cut-and-cover tunnel excavation for the Hotel Street/Kawaiaha'o Street/Kapi'olani Boulevard alignment would have the highest potential for encountering burials because of the large area excavated. The other tunnel alignments, Beretania Street/South King Street and King Street/Waimanu Street/Kapi'olani Boulevard, would be excavated using a tunnel boring machine, which would not disturb the surface and would dig at a depth generally below where burials are located.

Archaeological Resource Mitigation

Archaeological mitigation would include burial treatment, archaeological data recovery, and archaeological monitoring. If some flexibility in the construction design exists, it may be possible to preserve the archaeological resources in place.

Because a reasonable potential exists for Alternatives 3 and 4 to affect burials, particularly Native Hawaiian burials, the project's program for the treatment of burials should be proactive and conscientious. As a unique class of archaeological resource, burial treatment must be carried out in accordance with the specific guidelines of Hawai'i State and federal burial law. If federal lands are involved, Native American Grave Protection and Repatriation Act guidelines would need to be followed. Early consultation with the O'ahu Island Burial Council is appropriate. A project burial plan should be developed to outline the treatment for all previously identified and inadvertent burial finds encountered by the project.

Archaeological data recovery is a method of extracting important information from archaeological sites to mitigate a project's effect on the site's destruction. In consultation with State Historic Preservation Division, a detailed data recovery plan would be written that describes the data recovery investigation's research questions, data requirements, and methods for acquiring the needed information to answer research questions. Once the archaeological investigation is complete, a data recovery report would be written to document all results.

Archaeological monitoring can minimize the impact of a development on as-yet-unidentified or incompletely documented archaeological resources. The goal is to document exposed archaeological resources and, for the most important archaeological resources, potentially save them from destruction. Typically, archaeological monitoring programs follow a plan that outlines the construction methods and impacts of the proposed project, the types of archaeological resources expected, and the methods to be used to document the archaeological resources encountered. A monitoring report is prepared to document all results.

Archaeological preservation involves avoiding impacts to archaeological resources and protecting and safeguarding these resources in place. Archaeological preservation can include active interpretation of the resource, for example with signage and other forms of public interpretation. It can also involve conserving the resource through evasion. Preservation strategies and methods differ depending on the type of archaeological resource encountered. Typically, a preservation plan is written to describe the archaeological resource and the preservation measures to be enacted. Once approved by the State Historic Preservation Division (SHPD), the plan is implemented.

Conclusions Regarding Environmental Consequences

The proposed project alternatives present a range of trade-offs when considering their effects on various elements of the environment. The No Build and TSM Alternatives have the fewest physical impacts, but would require more operating energy and generate more air and water pollution that the Fixed Guideway Alternative. Within the Managed Lane and Fixed Guideway Alternatives, the environmental effects would vary by the option or alignment selected.

Alternative 3: Managed Lane

The Reversible Option would be narrower than the Two-Direction Option, creating less visual impact. However, it would have greater energy consumption, air pollution, and water pollution emissions. Overall, the differences in environmental effects between the two options are not sufficient to select one over the other.

Alternative 4: Fixed Guideway

The Fixed Guideway Alternative would generate the greatest environmental benefit for several elements of the environment. The impacts would vary substantially between alignments. The long-term environmental effects that differentiate each alignment are discussed in the following sections. Overall, trade-offs exist between the various alignments, but two alignment options would have substantially greater environmental impacts than the other alignments within their section. In Section III, the Salt Lake Boulevard alignment would cause a substantially greater number of noise impacts than any other alignment within the study corridor. In Section IV, the Hotel Street/Kawaiaha'o Street/Kapi'olani Boulevard alignment would require more residential property acquisitions and would have a greater potential to disturb cultural practices and burials than any other alignment.

Section I. Kapolei to Fort Weaver Road

Overall, fewer social and environmental impacts would occur in Section I than in other portions of the corridor. The Kapolei Parkway/North-South Road and Saratoga Avenue/North-South Road alignments would better support planned land use, because they would serve a greater portion of the future population (Table 4-1.). The Saratoga Avenue/North-South Road alignment would have the fewest noise impacts (Table 4-13). These alignments are not greatly differentiated by other elements of the environment.

Section III. Aloha Stadium to Middle Street

The Salt Lake Boulevard alignment would serve more residents than the other three alignments, but would serve fewer jobs (Table 4-1.). The Salt Lake Boulevard and Aolele Street alignments would affect fewer land parcels than the other alignments (Table 4-3). The makai of the Airport Viaduct and Aolele Street alignments would each cross a portion of Keehe Lagoon Park near H-1 (Table 4-5). The greatest number of noise impacts within the entire study corridor would occur along the Salt Lake Boulevard alignment (Table 4-13). More potential contaminated sites would be crossed mauka of the Airport viaduct than with any of the other alignments (Table 4-16).

Section IV. Middle Street to Iwilei

The North King Street alignment would serve more residents than the Dillingham alignment, but would serve fewer jobs (Table 4-1.). The Dillingham alignment would require more parcel acquisitions, but fewer residential parcels would be acquired (Table 4-3). More noise impacts would occur with the North King Street alignment (Table 4-13). A greater number of potentially historic properties are located along the North King Street alignment (Table 4-18) than along the other alignments.

Section V. Iwilei to UH Mānoa

The Beretania Street/South King Street alignment would serve the fewest residents and jobs (Table 4-1.). The Hotel Street/Kawaiaha''o Street/Kapi''olani Boulevard alignment would require acquisition of the greatest number of residential parcels of any alignment within the study corridor (Table 4-3). Noise impacts would be greater with a Waikīkī Branch than at any other location in Section V, but would be fewer than with the Salt Lake Boulevard or North King Street alignments (Table 4-13). The Hotel Street/Kawaiaha'o Street/Kapi'olani Boulevard alignment could affect a greater number of cultural practices (Table 4-17) and disturb the greatest number of burials (Table 4-20) compared to any alignment within the study corridor.

Chapter 5 Financial Feasibility Analysis

This chapter compares relative costs among the alternatives and evaluates their financial feasibility. The details of the financial information will continue to be refined once the LPA is selected and as it advances through planning and development. Project cost estimates become more reliable as the project scope is defined in greater detail and funding strategies become more certain. Consistent with the other technical components of the FTA's project development process, the level of the financial analysis increases as the work moves from a relatively broad comparison of alternatives (as in an alternatives analysis) to preliminary and final engineering.

Capital Costs

Estimation Methods

The AA cost estimates were developed using FTA's capital cost format, the Standard Cost Categories (SCC). The SCC establishes a consistent format for estimating capital costs for FTA New Starts projects. The SCC is structured to accommodate all possible project elements in the following 10 categories:

10: Guideway and Track Elements

20: Stations, Stops, Terminals, Intermodal Facilities

30: Support Facilities: Yards, Shops, Administration Buildings

40: Site Work & Special Conditions

50: Systems

60: Right-of-Way, Land, Existing Improvements

70: Vehicles

80: Professional Services (soft costs)

90: Unallocated Contingency

100: Finance Charges (derived from the project's financial plan).

Initially, unit costs for specific items were established. Examples of these items include "trench excavation" (per cubic yard), "labor to install direct fixation rail (excluding welds)" (per track foot), "lighting, aerial guideway" (per linear foot), and "fare collection" (per station). These unit costs were used throughout the cost-estimating process to provide uniformity and comparability of cost estimates for all alternatives.

The cost estimates include a variety of contingencies. The design/estimating construction contingency percentages for design elements are inversely proportional to the level of design detail for each element because uncertainties in the project implementation decrease as the level of design increases. Other contingencies incorporated into the cost estimates include a change order contingency, vehicle contingency, right-of-way contingency, and project reserve contingency.

All construction and capital costs are expressed in 2006 dollars (dollar value as of fourth-quarter 2006). Unit costs were developed from HDOT cost data or other historical sources from other systems throughout the country. When cost data from sources outside of Hawai'i were used, adjustments were made, as needed, using historic state adjustment factors, such as those used in the U.S. Army Corps of Engineers Civil Works Construction Cost Index System.

Capital Cost Estimates by Alternative

Table 5-1 presents the capital cost estimates for each of the alternatives. Included are the costs of implementing each major investment alternative (including construction, systems, vehicles, right-of-way, contingencies, and soft costs), as well as the costs associated with providing bus services. Financing costs are not included.

Table 5-1. Capital Cost Estimates (millions 2006 dollars)

Alternative	Major Investment Facility Capital Costs[1]	Bus Capital Costs				Total Capital Costs
		2030 Bus Fleet[2]	Bus Replacements Prior to 2030	HandiVan Vehicle Replacements	Bus Facilities	
Alternative 1: No Build						
No Build Alternative	-	318	227	69	46	660
Alternative 2: Transportation System Management						
TSM Alternative	-	384	260	69	143	856
Alternative 3: Managed Lane						
Two-Direction Option	3,770	431	263	69	194	4,727
Reversible Option	2,570	467	269	69	226	3,601
Alternative 4: Fixed Guideway						
Kalaeloa - Salt Lake - North King - Hotel	4,730	243	216	69	43	5,301
Kamokila - Airport - Dillingham - King with a Waikīkī Branch	5,510	241	212	69	43	6,075
Kalaeloa - Airport - Dillingham - Halekauwila	4,620	249	213	69	43	5,194
20-mile Alignment East Kapolei to Ala Moana Center	3,600	275	205	69	43	4,192

[1] Finance charges are not included.
[2] The expenditure needed to purchase the forecast year 2030 fleet for each alternative.

Capital costs for the Fixed Guideway Alternative would include both costs for the fixed guideway transit system (guideway, systems, vehicles, etc.) and the cost of the assumed bus system (Table 5-1). Estimated costs for the fixed guideway system, in 2006 dollars, would range between $3.6 billion, for the 20-mile Alignment East Kapolei to Ala Moana Center, and $5.5 billion for the Kamokila - Airport - Dillingham - King with a Waikīkī Branch alignment. The cost would vary by alignment within each section (Table 5-2).

