WATER RESOURCES TECHNICAL REPORT

PRODUCT 7.8.4

HONOLULU HIGH-CAPACITY TRANSIT CORRIDOR
ALTERNATIVES ANALYSIS / DRAFT ENVIRONMENTAL IMPACT STATEMENT

prepared for:
City and County of Honolulu and
Federal Transit Administration

prepared by:
Parsons Brinckerhoff Quade & Douglas, Inc. &
Yukie Ohashi Planning Consultant

13 February 2007

Water Resources Technical Report
Honolulu High-Capacity Transit Corridor Project

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Acronyms Used in this Document

AA	Alternatives Analysis
ACOE	U.S. Army Corps of Engineers
BMP	Best Management Practice
CFR	Code of Federal Regulations
CWA	Clean Water Act
CZM	Coastal Zone Management
DA	Department of the Army
DBEDT	Department of Business, Economic Development, and Tourism
DEIS	Draft Environmental Impact Statement
DLNR	Department of Land and Natural Resources
DP	Development Plan
DTS	Department of Transportation Services
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FTA	Federal Transit Administration
FHWA	Federal Highway Administration
GWIA	Groundwater Impact Assessment
HAR	Hawai'i Administrative Rules
HOV	High-Occupancy Vehicle
HRS	Hawai'i Revised Statutes
HDOH	Hawai'i State Department of Health
HNL	Honolulu International Airport
LPA	Locally Preferred Alternative
NPDES	National Pollution Discharge Elimination System
OMPO	O'ahu Metropolitan Planning Organization
ORTP	O'ahu Regional Transportation Plan
R&HA	Rivers and Harbors Act
SCAP	Stream Channel Alteration Permit
SMA	Special Management Area
SOBA	Southern O'ahu Basal Aquifer

TSM	Transportation System Management
UH	University of Hawai‘i
UIC	Underground Injection Control
USFWS	United States Fish and Wildlife Service
WQC	Water Quality Certification

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), is preparing an Alternatives Analysis (AA) and an Environmental Impact Statement (EIS) to evaluate alternatives that would provide high-capacity transit service on O‘ahu. The alternatives being considered are a No Build Alternative, a Transportation System Management (TSM) Alternative, a Managed Lane Alternative and a Fixed Guideway Alternative.

Environmental analysis in this document focuses on water resources – surface water, wetlands and groundwater. Information from this report will be integrated with other environmental disciplines in the AA and the EIS.

Projects associated with the No Build Alternative and the TSM Alternative would be evaluated separately from this project. This document describes the impacts of the two Build Alternatives: Alternative 3 – Managed Lane, and Alternative 4 – Fixed Guideway.

The two Build Alternatives have similar impacts on water resources. Both would require an elevated structure. The Managed Lane Viaduct is not as long as the one proposed for the Fixed Guideway, so the impacts would be less widespread. To simplify the comparison of the alternatives, including the various alignments for the Fixed Guideway Alternative, Table S-1 lists the types of stream and river crossings. At each crossing, there is the need for a Coast Guard permit if the water body is considered navigable. If building the bridge requires soil or other fill material (including piers or columns) be discharged to or dredged from the river/stream or associated wetland, a permit from the Army Corps of Engineers would be required in addition to permits from other state agencies. If the water body has been listed as impaired by the State Department of Health, additional permits may apply.

The viaduct structure for both the Managed Lane Alternative and the Fixed Guideway Alternative 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 which could pollute the aquifer (i.e., when piers penetrate into the basalt) will be evaluated in a Groundwater Impact Assessment (GWIA) as required by Section 1524(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 of water may be contaminated with petroleum and other hazardous chemicals. Treatment of the contaminated water would need to occur in order to discharge the water into nearby storm sewers, streams or marine waters. Similarly, soil removed to build the piers may be contaminated. When exposed to rain, contaminated stormwater may runoff into surface water bodies.

Dewatering also can cause subsidence as water is removed from the ground and soils compact in the area being dewatered. Walls, buildings, roads and other infrastructure may be damaged. Subsidence, water disposal issues and drinking water protection are all issues common to both alternatives when building the required viaducts. In addition, these issues would be central when evaluating the impacts of the tunnels proposed as part of the Fixed Guideway Alternative.

When the new transit system is operational, stormwater runoff would increase due to the additional pavement associated with the transit system. The Fixed Guideway Alternative would include a longer structure and additional transit stations and parking lots, and therefore, would cause a greater increase in stormwater runoff.

Table S-1. Summary of Water Resources Impacts

Alternative	Potential Navigable Water Crossings[1]	Potential Impact to Riverine Wetlands	Potential Crossings of Impaired Water Bodies[2]
Alternative 1: No Build Alternative	0	0	0
Alternative 2: TSM Alternative	0	0	0
Alternative 3: Managed Lane Alternative	6	8	6
Alternative 4: Fixed Guideway Alternative (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
Hotel 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 Spur	1	1	1

Notes: [1]Navigability as defined by the U.S. Coast Guard
[2]305b Impaired Waterway list as defined by Hawai'i State Department of Health

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 1-1). 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.

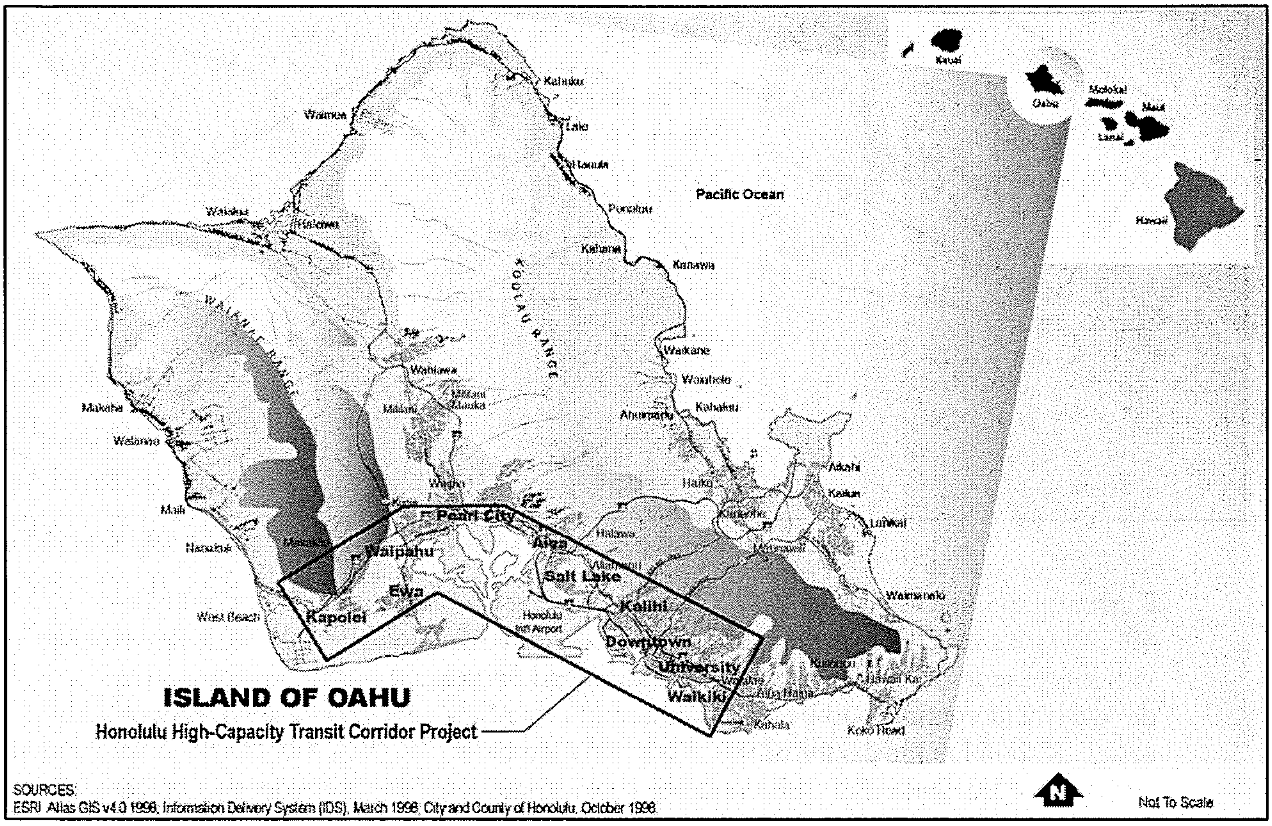

Figure 1-1. Project Vicinity

Project Description

Description of the Study Corridor

The study corridor extends from Kapolei in the west (Wai'anae or 'Ewa direction) to the University of Hawai'i 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 (PUC) 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 1-2).

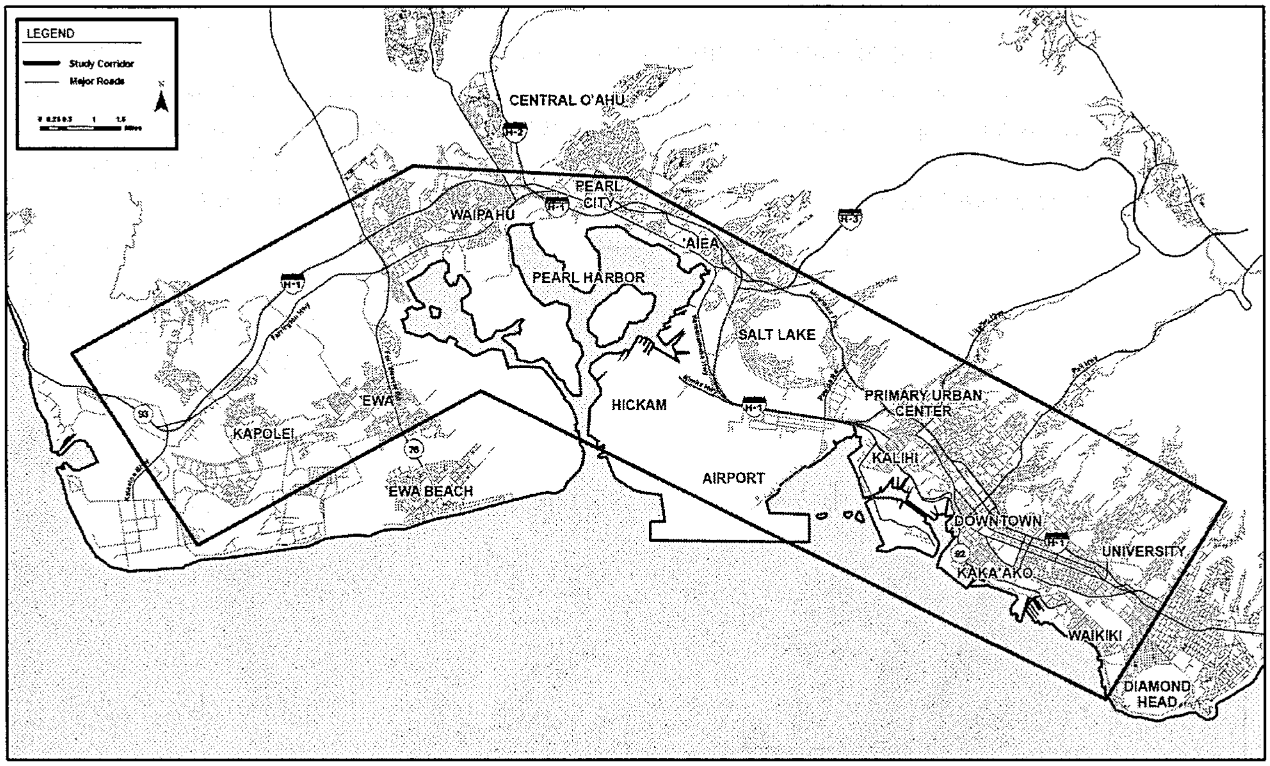

Figure 1-2. Areas and Districts in the Study Corridor

Currently, 63 percent of the 876,200 people living on O‘ahu and 81 percent of the 499,300 jobs 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 PUC and ‘Ewa Development Plan areas. Kapolei is the center of the ‘Ewa Development Plan area and has been designated as 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 is planning 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 PUC 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 (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 UH Mānoa. 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.

