Item 10 Attachment B

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Hovercraft Feasibility Study

San Francisco Water Emergency Transportation Authority

AECOM Project number: 60617240
WETA Contract number: 19-008

November 30, 2020

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Table of Contents

Figures

Tables

List of Acronyms and Abbreviations

ACS	American Community Survey
ACTC	Alameda County Transportation Commission
BAC	Bay Area Council
BART	Bay Area Rapid Transit
BCDC	Bay Conservation and Development Commission
BPC	Bay Planning Coalition
CARB	California Air Resources Board
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CFD	Community Facility District
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_{2e}	Carbon dioxide equivalent
Coast Guard	United States Coast Guard
cSEL	cumulative sound exposure level
dB	decibel
dBA	A-weighted decibel
EIFD	Enhanced Infrastructure Finance District
EIR	Environmental Impact Report
ETMA	Emeryville Transportation Management Association
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FHWG	Fisheries Hydroacoustic Working Group
FTA	Federal Transit Administration
gal/hr.	gallons per hour
GHG	greenhouse gas
HART	Hillsborough Area Regional Transit Authority
hp	horsepower
kHz	kilohertz
kn	knots
kW	kilowatts
L_{dn}	day-night average sound level
MOU	Memoranda of Understanding
N_2O	nitrous oxide
NHPP	National Highway Performance Program
NMFS	National Marine Fisheries Service
NO_x	nitrogen oxides
P3	public-private partnership
PBID	Property-Based Improvement District
PDA	Priority Development Area
PM_{10}	particulate matter less than 10 microns in aerodynamic diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in aerodynamic diameter
ppm	parts per million
PTS	permanent threshold shift
re: 1 uPa	referenced to 1 micro Pascal
RM	Regional Measure
rms	root mean square
ROG	reactive organic gases
SO_x	sulfur oxides
TMA	Transportation Management Agreement
TTS	temporary threshold shift

USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VTA	Valley Transportation Authority
WETA	Water Emergency Transportation Authority

1. Executive Summary

In 2011, URS developed an initial feasibility study of the use of hovercraft to serve terminals, primarily along the Carquinez Straight. This new Hovercraft Feasibility Study updates the 2011 study, considering current hovercraft technology and costs, and expanding the geographic extent of the study. The 2011 study concluded that some routes could be feasible, but that further study of operating, maintenance, and capital expenditure costs were required, as well as analysis of environmental impacts such as noise and air quality. These recommendations from the 2011 study are addressed in this feasibility study update report.

The study was divided into two phases:

- Phase 1 consisted of general investigations of hovercraft technology and Bay Area environmental and operational constraints impacting hovercraft feasibility. A key output from Phase 1 is a list of 12 routes for refined analysis. Some Phase 1 results that were refined in Phase 2 are included in appendices to show the progression of the study, such as the long list of terminal locations originally identified for consideration.
- Phase 2 consisted of route-specific analysis of operating and capital costs, environmental impacts, ridership demand, potential terminal sites, and funding and financing opportunities.

AECOM's primary findings over the course of the Hovercraft Feasibility Study are as follows:

- Hovercraft are technically feasible to operate on San Francisco Bay. Whether or not they are economically feasible in the Bay area depends on the characteristics of each route, ridership base level of tolerance for high fares, and the level of potential funding available to offset high operating costs. Routes that combine high market demand (which allows for high craft utilization and high fares) with relatively short trip time, enabling the most passenger trips per labor shift, would have the greatest appeal from an economic standpoint.
- As in 2011, hovercraft are very versatile from an operating perspective and can reach many places for emergency evacuation services that cannot be reached by traditional ferries.
- Some hovercraft models are quieter and more fuel-efficient than they were 9 years ago. The relevant size of hovercraft is about 75 to 80 passengers, with a cruising speeds of 35 to 38 knots (kn). This is based on the same Griffon 12000TD hovercraft model used in the UK's Isle of Wight service. This craft has been optimized for improved fuel, noise, and maintenance cost performance, and thus has a better cost and environmental performance than larger craft of older design.
- Hovercraft are significantly smaller and not much faster than the San Francisco Water Emergency Transportation Authority's (WETA's) fastest catamarans. WETA catamarans can carry 250 to 445 passengers versus 75 to 80 passengers for the hovercraft analyzed in this study. Hovercraft cannot effectively use deep-water docks as-is. This, and the higher operating costs of hovercraft compared to traditional catamarans, led to the elimination of routes that can be served with traditional boats.
- Tier 4 engines would be required for any new hovercraft service in the Bay Area. Griffon's 12000TD hovercraft includes Tier 4 equivalent engines, another reason for its selection as a base craft for consideration of feasibility. Hovercraft generate significantly more air emissions per than catamarans. For example, they generate 340 percent more carbon dioxide (CO_2) than catamarans per passenger trip. Electric hovercraft are not expected to be viable in the foreseeable future, so this air-quality impact would likely remain an issue for years to come.
- The South Bay, with its naturally shallow water and large number of employers who are not well served by transit, is a natural target for hovercraft service. However, a great deal of the South Bay

shoreline is protected wildlife areas and establishing hovercraft routes through these protected areas is unlikely to be feasible. Additionally, if rail service over the Dumbarton rail bridge resumes, access to terminals in the South Bay could be cut off. Finally, long serpentine sloughs through which hovercraft would have to travel are an operational barrier, requiring long transits at slow speeds; hovercraft are not operationally feasible at all in the most constrained locations. As a result of these factors, the South Bay past the Dumbarton rail bridge was eliminated from consideration in Phase 2.

- The complexity of operating and maintaining hovercraft, as well as training new captains and maintenance staff, would be a key challenge when starting a new hovercraft service. Hovercraft would require new dedicated maintenance and overnight storage facilities. Maintenance staff and captains would also require different skill sets and training than current WETA staff.
- If any specific route or combination of routes were to be pursued by WETA, a programmatic Environmental Impact Report (EIR) pursuant to the California Environmental Quality Act (CEQA) would be required to analyze impacts to the physical, natural, and human environment in more detail. For example, some of the potential routes and terminal locations identified in this study are proximate to sensitive habitats used by special-status species, and the potential impacts of hovercraft noise and operation on such resources would require further study on a site-specific basis. It is important to keep in mind that any of the routes analyzed in this study would introduce new impacts in new geographic areas because an objective of this hovercraft study is to assess the feasibility of expanding the geography of WETA's existing service network through hovercraft use.
- Funding and financing would be a challenge for a hovercraft service. Conventional sources of public transit funding and financing require higher ridership and more cost-effective operating ratios than hovercraft can provide.
- Hovercraft service would be more expensive to operate than typical WETA ferry service and would likely draw high-earning commuters as its primary ridership. Social equity would need to be considered in developing new services and tactics such as providing discounts for low-income riders should be considered as a part of the overall program.
- There appears to be some corporate interest in new nonroad commuter options. Genentech, for example, is currently operating a private ferry service, and other companies have either run pilot programs or considered ferry transportation. There may be opportunities for public private partnerships to help defray the costs of potential hovercraft routes near major employers.

