ESTUARY CROSSING STUDY: DETAILED FEASIBILITY AND TRAVEL DEMAND ANALYSIS

PREPARED FOR:

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Vicinity Map

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Acronyms and Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
AC Transit	Alameda-Contra Costa Transit District
ADA	Americans with Disabilities Act
Alameda CTC	Alameda County Transportation Commission
BART	Bay Area Rapid Transit
Caltrans	California Department of Transportation
CHTS	California Household Travel Survey
e-bike	Electric bicycle
EIR	Environmental Impact Statement
FEE	Functional Evaluation Earthquake
GPS	Global Positioning System
kV	Kilovolt
LRFD	Load Resistance Factor Design
MHW	Mean High Water
OD	Origin-Destination
PEAR	Preliminary Environmental Analysis Report
PSR	Project Study Report
SDC	Seismic Design Criteria
SEE	Safety Evaluation Earthquake
TAZ	Traffic Analysis Zone

Executive Summary

Oakland and Alameda are neighbor cities in the East Bay that are separated by the Oakland Estuary, which is approximately 600 feet wide. Every day thousands of commuters, residents, and visitors cross the estuary using a variety of modes: vehicle, bus, bicycle, water shuttle, and on foot. Four bridges connect the north and east sides of Alameda Island to Oakland. On the west side of the island, the Webster and Posey tubes connect Alameda to downtown Oakland and Jack London Square.

The only existing link for bicyclists and pedestrians across the estuary is a narrow pathway through the Posey Tube. With strong local bicycle networks in both Oakland and Alameda like the San Francisco Bay Trail and the Cross Alameda Trail, there is a great opportunity to create a multimodal crossing for bicyclists, pedestrians, and/or transit users, and to establish a sustainable link between the two cities and to the wider East Bay.

This *Estuary Crossing Study* expands on the previous efforts initiated in the *Estuary Crossing Feasibility Study* by the City of Alameda (2009), plus more recent evaluations of numerous possible bicycle/pedestrian bridge alignments in the study area, as seen in the Vicinity Map. Eleven alternatives to better connect Alameda and downtown Oakland were studied. These included three possible bridge alignments each with various ramping options that account for eight of the alternatives. The other three alternatives considered a new transit/bicycle/pedestrian tube, new water shuttle service, and improvements to the existing Webster Tube. These alternatives all have different benefits and drawbacks based on their alignments, touchdown locations, and constructability. All alternatives were conceptualized to comply with standards from the U.S. Coast Guard, California Department of Transportation (Caltrans), and local agencies, and considered impacts to new and existing developments on the waterfronts. The tentative costs to design and construct these projects ranged from $1 million to $2.7 billion based on a construction year of 2030.

Table 1: Summary of Alternatives

Alternative		Weekday Ridership[1] (daily, two-way)	Project Cost[2]	Operation & Maintenance Cost (annual)
A	Bridge at Jack London Square/Alameda Landing [5 ramping options]	5,320	$197M	$3.4M
B	Franklin Transit Tube	690	$2.7B	$27M
C	Existing Webster Tube Improvements	460	$6.0M	n/a
D	Bridge at Estuary Park/Alameda Shipways [2 alignment options]	4,910	$196M	$3.4M
E	Water Shuttle Service	1,240	$1.0M	$2.0M
F	Bridge at Alice Street	4,940	$194M	$3.3M

[1] See Table 8 for details. Includes walk and bike modes forecasted for 2030.

[2] See Appendix E for cost assumptions and details.

Chapter 1
Background

1.1 Project Description

The *Estuary Crossing Study* investigated connecting downtown Oakland and Alameda Island with a multimodal facility across the Oakland Estuary. The study was completed in March 2020 and finalized in January 2021 when the U.S. Coast Guard letter of preliminary support was received. Multiple alternatives were considered to better serve bicyclists and pedestrians ranging from a new bridge to new water shuttle services to improvements in the Webster Tube. All alternatives were developed with proper U.S. Coast Guard clearances to maintain all current estuary operations. Details are available in Chapter 3.

This study is comprised of three components. The first component, Alternatives Analysis, includes the conceptualization of various alignments for the proposed facilities and is described in Chapter 2. The second component, Structure Design, includes the analysis of the proposed bridge and its foundations and is described in Chapter 3. The third component, Travel Demand Analysis, describes the expected bicycle and pedestrian volumes for the different alternatives based on their origin-destination (OD) geometry and is described in Chapter 4. The appendices include exhibits and data that were used for the study.

1.2 Project History

1.2.1 Existing Conditions

There are currently two tubes and four bridges that traverse the Oakland Estuary and that separate Alameda Island and Oakland. Within the study area, the Webster Tube carries two lanes of southbound traffic to Alameda, and the Posey Tube carries two lanes of northbound traffic to downtown Oakland. The Posey Tube has the only existing facility for bicyclists and pedestrians, a 36-inch-wide, two-way shared-use pathway. The tubes are approximately 3,500 feet in length. In the study area, the estuary varies from 600 to 1,100 feet wide.

In Oakland, the tubes connect to Webster and Harrison streets at 6th Street. Commuters from Alameda currently use local roads to access the I-880 and I-980 freeways from the tubes. The surrounding area includes Chinatown, downtown Oakland, Jack London Square, and Laney College. Recent commercial and residential development is continuing to create a vibrant community on both sides of the estuary. The nearest Bay Area Rapid Transit (BART) stop is Lake Merritt Station located near 8th and Oak streets. There is also an Amtrak station in Jack London Square. Alameda-Contra Costa Transit District (AC Transit) runs several routes through the tubes, including the 51A trunk line. The existing Bay Trail runs through the area, connecting to the north via 2nd and 3rd streets and to the south with Embarcadero West.

On the Alameda side, the tubes can be accessed from Constitution Way and Webster Street at Willie Stargell Avenue. The surrounding area contains office parks, residential housing, two shopping centers, and the College of Alameda. Alameda Landing, the shopping center adjacent to the study area, contains a wide variety of stores, including a Target and Safeway, as well as restaurants and a gym. Nearby schools include the College of Alameda and Ruby Bridges Elementary School. Proposed development on the Alameda side of the waterfront would be primarily residential. Many of the roads in Alameda serve bicyclists, and the Cross Alameda Trail runs along Atlantic Avenue.

1.2.2 Nearby Projects

There are several projects currently in development near the study area. These projects will all increase demand to visit, work, or live in the area and better connect the two sides. On the Alameda side, these projects are also generating funds for the development of future transportation projects through the Transportation Management Association.

The Oakland Alameda Access Project proposes multimodal connections from Alameda to I-880 and I-980 in Oakland. The project would remove highway-bound traffic from local streets providing safer facilities for bicyclists and pedestrians on nearby local roads, such as 6th Street. Improvements to the highway on- and off-ramps would better connect downtown Oakland to Jack London Square and the waterfront area.

In Oakland, directly northwest of the study area, the Oakland Athletics (A's) are proposing construction of a new baseball stadium at Howard Terminal. This project would partially replace the existing shipping terminal and create a new attraction in the area, especially on game days. This project is currently in the planning phase and may include a gondola connection from the waterfront to downtown Oakland.

To the east of the study area, construction has begun on Brooklyn Basin, a project that will establish multiple buildings for housing and retail, as well as open space for public parks. Also within the study area, the City of Oakland is planning a renovation and expansion of Estuary Park.

In Alameda, there are two residential projects proposed in the study area. Alameda Landing Bay 37 would build a new housing complex along the waterfront area to the northwest of Alameda Landing near Mitchell Ave and 5th Street. Alameda Shipways is proposing housing in the waterfront space to the eastern end of the study area near Marina Village.

To the west of the study area, extensive development is proposed at Alameda Point. This would replace the former Naval Air Station with new housing, commercial, and wildlife refuge developments. Phase 1, Alameda Point Site A, broke ground in 2018 and the first residents will move in by mid-2020.

Various projects are continuing to strengthen the Oakland and Alameda bicycle and pedestrian networks, including extending the San Francisco Bay Trail in the area. The Lake Merritt to Bay Trail Bicycle/Pedestrian Connector will establish the missing link from Lake Merritt to the Bay Trail near Jack London Square enabling Bay Trail users to easily access the Lake Merritt and Grand Lake areas. Development of the Bay Trail near the Park Street Bridge, another Oakland Estuary crossing on the east side of Alameda Island, will create a potential loop running along both sides of the estuary between the Park Street Bridge and Jack London Square.

1.2.3 Previous Study Effort

In 2009, the City of Alameda completed the *Estuary Crossing Study Final Feasibility Study Report*. Funding was provided by the Alameda County Transportation Improvement Authority, Caltrans, City of Alameda, and City of Oakland. The report evaluated a wide range of possibilities (17 options). It stressed the importance of stakeholders and public involvement and established a need for short-, medium-, and long-term solutions.

1.2.4 Support

Given the limited existing options for bicyclists and pedestrians to traverse the estuary, this study recognized the need for an attractive, convenient, safe, and zero- to low-cost multimodal facility. Furthermore, an additional crossing could act as a critical transportation corridor to and from Alameda Island in case of an emergency. The cities of Oakland and Alameda, as well as community groups, such as Bike Walk Alameda, Bike East Bay, and San Francisco Bay Trail, have lent their support to further study an estuary crossing and the potential benefits the proposed improvements could bring.

1.2.5 Stakeholders

Due to the location of the study area, many nearby groups, companies, and agencies will act as stakeholders, and they will need to be involved during design of the proposed crossing. These include the City of Alameda, City of Oakland, Caltrans, Alameda County Transportation Commission (CTC), Bike Walk Alameda, Bike East Bay, and San Francisco Bay Trail Project.

7 meetings were held between January 2019 and July 2020, including the City of Alameda, U.S. Coast Guard, and Port of Oakland. The U.S. Coast Guard and Port of Oakland are two major stakeholders due to their proximity to the study area, and their established use of the estuary.

U.S. Coast Guard

The U.S. Coast Guard operates along the estuary and has a base on Coast Guard Base Alameda, an island in the Brooklyn Basin area of the Oakland Estuary. They have requirements regarding vertical and horizontal clearances to the bridge, as detailed in their letter to the project development team and in the design criteria document. A letter of concurrence was received on January 21, 2021. See Appendix F.

Port of Oakland

The Port of Oakland is a major container ship facility located along the Oakland Estuary. The Port is one of the busiest in the country, and a new crossing could impact the scheduling of and ability to accommodate larger ships. The dimensions of the Port's reaches have also been provided to the project development team and proper clearance has been incorporated where possible. A letter of concurrence was received on May 11, 2020. See Appendix F.

1.2.6 Future Development Effort

Moving forward, the project will need to go through several phases before being completed:

1. Project Study Report (PSR) – Define the alternatives, identify costs, funding sources, ownership, maintenance, and prepare preliminary environmental analysis report (PEAR).
2. Environmental Review – Confirm scope of project and level of document, establish an Area of Potential Effects, and evaluate alternatives. Circulate *Draft and Final Environmental Document*. Select a preferred alternative.
3. Final Design – Finalize engineering, and issue detailed design drawings and cost estimate for bid.
4. Construction – Build the project.

2.1 Alternatives

Eleven alternatives were developed for this study. Their locations and alignments are shown in Figure 1. Alternatives A, D, and F are bridges. Alternative B is a tube for transit, bicycles, and pedestrians. Alternative C is a pathway through the existing Webster Tube. Alternative E is a water shuttle service. The horizontal and vertical geometry of each complies with the *Highway Design Manual* and Americans with Disabilities Act (ADA) standards. The alternatives that propose a new bridge use the same main span, but they propose different crossing locations and approaches. Exhibits of the alternatives are in Appendix A. Costs associated with each alternative can be found in Table 1 in the Executive Summary.

Figure 1: Estuary Crossing Alternative Key Plan

In previous evaluations, over 20 bicycle/pedestrian bridge alignments were reviewed and discussed with key stakeholders, and they were deemed considerably less feasible either physically or politically. The bridge alternatives A, D, and F that are discussed in this study appear to have the most potential to move forward. Therefore, they were considered for evaluation here.

All three of these bridge alternatives have several commonalities, including the new lifting main spans, which are identical between the alternatives. The bridge's main span would provide a 600-foot-wide opening between the fenders. In the lifting bridge's closed configuration, the vertical clearance between the mean high water (MHW) line and the bottom of the girder (low steel) would be 61 feet. In the open configuration, it would be 175 feet. The bridge structure would have a width of 22 feet on its main span and a width of 18.5 feet on its approaches. The space available for the bicycle/pedestrian shared-use facility would be 15.5 feet wide since the railings and cables (which are at a slight angle) would take up a portion of the space. Above land, a 40-foot easement would need to be established for setback and maintenance requirements. The locations of the piers have been designed to maintain proper clearance from the Port of Oakland's Inner Harbor Reach 6.

2.1.1 Alternative A

There are five variations of Alternative A, located on the western end of the study area. In addition to having similar bridge structures, all five variations propose identical approaches on the Alameda side where an easement has been reserved in the Alameda Landing (Pulte) development. The approaches differ on the Oakland side and are detailed below. The approaches on the Alameda sides align with the bioswales in the Alameda Landing development. A circular helix ramp would connect to the Alameda Landing shopping center at the corner of Mitchell Avenue and 5th Street. These alternatives would require changes to the existing bioswale configuration near the Alameda touchdown.

Alternative A1 – Bridge

On the Oakland side, the ramp to the bridge would terminate on Water Street, directly connecting to the proposed Oakland A's stadium. The ramp would run along Water and Washington streets and the roundabout. This alternative was also developed with a connection to the potential gondola platform nearby on Washington Street. This alternative would close Washington Street to vehicles south of Embarcadero, and it would prevent use of the roundabout at the intersection of Water and Washington streets. Washington Street is currently only used by delivery vehicles and those accessing the Waterfront Hotel.

Alternative A2 – Bridge

On the Oakland side, the bridge would be connected to a circular helix ramp that would be located in the roundabout at Water and Washington streets. This location would provide direct access to Jack London Square and the proposed Oakland A's stadium. To access downtown Oakland, users would be able to take Washington Street or Broadway. This alternative would require closing the roundabout.

Alternative A3 – Bridge

On the Oakland side, the bridge would be connected to the potential Washington Street gondola platform before returning to the roundabout on Water Street and descending in a circular helix ramp. This location would provide direct access to Jack London Square and the proposed Oakland A's stadium. To access downtown Oakland, users would be able to take Washington Street or Broadway. This alternative would close Washington Street to cars, and it would prevent use of the roundabout.

Alternative A4 – Bridge

On the Oakland side, the bridge would ramp down just east of the Jack London Square Ferry Terminal into a rectangular ramp down to the future Oakland A's stadium. A staircase from the ramp would connect to Water Street near the Ferry Terminal. This location would provide direct access to the new stadium, but it would require users to walk farther to get to Jack London Square and downtown Oakland. Also, it would not connect to the potential gondola.

Alternative A5 – Bridge

On the Oakland side, the bridge would ramp down towards the roundabout at Water and Washington streets, and it would begin the circular helix ramp descent in the lawn next to the Ferry Terminal. This location would provide direct access to Jack London Square and the new Oakland A's stadium, and it would not require the closure of Washington Street. This alternative would not connect to the potential Washington Street gondola.

2.1.2 Alternative B – Transit/Bicycle/Pedestrian Tube

Alternative B would be a new transit/bicycle/pedestrian tube under the estuary to the west of the existing Webster and Posey tubes. This alternative was included in the City of Alameda's *2018 Transportation Choices Plan* as long-term project #37 for further study. The plan states that "the ultimate need also would depend on whether BART to Alameda becomes a reality." The tube would only carry two-way traffic comprised of clean transit vehicles, bicyclists, and pedestrians. The tube would run from Franklin and 6th streets in Oakland to Marina Village Parkway and 5th Street in Alameda with a total length of 4,200 feet (3,200 feet between tube portals). The proposed geometry at Franklin Street would split 5th Street into discontinuous segments (like the existing situation at the Posey Tube Portal), and it would require the removal or reconstruction of the southbound I-880 Broadway on-ramp. The Class I bicycle/pedestrian facility would be 10 feet wide, and the total width of the tube would be 63 feet. The existing 115 kV electric line, currently running in a dedicated submerged conduit, could be relocated to the utility spaces within the tube. The tube would occupy an 80 foot easement. Though this alternative has a much higher cost than the bridge, water shuttle, or existing tube improvements, the construction of a new tube with vehicle access would be the most robust emergency transportation corridor out of all the alternatives considered, and it could be repurposed to serve personal vehicles in case there is an emergency at the other estuary crossings.

2.1.3 Alternative C – Widen Pathway in the Webster Tube

Alternative C would create bicycle/pedestrian access through the existing Webster Tube. The project would widen the existing 2.5-foot-wide maintenance pathway in the Webster Tube to a 4-foot-wide bicycle and pedestrian pathway. It would extend from 4th and Webster streets in Oakland to Mariner Square Loop in Alameda, and it would be 4,400 feet long (3,200 feet between tube portals). In the Webster Tube, the widened pathway would require restriping of the two 12-foot-wide lanes to two 11-foot-wide lanes. Currently, this improvement is being further analyzed and is included in the Oakland Alameda Access Project.

2.1.4 Alternative D1 – Bridge

Alternative D1 would cross the Oakland Estuary with a similar span to Alternatives A and F, but it would be located at the eastern end of the study area. On the Alameda side, the bridge would ramp down along one of the new Alameda Shipway development piers and connect to Marina Village Parkway via a rectangular ramp. On the Oakland side, the bridge would ramp down over parking lots and Embarcadero West then terminate next to the Amtrak right-of-way impacting the adjacent properties, but not the tracks. This alternative would provide better access from Alameda to the Brooklyn Basin housing and commercial development as well as the proposed separated bike lanes on Oak Street. The Oak Street separated bike lanes would connect bicyclists to Lake Merritt, the Lake Merritt BART Station, downtown Oakland, and the existing San Francisco Bay Trail on Embarcadero. Bicyclists would be able to use bicycle facilities along cross streets or ride along the waterfront to access Jack London Square and the new Oakland A's stadium about a half mile away.

2.1.5 Alternative D2 – Bridge

Alternative D2 is similar to Alternative D1, but it would cross the Oakland Estuary 400 feet to the east. This is the eastern most alternative of the study. On the Alameda side, the bridge would ramp down to a wide circular helix ramp in a City-owned park along the Alameda waterfront. It would connect to Marina Village Parkway, the proposed Alameda Shipways housing development, and Shoreline Park via existing paths. This approach would impact views on the Alameda waterfront. On the Oakland side, the bridge would ramp down along the western edge of Estuary Park and terminate on the south side of Embarcadero West. Estuary Park would be redesigned, reconstructed, and expanded, in part because of the Brooklyn Basin project. This alternative would connect directly to the Brooklyn Basin and the San Francisco Bay Trail. This alternative would connect to the proposed separated bike lanes on Oak Street, connecting bicyclists to Lake Merritt, the Lake Merritt BART Station, downtown Oakland, and the existing San Francisco Bay Trail on Embarcadero. Bicyclists would be able to use bicycle facilities along cross streets or ride along the waterfront to access Jack London Square and the new Oakland A's stadium about a half mile away.

2.1.6 Alternative E – Water Shuttle

Originally explored in the *2009 Estuary Crossing Study*, this alternative would provide a medium-term improved connection between Oakland and Alameda by offering a water shuttle service between existing and planned docks. The service could be designed with operating hours and headways to balance available revenue and demand. The service would complement the existing Oakland-Alameda-San Francisco ferry service by providing a more regular shuttle along the estuary. There would be a 15-minute headway using two new vessels. Each vessel would have a capacity of approximately 12 passengers. This option would use the existing public dock at Jack London Square in Oakland, and a new public dock at the end of 5th Street in Alameda would be constructed by the Alameda Landing (Pulte) development. Whereas the other alternatives could accommodate a majority of boats traveling along the estuary without any action, the additional service across the estuary in this alternative would require more communication and cooperation between various estuary movements. The alternative would require permanent staff as well as accommodations for fuel and maintenance needs.

2.1.7 Alternative F – Bridge

Alternative F would cross the Oakland Estuary with a similar span as Alternatives A and D, but it is located in the middle of the study area along Alice Street in Oakland. On the Alameda side, the bridge would ramp down to a rectangular helix ramp along the Alameda waterfront. It would terminate at existing paths along the water and provide a connection to Marina Village Parkway. However, it would displace residents of Barnhill Marina, a houseboat community on the Alameda waterfront at the touchdown location. On the Oakland side, the bridge would ramp down to a circular helix ramp that would connect to Alice Street and the San Francisco Bay Trail. This alternative is the closest to the Jack London Amtrak Station, and users could access downtown Oakland via the existing pedestrian crossing over the Amtrak tracks.

2.1.8 Alternatives Summary

Table 2 highlights the major differences and similarities between the proposed alternatives. This includes dimensions of the proposed structure as well as pros and cons of the connection approaches.

Table 2: Estuary Crossing Alternatives

Alternative	Type	Length	Width	Height	R/W	Advantages	Disadvantages
A1	Bridge	3,430’	18.5’ to 22’	70’ over MHW	40’	-Oakland approach is elevated and allows use of roundabout by vehicles. -Allows access for potential future gondola. -More direct route across the estuary.	-Constructs ramp between the Oakland A’s stadium and the Port of Oakland’s offices.
A2	Bridge	3,200’	18.5’ to 22’	70’ over MHW	40’	-Shorter bridge length over the estuary. -Uses existing roundabout.	-Vehicles are prohibited in roundabout. -Impacts the Waterfront Hotel.
A3	Bridge	3,430’	18.5’ to 22’	70’ over MHW	40’	-Hybrid alternative of A1 and A2.	-Vehicles are prohibited in the roundabout.
A4	Bridge	3,200’	18.5’ to 22’	70’ over MHW	40’	-Does not impact roundabout. -Oakland approach is closer to the Oakland A’s stadium.	-Does not connect with bike lanes on Washington Street. -Does not connect to potential future gondola.
A5	Bridge	3,200’	18.5’ to 22’	70’ over MHW	40’	-Does not impact the roundabout.	-Does not connect to potential future gondola.
B	Tube	4,660’	63’	n/a	80’	-Increases capacity of buses and bicycles/ pedestrians. -Provides additional lifeline route between Oakland and Alameda.	-Has construction impacts on 5th Street in Alameda and Franklin Street in Oakland -Removes Broadway on-ramp.

Alternative	Type	Length	Width	Height	R/W	Advantages	Disadvantages
C	Existing Tube	4,000’	4’	n/a	n/a	-Opens and widens pathway to 4’ in existing Webster Tube.	-Narrows lanes in Webster Tube.
D1	Bridge	3,370’	18.5’ to 22’	70’ over MHW	40’	-Utilizes shipways development on Alameda approach.	-Crosses over the Bay Trail and runs along the Portobello Marina parking lot on Oakland approach.
D2	Bridge	3,380’	18.5’ to 22’	70’ over MHW	40’	-Utilizes space in Estuary Park.	-Crosses over Bay Trail and obstructs views at the Alameda approach. -Impacts Marina Village docks.
E	Water Shuttle	n/a	n/a	n/a	n/a	-Uses existing public dock on Oakland side and a new dock from Pulte Development on the Alameda side.	-May obstruct maritime traffic through the estuary. -Will require the purchase of vessel(s) and operators.
F	Bridge	3,200’	18.5’ to 22’	70’ over MHW	40’	-Connects to Oakland Amtrak. -Connects to existing path along the Alameda waterfront.	-Impacts Barnhill Marina. -Displaces low-income households.

Chapter 3
Structure Design

3.1 Bridge Design Assumptions

The bridge design will follow the current American Association of State Highway and Transportation Officials (AASHTO) Load Resistance Factor Design (LRFD) bridge design criteria, AASHTO Guide Specifications for the Design of Pedestrian Bridges (PED), Caltrans Seismic Design Criteria (SDC), and Caltrans SDC for Steel Bridges. All bridge alternatives will be ADA accessible and will feature a maximum grade of 5 percent. Therefore, a vertical increase of 5 feet in the fixed span would result in approximately 100 feet of additional horizontal approach length.

A seismic evaluation of the proposed bridge was performed for three different scenarios. Table 3 shows the post-earthquake damage state and service levels for corresponding levels of seismic events depending on the bridge category per the definitions from the Caltrans SDC. All scenarios were done in the non-lifted position. Were the bridge in the lifted position, it would be much more susceptible to seismic events. The Caltrans SDC defines two standard design events: Safety Evaluation Earthquake (SEE), which has a 975-year return period, and Functional Evaluation Earthquake (FEE), which has a 225-year return period.

The Caltrans SDC also defines three bridge categories:

1. **Ordinary Bridge Category:** The bridge considers SEE only. The bridge will not collapse due to SEE, but it will be severely damaged in the event of a SEE, and the majority of the diagonal members of the lower part of the tower truss will need to be retrofitted or replaced after the event.
2. **Recovery Bridge Category:** The bridge considers both a SEE and a FEE. The lifting tower will sustain minimal damage due to FEE or repairable damage due to a SEE. The bridge will be serviceable immediately after a FEE or several weeks after a SEE (the bridge costs in the executive summary assume this category of bridge).
3. **Important Bridge Category:** The bridge considers both a SEE and a FEE. The lifting tower will sustain almost no damage due to a FEE or minimal damage due to a SEE. The bridge will be serviceable immediately after a FEE or several days after a SEE.

Table 3: Bridge Category and Expected Performance

Bridge Category	Seismic Hazard Evaluation Level	Expected Post-Earthquake Damage State	Expected Post-Earthquake Service Level
Ordinary	SEE	Major	No Service
Recovery	SEE	Moderate	Limited Service for Several Weeks
	FEE	Minimal	Full Service

Bridge Category	Seismic Hazard Evaluation Level	Expected Post-Earthquake Damage State	Expected Post-Earthquake Service Level
Important	SEE	Minimal	Limited Service for Several Days
	FEE	No damage	Full Service

Figure 5 shows a rendering of the lift bridge in the Alternative A location.

Figure 5: Bicycle/Pedestrian Lift Bridge Rendering

3.1.1 Lift Span

The lift span would be 664 feet long to provide a 600-foot-wide clear channel opening between fenders. A network tied-arch bridge would be used for the lift span, which is lightweight, aesthetically pleasing, and highly redundant to reduce risk of failure in case of cable damage. A steel orthotropic deck system would be used for the lift span supported by steel box tie girders and floor beams. The deck system would have a depth of 3 feet.

3.1.2 Lifting Tower Foundation System

Concrete pile cap and concrete-filled steel tube piles are proposed for the lifting tower foundations per the *Preliminary Foundation Report* (see Appendix C). The tall lifting tower would experience significant overturning moment under seismic conditions, particularly if the lift span is open, and the steel tube would help retain the required shear capacity in the piles under tension. Deeply embedded piles would be used to avoid foundation damage from tidal and hydraulic loads as well as effects from scour and erosion.

3.1.3 Bridge Protection for Vessel Collision

A vessel collision analysis was performed per the AASHTO *Guide Specification for Vessel Collision of Highway Bridges* to evaluate what the maximum annual frequency of collapse of the bridge and the maximum collision force to the deck would be.

The assumed design vessel for the evaluation was the National Security Cutter, which is used by the U.S. Coast Guard. Data was provided for the weight, average speed in the estuary, and average number of trips made per year. The bridge satisfied the critical or essential operational classification criteria for which the maximum annual probability of bridge collapse is less than 0.01 percent. The bridge would be further protected by the concrete fender system around the perimeter of the pile caps. The fender system would be longer in the direction of the channel because collisions would likely be head-on with the fender rather than against the sides.

In addition, the lift span was evaluated for a deckhouse collision, a collision between the bridge of the ship and the estuary crossing's main span. The lift span would be damaged, but it would not collapse.

3.1.4 Approach Span

The approach structure would be a precast/prestressed box girder over the water and a cast-in-place/prestressed structure over land. The maximum span between columns would be 120 feet. The typical girder depth for the approach structure would be 6 feet, and columns would be supported by driven piles. Depending on the alternative, the approach structure could include a circular or rectangular helix ramp. The last 250 feet of each approach would be supported by retaining walls with lightweight fill.