Alternatives under Consideration

Four alternatives will be evaluated in the Alternatives Analysis (AA) 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 housing and employment data for the corridor, a literature review of technology modes, work completed by the O‘ahu Metropolitan Planning Organization (OMPO) for its Draft 2030 Regional Transportation Plan, and public and agency comments received during a formal project scoping process held in accordance with requirements of the National Environmental Policy Act (NEPA) and the Hawai‘i EIS Law (Chapter 343, Hawai‘i Revised Statutes). The four alternatives are described in detail in the *Honolulu High-Capacity Transit Corridor Project Alternatives Analysis Definition of Alternatives Report* (DTS, 2006a). The alternatives identified for evaluation in the AA report 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 O'ahu 2030 Regional Transportation Plan prepared by OMPO. The committed highway elements of the No Build Alternative will also be included in the build alternatives (discussed below).

The No Build Alternative's transit component would include an increase in fleet size to accommodate growth in population, while allowing service frequencies to remain the same as today. The specific number of buses, as well as required ancillary facilities, will be determined during the preparation of the AA.

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 and relatively low-cost capital improvements on selected roadway facilities to give priority to buses. The TSM Alternative would include 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 for use by buses, paratransit vehicles, and vanpool vehicles. High-occupancy vehicles (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 ensure free-flow speeds for high-occupancy vehicles.

Intermediate bus access points would be provided in the vicinity of Aloha Stadium and Middle Street. Buses using the managed lane facility would be restructured and enhanced, providing additional service between Kapolei and other points 'Ewa of the PUC, as well as Downtown Honolulu and UH Mānoa.

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 fixed-guideway transit technology approved by FTA and meeting performance requirements, and could be automated or employ drivers.

Station and supporting facility locations are currently being identified and would include a vehicle maintenance facility and park-and-ride lots. Bus service would be reconfigured to bring riders on local buses to nearby fixed-guideway transit stations.

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 is expected to be necessary. Future extensions of the system to Central O'ahu, East Honolulu, or within the corridor are possible, but are not being addressed in detail at present.

A broad range of modal technologies was considered for application to the Fixed Guideway Alternative, including light rail transit, personal rapid transit, automated people mover, monorail, magnetic levitation (maglev), commuter rail, and emerging technologies still in the developmental stage. Several technologies were selected in an earlier screening process and will be considered as possible options for the fixed-guideway technology. Technologies that were not carried forward from the screening process include personal rapid transit, commuter rail, and the emerging technologies. The screening process is documented in the *Honolulu High-Capacity Transit Corridor Project Screening Report* (DTS, 2006b).

The study corridor for the Fixed Guideway Alternative will be evaluated in five sections to simplify analysis and impact evaluation in the AA process and report. In general, each alignment under consideration within each of the five sections may be combined with any alignment in the adjacent sections.

Each alignment has distinctive characteristics and environmental impacts and provides different service options. Therefore, each alignment will be evaluated individually and compared to the other alignments in each section. The sections that will be evaluated and the alignments being evaluated for each section are listed in Table 1-1. In addition to the combinations of alignments, a shorter 20-mile Alignment also was evaluated.

Table 1-1. Fixed Guideway Alternative Analysis Sections and Alignments

Section	Alignments Being Considered
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
	Makai of the Airport Viaduct
	Mauka of the Airport Viaduct
	Aolele Street
IV. Middle Street to Iwilei	North King Street
	Dillingham Boulevard
V. Iwilei to UH Mānoa	Hotel Street/Kawaiaha'o Street/Kapi'olani Boulevard with or without Waikīkī Branch
	Hotel Street/Waimanu Street/Kapi'olani Boulevard with or without Waikīkī Branch
	Nimitz Highway/Queen Street/Kapi'olani Boulevard with or without Waikīkī Branch
	Nimitz Highway/Halekauwila Street/Kapi'olani Boulevard with or without Waikīkī Branch
	Beretania Street/South King Street
	Waikīkī Branch

Project Purpose

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.

Project Area Needs

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 miles per hour (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 'Ewa/Kapolei/Makakilo as a Way of Supporting Policy to Develop the Area as a Second Urban Center

The General Plan for the City and County of Honolulu projects the highest population growth rates for the island will occur in the 'Ewa Development Plan area (comprised of the 'Ewa, 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 Wai'anae, Wahiawā, North Shore, Windward, Waimānalo, and East Honolulu areas will have population growth of between zero and 16 percent because of this policy, which 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 'Ewa neighborhood by 100 percent, and Makakilo by 125 percent between 2000 and 2030. Accessibility to the overall 'Ewa 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 O'ahu; therefore, the 'Ewa, 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 PUC 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.

Project 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 need for the project as discussed in this chapter. The anticipated project development schedule for completion of the 20-mile Alignment is shown in Figure 1-3.

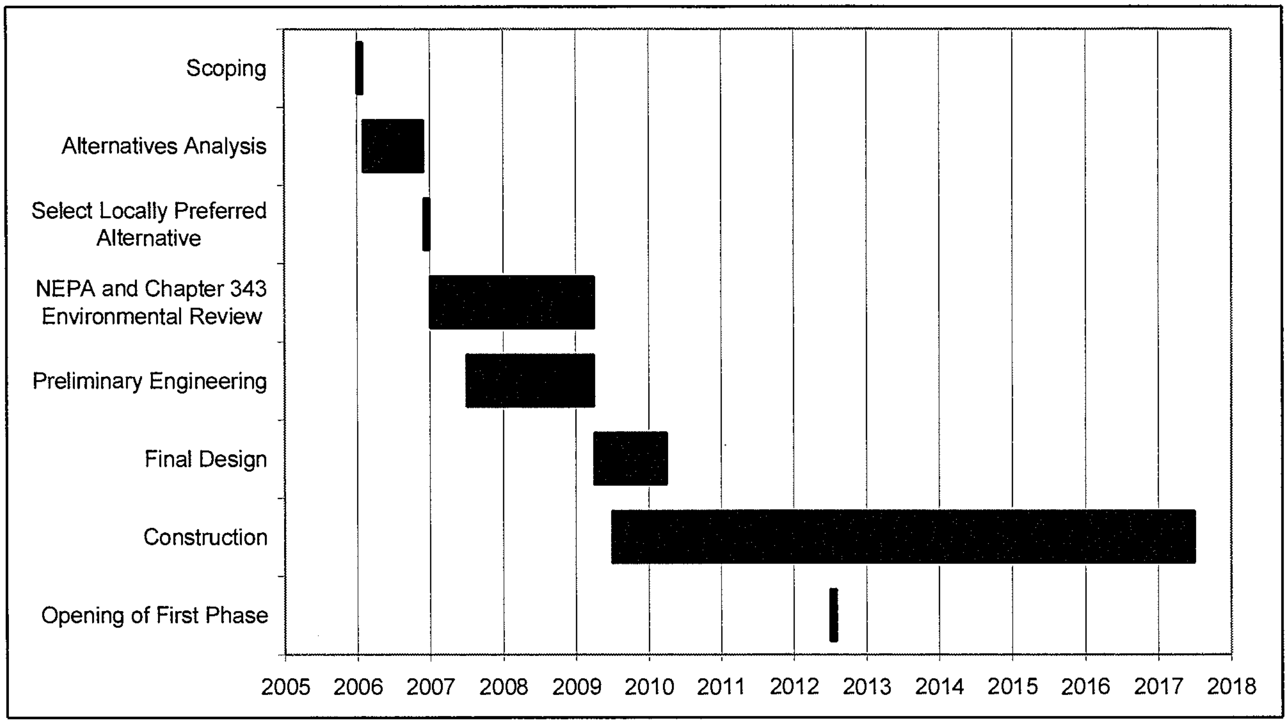

Figure 1-3. Project Schedule

Surface Water and Wetlands

Several federal and state agencies are authorized to regulate inland surface and tidal waters or wetlands (collectively, "waters of the United States"). The authority is derived primarily through the Clean Water Act (CWA) and the Rivers and Harbors Act (R&HA), and associated state rules for water quality standards.

The U.S. Army Corps of Engineers (ACOE) requires a permit for any structure or work in or affecting waters of the United States. Construction in wetlands would require ACOE approval. Pursuant to 33 CFR Parts 320 through 330 of the Regulatory Program of the ACOE, a Section 10 (of the Rivers and Harbors Act) permit is required for the placement of structures in navigable waters (i.e., waters subject to the ebb and flow of the tides). In addition, authorization is required for the placement of fill in wetlands pursuant to Section 404 of the Clean Water Act.

An application must be submitted to the ACOE for a Jurisdictional Determination, which delineates the extent of the waters affected by the project. This application would require staking of the wetland boundary, a surveyed map, and completion of the Corps' wetland delineation form identifying the presence of hydrology, hydrophytic plants, and hydric soils.

The substantive criteria used to evaluate fill placed in a Section 404 regulated wetland have been promulgated by the U.S. Environmental Protection Agency (EPA) in 40 CFR Part 230, also known as the "404(b)(1) Guidelines". An extensive alternatives analysis to determine that there are no practicable alternatives to placing fill in wetlands must be prepared to demonstrate compliance with the guidelines. The guidelines establish a sequential approach to project planning beginning with "avoidance", followed by "minimization" if avoidance is not possible, and finally "mitigation" to compensate for any detrimental effects of filling wetlands. Coordination with the ACOE and the EPA would occur though the "Memorandum of Understanding for the National Environmental Policy Act/Clean Water Act Section 404 Integration Process for Surface Transportation Projects in the State of Hawai'i" if a CWA Section 404 or R&HA Section 10 permit is needed.

Under Section 404 of the federal CWA, the discharge of dredge or fill material into "waters of the U.S.", as defined by 33 CFR Part 328, automatically triggers the need for a permit from the ACOE. Under Section 401 of the CWA, the need for an ACOE permit triggers the need for a Section 401 Water Quality Certification (WQC) from the State of Hawai'i Department of Health (HDOH)-Clean Water Branch and a Coastal Zone Consistency determination from the State of Hawai'i Department of Business, Economic Development, and Tourism (DBEDT) Coastal Zone Management Program office.

The State's general policy is to maintain or improve existing water quality of all State waters. All waters of the State of Hawai'i are classified as inland waters or marine waters. Inland waters include fresh waters, brackish waters, or saline waters, including streams, springs, wetlands, estuaries, anchialine pools, and saline lakes. Marine waters include embayments, open coastal waters, and oceanic waters. The State has defined water use classifications for inland and marine waters and set water quality criteria for each water use classification.

According to the HDOH administrative rules, inland waters can be either water use Class 1 or Class 2. The water quality in Class 1 waters is to be maintained in their natural states; no waste discharge is allowable. Class 2 waters are those to be protected for recreational use, propagation of aquatic life, agricultural and industrial water supplies, shipping, and navigation.

The HDOH maintains the 303(d) List of Impaired Waters. This list is composed of inland surface waters not expected to meet state water quality standards even after application of technology-based effluent limitations. Tributaries to water bodies which appear on the 303(d) list also may be considered impaired for regulatory purposes and permits.

Marine waters are categorized as Class AA or Class A. Class AA waters are to "remain in the natural pristine state as nearly as possible with an absolute minimum of pollution or alteration of water quality from any human-caused source or actions." Class A waters can be used for "recreational use and aesthetic enjoyment," among other allowable uses compatible with protecting the natural resources in these waters (Hawai'i Administrative Rules (HAR), Chapter 11-54, Water Quality Standards).

Coastal areas and embayments can be listed by HDOH as "Water Quality-Limited Segments," as required by the CWA Section 305(b) and defined by 40 CFR 130.8. Water Quality-Limited Segments are water bodies having pollutants in excess of the established water quality standards, such that they cannot reasonably be expected to attain or maintain state water quality standards without additional action to control sources of pollution.

Section 402 of the CWA establishes the National Pollutant Discharge Elimination System (NPDES). The NPDES program, administered by the HDOH, establishes a permitting system that regulates the discharge of water-borne pollutants into the nation's waters. Some discharges from the construction and operation of transportation facilities are usually unavoidable, triggering the need for NPDES permits for most transportation projects.

The State Commission on Water Resource Management (Water Commission) regulates activities affecting stream channels, which are defined as any natural or artificial watercourse with a definite bed and banks, which periodically or continuously contains flowing water. Among the regulatory responsibilities of the Water Commission is the regulation of alterations to stream channels through a permit called a Stream Channel Alteration Permit (SCAP).