Table 5-2. Capital Cost Estimates of the Fixed Guideway Alternative Alignments

Section and Alignment	Capital Cost (millions of 2006 dollars)[1]
Cost common to all alignments	480
I. Kapolei to Fort Weaver Road	
Kamokila Boulevard/Farrington Highway	670
Kapolei Parkway/North-South Road	790
Saratoga Avenue/North-South Road	820
Geiger Road/Fort Weaver Road	850
II. Fort Weaver Road to Aloha Stadium	
Farrington Highway/Kamehameha Highway	990
III. Aloha Stadium to Middle Street	
Salt Lake Boulevard	580
Mauka of the Airport Viaduct	680
Makai of the Airport Viaduct	820
Aolele Street	690
IV. Middle Street to Iwilei	
North King Street	450[2]
Dillingham Boulevard	400
V. Iwilei to UH Mānoa	
Beretania Street/South King Street	1,340[3]
Hotel Street/Kawaiaha'o Street/Kapi'olani Boulevard	1,480[4]
King Street/Waimanu Street/Kapi'olani Boulevard	1,900
Nimitz Highway/Queen Street /Kapi'olani Boulevard	1,150
Nimitz Highway/Halekauwila Street/Kapi'olani Boulevard	1,230[5]
Waikīkī Branch	350

[1] Finance charges are not included.
[2] Connecting from Salt Lake Boulevard to North King Street would reduce this value to $400 million.
[3] Connecting from North King Street to Beretania Street would reduce this value to $1.12 billion.
[4] Connecting from North King Street to Hotel Street would reduce this value to $1.45 billion.
[5] Connecting from North King Street to Nimitz Highway would increase this value to $1.24 billion.

Operating and Maintenance Costs

Estimation Methods

Detailed bus budgetary and operating data were obtained from O'ahu Transit Services for FY 04-05, and the associated unit costs were developed for that year. These costs were escalated to standardize bus costs in 2006 dollars.

Unit costs for the fixed guideway operation and maintenance (O&M) cost model were developed using data from FTA's National Transit Database by assigning driving variables to line item object class expenses. Sacramento's Regional Transit District light rail system was determined to be representative of the fixed guideway service, and 2003 to 2004 light rail cost data from that system were used to develop fixed guideway unit costs. The costs were escalated to standardize fixed guideway costs in 2006 dollars and further adjusted upward to account for higher costs in Honolulu, as compared to the Sacramento area.

Peak operating fleet sizes were determined from the operating plans for each alternative. The total fixed guideway fleet size is based on limiting the average annual vehicle mileage to 80,000, and is calculated by dividing the annual revenue vehicle miles by this number.

Transit Operating and Maintenance Cost Estimates by Alternative

Table 5-3 presents estimated year 2030 transit operating and maintenance costs for each alternative in 2006 dollars. Operating costs in 2030 for the No Build Alternative are estimated to be approximately $192 million. This compares to current operating costs for the existing bus system of about $132 million. The increase would result from expansion of the bus system, including the use of more articulated vehicles, to continue to meet current service levels with increased demand and roadway congestion.

Table 5-3. Estimated Year 2030 Annual Transit Operating and Maintenance Costs (millions 2006 dollars)

Alternative	Bus O&M Cost	Fixed Guideway O&M Cost	Total O&M Cost
Alternative 1: No Build			
No Build Alternative	191.9	-	191.9
Alternative 2: Transportation System Management			
TSM Alternative	234.2	-	234.2
Alternative 3: Managed Lane			
Two-Direction Option	250.9	-	250.9
Reversible Option	261.1	-	261.1
Alternative 4: Fixed Guideway			
Kalaeloa - Salt Lake - North King - Hotel	169.3	78.9	248.2
Kamokila - Airport - Dillingham - King with a Waikīkī Branch	168.7	79.9	248.6
Kalaeloa - Airport - Dillingham - Halekauwila	173.0	83.1	256.1
20-mile Alignment East Kapolei to Ala Moana Center	189.2	61.4	250.6

The estimated operating costs for the TSM Alternative would be approximately $42 million greater than for the No Build Alternative, reflecting the higher level of bus service. Transit operating costs for the Managed Lane Alternative would range between approximately $251 and $261 million as a result of additional buses that would be put in service under that alternative.

Estimated operating costs for the Fixed Guideway Alternative would range between approximately $248 and $256 million. The bus operating cost would be greatest for the 20-mile Alignment East Kapolei - Ala Moana Center because more buses would be required for that option than for the Full-corridor Alignments. Overall, bus operating costs would be less for the Fixed Guideway Alternative than for the other alternatives.

Proposed Funding Sources

Sources of Project Capital

Funding sources for capital investments include a State General Excise and Use Tax (GET) surcharge, City general obligation bonds, and FTA funds. In addition, other potential sources are discussed in a later section of this chapter.

General Excise and Use Tax Surcharge

A 0.5 percent surcharge on the GET will be levied on transactions generated in the City and County of Honolulu from January 1, 2007 to December 31, 2022. The State Council on Revenues' May 2006 forecast of GET revenues from Fiscal Years 2006-2007 to 2012-2013 was used in conjunction with a baseline historical trend in developing a forecast for this revenue source. Table 5-4 presents the estimated annual GET surcharge revenues for three scenarios, net of a 10 percent reduction from the State for tax collection and administration purposes. The "Trend Forecast" is a statistical projection based on historical GET collections for O'ahu. The second scenario, "Council on Revenues 1," is based on the Council on Revenues' GET forecast through June 30, 2013, with a growth stabilized to historical levels through 2022. The "Council on Revenues 2" scenario is the Council on Revenues' GET forecast through June 30, 2013, with sustained growth at the 2007 to 2013 levels through 2022.

The State legislation establishing the GET surcharge limits the expenditure of monies collected to operating or capital costs of a locally preferred alternative for a mass transit project. The funds cannot be used to build or repair public roads or highways, bicycle paths, or support public transportation systems existing as of July 2005. Accordingly, under current law, the GET surcharge can be expended on the Fixed Guideway Alternative but cannot be used for existing transit services for the No Build and TSM Alternatives or to construct the Managed Lane Alternative.

City General Obligation Bonds

The City issues general obligation bonds to construct bus facilities and to purchase equipment and rolling stock. General obligation bonds are direct obligations of the City for which its full faith and credit are pledged. This source can be used by all alternatives, but expenditures are subject to appropriation by the Honolulu City Council.

FTA Section 5309 New Starts Program (49 U.S.C. Section 5309)

The New Starts program provides funds for construction of new fixed guideway systems or extensions to existing fixed guideway systems costing at least $250 million. A fixed guideway refers to any transit facility that uses exclusive or controlled rights-of-way or rails, entirely or in part.

Eligible purposes for these funds include light rail line, rapid rail (heavy rail), commuter rail, automated fixed guideway system (such as a "people mover"), a busway/HOV facility, or an extension of any of these. Also, New Starts projects can involve the development of transit corridors and markets to support the eventual construction of fixed guideway systems, including the construction of park-and-ride lots and the purchase of land to protect rights-of-way.

Table 5-4. GET Surcharge Revenues for Three Growth Scenarios 2007-2022

Calendar Year	Trend Forecast		Council on Revenues 1		Council on Revenues 2	
	Net Revenues (2006 $ M)	Net Revenues (YOE[1] $ M)	Net Revenues (2006 $ M)	Net Revenues (YOE $ M)	Net Revenues (2006 $ M)	Net Revenues (YOE $ M)
2007	154	162	164	172	164	172
2008	155	169	170	185	170	185
2009	156	175	175	196	175	196
2010	157	181	178	206	178	206
2011	158	188	181	216	181	216
2012	159	195	185	227	185	227
2013	161	203	187	236	190	240
2014	162	211	189	246	195	253
2015	164	220	191	256	200	267
2016	166	229	193	267	205	283
2017	168	239	195	278	210	299
2018	170	249	198	289	215	316
2019	172	259	200	301	221	333
2020	173	269	202	314	227	352
2021	175	280	204	327	233	372
2022	177	292	206	340	239	393
TOTAL	**2,626**	**3,520**	**3,018**	**4,056**	**3,185**	**4,310**

[1]YOE = year of expenditure

Only the Fixed Guideway Alternative would be eligible for New Starts funding. The No Build and TSM Alternatives would not be eligible because they do not entail construction of a fixed guideway facility. The Managed Lane Alternative would not be eligible for New Starts funding because of use by toll-paying single-occupancy vehicles, which are excluded from the statutory definition of "fixed guideway" (49 USC Section 5302).

Projects become candidates for funding under this program by successfully completing the appropriate steps in FTA's major capital investment planning and project development process. Projects must also meet certain project justification and financial commitment criteria specified in law and regulation. Funding allocation recommendations are made by FTA in an annual report to Congress. For this report, a funding level between $800 million and $1,200 million in YOE dollars was assumed to be reasonable and plausible.

Sources for System Capital Replacement and Operating and Maintenance (O&M) Expenses

Establishing that the initial capital expenses of a particular alternative can be funded does not necessarily imply that the long-term operating and maintenance and capital replacement expenses also can be funded. The feasibility of sustaining the investment in an alternative during and after the implementation period was also assessed.

Honolulu currently receives the following sources of Federal funding for transit:

- Section 5307 Urbanized Area Formula Program
- Section 5309 Capital Investment Grants and Loans - Rail and Fixed Guideway Modernization Program
- Section 5309 Bus and Bus Facilities Discretionary Funds.

FTA Urbanized Area Formula Program (49 USC Section 5307)

FTA Section 5307 funds are apportioned on the basis of legislative formulae. For areas of 50,000 to 199,999 in population, the formula is based on population and population density. For areas with populations of 200,000 and more, the formula is based on a combination of bus revenue vehicle miles, bus passenger miles, fixed guideway revenue vehicle miles, and fixed guideway route miles, as well as population and population density. The City is the designated recipient for Section 5307 funds apportioned to the Honolulu urbanized area and to the Kailua-Kāne'ohe urbanized area.

Activities eligible for Section 5307 funds include planning, engineering design, and evaluation of transit projects and other technical transportation-related studies; capital investments in bus and bus-related activities, such as replacement of buses, overhaul of buses, rebuilding of buses, crime prevention and security equipment, and construction of maintenance and passenger facilities; capital investments in new and existing fixed guideway systems; and preventative maintenance.

The Section 5307 apportionment amounts for 2007 to 2009 reflect FTA's estimates net of an annual $1 million transfer to the State of Hawai'i for its vanpool program. For 2010 to 2022, the apportionment amounts are assumed to grow at an annual rate of 2.1%, consistent with the Congressional Budget Office forecast of the Highway Trust Fund revenues through 2016. This growth rate was assumed to remain the same from 2016 to 2022. In addition to this base growth rate, each alternative is likely to increase the formula amount of Section 5307 funding as a result of an improved level of service, e.g. more bus or fixed guideway passenger miles. Section 5307 funds can be used for all cost elements of the No Build, TSM, and Fixed Guideway Alternatives, and bus and related bus facility elements of the Managed Lane Alternative.