1.1 Stakeholder Outreach

Substantial outreach efforts were conducted to support the Hovercraft Feasibility Study. Workshops were held at key milestone stages throughout the study, including two committees: a Technical Advisory Committee, which provided feedback on local regulations and other technical issues impacting feasibility; and a Stakeholder Advocacy Committee to gather feedback from local cities, business, environmental groups, and other organizations interested in providing feedback and expressing their preferences regarding the study direction. Additionally, representatives of cities identified as possible locations for hovercraft terminals in the second phase of the study were interviewed, as were representatives of some local large employers and business interest groups. A summary of outreach efforts is presented in Table 1.

Table 1. Summary of Outreach Meetings

Date	Workshop/Meeting Name	Topic	# of Attendees
2/26/2020	Technical Advisory Workshop #1	Introduce project team. Overview of study purpose and process, and of existing hovercraft technology. Summary of existing WETA operations.	19
2/26/2020	Stakeholder Advocacy Workshop #1	Introduce project team. Overview of study purpose and process, and of existing hovercraft technology. Summary of existing WETA operations.	19
5/14/2020	Technical Advisory Workshop #2	Presentation of cost model and route selection methodology. Introduction of long list of routes under consideration. Gathered feedback from technical advisors on feasibility of routes.	15
5/15/2020	Stakeholder Advocacy Workshop #2	Presentation of cost model and route selection methodology. Introduction of long list of routes under consideration. Gathered feedback from stakeholders on preferred routes.	23
9/1/2020	Technical Advisory Workshop #3	Provide an update on the operations analysis, ridership modeling, capital expenditure analysis, and environmental analysis. Received feedback on the top 12 routes for consideration.	19
9/2/2020	Stakeholder Advocacy Workshop #3	Provide an update on the operations analysis, ridership modeling, capital expenditure analysis, and environmental analysis. Received feedback on the top 12 routes for consideration.	38
7/8/2020	Meeting with City of Richmond	Discuss city interest in a hovercraft service, possible terminal locations, parking, and possible use of existing boat ramp.	7
7/13/2020	Meeting with City of San Leandro	Discuss city interest in a hovercraft service, possible terminal locations near the marina, and parking/traffic issues.	8
7/14/2020	Meeting with City of Alameda	Discuss city interest in a hovercraft service, possible terminal and maintenance facility locations, transit connectivity, and parking.	7
7/14/2020	Meeting with City of Martinez	Discuss city interest in a hovercraft service, possible terminal locations (likely in same area planned for a ferry terminal), and parking.	7
7/15/2020	Meeting with Foster City	Discuss city interest in a hovercraft service, possible terminal locations (either base of the bridge or current golf course that may be redeveloped), and transit connectivity.	6
8/17/2020	Meeting with City of South San Francisco	Discuss city interest in a hovercraft service, possible terminal locations, and transit connectivity/shuttle services.	8
8/19/2020	Meeting with City of Antioch	Discuss city interest in a hovercraft service, possible terminal locations, and existing parking that can be used for a hovercraft service.	7
8/21/2020	Meeting with City of Berkeley	Discuss city interest in a hovercraft service, possible terminal locations, existing parking, environmental issues, and recreational uses at the marina.	8
9/11/2020	Meeting with Bay Area Council (BAC)	Discuss BAC member opinions on hovercraft services and options for funding and financing.	9
9/16/2020	Meeting with Bay Planning Coalition (BPC)	Discuss BPC member opinions on hovercraft services and options for funding and financing.	10
9/18/2020	Meeting with Genentech	Discuss Genentech interest in supporting a hovercraft service, their experiences with hovercraft and providing other transit services (buses and catamarans) for employees.	8
10/9/2020	Meeting with Facebook	Discuss Facebook interest in supporting a hovercraft service, their experiences with studying hovercraft and providing other transit services (buses) for employees.	10

2. Hovercraft Technology

2.1 Overview of Hovercraft Technology Update

The most critical technology updates in this study pertain to costs and to the application of hovercraft analysis to new potential routes and terminal locations, particularly in the South Bay.

At a high level, AECOM findings indicate that the primary advantage of hovercraft is access; they are the only type of craft that can expand WETA's access to new markets without the need for dredging. They were not found to be much faster than the fastest existing WETA catamarans, which have 34 knot service speeds, whereas hovercraft are recommended to operate at top speeds of 35 to 38 knots to optimize fuel consumption. Capital and operating costs would also be higher than for traditional catamarans and would need to be offset by robust funding and high fares to reach a target farebox recovery ratio of 50 percent.

Detailed results are summarized in the following sections.

2.2 Commercial Hovercraft Models, Costs, and Fuel Consumption

AECOM has based most of its hovercraft technology analysis on Griffon Hoverwork designs because these are the most well-known machines available for a reputable supplier, with the most robust information available. Their craft are also used in the only commercial hovercraft passenger ferry service operated worldwide, serving the Isle of Wight off the south coast of England. Any craft used for Bay Area ferry operations would likely be custom-spec machines, but AECOM and WETA are not intending to design a specific hovercraft for this study; rather, the study will determine whether hovercraft may be suitable for ferry operations in the Bay Area in general, as a class of craft. For this purpose, using existing off-the-shelf machines was considered suitable.

A range of hovercraft from Griffon Hoverwork was analyzed for consideration early in the study before deciding to use the 12000TD model as the base craft for consideration. Key specifications for four of these crafts are summarized in Table 2.

Table 2. Key Existing Hovercraft Models and Specifications [1] [2] [3]

Craft Name	Max. Passenger Capacity	Purchase Cost	Max. Speed (kn)	Min Crew	Standard Engine Model and Power	Cruising Fuel Consumption (gal/hr.)
8000 TD	56	$8 million	40	3	2 × IVECO, 735 kW ea.	50 to 75
8100 TD	75	$8.5 million	40	3	2 × IVECO, 735 kW ea.	50 to 75
12000 TD (craft used in refined analysis)	**80**	**$10 million**	**45 (cruise speed 30 to 38 kn)**	**3**	**2 × MAN, 793 kW ea.**	**78 to 117**
BHT	150	$13 to 14 million	45	4	4 × MTU, 597 to 895 kW ea.	125 to 190

Notes:

gal/hr. = gallons per hour

kW = kilowatts

For comparison, the fuel consumption of WETA catamarans varies by vessel size and age, but on average is about 120 gallons per hour, based on 2019 data. Because WETA vessels have capacities from 250 to 445 passenger, hovercraft have greater fuel burn rates and costs per passenger trip than existing catamarans.

1 Source: *Griffon Commercial Brochure*, available at https://www.griffonhoverwork.com/downloads/.
2 Source: Interview of Tim Kolb and Art Parker of Vigor on December 13, 2019.
3 Source: Email from Griffon Hoverwork on May 14, 2020, on 12000TD speed and fuel consumption.