The Department of Land and Natural Resources (DLNR), Division of Boating and Ocean Recreation, manages the recreational uses of shore waters and shore areas in accordance with HRS Chapter 200, Subtitle 8, entitled "Ocean Recreation and Coastal Areas." It divides the coastal areas into segments and specifies what water-based uses are allowed within specific zones.

Navigable Waters

Waters subject to tidal influence are generally defined as navigable by the U.S. Coast Guard. In addition to tidal waters, non-tidal streams carrying commercial traffic are deemed navigable.

The U.S. Coast Guard is responsible for issuing bridge permits for navigable waters. To protect the right of navigation, bridge permits restrict the location and design of a proposed new bridge or causeway, or reconstruction/modification of existing bridges and causeways. The U.S. Coast Guard's authority comes from Section 9 of the Rivers and Harbors Appropriation Act of 1899, the Act of March 23, 1906, and the General Bridge Act of 1946.

For the purposes of the Department of the Army permitting requirements, the District Engineer for the U.S. ACOE determines navigability under the authority of 33 Code of Federal Regulations (CFR) Part II, Section 329.14(b). The Coast Guard determination may not be consistent with the ACOE permitting jurisdiction determination.

Coastal Zone Management (CZM) Areas

The U.S. Department of Commerce, in September 1978, approved the Hawai'i Coastal Zone Management (CZM) Program with the following goals:

- Protect valuable resources;
- Preserve management options;
- Ensure public access to beaches, recreation areas, and natural reserves; and
- Provide for solid and liquid waste treatment within the Special Management Area (SMA).

In Hawai'i, the Department of Business, Economic Development, and Tourism (DBEDT) administers the program. Federally funded activities on O'ahu must receive a consistency determination from the CZM program to assure that they meet the guidelines in the State policy.

Groundwater

The Southern O'ahu Basal Aquifer (SOBA) is the principal aquifer underlying all of southern O'ahu. The portions of the SOBA within the study corridor are the Pearl Harbor Aquifer Sector and the 'Ewa Aquifer System. The EPA has designated the SOBA as the sole or principal source of drinking water for the Pearl Harbor area. Based on Hawai'i status codes related to the protection of drinking water, the SOBA is designated as a currently used source of fresh drinking water that is both irreplaceable and highly vulnerable to contamination (Mink and Lau, 1990). In accordance with the 1984 Sole Source Aquifer Memorandum of Understanding between EPA and the FHWA a

Groundwater Impact Assessment (GWIA) will be prepared to meet the coordination requirements of Section 1424(e) of the Safe Drinking Water Act.

The boundary between non-drinking water aquifers and underground sources of drinking water is generally referred to as the Underground Injection Control (UIC) Line. Restrictions on injection wells differ, depending on whether the area is mauka or makai of the UIC line. The UIC program is administered by the HDOH Safe Drinking Water Branch.

Surface water resources in the project area were identified from existing maps. Areas of potential conflict with the project alternatives were delineated and evaluated, and mitigation measures to reduce impacts were identified. Techniques to minimize surface water contamination due to increased runoff from additional highway surfaces were considered and any necessary permits identified. Potential permits required to cross surface water bodies were discussed. Should the project require a Clean Water Act Section 404 individual permit from the Army Corps of Engineers, coordination would occur through the "Memorandum of Understanding for the National Environmental Policy Act/Clean Water Act Section 404 Integration Process for Surface Transportation Projects in the State of Hawai'i".

The project alternatives were assessed to determine any impacts on shoreline and coastal resources. Special aquatic sites were identified and steps outlined to avoid or minimize impacts to these areas. Permits involving the coastal area also were identified.

Construction impacts on water quality were assessed and mitigation measures proposed. The number of acres disturbed during construction was tabulated for each alternative and potentially necessary permits were identified.

Fieldwork was conducted to identify and quantify any areas within each of the proposed sections for ground conditions that would qualify as jurisdictional wetlands or waters of the United States. Functions and values (i.e., water bird habitat, stormwater storage, riverine watercourse, etc.) were qualitatively determined for any wetlands potentially affected. All wetland determinations will follow the U.S. Army Corps of Engineers' 1987 Wetlands Delineation Manual.

Areas of concern regarding potential wetlands were addressed as follows during the Alternatives Analysis phase:

- Preliminary determination of wetlands began with a review of the hydric soils present within the study area utilizing the NRCS Soil Survey of O'ahu and a visual investigation.
- Areas that appeared to be potential wetlands were investigated further; hydrophytic vegetation were documented by creating a list of all plant species present in the area, including estimated percent cover and indicator categories listed in the "National List of Plant Species that occur in Wetlands: Hawai'i (Region H)" (Reed, 1988).
- Those areas with hydrophytic vegetation were further examined for hydrology and presence or absence of hydric soils by digging test pits in order to determine if they possess characteristics that are associated with reducing soil conditions. All information was tabulated in the Army Corps of Engineers Routine Wetland Determination Data Form (1987).
- Rough boundaries of proposed wetlands were mapped using GPS, and wetland functions and values were qualitatively described.

Most of the transit corridor overlies the Southern O'ahu Basal Aquifer (SOBA), a sole source aquifer; therefore, a Groundwater Impact Assessment (GWIA) will need to be initiated once the LPA is selected to meet the requirements of Section 1424 (e) Review under the Safe Drinking Water Act. The GWIA is intended to provide the EPA information necessary to determine the project's impact on the quality of the groundwater. The project alternatives were evaluated based on the extent of the SOBA, aquifer recharge areas, caprock thickness, location of the UIC line, total acres of impervious surface required for each alternative, and other factors affecting groundwater in the project area. Mitigation measures to reduce impacts were discussed.

Surface Waters

Streams

Many streams are located within the study corridor (Table 4-1). 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 HDOH. Many streams in the state are not listed because data collection is ongoing. Tributaries to water bodies which appear on the 303(d) list may also be considered impaired for regulatory purposes and permits.

Navigable Waters

Table 4-1 also lists the streams deemed navigable at alignment crossings by the U.S. Coast Guard. Most navigation is limited to small recreational boats, such as canoes and kayaks.

Table 4-1. Streams in Project Corridor

Alternative and Section	Navigable Water[1]	Associated Floodplain[2]	303(d) Impaired[3]
Alternative 3: Managed Lane			
Waiawa Stream	No	Yes	No
Waimalu Stream	Yes	No	Yes
Kalauao Stream	No	Yes	No
‘Aiea Stream	Yes	Yes	Yes
Hālawa Stream	Yes	No	Yes
Moanalua Stream	Yes	Yes	Yes
Kalihi Stream	Yes	Yes	Yes
Kapālama Stream	Yes	No	Yes
Alternative 4: Fixed Guideway (by section)			
I. Kapolei to Fort Weaver Road			
Kamokila Boulevard / Farrington Highway			
Makakilo Gulch at Kamokila Blvd	No	No	No
Hono‘uli‘uli Gulch at Farrington Highway	No	Yes	No
Kaloi Gulch at Farrington Highway	No	No	No
Kapolei Pkwy/North-South Road			
Makakiol Gulch at Kapolei Parkway	No	No	No
Kaloi Gulch at North-South Road	No	Yes	No
Hono‘uli‘uli Gulch at Farrington Highway	No	Yes	No
Kaloi Gulch at Farrington Highway	No	Yes	No
Saratoga Ave/North-South Road			
Makakilo Gulch at Saratoga Ave	No	No	No
Kaloi Gulch at North-South Road	No	Yes	No
Hono‘uli‘uli Gulch at Farrington Highway	No	Yes	No
Geiger Road/Fort Weaver Road			
Makakilo Gulch at Saratoga Ave	No	No	No

Alternative and Section	Navigable Water[1]	Associated Floodplain[2]	303(d) Impaired[3]
Kaloi Gulch at Geiger Road	No	No	No
Honoʻuliʻuli Stream at Fort Weaver Road	No	Yes	No
II. Fort Weaver Road to Aloha Stadium			
Hoaeae Stream at Farrington Highway	No	No	No
Waikele Stream at Farrington Highway	No	Yes	Yes
Kapakahi Stream at Farrington Highway	No	Yes	Yes
Makalena Stream at Farrington Highway	No	Yes	No
Waiawa Stream at Farrington Highway	No	Yes	No
Waiau Stream at Kamehameha Highway	No	No	No
Waimalu Stream at Kamehameha Highway	No	No	Yes
Kalauao Stream at Kamehameha Highway	No	Yes	No
ʻAiea Stream at Kamehameha Highway	Yes	Yes	Yes
III. Aloha Stadium to Middle Street			
Salt Lake Boulevard			
Hālawa Stream at Salt Lake Boulevard	No	No	Yes
Moanalua Stream in Mapunapuna	Yes	Yes	Yes
Mauka/ Makai of the Airport Viaduct			
Hālawa Stream at Kamehameha Highway	Yes	No	Yes
Moanalua Stream at Nimitz Highway	Yes	Yes	Yes
Aolele Street			
Hālawa Stream at Kamehameha Highway	Yes	No	Yes
Moanalua Stream at Nimitz Highway	Yes	Yes	Yes
IV. Middle Street to Iwilei			
North King Street			
Kalihi Stream at North King Street	No	Yes	Yes
Kapālama Canal at North King Street	Yes	No	Yes
Dillingham Boulevard			
Kalihi Stream at Dillingham Boulevard	Yes	Yes	Yes
Kapālama Canal at Dillingham Boulevard	Yes	No	Yes
V. Iwilei to UH Mānoa			
Beretania Street/South King Street			
Nuʻuanu Stream at South Beretania Street	Yes	No	Yes
Hotel Street/Kawaiahao Street/ Kapiʻolani Boulevard			
Nuʻuanu Stream at Hotel Street	Yes	No	Yes
Ala Wai Tributaries on *Kapiʻolani Boulevard*	No	Yes	Yes
Hotel Street/Waimanu Street/ Kapiʻolani Boulevard			
Nuʻuanu Stream at Hotel Street	Yes	No	Yes
Ala Wai Tributaries on *Kapiʻolani Boulevard*	No	Yes	Yes
Nimitz Highway/Queen Street/ Kapiʻolani Boulevard			
Nuʻuanu Stream at Queen Street	Yes	No	Yes
Ala Wai Tributaries on *Kapiʻolani Boulevard*	No	Yes	Yes
Nimitz Highway/Halekauwila Street /Kapiʻolani Boulevard			
Nuʻuanu Stream at Queen Street	Yes	No	Yes
Ala Wai Tributaries on *Kapiʻolani Boulevard*	No	Yes	Yes
Waikīkī Spur			
Ala Wai Canal at Kalākaua Avenue	Yes	Yes	Yes

Notes: [1] Navigability as defined by the U.S. Coast Guard
[2] Floodplains as defined by FEMA, see *Honolulu High-Capacity Transit Corridor Project Natural Resources Technical Report*
[3] 303(d) Impaired Waterway list as defined by HDOH

Wetlands

The Hawaiian Islands have many wetlands and wetland habitats. On O‘ahu, perennial and intermittent streams originating in the higher elevations of the Ko‘olau and Wai‘anae Mountains represent a major "riverine" or stream wetland system.

Wetland complexes within the study area from Kapolei (to the west) to Waikīkī (to the east) 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 already been altered through channelization, lining, dredging, or other alteration (Hawaii Cooperative Park Service Unit, 1990).

Field investigation for wetlands along the proposed alternative alignments was conducted during February 2006. A preliminary search for wetlands was conducted along all alignments being considered for the Managed Lane Alternative and Fixed Guideway Alternative.

While as complete as possible, the following descriptions of wetlands are not comprehensive because access was limited without a right-of-entry from property owners. Table 4-2 lists numerous stream crossings throughout the study area and identifies those having characteristics that indicate possible wetlands. Characteristics of possible wetlands include: presence of water (hydrology), hydrophytic vegetation, and hydric soils. The classification of wetlands is based on *Classification of Wetlands and Deepwater Habitats* (Cowardin etal 1979). The descriptions of soil types are from the Natural Resources Conservation Service (formerly Soil Conservation Service) (Foote et al, 1972).