FTA Transit Capital Investment Program (49 USC Section 5309)

The transit capital investment program (49 USC 5309) provides capital assistance for three primary activities:

- New and replacement buses and facilities
- Modernization of existing rail systems
- New fixed guideway systems and extensions to fixed guideway systems.

Bus and Bus Capital Program

Bus Capital Program funds are allocated at the discretion of the Secretary of the U.S. Department of Transportation, although Congress fully earmarks all available funding.

Eligible purposes include: acquisition of buses for fleet and service expansion; bus maintenance and administrative facilities; transfer facilities; bus malls; transportation centers; intermodal terminals; park-and-ride stations; acquisition of replacement vehicles; bus rebuilds; bus preventative maintenance; passenger amenities such as passenger shelters and bus stop signs; accessory and miscellaneous equipment such as mobile radio units; supervisory vehicles; fareboxes; and computers, shop and garage equipment. The bus-related elements of all the alternatives are eligible for Bus Capital funds, if so allocated by Congress.

The discretionary nature of this program makes the level of funding difficult to predict, as it is subject to Congressional earmarking. Future allocations were forecast using the City's historical 10-year growth rate in bus and bus capital funding of 4.8 percent.

Rail and Fixed Guideway Modernization (FGM) Program

A fixed guideway refers to any transit service that uses exclusive or controlled rights-of-way or rails, entirely or in part. The term includes that portion of motor bus service operated on exclusive or controlled rights-of-way and HOV lanes.

Eligible purposes include capital projects to modernize or improve fixed guideway systems (e.g., purchase and rehabilitation of rolling stock, track, line equipment, structures, signals and communications, power equipment and substations, passenger stations and terminals, security equipment and systems, maintenance facilities and equipment, operational support equipment, including computer hardware and software, system extensions, and preventative maintenance). All alternatives would be eligible for FGM funds.

FGM funds are apportioned using a formula containing seven tiers, and the City's apportionment is based on bus service operating on the Fort Street Transit Mall and HOV lanes. FGM apportionment amounts for 2007 to 2009 reflect FTA's estimates. For 2010 to 2022, the apportionment amounts are assumed to grow at an annual rate of 2.1%, consistent with the Congressional Budget Office forecast of the Highway Trust Fund revenues through 2016, extended through 2022. As with the Section 5307 formula funds, the implementation of an alternative would lead to an increase in the formula apportionment amount due to the improved level of service.

Growth in Federal Funding Due to Project Implementation

Each of the four alternatives studied in the AA would have some incremental effect on the amount of funding that Honolulu receives from these sources. In the case of the Section 5307 Urbanized Area Formula program and the Section 5309 Fixed Guideway Modernization program, an expansion of the parameters considered in the calculation of funding would result in increased assistance for Honolulu, subject to a growing national authorization for these programs. In the case of the Section 5309 Bus Discretionary program, added buses or bus-related improvements do not necessarily correspond to increases in the FTA contribution. Table 5-5 shows the 2007 and 2030 FTA revenue expectations for each alternative.

Table 5-5. Expected FTA Revenues by Alternative in 2007 and 2030 (in millions of year of expenditure dollars)

Year	Source	Alternative				
		No Build	TSM	Managed Lane	20-mile Alignment East Kapolei to Ala Moana Center	Full-corridor Alignments
FY 2007	5307	26	26	26	26	26
	5309 FGM	1	1	1	1	1
	5309 Bus	8	8	8	8	8
	TOTAL	**35**	**35**	**35**	**35**	**35**
FY 2030	5307	58	60	59	79	101
	5309 FGM	2	2	2	35	48
	5309 Bus	23	23	23	23	23
	TOTAL	**83**	**85**	**84**	**137**	**172**

City and County Revenue Sources

The City's contribution to transit O&M is funded using local revenues from the General and Highway Funds. During the 1994 to 2005 period, revenues from these two local sources total a combined $8.4 billion, of which $920 million (11 percent) has gone to transit. During this period, the General Fund and Highway Fund grew at a real annual rate (net of inflation) of 0.65%. This growth rate is assumed to continue through the analysis period.

The City provides the local match to federal funds for capital replacement and expansion from the Highway Improvement Bond Fund.

Additional Sources

The discussion above focuses on sources that are the most likely to have the largest impact on the feasibility of the project alternatives. However, other sources for both project capital and ongoing expenses can be sought as additional revenues, if needed. These additional sources include, on the project capital side, additional local taxes not yet passed for transit use, private real-estate-related sources, such as Tax Increment Financing, Benefit Assessment Districts, and Developer Mitigation Fees, as well as bonding against future user fees for the Managed Lane Alternative. On the ongoing funding side, increases in fares and other user fees and increases in local taxes could be used to fund any shortage in the City's transit budget. These sources have not yet been explored to determine their applicability to the Honolulu High-Capacity Transit Corridor Project; therefore their impact at this time is unquantifiable.

Financing Options

There are a range of options for financing a capital-intensive transit project, from relying on the City's current GO bonding capacity to selling debt instruments leveraging future GET surcharge collections and New Starts contributions. The City and County of

Honolulu currently issues General Obligation (GO) debt for the benefit of transit. Though GO debt capacity for this use is currently constrained by current obligations, given affordability guidelines, it is reasonable to assume that the capacity for future GO debt would increase if GET surcharge revenues are received, thereby enabling GO bonding for the project. Another option would be the issuance of revenue bonds backed only by future GET surcharge collections.

Assessment of Financial Feasibility of the Alternatives

Financial Feasibility of Major Capital Investment

No Build and TSM Alternatives

The No Build and TSM Alternatives correspond essentially to an improvement in bus service. Therefore, their relative capital cost is not differentiated from the ongoing bus replacement, and expansion capital cost and financial feasibility will be determined in the context of ongoing systemwide capital needs discussed below.

Managed Lane Alternative

The Managed Lane Alternative is not eligible for GET surcharge revenues. Therefore, the financial feasibility of the capital investment has to be assessed using existing local funding in the form of GO Bonds, as well as toll revenues from users of the managed lane facility. Since the Reversible Option is the lesser cost option and its transportation performance is similar to that of the Two-Direction Option, the financial feasibility analysis for the Managed Lane Alternative focuses on the Reversible Option.

The Managed Lane Alternative generates revenue from tolls paid by vehicles using the facility. The toll rates would be set at such a level as to manage vehicular demand to maintain operating conditions at a speed of 50 mph or better. For year 2030, peak period toll rates are estimated to be $6.40 for the Reversible Option, in 2006 dollars. In off-peak times, the toll rates are estimated to be $2.85 for the Reversible Option, in 2006 dollars. On an average weekday in 2030, 14,660 toll-paying vehicles are estimated to use the facility in the peak period; 940 vehicles in the off-peak period. This is estimated to yield approximately $29 million in annual toll revenue, in 2006 dollars. The cost of operating and maintaining the toll facilities is estimated to be $7.6 million, for net revenues of $21.4 million, in 2006 dollars, and $43.4 in YOE dollars.

Table 5-6 shows sources and uses of funds for the financing of the Reversible Option. The alternative has an estimated capital cost of $2.57 billion in 2006 dollars. In Year of Expenditure dollars, the estimated amount is $3.27 billion. Since no toll revenues would be obtained until after the managed lane facility is in operation, the City would need to issue bonds with the net toll revenues as a first pledge, along with other City tax revenues. That decision would have cost and policy implications that go beyond the scope of the present study. The City's debt policy and affordability guidelines imply a stringent limit on annual debt service, and preliminary analysis of outstanding debt as of August 2005 suggests that there is only a limited amount of room left for incremental debt issuance beyond the current level. Going beyond that level risks a potential credit rating downgrade, incurring a higher interest cost not only for the project itself, but for any other city project funded by GO Bonds.

Table 5-6. Sources and Uses of Funds for the Managed Lane Reversible Option

	2006$ M	YOE[1]$ M
Net Toll Revenues	664	1,524
Other Sources	3,020	5,220
Total Revenues	3,684	6,744
Capital Costs	2,572	3,267
Financing Costs	1,112	3,477
Total Costs	3,684	6,744

[1]YOE - year of expenditure
Amounts may not add up due to rounding.

Assuming that the full cost of the Managed Lane - Reversible Option is financed with 30-year bonds with an interest rate of 5.5%, principal and interest payments over the term of the loan period would total approximately $6.74 billion in YOE dollars. The debt service payment, in FY 2030, would be approximately $225 million in YOE dollars. Estimated net toll revenues in 2030 would be approximately $43 million in YOE dollars, leaving a balance of over $180 million to be paid from other City sources. Over the life of the loans, through 2047, net toll revenues are anticipated to pay for approximately 23 percent ($1,524 million) of the total debt service, and the remaining 77 percent ($5,220 million) would be paid from the General Fund or Highway Fund.

Fixed Guideway Alternative

The financial feasibility of two Fixed Guideway alignments has been explored: the lowest cost Full-corridor Alignment, the Kalaeloa - Airport - Dillingham - Halekauwila alignment, and the 20-mile Alignment East Kapolei to Ala Moana Center.

The financial feasibility analysis assumed that debt financing would be limited to meeting the needs of the peak years of project construction when yearly costs would exceed revenues available from the GET surcharge and federal sources. A generic limited-duration loan debt structure was modeled with interest rate assumptions based on a tax-exempt coupon equivalent to six percent. The six percent interest rate is based on four percent insured tax-exempt security as of October 2, 2006, plus 100 basis points accounting for future increases in interest rates and 100 basis points for other fees. For the alternative that is eligible for GET surcharge revenues, funds at the beginning of the project, when in excess of project costs, are entered into a trust or savings account in which they earn interest based on the prevailing savings rate, assumed to be five percent. The five percent interest rate corresponds to the U.S. Treasury interest rate on two-year notes as of October 2006. As project expenses net of New Starts contributions commence, the trust account is depleted to meet these expenses, after which point the loan facility is drawn against. The financial feasibility of the project alternative is demonstrated in cases where the loan is fully repaid using GET surcharge revenues by 2022, the last authorized year of collection.

Table 5-7 and Table 5-8 show sources and uses of funds for the financing of the Full-corridor Alignment and the 20-mile Alignment, assuming the different GET surcharge revenue scenarios, described previously. Table 5-7 shows that for all three scenarios GET surcharge revenues and $1.2 Billion (YOE $) in New Starts funds would be insufficient to fund the Full-corridor Alignment project. Other sources of revenue would be needed, in addition. Table 5-8 shows that for both Council on Revenues scenarios, GET surcharge revenues and New Starts funds of less than $1.2 Billion would be sufficient to fund the 20-mile Alignment project. Additional revenue would be needed in the case of the Trend Forecast scenario.