Table 4: Approach Span Lengths

Alternative	Span Length			
	Alameda Approach	Oakland Approach	Clear Span Over Channel	Total Bridge Length
A1	1,300’	1,530’	600’	3,430’
A2	1,300’	1,300’	600’	3,200’
A3	1,300’	1,530’	600’	3,430’
A4	1,300’	1,300’	600’	3,200’
A5	1,300’	1,300’	600’	3,200’
D1	1,275’	1,495’	600’	3,370’
D2	1,275’	1,505’	600’	3,380’
F	1,300’	1,300’	600’	3,200’

3.2 Operations

All bridge alternatives would remain open for users 24/7, and they would require continuous staffing during that time. The alternatives were designed to accommodate this need. Based on an analysis of vessels crossing under the bridge, 96 percent will be able to clear the 70-foot-high (at the center) closed bridge configuration. The assumed total opening/closing time for a full bridge lift (to 175 feet) is 9 minutes. The assumed total opening/closing time for a partial bridge lift (to 100 feet) is 8 minutes. It is assumed that most bridge lifts would be partial, and that a maximum of one bridge lift per 15-minute period would be allowed. Only the tallest U.S. Coast Guard vessels would require a full lift to 175 feet. The full breakdown of the lift operation is detailed in Table 5.

Table 5: Lift Durations

Description	Time Duration	Comments
Pedestrian crossing time before initiation of the lift	3.0 minutes	For all bicyclists and pedestrians to clear the lift span after the alarm goes off
Full lift	2.5 minutes	Lift up to 175 feet
Full lowering	2.5 minutes	Back to 60 foot elevation
Partial lift	2.0 minutes	Lift up to 100 feet
Partial lowering	2.0 minutes	Back to 60 foot elevation
Wait time for vessel passage	1.0 minute	n/a
Full maximum cycle	9.0 minutes	Includes time for mechanical movement only. Does not include communications (e.g., time for the vessel to contact bridge operator and operator scheduling lift).

3.3 Structure Cost

The cost of the bridge would vary based on the seismic design category selected. The cost differential for the Important, Recovery, and Ordinary categories is shown in Table 6. A 10 percent mobilization cost and 25 percent contingency cost are included. An additional 4 percent per year was applied to account for unit price escalation in the year of construction, which is assumed to be 2030. For approach spans, the total length was assumed to be 2,766 feet (total length of 3,430 feet minus the lift span of 664 feet). Based on the expected usage, estimated cost, and post-earthquake service levels, the Recovery category was selected to use when discussing the bridge crossing alternatives. A detailed cost estimate for all three seismic design categories is included in Appendix B.

Table 6: Seismic Design Category Construction Cost Summary

Structure	Important Bridge	Recovery Bridge	Ordinary Bridge
Lift Span	$140,500,000	$113,500,000	$95,500,000
Approach Spans	$33,500,000	$27,000,000	$23,000,000
Total	**$174,000,000**	**$140,500,000**	**$118,500,000**

Chapter 4
Transportation Demand Model

This chapter describes the transportation demand modeling methodology and spreadsheet-based forecasting tool that Kittelson & Associates, Inc. (Kittelson) developed to forecast demand for a crossing between downtown Oakland and Alameda Island. The tool allowed users to adjust the characteristics of a potential crossing, and to observe changes in the forecasted person trips by travel mode (walk, bicycle, transit, and personal vehicle). Kittelson developed the tool concurrently with HNTB's work identifying feasible crossing alignments. It was used to evaluate Alternatives A through F. Kittelson also developed the User Guide for the demand modeling tool, as well as the Forecast Tool Literature Review (both provided in Appendix D) to provide background for the design and forecasted demand of the crossing alternatives. The forecast tool is provided electronically as an Excel file that is available for download.

This chapter is structured in three parts:

1. **Overview of Data Sources**: Provides an overview of the methodology used to forecast demand for a crossing between downtown Oakland and Alameda Island.
2. **Forecast Process:** Describes the data sources used to establish local travel and land-use conditions, and the process used to forecast crossing demand based on the crossing type and characteristics.
3. **Summary of Results**: Presents and compares forecasts for a set of scenarios.

4.1 Overview of Data Sources

Travel demand for a new crossing between downtown Oakland and Alameda Island was estimated using data from multiple sources and are detailed in this section.

Count Data. Crossing count data taken on average weekdays (Tuesday - Thursday) from the Posey Tube, Park Street Bridge, and Fruitvale Avenue Bridge were used (see Table 7) to establish baseline estimates of bicycling and walking volumes on the crossings.

Table 7: Bicycle and Pedestrian Crossing Counts

Location	Time	Year	Bike	Walk
Posey Tube	6:00 am - 9:00 pm	2016	117	25
Park Street Bridge	6:00 am - 9:00 pm	2016	419	261
Fruitvale Avenue Bridge	7:00 am - 9:00 am	2019	104	47
	4:00 pm - 6:00 pm	2018	43	25

Note - Fruitvale Avenue Bridge counts collected on different days

StreetLight Data. StreetLight Data (StreetLight) provided an estimate of trips based on a sample of trip trajectories collected from "big data" sources like smartphones and navigation devices in cars and trucks. A specific order of StreetLight data was placed for Alameda and the portions of Oakland within common walking or bicycling distance from the proposed crossings, including 12 months of travel from September 2018 to August 2019. StreetLight trip estimates were used to establish baseline estimates of trip volumes by distance and existing OD travel by crossing (see Figure 2 for an example illustration of OD patterns between Jack London Square and the surrounding analysis zones).

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Figure 2: Weekday Origin-Destination Patterns, Jack London Square – StreetLight Data

California Household Travel Survey (CHTS) Data. The CHTS is a statewide survey Caltrans conducts every 10 years to understand the travel behavior of California households. Participants in the survey record all trips in a journal (work and non-work trips).[3] Data from the 2011/2012 survey of all trips made by members of sample households in the state were used to establish bicycle and walk mode share estimates for households in Oakland and Alameda near the Oakland Estuary. Bicycle and walk mode share by trip distance is shown in Figure 3. A majority of trips under one mile are walked, but that quickly declines with distances greater than one mile. The share of bicycle trips peaks around 15 percent between one to two miles and decreases until about 4.5 miles. These numbers were used when considering the connections between the crossing alternatives and nearby networks.

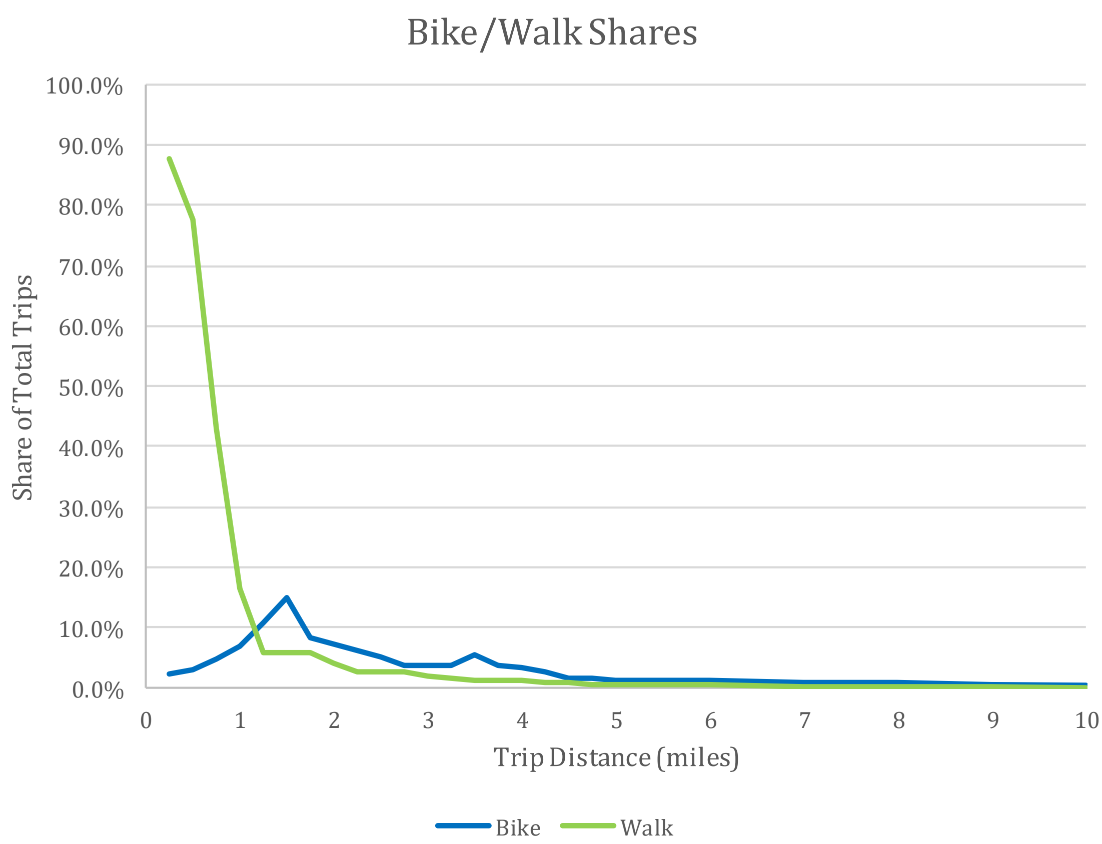


Figure 3: Bicycle and Walk Mode Share by Distance – CHTS

Alameda Countywide Travel Demand Model. Alameda Countywide travel demand model data, which includes estimates of bicycle trips, were used to calibrate existing data, and to develop perception factors for the Posey Tube. A screen capture illustrating PM peak hour bicycle counts and model estimates is shown in Figure 4, showing the routes that bicyclists choose to take in the peak hour traffic. A large amount of bicyclists already choose to take the existing tubes to cross between downtown Oakland and Alameda Island. The Alameda Countywide model was also the primary source for forecasting the population and employment in 2030 (the study year).

[3] Additional information about the California Household Travel Survey information is available at https://dot.ca.gov/programs/transportation-planning/economics-data-management/transportation-economics/ca-household-travel-survey

Literature Review. In addition to the data collected and described in this section, Kittelson conducted a literature review of similar bridges and ferries to support development of user perception factors associated with access quality, wait time, crossing time, trip cost, and relative attractiveness of each alternative for people bicycling and walking. The literature review is included in Appendix D.

Figure 4: Bicycle Counts and Model Estimates – Alameda Countywide Travel Demand Model

4.2 Forecasting Process

The forecast tool estimated baseline trip volumes, and it allowed users to evaluate demand shifts based on alterations to the alignment and the character of a new crossing. For each step of the forecasting process this document provides the:

- **Step Outline:** Describes the step in the forecast process.
- **Step Output:** Summarizes what data the tool generated at the step.
- **Data Source:** States the data source(s) used to inform the step of the tool. If a data source was used for multiple steps, it is described in detail the first time it is used and referenced in future steps.

The forecasting process is illustrated in Figure 5.

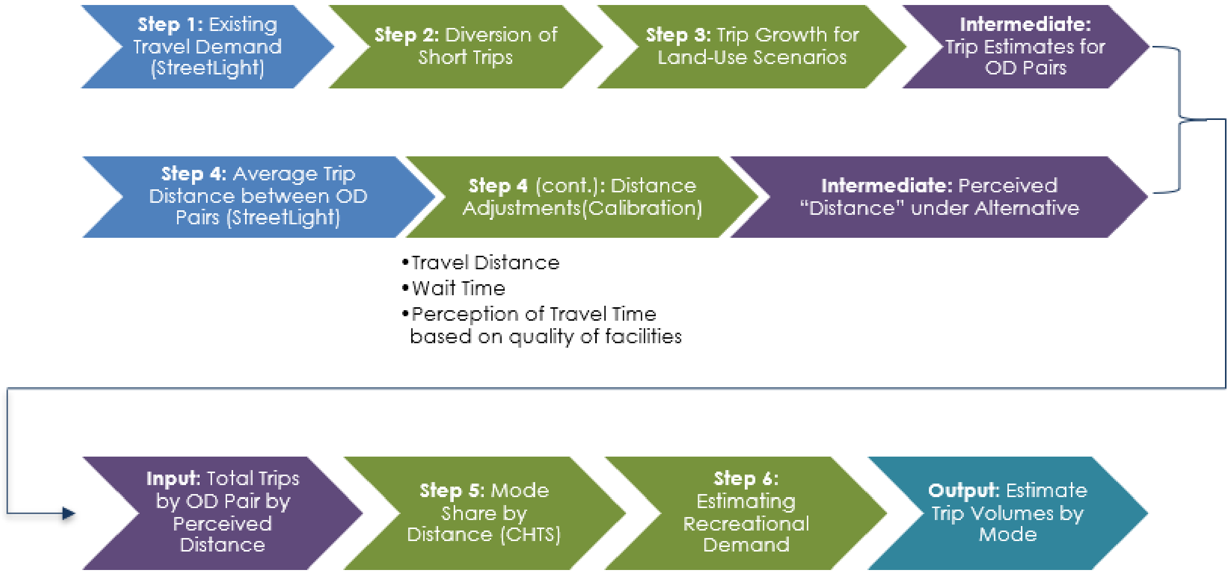


Figure 5: Overview of Forecasting Process

Step 1: Existing Travel Demand

Step Outline*:* The forecast process relied on an estimate of existing travel demand across the Oakland Estuary. Kittelson constructed this estimate using data from StreetLight.

The travel zones used for the StreetLight data and within the forecast tool are shown in Figure 6. Trips that start or end outside the user-defined zones were not included in the estimate as the length of the trips made it unlikely they would shift to bicycling or walking. Existing travel demand was summarized in the tool by two OD matrices that described an average weekday day (Tuesday – Thursday) and an average weekend day (Saturday – Sunday) stratified by hours of the day. The tool then adjusted the estimates based on what percent of trips were expected to take the proposed crossing versus one of the existing crossings. This adjustment was done based on existing travel patterns in the StreetLight data, and for each OD pair, a factor between 0 and 1 was calculated and used to adjust for the share of existing trips.

This created a baseline measure of existing trips by all modes that travel between Oakland and Alameda at the proposed crossing locations. The baseline assumed the existing share of trips using the Posey or Webster tubes would be similar to the share of trips using the proposed crossing. In later steps, the tool identified new trips that could be generated to use the proposed crossing.

Figure 6: StreetLight Data Travel Zones

The forecasting process included an additional calculation for alternatives that would have varying service characteristics based on the time of day, such as the water shuttle alternative. Specifically, the bicycle and pedestrian trip estimates were constrained based on service hours relative to a 24-hour period. StreetLight data that contained hourly person trips by OD pair were referenced.

Step Output: Estimate of existing person trips across the Oakland Estuary between each pair of travel zones was classified by day type (weekday or weekend).

Data Source*:* StreetLight generated transportation data from location records created by cell phone applications. StreetLight reviewed individual location records to identify unique trips. This trip data was then aggregated to create summary data sets for users to analyze. The trips included all person trips regardless of mode. The aggregation was based on geography, day of week, and time of day choices made by the user. The forecast tool used two different data sets.

1. *Origin-Destination:* Estimate of trips between travel zones that are defined by the user (Figure 6).
2. *Middle Filter Analysis:* Estimate of trips between travel zones that travel through a third middle location. For this project, middle filters were set for each crossing between Oakland and Alameda to provide an estimate of the proportion of trips that would use each crossing.

The data sets reflected trip estimates for the time period between September 1, 2018 and August 31, 2019 for all-day travel. Weekday trips were based on trip estimates for Tuesday to Thursday and weekend trips were an average of Saturday and Sunday travel.

Step 2: Diversion/Rerouting of Short Trips

Step Outline: In Step 2, the process accounted for the potential new trips across the Oakland Estuary that were generated by rerouting short trips that currently do not cross the estuary. For example, if the crossing was improved, a person working in Alameda might consider eating lunch in Jack London Square, whereas the existing crossing would dissuade them from crossing the Oakland Estuary by bicycle or on foot.

The estimate was generated by measuring the number of short trips that start or end in a travel zone adjacent to the shoreline that do not currently cross the Oakland Estuary that could be rerouted. Kittelson created this estimate using StreetLight data on person-trip volumes and average travel distance between travel zones. Short trips were defined as trips that were less than 1.5 miles, roughly 60 minutes roundtrip walking. It was assumed that 5 percent of these trips would be diverted/rerouted to the new crossing.

The forecast tool included the potential rerouted trips for estimating bicycling and walking trips. It did not include rerouted trips for other modes because the alternatives would not significantly improve access for short driving or transit trips across the Oakland Estuary.

Step Output: Estimate of existing person trips across the Oakland Estuary and potential rerouting of short bicycle and walking trips.

Data Source*:* StreetLight data of average daily person trips and average distance data for trips.

Step 3: Forecast Person Trips for Different Land-Use Scenarios

Step Outline: Existing person trip estimates from Step 2 were adjusted based on planned land-use changes, and the resulting changes in total jobs and residents. These data were used to forecast person trips across a new crossing for the following two land-use scenarios:

1. *Existing Conditions:* The existing conditions scenario was based on StreetLight person-trip data collected between September 1, 2018 and August 31, 2019. It did not include any adjustments for planned job or residential growth.
2. *Year 2030:* The estimated growth in total jobs and residents was based on planned growth in *Plan Bay Area 2040* that was interpolated for 2030. The tool then adjusted the estimate for trips between travel zones based on average job and residential growth across the two travel zones.

This study was originally intended to include forecasts for a third scenario that included the Oakland A's stadium. However, information on the travel characteristics of the proposed Oakland A's stadium could not be made available within the time frame of this study.

Step Output: Estimate of person trips across the Oakland Estuary and potential rerouting of short trips for the land-use scenarios described above.

***Data Source*:** Growth factors were calculated based on *Plan Bay Area 2040* estimates of population and employment for 2020 and 2040 as implemented in the Alameda Countywide travel model that was interpolated for 2030. The changes in jobs and residents in Alameda were refined based on feedback from City of Alameda staff. The population and employment data were organized by Alameda Countywide model traffic analysis zones (TAZ). Kittelson assigned the growth in TAZs proportionally to the travel zones defined in the StreetLight data and used it in the forecast tool based on the percentage of overlap in the zones.

Step 4: Travel Distance Estimates

Step Outline: Mode share was estimated based on the distance between travel zones. Shorter trips had a greater percentage of bicycling and walking trips (e.g., the greatest mode share was 1.5 miles and less than a half mile respectively), while transit and driving trips got larger shares of trips for longer trips. Step 4 calculated the distances between scenarios for each pair of travel zones as defined by the user.

The process began with a matrix of travel zone pairs that provided the average length for observed trips between travel zones in the StreetLight data (generated from the person-trip estimates from Step 1 and Step 2). An adjusted *perceived distance* was then calculated that considered how a proposed crossing would alter user experience through changes to:

- *Distance Traveled:* Distance changes based on the selected crossing alignment.
- *Wait Time:* Average wait time based on expected time spent waiting for shuttle service (water shuttle alternative) or for a bridge to reset if raised (bridge alternative).
- *Perception of Travel Distance:* Changes in perceived distance based on the quality of the bicycle and pedestrian network near the proposed crossing, ease of accessing the crossing, and effort needed to travel uphill over a bridge (bridge alternative).

Perceived distances were adjusted down if the characteristics of the proposed crossing reduced the distance or wait time or improved quality of travel relative to existing conditions. In contrast, a characteristic that increased distance or travel time between zones or made the trip less appealing resulted in an increase in *perceived distance*.

The process was designed to estimate the impact of changes to travel behavior related to the new crossing and its immediate area. As a result, adjustment factors did not consider the length of the overall trip. Instead they limited the total distance reduction for shorter trips to half the average baseline distance. The impact of each design characteristic on distance is discussed in more detail in the User Guide, which is included in Appendix D.

Step Output: Perceived distance by travel zone pair, as adjusted, to reflect the estimated impact of alternative crossing characteristics.

Data Sources:

- Baseline distance under existing conditions from StreetLight data.
- Bike Walk Alameda counts of people bicycling and walking were used to calibrate the model to measure the impact of different conditions. The calibration was done by examining observed counts relative to expected counts based on trip volumes and distance ,and by adding distance adjustment factors to determine the adjustment that resulted in the observed count of people. For example, the calibration determined the impact of conditions in the Posey Tube on bicyclists and pedestrians was equivalent to three additional miles of travel.
- *Bicycle Route Choice Model Developed Using Revealed Preference GPS Data* by Broach, Gliebe, and Dill research paper examined how built environment factors impacted route choice for people riding bicycles in Portland, Oregon. The paper provided estimates of trade-offs for different roadway factors, including how far bicyclists are willing to divert from their route to avoid slopes of different grades. It also was used to estimate the impact of the entry point connection and local transportation network quality on bicyclists and pedestrians.

Step 5: Apply Mode Share

Step Outline: Mode share was applied using a reference table that linked trip distance with mode share. A portion of the table for existing conditions is shown in Figure 7. First, the average perceived travel distance estimated for the new crossing from Step 4 was identified. Then, the person trips calculated in Step 3 were split by distance traveled to reflect the appropriate mode share for that perceived distance.

Distance	Walk	Bike	Transit	Drive
0.25	88%	2%	1%	9%
0.50	78%	3%	5%	14%
0.75	43%	5%	7%	45%
1.00	16%	7%	9%	68%
1.25	6%	11%	11%	72%
1.50	6%	15%	13%	66%
1.75	6%	8%	14%	72%
2.00	4%	7%	14%	75%

Figure 7: Example of How Distance Was Used to Reference Mode Splits

The tool included three separate tables for testing different mode share scenarios:

1. **CHTS:** Estimated mode share using data from the CHTS. The table was based on records for people who live in Oakland and Alameda.
2. **Adoption of Transportation Technology/Device Scenario:** Estimated mode share in a future scenario where reduction in price and increases in access resulted in more people using electric bicycles, scooters, or a yet to be determined technology. For the scenario, the mode share for bicycling decreased at a slower rate at longer distances. Specific assumptions for the tables are explained in more detail in the User Guide, which is included in Appendix D.
3. **User Defined Scenario:** Allowed users to understand what proportion of people crossing the Oakland Estuary would need to bicycle or walk to achieve different mode splits at the crossing.

Step Output: Forecasted trip volumes by mode share for each land-use scenario for the selected mode share scenario.

Data Sources:

- Using data from the CHTS, the forecast tool calculated mode share by distance based on the travel patterns of residents traveling near the crossings in Oakland and Alameda. The survey was conducted between 2011 and 2012. Although travel attitudes may have changed since 2011/2012, particularly with regard to the popularity of bicycling, the survey mode shares were adjusted and calibrated to reflect more recent personal observations of bicycle and pedestrian crossings of the estuary.
- AC Transit ridership data for buses crossing through the Posey Tube were used to calibrate transit mode share data from the CHTS so the forecast tool's estimates of bus ridership were generally in line under current conditions.
- *Physical Activity of Electrical Bicycle Users Compared to Conventional Bike Users and Non-Cyclists: Insights based on Health and Transport Data from an Online Survey in Seven European Cities*, Castro et al. research paper reviewed survey data in European cities to understand the physical activity of electric bicycle (e-bike) users. The finding that informed the forecast was that on average e-bike users traveled twice as far as conventional bicycle users. While the finding is not causal (e-bike users may have purchased an e-bike because they travel far distances already or may be encouraged to take longer trips with the purchase of an e-bike), it helped inform the potential impact of the expansion of e-bike usage.

Step 6: Estimating Weekday Peak

Step Outline: Peak AM and PM person trips were estimated using factors developed from StreetLight hourly trip estimates. Hourly trip estimates from StreetLight data were used to determine the percentage of current travel that occurs during the AM and PM peak (6 am to 9 am, 4 pm to 7 pm) for each OD pair. Then, a peaking factor based on the total number of trips for the OD pair was applied to the daily forecasts to create peak period forecasts.

Step Output: Estimated AM and PM person trips for the AM and PM peak periods.

Step 7: Estimating Recreational Demand

Step Outline: Latent recreational demand was estimated separately because the StreetLight data used to estimate baseline conditions did not include circuitous trips that start and end in the same locations, such as going on a run for exercise. To forecast these types of trips, survey results from the Alameda Active Transportation Survey[4] were used to estimate the average number of recreational bicycle and pedestrian trips that were made by residents.

The number of trips per person was multiplied by the number of residents in the travel zones to estimate the total number of recreational trips per travel zone, as shown in Table 8. The methodology assumed that recreational bicyclist and pedestrian behavior for residents on the Oakland side of the estuary would be similar on the Alameda side.

Table 8: Estimate of Recreational Activity

Question	Every day	At least a few times/ week	About once/ week	At least once/ month	Less than once/ month	Never/ Don't Know	Average Estimate Daily Trips	Average Estimate Weekly
Walk/Jog/Run for fun or exercise	24%	34%	17%	10%	7%	8%	0.38	2.67
Bicycling for fun or exercise	14%		13%	20%		54%	0.08	0.59

Source: Alameda Active Transportation Survey (2019) questions 85 and 87

Next, *perceived distance* between each travel zone and the potential crossing was estimated using a methodology similar to that in Step 4. One modification to the methodology was that lower quality infrastructure was assumed to have twice the impact on *perceived distance.* This reflected research, some of which can be found in the Literature Review in Appendix D, showing people are more likely to avoid poor quality infrastructure when traveling recreationally as opposed to for a commute.

The tool then forecasted what share of recreational travel in each travel zone would use the new crossing based on *perceived distance*. Where distance was less than a quarter mile, 12 percent of trips were captured, and as *perceived distance* increased, the percent of trips decreased. No recreational trips to the new crossing were projected if distance was more than 1 mile away for walking trips and 3 miles away for bicycling trips (corresponding to a 2 mile and 6 mile roundtrip respectively). The forecast added two crossings for each projected recreational trip, one for the departure and one for the return.

Step Output: Produced a daily and weekly forecast of recreational bicycling and walking trips across the proposed crossing. Projected recreational trips were evenly distributed across the week, and they were incorporated into the all-day forecasts. They were not included in the peak period estimates.

Data Sources*:*

- Alameda Active Transportation Survey was conducted in late 2019 by EMC Research. It included questions relating to active transportation activity and perception in Alameda. The forecast used data from questions 85: *In the past month, how often did you bike for fun or exercise*, and 87: *In a typical month, how often do you Walk, Jog, or Run for fun or exercise?*

[4] Data for the survey was collected in late 2019. The survey results were not publicly produced during the writing of this study.

- *Bicycle Route Choice Model Developed Using Revealed Preference GPS Data* by Broach, Gliebe, and Dill research paper was used to compare route choice decisions on recreational and commute trips. The comparison was used to identify sensitivity to negative conditions.
- Resident estimates for existing and 2030 were interpolated based on *Plan Bay Area 2040*. Resident numbers in Alameda were refined based on feedback from City Alameda staff. The data for *Plan Bay Area 2040* is organized by model TAZs. Kittelson assigned residents to TAZs using proportions from the travel zones defined in the StreetLight data.

4.3 Summary of Results

This section presents initial results for scenarios that are based on the most likely conditions for the alternatives under consideration. These results provide a broad overview of how each alternative would perform, and it gives users a starting point to experiment with alterations to proposed alternatives (e.g., increasing water shuttle frequency or reducing the height of a bridge). The results are presented as number of person trips per mode (i.e., walk, bicycle, transit, and vehicle), and the percent share of all person trips that start and end within the study area (shown in Figure 6Figure 8).

The forecasting process estimated the change in bicycle and pedestrian trips for each crossing. The expectation is that existing bicycle and pedestrian trips in the Posey Tube would move to an improved crossing (the tool did not estimate a number for those choosing to continue crossing through the Posey Tube). Changes in bus and vehicle person trips were not modeled. The bus and vehicle person trips presented in Figure 8 represent the existing mode shares of person trips by the modes that are using the Webster and Posey tubes.

The forecasts for each analysis scenario are included in Figure 8 (provided as a PDF attachment) and the assumptions for each scenario are described below . For each scenario, *network quality* describes the quality of the transportation network for people bicycling and walking in the 1 mile area around the proposed bridge access. *Entry point quality* describes the quality of the start of each crossing approach as it connects to the nearby transportation network.