A variety of factors led to the conclusion that the 12000TD model is the most suitable hovercraft for analysis in this feasibility study. These include:

- No other existing off-the-shelf hovercraft models have Tier 4 equivalent engines. The capital cost to redesign another model to have Tier 4 engines cannot be established at this time due to the lack of relevant example data, but conversations with Vigor indicate that it is likely to be a large capital cost barrier (at least a few million dollars per craft), in addition to adding time and complexity to the project implementation process.

- The 12000TD model is used in the only currently operating passenger hovercraft service in the world; it therefore complies with UK safety standards for passenger operations, which are similar to safety standards in the United States. Again, this has the benefit of eliminating the potential need for the costly and time-consuming redesigns that would apply to other hovercraft models.

- Griffon cites this craft as “the most technically advanced and modern hovercraft available today, offering better fuel efficiency, low emissions and significantly less noise.”[4] Although larger hovercraft are technically possible, they would also have to be redesigned to achieve improvements to fuel, emissions, and noise similar to those already present in the 12000TD. Furthermore, in the September 2, 2020, Stakeholder Workshop, Griffon cited a top-end limit of about 200 passengers before substantial redesigns are required compared to the 12000TD. This would include requiring four engines rather than two, and would lead to commensurate increases to fuel needs, maintenance costs, and noise.

- Based on the factors discussed above, AECOM concluded that the performance of the 80 passenger Griffon Hoverwork 12000TD model is likely to be superior to that of any other existing craft in the categories relevant to this study, particularly in regard to capital costs, operating costs, environmental performance, and complexity of implementation in the United States regulatory environment. Effectively, if WETA finds that this craft does not meet their requirements for criteria such as cost and environmental performance, it is likely no other craft will. Therefore, the 12000TD was considered the most applicable hovercraft model for analysis in this feasibility study.

2.3 Hovercraft Maintenance Costs

Maintenance costs for hovercraft are higher than those of traditional catamarans. The main hovercraft components of concern with regard to maintenance are the main vessel skirt, skirt fingers, engines, and propellers. Maintenance of the skirts presents the biggest challenge because the rubber component along the base of the craft is subject to frequent wear and tear.

Hovercraft maintenance cost estimates for the 12000TD model were provided by Griffon Hoverwork, for both scheduled maintenance and intermittent repair work. Some years would have higher maintenance costs than others for items like engine overhauls. Total scheduled maintenance over 10 years totaled approximately $4.2 million per hovercraft. Griffon also recommended $60,000 per year in additional upkeep and repair work, yielding an annual maintenance cost per craft of $480,000. Assuming 520 shifts per year (2 shifts per weekday times 5 days per week times 52 weeks per year), this is about $920 per hovercraft per shift. AECOM added 10 percent contingency and rounded this to a per-shift maintenance cost estimate of $1,000 per hovercraft in cost models.

WETA catamaran maintenance costs vary depending on the age, size, and hours of service of the vessel and route in question, but as a blended average cost about $1,700 in maintenance per shift. It is important to keep in mind, however, that hovercraft have a maximum capacity of 75 to 80 passengers, whereas WETA catamarans vary in size from 250 to 445 passengers, with most having a capacity of more than 300 passegners. Therefore, hovercraft have higher maintenance costs per passenger trip than catamarans.

[4] Source: *Griffon Commercial Brochure*, available at https://www.griffonhoverwork.com/downloads/.

Hovercraft would also require new maintenance facilities and either new maintenance staff or retraining of existing staff; see Section 6.2, Maintenance and Overnight Storage Facility Needs and Capital Costs, for further discussion of maintenance facility needs.

2.4 Crew Size

The same United States Coast Guard (Coast Guard) rules that apply to other high-speed vessels (defined as traveling over 30 kn) would also apply to hovercraft. For smaller craft like the 80 passenger 12000TD model used for analysis in this study, a captain and mate in the pilot house are required, plus at least one deckhand. The number of deckhands (either one or two) is up to Coast Guard discretion based on inspections and safety exercises on actual crafts.

3. Phase 2 Routes and Operating Cost Modeling

3.1 Phase 2 Routes

Twelve total routes were considered in Phase 2, based on a combination of Committee feedback, Phase 1 initial results, and WETA preference. See Appendix B for a discussion of the long list of terminal locations originally under consideration, and the reasons each was either carried forward into Phase 2 or eliminated from further consideration. Note that these 12 routes are not intended to be an exhaustive list of every possibility, but rather a list of promising routes based on Phase 1 results, to help WETA determine whether feasible routes for hovercraft services exist.

The 12 routes considered in Phase 2 were:

1. Richmond-South San Francisco
2. Richmond-Foster City
3. Berkeley-Downtown San Francisco
4. Berkeley-South San Francisco
5. Berkeley-Foster City
6. Berkeley-West Dumbarton
7. Alameda-Foster City
8. Alameda-West Dumbarton
9. San Leandro-South San Francisco
10. Downtown San Francisco-West Dumbarton
11. Hercules-Downtown San Francisco
12. Martinez/Antioch-Downtown San Francisco

3.2 Travel Speeds and Times

Hovercraft typically have cruising speeds of 35 to 38 kn, although designing higher-speed craft is also possible. A service based in Akutan, Alaska, used a craft with a design speed of 60 kn.[5] However, these higher speeds also come with significant increases in fuel costs, which are already substantial even at milder 35 to 38 kn speeds. For example, the 12000TD hovercraft is expected to burn 18 percent more fuel at 35 kn versus 30 kn, and a further 10 percent increase in fuel burn is required for a 38 kn cruising speed versus 35 kn. The total fuel burn increase for 38 kn versus 30 kn is more than 30 percent.

AECOM developed simulation models of all 12 proposed routes using our in-house Vessel Network Model (VNM), which is a flexible tool used to analyze any type of maritime transportation network. Hovercraft were modeled at both 35 kn and 38 kn cruise speeds to analyze the impact on both travel time and fuel use (see Section 2.2 for background on fuel use versus speed). The model includes the effect of accelerating up to maximum speed and decelerating when approaching a destination. Taking this effect into account, hovercraft travel at average speeds of 80 to 85 percent of their maximum, depending on route length, with longer routes spending more time at maximum speed.

Dwell times at terminals are conservatively estimated at 10 minutes, consistent with WETA's existing schedule standards. This is not the fastest turn time possible, but rather a comfortable level of time for passenger loading/offloading. This also includes time to make up any small delays, such as those resulting from poor weather, while still meeting schedule timetables. In the September 2, 2020 Stakeholder Workshop, Griffon shared that minimum turnaround time for Isle of Wight hovercraft service is three minutes, though this can increase to seven minutes during severe weather.

Figure 1 shows a screenshot of AECOM's Phase 2 VNM model. Figure 2 shows mean travel time for each route, depending on speed. This does not include dwell time.

[5] Interview with Marty Robbins of WETA, January 30, 2020.

The fastest routes are those for trips consisting only of direct bay crossings, such as the Berkeley-San Francisco and San Leandro-South San Francisco routes. The longest route considered was Downtown San Francisco to Martinez.