Table 5-7. Sources and Uses of Funds - Full-corridor Alignment

	Trend Forecast		Council on Revenues 1		Council on Revenues 2	
	2006 $M	YOE[1] $M	2006 $M	YOE $M	2006 $M	YOE $M
Total Net GET Surcharge Revenues	2,626	3,520	3,018	4,056	3,185	4,310
New Starts Funds	933	1,200	934	1,200	934	1,200
Other Sources	1,234	1,586	860	1,106	717	922
Total Revenues	4,793	6,306	4,812	6,362	4,836	6,432
Fixed Guideway Capital Cost	4,621	5,943	4,621	5,943	4,621	5,943
Net Interest Costs	172	363	191	418	216	488
Total Cost	4,793	6,306	4,812	6,362	4,836	6,432

[1]YOE - year of expenditure
Amounts may not add up due to rounding.

Table 5-8. Sources and Uses of Funds - 20-mile Alignment

	Trend Forecast		Council on Revenues 1		Council on Revenues 2	
	2006 $M	YOE[1] $M	2006 $M	YOE $M	2006 $M	YOE $M
Total Net GET Surcharge Revenues	2,626	3,520	3,018	4,056	3,185	4,310
New Starts Funds	948	1,200	802	1,015	662	837
Other Sources	223	282	0	0	0	0
Total Revenues	3,797	5,002	3,820	5,071	3,847	5,147
Fixed Guideway Capital Cost	3,605	4,559	3,605	4,559	3,605	4,559
Net Interest Costs	192	443	216	511	243	587
Total Cost	3,797	5,002	3,820	5,071	3,847	5,147

[1]YOE - year of expenditure
Amounts may not add up due to rounding.

Cash Flow Table

An example of financing using a generic limited-duration loan debt structure is presented in Table 5-9. A cash flow table through 2022 is presented for the 20-mile Alignment East Kapolei to Ala Moana Center, with the Council on Revenue 1 revenue scenario. As shown, in 2007 and 2008 funds from the GET surcharge and FTA New Starts are greater than are needed for project expenditures, so the balance is deposited into a savings account. The savings account balance is drawn down over the following three years, 2009 to 2011. The total Transfer from Savings amount, $320 million, exceeds the

Deposit to Savings amount, $284 million, reflecting $36 million in interest earnings. Beginning in 2011, through 2016, loan proceeds of $1,378 million are used to supplement other revenue sources in completing the project. The loan principal is repaid in the period from 2017 to 2022. Financing costs are paid during the 2012 to 2022 period. These financing costs of $547 million, less the $36 million in interest earnings described above, total a net interest cost of $511, as shown in Table 5-8.

Financial Feasibility of the Capital Replacement and Operating Needs

Table 5-5 showed the estimated amount of Federal funds expected from the Section 5307 Urbanized Area Formula program, the Section 5309 Fixed Guideway Modernization program, and the Section 5309 Bus Discretionary program. These funds would be sufficient to meet expected bus replacement and capital expansion needs for all alternatives

Section 5307 funds are assumed to be used in priority for capital needs. Any surplus is then used for preventative maintenance, which is budgeted as an operating expense.

Four main sources of revenues are assumed in the financial feasibility assessment of the operating outlays:

- Fare box revenues
- Non-fare revenues, such as advertising and rental income
- FTA 5307 formula funds (for preventative maintenance)
- City operating support for Transit O&M.

Fare revenues were estimated by multiplying the current average fare, adjusted for inflation, by the number of expected riders. Table 5-10 shows the expected fare box recovery ratio for each alternative for FY 2007 and FY 2030. A City Council policy requires that the bus fare box recovery ratio is maintained between 27 and 33 percent of the total annual operating costs. As shown in the table, the TSM Alternative and the Managed Lane Alternative would not achieve this policy in FY 2030. The fare level could be raised and this could result in some temporary loss of patronage.

Non-fare revenues include advertising revenues and rental income. They were set to equal 1 percent of the annual fare revenues in order to reflect the synergy between the ability of the transit system to attract riders and advertising revenues.

Section 5307 funds are assumed to be used in priority for capital needs. Any surplus is then used for preventative maintenance, which is budgeted as an operating expense. The amount of funds available for preventative maintenance uses would vary by alternative. Those alternatives with larger bus capital requirements (Table 5-1) and fewer expected FTA revenues (Table 5-5), in particular the TSM Alternative and the Managed Lane Alternative, would require a larger portion of Section 5307 funds be spent on capital and would thus have a lesser amount available for preventative maintenance.

Table 5-9. Fixed Guideway 20-mile Alignment Cash Flow, Council on Revenues Scenario 1

Transaction	Year and amount in millions of year-of-expenditure dollars																
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
Capital Funding Sources																	
FTA New Starts	4	4	4	91	134	178	165	162	142	81	44	6	-	-	-	-	**1,015**
GET Surcharge	172	185	196	206	216	227	236	246	256	267	278	289	301	314	327	340	**4,056**
Transfer from Savings	-	-	118	81	120	-	-	-	-	-	-	-	-	-	-	-	**320**
Loan Proceeds	-	-	-	-	86	344	314	311	256	68	-	-	-	-	-	-	**1,378**
Total Sources	**176**	**189**	**318**	**378**	**556**	**749**	**715**	**719**	**654**	**416**	**322**	**295**	**301**	**314**	**327**	**340**	
Capital Outlays																	
Construction Costs	-	-	249	302	463	629	578	564	487	257	150	-	-	-	-	-	**3,680**
Soft Costs	40	41	69	76	92	110	106	106	101	81	32	25	-	-	-	-	**880**
Subtotal	*40*	*41*	*318*	*378*	*555*	*739*	*684*	*670*	*588*	*338*	*185*	*25*					***4,560***
Deposits to Savings	137	148	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**284**
Loan Principal Repayment	-	-	-	-	-	-	-	-	-	-	59	195	238	265	294	326	**1,378**
Financing Costs	-	-	-	-	-	10	30	48	66	78	81	75	63	49	32	15	**547**
Total Outlays	**176**	**189**	**318**	**378**	**556**	**749**	**715**	**719**	**654**	**416**	**322**	**295**	**301**	**314**	**327**	**340**	

Note: Amounts may not add up due to rounding.

Table 5-10. Average Fare Box Recovery Ratio and City Operating Support to Transit

Alternative	Fare Box Recovery Ratio		City Operating Support to Transit[1]	
	FY 2007	FY 2030	FY 2007	FY 2030
No Build Alternative	29%	28%	11%	13%
TSM Alternative	29%	24%	11%	18%
Managed Lanes Alternative - Reversible Option	29%	22%	11%	21%
Full Length Fixed Guideway Alternative, Kalaeloa - Airport - Dillingham - Halekauwila alignment	29%	29%	11%	14%
20-Mile Fixed Guideway Alignment East Kapolei to Ala Moana Center	29%	28%	11%	15%

[1]Transit operating subsidy as a percentage of total General Fund and Highway Fund revenues.

The final funding source available for O&M expenses are funds from the Highway Fund and General Fund. As shown in Table 5-10, the TSM Alternative and the Managed Lane Alternative would require the largest percentage subsidy from the City's operating budget.

Risks and Uncertainties

The foregoing analysis has discussed the financial feasibility of implementing the various alternatives, given current cost and revenue estimates. However, uncertainties around key economic and financial factors remain, and the City will have to take the necessary steps in order to mitigate those risks as much as possible.

Economic Risk

Economic risks include such factors as the inflation rate and the vitality of the general economy. An increase in inflation beyond current expectations would result in increased costs for all alternatives, including capital costs, financing costs, and O&M costs. On the other hand, key revenue sources, including the GET surcharge and several of the City's General Fund and Highway Fund revenue sources, would likely experience additional growth with an increase in inflation rates. A downturn in the economy would negatively affect revenues from tax collection on the island but could also result in a slowing in the growth of construction costs.

Level of FTA Funds

The level of FTA funds is subject to annual appropriations and program reauthorizations approximately every six years. The analyses assume that future FTA funding levels will have the same growth trends as in the recent past. Future reauthorization legislation may result in different growth levels. Additionally, all projects following FTA's New Starts process compete for a limited amount of New Starts funds. The total amount of New Starts funds pledged to a project is not finalized until just prior to entering into a Full Funding Grant Agreement.

Construction Risk

Scheduling delays, world market conditions, the availability of skilled labor, and unforeseen construction challenges can lead to cost increases that may challenge the financial feasibility of the project. The capital cost estimates include contingencies, both those allocated to specific cost elements and an overall project reserve amount, which add approximately 33% to the cost estimate, in year 2006 dollars. The financial analysis also makes assumptions concerning construction cost inflation. During the 1990s, construction cost escalation consistently trailed the general rate of inflation. In the early 2000s, due to world market conditions and storm impacts, that situation was reversed, with construction costs growing more rapidly than the general rate of inflation. This analysis assumes that construction costs will continue to grow more rapidly than the general rate of inflation through 2008, then will grow at the general rate of inflation.

Chapter 6 Comparison of Alternatives

Optimum Alternatives

Several options were evaluated within the Managed Lane and Fixed Guideway Alternatives. Over the course of the analysis presented in Chapter 3 through Chapter 5, the relative merits of the various operational and alignment options became clear. This section compares the various options and selects the optimum Managed Lane and Fixed Guideway option for comparison between all of the alternatives later in this chapter.

Managed Lane Alternative

Two options were evaluated for the Managed Lane Alternative: a Reversible Option and a Two-direction Option. The Two-direction Option would allow express buses to use the managed lane roadway in both directions throughout the day; however, the difference in transit benefit would be very small. Travel times in the corridor are similar for both options, with each option showing a one or two minute advantage between some locations. Comparison of environmental impacts between the options shows small trade-offs, but neither option is substantially better than the other.

Project costs are the greatest differentiator between the options. At $2.5 billion (in 2006 dollars), the Reversible Option would be nearly 30 percent less expensive than the Two-direction Option. The lower cost and similar performance between the two options results in better cost-effectiveness for the Reversible Option (Table 6-1). Because the performance differences between the two options would be small, the Reversible Option would offer a better benefit-to-cost ratio; therefore, it would be the optimum Managed Lane option. The evaluation of the Managed Lane Alternative that appears later in this chapter considers the Reversible Option only.