- *Scenario 1: Widen Walkway in Webster Tube* – Assumes network quality would be improved to *high* in Oakland and Alameda, and the entry point quality would be *low.*
- *Scenario 2: Transit/Bicycle/Pedestrian Tube* – Assumes network quality would be improved to *high* in Oakland and Alameda, and the entry point quality would be *high.* The forecasting process estimated the change in bicycle and pedestrian trips for each crossing. Changes in transit and vehicle person trips were not modeled.
- *Scenario 3: Water Shuttle* –Assumes the shuttle would run from 6 am to 10 pm with water shuttles arriving once every 15 minutes during the peak periods and every 30 minutes during the off-peak periods and on the weekend. The trip would take 15 minutes (including loading and unloading times), and the network quality and entry point quality would be *high*. The forecasting process estimated the change in bicycle and pedestrian trips for each crossing. Changes in transit and vehicle person trips were not modeled.
- *Scenario 4: Bridge* – Assumes the bridge would have a maximum grade of 4.9 percent, and people using the crossing would travel uphill on the bridge for 1,600 feet. The network and

entry point quality would be *high*. The scenario assumed the bridge would be raised once an hour with a 10-minute delay for people crossing each time it is raised. The bridge would be prohibited from being raised between 8 am and 9 am and between 4:30 pm and 6:30 pm on weekdays. Scenario 4 included three variations, one for each of the bridge alignments under consideration.

Initial findings show the bridge alternatives expect around 5,000 bicyclists and pedestrians on the average weekday, with Alternative A expecting the most with 5,320. The other alternatives expect around 1,200 or less with Alternative C only expecting 460 bicyclists and pedestrians on the average weekday.

Figure 8: Summary of Results

(provided as a PDF attachment)

Figure 8 - Summary of Results

Scenario 1: Webster Tube Path

Description : Walkway through the existing Webster Tube
Alignment: ***Alignment C***
Network Quality: High
Immediate Approach: Low

	Existing Conditions							Plan Bay Area - 2030						
	Avg. Weekday				Avg. Weekend Day		Week	Avg. Weekday				Avg. Weekend Day		Week
Mode	**All-Day**	**All-Day (%)**	**Peak**	**Peak (%)**	**All-Day**	**All-Day (%)**	**Total**	**All-Day**	**All-Day (%)**	**Peak**	**Peak (%)**	**All-Day**	**All-Day (%)**	**Total**
Walk	80	*0.2%*	30	*0.2%*	70	*0.2%*	540	100	*0.2%*	40	*0.2%*	90	*0.2%*	680
Bike	300	*0.6%*	120	*0.6%*	250	*0.6%*	2,000	360	*0.6%*	140	*0.6%*	310	*0.6%*	2,420
Walk + Bike	380	*0.8%*	150	*0.8%*	320	*0.8%*	2,540	460	*0.8%*	180	*0.8%*	400	*0.8%*	3,100
Transit	2,370	*4.9%*	960	*4.9%*	2,000	*4.7%*	15,850	2,810	*5.0%*	1,140	*5.0%*	2,410	*4.8%*	18,870
Auto	45,310	*94.3%*	18,330	*94.3%*	39,990	*94.5%*	306,530	53,290	*94.2%*	21,520	*94.2%*	47,740	*94.4%*	361,930
Total	**48,060**		**19,440**		**42,310**		**324,920**	**56,560**		**22,840**		**50,550**		**383,900**

Scenario 2: Transit Only Tunnel

Description: Path through a new tunnel reserved for transit and people walking and biking
Alignment: ***Alignment B***
Network Quality: High
Immediate Approach: High

	Existing Conditions							Plan Bay Area - 2030						
	Avg. Weekday				Avg. Weekend Day		Week	Avg. Weekday				Avg. Weekend Day		Week
Mode	**All-Day**	**All-Day (%)**	**Peak**	**Peak (%)**	**All-Day**	**All-Day (%)**	**Total**	**All-Day**	**All-Day (%)**	**Peak**	**Peak (%)**	**All-Day**	**All-Day (%)**	**Total**
Walk	140	*0.3%*	60	*0.3%*	120	*0.3%*	940	170	*0.3%*	70	*0.3%*	150	*0.3%*	1,150
Bike	430	*0.9%*	170	*0.9%*	370	*0.9%*	2,890	520	*0.9%*	210	*0.9%*	450	*0.9%*	3,500
Walk + Bike	570	*1.2%*	230	*1.2%*	490	*1.2%*	3,830	690	*1.2%*	280	*1.2%*	600	*1.2%*	4,650
Transit	3,140	*6.5%*	1,270	*6.5%*	2,680	*6.3%*	21,060	3,730	*6.6%*	1,510	*6.6%*	3,250	*6.4%*	25,150
Auto	44,380	*92.3%*	17,950	*92.3%*	39,170	*92.5%*	300,240	52,130	*92.2%*	21,050	*92.2%*	46,680	*92.4%*	354,010
Total	**48,090**		**19,450**		**42,340**		**325,130**	**56,550**		**22,840**		**50,530**		**383,810**

Scenario 3: Water Shuttle Service

Description: New service between Jack London and Alameda Island that would carry people and bikes
Alignment: ***Alignment E***
Service Frequency : 15 min peak / 30 min off-peak + weekends
Service Hours : 6 am to 10 pm
Fare : Free
Network Quality : High *Immediate Approach* : High

	Existing Conditions							Plan Bay Area - 2030						
	Avg. Weekday				Avg. Weekend Day		Week	Avg. Weekday				Avg. Weekend Day		Week
Mode	**All-Day**	**All-Day (%)**	**Peak**	**Peak (%)**	**All-Day**	**All-Day (%)**	**Total**	**All-Day**	**All-Day (%)**	**Peak**	**Peak (%)**	**All-Day**	**All-Day (%)**	**Total**
Walk	290	*0.6%*	120	*0.6%*	210	*0.5%*	1,870	340	*0.6%*	140	*0.6%*	250	*0.5%*	2,200
Bike	750	*1.6%*	320	*1.6%*	550	*1.3%*	4,850	900	*1.6%*	380	*1.7%*	670	*1.3%*	5,840
Walk + Bike	1,040	*2.2%*	440	*2.3%*	760	*1.8%*	6,720	1,240	*2.2%*	520	*2.3%*	920	*1.8%*	8,040
Transit	3,870	*8.0%*	1,570	*8.1%*	3,190	*7.5%*	25,730	4,580	*8.1%*	1,850	*8.1%*	3,860	*7.7%*	30,620
Auto	43,210	*89.8%*	17,480	*89.7%*	38,400	*90.7%*	292,850	50,600	*89.7%*	20,440	*89.6%*	45,640	*90.5%*	344,280
Total	**48,120**		**19,490**		**42,350**		**325,300**	**56,420**		**22,810**		**50,420**		**382,940**

Scenario 4.1: Pedestrian and Bike Bridge

Description: Bridge that serves pedestrians and bicycles only
Alignment: ***Alignment A***
Max Grade : 4.9% *Uphill Distance* : 1,600 feet
Frequency Raised : 1 / hour *Time to Raise / Reset*: 10 min
Restrictions : Prohibit during weekday peak

	Existing Conditions							Plan Bay Area - 2030						
	Avg. Weekday				Avg. Weekend Day		Week	Avg. Weekday				Avg. Weekend Day		Week
Mode	**All-Day**	**All-Day (%)**	**Peak**	**Peak (%)**	**All-Day**	**All-Day (%)**	**Total**	**All-Day**	**All-Day (%)**	**Peak**	**Peak (%)**	**All-Day**	**All-Day (%)**	**Total**
Walk	2,670	*5.5%*	1,000	*5.1%*	2,460	*5.7%*	18,270	3,290	*5.8%*	1,230	*5.4%*	3,030	*6.0%*	22,510
Bike	1,700	*3.5%*	690	*3.5%*	1,420	*3.3%*	11,340	2,030	*3.6%*	820	*3.6%*	1,730	*3.4%*	13,610
Walk + Bike	4,370	*9.0%*	1,690	*8.6%*	3,880	*9.0%*	29,610	5,320	*9.4%*	2,050	*9.0%*	4,760	*9.5%*	36,120
Transit	4,430	*9.1%*	1,800	*9.1%*	3,830	*8.9%*	29,810	5,130	*9.1%*	2,080	*9.2%*	4,510	*9.0%*	34,670
Auto	39,990	*82.0%*	16,220	*82.3%*	35,210	*82.0%*	270,370	45,880	*81.4%*	18,600	*81.8%*	40,940	*81.5%*	311,280
Total	**48,790**		**19,710**		**42,920**		**329,790**	**56,330**		**22,730**		**50,210**		**382,070**

Scenario 4.2: Pedestrian and Bike Bridge

Description: Bridge that serves pedestrians and bicycles only
Alignment: ***Alignment F***
Max Grade : 4.9% *Uphill Distance* : 1,600 feet
Frequency Raised : 1 / hour *Time to Raise / Reset*: 10 min
Restrictions : Prohibit during weekday peak

	Existing Conditions							Plan Bay Area - 2030						
	Avg. Weekday				Avg. Weekend Day		Week	Avg. Weekday				Avg. Weekend Day		Week
Mode	**All-Day**	**All-Day (%)**	**Peak**	**Peak (%)**	**All-Day**	**All-Day (%)**	**Total**	**All-Day**	**All-Day (%)**	**Peak**	**Peak (%)**	**All-Day**	**All-Day (%)**	**Total**
Walk	2,410	*4.9%*	910	*4.6%*	2,200	*5.1%*	16,450	2,880	*5.1%*	1,090	*4.8%*	2,650	*5.2%*	19,700
Bike	1,740	*3.6%*	700	*3.6%*	1,450	*3.4%*	11,600	2,060	*3.6%*	830	*3.6%*	1,730	*3.4%*	13,760
Walk + Bike	4,150	*8.5%*	1,610	*8.2%*	3,650	*8.5%*	28,050	4,940	*8.7%*	1,920	*8.4%*	4,380	*8.7%*	33,460
Transit	4,470	*9.2%*	1,820	*9.2%*	3,870	*9.0%*	30,090	5,220	*9.2%*	2,120	*9.3%*	4,600	*9.1%*	35,300
Auto	40,160	*82.3%*	16,270	*82.6%*	35,400	*82.5%*	271,600	46,500	*82.1%*	18,830	*82.3%*	41,580	*82.2%*	315,660
Total	**48,780**		**19,700**		**42,920**		**329,740**	**56,660**		**22,870**		**50,560**		**384,420**

Scenario 4.3: Pedestrian and Bike Bridge

Description: Bridge that serves pedestrians and bicycles only
Alignment: ***Alignment D***
Max Grade : 4.9% *Uphill Distance* : 1,600 feet
Frequency Raised : 1 / hour *Time to Raise / Reset*: 10 min
Restrictions : Prohibit during weekday peak

	Existing Conditions							Plan Bay Area - 2030						
	Avg. Weekday				Avg. Weekend Day		Week	Avg. Weekday				Avg. Weekend Day		Week
Mode	**All-Day**	**All-Day (%)**	**Peak**	**Peak (%)**	**All-Day**	**All-Day (%)**	**Total**	**All-Day**	**All-Day (%)**	**Peak**	**Peak (%)**	**All-Day**	**All-Day (%)**	**Total**
Walk	2,410	*4.9%*	910	*4.6%*	2,180	*5.1%*	16,410	2,870	*5.1%*	1,080	*4.7%*	2,610	*5.2%*	19,570
Bike	1,720	*3.5%*	700	*3.6%*	1,440	*3.4%*	11,480	2,040	*3.6%*	820	*3.6%*	1,720	*3.4%*	13,640
Walk + Bike	4,130	*8.5%*	1,610	*8.2%*	3,620	*8.4%*	27,890	4,910	*8.7%*	1,900	*8.3%*	4,330	*8.6%*	33,210
Transit	4,470	*9.2%*	1,820	*9.2%*	3,870	*9.0%*	30,090	5,210	*9.2%*	2,120	*9.3%*	4,590	*9.1%*	35,230
Auto	40,180	*82.4%*	16,280	*82.6%*	35,440	*82.6%*	271,780	46,540	*82.1%*	18,840	*82.4%*	41,650	*82.4%*	316,000
Total	**48,780**		**19,710**		**42,930**		**329,760**	**56,660**		**22,860**		**50,570**		**384,440**

Appendices

Appendix A: Conceptual Drawings

- Key Map
- Alternative A1 – Layout
- Alternative A2 – Layout
- Alternative A3 – Layout
- Alternative A4 – Layout
- Alternative A5 – Layout
- Bridge Alternatives – Profile (with gondola platform)
- Bridge Alternatives – Profile (direct)
- Bridge Alternatives – Typical Sections
- Alternative B – Layout
- Alternative B – Profile
- Alternative B – Typical Sections
- Alternative C – Layout
- Alternative C – Typical Sections
- Alternative D1 – Layout
- Alternative D2 – Layout
- Alternative E – Layout
- Alternative F – Layout

Appendix B: Structural Design

- General Plan
- Structure Cost Estimate

Appendix C: Preliminary Foundation Report

Appendix D: Travel Demand Memorandum

- Forecasting Tool (electronic only)
- User Guide
- Literature Review

Appendix E: Cost Estimate

Appendix F: Letters of Concurrence

- Port of Oakland
- U.S. Coast Guard

Appendix A

Conceptual Drawings

ESTUARY CROSSING STUDY
ESTUARY CROSSING CONCEPTS

SCALE: 1" = 300'
01/25/2021

PRELIMINARY
FOR DISCUSSION ONLY

HNTB
ALAMEDA County Transportation Commission

ESTUARY CROSSING STUDY
ESTUARY CROSSING BRIDGE CONCEPT A1

SCALE: 1" = 100'

PRELIMINARY
FOR DISCUSSION ONLY

HNTB

ALAMEDA County Transportation Commission

01/25/2021

ESTUARY CROSSING STUDY
ESTUARY CROSSING BRIDGE CONCEPT A2

SCALE: 1" = 100'

01/25/2021

PRELIMINARY
FOR DISCUSSION ONLY

HNTB

ALAMEDA County Transportation Commission

ESTUARY CROSSING STUDY
ESTUARY CROSSING BRIDGE CONCEPT A3

SCALE: 1" = 100'

PRELIMINARY
FOR DISCUSSION ONLY

HNTB

ALAMEDA County Transportation Commission

01/25/2021

ESTUARY CROSSING STUDY
ESTUARY CROSSING BRIDGE CONCEPT A4

SCALE: 1" = 100'

PRELIMINARY
FOR DISCUSSION ONLY

HNTB

ALAMEDA County Transportation Commission

01/25/2021

ESTUARY CROSSING STUDY
ESTUARY CROSSING BRIDGE CONCEPT A5

SCALE: 1" = 100'

PRELIMINARY
FOR DISCUSSION ONLY

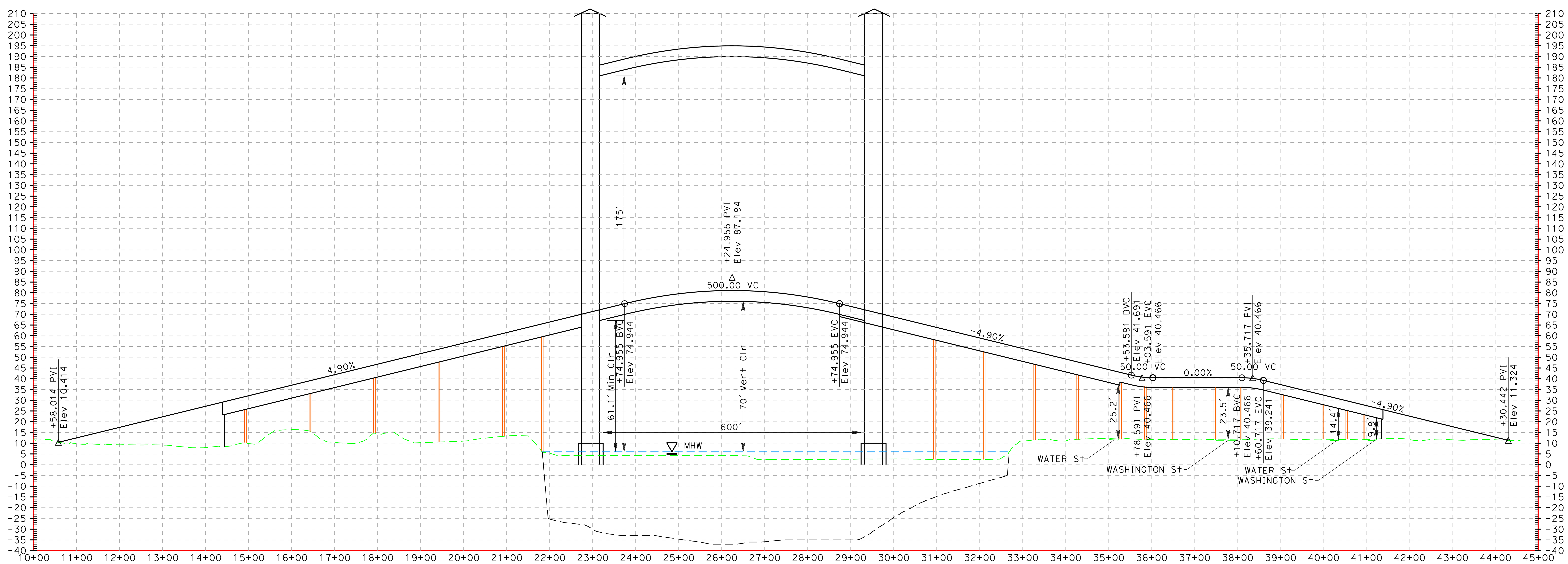
HNTB

ALAMEDA County Transportation Commission

01/25/2021

ESTUARY CROSSING STUDY

ESTUARY CROSSING BRIDGE CONCEPT A (GONDOLA) - PROFILE



Horiz SCALE: 1" = 150'
Vert SCALE: 1" = 30'

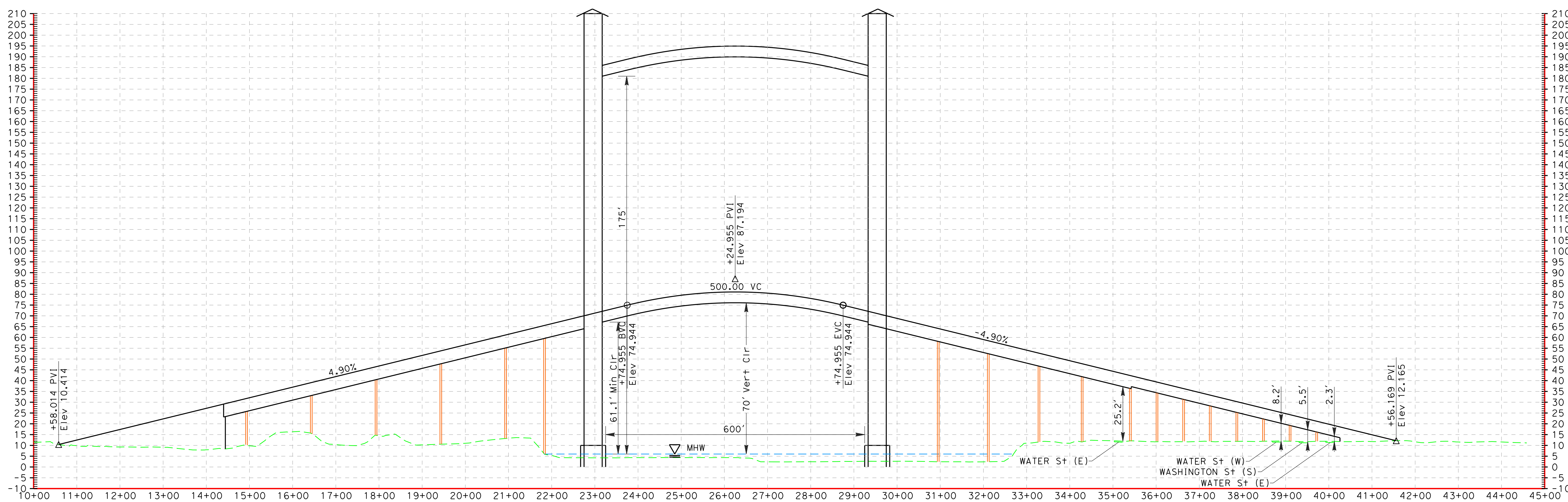
01/25/2021

PRELIMINARY
FOR DISCUSSION ONLY

HNTB

ALAMEDA County Transportation Commission

ESTUARY CROSSING STUDY
ESTUARY CROSSING BRIDGE CONCEPT A (SPIRAL) - PROFILE



Horiz SCALE: 1" = 150'
Vert SCALE: 1" = 30'

01/25/2021

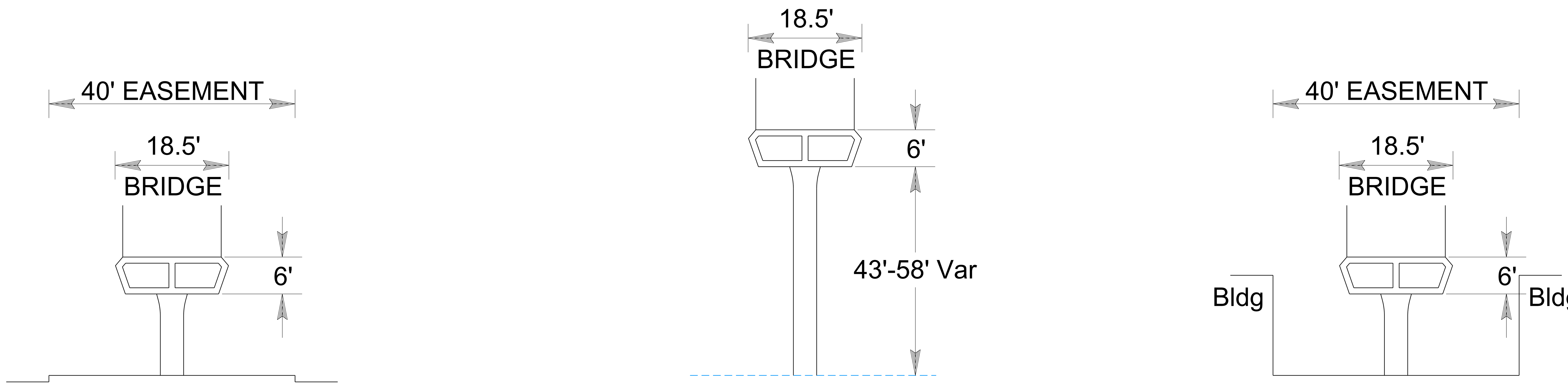
PRELIMINARY
FOR DISCUSSION ONLY

HNTB

ALAMEDA County Transportation Commission

ESTUARY CROSSING STUDY

ESTUARY CROSSING BRIDGE - TYPICAL SECTION



ALAMEDA

APPROACH OVER WATER

OAKLAND

PRELIMINARY

FOR DISCUSSION ONLY

HNTB

ALAMEDA County Transportation Commission

01/25/2021

ESTUARY CROSSING STUDY
ESTUARY CROSSING TUNNEL CONCEPT B

SCALE: 1" = 150'

01/25/2021

PRELIMINARY
FOR DISCUSSION ONLY

HNTB

ALAMEDA County Transportation Commission

ESTUARY CROSSING STUDY

ESTUARY CROSSING TUNNEL CONCEPT B - PROFILE

Horiz SCALE: 1" = 150'
Vert SCALE: 1" = 30'

01/25/2021

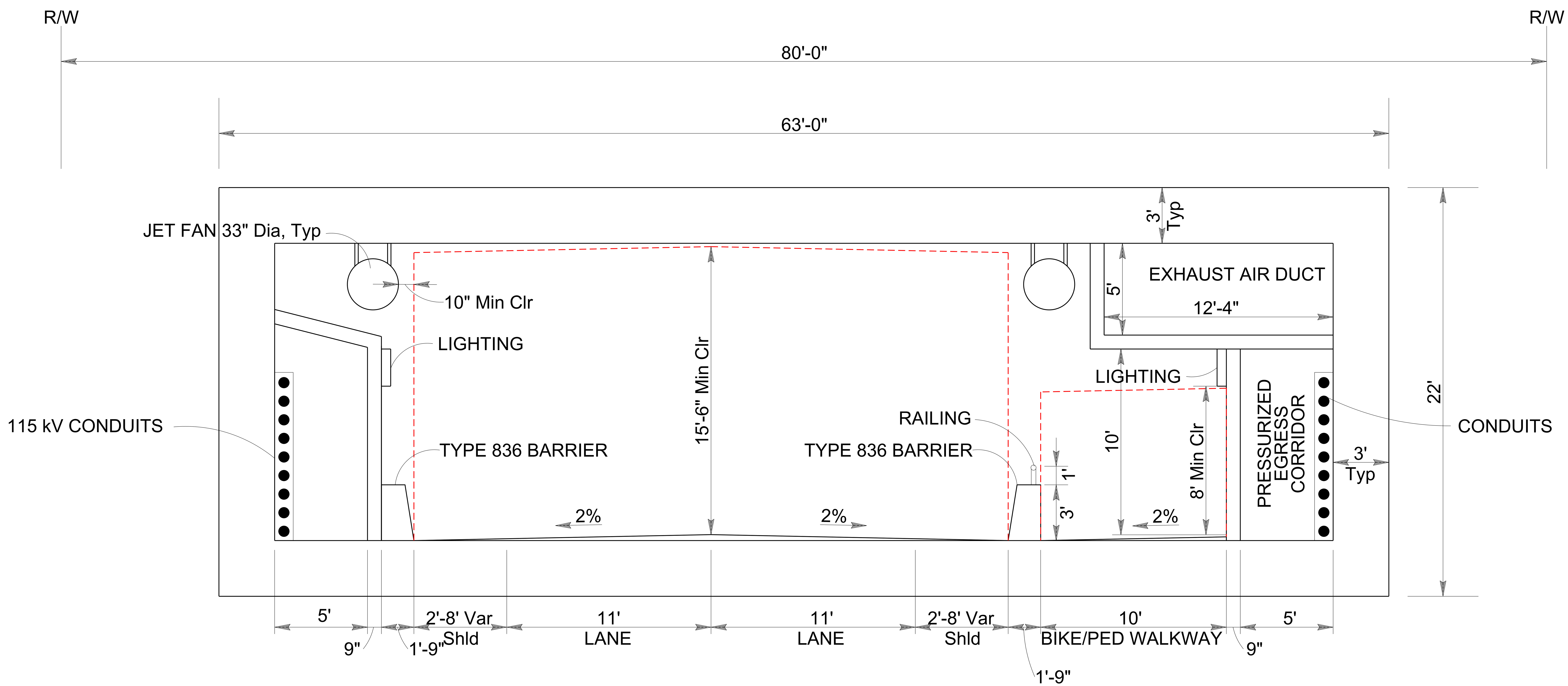
PRELIMINARY
FOR DISCUSSION ONLY

HNTB

ALAMEDA County Transportation Commission

ESTUARY CROSSING STUDY

ESTUARY CROSSING TUNNEL CONCEPT B - TYPICAL CROSS SECTION



PRELIMINARY
FOR DISCUSSION ONLY

HNTB

ALAMEDA County Transportation Commission

01/25/2021

ESTUARY CROSSING STUDY
ESTUARY CROSSING TUNNEL CONCEPT C

SCALE: 1" = 150'

01/25/2021

PRELIMINARY
FOR DISCUSSION ONLY

HNTB

ALAMEDA County Transportation Commission

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	880,260	R30.47/R31.61 R0.78/R1.90	3	21