There are only a few areas that are not directly connected to riverine systems within the study area that are believed to be wetlands - primarily those sites associated with natural springs in the Pearl Harbor area. Namely, these are identified as the Waiau Spring pond, Sumida Watercress Farm, and a drainage ditch at Aolele Street. Stream inspection to identify possible wetlands was limited to the location of specific crossings.

Alternative 3: Managed Lane Alternative

Along the Waiawa Interchange to Hālawa Stream section of the Managed Lane Alternative, there are two distinct spring-fed wetlands along Kamehameha Highway, at Waiau Spring and the Sumida Watercress Farm. Numerous streams are also present, which are considered to be riverine wetlands (Cowardin et al 1979).

Similar to the ‘Ewa section, the section of the Managed Lane Alternative between Hālawa Stream and Pacific Street also crosses numerous channelized streams which are considered as riverine wetlands (Cowardin et al 1979).

Alternative 4: Fixed Guideway

The survey results for the Fixed Guideway Alternative are summarized in Table 4-2. A general overview is provided in the following sections.

Table 4-2. Wetlands and Water Resources Existing Conditions

Alternative and Section	Hydrology	Soils	Vegetation	Wetlands Classification	Functions and Values
ALTERNATIVE 3: Managed Lane Alternative					
Waiawa Interchange to Hālawa Stream					
Park-&-Ride location at Waiawa Stream	No hydrology observed	KIA – Kawaihapa clay loam (Non-hydric) Appears to have top layer of fill material.	Non-hydrophytic	Need to determine buffer from Waiawa Stream	Undetermined (Current site use is residential and baseyard)
Waiau Stream at Kamehameha Highway	Perennial Stream	Natural Drainage	Hydrophytic	Riverine	Drainage
Waiau Spring at Kamehameha Highway (mauka of HECO power plant)	Surface Water Source: Waiau Spring	Saturated soil TR – Tropaquets (Hydric) HnB – Hanalei silty clay (Hydric)	Hydrophytic	Palustrine	Wet agricultural field
Waimalu Stream at Kamehameha Highway	Perennial Stream	Natural drainage	Hydrophytic	Riverine	Drainage
Sumida Watercress Farm at Kamehameha Highway	Surface Water Source: Kalauao Spring	Saturated soil Ph – Pearl Harbor (Hydric)	Hydrophytic	Wet agricultural field	Wet agricultural field
Kalauao Stream at Kamehameha Highway	Perennial Stream	Natural drainage	Hydrophytic	Riverine	Drainage
‘Aiea Stream at Kamehameha Highway	Perennial Stream	Natural drainage	Hydrophytic	Riverine	Drainage
Hālawa Stream at Kamehameha Highway	Perennial Stream	Concrete channel	No vegetation	Riverine	Drainage
Hālawa Stream to Pacific Street					
Drainage Ditch parallel Aolele Street	Surface water	Saturated Keaau stony clay (KmaB) - Hydric	Hydrophytic and non-hydrophytic	Man-made channel	Localized drainage sump
Moanalua Stream at Nimitz Highway	Perennial Stream	Concrete channel	Hydrophytic on banks	Riverine	Drainage
Kalihi Stream at Nimitz Highway	Perennial Stream	Natural drainage	Hydrophytic on banks	Riverine	Drainage
Kapālama Canal at Nimitz Hitghway	Perennial Stream	Concrete channel	Hydrophytic on banks	Riverine	Drainage

Alternative and Section	Hydrology	Soils	Vegetation	Wetlands Classification	Functions and Values
ALTERNATIVE 4: Fixed Guideway Alternative					
I. Kapolei to Fort Weaver Road					
Kamokila Boulevard / Farrington Highway					
Flume at Kapolei Park-&-Ride	Dry	Dirt (covered with rusting metal liner)	Non-hydrophytic	Not wetland	
Unnamed drainage at Kapolei Parkway/Kalaeloa Boulevard	Wet	Man-made (?) drainage, concrete sides extending from concrete culvert	Hydrophytic	Not wetland	
Unnamed gulch at Farrington Highway	Dry (possibly linked to Makakilo Gulch)	Man-made (?)	Non-hydrophytic	Not wetland	
Pond south of Farrington Highway (makai of Makakilo Gulch)	Deep pond water feature with aeration	Possibly lined	None	Not wetland	
Unnamed gulch at Farrington Highway	Dry	Natural drainage	Non-hydrophytic	Not wetland (No ACOE Jurisdiction)	
Hunehune Gulch at Farrington Highway	Dry	Natural drainage	Non-hydrophytic	Not wetland (No ACOE Jurisdiction)	
Kaloi Gulch at Farrington Highway	Dry	Natural drainage	Non-hydrophytic	Not wetland (No ACOE Jurisdiction)	
Hono'uli'uli Gulch at Farrington Highway	Dry	Natural drainage	Non-hydrophytic	Riverine	Drainage
Kapolei Parkway/North-South Road					
Man-made drainage (Makakilo Gulch) at Kapolei Pkwy	Dry	Dirt	Non-hydrophytic	Not wetland	
Kaloi Gulch at North-South Road	Dry	Natural drainage	Non-hydrophytic	Not wetland (No ACOE Jurisdiction)	
Hono'uli'uli Gulch at Farrington Highway	Dry	Natural drainage	Non-hydrophytic	Riverine	
Kaloi Gulch at Farrington Highway	Dry	Natural drainage	Non-hydrophytic	Not wetland (No ACOE Jurisdiction)	
Saratoga Avenue/North-South Road					
Man-made drainage (Makakilo Gulch) at Kapolei Pkwy	Dry	Dirt	Non-hydrophytic	Not wetland	
Kaloi Gulch at North-South Road	Dry	Natural drainage	Non-hydrophytic	Not wetland (No ACOE Jurisdiction)	

Alternative and Section	Hydrology	Soils	Vegetation	Wetlands Classification	Functions and Values
Hono'uli'uli Gulch at Farrington Highway	Dry	Natural drainage	Non-hydrophytic	Riverine	
Geiger Road/Fort Weaver Road					
Kaloi Gulch at Geiger Road	Dry	Natural drainage	Non-hydrophytic	Not wetland (No ACOE Jurisdiction)	
Hono'uli'uli Stream at Fort Weaver Road	Dry	Concrete culvert	No vegetation	Riverine	Drainage
II. Fort Weaver Road to Aloha Stadium					
Farrington Highway					
Hoaeae Stream at Farrington Highway	Dry	Concrete channel	Hydrophytic	Riverine	Drainage
Waikele Stream at Farrington Highway	Perennial Stream	Concrete channel	No vegetation	Riverine	Drainage
Kapakahi Stream at Farrington Highway	Flowing	Natural drainage	Hydrophytic	Riverine	Drainage
Makalena Stream at Farrington Highway	Flowing	Concrete channel	No vegetation	Riverine	Drainage
Waiawa Stream at Farrington Highway	Perennial Stream	Natural drainage	Hydrophytic	Riverine	Drainage
Kamehameha Highway					
Park-&-Ride location at Waiawa Stream	No hydrology observed	KIA – Kawaihapa clay loam (Non-hydric) Appears to have top layer of fill material.	Non-hydrophytic	Need to determine buffer from Waiawa Stream	Undetermined (Current site use is residential and baseyard)
Waiau Stream at Kamehameha Highway	Flowing	Natural drainage	Hydrophytic	Riverine	Drainage
Waiau Spring at Kamehameha Highway (mauka of HECO power plant)	Surface Water Source: Waiau Spring	Saturated soil TR – Tropaquets (Hydric) HnB – Hanalei silty clay (Hydric)	Hydrophytic	Palustrine	Wet agricultural field
Waimalu Stream at Kamehameha Highway	Perennial Stream	Natural drainage	Hydrophytic	Riverine	Drainage
Sumida Watercress Farm at Kamehameha Highway	Surface Water Source: Kalauao Spring	Saturated soil Ph – Pearl Harbor (Hydric)	Hydrophytic	Wet agricultural field	Wet agricultural field
Kalauao Stream at Kamehameha Highway	Perennial Stream	Natural drainage	Hydrophytic	Riverine	Drainage

Alternative and Section	Hydrology	Soils	Vegetation	Wetlands Classification	Functions and Values
ʻAiea Stream at Kamehameha Highway	Perennial Stream	Natural drainage	Hydrophytic	Riverine	Drainage
Waipahu Canal	Flowing	Concrete channel	No vegetation	Riverine	Drainage
III. Aloha Stadium to Middle Street					
Salt Lake Boulevard					
Hālawa Stream at Salt Lake Boulevard	Perennial Stream	Concrete channel	No vegetation	Riverine	Drainage
Moanalua Stream at Salt Lake Boulevard (Kikowaena Street)	Perennial Stream	Natural drainage	Hydrophytic on banks	Riverine	Drainage
Mauka side of the Airport Viaduct					
Hālawa Stream at Kamehameha Highway	Perennial Stream	Concrete channel	No vegetation	Riverine	Drainage
Moanalua Stream at Nimitz Highway	Perennial Stream	Concrete channel	No vegetation	Riverine	Drainage
Makai of the Airport Viaduct					
Moanalua Stream at Nimitz Highway	Perennial Stream	Concrete channel	Hydrophytic on banks	Riverine	Drainage
Aolele Street					
Drainage Ditch parallel Aolele Street	Surface water	Saturated Keaau stony clay (KmaB) - Hydric	Hydrophytic and non-hydrophytic	Man-made channel	Localized drainage sump
IV. Middle Street to Iwilei					
North King Street					
Kalihi Stream at North King Street	Perennial Stream	Natural drainage	Non-hydrophytic	Riverine	Drainage
Kapālama Canal at North King Street	Perennial Stream	Concrete channel	No vegetation	Riverine	Drainage
Nuʻuanu Stream at North King Street	Perennial Stream	Natural drainage	No vegetation	Riverine	Drainage
Dillingham Boulevard					
Kalihi Stream at Dillingham Boulevard	Perennial Stream	Natural drainage	Non-hydrophytic	Riverine	Drainage
Kapālama Canal at Dillingham Boulevard	Perennial Stream	Concrete channel	No vegetation	Riverine	Drainage

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Alternative and Section	Hydrology	Soils	Vegetation	Wetlands Classification	Functions and Values
V. Iwilei to UH Mānoa					
Beretania Street/South King Street					
Nu'uanu Stream at South Beretania Street	Perennial Stream	Natural drainage	No vegetation	Riverine	Drainage
Hotel Street/Kawaiahao Street/Kapi'olani Boulevard					
Nu'uanu Stream at Hotel Street	Perennial Stream	Natural drainage	No vegetation	Riverine	Drainage
Ala Wai Canal tributaries (2) at Kapi'olani Boulevard	Surface runoff	Concrete	No vegetation	Probably not wetlands	Drainage
Hotel Street/Waimanu Street/Kapi'olani Boulevard					
Nu'uanu Stream at Hotel Street	Perennial Stream	Natural drainage	No vegetation	Riverine	Drainage
Ala Wai Canal tributaries (2) at Kapi'olani Boulevard	Surface runoff	Concrete	No vegetation	Probably not wetlands	Drainage
Nimitz Highway/Queen Street/ Kapi'olani Boulevard					
Nu'uanu Stream at Nimitz Highway	Perennial Stream	Natural drainage	No vegetation	Riverine	Drainage
Ala Wai Canal tributaries (2) at Kapi'olani Boulevard	Surface runoff	Concrete	No vegetation	Probably not wetlands	Drainage
Nimitz Highway/Halekauwila Street /Kapi'olani Boulevard					
Ala Wai Canal tributaries (2) at Kapi'olani Boulevard	Surface runoff	Concrete	No vegetation	Probably not wetlands	Drainage
Waikīkī Spur					
Ala Wai Canal at Kalākaua Avenue	Perennial Stream	Channelized drainage	No vegetation	Riverine	Drainage

Section I: Kapolei to Fort Weaver Road

The soils that comprise the study area in the dry ʻEwa plain are predominantly from the Lualualei and ʻEwa Series, which are well-drained (non-hydric) soils in coastal plains and basins, and on alluvial fans. Several gulches that originate on the slopes of the Waiʻanae Mountain range form drainages that intermittently cross the various alignments.