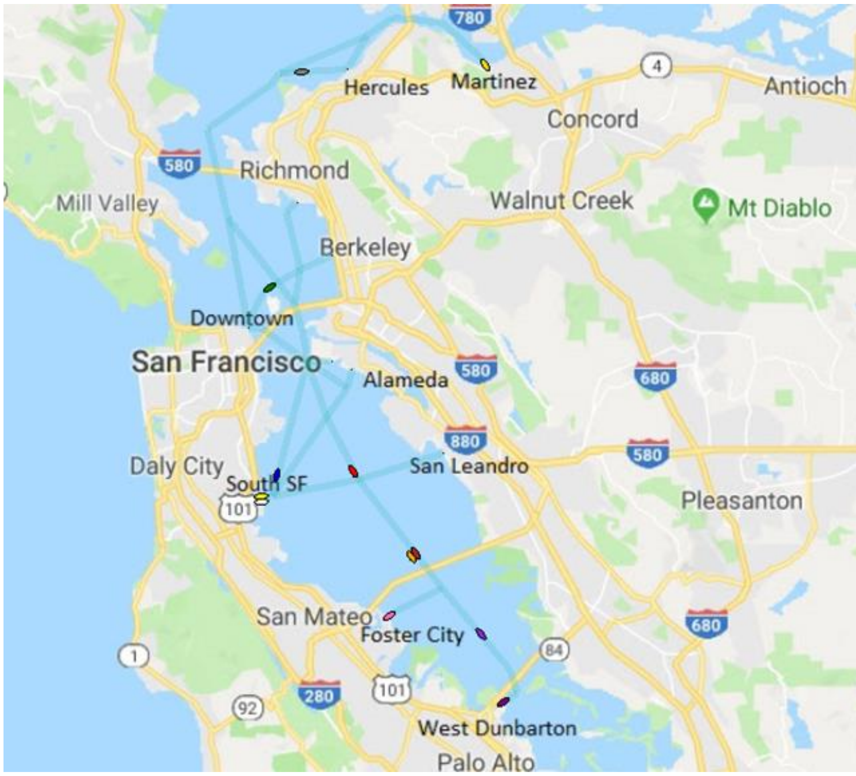

Figure 1. AECOM VNM Screenshot showing Phase 2 Routes

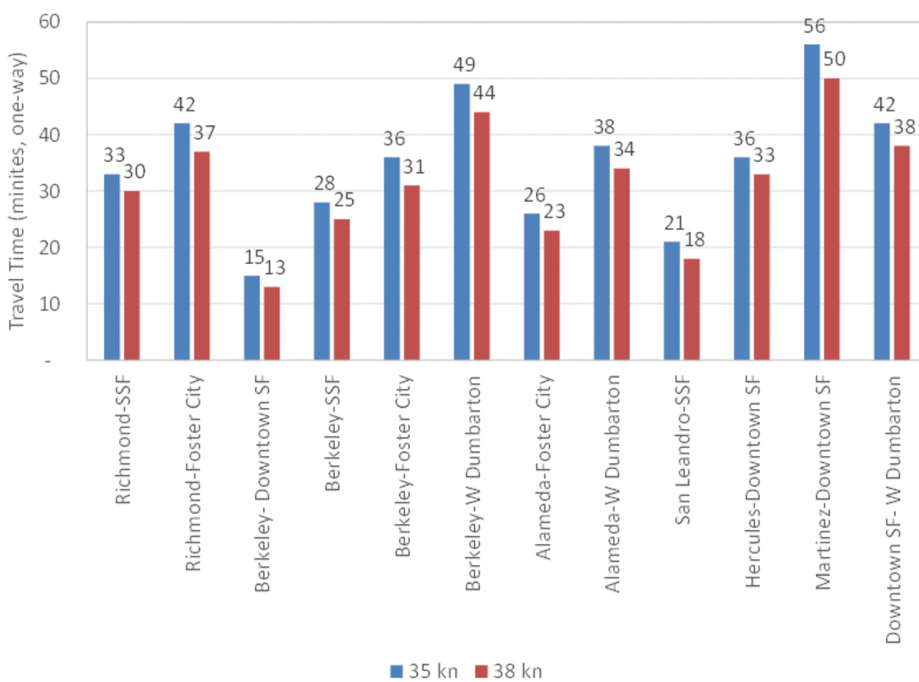

Figure 2. Mean Travel Time in Minutes by Route and Speed

3.3 Refined Operating Cost Analysis

Key operating cost categories analyzed were labor, fuel, maintenance, and other/indirect costs. See Appendix A for details on existing WETA operating cost data and how these were incorporated into hovercraft operating cost analysis where appropriate. All costs are unitized on a per hovercraft, per 8-hour labor shift basis.

The following key inputs were used for each major cost category:

Labor: Labor costs are based on a three-person crew size using mean labor rates from 2019 WETA data, with a 25 percent premium to account for the need to hire hovercraft captains who may be more expensive than existing boat captains due to their scarcity and the additional training required.

Maintenance: Maintenance costs are based on data provided by Griffon Hoverwork regarding the 12000TD model, with a 10 percent contingency added due to high mechanic labor costs in the Bay Area, and based on benchmarking with existing WETA operating data (e.g., to take into account the fact that hovercraft have higher maintenance costs than catamarans, based on historical hovercraft operations and their general mechanics and construction). Total costs are $1,000 per hovercraft shift (see Section 2.3).

Fuel: Fuel usage is largely based on data provided by Griffon for the 12000TD model, which were in line with AECOM and Vigor estimates. Usage rates are about 100 gallons per hour (gal/hr.) at 35 kn maximum speed, or 117 gal/hr. at 38 kn maximum speed. Costs are based on $2.50 per gallon of diesel. See Section 2.2 for further details on fuel consumption and cost.

Other/indirect costs: Other costs include administrative staff, ticketing, and anything else not directly tied to operation of a craft. These costs are estimated to be 85 percent of labor costs per shift, based on the cost ratio from 2019 WETA data (see Appendix A).

Figure 3 summarizes total hovercraft operating cost per 8-hour labor shift per hovercraft.