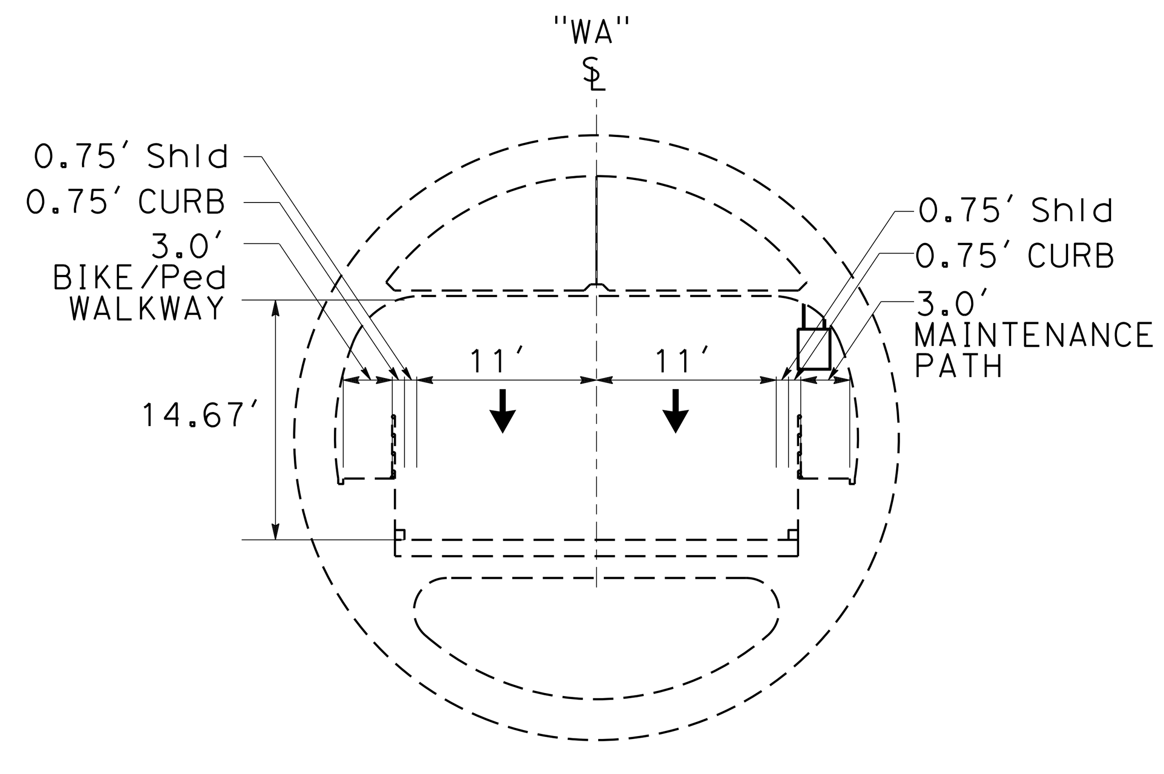
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

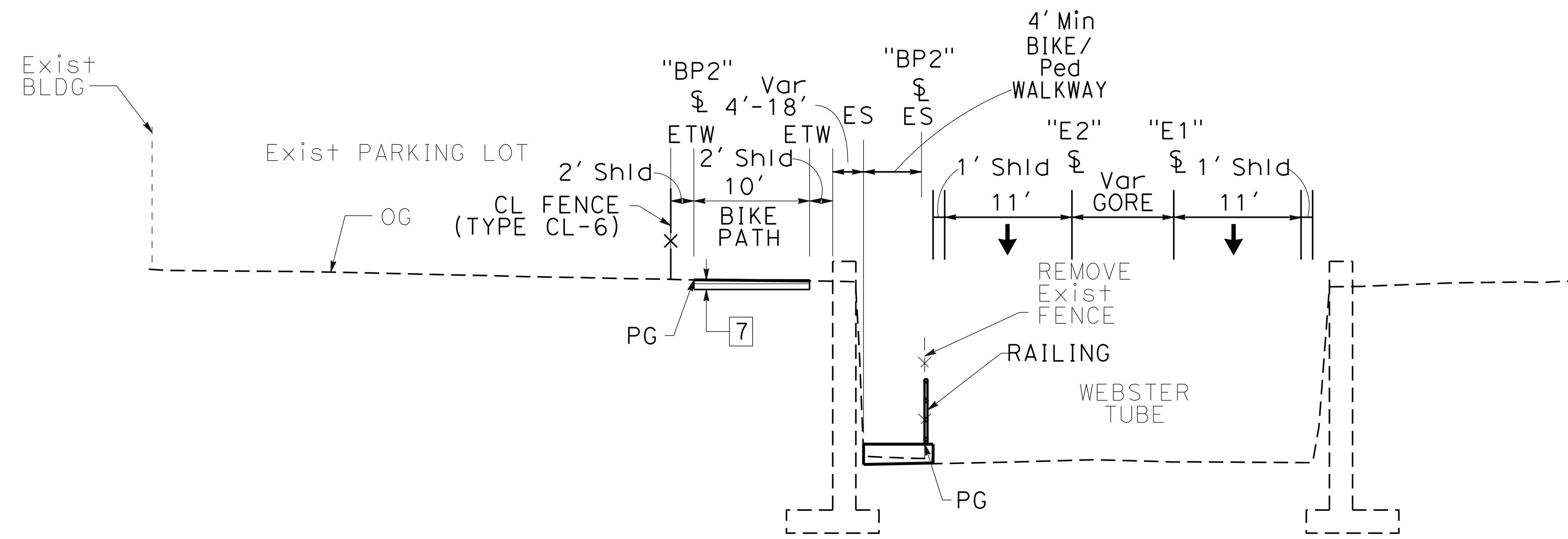
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

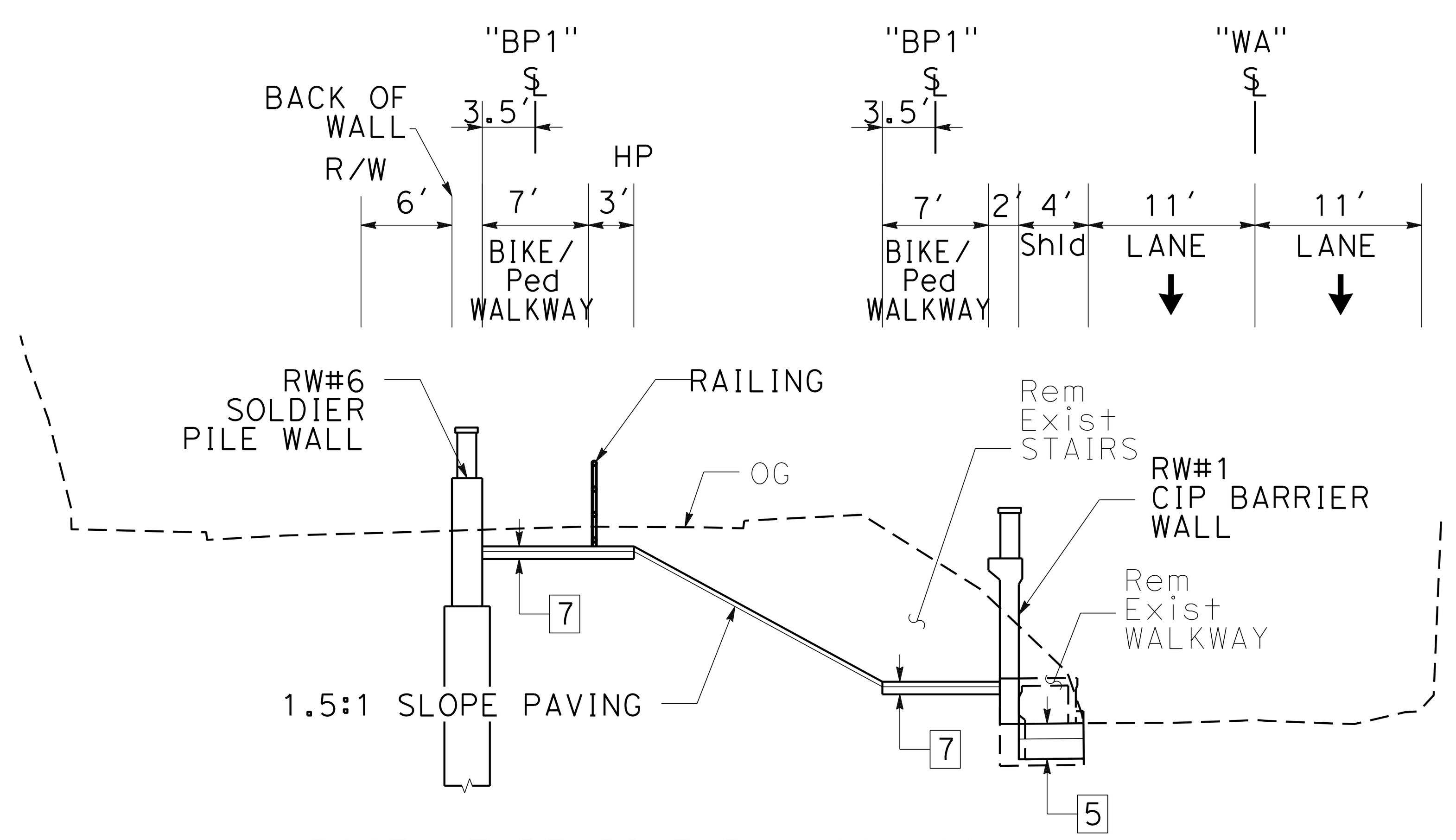
~~HNTB~~ CORPORATION 1111 BROADWAY 9TH FLOOR OAKLAND, CA 94607	ALAMEDA CTC 1111 BROADWAY SUITE 800 OAKLAND, CA 94607



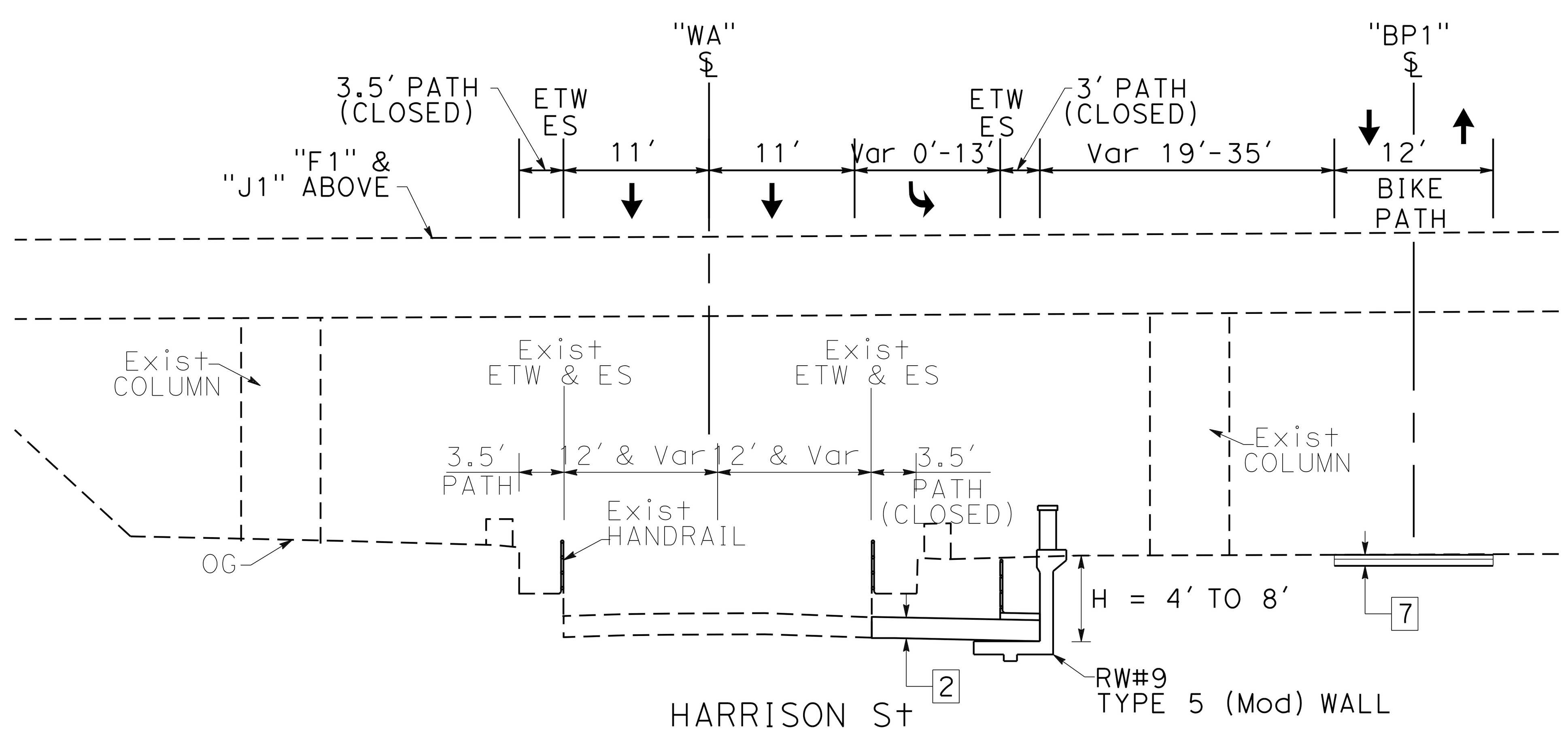
POSEY TUBE
"WA" 104+54 TO 139+44



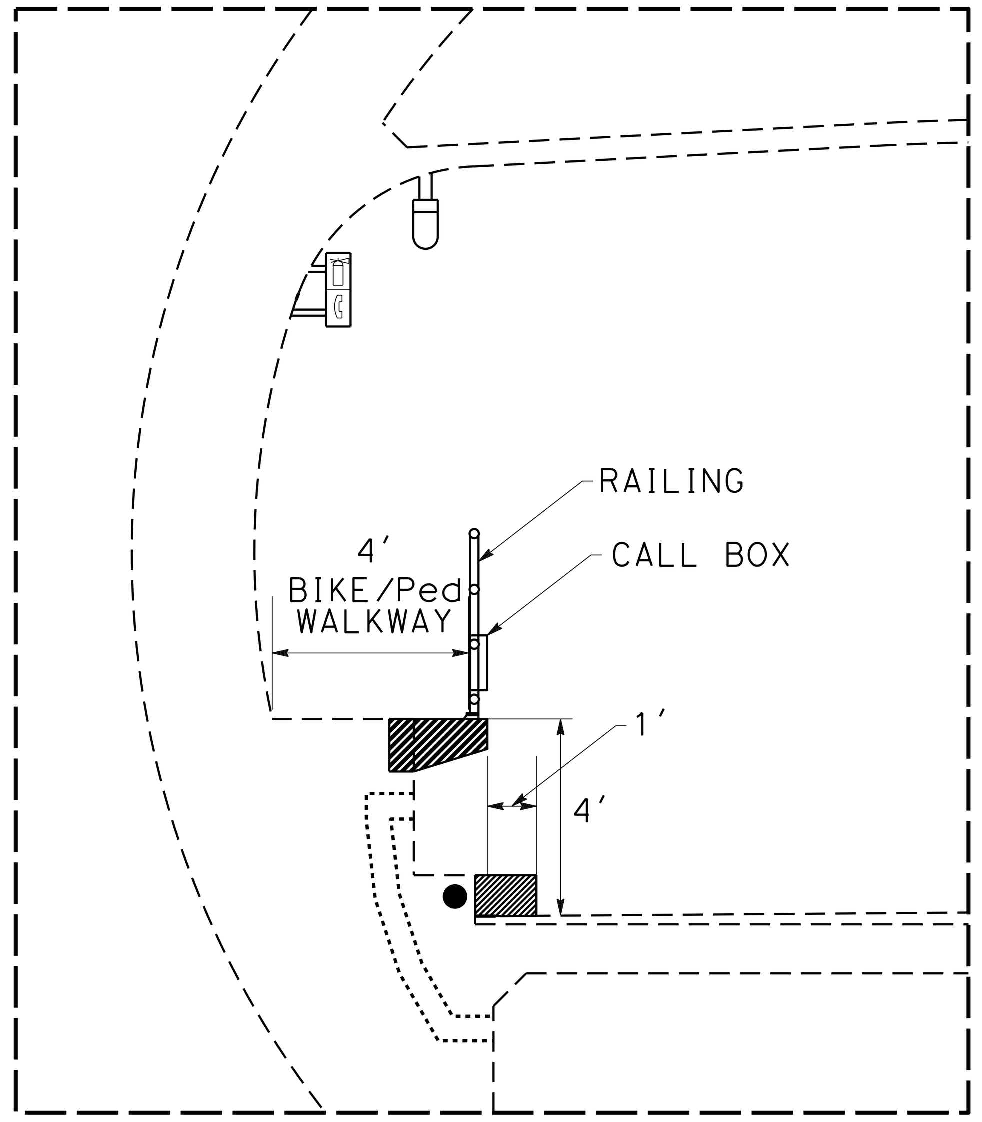
WEBSTER TUBE BIKE/Ped WALKWAY
OAKLAND PORTAL
"E2" 165+62 TO 166+95



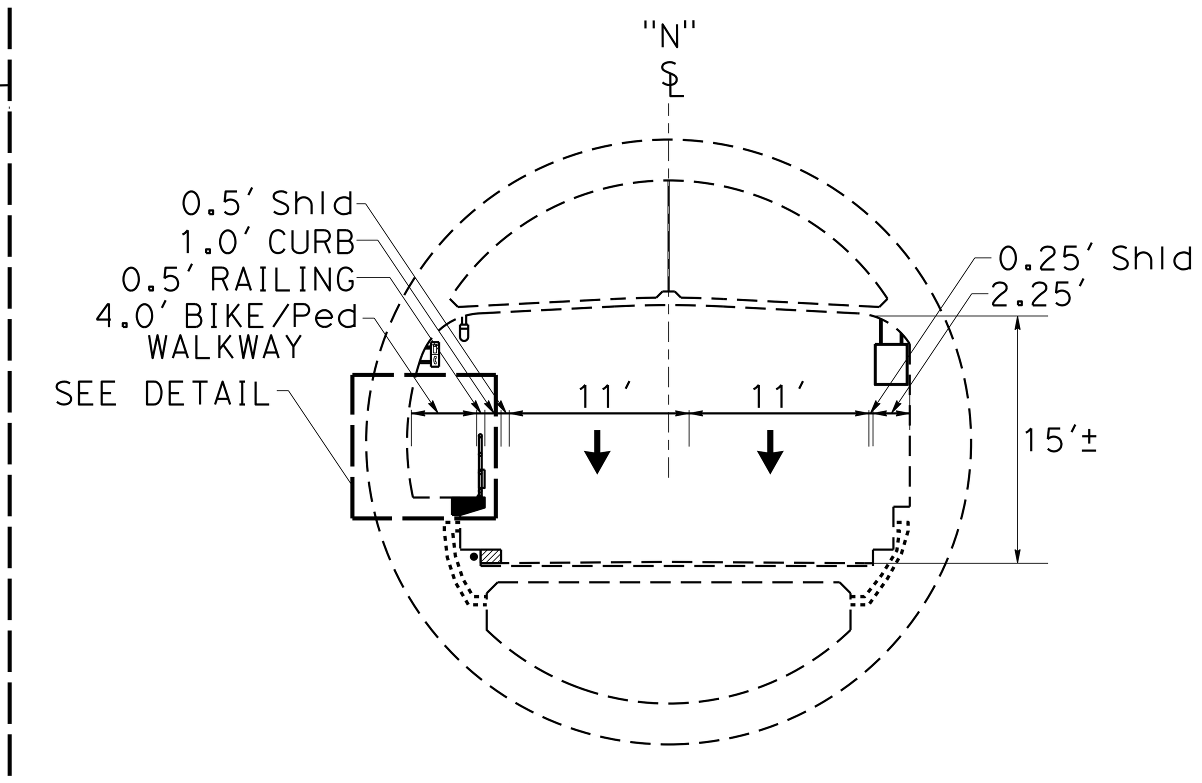
POSEY TUBE BIKE/Ped WALKWAY
OAKLAND PORTAL
"WA" 103+67 TO 104+54



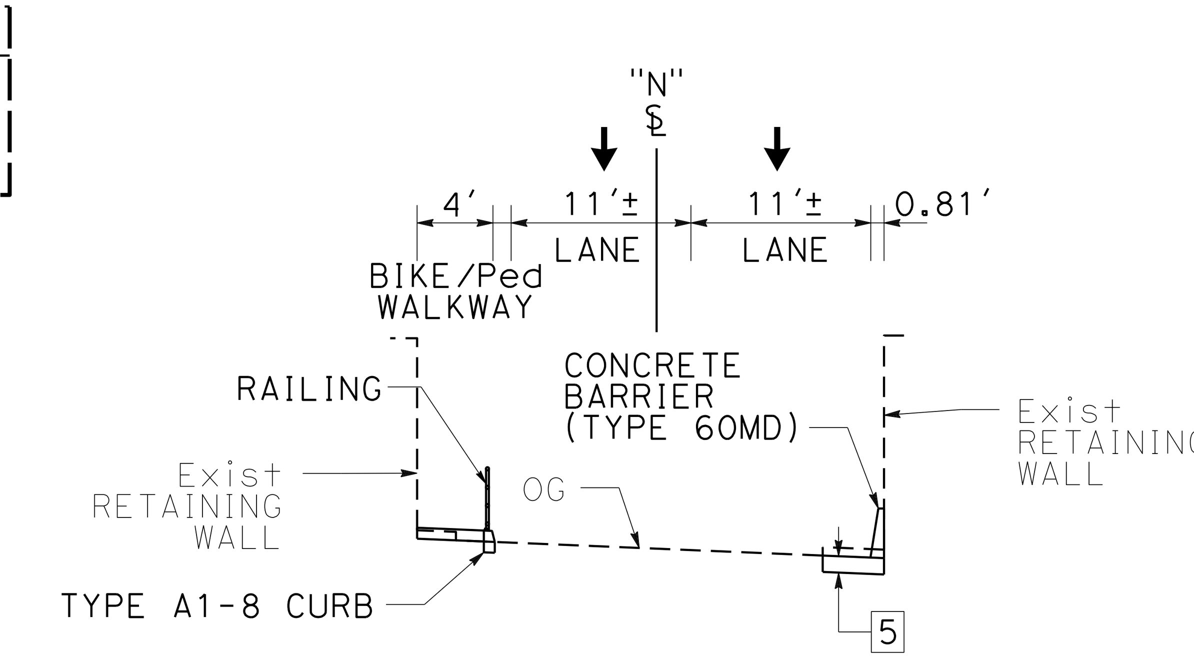
HARRISON St
FIFTH St TO SIXTH St
"WA" 100+41 TO 101+45



WEBSTER TUBE
DETAIL



WEBSTER TUBE
"N" 130+40 TO 164+71



WEBSTER TUBE BIKE/Ped WALKWAY
ALAMEDA PORTAL
"N" 125+00 TO 130+40

TYPICAL CROSS SECTIONS

NO SCALE

X-2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR | CALCULATED-DESIGNED BY | CHECKED BY | REVISED BY | DATE REVISED

LAST REVISION 00-00-00 | DATE PLOTTED => $DATE | TIME PLOTTED => $TIME

ESTUARY CROSSING STUDY

ESTUARY CROSSING BRIDGE CONCEPT D1

SCALE: 1" = 100'

01/25/2021

PRELIMINARY
FOR DISCUSSION ONLY

HNTB

ALAMEDA County Transportation Commission

ESTUARY CROSSING STUDY
ESTUARY CROSSING BRIDGE CONCEPT D2

SCALE: 1" = 100'

01/25/2021

PRELIMINARY
FOR DISCUSSION ONLY

HNTB

ALAMEDA County Transportation Commission

ESTUARY CROSSING STUDY
ESTUARY CROSSING FERRY ALTERNATIVE E

SCALE: 1" = 100'

01/25/2021

PRELIMINARY
FOR DISCUSSION ONLY

HNTB

ALAMEDA County Transportation Commission

ESTUARY CROSSING STUDY
ESTUARY CROSSING BRIDGE CONCEPT F

SCALE: 1" = 100'

01/25/2021

PRELIMINARY
FOR DISCUSSION ONLY

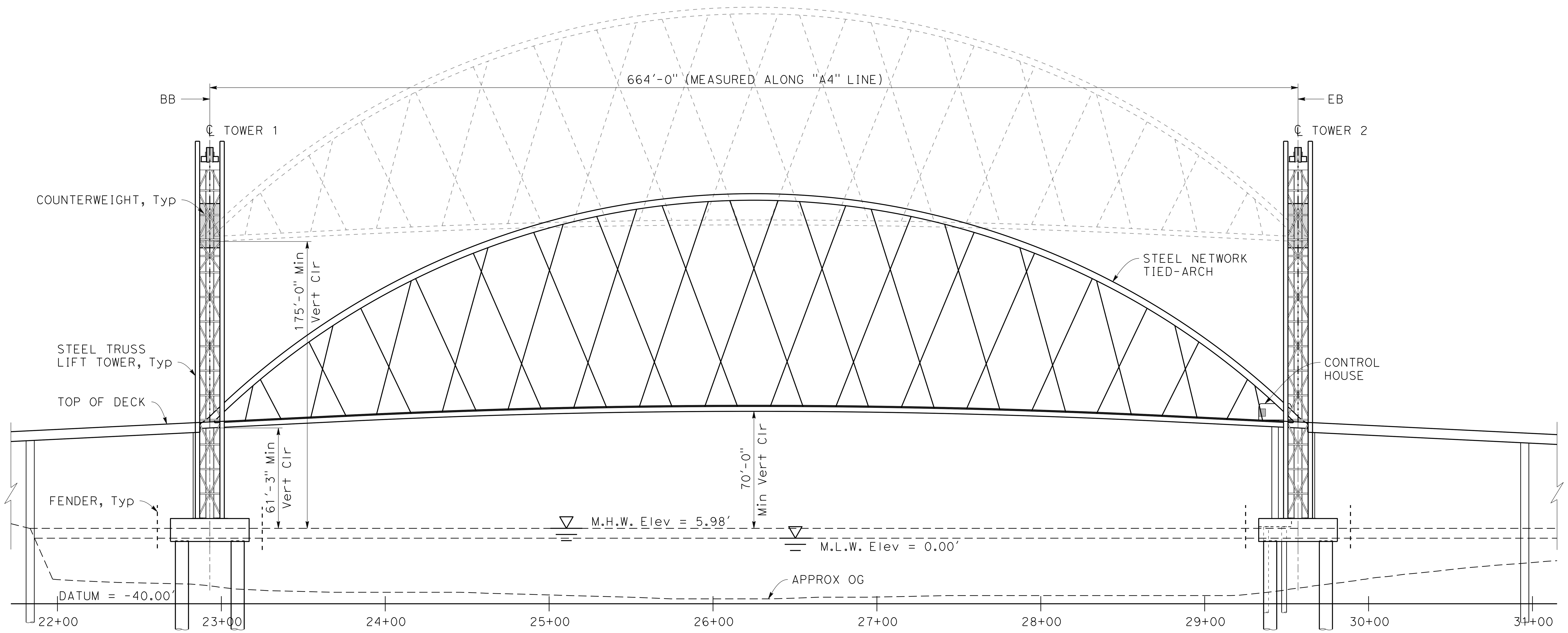
HNTB

ALAMEDA County Transportation Commission

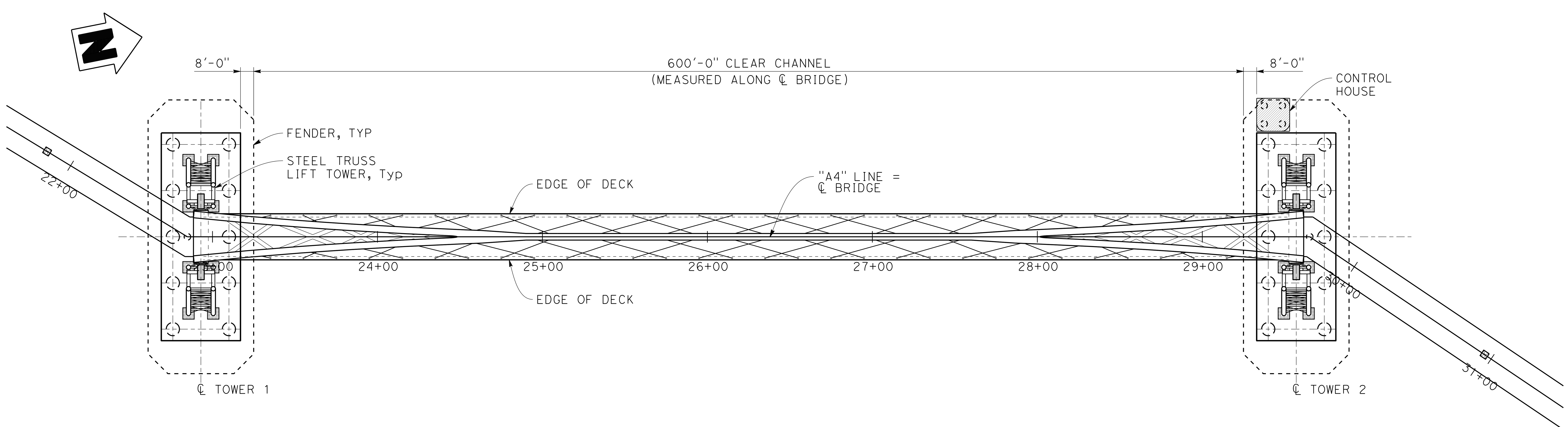
Appendix B

Structural Design

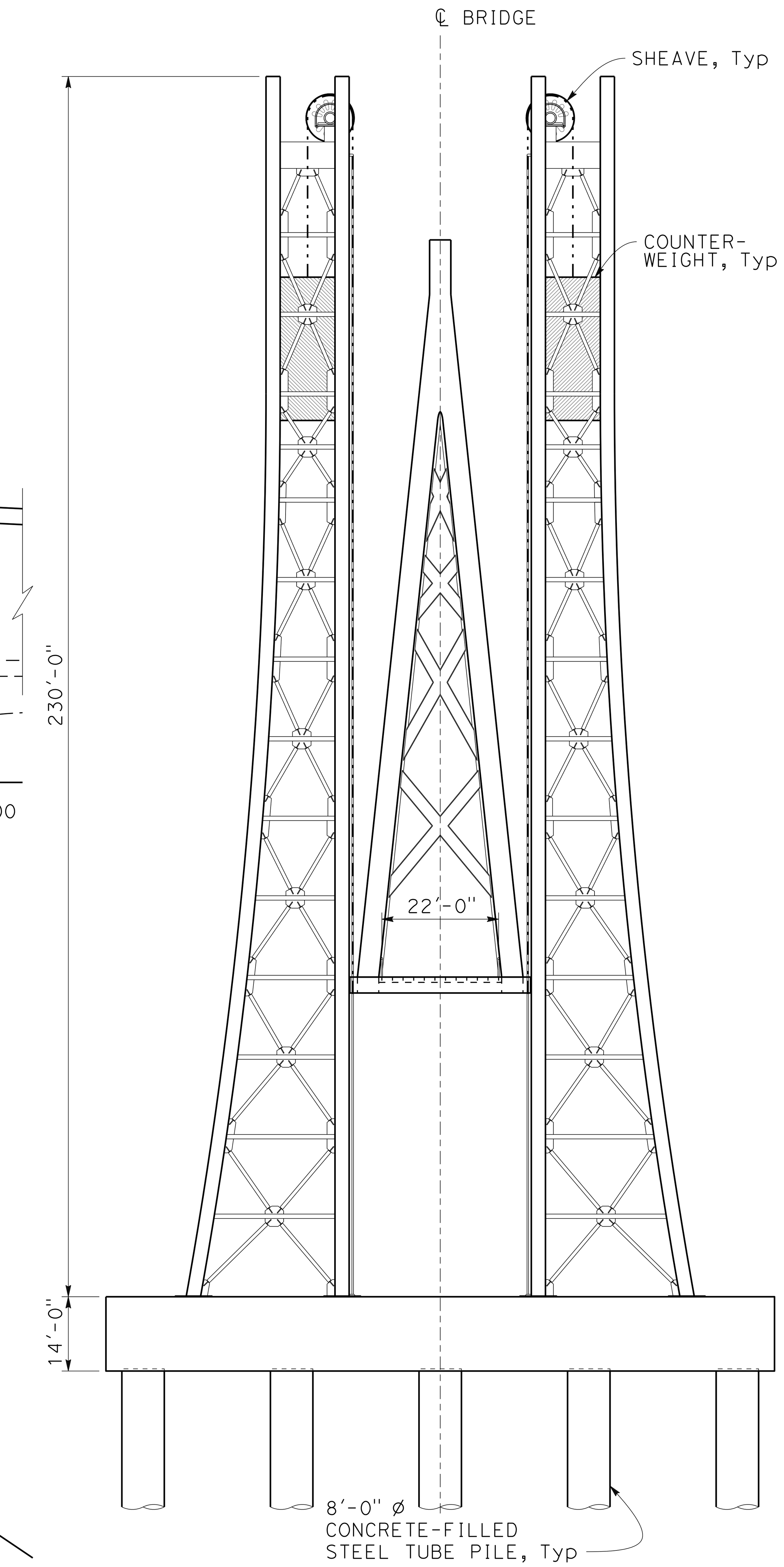
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT
X	X	X	