Generally, these gulches do not exhibit clear indicators of wetlands, and a recent determination by ACOE noted that Kaloi Gulch and its tributaries with no ocean outlet will not be regulated by ACOE. The intermittent Honoʻuliʻuli Gulch, like Kaloi Gulch, has been breached, channelized, or re-routed into culverts at several locations along its alignment. However, because its discharge point is at the West Loch of Pearl Harbor, portions of this stream may be classified as a regulatory wetland.

Section II: Fort Weaver Road to Aloha Stadium

In this section of Farrington Highway and Kamehameha Highway, there are several streams which discharge into Pearl Harbor. Waikele, Waiawa, Waimalu, Kalauao, and ʻAiea Streams are designated as perennial streams. Hoaeae, Kapakahi, Makalena, and Waiau Streams are intermittent.

Two spring-fed wetlands were identified adjacent to Kamehameha Highway: a small pond associated with Waiau Spring, and the Sumida Watercress Farm associated with Kalauao Spring.

The Waiau Spring ponds were previously more extensive and spanned the area mauka and makai of Kamehameha Highway. Soils are mapped as Tropaquepts (TR), a hydric soil. Tropaquepts are poorly drained soils that are flooded and used for production of water-dependent crops such as taro, rice, and watercress. The land adjacent to the east of the pond consists of Hanalei silty clay (HnB), another hydric soil. This adjacent area is developed with residential housing.

The Sumida Watercress Farm is hydrologically linked to the Kalauao Spring, approximately 900 feet to the north of the highway. Soils are mapped as Pearl Harbor (Ph), a hydric soil. Pearl Harbor soils are very poorly drained and occur on nearly level coastal plains. Historically this land has been used for wet agricultural fields since the early Hawaiʻians cultivated taro at Kalauao. Rice was grown after taro production stopped and watercress has been grown at this location since 1928.

The proposed park-and-ride location at the Waiawa Interchange may be a wetland. The soils there are identified as Kawaihapai clay loam, 0 to 2 percent slopes (KIA). The Kawaihapai Series consists of well-drained soils in drainageways and alluvial fans on the coastal plains. This soil is not considered to be "hydric" by NRCS. There is increased vegetation due to the Waiawa Stream and the unmaintained areas. The stream banks are dominated by California grass (*Brachiaria mutica*), and honohono grass (*Commelina diffusa*), both hydrophytic plants. Trees include monkeypod, opiuma, macaranga

(*Macaranga tanarius*), and java plum (*Syzygium cumini*). The drier areas are dominated by koa haole scrub with guinea grass (*Panicum maximum*).

The property is developed with several single-family dwellings and a portion is used as a baseyard. One resident indicated that the area has a history of flooding, but that in recent times, the problem had been resolved.

Section III: Aloha Stadium to Middle Street

Salt Lake Boulevard

Along Salt Lake Boulevard water sources are lacking and soils are mapped as Makalapa Series (MdD, MdB), Fill Land (FL), and Rock land (rRK). None of these soils types are listed on the NRCS hydric soils list, nor are there stream crossings in the vicinity.

Mauka and Makai of Airport Viaduct

The areas both mauka and makai of the Airport Viaduct consist of soils in the Makalapa Series (MdB), a non-hydric soil.

Aolele Street

A band of Keaau Series soil (KmaB), a poorly drained hydric soil, is mapped by NRCS along Aolele Street, which correlates with a drainage ditch paralleling the street. The ditch discharges into Ke‘ehi Lagoon to the east.

Section IV. Middle Street to Iwilei

North King Street

In this section, North King Street crosses Kalihi Stream, Kapālama Canal, and Nu‘uanu Stream. All crossings are channelized and the Kapālama Canal crossing is concrete lined. Although hydric soils (Hanalei HnA) are present on upstream top banks of Kapālama Canal, it is beyond the reach of the crossing. Other soils at Kalihi Stream include the Hono‘uli‘uli series (HxA), and ‘Ewa silty clay (EmA) at Nu‘uanu Stream which are not hydric soils.

Dillingham Boulevard

Dillingham Boulevard crosses Kalihi Stream, which is a natural channel, and Kapālama Canal, which is a concrete-lined channel at the crossing. Similar to the crossing on North King Street, Kapālama Canal at Dillingham Boulevard is flanked by hydric soils (Pearl Harbor – Ph) on the north outside the crossing area. Other dominant soils surrounding Kapālama Canal include Fill Land (FL).

Section V: Iwilei to UH Mānoa

In this section, all alignments cross Nu‘uanu Stream near the mouth where it discharges to Honolulu Harbor; in this area the stream is highly channelized using rock retaining walls. The surrounding land is comprised of fill, at all crossings of this stream at Beretania Street, Hotel Street, and Nimitz Highway.

The only other crossings in this section are two drainage channels along either Kapiʻolani Boulevard or South King Street. The two channels flow into the Ala Wai Canal and provide drainage for the surrounding urbanized areas. Surrounding lands are fill and ʻEwa Series soils (EmA).

Waikīkī Spur

Historically, the Waikīkī land area surrounding the Ala Wai Canal was marshland until its reclamation (flood control) in the 1920's. The 2.5 mile long, 160 foot to 260 foot wide canal was excavated from the coral substrate, which was side cast to fill the extensive marshes previously farmed as taro and rice fields. Much of present day Waikīkī rests upon the material created by the original excavation of the canal. The primary sources of water are the perennial Mānoa and Pālolo Streams. Secondary sources are two tributary canals that collect surface runoff. At the Kalākaua Avenue crossing, the canal appears to have a natural earthen substrate. This flood control project is also a major recreational venue for canoe paddling and use of other small water craft.

Marine Waters

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

- Pearl Harbor
- Keʻehi 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."

Pearl Harbor

Pearl Harbor is an estuary designated as a Class 2 inland water, with a special set of water quality criteria due to its polluted condition. Pearl Harbor receives flows from a drainage basin of approximately 260 square kilometers (100 square miles). Freshwater inflows create a stratified estuary where a surface layer of brackish water flows out of the main channel with little tidal influence. The abundant rainfall at the heads of the streams that drain into Pearl Harbor results in runoff that transports pollutants from upland forest, agricultural, commercial, industrial, military, and residential lands. Water quality parameters for nitrogen, phosphorus, turbidity, fecal coliform, temperature, and chlorophyll are frequently violated in Pearl Harbor. The narrow entrance channel and the configuration of the lochs retard flushing of the harbor. Siltation is also a major problem, which is addressed by frequent maintenance dredging, and sediments are continuously resuspended by ship traffic.

Ke'ehi Lagoon

Ke'ehi Lagoon is a highly modified water body, designated Class A by HDOH. After World War II, seaplane runways were dredged, greatly increasing the water volume and retarding flushing of the lagoon. When the Honolulu International Airport (HNL) was built, an additional circulation channel was constructed that improved water quality, but a gradient of increasing turbidity and plant nutrients exists toward the discharges of Kalihi and Moanalua Streams. Other point source discharges to the lagoon include a drainage canal from HNL and adjacent industrial areas, and several additional drainage outlets along Lagoon Drive on the more southwesterly shoreline of the lagoon.

The currents in O'ahu's southern coastal waters move from Honolulu Harbor into Ke'ehi Lagoon. These currents may transport pollutants into Ke'ehi Lagoon and recirculate suspended matter. Various causes, effects and symptoms of water pollution in the lagoon have been documented, including petrochemical contamination of sediments and water, fish kills, and the presence of human enteric viruses. Although circulation in Ke'ehi Lagoon is good, the lagoon regularly experiences violations of water quality parameters for phosphorus and turbidity. Nearly the entire lagoon includes fill material deposited from nearby dredging and from other sources.

In 1943, Kalihi Channel was dredged to the depth of 35–40 feet as part of a military project to connect Kapālama Basin in Honolulu Harbor with the open ocean. Currently, there are two bridges over the Kalihi Channel effectively blocking ship access to Honolulu Harbor from Ke'ehi Lagoon.

Over 300 vessels (e.g. boats and floating structures) are anchored throughout Ke'ehi Lagoon and are often used as residences. Many of the vessels are not seaworthy and cannot propel themselves under their own power.

Honolulu Harbor

Honolulu Harbor is a Class A marine embayment. Water pollution problems in Honolulu Harbor have been recognized as far back as the 1920s. Two streams, Kapālama and Nu'uanu, and numerous ditches and storm drains contribute runoff to the harbor, along with associated pollutants. Water quality in the Kapālama Basin portion of the harbor is particularly poor because of discharges from Kapālama Stream. The parameters of greatest concern are nutrients, metals, suspended solids, pathogens, and turbidity. Bacteria, nitrogen, phosphorus, and turbidity levels regularly exceed State water quality standards.

Kewalo Basin

Two major storm drains discharge into Kewalo Basin, a Class A marine embayment. One drain serves Ala Moana Park and Ala Moana Center and the mauka residential and commercial areas. The other drain serves the Ward Avenue and Kaka'ako area, which consists of mostly light industrial and commercial businesses. All areas support heavy vehicular traffic.

Kewalo Basin's design hinders circulation of water in the basin. As a result, the urban pollutants that collect in the basin remain concentrated for extended periods. Street debris, oil, chemicals, nutrients, and heavy metals are transported by urban runoff into Kewalo Basin. Water quality standards have been exceeded for nitrogen, phosphorus, chlorophyll a and turbidity.

Ala Wai Canal and Boat Harbor

The Ala Wai Canal is a Class 2 inland water or estuary and the Ala Wai Boat Harbor, at the mouth of the Ala Wai Canal, is a Class A marine water body. As the connecting point for the Makiki, Mānoa, Pālolo, and Kapahulu watersheds, the Ala Wai Canal accumulates sediments, nutrients, some heavy metal contaminants, solid waste, and trash. Phytoplankton growth, suspended sediments, and visually objectionable trash discolor water in the canal. In addition, some incidences of bacterial infection have been reported. Water circulation from the point where the Mānoa Stream meets the canal to near Kapahulu Avenue is poor. Floating debris collects under the makai side of the McCully Street Bridge, creating an unsightly mess.

Water Recreation

Recreational uses of surface waters within or adjacent to the corridor are limited primarily to the ocean and the Ala Wai Canal. The 'Ewa portion of the corridor falls within a Non-designated Ocean Recreation segment, from Pearl Harbor to Kalaeloa (formerly Barbers Point). The rest of the corridor falls within the South Shore O'ahu Ocean Recreation Management segment, which includes all ocean waters and navigable streams from Makapuu Point to the west boundary of the Reef Runway of Honolulu International Airport. In addition to swimming and sunbathing, people surf, snorkel, paddle, canoe, sail, cruise, ride jet skis, whale watch, water ski, and fish in this area.

Offshore of Ala Moana Regional Park is the Ala Moana Commercial Thrill Craft Zone, which is restricted to commercial operators. Between Sand Island and the Honolulu International Airport is Ke'ehi Lagoon, a portion of which is a commercial thrill craft and other commercial ocean activities. Recreational thrill craft are accommodated in the Reef Runway Zone that parallels the airport's Reef Runway.

Recreational use of the navigable streams in the corridor is minimal. Recreational use of the Ala Wai Canal consists primarily of paddling and fishing. However, as mentioned earlier in this section, the water quality is poor and HDOH has issued a health advisory regarding the consumption of fish from the Ala Wai Canal (HDOH, May 21, 1998).

Groundwater

Within the 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 (Figure 4-1 and Figure 4-2). Caprock is composed predominantly of coral-algal limestone, interlaid with terrigenous clays and muds. Volcanic ash from the Honolulu volcanic series is often found in the caprock. The caprock ranges between approximately zero and 1,000 feet thick in the corridor (Wentworth, 1951).

The 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 Koʻolau Range and constitutes a barrier that retards the seaward flow of groundwater. The caprock layer thins with distance from the shoreline and ends at varying distances inland, and the basalt layer is then exposed or underlies relatively thin surficial materials. As a consequence, inland areas of central Honolulu have the highest water tables in southern Oʻahu.

Beneath the caprock and underlying all of southern Oʻahu, the SOBA is heavily utilized, containing large supplies of fresh water. The basal groundwater is under artesian pressure and water levels range from ten to thirty feet above sea level. Although the capacity of the caprock to store and transmit water is small compared to that of the basalt aquifer, the caprock contains large quantities of water accumulating from rainfall, irrigation return, and leakage upward from the artesian portion of the basalt aquifer. Caprock water is generally of poor quality because of its relatively high chloride content, but has been developed for agricultural and industrial purposes. Groundwater levels in the caprock in the corridor vary with ocean tides and may also be influenced locally by streams. Depths of the caprock water may be as little as five feet below ground surface in the Honolulu portion of the corridor.