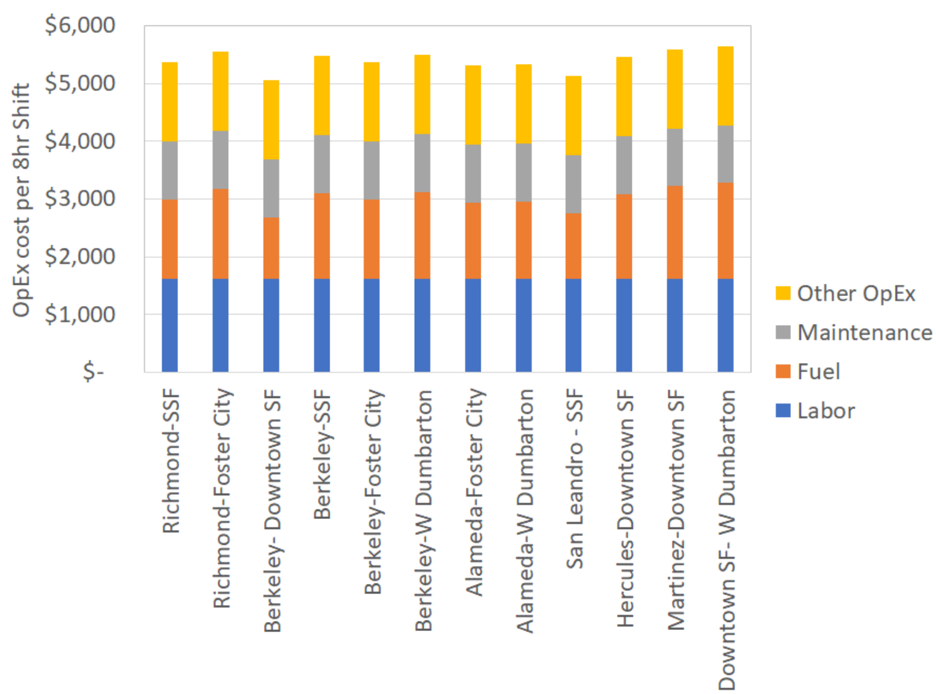

Figure 3. Operating Costs per Shift per Hovercraft

For shorter routes, each hovercraft is able to make more round trips per shift, so overall results per hovercraft shift are similar across routes. Annual costs depend on total ridership demand, which, along with craft capacity limitations, determines the number of daily hovercraft shifts needed or possible per route. This analysis is presented in the following section on ridership and fares.

Additional annual cost data on a per passenger basis are presented in Section 4, following the ridership analysis which is used to determine how many hovercraft are needed in operation to support total demand.

4. Ridership, Fare, and Annual Cost Analysis

4.1 Ridership Analysis

This section discusses the methodology used to forecast potential hovercraft trips, along with unconstrained and constrained forecasts. The constrained forecasts reflect capacity constraints of the proposed hovercraft.

4.1.1 Methodology

To estimate the ridership for the proposed new hovercraft services, the latest Alameda Countywide Travel Model (2018) from Alameda County Transportation Commission (ACTC) was obtained. ACTC's model uses assumptions from the Regional Transportation Plan, Plan Bay Area 2040, which was adopted in 2017. The model has a base year of 2010, opening year of 2020, and a future year of 2040. The base year (2010) and opening year (2020) year models were validated to ensure that they reasonably represent the 2010 and 2020 conditions. See Appendix C for details on the model validation process and initial unconstrained model ridership demand results.

Many initial demand estimates were higher than a 75-passenger hovercraft could reasonably accommodate. Therefore, AECOM and WETA developed a methodology to constrain ridership demand based on hovercraft capacity where needed. The focus of the analysis was to determine whether there are routes where it would be feasible to start up a simple service with a single hovercraft pad. Because there is a hovercraft dwell time at each terminal of 10 minutes, and 5 minutes of separation are needed, it was estimated that demand would be capped at four hovercraft departures per terminal per hour. A standard maximum utilization factor of 80 percent was also used, so the maximum boardings at a single terminal in an hour is 75 × 4 × 80 percent = 240.

4.1.2 Capacity Constrained Ridership by Route

Figure 4 summarizes daily ridership per route (i.e., round trips) based on capacity-constrained model results.

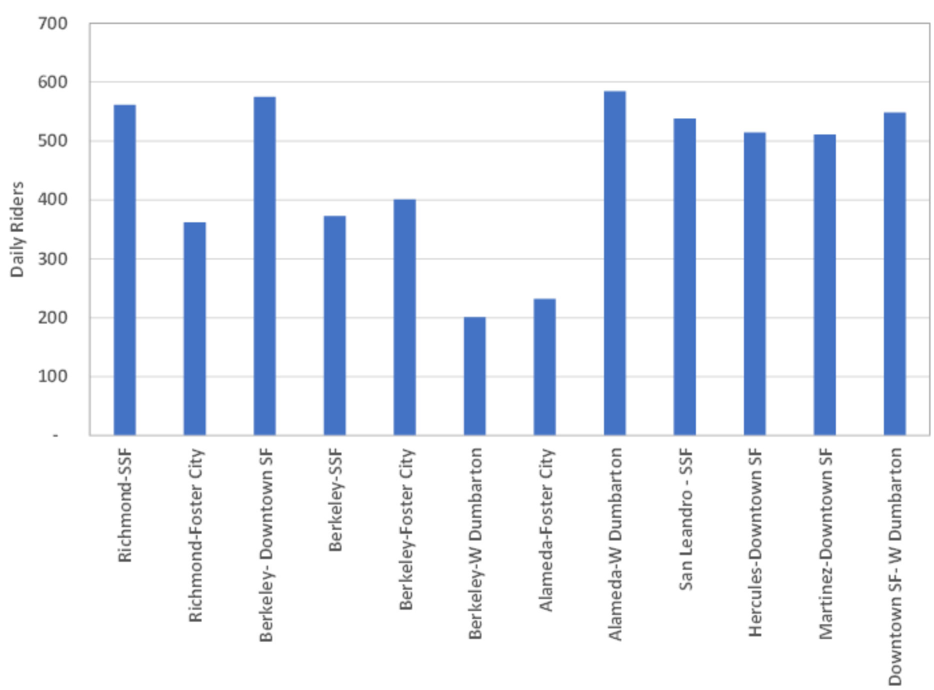

Figure 4. Daily Ridership for All Routes

4.2 Fares

Figure 5 shows one-way fares by route used in ridership analysis. Mean fares shown here include discounted clipper, senior, and youth fares; adult cash fares would be higher. Fares are based on 50 percent farebox recovery of operating costs only; they do not factor in capital costs to build terminals, a maintenance facility, land for overnight storage, or to buy hovercraft.

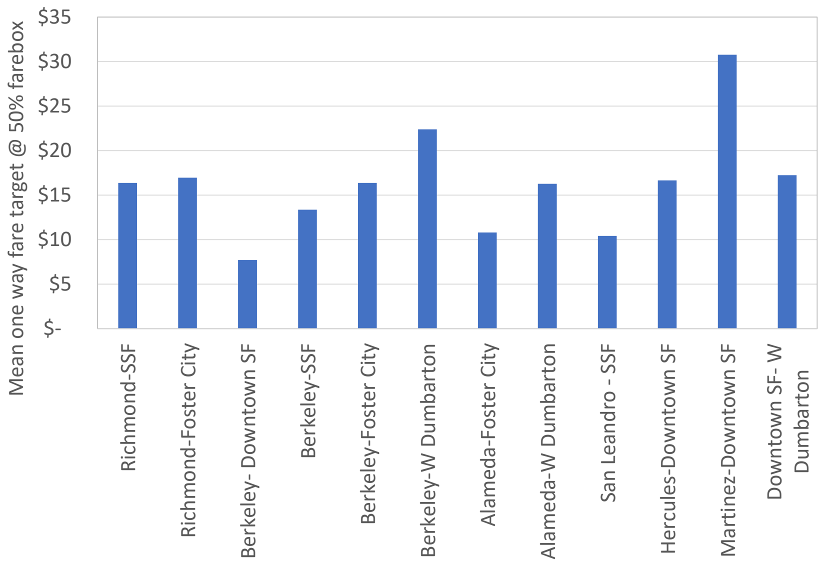

Figure 5. Mean One-Way Fares by Route at 50 Percent Farebox Recovery

4.3 Annual Operating Cost per Route

Figure 6 summarizes annual operating costs by route, based on cost per hovercraft-shift in Figure 3, and on the total number of hovercraft needed in operation to support the ridership given in Figure 4. The highest-demand routes require four crafts (the maximum feasible with a single landing pad); the two lowest-demand routes require two hovercraft in operation. For comparison, the cost of WETA's Richmond to San Francisco service for fiscal year 2019 was about $4 million, versus the $6 to $11 million estimated below for services with much lower passenger capacities.