ELEVATION
1" = 40'



PLAN
1" = 40'



TYPICAL SECTION
1" = 20'

DESIGNED BY X	DATE X	X PROJECT ENGINEER	**ESTUARY CROSSING BRIDGE**
DRAWN BY X	DATE X		**PLAN - BRIDGE ALT 4**
CHECKED BY X	DATE X		BRIDGE NO. X / UNIT: X
APPROVED X	DATE X		SCALE: X / PROJECT NUMBER & PHASE: X

X
DESIGN OVERSIGHT
X
SIGN OFF DATE

ADVANCE PLANNING STUDY SHEET (ENGLISH) (REV. 7/16/10)

FILE => $REQUEST

CONTRACT NO.: X

TIME PLOTTED => $TIME
DATE PLOTTED => $DATE
USERNAME => $USER

	GENERAL PLAN ESTIMATE	X	ADVANCE PLANNING ESTIMATE

Revised - December 3, 2007

		RCVD BY:	**IN EST:**
			OUT EST:
BRIDGE:	Estuary Crossing Pedestrian Bridge - "Recovery" Option	**BR. No.:**	**DISTRICT:**
TYPE:	Network Arch Lifting Bridge		**RTE:**
CU:			**CO:**
EA:			**PM:**
	LENGTH: 664.00	**WIDTH:** 29.50	**AREA (SF)=** 19,588

DESIGN SECTION:	
# OF STRUCTURES IN PROJECT :	**EST. NO.**
PRICES BY :	**COST INDEX:**
PRICES CHECKED BY :	**DATE:**
QUANTITIES BY:	**DATE:**

	CONTRACT ITEMS	TYPE	UNIT	QUANTITY	PRICE	AMOUNT
1	STRUCTURAL STEEL (BRIDGE) - ARCH		LB	1,722,000	$10.00	$17,220,000.00
2	ORTHOTROPIC DECK		LB	525,900	$10.00	$5,259,000.00
3	CABLE HANGERS (INCLUDING END FITTINGS)		LF	6,212	$127.50	$792,030.00
4	FURNISH STRUCTURAL STEEL (BRIDGE) - TOWER		LB	1,798,400	$5.00	$8,992,000.00
5	FURNISH BUCKLING RESTRAINED BRACE		EA	480	$5,500.00	$2,640,000.00
6	ERECT STRUCTURAL STEEL (BRIDGE) -TOWER		LB	1,798,400	$5.00	$8,992,000.00
7	MACHINERY FOR LIFTING BRIDGE		LS	1	$15,000,000.00	$15,000,000.00
8	STRUCTURAL CONCRETE, BRIDGE FOOTING		CY	6,272	$600.00	$3,763,200.00
9	BRIDGE PEDESTRIAN RAILING AND FENCING		LF	1,340	$225.00	$301,500.00
10	96" PERMANENT STEEL CASING		LF	2,800	$840.00	$2,352,000.00
11	96" CAST-IN-DRILLED HOLE CONCRETE PILING		LF	2,800	$1,909.00	$5,345,200.00
12	FENDER CONCRETE		CY	823	$600.00	$493,800.00
13	WEARING SURFACE		SF	14,608	$22.50	$328,680.00
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

SUBTOTAL		$71,479,410
TIME RELATED OVERHEAD		$7,147,941
MOBILIZATION (@ 10 %)		$8,736,372
SUBTOTAL BRIDGE ITEMS		$87,363,723
CONTINGENCIES	(@ 25%)	$21,840,931
BRIDGE TOTAL COST		$109,204,654
COST PER SQ. FOOT		$5,575.08
BRIDGE REMOVAL (CONTINGENCIES INCL.)		
WORK BY RAILROAD OR UTILITY FORCES		
GRAND TOTAL		$109,204,654
BUDGET ESTIMATE AS OF		$109,205,000
BUDGET ESTIMATE FOR CONSTRUCTION IN 2030 (@ 4%)		**$113,573,000**

ROUTING

1. DES SECTION
2. OFFICE OF BRIDGE DESIGN - NORTH
3. OFFICE OF BRIDGE DESIGN - CENTRAL
4. OFFICE OF BRIDGE DESIGN - SOUTH
5. OFFICE OF BRIDGE DESIGN - WEST
6. OFFICE OF BRIDGE DESIGN SOUTHERN CALIFORNIA

COMMENTS:

Escalated Budget Estimate to Midpoint of Construction *

Escalation Rate per Year

Years Beyond Midpoint	Escalated Budget Est.	Years Beyond Midpoint	Escalated Budget Est.
1	$109,205,000	4	$109,205,000
2	$109,205,000	5	$109,205,000
3	$109,205,000		

* Escalated budget estimate is provided for information only, actual construction costs may vary. Escalated budget estimates provided do not replace Departmental policy to update cost estimates annually.

	GENERAL PLAN ESTIMATE	X	ADVANCE PLANNING ESTIMATE

Revised - December 3, 2007

RCVD BY:

IN EST:

OUT EST:

BRIDGE: Estuary Crossing Pedestrian Bridge - "Recovery" Option

BR. No.:

DISTRICT:

TYPE: Approach Span

RTE:

CU:

CO:

EA:

PM:

LENGTH: 2,766.00 **WIDTH:** 22.00 **AREA (SF)=** 60,852

DESIGN SECTION:

 # OF STRUCTURES IN PROJECT : **EST. NO.**

PRICES BY : **COST INDEX:**

PRICES CHECKED BY : **DATE:**

QUANTITIES BY: **DATE:**

	CONTRACT ITEMS	TYPE	UNIT	QUANTITY	PRICE	AMOUNT
1	STRUCTURAL CONCRETE, BRIDGE		SF	60,852	$280.00	$17,038,560.00
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

SUBTOTAL	$17,038,560
TIME RELATED OVERHEAD	$1,703,856
MOBILIZATION (@ 10 %)	$2,082,491
SUBTOTAL BRIDGE ITEMS	$20,824,907
CONTINGENCIES (@ 25%)	$5,206,227
BRIDGE TOTAL COST	$26,031,133
COST PER SQ. FOOT	$427.78
BRIDGE REMOVAL (CONTINGENCIES INCL.)	
WORK BY RAILROAD OR UTILITY FORCES	
GRAND TOTAL	$26,031,133
BUDGET ESTIMATE AS OF	$26,031,000
BUDGET ESTIMATE FOR CONSTRUCTION IN 2030 (@ 4%)	**$27,072,000**

ROUTING

1. DES SECTION
2. OFFICE OF BRIDGE DESIGN - NORTH
3. OFFICE OF BRIDGE DESIGN - CENTRAL
4. OFFICE OF BRIDGE DESIGN - SOUTH
5. OFFICE OF BRIDGE DESIGN - WEST
6. OFFICE OF BRIDGE DESIGN SOUTHERN CALIFORNIA

COMMENTS:

Escalated Budget Estimate to Midpoint of Construction *

Escalation Rate per Year

Years Beyond Midpoint	Escalated Budget Est.	Years Beyond Midpoint	Escalated Budget Est.
1	$26,031,000	4	$26,031,000
2	$26,031,000	5	$26,031,000
3	$26,031,000		

* Escalated budget estimate is provided for information only, actual construction costs may vary. Escalated budget estimates provided do not replace Departmental policy to update cost estimates annually.

Appendix C

Preliminary Foundation Report

PRELIMINARY FOUNDATION REPORT

ESTUARY CROSSING IMPROVEMENT PROJECT
ESTUARY CROSSING PEDESTRIAN BRIDGE

ALAMEDA AND OAKLAND, ALAMEDA COUNTY, CALIFORNIA

Prepared for:

HNTB Corporation

Prepared by:

Earth Mechanics, Inc.
3541 Investment Blvd., Suite 4
Hayward, California 94545

EMI Project No. 19-142

January 22, 2020

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

January 22, 2020

EMI Project No. 19-142

HNTB Corporation
44 Montgomery St, Suite 880
San Francisco, CA 94104

Attention: Mr. Rodney Pimentel

Subject: **Estuary Crossing Improvement Project**
Estuary Crossing Pedestrian Bridge
Alameda and Oakland, Alameda County, California

Dear Mr. Pimentel:

Attached is our Preliminary Foundation Report for the Estuary Crossing Pedestrian Bridge in the cities of Alameda and Oakland, Alameda County, California.

EMI has prepared this report in accordance with Caltrans Guidelines for Structure Foundation Reports, dated February 2017, to assist the structural designers in the Bridge Type Selection process. The recommendations contained in this report are based on existing information from adjacent projects and should be considered preliminary. Final design recommendations will be provided after the bridge type selection is approved.

We appreciate the opportunity to provide geotechnical services for this project. If you have any questions please do not hesitate to contact us.

Sincerely,
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1.0 INTRODUCTION

1.1 Scope of Work

This Preliminary Foundation Report (PFR) has been prepared to provide necessary geotechnical information to assist the structural designers in bridge type selection process of the Estuary Crossing Pedestrian Bridge Project, connecting the Cities of Alameda and Oakland in Alameda County, California.

The preliminary recommendations provided in this report are based on subsurface information contained on as-built Log-of-Test-Borings (LOTB) sheets of the nearby structures (The Posey & Webster Street Tubes), included in Appendix A. Additional site-specific geotechnical investigation will be performed for this bridge during the final design phase; therefore, the recommendations in this report should be considered preliminary, and require verification when additional site-specific information becomes available.

1.2 Project Description

The Cities of Alameda and Downtown Oakland have proposed to construct a pedestrian bridge over the Oakland Estuary to provide an easier way of transportation between the two cities. Currently the bikeway that connects west Alameda and Oakland is the Posey Tube, which is inadequate for passing cyclists and pedestrians due to bike path being three feet in width. In addition, this link is unpleasant for users due to vehicle noise and emissions. Other routes that mainly serve east Alameda would include the Park Street Bridge, Fruitvale (Miller Sweeny) Bridge and the High Street Bridge. As populations of west Alameda and Oakland grow, congestion and conditions in the Posey and Webster Tubes will degrade. This new proposed crossing will help provide a convenient and efficient option for recreational riders, tourists and commuters to travel between the two cities.

1.2.1 Project Location

The project site is located in Alameda County at the Alameda and Oakland Estuary just west of the Webster and Posey Tubes. The proposed structure will begin in Alameda just north of Mitchell Ave. It will continue north across the estuary into Oakland where it will terminate around the Ferry Lawn in a spiraling fashion, ultimately ending on Washington Street. The pedestrian bridge will run across the developed Marina Village and be elevated from street traffic through the residential neighborhood. The project location can be seen in the site location map in Figure 1.

1.2.2 Existing and Proposed Structure

Currently there is no structure at the proposed bridge location connecting Alameda and Oakland.

Based on the preliminary plans provided by the structural engineers, the proposed structure will utilize a vertical lift bridge to comply with the Coast Guard requirements for clearances along the estuary. The structure will have a minimum 600 feet horizontal opening, and a vertical clearance of 175 feet when open and 70 feet when closed. The structure for the POC will have a 15.5' inside width.

Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	**Estuary Crossing Pedestrain Bridge**	**Site Location Map**
	Project No.: 19-142 **Date: 09/26/2019**	**Figure 1**

2.0 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 Existing Information

Previous geotechnical studies at the site are as follows:

- The Posey & Webster Street Tubes Seismic Retrofit – Contract No. 59X797 (1997)
- The as-built LOTBs from the Webster Street Bulkhead Replacement (1979)
- The as-built LOTBs from the Posey Tube – Protective Cover – Contract No. 62-1471367 (1960)
- The as-built LOTBs from the Webster Street Tube (1959)
- The as-built LOTBs from the Posey Tube/Estuary Subway (1924)

Previous boring data includes 85 rotary type sampler borings and 41 CPTs from the as-built and retrofits of the adjacent Webster Street and Posey Tubes. Table 1 summarizes the information from the previous subsurface investigations. In general top-of-hole elevation at the time of the investigations ranged between +26.0 and -36.5 feet. The deepest boring was advanced to El. -195, approximately 200 feet below grade. LOTB sheets are included in Appendix A.

Vertical control of all the existing available subsurface information is based upon the National Geodetic Vertical Datum of 1988 (NGVD 88), unless otherwise stated.

Table 1. Existing Site Investigation Information

Tube	Boring Type	Date of Exploration	Surface Elevation Range (feet)	Bottom of Boring Elevation Range (feet)	No. of Borings
Seismic Retrofit Project					
Posey	CPT	4/96 – 7/00	+8.9 to +4.1	-35 to -115	12
	Rotary Boring	3/96 – 8/96	+7.0 to -36.5	-60 to -125	8
Webster St	CPT	4/96 – 4/96	+7.7 to +6.6	-75 to -95	3
	Rotary Boring	4/96 – 5/96	+8.0 to -38.5	-90 to -195	4
Webster Street Bulkhead Replacement					
Webster St	Rotary Boring	7/72 – 9/79	+8.3 to +6.1	-5 to -40	8
Posey Tube – Protective Cover					
Posey	Rotary Boring	4/59 – 5/59	-31.0 to -34.7	-42 to -75	7
Webster Street Tube As-Built					
Webster St	CPT	11/51 – 11/57	+23.1 to +7.0	-1 to -135	26
	Boring	11/51 – 6/58	+26.0 to -36.8	+2 to -195	33
Posey Tube As-Built[1]					
Posey	Boring	11/23 – 1/24	+112 to +93.8	+52 to -35	25
Notes: 1. Elevations are based off Estuary Datum					

3.0 GEOLOGY

3.1 Physiography and Topography

The project area is located in the Coast Ranges geomorphic province of California. The Coast Ranges are bounded by the Pacific Ocean on the west and the Great Valley on the east. The ranges extend from the Oregon border south to the Santa Ynez River near Santa Barbara; San Francisco Bay further subdivides the province into the northern and southern sections. The Coast Ranges are characterized by discontinuous, northwest-trending mountain ranges, ridges, and valleys. East of the San Andreas Fault, most of the province bedrock is composed of a heterogeneous mix of marine and volcanic rocks of the Franciscan Assemblage, including chert, greywacke sandstone, altered mafic volcanic rock, shale, serpentinite, and metamorphic rock. Granitic rocks of the Salinian block comprise much of the basement rock of the ranges located west of the San Andreas Fault.

The project area is situated on the generally level Oakland alluvial plain, with a gentle slope down to the west at an average gradient of about 50 feet per mile. The plain is bounded by the Oakland Estuary and San Francisco Bay, located about 0.25 miles to the southwest and the Oakland hills, located about 2.5 miles to the northeast. The Oakland alluvial plain extends for approximately 25 miles from north to south and, along its length, varies from 2 to 7 miles in width, east to west. The alluvial plain includes all or portions of the cities of Richmond, San Pablo, El Cerrito, Albany, Berkeley, Emeryville, Piedmont, Alameda, Oakland, San Leandro, San Lorenzo and Hayward.

3.2 Geologic Structure

Positioned between major faults of the San Andreas fault system, San Francisco Bay is a structural depression formed by down-warping and subsidence of the structural block in response to activity along individual faults. The San Andreas Fault system is a right-lateral, strike-slip fault zone that extends from the Gulf of California north to Cape Mendocino and defines the boundary between the North American Plate to the east and the Pacific Plate to the west. The Pacific plate moves about 35-40 mm per year relative to central California across a broad, approximately 60 mile wide zone in northern California. Within the San Francisco Bay Area, movement across this plate boundary is distributed across a complex system of primarily northwest-trending, right-lateral, strike-slip faults. Major regional faults of this system include the San Andreas, Hayward, Calaveras, Concord-Green Valley, Mount Diablo Thrust, and Greenville faults (Figure 2). There is also a significant degree of compression across the greater Bay Area, most prominently evident in the faults and associated folds of the Mt. Diablo thrust and fold belt. These thrust faults generally trend west-northwest, are oblique to the strike-slip faults of the San Andreas system, and exhibit a well-defined right-stepping, en echelon geometry.

A summary of active regional faults, distances to project site, maximum earthquakes, slip rates, and fault types is presented in Table 2.

Table 2. Existing Fault Location Relative to Project Site

Fault	Approx. Distance to Project Site (mi.)	Maximum Recorded Magnitude (M_{max})	Slip Rate (mm/yr)	Fault Type
Hayward	3.5	7.3	9	Right lateral strike-slip
Calaveras	12.5	6.9	6	Right lateral strike-slip
Mt Diablo Thrust	15.0	6.6	2	Reverse
San Andreas (Peninsula)	15.2	8.0	17	Right lateral strike-slip
Concord/Green Valley	16.4	6.6	4.3	Right lateral strike-slip
Greenville	20.7	6.9	3	Right lateral strike-slip

3.3 Geologic Hazards

Significant geologic hazards at the project site include strong seismic ground shaking, liquefaction, and lateral spreading. Instances of historical liquefaction, ground settlement, and other failures have been documented along the Estuary Crossing (Figure 3).

The project site lies within the California Emergency Management Agency's currently defined Tsunami Inundation Area, as developed for evacuation planning (CalEMA, 2009). It should be noted that this map shows the maximum considered tsunami run up from a number of extreme, yet realistic tsunami sources, but it does not provide any information about the probability of tsunami affecting the area. There are no known occurrences of tsunamis in the Bay Area in the historical records. We believe due to topography of the San Francisco Bay, the probability of tsunami having major impact on the project site is low.

The site is not subject to ground rupture, landslide, or volcanic hazards. The site is not located within an Alquist-Priolo Fault Rupture Hazard Zone and no known active faults cross the project site. There are no volcanoes in the region. The flat-lying topography of the area is not susceptible to landsliding, either.

3.4 Seismicity

The project site is located within a seismically active region. Historical, ground-rupturing earthquakes have occurred on the nearby Hayward, San Andreas, Calaveras, and Greenville faults. The Hayward-Rodgers Creek and Calaveras faults are considered by the United States Geological Survey (USGS) to be the faults most likely to generate a magnitude 6.7 or greater quake in the San Francisco Bay area (Field et al., 2014).

Historical earthquake epicenter maps show seismicity generally clustered along the traces of the major fault zones. The majority of earthquakes are predominantly right-lateral, strike-slip quakes with varying degrees of minor reverse-oblique motion. A summary of significant historical regional earthquakes in the San Francisco Bay area (Toppozada, 2000) is presented in Table 3.

Table 3. Significant Historical Earthquakes in the San Francisco Bay Area

Fault	Year	Approx. Magnitude	Approx. Epicenter Location
Unknown	1836	6.4	Between Monterey and Santa Clara
San Andreas	1838	7.4	Santa Clara
Unknown	1865	6.5	Santa Cruz Mountains
Hayward	1868	6.8	Hayward
Unknown	1892	6.4	Vacaville
Rodgers Creek	1898	6.3	Mare Island
San Andreas	1906	7.8	Daly City
Calaveras	1911	6.5	Morgan Hill
Calaveras	1984	6.2	Morgan Hill
San Andreas Fault System	1989	6.9	Santa Cruz Mountains

The largest historical earthquake in the San Francisco Bay area was the 7.8 Mw 1906 earthquake on the San Andreas fault. Accepted magnitudes for this event generally range from 7.7 Mw (Wald et al., 1993) to 7.9 Mw (Thatcher et al., 1997). The earthquake ruptured the northernmost 296 miles of the San Andreas fault, extending from northwest of San Juan Bautista to the triple junction at Cape Mendocino. Measured slip maxima varied from 28.2 and 24.6 ft at Shelter Cove and Tomales Bay to 14.8 ft near Mount Tamalpais and 8.9 ft at Loma Prieta.

In terms of damage, the 1868 earthquake on the Hayward fault was the second most significant regional earthquake. The 1868 rupture damaged buildings from Hayward to San Francisco and was referred to as "the great San Francisco earthquake" until the 1906 earthquake occurred. Ground rupture along the Hayward fault was traced for about 20 miles from San Leandro to Warm Springs in Fremont. However, recent modeling of survey data (Yu and Segall, 1996) suggest that the fault moved as far north as Berkeley, with about 32 miles of rupture, and from this data, the average amount of horizontal movement along the fault is inferred to be about 6 feet.

The 1989 Loma Prieta earthquake occurred not on the main trace of the San Andreas fault, but on a nearby fault associated with the larger San Andreas fault system. The rupture occurred about 10.5 miles beneath the Santa Cruz Mountains along a left-stepping, restraining bend in the San Andreas fault system on a steep, southwest-dipping, right-lateral reverse fault that did not rupture to the surface. Six feet of right-lateral strike-slip and 4 feet of reverse-slip was inferred from geodetic data. The most significant effect of the Loma Prieta earthquake was damage and disruption to transportation systems; in Oakland and San Francisco reinforced-concrete viaducts collapsed: the Nimitz Freeway (Interstate 880) in Oakland, and the Embarcadero Freeway, Highway 101, and Interstate 280 in San Francisco.

Ground rupture during the 1838 earthquake was previously believed to have been limited to the 60-km peninsula segment of the San Andreas Fault. However, a reevaluation of the quake by Toppozada and Borchardt (1998) indicate that faulting probably extended almost 100 miles, from San Francisco to San Juan Bautista, indicating a significantly larger earthquake than previously thought, possibly 7.4 M. The northern end of the 1838 faulting was previously assumed to be 25 km south of San Francisco. However, Mission San Francisco Dolores was damaged in 1838 but not in 1906, suggesting that the 1838 faulting extended to San Francisco. Also, the 1838 aftershocks were felt in Oakland as frequently and violently as those following the major 1868 Hayward earthquake, suggesting that the 1838 faulting on the San Andreas extended to the latitude of Oakland. The 1838 fault segment ruptured again 68 years later as part of the overlapping 1906 San Andreas Fault rupture.

3.5 Geologic Mapping

The project area is underlain by Urban land soils as shown on the USDA soil survey of Alameda County (Welch, 1981). Urban land generally consists of areas covered by buildings, roads, parking lots, and other urban structures. The soil material is mainly heterogeneous fill adjacent to San Francisco Bay.

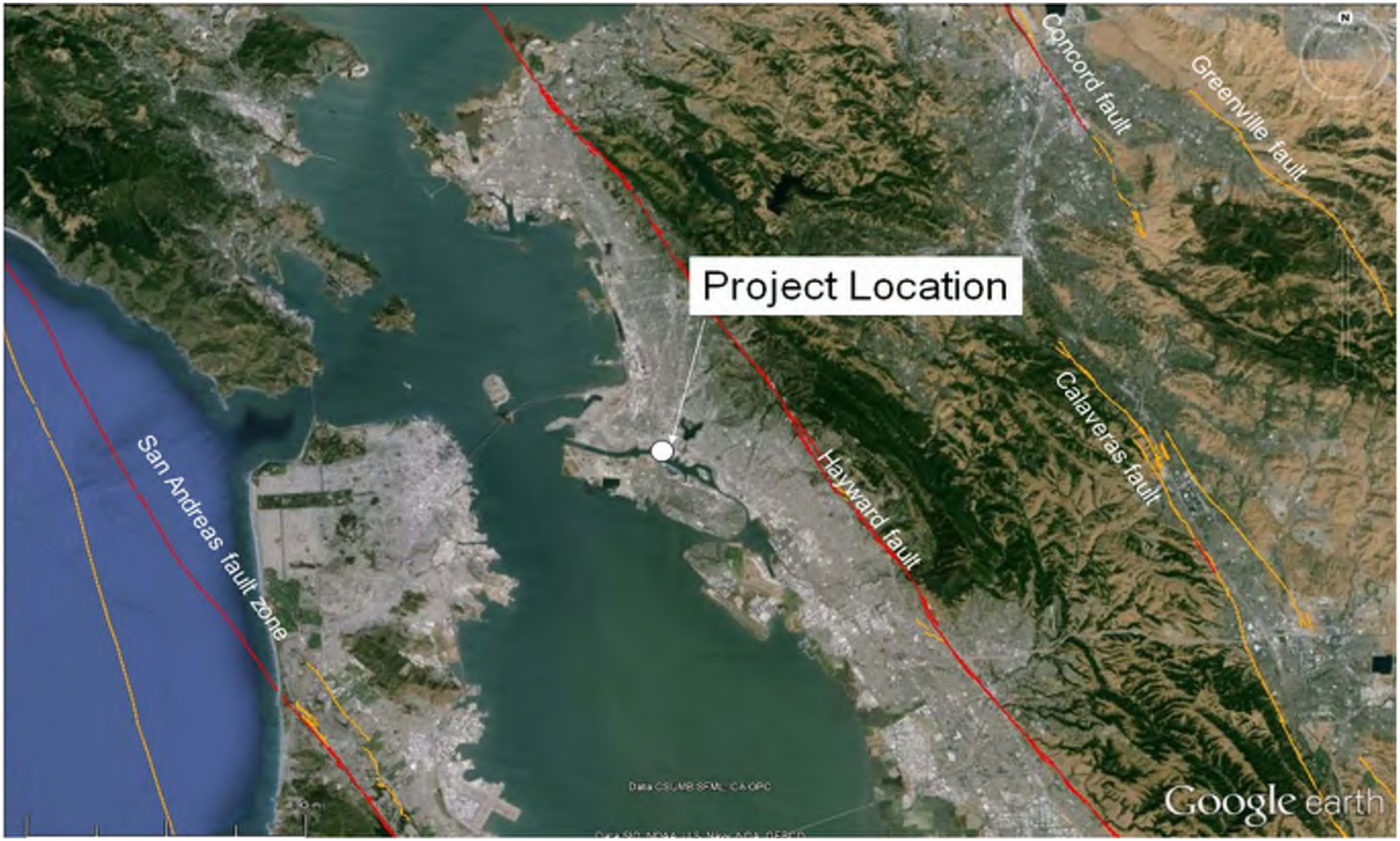
The project site is mapped as historic artificial fill (af) by Graymer (2000) (Figure 4). Helley and Graymer (1997), Knudsen et al. (2000), and the California Geological Survey (CGS) (2003) indicate that the site is underlain by artificial fill over Young Bay Mud (afbm).