Fixed Guideway Alternative

The various alignment options would provide a range of benefits, impacts, and costs within each corridor section evaluated for the Fixed Guideway Alternative. The alignment options are compared by section below. The comparison results in an optimum alignment of Saratoga Avenue/North-South Road to Farrington Highway/Kamehameha Highway to Aolele Street to Dillingham Boulevard to Nimitz Highway/Halekauwila Street/Kapiʻolani Boulevard (Kalaeloa - Airport - Dillingham - Halekauwila combination). The evaluation of the Fixed Guideway Alternative that appears later in this chapter considers this combination of alignments only.

Table 6-1. Transportation System Costs and Transit User Benefits Compared to No Build

Measure	No Build Alternative	TSM Alternative		Managed Lane Alternative: Two-Direction Option		Managed Lane Alternative: Reversible Option		Fixed Guideway Alternative: Kalaeloa - Salt Lake - North King - Hotel		Fixed Guideway Alternative: Kamokila - Airport - Dillingham - King with a Waikīkī Branch		Fixed Guideway Alternative: Kalaeloa - Airport - Dillingham - Halekauwila		Fixed Guideway Alternative: 20-mile Alignment East Kapolei to Ala Moana Center	
		Value	Incremental Change	Value	Incremental Change	Value	Incremental Change	Value	Incremental Change	Value	Incremental Change	Value	Incremental Change	Value	Incremental Change
Annualized Capital Cost (Millions 2006 Dollars)	$43.52	$59.80	$16.28	$335.14	$291.62	$257.87	$214.35	$387.31	$343.79	$445.73	$402.21	$380.66	$337.14	$308.23	$264.71
Year 2030 Systemwide O&M Cost (Millions 2006 Dollars)	$191.90	$234.20	$42.30	$250.90	$59.00	$261.10	$69.20	$248.20	$56.30	$248.60	$56.70	$256.10	$64.20	$250.60	$58.70
Total 2030 Annualized Cost (Millions 2006 Dollars)	$235.42	$294.00	$58.58	$586.04	$350.62	$518.97	$283.55	$635.51	$400.09	$694.33	$458.91	$636.76	$401.34	$558.83	$323.41
Year 2030 Incremental User Benefits (Hours of Benefit)	N/A	N/A	4,325,100	N/A	5,528,500	N/A	5,632,700	N/A	18,770,200	N/A	16,963,900	N/A	18,573,900	N/A	15,153,600
Cost-Effectiveness (Cost per User Benefit)	N/A	N/A	$13.54	N/A	$63.42	N/A	$50.34	N/A	$21.32	N/A	$27.05	N/A	$21.61	N/A	$21.34

N/A = Not Applicable. Transit user benefits are calculated relative to the performance of the No Build Alternative.

Section I. Kapolei to Fort Weaver Road

In Section I, the Saratoga Avenue/North-South Road alignment would be of greatest benefit to transit riders, allowing walking access to the greatest number of transit riders in 2030. Also, by providing a park-and-ride and bus transfer station in Kalaeloa, it would provide better connections to ʻEwa Beach than either the Kapolei Parkway/North-South Road or Kamokila Boulevard/Farrington Highway alignment. The Kamokila Boulevard/Farrington Highway alignment would provide the fewest benefits to transit riders.

Considering environmental factors, the Saratoga Avenue/North-South Road alignment would have the fewest noise impacts. Overall, fewer social and environmental impacts would occur in Section I than in other portions of the corridor, and the alignments are not greatly differentiated by other elements of the environment.

The Geiger Road/Fort Weaver Road alignment would be the most expensive at $850 million. The Saratoga Avenue/North-South Road and Kapolei Parkway/North-South Road alignments are in the middle at $820 million and $790 million, respectively. The Kamokila Boulevard/Farrington Highway alignment would be the least expensive at $670 million.

Because the Saratoga Avenue/North-South Road alignment would provide the best transportation and environmental benefits, while ranking in the middle of the cost range, it would be the best alignment option within Section I.

Section II. Fort Weaver Road to Aloha Stadium

No comparison is made in this section because only one alignment along Farrington and Kamehameha Highways was identified as a feasible option.

Section III. Aloha Stadium to Middle Street

In Section III, the Makai of the Airport Viaduct and Aolele Street alignments would provide the greatest benefits to transit riders. The fewest number of riders would use the Mauka of the Airport Viaduct alignment.

The greatest number of noise impacts within the entire study corridor would occur along the Salt Lake Boulevard alignment. Fewer properties would need to be acquired for the Aolele Street alignment than by the Makai of the Airport Viaduct alignment.

The Salt Lake Boulevard Alignment would be the least expensive, followed by the Aolele Street alignment.

Because the Aolele Street alignment would provide the best transportation benefit and would be the second-least-expensive option, it would be the best alignment option within Section III.

Section IV. Middle Street to Iwilei

A greater number of transit riders would use the Dillingham alignment compared to the North King Street alignment.

The Dillingham alignment would require more property acquisitions; however, fewer would be residential parcels. More noise impacts would occur and a greater number of potentially historic properties is located along the North King Street alignment.

When connecting to the Section III alignments at Nimitz Highway, the Dillingham alignment would cost less at $400 million than the North King Street alignment at $450 million.

The Dillingham alignment would be the best alignment option within Section IV.

Section V. Iwilei to UH Mānoa

Section V is the most complex area within the study corridor. The Beretania Street/South King Street alignment would serve substantially fewer transit riders than the other alignments.

The Hotel Street/Kawaiaha'o Street/Kapi'olani Boulevard alignment would require acquisition of the greatest number of residential parcels and affect a greater number of cultural practices and the greatest number of burials of any alignment within the study corridor.

The King Street Tunnel alignment is the most expensive alignment within the study corridor at $1.9 billion. The Queen Street alignment would be least expensive at $1.15 billion, followed by the Halekauwila Street alignment at 1.23 billion.

While the Waikīkī Branch would provide considerable additional benefits to transit riders and have environmental consequences comparable to the other alignments considered, it would add $350 million to the cost of the project.

Three alignments rank poorly in the areas of transportation benefits, environmental consequences, and costs. The Beretania Street/South King Street alignment provides poor transit benefits. The Hotel Street/Kawaiaha'o Street/Kapi'olani Boulevard alignment would create substantial environmental impacts compared to the other alignments. The King Street Tunnel/Waimanu Street/Kapi'olani Boulevard alignment would cost over $500 million more than the least expensive alignment.

The remaining alignments, Nimitz Highway/Queen Street/Kapi'olani Boulevard and Nimitz Highway/Halekauwila Street/Kapi'olani Boulevard would have similar transportation benefits. The Queen Street alignment would have somewhat greater negative visual impact because the narrow available right-of-way would require a stacked alignment in the Downtown area and because it would cross between Hale Auhau and the rest of the Hawai'i Capital Historic District.

The Nimitz Highway/Halekauwila Street/Kapi‘olani Boulevard alignment would be the best alignment option within Section V. The Waikīkī Branch is not included because of the cost that it would add to the project.

Twenty-mile Alignment

As discussed in Chapter 2, the FTA guidance recommends evaluation of one or more options of various lengths within the study corridor to provide intermediate-cost alternatives within an AA.

Several portions of the corridor could be selected within the Kalaeloa - Airport - Dillingham - Halekauwila Alignment; however, the 20-mile Alignment should be able to provide substantial benefit to transit users independent of the remainder of the system under long-range consideration. As indicated by the financial analysis presented in Chapter 5, identified funding sources may be reasonably expected to generate approximately $3.6 billion to support the project.

The project that would serve as much of the study corridor as practical and provide the greatest user benefit within $3.6 billion would be the section that begins at one station makai of UH West O‘ahu and continues Koko Head following Farrington Highway/Kamehameha Highway to Aolele Street and Dillingham Boulevard, and then continues elevated following Nimitz Highway to Ala Moana Center.

Effectiveness at Meeting Goals and Objectives

Improve Corridor Mobility

The No Build and TSM Alternatives would continue to serve the study corridor with bus service. Transit would serve 6.1 percent of daily trips for the No Build Alternative and 6.4 percent of daily trips with the TSM Alternative (Table 3-3). Daily vehicle miles traveled and vehicle hours of delay, a measure of time lost to traffic congestion, would increase substantially compared to today (Table 3-10). During the a.m. peak-period, travel times on transit would remain similar to today or decrease slightly because of increased transit service, while auto travel times would increase in the corridor (Table 3-6). Transit reliability would continue to be affected by roadway conditions.

The Managed Lane Alternative would provide transit service similar to the TSM Alternative, only with an additional roadway facility for express service in a portion of the corridor. Transit would serve 6.4 percent of daily trips, similar to the TSM Alternative (Table 3-3). Daily vehicle miles traveled and vehicle hours of delay, a measure of time lost to traffic congestion, would increase substantially compared to today and would be similar to the No Build Alternative (Table 3-10). During the a.m. peak-period, travel times on transit would be similar to the No Build Alternative (Table 3-6). Transit reliability would continue to be affected by roadway conditions when operating outside of the managed lane.

The Fixed Guideway Alternative would provide a new transit option for reliable transit travel in the study corridor. Transit would serve 7.7 percent of daily trips for the Full-corridor Alignment and 7.4 percent of daily trips with the 20-mile Alignment (Table 3-3).

During peak-periods, the transit share would be even higher, with 16.2 percent of home-based work trips served by transit for the Full-corridor Alignment and 15.2 percent with the 20-mile Alignment (Table 3-4). Daily vehicle miles traveled and vehicle hours of delay, a measure of time lost to traffic congestion, would be less than for the No Build Alternative (Table 3-10). Daily vehicle miles traveled would be 3.4 percent less for the Full-corridor Alignment and 3.1 percent less with the 20-mile Alignment. Daily vehicle hours of delay would be 18 percent less for the Full-corridor Alignment and 11 percent less with the 20-mile Alignment; this represents a substantial reduction in traffic congestion compared to the No Build Alternative in 2030. During the a.m. peak-period, travel times on transit would be substantially reduced for several travel routes compared to the No Build Alternative (Table 3-6).

Encourage Patterns of Smart Growth and Economic Development

The No Build and TSM Alternatives would continue to serve the study corridor with bus service. Neither alternative would provide concentrations of transit service that would serve as a nucleus for transit-oriented development.

The Managed Lane Alternative would provide similar transit service to the TSM Alternative, with an additional roadway facility for express service in a portion of the corridor. It would not further encourage smart growth compared to the TSM Alternative. Daily vehicle miles traveled would be greater for the Managed Lane Alternative than for any other alternative (Table 3-10).