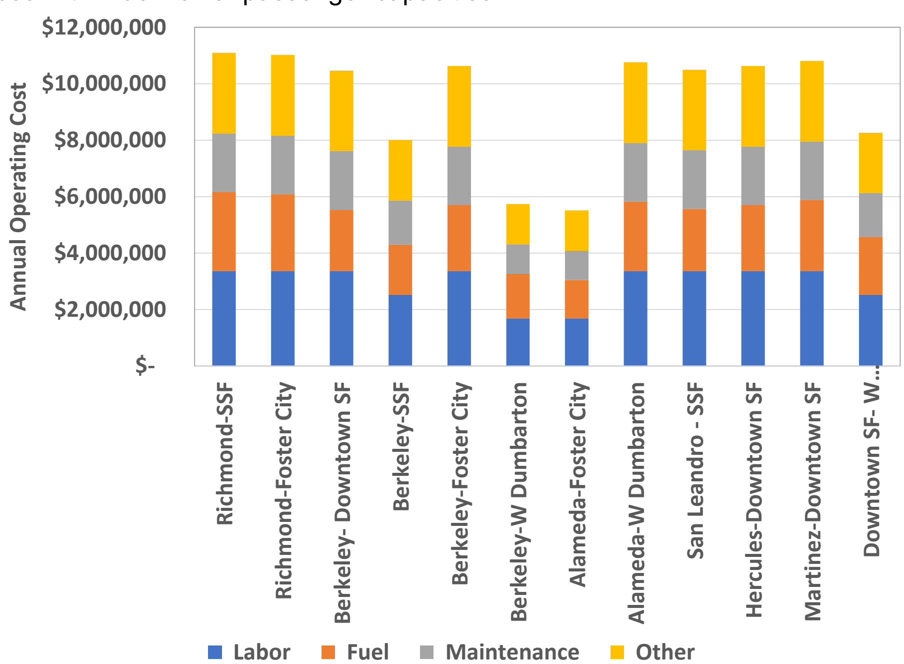

Figure 6. Annual Operating Cost by Route

5. Environmental Considerations

AECOM considered several disciplines of environmental analysis over the course of the full Hovercraft Feasibility Study. These included:

- Habitat impacts;
- Noise impacts, both airborne and underwater;
- Engine requirements and subsequent air quality and greenhouse gas (GHG) impacts; and
- Permitting and regulatory considerations.

For the first phase of the study, the most critical environmental considerations were noise and habitat impacts, which are crucial to identifying feasible terminal locations, and thus to identifying feasible routes. Other factors include lack of agency and stakeholder experience with hovercraft in the Bay Area, and potential public acceptability.

Phase 2 of the study included analysis of route-specific air quality and GHG impacts.

5.1 Engine Requirements

A new hovercraft operating in the San Francisco Bay Area, for the purpose of WETA passenger transportation, is required to meet United States Environmental Protection Agency (USEPA) Tier 4 emissions standards. The California Air Resources Board (CARB) Regulation for Airborne Toxic Control Measure for Commercial Harbor Craft Section 93118.5 (e)(4) requires that propulsion and auxiliary engines on vessels meets applicable marine standards in effect on the date of acquisition.[6] The standards in effect are indicated in 40 Code of Federal Regulations (CFR) Part 1042, Control of Emissions from New and In-Use Marine Compression-Ignition Engines and Vessels.[7] Engines required to meet the needs of a hovercraft for WETA would be Category 1 or 2 engines at or above 600 kilowatts, all of which must meet Tier 4 requirements as of 2017. Exact emissions control requirements for a more specific engine could be assessed further in 40 CFR Part 1042.

Griffon's GHL 12000TD model, used for analysis in this study, has Tier 4 compatible engines.

5.1.1 Alternative Fuels

Currently, there are no hovercraft operated on anything but diesel worldwide. Battery-electric hovercraft are not feasible at this time because heavy battery weights are not compatible with hovercraft, which would need to generate enough power to lift the craft, including batteries. Hovercraft are expected to require diesel fuel for the foreseeable future, so alternative fuels were not considered in Phase 2 environmental analyses.

5.2 Emissions Analysis

This section describes the emissions analysis for the Hovercraft Feasibility Study. Findings include estimation and comparison of emissions based on passenger trips for hovercraft and catamarans for the following pollutants:

- Nitrogen oxides (NO_x)
- Particulate matter less than 10 microns in aerodynamic diameter (PM_{10})
- Particulate matter less than 2.5 microns in aerodynamic diameter ($PM_{2.5}$)
- Reactive organic gases (ROG)
- Carbon monoxide (CO)
- Sulfur oxides (SO_X)
- Carbon dioxide equivalent (CO_{2e}), including CO_2, methane (CH_4), and nitrous oxide (N_2O)

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6 Available at: https://ww3.arb.ca.gov/regact/2010/chc10/frochc931185.pdf?_ga=2.91477406.523367852.1583869536-2092636485.1557247809.

7 Available at: https://www.ecfr.gov/cgi-bin/text-idx?SID=a8a469920cf35098c9f7bcd496ab758a&mc=true&node=pt40.36.1042&rgn=div5.

The public health impacts of each of these pollutants can be found under both CARB and USEPA resources.[8,9,10,11]

Technical details of the emissions analysis and charts of the results comparing transportation modes for each pollutant can be found in Appendix F.

Based on the emissions analysis, hovercraft result in greater emissions than the catamaran across all pollutant types when comparing per passenger trip. The primary driver for the difference in emissions between hovercraft and catamarans is the ridership potential. Hovercraft were assumed to have a greater percentage of ridership (70 percent) than catamarans (50 percent); however, total passenger capacity is more than double for catamarans.

5.3 Noise and Habitat Impacts in Phases 1 and 2

An analysis of environmental sensitivity was incorporated into the Phase 1 site selection study and used to refine the list of sites considered for route-specific analysis in Phase 2. The South Bay was of particular interest early on in the study, but the environmental sensitivity of the region, in conjunction with operational feasibility factors (see Appendix B), led to the exclusion of sites south of the Dumbarton rail bridge from future consideration. See Appendix D: Noise Analysis and Appendix E: South Bay Environmental Considerations for further details of environmental analyses conducted.