3.6 Liquefaction and Lateral Spreading

Liquefaction is a phenomenon whereby saturated granular soils lose their inherent shear strength due to increased pore water pressures, which may be induced by cyclic loading such as that caused by an earthquake. Low density granular soils, shallow groundwater, and long duration/high acceleration seismic shaking are some of the factors favorable to cause liquefaction.

According to the Liquefaction Susceptibility Map of the San Francisco Bay Area (USGS, 2015), liquefaction potential at project site is moderate to very high on Oakland side, and very high on Alameda side. Liquefaction susceptibility map of the project area is shown on Figure 5.

According to Liquefaction Hazard Zone Report for Oakland West Quadrangle (CGS, 2003), evidence of ground failure during past earthquakes (subsidence, lateral spreading) has been observed near the project site (See Figure 3).



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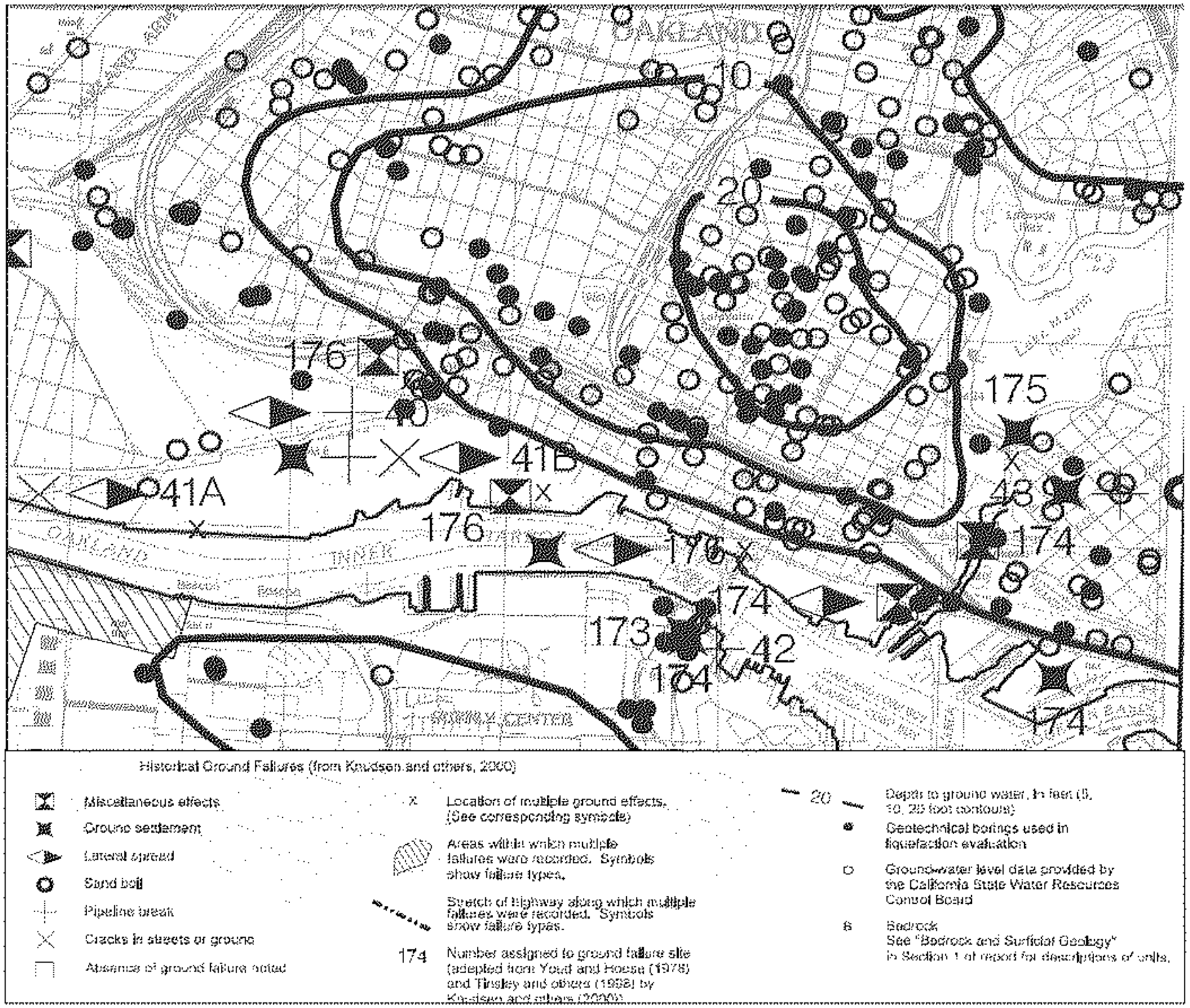
Estuary Crossing Pedestrian Bridge

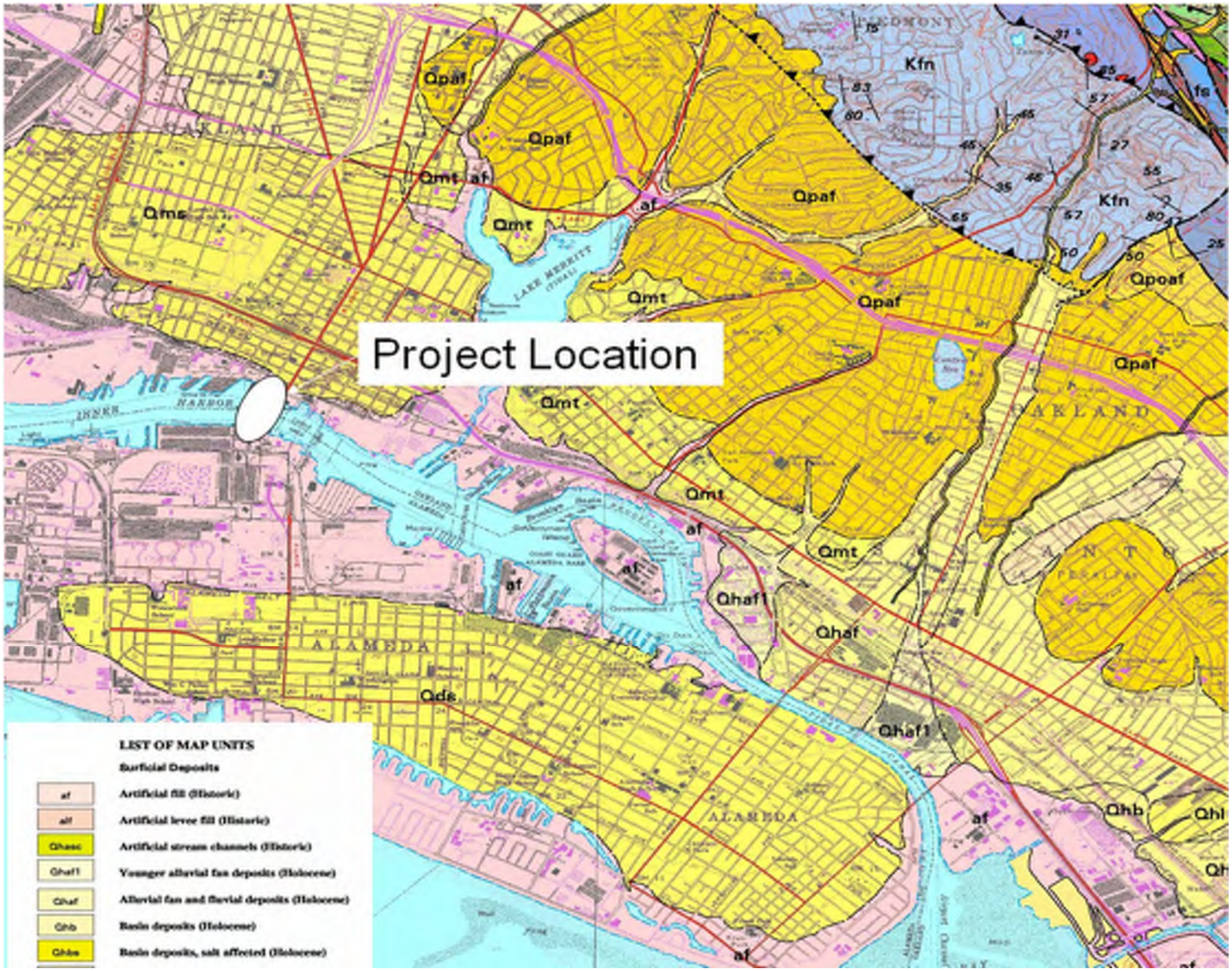
Project No.: 19-142 | **Date: 09/26/2019**

Regional Fault Map

Figure 2



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	Estuary Crossing Pedestrian Bridge		Historic Groundwater and Historic Ground Failures
	Project No.: 19-142	Date: 09/26/2019	Figure 3



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	**Estuary Crossing Pedestrian Bridge**	**Geologic Map**
	Project No.: 19-142 / **Date: 09/26/2019**	**Figure 4**

* Source: Witter, R.C., et al., 2006, USGS Open-File Report 2006-1037.

Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	Estuary Crossing Pedestrian Bridge		Liquefaction Hazard Zone Map
	Project No.: 19-142	Date: 09/26/2019	Figure 5

4.0 SUBSURFACE CONDITIONS

4.1 Subsurface Conditions

As described in Section 3.5, the subject site is underlain by artificial fill over Young Bay Mud. According to the available subsurface information, the deeper site soils are alluvial deposits, which become stiffer and denser as the depth increases.

As shown in the CGS (2003) Seismic Hazard Zone Report for the Oakland West quadrangle, artificial fill along the Estuary Crossing would be anticipated to have a dry density of approximately 98-102 lb/ft^3 and a standard penetration resistance of approximately 15-22 blows/ft. Young Bay mud would be anticipated to have a dry density of approximately 64-104 lb/ft^3 and a standard penetration resistance of approximately 3-12 blows/ft.

4.2 Groundwater Conditions

The project site lies in the East Bay Plain Groundwater Basin a northwest-trending alluvial plain bounded on the north by San Pablo Bay, on the east by Franciscan Basement rock, on the south by the Niles Cone Groundwater Basin, and on the west by San Francisco Bay. The East Bay Plain extends from Richmond to Hayward.

Historic high groundwater levels as given by the CGS in the Seismic Hazard Zone report for the Oakland West Quadrangle (CGS, 2003) indicate that the site is within an area where the depth to historic high groundwater is between 5 and 10 feet below ground surface (Figure 3). This was also validated by the as-built LOTBs, showing a recorded water table at various depths below ground surface (with the highest groundwater elevation of about +1 feet). Considering that groundwater levels can fluctuate significantly due to seasonal factors, a design groundwater elevation of +4 feet is recommended for the subject site.

4.3 Preliminary Idealized Soil Profiles

Based on the information collected from as-built drawings, idealized soil profiles for foundation analysis and design were developed. The subsurface profiles for the Estuary Crossing Pedestrian Bridge and estimated soil engineering parameters are shown in Table 4.

Table 4. Preliminary Idealized Soil Profile

Approximate Layer Depth Range (feet)	Predominant Soil Type	Soil Description
Oakland Side (North)		
0 to 10	SC/SP/CL	Fill: Clayey Sand, Poorly Graded Sand and Lean Clay (dense/stiff)
10 to 50	SP/SC	Sands with streaks of Clay: Loose to medium dense sands, thin interbedded clay layers
50 to 60	CL/SC/ML-CL	Sandy Clays: Stiff to Very Stiff clays, undrained shear strengths 500 psf to 2,000psf increasing with depth
60 to 110	CL/ML-CL	Tough Clay: Hard Clays and Silts, undrained shear strengths to 4,000psf increasing with depth.
Estuary Crossing		
25 to 45 (below water surface)	SC/SP/ML-CL	Webster Sand: Clayey Sands to Poorly graded Sands
45 to 70 (below water surface)	CL/SC/ML-CL	Sandy Clays: Stiff to Very Stiff clays, undrained shear strengths 500 psf to 2,000psf increasing with depth
70 to 90 (below water surface)	CL/ML-CL	Tough Clay: Hard Clays and Silts, undrained shear strengths to 4,000psf increasing with depth.
Alameda Side (South)		
0 to 10	SP/SW/SC	Fill: Poorly Graded to Well-graded Sands, and Clayey Sands (medium dense)
10 to 40	CH/CL	Soft Mud: Soft fat clay/lean clay with a few sand layers, undrained shear strength 100 to 500 psf, increasing with depth
40 to 65	SC/SP/ML-CL	Coarse Webster Sand: Clayey Sands to Poorly graded Sands (medium dense)
65 to 75	CL/SC/ML-CL	Sandy Clays: Stiff to Very Stiff clays, undrained shear strengths 500 psf to 2,000psf increasing with depth
75 to 110	CL/ML-CL	Tough Clay: Hard Clays and Silts, undrained shear strengths to 4,000psf increasing with depth.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Acceleration Response Spectra

The preliminary design acceleration response spectra (ARS) for the bridge were developed in accordance with the Seismic Design Criteria Version 2.0 (Caltrans, 2019) procedures. The bridge is classified as a "Recovery Bridge", as defined in SDC 2.0. Recovery bridges shall serve as vital links for rebuilding damaged areas and provide access to the public shortly after an earthquake. Recovery bridges shall be designed using two levels of Design Seismic Hazard (DSH): the Safety Evaluation Earthquake (SEE) is based on a ground motion with 5% in 50 years probability of exceedance (975-year return period). The Functional Evaluation Earthquake (FEE) level has a 20% probability of exceedance in 50 years (225-year return period).

The parameters of small-strain shear wave velocity for the upper 100 ft (V_{s30}) of subsurface materials was correlated based on the SPT blowcounts in the available borings, and the response spectra account for soil effects through incorporation of the parameter V_{s30}.

The following table summarizes the pertinent site specific input data for SEE and FEE seismic hazard analyses:

Site Latitude, Longitude:	37.7934°, -122.2794°
V_{s30} – Shear Wave Velocity for upper 100 feet:	590 ft/sec (180 m/sec)

The Caltrans ARS Online (V3.0) tool was used to develop the SEE level ARS curve. The USGS Unified Hazard Tool (2019) was used to evaluate the 225-year return period unified hazard spectra for the site. The results from the unified hazard tool were multiplied by SEE level near-fault amplification factors to evaluate FEE level ARS curve. The resulting preliminary ARS curves for SEE and FEE levels for the project site, along with the digitized coordinates are presented in Figure 6.

For final design, it is recommended to perform site response analyses using site-specific soil information.

5.2 Scour Evaluation

The proposed structure crosses Estuary Crossing. The foundations are expected to be subject to local and long-term scour. Local and long-term scour will be addressed in the subsequent Foundation Report.

5.3 Liquefaction and Lateral Spreading

Preliminary liquefaction evaluations were performed based on soil type and SPT blowcounts in PB-101 and PB-104 from the Webster Tube Ground Improvement Demonstration Project and PB-201 and PB-204 from the Posey Tube Seismic Retrofit Project. These analyses results indicate low liquefaction and seismic settlement potential at the Posey Tube site and higher potential in the Webster Tube due to a lower presence of fine-grained soils near the surface.

Based on these results, liquefiable zones should be anticipated within shallow artificial fills below groundwater level and sand deposits in the Estuary. In addition, potential for lateral spreading is high, and the impact on foundations shall be considered during bridge design.

Additional liquefaction and lateral spreading analyses will be performed once the project-specific field investigation is completed.

5.4 Foundation Recommendations

5.4.1 As-Built Foundation Data

The proposed bridge for the bicycle and pedestrian gap closure is new, therefore there are no as-built foundation types. The nearby overhead structures include the 5th Avenue Overhead (Bridge #33-0027), where bents are founded on 96-inch diameter cast-in-steel-shell (CISS) piles. The average length for these piles at Lake Merritt Channel is about 150 feet.

For the Embarcadero bridge over Lake Merritt Channel (Bridge #33C-0030), the bents are founded on 120-inch diameter cast-in-drilled-hole (CIDH) piles. Average length for these piles is about 180 feet.

5.4.2 Proposed Foundation Type

Based on the preliminary design ARS, large design seismic lateral forces are expected on bridge foundations. The as-built boring logs from adjacent structures indicate the site is underlain by soft compressible clay layers and liquefiable sands, and it is not suitable for shallow foundations. Therefore, deep pile foundations are recommended for the new bridge.

Based on existing information, both driven cast-in-steel-shell (CISS) or pipe piles and large diameter cast-in-drilled-hole (CIDH) piles are believed to be appropriate for the site. Particularly, if further liquefaction evaluations indicate significant liquefaction and lateral spreading potential, large diameter CIDH piles will be the preferred foundation type. CIDH piles can be installed using wet construction method and a temporary casing, or using an oscillator.

5.4.3 Estimated Pile Length

Pile length for the main span was estimated assuming a total service load of 5,500 kips per foundation. Using this load, the estimated pile length for 7-ft. diameter CIDH or CISS piles, arranged in a 2x2 pattern (4 piles per support) is 140 foot (measured from the bottom of the channel). Figure 6 shows the preliminary estimated axial capacity in compression and tension for 7-ft. diameter CISS piles. For 3-foot diameter CISS piles, assuming a 5x5 pattern (25 piles total), the estimated tip is 70 feet below the bottom of the channel.

It should be noted that these lengths are based on preliminary information, and actual pile lengths based on site-specific geotechnical information and more detailed loading data could be significantly different.

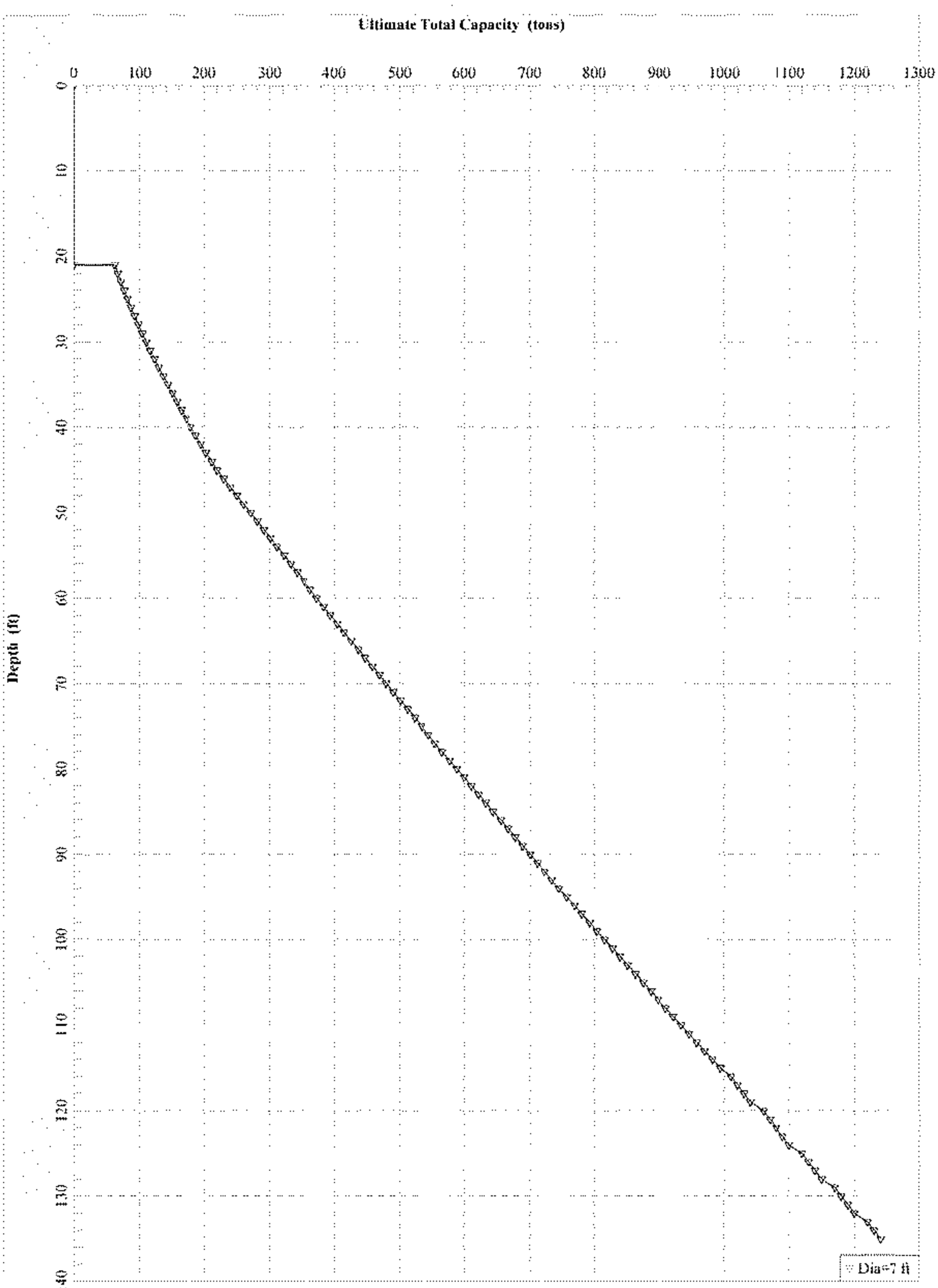


Figure 6. Estimated Ultimate Axial Resistance (7-ft. Dia. CISS Pile)

5.4.4 Pile Lateral Capacity

Preliminary pile lateral capacities were estimated for free-head and fixed-head pile top connections and for non-liquefied and liquefied soil conditions. The results are shown in Table 5. For 7-ft. dimeter CIDH pile, 50% of the gross moment of inertia was used, to account for cracked concrete section. For 7-ft. diameter CISS piles, 1.125 in. steel shell wall thickness, and 20 #18 rebars with 3 in. cover was assumed. For the 3-foot diameter CISS pile, moment of inertia of a 36-inch diameter pipe with 1-inch wall thickness was used.

5.4.5 Settlement Period for Embankments

Embankment fill height for approach embankments shall be minimized, particularly on Alameda side. Consolidation settlement is anticipated to be significant due to presence of compressible clayey soils. Settlement period is expected to be long (months or years) due to high groundwater levels. Large volume fill placement adjacent to existing structures is not recommended due to settlement and downdrag loads on existing foundations. Once consolidation test results are available, settlement calculations will be performed and results and recommendations will be included in the subsequent Foundation Report.

5.5 Future Field Investigation

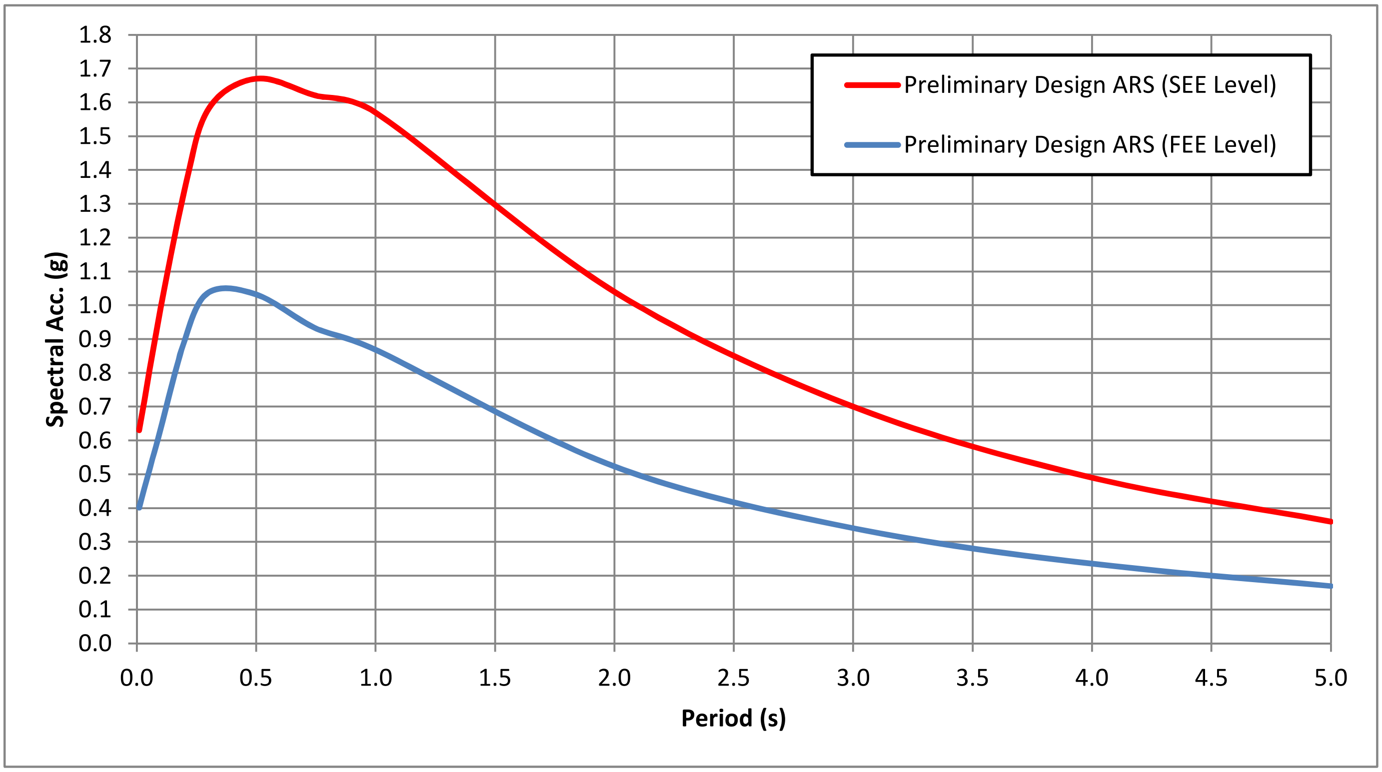
A site-specific field investigation comprising of soil borings, laboratory testing and CPTs will be performed after bridge type selection has been approved. Based on conceptual plans, we anticipate a minimum of eight soil borings and/or CPTs, including two offshore borings, for the bridge design. Additional borings and/or CPTs maybe needed for design of the approach embankments and retaining walls.