The Fixed Guideway Alternative is the only alternative that would include new stations providing reliable high-capacity transit at locations zoned for new development or suitable for redevelopment. With supportive regulations, substantial transit-oriented development could be served by the Fixed Guideway Alternative. Because the Full-corridor Alignment would better serve Kapolei, it would provide more opportunity for smart growth and transit-oriented economic development than the 20-mile Alignment.

Find Cost-Effective Solutions

User benefits have been defined by FTA as a measure of transit user time savings calculated in comparison to the TSM Alternative. The Managed Lane Alternative would provide approximately 2 million hours of user benefits annually at an annualized incremental cost compared to the TSM Alternative of approximately $225 million (Table 6-2). This reflects a cost of approximately $103 per hour of transit user benefit gained. The Fixed Guideway Alternative would provide approximately 16 and 12 million hours of user benefits annually at an annualized incremental cost of approximately $343 and $265 million for the Full-corridor Alignment and 20-mile Alignment, respectively (Table 6-2). This reflects a cost of between $22 and $23 per transit user benefit gained with the Fixed Guideway Alternative. The Fixed Guideway Alternative is approximately four times as effective at providing transit user benefits per annualized incremental dollar cost as the Managed Lane Alternative.

Table 6-2. Incremental Cost per Hour of Transportation System User Benefits Compared to TSM Alternative

Measure	TSM Alternative	Managed Lane Alternative		Fixed Guideway Alternative: Full-corridor Alignment		Fixed Guideway Alternative: 20-mile Alignment East Kapolei to Ala Moana Center	
		Value	Incremental Change compared to TSM	Value	Incremental Change compared to TSM	Value	Incremental Change compared to TSM
Annualized Capital Cost (2006 Dollars)	$59,797,000	$257,868,000	$198,073,000	$380,658,000	$320,863,000	$308,228,000	$248,433,000
Year 2030 Systemwide O&M Cost (2006 Dollars)	$234,200,000	$261,100,000	$26,900,000	$256,100,000	$21,900,000	$250,600,000	$16,400,000
Total 2030 Annualized Cost (2006 Dollars)	$293,997,000	$518,968,000	$224,973,000	$636,758,000	$342,763,000	$558,828,000	$264,833,000
Year 2030 Incremental User Benefits (Hours of Benefit)	N/A	N/A	2,191,900	N/A	15,504,500	N/A	11,638,500
Cost Effectiveness (Cost per Hour of User Benefit)	N/A	N/A	$102.64	N/A	$22.11	N/A	$22.75

N/A = Not Applicable. User benefits are calculated relative to the performance of the TSM Alternative.

Provide Equitable Solutions

The No Build and TSM Alternatives generally maintain the status quo, serving transit-dependent communities with bus service that is increasingly affected by traffic congestion (Figure 1-6).

Transit use would increase somewhat with the Managed Lane Alternative; however, it would not substantially improve service or access to transit for transit-dependent communities, as buses that use existing HOV facilities would be routed to the managed lane facility but would continue to be affected by congestion in other parts of their routes. Arterial congestion would increase in the study corridor with the Managed Lane Alternative, making bus access to the managed lanes less reliable.

The Fixed Guideway Alternative would provide a new travel option to all travelers in the study corridor. The substantial concentration of transit-dependent communities (Figure 1-5) would have access to reliable transit in the study corridor, and shortened bus routes serving transit stations would provide more reliable service because their routes would be shorter and less affected by islandwide congestion. Also, overall congestion, as measured in daily hours of traffic delay (Table 3-10), would be less for the Fixed Guideway Alternative than for any of the other alternatives. The Full-corridor Alignment would provide proportionately greater benefit than the 20-mile Alignment.

Develop Feasible Solutions

The No Build and TSM Alternatives do not include major construction. Both the Managed Lane and Fixed Guideway Alternatives include areas where construction would be difficult, but neither one would rely on extreme or unproven construction methods. In general, the managed lane structure is wider, requiring larger foundations, and would disturb more traffic lanes during construction. It also includes construction of ramps to H-1 and H-2; maintenance of traffic during construction is more complex when working on a freeway. In the vicinity of the airport, placement of the roadway sections would be difficult because of limited working space and high-voltage transmission lines mauka of the H-1 viaduct. Nimitz Highway has sufficient space, but traffic volumes, particularly truck volumes are high and construction would require closure of the contra-flow lane.

For the Fixed Guideway Alternative, construction in the ‘Ewa area would be relatively simple. Between the Waiawa Interchange and the airport area, construction issues would be similar to the Managed Lane Alternative, except the magnitude of impacts would be less because the foundation and working space requirements are less. In the vicinity of the airport, construction along Aolele Street would be substantially easier than it would be for the Managed Lane Alternative. High-voltage transmission lines and limited working space are concerns along Dillingham Boulevard, but lower traffic volumes compared to Nimitz Highway partially compensate for these challenges. In the Downtown to UH Mānoa area, underground utilities and traffic congestion would present challenges, but they would not be any more difficult than those for construction of the segment from Pearl City to Downtown. Limited working space on Kona Street would slow construction, but it would be manageable.

Minimize Community and Environmental Impacts

The No Build and TSM Alternatives would generate no direct environmental impacts; however, they would also not generate any environmental benefits.

The Managed Lane Alternative would require a moderate number of displacements and would affect a moderate number of potentially historic structures, as well as one recreational facility. It would generate the greatest amount of air pollution, require the greatest amount of energy for transportation use, and would result in the largest number of transportation noise impacts. It would provide little community benefit, as it would not provide substantially improved transit access to the corridor.

The Fixed Guideway Alternative would require more displacements and affect more potentially historic structures, as well as three park or recreational facilities. It would result in fewer transportation noise impacts than the Managed Lane Alternative.

Visual impacts for the Fixed Guideway Alternative would be less than those for the Managed Lane Alternative in areas where both alternatives would include structures, but the Fixed Guideway Alternative would extend beyond the area of the Managed Lane Alternative. The visual impacts of the 20-mile Alignment would be less than for the Full-corridor Alignment because the area of effect would be less.

The Fixed Guideway Alternative would generate the least air pollution and require the least energy for transportation. It would provide improved connections between communities, employment, and services in the corridor. The benefits of the Full-corridor Alignment would be somewhat greater than those for the 20-mile Alignment.

Achieve Consistency with Other Planning Efforts

All alternatives are generally consistent with Local, District, and State plans. The Fixed Guideway Alternative best serves the areas of O'ahu that are designated for future growth and development. The Fixed Guideway Alternative is the only alternative that is consistent with regional transportation system planning defined in the *2030 O'ahu Regional Transportation Plan* (OMPO, 2006a).

Comparison of Benefits and Consequences among the Alternatives

Table 6-3 compares each of the alternatives in relation to the project goals and objectives listed in Table 1-2. The Fixed Guideway Alternative performs the best when considering all of the objectives related to the goal of improving corridor mobility. The Full-corridor Alignment provides additional transportation benefits relative to the 20-mile Alignment; however, the 20-mile Alignment is more effective at providing improved mobility than any of the other three alternatives.

In relation to encouraging patterns of smart growth and economic development, the No Build, TSM, and Managed Lane Alternatives generally maintain existing transit service patterns and methods. None of these alternatives would provide concentrations of transit service that would serve as a nucleus for transit-oriented development. The Fixed Guideway Alternative would include new stations providing reliable high-capacity transit at locations zoned for new development or suitable for redevelopment. The Full-corridor Alignment would provide the greatest opportunity for smart growth, but considerable opportunities also would occur with the 20-mile Alignment.

The Fixed Guideway Alternative is substantially more cost-effective than the Managed Lane Alternative when the respective cost per transit user benefit relative to the TSM Alternative are compared (Table 6-2).

The Fixed Guideway Alternative best meets the goal of providing equitable solutions. The Full-corridor Alignment would best serve transit-dependent populations, but the 20-mile Alignment would serve the majority of those served by the Full-corridor Alignment.

The No Build and Fixed Guideway Alternatives are financially feasible considering reasonably certain funding sources. The No Build Alternative would continue bus service using existing funding mechanisms. The TSM Alternative would require a limited amount of additional funds, but the source of those funds is not defined. Because the implementing legislation prohibits the GET surcharge from being used to fund existing transit systems, it would not be available to fund the TSM Alternative. The Managed Lane Alternative has no defined funding source. Because it would be open to general purpose vehicles, neither the GET surcharge nor FTA funds could be used for its construction. The toll revenues would cover only 23 percent of the total debt service and the remaining 77 percent would need to come from other sources that are not available at this time. The 20-mile Alignment for the Fixed Guideway Alternative could be funded with a combination of expected GET revenues and FTA New Starts funds. There is more uncertainty in funding of the Full-corridor Alignment. Additional local or FTA funds beyond those that have specifically been identified would be required for completion of the Full-corridor Alignment.

The alternatives range widely in relation to community and environmental impacts. The No Build and TSM Alternatives would have little direct effect on existing resources; however, they also would not offer community or environmental benefits. The Managed Lane Alternative would require acquisition of private property, generate the highest levels of air and water pollution, consume the greatest amount of transportation energy, and create the greatest number of noise impacts. The Fixed Guideway Alternative would require the greatest number or property acquisitions and have the greatest number of utility conflicts, but it would also provide a new safe transportation connection between communities in the corridor. The small amount of on-street parking taken by the Fixed Guideway Alternative would be more than compensated by the resulting reduction in corridor parking demand as a consequence of fewer automobile trips. It would provide the greatest environmental benefits related to air and water pollution and energy consumption.