Although largely not as sensitive as the South Bay on a contiguous landscape scale, some of the routes and terminals still under consideration in Phase 2 may impact sensitive areas. Tidal marshes, mudflats, and other aquatic habitats used by special-status species (including numerous bird species), as well as haul-out sites used by seals and sea lions, occur in the vicinity of some of the studied terminal locations or along the routes to these locations. Areas noted by stakeholders include bird and other wildlife habitats near the San Leandro and Berkeley marinas and West Dumbarton Bridge. An EIR would be needed for any proposed new services, requiring detailed site-specific analysis of potential impacts to special-status species and habitats, as well as other aspects of the physical, natural, and human environment considered under CEQA. Because exact sites for new services have not been selected in this study, but rather are only discussed in terms of general possibilities, potential environmental impacts were evaluated at a high level for the purpose of screening locations and routes, and are discussed in the relevant appendices.

8 Available at: https://ww2.arb.ca.gov/resources/common-air-pollutants.
9 Available at: https://ww2.arb.ca.gov/our-work/topics/climate-change.
10 Available at: https://www.epa.gov/criteria-air-pollutants.
11 Available at: https://www.epa.gov/ghgemissions/overview-greenhouse-gases.

6. Capital Costs and Site Selection

6.1 Terminal Site Locations and Capital Costs

Figure 7 shows aerial photographs from the two terminals used at each end of the Isle of Wight route in the UK. The primary element of infrastructure is a concrete ramp that provides for a smooth transition from water to land. In each case, the concrete paved area is approximately half an acre. In both cases, cars are parked in at-grade lots.

Figure 7. Isle of Wight Hovercraft Terminals

Most but not all of the terminals considered in this study in the Bay Area would be similar to those shown above in Figure 7. With the exception of Downtown San Francisco, all of the proposed terminals are on a shallow water shoreline. Most of these have some type of rock in place for shoreline protection, as opposed to the sandy beach shown in Figure 7. This rock would need to be removed to allow for construction of a concrete landing ramp. The Downtown San Francisco terminal would likely feature an entirely new hovercraft terminal, built out beyond the end of an existing ferry dock.

Regarding parking, the morning commute direction is a key indicator of parking demand. Terminals that are busy in the morning commute, with many departing passengers, would need sufficient parking. Terminals on the receiving end of the morning commute would need adequate walking, shuttle, or public transit options to allow passengers to move from the hovercraft to their final destination.

In some cases, proposed hovercraft terminals are adjacent to existing recreational marinas. These areas may see heavy demand for parking on weekends, but lower demand on weekdays. A commuter hovercraft service would generate the opposite demand for parking and therefore may be able to leverage a great deal of existing parking. Terminals that do not have existing parking that can be leveraged would need to build new parking areas as part of any new hovercraft service.

Table 3 summarizes the infrastructure required at each terminal.

Table 3. Infrastructure Needs by Terminal

Terminal	AM Peak Departures (Y/N)	Water Access	Parking/Terminal Access
Martinez	Y	New ramp	Existing lots nearby at marina. Would have to share with recreational uses, which are light on weekdays during commute periods.
Antioch	Y	New ramp	Existing lots for recreational users are nearby and are generally vacant during weekday commute periods.
Hercules	Y	New ramp	New lot required waterside of railroad line.
Richmond	Y	Existing ramp or Deep-water dock	Existing lots nearby; would have to share with existing ferry parking.
Berkeley	Y	New ramp	Existing lots nearby at some locations; some locations may have to share parking or require new parking.
West Alameda	Y	New ramp	Existing lots nearby planned as part of Seaplane Lagoon service; would require sharing with catamaran users.
San Leandro	Y	New ramp	New garage required.
San Francisco Downtown	N	Deep-water dock	Excellent transit available.
South San Francisco	N	New ramp	Would require walking or use of shuttles.
Foster City	N	New ramp	Some new shuttle infrastructure may be needed.
West Dumbarton	N	New ramp	No walking; all passengers would need shuttles.

6.1.1 Martinez Locations

Figure 8 shows an aerial view of the Martinez waterfront. It seems unlikely that it would be desirable to run a hovercraft service inside the existing breakwater. A hovercraft terminal in Martinez would likely consist of a new concrete ramp to the west of the existing breakwater and could take advantage of the large amount of existing at-grade parking.

Figure 8. Martinez Waterfront

6.1.2 Antioch Location

Figure 9 shows a possible area for a hovercraft terminal at the Antioch waterfront. The parking lot shown in the image is primarily used by recreational users on the weekends; it is usually close to empty during commute periods, and could be available in those times for hovercraft passenger parking. The existing boat ramps on the east end of the image are too small for a hovercraft, so a new ramp would be needed. Importantly, this location and parking are all on the waterside of the rail line.

Figure 9. Antioch Waterfront

6.1.3 Hercules Area

Figure 10 shows the waterfront near Hercules, with the likely hovercraft terminal location highlighted.

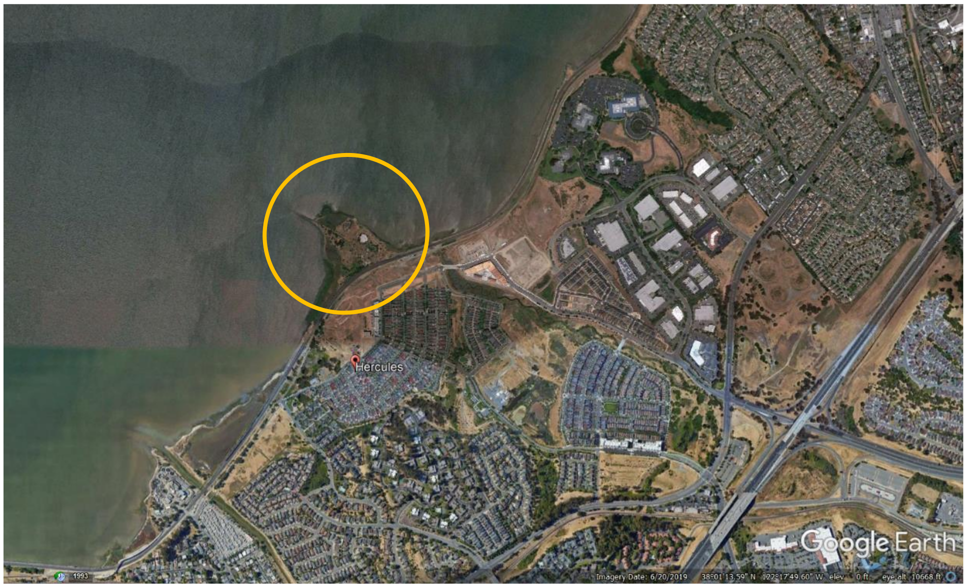

Figure 10. Potential Hercules Terminal Site

Rail tracks run very close to the bay in most of this region. AECOM does not anticipate hovercraft crossing any rail tracks on land, so any new hovercraft terminal would need to be built on the bay side of the railroad tracks. There is no existing parking in this area, so all parking related to the hovercraft terminal would need to be built as part of any new service in Hercules.