Table 5. Preliminary Lateral Pile Analysis Solutions

Soil Condition	Pile Type	Pile Head Deflection (in)	Pile Head Shear (kip)	Max Moment (kip-in)	Depth to Maximum Moment from Pile Top (ft)
No Liquefaction	7-ft CIDH (free-head)	½	188.2	26,262	18.20
		1	327.5	47,311	18.20
		2	476.7	75,014	19.50
		4	600.1	108,900	26.00
w/ Liquefaction	7-ft CIDH (free-head)	½	70.7	19,107	29.90
		1	117.1	32,787	31.20
		2	180.5	55,715	33.80
		4	271.2	93,813	36.40
No Liquefaction	7-ft CIDH (fixed-head)	½	456.3	73,263	0
		1	704.6	121,800	0
		2	926.9	185,000	0
		4	1202.8	282,100	0
w/ Liquefaction	7-ft CIDH (fixed-head)	½	201.6	47,875	0
		1	320.0	81,890	0
		2	489.1	137,600	0
		4	744.7	230,400	0
No Liquefaction	7-ft CISS (free-head)	½	321.0	56,881	27.30
		1	492.8	86,508	27.30
		2	663.2	130,800	32.50
		4	836.7	200,300	37.70
w/ Liquefaction	7-ft CISS (free-head)	½	151.6	49,711	35.10
		1	226.6	76,777	37.70
		2	326.6	118,800	40.30
		4	476.3	188,600	42.90
No Liquefaction	7-ft CISS (fixed-head)	½	684.5	139,100	0.00
		1	989.8	217,700	0.00
		2	1297.8	328,400	0.00
		4	1664.1	471,000	0.00
w/ Liquefaction	7-ft CISS (fixed-head)	½	389.2	109,500	0.00
		1	572.8	173,000	0.00
		2	837.6	276,400	0.00
		4	1213.6	431,300	0.00

Table 5. Preliminary Lateral Pile Analysis Solutions

Soil Condition	Pile Type	Pile Head Deflection (in)	Pile Head Shear (kip)	Max Moment (kip-in)	Depth to Maximum Moment from Pile Top (ft)
No Liquefaction	3-ft CISS (free-head)	½	51.4	5,630	14.00
		1	80.4	10,164	15.40
		2	115.3	16,895	16.80
		4	147.8	24,163	18.90
w/ Liquefaction	3-ft CISS (free-head)	½	15.3	3,022	25.90
		1	24.1	5,326	26.60
		2	35.9	9,186	28.70
		4	53.3	15,630	30.80
No Liquefaction	3-ft CISS (fixed-head)	½	127.1	15,592	0
		1	184.2	25,282	0
		2	234.5	37,051	0
		4	295.8	54,425	0
w/ Liquefaction	3-ft CISS (fixed-head)	½	42.0	7,987	0
		1	64.6	13,544	0
		2	97.9	22,756	0
		4	150.2	38,466	0



Design ARS Curve for 5% Damping

Shear Wave Velocity (Vs30) = 180 m/s

Preliminary Design ARS (SEE Level)

Period (sec)	**Acc.** (g)
PGA	0.630
0.10	0.990
0.20	1.340
0.30	1.580
0.50	1.670
0.75	1.620
1.00	1.570
2.00	1.040
3.00	0.700
4.00	0.490
5.00	0.360

Preliminary Design ARS (FEE Level)

Period (sec)	**Acc.** (g)
PGA	0.401
0.10	0.635
0.20	0.896
0.30	1.037
0.50	1.032
0.75	0.931
1.00	0.868
2.00	0.523
3.00	0.341
4.00	0.235
5.00	0.169

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

Estuary Crossing Pedestrian Bridge

Project No.: 19-142 | **Date: 11/11/2019**

Preliminary Design Acceleration Reponse Spectra

Figure 7

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Appendix D

Travel Demand Memo

KITTELSON & ASSOCIATES

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MEMORANDUM

Date:	March 17, 2020	Project #: 23559
To:	HNTB & Alameda CTC	
From:	Amanda Leahy, AICP; Alex Garbier; and Mike Aronson, PE	
Project:	Estuary Crossing Study – Bike & Ped Travel Demand Modeling	
Subject:	User Guide	

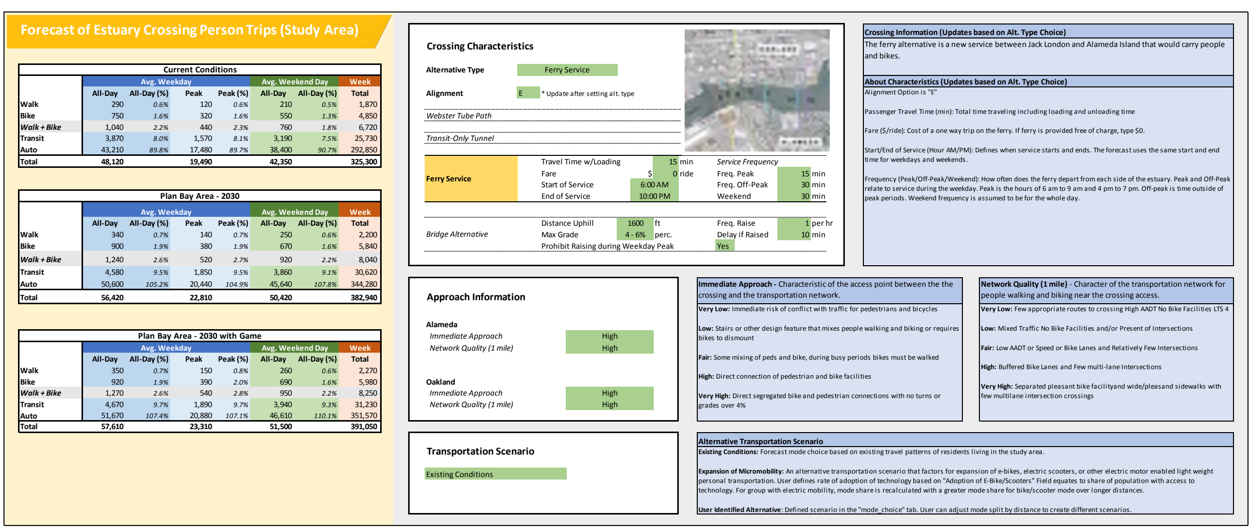
This memorandum is intended to serve as a user guide for the spreadsheet-based forecasting tool created to forecast bike and walk demand for a new Oakland Estuary crossing. The memorandum is organized as follows:

- User Interface
- User Inputs and Parameters
- Tool Output

User Interface

The forecast tool generates results based on user inputs in a user interface tab, as shown in Figure 1. On the interface tab, users set the descriptive characteristics of a proposed crossing. The tool updates the forecast for the new crossing as the inputs are changed.

Figure 1: User Interface



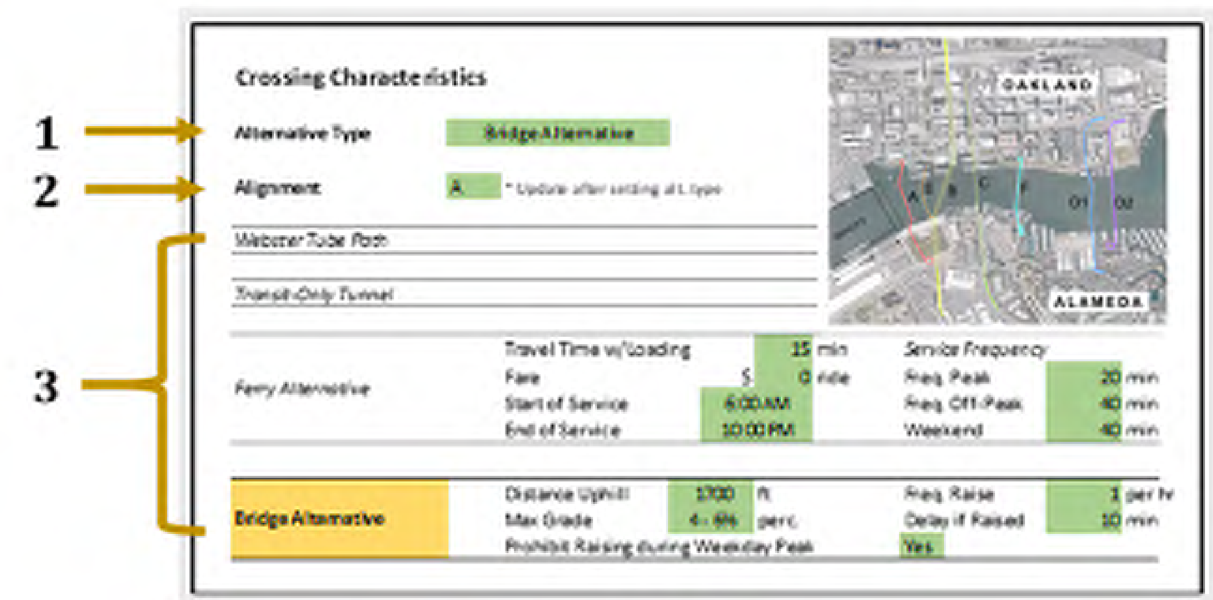
FILENAME: H:\23\23559 - ALA-OAK ESTUARY CROSSING PED-BIKE DEMAND\REPORT\DRAFT\APPENDIX\ESTUARY CROSSING_FORECAST TOOL_USER GUIDE.DOCX

User Inputs and Parameters

Crossing Characteristics

This section of the tool shown in Figure 2 identifies the characteristics of proposed crossing, including overarching design and alignment.

Figure 2: Crossing Characteristics Inputs



1. Alternative Type

Users identify the Alternative Type. Each alternative corresponds to a specific calibration factor that estimates the appeal of the alternative.

- ***Webster Tube Path*** – Pathway through existing Webster Tube
- ***Transit-Only Tunnel*** –Transit tunnel with pathway for people walking and biking
- ***Ferry Alternative*** – Service between Alameda and Oakland that accommodates bikes
- ***Bridge Alternative*** – Bridge reserved for people walking and biking

2. Alignment

The user then selects the alignment for the alternative from the options provided in the drop-down. The drop-down updates based on the alternative selection. The cell will turn red if the alignment selection does not correspond to a valid alignment for the crossing alternative. The tool considers alignment selection in two ways:

- **Is Access at Shoreline** – Currently, people access the Posey and Webster Tube approximately 0.5 miles from the shoreline. The ferry and bridge alternatives set access adjacent to the shoreline reducing travel distance for trips that start between the shoreline and the current access points.
- **Is Crossing East/West of Existing Crossing** – Shifting the crossing east or west changes the trip length for trips that crossing the Oakland Estuary that start and end east of the existing crossing or start and end west of the existing crossing.

3. Crossing Specific Parameters

Lower in the Crossing Characteristics box, the selected Alternative Type is highlighted with orange shading to prompt the user to input crossing specific characteristics if necessary (the Webster Tube Path and Transit-Only Tunnel do not require additional inputs). The factors are converted within the tool into distance-based factors.

- *Time* – Converted using a factor of 10 minutes to a mile. This is the midpoint of travel time for traveling a mile by walking and by biking.
- *Cost* – Converted based on the value of time factor using in Plan Bay Area 2040: Final Performance Assessment Report ($1.06 to a mile).[1]

<u>Ferry Alternative</u>

- *Travel Time w/Loading* – Expected travel time for users including time spent boarding and alighting from the vehicle.
- *Fare* – Cost of a one-way fare across the Oakland Estuary.
- *Start and End of Service* – Sets when service starts and ends. Start and end times are used to estimate both weekday and weekend trips.
- *Frequency Peak / Off-Peak* / *Weekend* – Frequently that Ferry departs from each dock. The tool calculates delay to user as half the time of the frequency. For the weekday forecast, the tool calculates the impact of frequency by calculating delay for peak and off-peak frequency and taking an average of the two numbers weighted by person trips during the peak and off-peak. Peak is 6 am to 9 am and 4 pm to 7 pm.

<u>Bridge Alternative</u>

Research indicates that route choice is impacted by the presence of up-hill section but not down-hill travel. As a result, the tool factors for the up-hill portion of the design.

- *Distance uphill* – Length of the bridge that has a positive grade as measured from the foot of the bridge to the highest point traveling in one direction.
- *Max Grade* – The grade is separated into three buckets. The user chooses the bucket that corresponds to the maximum grade of the uphill portion of the bridge. The greater the positive slope the larger the impact of the uphill distance.

1

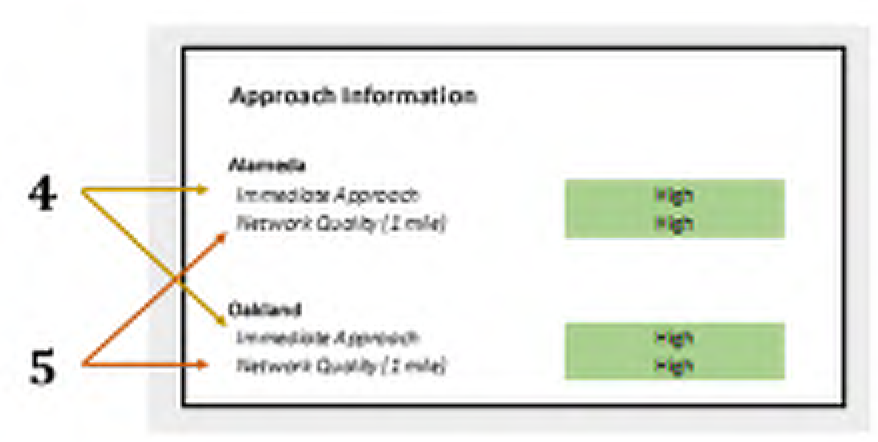
The second set of characteristics relate to delay from lifting the bridge to serve boats traveling through the Oakland Estuary.

- *Delay if Raised* – Time required to raise and lower the bridge from the moment the bridge is closed to when it is reopened for people crossing. The tool assumes that people crossing experience half of the delay if they are delayed by an opening of the bridge.
- *Frequency Raised* – How often the bridge is raised for large boats. The tool considers this number with the delay if raised to estimate the likelihood that a person will arrive at a time when the bridge is raised.
- *Prohibit Raising during Weekday Peak* – User selects yes or no to reflect if bridge will be prohibited from being raised 6 am to 9 am and 4 pm to 7 pm.

Approach Characteristics

This section of the tool shown in Figure 3 identifies the characteristics of transportation features that people would experience as they approach each side of the crossing. The characteristics are selected separately for Oakland and Alameda.

Figure 3: Approach Information Inputs



4. Immediate Approach

Characterizes the quality of the access point between the crossing and local transportation network. The inputs range from *very low*, people walking and biking experience immediate conflicts with vehicles and each other with no connection to mode specific facilities, to *very high* where the approach is integrated into the pedestrian and bike network, with no turns or grades exceeding four percent. As an example, the Tilikum Bridge in Portland, Oregon has *very high*-quality approaches and the existing approaches are to the Posey Tube are *very low*.

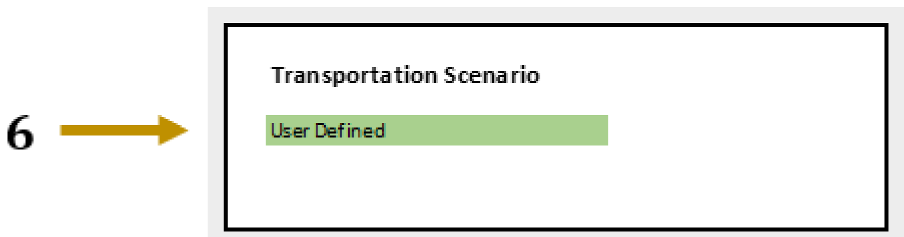
5. Network Quality

Characterizes the quality of the transportation network for people walking and biking near the crossing access. The inputs range from *very low*, few routes providing direct access and presence of higher ADT and speed roads, to *very high* where there is direct access for people walking and biking with from all directions with minimal high-stress crossing and low-stress facilities.

Transportation Scenario

This section of tool identifies the transportation scenario modeled by the tool as shown in Figure 4.

Figure 4: Transportation Scenario Input



6. Transportation Scenario

There are three transportation scenarios that relate mode split to trip distance.

- *Existing Conditions*: Forecast mode choice based on existing travel patterns of residents living in the study area. If the user selects this alternative no further action is needed.
- *Increase in Electric Micromobility*: Alternative transportation scenario that factors for expansion of e-bikes, electric scooters, or other electric motor enabled light weight personal transportation. User defines rate of adoption of technology based on "Adoption of E-Bike/Scooters" field. The rule used to create this table is that
    - **At or below 1.5 miles** there is no impact. This is the distance where mode share for bikes is at its maximum.
    - **Above 1.5 miles** the proportion of the population that adopts the technology transition out of the bike mode share at half the rate (i.e., if mode split is 7% at 2 miles under current conditions, mode split is 7% at 4 miles for populations that adopt technology). The proportion of the population adopting the technology is set based on the “Adoption of E-Bike/Scooters” field input.
- *User Defined*: Mode split alternative set by the user. This is the one input that is not located on the primary user interface. The user can find the table on the "mode_choice" tab. As a default, the scenario is set to match the existing conditions mode split by distance table.

Tool Output

The forecast tool presents results on the left most side of the user interface. The results are presented for three land use scenarios and are update automatically as the user completes the steps described in the User Instructions section. The three land use scenarios are:

- Existing Conditions: Estimates based on existing travel conditions as measured by StreetLight person trip data collected between September 1, 2018 and August 31, 2019.
- Year 2030: Scenario is for planned growth in Plan Bay Area 2040 interpolated for the year 2030.
- Year 2030 with Oakland A's Stadium: Scenario is for planned growth in 2030 plus the redevelopment of Howard Terminal as a mixed-use area with a new profession baseball stadium. The scenario specifically forecasts person trips across the Oakland Estuary on a game day and includes both trips generated by travel to and from the stadium and trips generated by adjacent land-uses planned as part of the project. *(NOTE TO REVIEWER – Language is preliminary. Tool will be updated when Project EIR is released. Text will be updated as necessary.)*

For each scenario, there is a box, illustrated in Figure 5, which shows the mode share generated for walk, bike, transit, and auto as person trips. *Note* the number represents trips that start and end inside of the study area. The trips are summarized as daily trips for the average weekday and weekend trip. For the right most column, the tool summarizes the forecast weekly total of use.

Figure 5: Results Table from Forecasting Tool

Forecast of Estuary Crossing Person Trips (Study Area)

Current Conditions							
	Avg. Weekday				Avg. Weekend Day		Week
	All-Day	All-Day (%)	Peak	Peak (%)	All-Day	All-Day (%)	Total
Walk	2,670	*5.5%*	1,000	*5.1%*	2,460	*5.7%*	18,270
Bike	1,700	*3.5%*	690	*3.5%*	1,420	*3.3%*	11,340
Walk + Bike	4,370	*9.0%*	1,690	*8.6%*	3,880	*9.0%*	29,610
Transit	4,430	*9.1%*	1,800	*9.1%*	3,830	*8.9%*	29,810
Auto	39,990	*82.0%*	16,220	*82.3%*	35,210	*82.0%*	270,370
Total	**48,790**		**19,710**		**42,920**		**329,790**

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MEMORANDUM

Date:	October 11, 2019	Project #: 23559
To:	HNTB & Alameda CTC	
From:	Kittelson & Associates	
Project:	Estuary Crossing Study – Bike & Ped Travel Demand Modeling	
Subject:	Literature Review	

INTRODUCTION

This memorandum was completed as part of the Task 2: Data Collection for the Alameda-Oakland Access Project Estuary Crossing. It augments the transportation data collected about local conditions by reviewing similar facilities and services to the proposed alternatives under consideration for connecting western Alameda and Oakland.

The memo is structures in three parts:

1. Alameda-Oakland Estuary Crossings Conditions
2. Facilities and Services at Locations with Similar Characteristics
3. Summary of Findings

ALAMEDA-OAKLAND ESTUARY CROSSING CONDITIONS

Kittelson is evaluating project alternatives for a new or upgraded crossing for people walking and biking between western Alameda and Jack London Square/Downtown Oakland. Currently, it is possible for people walking and biking to cross at this location through the Posey Street Tube on a path that runs adjacent to the roads. The path is about 4-feet wide. Its proximity to the road results in significant noise and emission for people on the path.

Western Alameda and Downtown Oakland both contain areas that are appealing for people walking and biking; however, the areas immediately at the entrances to the tunnel prioritize motor-vehicle movement with limited facilities for active transportation. On the Alameda side, people walking and biking can only access the tube on the east side of Webster Street and land uses are primarily car oriented. On the Oakland side, the path becomes a sidewalk that is parallel to a road used to access the I-880 Freeway.

The alternative to crossing at the Posey Street Tube for people walking and biking is the Park Street Bridge in eastern Alameda. The bridge is located about 2.5 miles from the Posey Street Tube and where the proposed alternative crossings would connect. Traveling across the Park Street Bridge adds about six miles to a trip between western Alameda and Downtown Oakland.

The goal of this study is to develop a forecasting tool that estimates the impact a higher quality, low-stress alternative for crossing between western Alameda and Downtown Oakland. To help inform this forecast, this memo identifies facilities and services that share multiple characteristics with the current conditions between western Alameda and Downtown Oakland, such as:

- *Limited Access* - Absence of a comfortable or appealing crossing for pedestrian and bicyclists
- *Lack of Alternatives* - Alternative paths are limited in number and require people walking and biking to complete a more circuitous trip
- *Presence of Pedestrian/Bicyclists in Area* – Locations where walking and biking is common, indicating potential demand for improved facilities

FACILITIES AND SERVICES AT LOCATIONS WITH SIMILAR CHARACTERISTICS

This memorandum describes four bridges and two ferries designed for people traveling by foot or by bicycle across comparable crossings. In each case, they provide a more direct and comfortable links across gaps in the transportation network. The locations are:

- Bridges:
  - Tilikum Bridge, Portland, OR
  - Pfluger Pedestrian Bridge, Austin, TX
  - North Bank Bridge, Boston/Cambridge, MA
  - Brygge Bridge / Cykelslangen, Copenhagen, Denmark
- Ferries:
  - Seabus, Vancouver, BC
  - San Diego to Coronado Ferry, San Diego, CA

Bridges

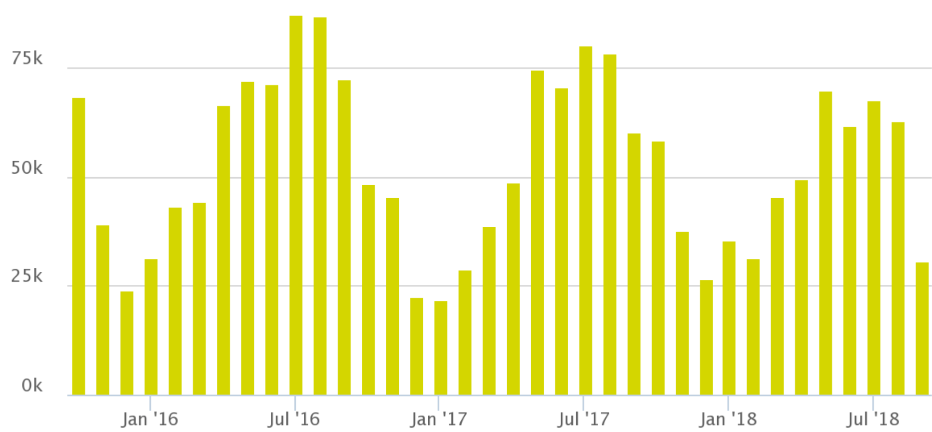
Tilikum Bridge, Portland, OR

The Tilikum Bridge was completed in 2015 and crosses the Willamette River between the eastside of Portland and the South Waterfront. The bridge is exclusively for people walking and biking, and transit vehicles. There bridge connects to bike paths on either side of the river and connects directly to the Oregon Health & Science University on the west side. Prior to its construction, the closest crossing of the Willamette River for people walking and biking was the Hawthorne Bridge. It is located half-a-mile from the Tilikum Bridge on the west side of the river and a mile on the west side. The Hawthorne Bridge enters directly into Downtown Portland and remained a shorter path to access Downtown Portland for most trips from the east side of the city after construction of the Tilikum Bridge.

Portland Bureau of Transportation maintains a bicycle counter on the Bridge (there is not an active count of pedestrians). During 2017, the Tilikum bridge averaged 2,089 weekday riders.[1] During summer months, ridership increases (August recorded the highest ridership month with 78,406 bike crossings). Generally, bicycle crossings are lower on the weekends; however, some of the highest crossing days corresponded to special events on weekends and holidays. After the opening of the Tilikum Bridge, the bike crossings on the Hawthorne bridge decreased indicating that some users shifted to the Tilikum Bridge. Figure 1 and Figure 2 show this impact by presenting the total monthly bike trips for the Tilikum Bridge and Hawthorne Bridge.

- Tilikum Bridge, Portland, OR – Google Map Location

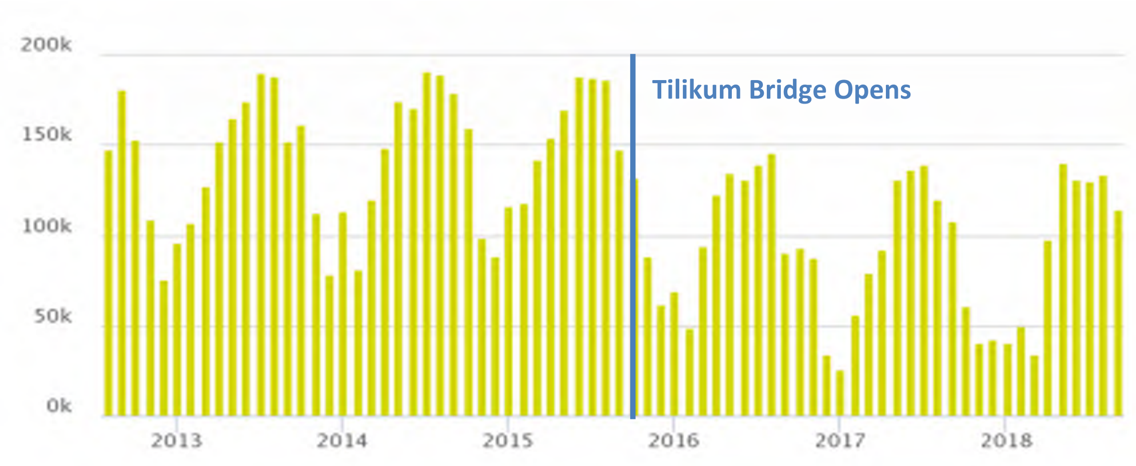
Figure 1: Bicycle Counts on the Tilikum Bridge, Monthly Crossings



Source: Portland Bureau of Transportation, Bicycle Counts

[1] http://portland-tilikum-crossing.visio-tools.com/

Figure 2: Bicycle Counts on the Hawthorne Bridge, Monthly Crossings



Source: Portland Bureau of Transportation, Bicycle Counts

Pfluger Pedestrian Bridge, Austin, TX

The Pfluger Pedestrian Bridge is located in Austin, Texas. It crosses the Colorado River to connect Downtown Austin to Austin neighborhoods on the south side of the river. The bridge is for non-motorized users and connects to walking and biking trails on either side of the river. The bridge was complete in 2001. Prior to the construction, people walking and biking crossed the river at the South Lamar Boulevard Bridge, which is adjacent to the Pfluger Pedestrian Bridge. The South Lamar Boulevard Bridge is a high-stress environment for pedestrians and bicyclists. Travel lanes on the bridge are not suitable for bicyclists due to elevated speeds and the sidewalks are only 3.5 feet wide providing limited space for users.

After completion of the bridge, the number of crossings at the location increased by around 400% percent from between 700 to 1,000 crossings to between 4,000 to 5,000 crossings.[2] Note that additional improvements were made to the riverfront that improved access on the approaches and conditions for users at the landing sites.

- Pfluger Pedestrian Bridge, Austin, TX – Google Map Location

North Bank Bridge, Boston/Cambridge, MA

The North Bank Bridge was completed in 2012 and connects Cambridge and Boston on the northside of the Charles River. The bridge crosses over commuter rail tracks and a tributary to the Charles River

[2] "Pfluger Pedestrian-Bicycle Bridge" Pedestrian and Bicycle Information Center, website: http://www.pedbikeinfo.org/examples/example_details.cfm?id=4822

and connects to multi-use pathways on either side. The bridge is designed with a curve to avoids conflicts with existing infrastructure (a characteristic shared with the Cykelslangen described in the next example). At a regional scale, the bridge also filled the final half-mile gap in the 22-mile Charles River Path, which starts in the western suburbs of Boston and now connects all the way to the Boston Harbor. While counts were not available on the bridge were not identified, around 800 people walk, bike, and jog each day on the segment of the trail immediately west of the bridge.[3]

Prior to construction of the bridge, the neighborhoods on either side of the bridge were separated by an elevated highway and commuter rail tracks. People walking or biking crossed the Charles River twice to travel between the neighborhoods – once to enter Downtown Boston and once to leave downtown. After completion, the bridge reduced the length of the trip between the two neighborhoods by a little more than half-a-mile and created more comfortable connections to the local network. The bridge was designed to tie directly into North Point Park in the west and Paul Revere Park in the east. There are low-stress access points to the road network form each park.