Table 6-3. Effectiveness of Alternatives at Meeting Goals and Objectives in the Year 2030

Objective	Evaluation Measure	Alternative 1 No Build Alternative	Alternative 2 TSM Alternative	Alternative 3 Managed Lane Alternative	Alternative 4: Fixed Guideway Full-corridor Alignment	Alternative 4: Fixed Guideway 20-mile Alignment East Kapolei to Ala Moana Center
Reduce corridor travel times	Reduction in transit travel times	-	9% reduction	3% reduction	14% reduction	17% reduction
	Total daily transit travel time savings (person hours)	-	14,000	18,000	60,000	49,000
	Reduction in daily vehicle hours of travel delay	-	2% reduction	1% increase	18% reduction	11% reduction
Improve corridor travel time reliability	Miles of alternative's alignment in exclusive right-of-way	0	0	16 miles	28 miles	20 miles
Provide convenient, attractive and effective transit service within the corridor	Increase in transit mode share	-	5% increase	7% increase	26% increase	21% increase
	Total daily transit trips	232,100	243,100	244,400	294,100	281,900
	Total daily new riders	-	11,900	16,400	60,700	49,000
	Reduction in daily vehicle trips	-	10,200	14,900	59,600	48,000
Provide transit corridor travel times competitive with auto travel times	Comparison of transit with auto travel times	22% increase	12% increase	19% increase	5% increase	2% increase
Maximize the number of persons within convenient access range of transit	Employees within one-half mile of stations	0	0	0	443,800	315,900
	Population within one-half mile of stations	0	0	0	364,400	214,400
Encourage transit-oriented development in existing and new growth areas	Potential for transit-oriented development	○	○	○	●	◕
Integrate transit with designated higher density development areas	Degree to which the alternative serves existing and planned higher density developments	○	○	○	◕	◑
Support economic development of major regional economic centers	Thousands of residents within 30 minutes travel by transit to Downtown Honolulu	215	219	218	235	226
	Thousands of residents within 30 minutes travel by transit to Kapolei	67	82	99	109	98
Provide solutions with benefits commensurate with their costs	Incremental annualized cost per user benefit (compared to TSM Alternative)	N/A	N/A	$102.64	$22.11	$22.75
Provide solutions that meet the project purpose and need while minimizing total costs	Total capital costs (2006 dollars)	0	0	$2.6 billion	$4.6 billion	$3.6 billion
	Annual operation and maintenance costs	$192 million	$234 million	$261 million	$256 million	$251 million
	Incremental annualized cost per new rider(compared to TSM)	N/A	N/A	$562	$22	$22
Improve transit operating efficiency	Operating cost per transit passenger mile	$0.35	$0.40	$0.47	$0.33	$0.35
Avoid disproportionate impacts on low income and minority population groups	Full or partial acquisitions to low income and minority communities	0	0	17	60	54
Provide effective transit options to transit-dependent communities	Number of transit trips originating from transit-dependent communities	56,000	57,200	58,000	60,300	59,800
The cost of building, operating, and maintaining the alternative is within the range of likely available funding	Degree to which the amount of funding required to build the alternative system is attainable	●	●	○	◑	●
	Proposed share of total project costs from sources other than New Starts Section 5309 funds	100%	100%	100%	66%	82%
	Ability to operate and maintain the transit system after it is built	●	◑	◑	◕	◕
Construction of the alternative is feasible in terms of constructability and ROW availability	High rating = standard construction/low degree of risk and known available ROW Low rating = unique or difficult construction/high degree of risk and ROW availability uncertain or doubtful	●	●	◑	◑	◕
Minimize impacts on natural and cultural resources	Use of land including natural areas and parklands	0	0	2	3	3
	Proximity to historic resources	0	0	30	82	70

Note: ○ = Lowest benefit or greatest impact, ● = Highest benefit or least impact

Objective	Evaluation Measure	Alternative 1 No Build Alternative	Alternative 2 TSM Alternative	Alternative 3 Managed Lane Alternative	Alternative 4: Fixed Guideway Full-corridor Alignment	Alternative 4: Fixed Guideway 20-mile Alignment East Kapolei to Ala Moana Center
Minimize the effect on homes and businesses	Number of full or partial acquisitions of residential or commercial parcels	0	0	31	90	79
Minimize disruption to traffic operations	Degree of physical roadway impacts	●	●	◕	◔	◑
Minimize conflicts with utilities	Degree to which utilities need to be relocated (relocation cost)	0	0	$220 million	$530 million	$460 million
Minimize construction impacts	Daily vehicle miles traveled impacted by construction of the alternative	-	-	670,000	631,000	524,000
	Impact to access to businesses and residences during construction	●	●	◑	○	◔
	Duration of construction impacts	-	-	6 to 8 years	8 to 10 years	7 to 9 years
Minimize impacts to community and community amenities	Community facilities/resources affected	0	0	0	8	5
	Impacts to parking	◔	◑	◑	●	◕
	Number of noise impacts to residences	0	0	260	200	170
	Visual impacts/view corridors affected	●	◕	◔	○	◔
Reduce energy consumption	Reduction in regional transportation-related energy consumption	N/A	◕	○	●	◕
Achieve consistency with adopted plans	Degree of consistency with adopted plans	◑	◑	◑	●	◕

Note: ○ = Lowest benefit or greatest impact; ● = Highest benefit or least impact

All alternatives are generally consistent with Local, District, and State plans. The Fixed Guideway Alternative best serves the areas of O'ahu that are designated for future growth and development. It is also the only alternative that is consistent with regional transportation system planning defined in the *2030 O'ahu Regional Transportation Plan* (OMPO, 2006a).

The general public in Honolulu is very concerned about transportation. In the *Honolulu Advertiser* Hawai'i Poll conducted in June 2006, traffic was identified by most respondents as the most important issue currently facing Hawai'i (Honolulu *Advertiser*, 2006). While preparing the *2030 O'ahu Regional Transportation Plan*, OMPO conducted a telephone survey of O'ahu residents to gauge public reaction to transportation solutions (OMPO, 2006b). More than 50 percent of the respondents said that they would use rapid transit regularly or occasionally.

Scoping conducted for the Honolulu High-Capacity Transit Corridor Project also indicated broad interest and a majority of support for the project. The majority of comments received during scoping related to a preference for one of the alternatives or a proposed modification to one of the alternatives. These comments are documented in the *Honolulu High-Capacity Transit Corridor Project Scoping Report* (DTS, 2006d). As a result of public comments, moderating the growth in traffic congestion was added to the purpose and need, a second Managed Lane option was added, and the presentation of the Fixed Guideway Alternative was changed.

Important Trade-offs

The greatest trade-off among the alternatives is between the transportation benefit provided and the cost to implement the alternative. The TSM Alternative provides little benefit, but it does so at a very low cost. The Managed Lane Alternative provides slightly more benefit, but at a substantial cost. While the Fixed Guideway Alternative would have the highest cost, it is also the only alternative that would provide a substantial transportation benefit, measured both by the benefit to transit users and in the reduction in congestion compared to the No Build Alternative.

Other trade-offs are related to environmental and social resources. Again, the No Build and TSM Alternatives would provide few benefits, but also would have the least number of impacts. The Managed Lane Alternative would require property acquisitions, have visual and noise impacts, and affect historic and cultural resources along its alignment. The Fixed Guideway Alternative generally would have similar but reduced environmental effects compared to the Managed Lane Alternative, but they would extend for a greater distance in the corridor. These environmental impacts should be compared to the benefits of reduced air and water pollution and energy consumption and the increased social connectivity provided by the system.

Chapter 7 Coordination and Consultation

Public Involvement

A public involvement process was undertaken to inform the citizens of O'ahu about the Honolulu High-Capacity Transit Corridor Project. The public involvement process had two goals: (1) to provide meaningful information throughout the project development process and (2) to solicit and record the public's views on key issues. Public information materials explained the alternatives considered and how they would affect residents in the corridor and throughout O'ahu. Additionally, the public involvement process solicited public input, promoted dialogue, addressed community concerns, and supported selection of a Locally Preferred Alternative that would best meet the needs of the citizens of O'ahu.

The public involvement process was designed to complement the technical flow of work while making every effort to inform and engage key stakeholders, property owners, policy makers, and the general public, especially those who live or work along the proposed alignments. The public involvement process included the following:

- Educating the public and keeping them up-to-date about project progress;
- Collecting and addressing community concerns;
- Building on the public participation programs from previous corridor projects;
- Planning public involvement efforts in cooperation with the Mayor and City staff; and
- Using the news media, community groups, neighborhood associations, and other resources within the corridor and throughout O'ahu.

These goals of the public involvement process were addressed through a multi-media, multi-avenue campaign to reach as many O'ahu citizens as possible. The following list highlights specific efforts:

- Community and civic group outreach via a speakers bureau and regularly scheduled community updates;
- Specific informational updates for individual communities in the corridor focused on the effects of the various alternatives and alignments on that localized community;
- Targeted information campaign for government officials;
- Continual public information dissemination in collaboration with the news media;
- Regularly updated website containing project details and reports;
- Bi-monthly newsletters sent to the project mailing list; and
- Rapid response plan to provide follow-up and documentation for every comment and a response to every question.

Scoping Meetings

Public scoping meetings were held at two locations within the study corridor. They were conducted in an open-house format that presented the purpose of and need for the project, proposed project alternatives, and scope of analysis to be included in the Alternatives

Analysis (AA) and future draft Environmental Impact Statement. The meetings allowed members of the public to ask individual questions of project staff and provided an opportunity for the public to provide written testimony or oral testimony, recorded by court reporters.

The first scoping meeting was at the Neal S. Blaisdell Center, Pīkake Room, 777 Ward Avenue on December 13, 2005, from 5 p.m. to 8 p.m. and was attended by approximately 450 people. The second meeting was at the Kapolei Middle School Cafeteria, 91-5335 Kapolei Parkway on December 14, 2005, from 7 p.m. to 9 p.m. and was attended by approximately 200 people. The large attendance at these meetings was a result of the project's substantial media and community outreach efforts, which included targeted outreach to underrepresented non-English speaking populations.

Comments received during the scoping process resulted in several changes to the alternatives being evaluated, including adding a second Managed Lane option and presenting the Fixed Guideway Alternative by section to allow for a simpler comparison of various alignment options in different portions of the study corridor. Also, an elevated alignment along Halekauwila Street was added to the range of alternatives being considered. The scoping process is presented in detail in the *Honolulu High-Capacity Transit Corridor Project Scoping Report* (DTS, 2006d).

Speakers Bureau

The Honolulu High-Capacity Transit Corridor Project's public outreach program is centered on a grassroots-oriented Speakers Bureau, staffed by technical professionals. This approach was developed considering the "local style", where "talking story" continues to be a socially important means of conveying information. . The speakers were formally trained and then briefed on a continuing basis as new information emerged. Between project scoping and completion of the AA, the speakers bureau addressed groups ranging from backyard gatherings and student brown-bags of fewer than ten people, to meetings of senior citizens and community organizations of between 50 and 100 people, and to Chamber of Commerce and professional association meetings with over 200 people. In total, the speakers bureau provided 179 presentations that were attended by an estimated 4,300 individuals.

This approach provided broad public involvement through established civic and professional organizations in a more informal "talk-story" grassroots manner. It is believed that this approach reached many members of the public who would not have been reached by a more traditionally structured outreach approach.