There are numerous injection wells for waste discharge into the caprock in central Honolulu, including those for thermal effluent, car-wash return, and rainwater. However, pollutants from these discharges do not reach the SOBA, due to upward artesian pressure.

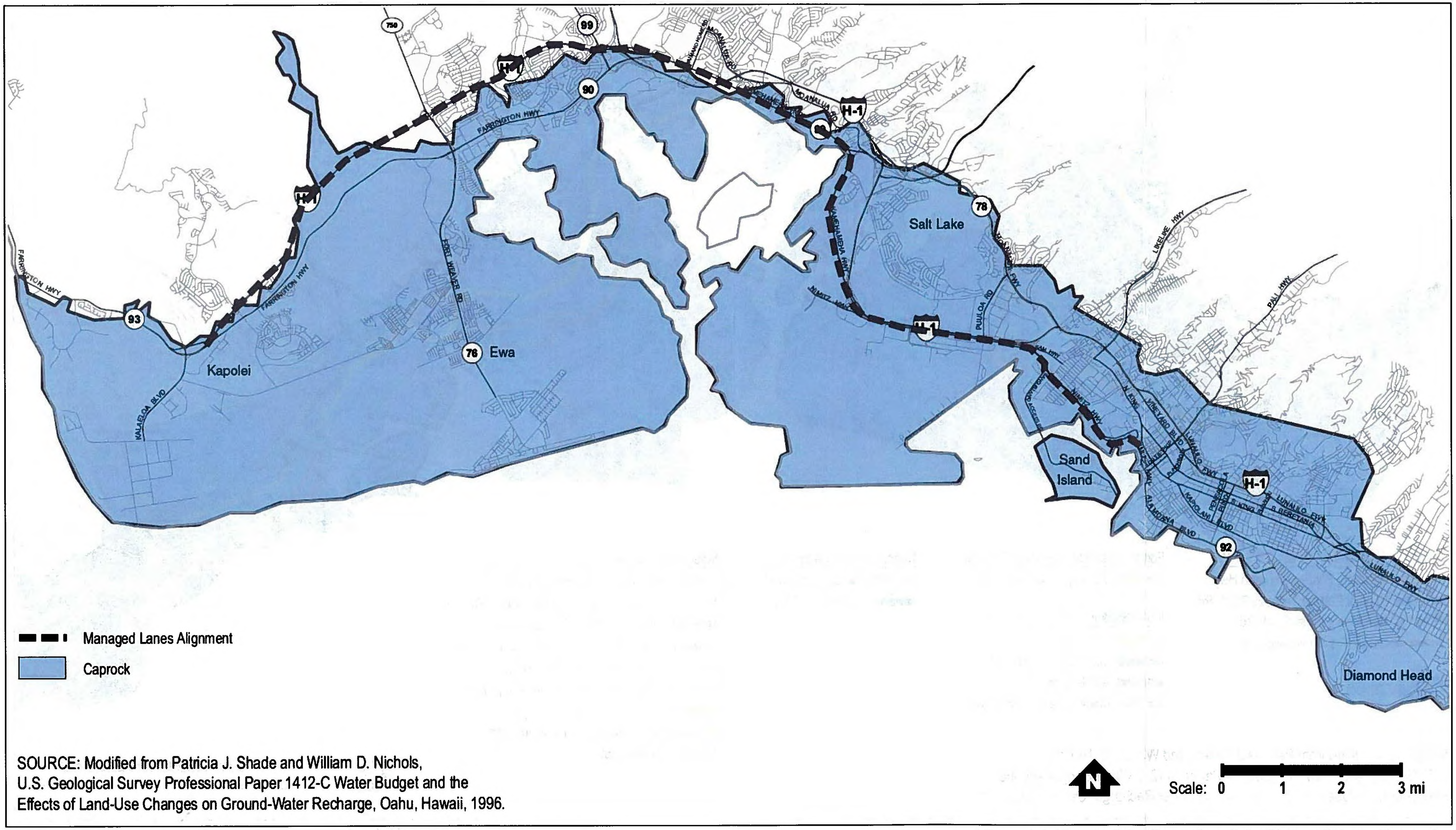

Figure 4-1. Extent of the Caprock and the Managed Lane Alternative

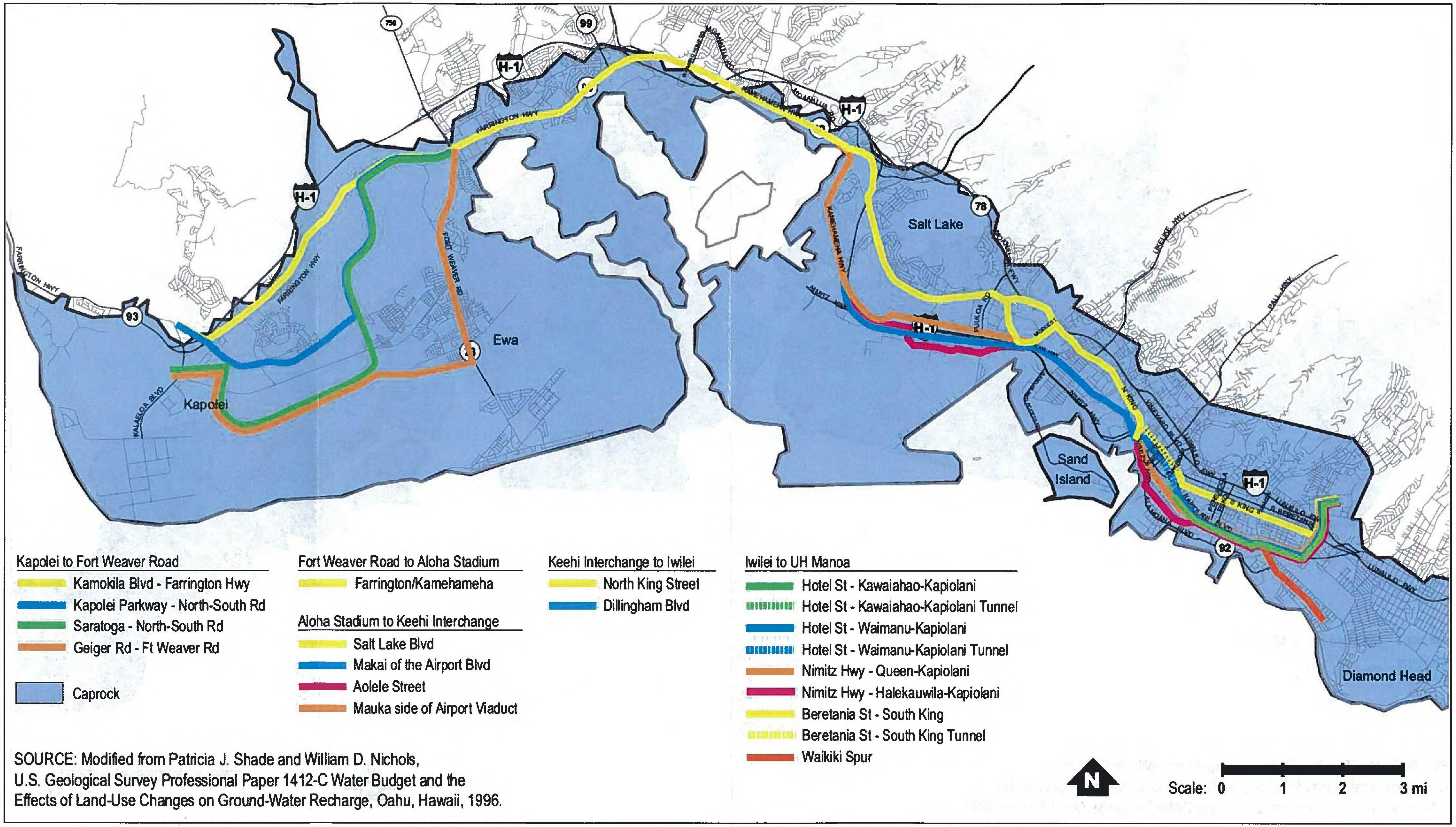

Figure 4-2. Extent of the Caprock and the Fixed Guideway Alternative

Alternative 1: No Build

While the No Build Alternative (see Chapter 1) assumes completion of projects defined in the 2030 O‘ahu Regional Transportation Plan (ORTP), no construction would be directly undertaken as part of this project. Water related impacts associated with development of the individual projects listed in the ORTP are not detailed in this evaluation because the projects will undergo planning and environmental review as part of their individual project development process. Therefore, no water related impacts are associated with the No Build Alternative for this project.

Alternative 2: Transportation System Management

While the Transportation System Management Alternative (see Chapter 1) 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 both a morning and afternoon peak-hour zipper-lane operation, and other relatively low-cost bus priority capital improvements on selected roadway facilities, as well as the completion of projects defined in the O‘ahu ORTP that are also included in the No Build Alternative, no major construction projects would be undertaken as part of this project. Water related impacts associated with development of the individual projects are not detailed in this evaluation because the projects would undergo planning and environmental review as part of their individual project development process. Therefore, no water related impacts are associated with the Transportation System Management Alternative for this project. Because vehicle miles traveled on O‘ahu would be less than with the No Build Alternative, transportation-related pollutants in stormwater would be somewhat less than for the No Build Alternative.

Alternative 3: Managed Lane

Long-term Impacts

Surface Waters and Wetlands

The Managed Lane Alternative would cover existing landscaped medians and include new bridges that would increase stormwater capture. New catch basins and drainage facilities meeting current highway drainage standards would be constructed. Stormwater collected on the viaduct would flow into storm drains within the median and would empty into the drainage system that discharges into adjacent water bodies.

Because of the heavily urbanized nature of the project area, the amount of stormwater and associated contaminants (gasoline, rubber, etc.) entering nearby surface waters would be similar under the No Build and the Managed Lane Alternative. Impacts to water quality would be somewhat greater under the Managed Lane Alternative because the number of vehicle miles traveled on O‘ahu would be greater with the Managed Lane

Alternative than with any of the other alternatives. No substantial long-term effects from the Managed Lane Alternative are expected on water quality of the nearby surface water bodies.

Waimalu Stream, ʻAiea Stream and Hālawa Stream are considered navigable waters at their crossings of Kamehameha Highway. Likewise, Moanalua Stream, Kalihi Stream and Kapālama Canal are all considered navigable waters at the Nimitz Highway crossings. The Managed Lane Alternative would have no impact on navigation to these streams. When present, navigation on these streams is already limited to small pleasure craft that would be unimpeded by new bridges. However, bridges over navigable waters would require approval from the U.S. Coast Guard prior to construction.

The Managed Lane Alternative is not expected to affect any water recreation activities within or adjacent to the project area. No restriction of access to water recreation activities and no water quality impacts that could affect recreational uses would occur.

Wetlands, identified as the Waiau Spring Pond and Sumida Watercress Farm, are present on the mauka side of Kamehameha Highway, and would not be in the path of the managed lane, elevated roadway structure over the median of Kamehameha Highway. No long term impacts to wetlands are anticipated.

Groundwater

In accordance with a 1984 Sole Source Aquifer Memorandum of Understanding between FHWA and the U.S. Environmental Protection Agency (EPA), a Groundwater Impact Assessment (GWIA) would be prepared and submitted to the EPA after the LPA is selected. The assessment will initiate Section 1424(e) Review under the Safe Drinking Water Act. The assessment will evaluate in detail the LPA's potential impact on the quality of the groundwater. The water quality assessment will also include discussion of the LPA's potential construction-phase impacts, which may require deep excavations for the viaduct columns. A general discussion of potential construction impacts is provided later in this chapter.

Potential impacts to groundwater quality may be slightly greater under the Managed Lane Alternative because the number of vehicle miles traveled on Oʻahu would be greater with the Managed Lane Alternative than with any of the other alternatives. Since the Managed Lane Alternative would increase total regional vehicle miles traveled, the amount of roadway runoff and the risk of accidental spills would be increased.