- North Bank Bridge – Google Map Location

Brygge Bridge / Cykelslangen, Copenhagen, Denmark

The Brygge Bridge is a bridge across the harbor in Copenhagen built exclusively for non-motorized users with separate pedestrian and bicycle lanes. The bridge was completed in 2006 and connected the activity centers along the harbor with central Copenhagen. Prior to the construction, the closest bridge over the harbor was a little less than a mile north. In 2014, the city completed a second bicycle-only bridge to the west of the Brygge Bridge, which is called the Cykelslangen ("the bike snake").

The new bridge acted as an extension of the Brygge Bridge for people biking. Before the construction of the Cykelslangen, people biking had to choose whether to weave between people walking in a popular shopping area or to travel up and down a set of stairs. The Cykelslangen removed this conflict and provided a gradually sloped exclusive route for riders. The two bridges are now critical components of the city's transportation network, serving over 12,000 daily bicycle riders.[4] They are also indicative of Copenhagen's investment in constructing low-stress routes by building direct connections across gaps in the walking and biking network.

- Brygge Bridge / Cykelslangen, Copenhagen, Denmark – Google Map Location

[3] "Charles River Basin Pedestrian and Bicycle Study: Non-Motorized Bridge and Pathway User Counts" Alta Planning January 2015, https://altaplanning.com/wp-content/uploads/CRB-Summary-Memo_Compiled_v3.pdf

[4] "The Bicycle Bridges of Copenhagen" Copenhagen.com, website: http://www.copenhagenize.com/2016/08/the-bicycle-bridges-of-copenhagen.html

Ferries

Seabus, Vancouver, BC

The Seabus is a ferry service in Vancouver, BC between Downtown Vancouver and the North Shore across Vancouver Harbor. The trip is around 15 minutes and has headways of 10 minutes during peak periods.[5] In 2018, the daily midweek ridership was 19,690.[6] Transit services connect directly to the ferry on either side of the harbor. The Vancouver transportation agency, Translink, has integrated the Seabus into a distance-based fare for travel in the system. There is not a specific fee for completing the trip. The minimum fare for a trip that includes the Seabus is $2.40 Canadian and maximum is $4.50.

The closest alternatives for crossing the harbor are the Lions Gate Bridge and Iron Workers Memorial Bridge. The two bridges have separated paths for people walking and biking; however, they require a much longer trip (the Lions Gate Bridge is a six-mile trip from the terminal locations for the Seabus and the Workers Memorial Bridge is longer) and require users to complete a steep ascent (the bridge is elevated to allow access to the harbor).

- Seabus, Vancouver, BC – Google Map Location

San Diego to Coronado Ferry, San Diego, CA

The ferry connects between Downtown San Diego and the island of Coronado. The island includes the city of Coronado and a Naval Air Station. The ferry service includes two components – a free commuter service that runs during the weekday during commute hours and a second service throughout the rest of the day to the Convention center in San Diego. The trip is 15 minutes long.

The commuter service runs about every 45 minutes in the morning and once an hour during the evening. The city of Coronado subsidizes the service to provide commuter service for free during the morning and evening. In 2017, the service cost $162,200 and served 73,000 passengers (1,400 per week). The all-day service is $5 each direction and had over $750,000 riders in 2017 (14,400 per week).[7] The Coronado bridge which directly connects San Diego and Coronado is not accessible to people walking and biking.

- San Diego to Coronado Ferry, San Diego – Google Map Location

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[5] "Seabus Schedule", Translink, website: https://www.translink.ca/Schedules-and-Maps/SeaBus-Schedules.aspx

[6] Seabus Route Summary, website: https://public.tableau.com/profile/translink#!/vizhome/2018TSPR-BusSeaBusSummaries/TheWorkbook

[7] https://www.sandiegouniontribune.com/news/politics/sd-me-coronado-ferry-20181024-story.html

FINDINGS

Data

- Data on pedestrian and bicycle counts is limited. In particular, it was difficult to find pedestrian counts. This makes it difficult to understanding the role of these crossings as recreational paths for walking and jogging.
- The most complete data for crossings is for the Tilikum Bridge. The city maintains an active bike counter on both Tilikum Bridge and Hawthorne Bridge. The counter on the Hawthorne Bridge predates the completion of the Tilikum Bridge and shows how use changes after the new crossing opened.

Change in Behavior

- Limited data indicates that improved crossings both increases total crossings by people walking and biking and can shift travelers away from less desirable options.

Integration

- The facilities and ferry services connect to the pedestrian and bike friendly environments. The bridges each connected to separated multi-use trails and avoid steep inclines. Similarly, the Seabus service is integrated completely into the transit system with a single payment system and direct connections to regional services.
- For this study, this emphasizes the importance of factoring for the quality of the connections leading to each alternative. While there are safe and comfortable paths for people walking and biking on either side of the estuary, the conditions are not uniformly strong. As a result, the impact of each alternative will be influenced by where and how it ties into the existing network.

Ferry Service Conditions

- Relative to the bridges, the two ferry services are located in locations where alternatives for walking or biking are significantly longer.
- The ferry services exist in two locations where bridge must by high enough to accommodate ships much larger than what is required in the estuary. In Vancouver, container ships must access the port, and in San Diego, military ships must travel into San Diego Bay.

Appendix E

Cost Estimate

Alternative A4-1

Description	Length (LF)	Area (SF)	$/SF	Total Cost	Year	Notes
Bridge Capital Cost				$ 140,500,000	2030	Source: Estuary Crossing Study - Structures Cost Estimate, HNTB, 2020. All new lift bridge alternatives assume "Recovery" seismic design category. See Chapter 3 for discussion of cost differentials associated with "Ordinary" and "Important" seismic design categories.
Project Support (30%)				$ 42,150,000		
Contingency (10%)				$ 14,050,000		
Total Project Cost				**$ 196,700,000**		
Maintenance Cost				$ 1,967,000		Assume 1%/year Source: Y. Zhang, D. Novick, A. Hadavi, R. Krizek. *Whole Life Cycle Cost for Chicago-Type Bascule Bridges*, Northwestern University
Labor				$ 1,400,000		Assume $150/hour * 8760 hours/year
Annual O&M Cost				**$ 3,367,000**		**per year**

Alternative A4-2

Description	Length (LF)	Area (SF)	$/SF	Total Cost	Year	Notes
Bridge Capital Cost				$ 138,500,000	2030	Source: Estuary Crossing Study - Structures Cost Estimate, HNTB, 2020. All new lift bridge alternatives assume "Recovery" seismic design category. See Chapter 3 for discussion of cost differentials associated with "Ordinary" and "Important" seismic design categories.
Project Support (30%)				$ 41,550,000		
Contingency (10%)				$ 13,850,000		
Total Project Cost				**$ 193,900,000**		
Maintenance Cost				$ 1,939,000		Assume 1%/year Source: Y. Zhang, D. Novick, A. Hadavi, R. Krizek. *Whole Life Cycle Cost for Chicago-Type Bascule Bridges*, Northwestern University
Labor				$ 1,400,000		Assume $150/hour * 8760 hours/year
Annual O&M Cost				**$ 3,339,000**		**per year**

Alternative A4-3

Description	Length (LF)	Area (SF)	$/SF	Total Cost	Year	Notes
Bridge Capital Cost				$ 140,500,000	2030	Source: Estuary Crossing Study - Structures Cost Estimate, HNTB, 2020. All new lift bridge alternatives assume "Recovery" seismic design category. See Chapter 3 for discussion of cost differentials associated with "Ordinary" and "Important" seismic design categories.
Project Support (30%)				$ 42,150,000		
Contingency (10%)				$ 14,050,000		
Total Project Cost				**$ 196,700,000**		
Maintenance Cost				$ 1,967,000		Assume 1%/year Source: Y. Zhang, D. Novick, A. Hadavi, R. Krizek. *Whole Life Cycle Cost for Chicago-Type Bascule Bridges*, Northwestern University
Labor				$ 1,400,000		Assume $150/hour * 8760 hours/year
Annual O&M Cost				**$ 3,367,000**		**per year**

Alternative A4-4

Description	Length (LF)	Area (SF)	$/SF	Total Cost	Year	Notes
Bridge Capital Cost				$ 138,500,000	2030	Source: Estuary Crossing Study - Structures Cost Estimate, HNTB, 2020. All new lift bridge alternatives assume "Recovery" seismic design category. See Chapter 3 for discussion of cost differentials associated with "Ordinary" and "Important" seismic design categories.
Project Support (30%)				$ 41,550,000		
Contingency (10%)				$ 13,850,000		
Total Project Cost				**$ 193,900,000**		
Maintenance Cost				$ 1,939,000		Assume 1%/year Source: Y. Zhang, D. Novick, A. Hadavi, R. Krizek. *Whole Life Cycle Cost for Chicago-Type Bascule Bridges*, Northwestern University
Labor				$ 1,400,000		Assume $150/hour * 8760 hours/year
Annual O&M Cost				**$ 3,339,000**		**per year**

Alternative A4-5

Description	Length (LF)	Area (SF)	$/SF	Total Cost	Year	Notes
Bridge Capital Cost				$ 138,500,000	2030	Source: Estuary Crossing Study - Structures Cost Estimate, HNTB, 2020. All new lift bridge alternatives assume "Recovery" seismic design category. See Chapter 3 for discussion of cost differentials associated with "Ordinary" and "Important" seismic design categories.
Project Support (30%)				$ 41,550,000		
Contingency (10%)				$ 13,850,000		
Total Project Cost				**$ 193,900,000**		
Maintenance Cost				$ 1,939,000		Assume 1%/year Source: Y. Zhang, D. Novick, A. Hadavi, R. Krizek. *Whole Life Cycle Cost for Chicago-Type Bascule Bridges*, Northwestern University
Labor				$ 1,400,000		Assume $150/hour * 8760 hours/year
Annual O&M Cost				**$ 3,339,000**		**per year**

Alternative B

Description	Length (LF)	Area (SF)	$/SF	Total Cost	Year	Notes
New Tunnel	4660	293580	$ 2,440	$ 1,900,652,665	2010	Source: for $/SF cost - Thimble Shoal Parallel Tunnel Conceptual Study, Jacobs, 2011 Thimble Shoal tunnel is 5711' portal-to-portal, 53' outside width --> 302,683 SQFT Cost as documented in 2011 study was $739M Alt B Tunnel is 4660' portal-to-portal, 63' outside width --> 293,580 SQFT
Project Support (30%)				$ 570,195,799		
Contingency (10%)				$ 190,065,266		
Total Project Cost				**$ 2,660,913,731**	2030	Escalated at 5% per year
Maintenance Cost				$ 26,609,137		Assume 1%/year Source: Y. Zhang, D. Novick, A. Hadavi, R. Krizek. *Whole Life Cycle Cost for Chicago-Type Bascule Bridges*, Northwestern University
Annual O&M Cost				**$ 26,609,137**		**per year**

Alternative C

Description	Length (LF)	Area (SF)	$/SF	Total Cost	Year	Notes
Tunnel Walkway Improvements		9750	$ 410	$ 4,000,000	2023	Source: Oakland Alameda Access Project, HNTB, 2020
Total Project Cost				**$ 5,628,402**	2030	
Maintenance Cost				$ -		Minimal incremental cost to maintain walkway as part of usual Tube maintenance
Annual O&M Cost				**$ -**		**per year**

Alternative D1

Description	Length (LF)	Area (SF)	$/SF	Total Cost	Year	Notes
Bridge Capital Cost				$ 140,000,000	2030	Source: Estuary Crossing Study - Structures Cost Estimate, HNTB, 2020. All new lift bridge alternatives assume "Recovery" seismic design category. See Chapter 3 for discussion of cost differentials associated with "Ordinary" and "Important" seismic design categories.
Project Support (30%)				$ 42,000,000		
Contingency (10%)				$ 14,000,000		
Total Project Cost				**$ 196,000,000**		
Maintenance Cost				$ 1,960,000		Assume 1%/year Source: Y. Zhang, D. Novick, A. Hadavi, R. Krizek. *Whole Life Cycle Cost for Chicago-Type Bascule Bridges*, Northwestern University
Labor				$ 1,400,000		Assume $150/hour * 8760 hours/year
Annual O&M Cost				**$ 3,360,000**		**per year**

Alternative D2

Description	Length (LF)	Area (SF)	$/SF	Total Cost	Year	Notes
Bridge Capital Cost				$ 140,000,000	2030	Source: Estuary Crossing Study - Structures Cost Estimate, HNTB, 2020. All new lift bridge alternatives assume "Recovery" seismic design category. See Chapter 3 for discussion of cost differentials associated with "Ordinary" and "Important" seismic design categories.
Project Support (30%)				$ 42,000,000		
Contingency (10%)				$ 14,000,000		
Total Project Cost				**$ 196,000,000**		
Maintenance Cost				$ 1,960,000		Assume 1%/year Source: Y. Zhang, D. Novick, A. Hadavi, R. Krizek. *Whole Life Cycle Cost for Chicago-Type Bascule Bridges*, Northwestern University
Labor				$ 1,400,000		Assume $150/hour * 8760 hours/year
Annual O&M Cost				**$ 3,360,000**		**per year**

Alternative E

Description	Length (LF)	Area (SF)	$/SF	Total Cost	Year	Notes
Capital cost - new water shuttle				$ 1,000,000	2030	Water Shuttle Background Information - City of Alameda, 2020. Assume 2 water shuttles @ 500k each. Each vessel is 22' x 12', 12 passenger capacity, providing 15-minute headways.
Total Project Cost				**$ 1,000,000**	2030	Escalated at 5% per year
Maintenance Cost				$ 10,000	2020	$5k per year, x2 shuttles
Labor				$ 1,050,000	2020	Assume $90/year * 16h/day * 365 days/year * 2 shuttles
Fuel Cost				$ 175,000	2020	Assume $3/gal * 5 gal/h * 16h/day * 365 days/year * 2 shuttles
Total Operating Cost				**$ 2,011,685**	2030	**per year**

Alternative F

Description	Length (LF)	Area (SF)	$/SF	Total Cost	Year	Notes
Bridge Capital Cost				$ 138,500,000	2030	Source: Estuary Crossing Study - Structures Cost Estimate, HNTB, 2020. All new lift bridge alternatives assume "Recovery" seismic design category. See Chapter 3 for discussion of cost differentials associated with "Ordinary" and "Important" seismic design categories.
Project Support (30%)				$ 41,550,000		
Contingency (10%)				$ 13,850,000		
Total Project Cost				**$ 193,900,000**		
Maintenance Cost				$ 1,939,000		Assume 1%/year Source: Y. Zhang, D. Novick, A. Hadavi, R. Krizek. *Whole Life Cycle Cost for Chicago-Type Bascule Bridges*, Northwestern University
Labor				$ 1,400,000		Assume $150/hour * 8760 hours/year
Annual O&M Cost				**$ 3,339,000**		**per year**

Appendix F

Letters of Concurrence

PORT OF OAKLAND

May 11, 2020

Carl T. Hausner
Chief, Bridge Section
Eleventh Coast Guard District
Coast Guard Island, Bldg. 50-2
Alameda, CA 94501-5100

RE: Oakland Estuary Crossing Study

Dear Mr. Hausner:

On behalf of the Port of Oakland, I am writing to follow up on an issue of mutual interest to the City of Alameda ("City") and the Port of Oakland ("Port") as it concerns the feasibility study of a Bicycle/Pedestrian Lift bridge, in addition to other connectivity alternatives, across the Oakland Inner Harbor. Thank you for your patience in receiving this letter, which is a follow-up to previous Port correspondence, sent on December 19, 2020, where the Port stated that it opposes Alternatives A, B, C and E, as they could block potential future expansion of Reach 6.

Port, City of Alameda staff, Alameda County Transportation Commission (Alameda CTC) staff, and their consultants have met at various times over the past few years to discuss several potential alignments for a bridge which could serve to increase the pedestrian and bicycle connectivity and access between Alameda and Oakland. I greatly appreciate that project management staff from the City and Alameda CTC, as well as representatives from Alameda CTC's consulting firm (HNTB) were able to meet with Port staff in February 2020 to help clarify certain aspects of the Alternatives. With this additional understanding, the Port does not oppose further study of these Alternatives. However, any final selected Alternative will need to be designed to meet future Port plans for expansion, as those are further defined over the coming years. We also support efforts to jointly engage representatives from the San Francisco Bar Pilots who can assist in providing additional navigational details that can inform the ongoing analysis of any potential bridge designs and ensure that they do not negatively impact operations in the federal shipping channel.

At the February meeting, Port staff was also able to provide some additional details on the status of the joint study effort that the Port will be initiating with the U.S. Army Corps of Engineers on potential modifications to the Inner Harbor Turning Basin (IHTB), which is proximate to the Alternative A alignment as detailed in the HNTB Preliminary Crossing Concepts schematics. We will ensure that City of Alameda staff and its consultants are kept informed of that planning process as it proceeds so that any potential modifications to the IHTB and/or navigational improvements needed for maritime operations can be incorporated into the bridge feasibility analysis. We also appreciated the additional clarification that the Alternative C improvements (a new walking/biking pathway in the Webster Tube) were proposed to remain completely within the Webster Tube and thus would not interfere with any maritime operations.

Thank you again for the opportunity for continued partnership on this and a host of issues of mutual interest between the City of Alameda and the Port of Oakland. We value the collaboration between our respective organizations and appreciate the opportunity to work with you to explore the benefits and feasibility of this proposal.

Sincerely,

Danny Wan
Executive Director

cc: Delphine Prevost, Port of Oakland
Matt Davis, Port of Oakland
Eric Levitt, City Manager
Andrew Thomas, City of Alameda
Rochelle Wheeler, City of Alameda
Rodney Pimentel, HNTB
Susan Chang, Alameda CTC

U.S. Department of Homeland Security
United States Coast Guard

Commander
Eleventh Coast Guard District

Coast Guard Island, Bldg. 50-2
Alameda, CA 94501-5100
Staff Symbol: dpw
Phone: (510) 437-3516
Fax: (510) 437-5836
Email: Carl.T.Hausner@uscg.mil

16591
Oakland Inner Harbor (3.3)
January 21, 2021

The Honorable Mayor Marilyn Ezzy Ashcraft
City of Alameda, Office of the Mayor
2263 Santa Clara Ave
Alameda, CA 94501

Dear Mayor Ezzy Ashcraft:

I have completed my review of the City of Alameda's proposal to construct a new Pedestrian Bridge over Oakland Inner Harbor at mile 3.3, between the City of Alameda and the City of Oakland, Alameda County, California.

The General Bridge Act of 1946 requires the location and plans for bridges over navigable waters of the United States be approved by the Commandant, U. S. Coast Guard prior to commencing construction. Oakland Inner Harbor is considered to be a navigable waterway of the United States for bridge administration purposes at the proposed bridge site.

Applications for bridge permits should be addressed to Commander (dpw), Eleventh Coast Guard District, Building 50-2, Coast Guard Island, Alameda, CA 94501-5100, Attn: Bridge Section. The application must be supported by sufficient information to allow a thorough assessment of the impact of the bridge and its immediate approaches on the environment. A Coast Guard Bridge Permit Application Guide is available online at: https://go.usa.gov/xRFk2.

In order to satisfy the requirements of the National Environmental Policy Act, as well as other environmental control laws, federal agencies involved in this proposed bridge project will coordinate to determine who will be designated as the Lead Federal Agency and will invite other federal agencies to act as cooperating/participating agencies.

The proposed new bridge's navigational clearances should provide, at a minimum, 175 feet of vertical clearance above Mean High Water, measured to the lowest hittable part of the bridge, and 600 feet of horizontal clearance measured pier face to pier face, or fender to fender, normal to the axis of the channel.

The U.S. Coast Guard, Pacific Area (USCG) has offered preliminary support of the proposed new bridge, conditional on whether mitigation efforts ensuring near-immediate waterway clearance to support both pre-planned USCG asset transits and short-notice USCG asset transits in the event of a contingency can be achieved, specifically:

a. During both construction and operation, sufficient short notice lift removal capability, similar to the proposal detailed in the enclosed Estuary Crossing Bridge Emergency Action Plan dated November 17, 2020, must be available to provide necessary vertical clearance for USCG assets to transit in the event of a bridge casualty prohibiting its proper operation.

b. In the event of a loss of electrical power, appropriate backup power supply must be available to allow the bridge to open as required in 33 CFR 117.5, thereby allowing 175 feet of vertical clearance.

c. During construction, the waterway must remain clear for inbound and outbound transits. During times where temporary obstruction of the waterway for construction purposes is necessary, the timing and duration of the temporary obstruction must be coordinated with the USCG to allow de-confliction with movements of USCG assets.

d. Alternatives and designs will be reviewed by the USCG, PacArea for input.

The Port of Oakland, in a letter dated May 11, 2020, does not oppose further study of the proposed alternatives as long as the final selected alternative is designed to meet future Port plans for expansion.

I look forward to coordinating this project with the City of Alameda, U.S. Coast Guard Pacific Area, the Port of Oakland, and commercial waterway users to ensure the final design meets the needs of navigation on the Oakland Inner Harbor.

You may contact me at (510) 437-3516 or (510) 219-4366 if you have any questions regarding this letter.

Sincerely,

CARL T. HAUSNER
Chief, Bridge Section
Eleventh Coast Guard District
By direction of the District Commander

Enclosure

Copy: Port of Oakland
Rodney Pimentel, HNTB
U.S. Coast Guard PAC-4
San Francisco Bar Pilots
U.S. Coast Guard, PAC-3
U.S. Coast Guard, D11 (d)
U.S. Coast Guard Sector San Francisco, Waterways Management

HNTB Companies
The HNTB Companies
Infrastructure Solutions

1111 Broadway
9th Floor
Oakland, CA 94607

Telephone (510) 208-4599

www.hntb.com

Memorandum

HNTB

To: Carl Hausner
Commander, Eleventh Coast Guard District
Coast Guard Island Building 50-2
Alameda, CA 94501

From: Rodney Pimentel
Project Manager, HNTB Corporation
1111 Broadway, 9th Floor
Oakland, CA 94607

Date: November 17, 2020

Re: Estuary Crossing Bicycle Pedestrian Bridge Emergency Action Plan

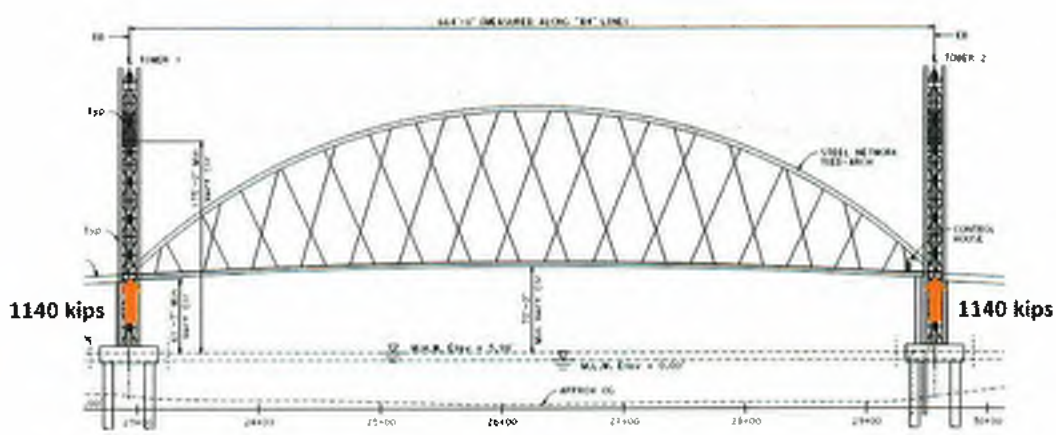
Dear Mr. Hausner:

Conceptual alignments and profiles for the Estuary Crossing Bicycle Pedestrian Bridge have been presented to the U.S. Coast Guard (USCG) in the draft Estuary Crossing Memo dated May 2020. In this memo, design criteria have been established including a 600' fender-to-fender horizontal clearance, 61'-3" clearance from mean high water (MHW) to low steel in the closed position, and 175' clearance from MHW to low steel in the open position. USCG has requested additional information on a proposed Emergency Action Plan in case the lift mechanism becomes disabled following a natural disaster or other emergency. The purpose of this memo is to summarize initial research on methods and equipment required to open the bridge in the event of failure.

In the event of an electrical supply failure an emergency generator will be part of the project. The generator will be located at the project site to provide a source of power to the lifting mechanism motors.

In the event of a lifting mechanism failure an action plan will be maintained to establish the vertical clearance. The preferred method for lifting the superstructure is with two crane barges. The superstructure would be raised to establish the required vertical clearance. The total weight of the arch span is 2280 kips, and the maximum lifting height is 175 ft; each crane would therefore need to support at least 1140 kips and lift the bridge at least 175 ft (see Figure 1).

Figure 1 – Arch Span Elevation View



ENCLOSURE ( )

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Initial investigation identified two possible types of cranes that could be suitable for this task. The first is a crawler crane unit (see Figure 2), which has been used on barge applications for conventional bridge construction, power plants, and refineries. The second is a mobile crane unit (see Figure 3), which is mounted on a truck which would need to be driven onto a barge and floated out to the site. Each would satisfy the load and lifting height requirements detailed in Figure 1. In both cases, cranes would be deployed to both sides of the bridge. Figures 4 and 5 show a sample application of a crawler crane on barges.

Figure 2 – Crawler Crane Unit

LR 1750/2

The LR 1750/2 crawler crane is suitable for universal use and is used in power plants, refineries, on bridge construction sites and for erecting wind turbines. The compact dimensions of the crane components and their moderate weights mean that the crane can be transported to the site at low cost. Suspended ballast with VarioTray also means work can be started quickly as there is no need for tiresome stacking and unstacking. A great deal of attention was also paid to the safety of the crane operator and area around the crane in the design – extensive railings, larger platforms and a clear cab with maximum all-round visibility. The 750 tonne (825 USt) crane can also be used as a "pedestal crane" on supports, a benefit for long term jobs in one position. Its SX boom with extra-wide sections sets new standards in lifting capacity and transport.

Unit Imperial

Max. load capacity	825 US t	(1650 kips)
Max. hoist height	626 ft	
Max. radius	512 ft	

Figure 3 – Mobile Crane Unit

LTM 1650-8.1

Children with famous parents often have a hard life – they are under great pressure from birth and are expected to be successful. The same can be said of the LTM 1650-8.1, which we unveiled at the Bauma 2019 event, the successor to the legendary LTM 1500-8.1, the best-selling large crane ever. Of course, this heavy duty crane has the same genetic concept as its predecessor – ultimate performance on eight axles. The result is that the 8-axle crane can complete hoisting work in the 700-tonne class or even higher with ease. It therefore has a nominal lifting capacity of 700 tonnes. In a lifting capacity comparison, the LTM 1650-8.1 exceeds its predecessor's capacity by between 15 and 50 percent, depending on its equipment package.

Unit Imperial

Max. load capacity	770 US t	(1540 kips)
Telescopic boom	263 ft	
Max. hoist height	465 ft	
Max. radius	370 ft	
Number of axles	8	

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Figure 4 – Crawler Crane on Barge (Example 1)

Figure 5 – Crawler Crane on Barge (Example 2)

The next step for the Estuary Crossing Bicycle Pedestrian Bridge study is to develop a Project Initiation Document (PID). Such a document would identify the lead agency for the proposed bridge, as well as the responsible agency for maintenance, operation, and implementation of the Emergency Action Plan. The Emergency Action Plan would also include provisions for response time to procure and deploy the barges and cranes needed to open the bridge. USCG will have additional opportunities to comment on the project as it progresses through the project development process.

We appreciate your continued involvement and support of this project and look forward to your future partnership in delivering the next phases of this study. Please feel free to contact me if you have any questions or concerns.

Sincerely,

Rodney Pimentel
Project Manager, HNTB Corporation
rspimentel@hntb.com
(510) 587-8691