While the ultimate goal of the speakers bureau was to raise public awareness and engage the community in advance of the City Council's selection of a preferred transportation alternative for Honolulu, these community briefings were also used to gain a better understanding of the varying perspectives of the general population. When appropriate, these perspectives were incorporated into the planning process.

Targeted Audiences

While the speakers bureau actively targeted established community and civic groups, social groups, neighborhood boards and associations, business and professional organizations, environmental groups and transportation groups, it was equally active in searching for less formal speaking opportunities. The speakers bureau was publicized at organized community meetings, and on the project website.

The Program

A standard Powerpoint presentation, which was updated regularly, was developed. Speakers were selected to match anticipated audiences and encouraged to customize their presentations to the audience as well.

At every presentation, sign-in sheets were circulated and comments, perspectives and concerns were documented and then made available to all transit team members. Those who placed their names on the sign-in sheets were added to the project mailing list for project newsletters and other announcements.

Note takers accompanied speakers, compiled summaries of concerns and questions, and recorded the demographics of the audience. These summaries were often used to update a list of Frequently Asked Questions, which is published on the project website. Comments and questions were also used to determine the content for the newsletters.

Community Updates

In addition to the speakers bureau presentations, 13 informational meetings were conducted at locations throughout O'ahu (Table 7-1). At these meetings, the Mayor, technical staff and consultants presented updated technical information about the project and the status of the Alternatives Analysis. Approximately 850 people attended these meetings.

Each meeting lasted approximately one and a half hours and began by providing the public with an opportunity to interact with technical staff at five stations located throughout the room. This was followed by a formal presentation on the status of the project and a question and answer period. Participants were then encouraged to return to the stations for further interaction.

Sign-in sheets were made available to register for the bi-monthly *Honolulu On The Move* newsletter, e-newsletter and other project announcements. Note takers documented the question and answer session between the public, the Mayor and the project team.

Table 7-1. Islandwide Community Updates

Date	Location	Attendance
June 24, 2006	Kapolei Hale	Approx. 100
June 26, 2006	Honolulu Hale – Mission Memorial Auditorium	Approx. 160
June 28, 2006	Āliamanu Middle School	Approx. 90
August 8, 2006	Mililani High School	Approx. 100
August 14, 2006	Kalani High School	Approx. 30
August 28, 2006	Farrington High School	Approx. 30
Sept. 18, 2006	University of Hawai'i	Approx. 200
Sept. 18, 2006	Waipahu Community	Approx. 30
Sept. 19, 2006	'Ewa Community	Approx. 30
Sept. 20, 2006	Pearl City/'Aiea	Approx. 50
Oct. 24, 2006	*Windward*	Approx. 30
Oct. 30, 2006	*Wai'anae*	Not completed at time of writing.

City & County of Honolulu Neighborhood Boards

In addition to the speakers bureau and the islandwide updates, the neighborhood boards within the project corridor were regularly briefed between January and November 2006. A representative from the public involvement team regularly attended board meetings to report and comment on the status of the Alternative Analysis and to answer questions from the boards. Public involvement team representatives also regularly attended the Mililani and Mililani Mauka Neighborhood Boards, which are outside the corridor. These boards and all other neighborhood boards received formal presentations upon request.

Newsletters

Honolulu On The Move, the project bi-monthly newsletter, provided the public with detailed information on project issues and milestones. A total of seven newsletters were published between December 2005 and November 2006. The U.S. Postal Service bulk mail service was the primary distribution vehicle; reaching nearly 20,000 households and businesses islandwide with each issue. More than 7,000 newsletters were distributed via email. Additional distribution points included the Satellite City Halls and the Hawai'i State Libraries on O'ahu.

Website: www.honolulutransit.org

A dedicated project website was created and maintained for the public to access current project information at all times. It also provides an opportunity for users to input their comments or questions. Project informational fliers are available in nine languages spoken by substantial numbers of people on O'ahu. The www.honolulutransit.org web site also has a link to the City & County of Honolulu's existing web site. Other information available includes:

- Project purpose and need;
- Project overview and schedule;
- Proposed alternatives, alignments and corridor maps;
- Public involvement opportunities and summaries; and
- Recent newsletters, articles and press releases.

Information Line

A dedicated transit information line was operational from November 2005 to November 2006, providing 24 hour access for public inquiry and comment. The outgoing messages were changed periodically to reflect various stages of the project and to inform callers of scoping meetings and community update meetings. During the one year that the hotline was operational, nearly 200 calls were received. Of the calls, 40 percent requested to be added or removed from the mailing list, 15 percent requested a presentation to their group, organization, or neighborhood board, 10 percent were comments regarding alternative preference, 25 percent requested additional information, such as enlarged maps, and the rest left no message.

Media

The project team recognized that the traditional media represented one of the most effective means of providing the public with factual information about the project. The media was informed about the project through media releases and prepared public service announcements to highlight key project issues or milestones and to publicize upcoming opportunities for public involvement. The media team identified appropriate media outlets and distributed and followed up on all media submittals. English-speaking and non-English speaking media were provided information to ensure maximum distribution of factual project data. The team drafted and submitted articles that were published in local publications and newspapers, and also arranged and attended editorial board meetings at both of the major daily newspapers, regional papers along the corridor and local business magazines.

Select media buys in print and broadcast mediums were used to enhance attendance at major selected public forums and at official public hearings. Additionally, project staff appeared on various broadcast programs (‘Ōlelo: Voter's Viewpoint, PBN Friday on PBS), at news conferences and in print, television and radio interviews.

From December 2005 through November 2006, over 500 articles, editorials, and letters to the editor that related to the Honolulu High-Capacity Transit Corridor Project were published in O‘ahu's two major newspapers, The Honolulu Advertiser and Honolulu Star-Bulletin. Editorials and letters to the editor outnumbered the articles by a two-to-one ratio. Printed media coverage increased around milestones of the project. For instance, in December 2005 when the first round of scoping meetings were held, the amount of print media coverage more than doubled compared to the previous month.

Print media coverage averaged about one article or letter every two days from November 2005 thru May 2006. From June 2006 to the completion of the Alternatives Analysis in November 2006, coverage escalated to an average two to three articles and letters published daily.

Transit Solutions Advisory Committee

A Transit Solutions Advisory Committee (TSAC) comprised of about 30 community leaders was formed to assist the Mayor and City Council in reviewing the technical work of the project and in evaluating alignment options. TSAC met four times during the course of the project with the Mayor, DTS staff and the project team for the purpose of serving as a sounding board to ensure that the information provided to the public is what people needed to make sound decisions. This committee also complemented public outreach efforts by using their individual community networks to ensure that all segments of the community were reached.

Agency Coordination

Scoping

An agency scoping meeting was held to provide an opportunity for those agencies with stakes in the project, or relevant expertise pertaining to the project, to provide input on the project at an early stage. Invitation letters were sent to 87 Federal, State and County agencies and utility companies that had either participated in prior transit planning efforts on O'ahu, or had responsibilities or expertise that were considered to play a role in the current transit planning program. The agency scoping meeting was held from 2 p.m. to 4 p.m. on December 13, 2005, at Neal S. Blaisdell Center. Twenty agencies and utility companies attended the scoping meeting. Informational comments and requests for coordination were received from 16 agencies and those requests were honored throughout the project analysis. Details of the agency scoping process are presented in detail in the *Honolulu High-Capacity Transit Corridor Project Scoping Report* (DTS, 2006x).

Ongoing Coordination

After the scoping process, agency coordination continued as project details emerged related to the jurisdiction of various agencies. Coordination efforts included formal meetings, written correspondence, and informal telephone and personal communication.

Formal meetings were often informational, where technical members of the project team would describe potential impacts of plans to stakeholders and land owners. In some cases, the meeting attendees expressed a preference of one option over another. Such preferences were noted but did not affect the analysis of alternatives. In other instances, the formal meetings were held to gain insight into the plans and timelines of other agencies. For example, meetings with the Hawai'i Department of Transportation were intended to exchange information about plans and timelines for projects to allow early identification of potential future conflicts, so that they could be mitigated.

Federal agency coordination was a mix of written correspondence and formal meetings. The Federal Transit Administration, the lead Federal agency for this project, was actively kept informed of progress and was consulted regularly during the travel model development and refinement. The Federal Highway Administration, Hawai'i Division, the Department of the Navy, the Department of the Army, the Environmental Protection Agency, the U.S. Fish and Wildlife Service and other environmental agencies were also consulted as necessary to ensure compliance with current guidelines and to share information on project progress.

Hawai'i State agencies included the Hawai'i Department of Transportation (HDOT), State Historic Preservation Division (SHPD), the Office of Hawaiian Affairs (OHA), the Department of Hawaiian Home Lands (DHHL), the Department of Land and Natural Resources (DLNR) and the University of Hawai'i. These agencies all have an interest in land and land use throughout the study corridor. As such, they were consulted regularly and kept informed of plans and details as the project developed. Some of the agency/land owners could be significantly impacted by the potential build alternatives and close coordination continued throughout the process to maintain cooperation.

Coordination with the O'ahu Metropolitan Planning Organization (OMPO) occurred at several levels. Presentations were made to OMPO's Policy, Citizen Advisory, and Technical Advisory committees over the course of development of the AA. Also, OMPO staff was consulted on technical issues, such as environmental justice analysis and long-range land use planning.

City and County of Honolulu departments were closely involved through direct coordination with their sister department, DTS. The Department of Planning and Permitting (DPP) was consulted regularly to ensure the accuracy of land use and zoning changes as they occurred during the preparation of the Alternatives Analysis. Coordination also occurred with the Department of Design and Construction (DDC) once preliminary engineering drafts were available. The Department of Parks and Recreation also was consulted because of their land holdings throughout the corridor. Other city and county agencies were informed of project progress through existing communication channels within the local government.

Local interest groups, including the Outdoor Circle, Kamehameha Schools and the Pearl Harbor Historic Sites group, were also involved. Coordination meetings were held with each of these groups to discuss their particular area of concern. The Outdoor Circle was concerned with the visual impact and other environmental impacts, Kamehameha Schools, a major land owner within the corridor, was concerned with potential land use, and the Pearl Harbor Historic Sites group was concerned about facilitating access to the Arizona Memorial.

Chapter 8 Section 4(f) Evaluation

The Section 4(f) evaluation was not completed because Section 4(f) consultation must be completed after entry into the National Environmental Policy Act process. Technical aspects of the evaluation are based on data included in Chapter 4 of this report.

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Appendix A List of Preparers

Appendix B List of Recipients

Appendix C Coordination List