Along the portion of the Managed Lane Alternative route that is on the caprock (Figure 4-1), any hazardous materials spills or stormwater runoff should only affect the brackish groundwater above the caprock. The potential for contamination of the SOBA from the Managed Lane Alternative in these areas is low because of the artesian conditions of the SOBA and the relative impermeability of the caprock. The SOBA's potable water resources would be expected to remain uncontaminated. In areas where cap rock is not present, there is the potential for contamination of the SOBA from contaminated stormwater runoff or hazardous materials spills infiltrating into the basalt and impacting the SOBA.

No long-term impacts on groundwater quality, quantity, or flow characteristics are anticipated under the Managed Lane Alternative. The piers would disrupt groundwater flow on a localized scale. However, they are spaced approximately every 125 feet, which would allow groundwater to move without major impediment.

The amount of impervious surface constructed as part of the Managed Lane Alternative would not measurably reduce groundwater recharge.

Construction Impacts

Surface Water / Wetlands

The exposure, stockpiling and transportation of excavated material would have the potential to impact the water quality of nearby surface waters during construction. The most extensive excavation and fill activities would be for the structure foundations and for utility trenching. No other major cut and fill activities are anticipated. Sediment loading of stormwater could occur when unstabilized, exposed soil at excavations and stockpiles experience heavy rains. Sediment-laden stormwater has the potential to create unacceptable levels of turbidity and high sedimentation rates in streams and near shore waters. Major erosion of cut areas should not occur because the project area is generally flat.

As described in the *Honolulu High-Capacity Transit Corridor Project Hazardous Materials Technical Report*, excavated material has the potential to contain oil, grease and other contaminants. Exposing the excavated material during construction activities could increase the potential for stormwater transport of these contaminants. These potential impacts and mitigation measures will be addressed in additional hazardous material studies as the project design advances.

The use and maintenance of construction equipment could pose a threat to surface waters. Potential spills associated with vehicle maintenance, such as changing oil and refueling equipment, could introduce new contaminants into the environment at the construction staging area.

Since the construction method resulting in greater construction impacts is assumed to be drilled shafts with a cast-in-place viaduct, this would require the transport of large amounts of concrete to the construction site. Each time concrete is transported, residue remaining in the cement truck must be washed out before it hardens. This wastewater contains fine particles that could cause sedimentation and turbidity if it enters surface waters. It is likely, however, because of access issues and traffic disruption, that the contractor would fabricate most of the viaduct off-site.

The Managed Lane Alternative would require new bridges across streams in the project corridor (Table 4-1). Construction activities in the streams would likely disturb sediments, resulting in increased turbidity. As described in Chapter 4, the sediments in several streams may contain high levels of heavy metals, pesticides, or other contaminants that could be introduced into the water column. Relocating sewer lines or utilities that cross streams could pose similar problems if the lines are relocated under the stream and constructed by normal trenching, which would disturb the stream sediment.

Prior to any construction and fill activities within wetlands, an ACOE permit application and a Section 401 Water Quality Certification would address construction methods, impacts, and mitigation measures. Similar to the impacts to surface waters, the exposure, stockpiling and transportation of excavated material has the potential to impact the water quality of receiving downstream waters during construction. However, as noted above, the managed lane roadway is expected to be elevated over the median of Kamehameha Highway and construction would be from the highway itself. Discharges into wetlands are not anticipated, and thus, no impacts are expected. The general measures identified for surface waters above, would apply to wetlands.

Groundwater

In accordance with a 1984 Sole Source Aquifer Memorandum of Understanding between FHWA and EPA, a GWIA would be performed once the LPA is selected.

The caprock along the route varies in thickness from zero to about 1,000 feet (Figure 4-1). The foundations for the managed lane structure's columns would require either driven piles or drilled shafts to a maximum depth of 200 feet. In some locations, the pilings would remain in the upper half of the caprock and would affect only the groundwater in the caprock. As described in Chapter 4, underlying the caprock is the volcanic basement, which contains the SOBA. The quality of the groundwater in this aquifer is excellent, and it is under artesian pressure because it is confined by the caprock. Because of the artesian pressure, water leaks upward from the SOBA into the caprock aquifer. In areas where the caprock is thin, the pilings would be drilled or driven into the basalt which contains the SOBA. This would have the potential to contaminate this sole source aquifer.

As described in Chapter 4, the water table is often near the surface within the project limits. Groundwater encountered by the excavations would be removed during construction, and water disposal and ground subsidence could occur. In areas where there is substantial artesian water flow, it may be difficult to pour concrete in drilled shafts and driven piles may ultimately be the necessary construction method.

Uncontaminated groundwater (e.g., not containing petroleum, hydrocarbons or other pollutants) removed from the excavations must either be returned to the groundwater system, added to the stormwater drainage system that would discharge into nearby surface waters, or removed and disposed of at an off-site location away from other water resources (e.g., within a retention basin). Groundwater would probably be pumped out of the excavation with a sump pump. This groundwater would likely contain suspended sediments. Its disposal in a nearby surface water body via a drainage system would require an NPDES permit. If the extracted groundwater is disposed of off site in a retention basin, for example, an NPDES permit for this activity may not be required.

As described in the *Honolulu High-Capacity Transit Corridor Project Hazardous Materials Technical Report*, groundwater could be contaminated with petroleum products at several locations where excavations are required. Any remediation or removal of contaminated groundwater or soil would potentially enhance the quality of the groundwater in the caprock, while leaving the SOBA unaffected.

Dewatering disturbs the natural level and flow characteristics of groundwater. Depression of the natural groundwater table can induce consolidation of subsoils and subsequent ground settlement, called subsidence. Subsidence can cause cracking and other damage to buildings and facilities. Although the actual method of dewatering would be determined in a later stage of design work, if a sump is not sufficient to achieve satisfactory drawdown, a sophisticated dewatering technique, such as a well-point system or a deep-well system within the excavation, may be required. These dewatering techniques could pose a risk of subsidence and subsequent structural damage. Simple pumping of groundwater from the excavation would not likely cause subsidence.

Alternative 4: Fixed Guideway

Long-term Impacts

Surface Water / Wetlands

By covering the existing landscaped median or roadside and providing new bridges, the Fixed Guideway Alternative would increase stormwater capture. Stormwater collected on the guideway would flow into storm drains and would empty into the drainage system which discharges into adjacent surface waters.

Because of the heavily urbanized nature of the project area, the amount of stormwater and associated contaminants (gasoline, rubber, etc.) entering nearby surface waters would be almost identical under all the alternatives. Impacts to water quality caused by transportation pollutants carried in stormwater would be less under the Fixed Guideway Alternative because the number of vehicle miles traveled on O‘ahu would be fewer with the Fixed Guideway Alternative than with any of the other alternatives. No long-term effects from the Fixed Guideway Alternative are expected on the water quality of the nearby surface water bodies.

At their crossing by the fixed guideway, many streams are considered navigable waters (Table 4-1). The Fixed Guideway Alternative should have no impact on navigation on these streams. When present, navigation on these streams is limited to small pleasure craft that would be unimpeded by new bridges or relocated utilities. However, bridges over navigable waters require approval from the U.S. Coast Guard prior to construction.

The Fixed Guideway Alternative is not expected to affect any water recreation activities within or adjacent to the project area. No restriction of access to water recreation activities and no water quality impacts that could affect recreational uses would occur.

Wetlands, identified as the Waiau Spring Pond and Sumida Watercress Farm, are present on the mauka side of Kamehameha Highway, and would not be in the path of the elevated fixed guideway structure over the median of Kamehameha Highway. No long term impacts to wetlands are anticipated as a result of the Fixed Guideway Alternative.

Groundwater

In accordance with a 1984 Sole Source Aquifer Memorandum of Understanding between FHWA and the U.S. Environmental Protection Agency (EPA), a GWIA would be prepared and submitted to the EPA after the LPA is selected. The assessment will initiate Section 1424(e) Review under the Safe Drinking Water Act. The assessment will evaluate in detail the LPA's potential impact on the quality of the groundwater. The GWIA will also include discussion of the LPA's potential construction-phase impacts, which may require deep excavations for the viaduct columns. A general discussion of potential construction impacts is provided later in this chapter.

No long-term impacts on groundwater quality, quantity, or flow characteristics are anticipated. The Fixed Guideway Alternative would provide a clean, convenient public transportation alternative to single-occupant automobiles. By replacing single-occupant vehicles with electric transit vehicles and reducing total regional vehicle miles traveled, the overall pollutant loading of roadway runoff would be reduced. The amount of gasoline, rubber and other highway contaminants should be reduced if fewer cars are on the highway because their former occupants are riding the transit system.

For the majority of the Fixed Guideway Alternative route, any stormwater runoff containing lubricants from the transit vehicles using the guideway would only affect the brackish groundwater in the caprock aquifer (Figure 4-2). The potential for contamination of the SOBA from the Fixed Guideway Alternative in these areas is low due to the artesian conditions of the SOBA and the relative impermeability of the caprock. The SOBA's potable water resources would remain uncontaminated. In the areas where the fixed guideway would run along places where the basalt containing the SOBA is not covered by a thick layer of caprock, stormwater runoff can percolate into the SOBA. In these areas, there is the potential for contamination of the SOBA from guideway drainage.

The fixed guideway piers and tunnels would disrupt groundwater flow on a localized scale. However, the piers are spaced several hundred feet apart allowing groundwater to move without major impediment.

The amount of impervious surface constructed as part of the Fixed Guideway Alternative would not measurably reduce the recharge of the SOBA.

Construction Impacts

Surface Water / Wetlands

The exposure, stockpiling and transportation of excavated material have the potential to impact the water quality of nearby surface waters during construction. The most extensive excavation and fill activities would be for the guideway foundations and abutments, for the tunnels, and for utility trenching. Sediment loading of stormwater could occur when unstabilized, exposed soil at excavations and stockpiles experience heavy rains. Sediment-laden stormwater has the potential to create unacceptable levels of turbidity and high sedimentation rates in nearby surface waters. However, erosion hazards are reduced because the project area is generally flat.

As described in the *Honolulu High-Capacity Transit Corridor Project Hazardous Materials Technical Report*, excavated material has the potential to contain oil, grease and other contaminants. Exposing the excavated material during construction activities could increase the potential for stormwater transport of these contaminants. These potential impacts and mitigation measures would be addressed in additional hazardous material studies during the design phase.

The use and maintenance of construction equipment can pose a threat to surface water. Potential spills associated with vehicle maintenance, such as changing oil and refueling equipment, can introduce new contaminants into the environment at the construction staging area.

Since the construction method for the guideway piers resulting in greater construction impacts is assumed to be cast-in-place, this would require the transport of large amounts of concrete to the construction site. In addition, the tunnel lining may be formed on site. Each time concrete is transported, residue remaining in the cement truck must be washed out before it hardens. This wastewater contains fine particles and could cause sedimentation and turbidity if they find their way to surface waters.

The Fixed Guideway Alternative would require new bridges across streams in the project corridor (Table 4-1). Construction activities in the streams would be likely to disturb sediments resulting in increased turbidity. As described in Chapter 4, the sediments in several streams may contain high levels of heavy metals, pesticides, or other contaminants that could be introduced into the water column. Relocating sewer lines or utilities that cross streams could pose similar problems if the lines are relocated under the stream and constructed by normal trenching, which would disturb the stream sediment.

Pre-requisite to any construction and fill activities within wetlands, an ACOE permit application and a Section 401 Water Quality Certification would address construction methods, impacts, and mitigation measures. Similar to the impacts to surface waters, the exposure, stockpiling and transportation of excavated material have the potential to impact the water quality of receiving downstream waters during construction. However, as noted above, the fixed guideway is expected to be elevated over the median and construction would be from the highway itself. Discharges into wetlands are not anticipated, and thus, no impacts are expected. The general measures identified for surface waters above, would also apply to wetlands.

Groundwater

In accordance with a 1984 Sole Source Aquifer Memorandum of Understanding between FHWA and EPA, a detailed GWIA will be prepared and submitted to the EPA after the LPA is selected.

The caprock along the route varies in thickness from zero to about 1,000 feet. The foundations for the viaduct columns would require either driven piles or drilled shafts to a maximum depth of 200 feet. Therefore, in some places, the pilings would remain in the upper half of the caprock and would affect only the groundwater in the caprock. As described in Chapter 4, underlying the caprock is the volcanic basement, which contains the SOBA. The quality of the groundwater in this aquifer is excellent, and it is under artesian pressure because it is confined by the caprock. Because of the artesian pressure, water leaks upward from the SOBA into the caprock aquifer.

In areas where the caprock is thin to nonexistent, the foundation columns would either be driven or drilled directly into the SOBA. This has the potential to contaminate this sole source aquifer.

As described in Chapter 4, the water table is near the surface within the project limits. Groundwater encountered by the excavations would need to be removed during construction, and water disposal and ground subsidence has to be considered. In areas where there is significant artesian water flow, it may be difficult to pour concrete in drilled shafts and driven piles may ultimately be the necessary construction method.

Uncontaminated groundwater (e.g., not containing petroleum hydrocarbons or other pollutants) removed from the excavations must either be returned to the groundwater system, added to the stormwater drainage system, which would discharge into nearby surface waters, or removed and disposed of at an off-site location away from other water resources (e.g., within a retention basin). Groundwater would probably be pumped out of the excavation with a sump pump. Because this groundwater would contain suspended sediment, its disposal in a nearby surface water body via a drainage system or in the ground would require an NPDES permit. If the extracted groundwater is disposed of off site in a retention basin, for example, an NPDES permit for this activity may not be required.

As described in the *Honolulu High-Capacity Transit Corridor Project Hazardous Materials Technical Report*, groundwater could be contaminated with petroleum products at several locations where excavations are required. Any remediation or removal of contaminated groundwater or soil would potentially enhance the quality of the groundwater in the caprock, while leaving the SOBA unaffected.

Dewatering disturbs the natural level and flow characteristics of groundwater. Depression of the natural groundwater table can induce consolidation of subsoils and subsequent ground settlement, called subsidence. Subsidence can cause cracking and other damage to buildings and facilities. Although the actual method of dewatering would be determined in a later stage of design work, a simple sump pump may not achieve satisfactory drawdown and a sophisticated dewatering technique, such as a well-point system or a deep-well system within the excavation, may be required. These dewatering techniques could pose a risk of subsidence and subsequent structural damage. Simple pumping of groundwater from the excavation would not likely cause subsidence.

Subsidence would be a concern during construction for many of the fixed guideway piers in areas where there are many buildings, roads and other facilities. In addition, the tunnels are planned under roads in densely built corridors with many historic and other important properties. Therefore, subsidence would be a concern during the tunneling operation as well.

Secondary and Cumulative

A cumulative impact, according to 40 CFR 1508.7, is defined as:

> . . . . an impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future

> actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

According to 40 CFR 1508.8, secondary impacts are impacts that have the potential to occur

> later in time or farther removed in distance but are still reasonably foreseeable.

They can be viewed as actions of others that are taken because of the presence of the proposed project. Secondary impacts from transportation projects often occur because they can induce development, which in turn has the potential to cause resource depletion, demands on infrastructure systems, loss of open space, and impacts to the natural and social environment.

Alternative 1: No Build

No secondary or cumulative impacts are attributed to the described project. Water related impacts associated with the development of the individual projects listed in the ORTP are not detailed in this evaluation because the projects will undergo planning and environmental review as part of their individual project development process.

Alternative 2: Transportation System Management

No secondary or cumulative impacts are attributed to the described alternative. Water related impacts associated with the development of the individual projects considered under the TSM Alternative are not detailed in this evaluation because the projects will undergo planning and environmental review as part of their individual project development process.

Alternative 3: Managed Lane

Cumulative Impacts

Large construction projects, such as the construction of the managed lane alternative, have the potential to increase sediment loading of surface waters during heavy rains. However, under the NPDES permit process, projects covering at least one acre are required to incorporate Best Management Practices (BMPs) to minimize this impact. The project would not establish a new corridor (i.e., new highway), and the alignment is already highly urban. Industrial uses that would require water discharges are not planned.

Secondary Impacts

The project area is, by design, already highly urban. Areas that are currently vacant are designated for future development. The proposed project is expected to influence development near bus stops and facilities entrances, as well as change and influence economic factors that would determine the mix of businesses. It is possible that streams and nearshore waters in areas served by the Managed Lane Alternative may be impacted by this future development. Similarly, the SOBA could be threatened by additional growth in the area.

Alternative 4: Fixed Guideway

Cumulative Impacts

Large construction projects, such as the construction of the guideway and transit stations, have the potential to increase sediment loading of surface waters during heavy rains. However, under the NPDES permit process, projects covering at least one acre are required to incorporate BMPs to minimize this impact. The project would not establish a new corridor (i.e., new highway), and all alignments are already highly urban or planned for development. Industrial uses that would require water discharges are not planned.

Secondary Impacts

The project area is, by design, already highly urban. Areas that are currently vacant are designated for future development. The proposed project is expected to influence development near transit stations, as well as change and influence economic factors that would determine the mix of businesses. It is possible that streams and nearshore waters crossed by the Fixed Guideway Alternative may be impacted by this future development. Similarly, the SOBA could be threatened by additional growth in the area.

Construction of the either the Managed Lane or Fixed Guideway Alternative, would require similar techniques for the construction of the elevated structure carrying either traffic or transit vehicles. However, the Fixed Guideway Alternative also requires tunnels, transit stations, and park-and-ride lots. Therefore, possible mitigation measures common to both alternatives are described together and additional information about the Fixed Guideway Alternative is added, as necessary.

Surface Water and Wetlands

Sedimentation and turbidity caused by sediment suspended in stormwater runoff would be mitigated by a site-specific Best Management Practices (BMP) plan, which would be reviewed by the HDOH during the National Pollutant Discharge Elimination System (NPDES) permit process for stormwater discharges from construction areas larger than one acre. The BMP plan would assure the use of proper sediment control techniques. BMPs could include:

- Proper design and construction of access areas;
- Planting of vegetation and/or mulching on highly erodible or critically eroding areas;
- Use of inlet system sediment control traps;
- Installation of debris basins and silt fences;
- Use of stilling basins to reduce the levels of sediments and other pollutants entering surface and coastal waters;
- Use of silt fencing and sand bags; and
- Construction of dikes or diversions to avoid runoff across erodible areas.

Building the pier foundations for both the Managed Lane Alternative and the Fixed Guideway Alternative would create substantial amounts of excavated material. The tunnels, however, proposed for the Fixed Guideway Alternative, have the potential to produce significant amounts of contaminated soil. As described in the *Honolulu High-Capacity Transit Corridor Project Hazardous Materials Technical Report*, a variety of techniques, such as covering the material or shipping it off site, could be employed to prevent contaminants from the excavated material from polluting the stormwater runoff.

Construction of the Managed Lane or the Fixed Guideway Alternative would require deep excavations for the piers. Groundwater could be contaminated with petroleum products at several locations where excavations are required. In addition, the tunnels planned for the Fixed Guideway Alternative are close to or below the water table and may potentially encounter contaminated groundwater. Groundwater encountered by the pier excavations or tunnels may need to be removed during construction, and water disposal has to be considered. Uncontaminated groundwater (e.g., not containing petroleum, hydrocarbons or other pollutants) removed from the excavations must either be returned to the groundwater system, added to the stormwater drainage system, which would discharge into nearby surface waters, or removed and disposed of at an off-site location away from other water resources (e.g., within a retention basin). Groundwater would probably be pumped out of the excavation with a sump pump. This groundwater would contain suspended sediment. Its disposal in a nearby surface water body via a drainage system would require an NPDES permit. If the extracted groundwater is disposed of in a retention basin or another excavation, for example, an NPDES permit for this activity may not be required.

If the contractor chooses to dispose uncontaminated groundwater into the drainage system or directly into a nearby water body, BMP measures would be required to prevent increasing the turbidity or sedimentation rates of the receiving waters. BMP measures may include filtering the extracted groundwater or allowing it to settle in order to remove sediment before discharge. A filtering system utilizing filter fabric and clean gravel could be used around the pump to prevent migration of fine soil material into the pumped-out water, and would assure that only clean water is pumped out of the excavation. If sediments remain in the pumped water, the discharge could be processed through a settling basin and/or a secondary filtering system. A monitoring program would assure compliance with water quality standards.

Contaminated groundwater would have to be treated prior to discharge into the storm sewer or nearby water body. Petroleum contaminants would be removed from water pumped from the excavations in accordance with standards established by HDOH. Removal of petroleum products might require the use of oil water separators, strippers or other remediation techniques. Additional studies will be required during the final design phase to determine the precise methods to be employed.

At the vehicle maintenance area, strict enforcement of BMPs would be required. Clean up equipment would be maintained on site and a clean up response plan would include detailed spill response measures.

Cement trucks would be washed out in accordance with identified procedures to ensure that water quality standards are not violated. Project specifications would prohibit the washing out of concrete trucks at the project site. A filtration or settling system would be constructed to prevent fine material from being discharged into surface waters.

Construction in the streams or wetlands crossed by the Managed Lane Viaduct or the Fixed Guideway could require ACOE permits pursuant to Section 404 of the Clean Water Act (CWA) and possibly Section 10 of the Rivers and Harbors Act (R&HA) because many of the streams are navigable water bodies (Table 4-1). CWA Section 404 requirements may apply because dredge and fill activities may occur within the "ordinary high water mark" of the stream, which are the limits of the ACOE jurisdiction. In addition to the CWA Section 404 permit, construction in the stream might require water quality certification (WQC) from the HDOT pursuant to CWA Section 401. The WQC requires a site-specific BMP plan and erosion control measures to prevent degradation of water quality in the streams. BMP measures may include phasing in-stream work and rerouting portions of the stream to create dry work areas within the stream bed. Construction activities within streams could be restricted to drier, low-flow periods of the year (May through September). If affected stream sediments are found to be contaminated during Phase II site investigations or actual construction, a remediation or removal plan will be developed as described in the *Honolulu High-Capacity Transit Corridor Project Hazardous Materials Technical Report.*

In the event that avoidance of wetlands is not practicable and wetlands are lost as a result of project construction, compensatory mitigation would be required by ACOE. Compensatory mitigation could involve the replacement of wetlands at an adjacent or offsite location within the same watershed. The ratio of fill wetland to the new compensatory wetland would require negotiation with ACOE. The mitigation plan would be also need to receive the review and approval of the USFWS and EPA.

Stormwater runoff from the structures and parking lots after operation of the transit system has commenced would be handled according to current design standards.

Groundwater

To support the piers, piles would either be driven or shafts would be drilled and concrete poured to form supports. The pier supports and the tunnels, by penetrating the SOBA, could contaminate the aquifer. To prevent this from happening, the drill hole in areas where the groundwater is contaminated would have to be cased or another method used to prevent an influx of contaminated water. When active drilling is not occurring, the drill hole would need to be capped. In accordance with a 1984 Sole Source Aquifer Memorandum of Understanding between FHWA and the EPA, a GWIA would be prepared and submitted to the EPA after the LPA is selected. The assessment would evaluate in detail the LPA's potential impact on the quality of the groundwater and appropriate mitigation measures.

Depression of the natural groundwater table can induce consolidation of subsoils and subsequent ground settlement, called subsidence. Subsidence can cause cracking and other damage to buildings and facilities. Subsidence would be a concern during construction for many of the piers for both the Fixed Guideway and the Managed Lane Alternatives in areas where buildings, roads and other facilities are in existence. In addition, the fixed guideway tunnels are planned under roads in densely built corridors with many historic and other important properties. Subsidence would be a major concern during the tunneling operation.

To mitigate the potential impacts of subsidence induced by a sophisticated dewatering system, a structural survey of buildings, roadways and other facilities adjacent to the site may be required prior to construction. During construction, a monitoring program would include such techniques as inclinometers to measure relative lateral movement of soil at different elevations, settlement points, and observation wells to study groundwater drawdown. Monitoring data would be reviewed immediately to ensure minimal disturbance to existing facilities. Recharging the groundwater outside the excavation location and other measures could be utilized to help minimize the effects of dewatering.

As described in Chapter 4, groundwater could be contaminated with petroleum products at several locations where pier excavations or tunnels are required. These petroleum contaminants would be removed from water pumped from the excavations in accordance with standards established by HDOH. Removal of petroleum products might require the use of oil water separators, strippers or other remediation techniques. Additional studies would be required during the final design phase to determine the precise methods to be employed.

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