6.1.4 Richmond Locations

Figure 11 shows the Richmond waterfront area.

Figure 11. Richmond Waterfront with Potential Hovercraft Terminal Sites Highlighted

There are two options for a hovercraft terminal in Richmond. Location A in Figure 11 shows an existing ramp that is approximately 55 feet wide (the Griffon 12000TD hovercraft is approximately 42 feet wide) and used for recreational boat access to the Bay. The City of Richmond does not control this ramp, so its use for hovercraft may not be feasible. This area has a significant amount of at-grade parking. It may be operationally possible to use this area almost as-is for a hovercraft terminal, but further investigations would be needed to determine whether this would create an unacceptable level of conflict with recreational users. If Location A is not feasible, Location B, the site of WETA's conventional ferry service operations, might be used for a hovercraft service. It may be possible to build a ramp in Location B to allow hovercraft to load passengers on land, or a deep-water ramp might be developed adjacent to WETA's existing dock.

6.1.5 Berkeley Locations

Figure 12 shows an aerial photograph of the Berkeley waterfront. Three potential hovercraft terminal sites are shown. Option A is at the extreme western edge of the Berkeley Marina and has a good deal of surface parking used by the nearby marina and restaurants. Option B is an area of undeveloped land close to the Interstate 80 and University Avenue interchange. Option C is an area of surface parking adjacent to the Gilman Avenue interchange sports complex. All three of these options would require a concrete access ramp and probably at least some new parking.

Figure 12. Berkeley Waterfront with Potential Hovercraft Terminal Sites Highlighted

6.1.6 Alameda (Seaplane Lagoon)

Figure 13 shows an aerial photograph of the Seaplane Lagoon area of Alameda, with likely hovercraft terminal sites highlighted.

Most of this area is deep water wharf, with a quay wall structure more than 10 feet above the water level of the bay. The highlighted area features several ramps of approximately 50-foot width that could likely be used by hovercraft, with minimal modifications. This area can be used as both a passenger terminal and a maintenance area for hovercraft. There is no immediately adjacent parking at the site at present, but there is a great deal of paved area that can potentially be repurposed into at-grade parking for a future hovercraft terminal.

Figure 13. Seaplane Lagoon Area with Potential Hovercraft Terminal Sites Highlighted

6.1.7 San Leandro Marina

Figure 14 shows an aerial photograph of the San Leandro Marina, with potential hovercraft terminal sites highlighted.

Figure 14. San Leandro Area with Potential Hovercraft Terminal Sites Highlighted

The most likely sites would be either just to the north or south of the existing small boat marina. City officials in San Leandro indicated that very little existing parking could be repurposed for hovercraft use, and furthermore that there are no nearby areas that can be developed into additional parking. Due to these restrictions, a parking structure may need to be constructed to support a future hovercraft terminal. This increases the capital cost of this particular terminal option considerably compared to other sites.

6.1.8 Downtown San Francisco

Figure 15 shows an artist's rendering of WETA's existing ferry terminal in Downtown San Francisco. There are multiple piers that can accommodate a conventional ferry on each side. If hovercraft are introduced to this terminal, they would likely need a new ramp structure to be built off of the end of the existing docks.

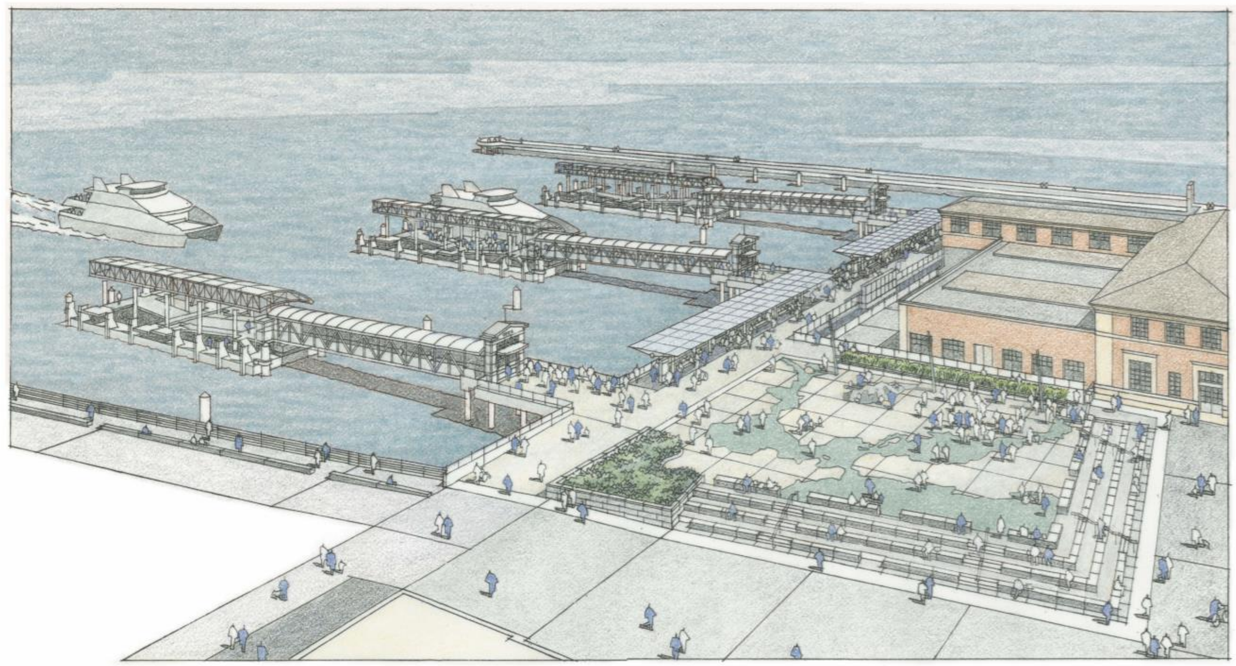

Figure 15. Rendering of WETA's Existing Ferry Operation in Downtown San Francisco

Figure 16 shows examples of floating hovercraft docking ramps from a past service in Sweden.

Figure 16. Examples of Floating Hovercraft Docks in Sweden

6.1.9 South San Francisco Area

Figure 17 shows an aerial photograph of South San Francisco, with likely hovercraft terminal sites highlighted.

Figure 17. South San Francisco with Potential Hovercraft Sites Highlighted in Yellow and Existing Marina in Red

Although WETA operates a conventional ferry service into the marina at the top of the photograph, a hovercraft terminal would likely take advantage of the ability to maneuver over shallow water to get physically closer to major employers in the South San Francisco area. No parking is expected to be needed in this area, due to the dominant inbound passenger flow in the AM commute direction. There may be a need for new shuttle stops near the hovercraft terminal, depending on the exact final location chosen.

6.1.10 Foster City Locations

Figure 18 shows an aerial photograph of Foster City, with two potential hovercraft terminal sites highlighted.

As with South San Francisco, neither of these sites would need significant vehicle parking, but would need to be integrated into the local public transit system to provide effective routes for passengers to reach their destinations after they disembark from a hovercraft.

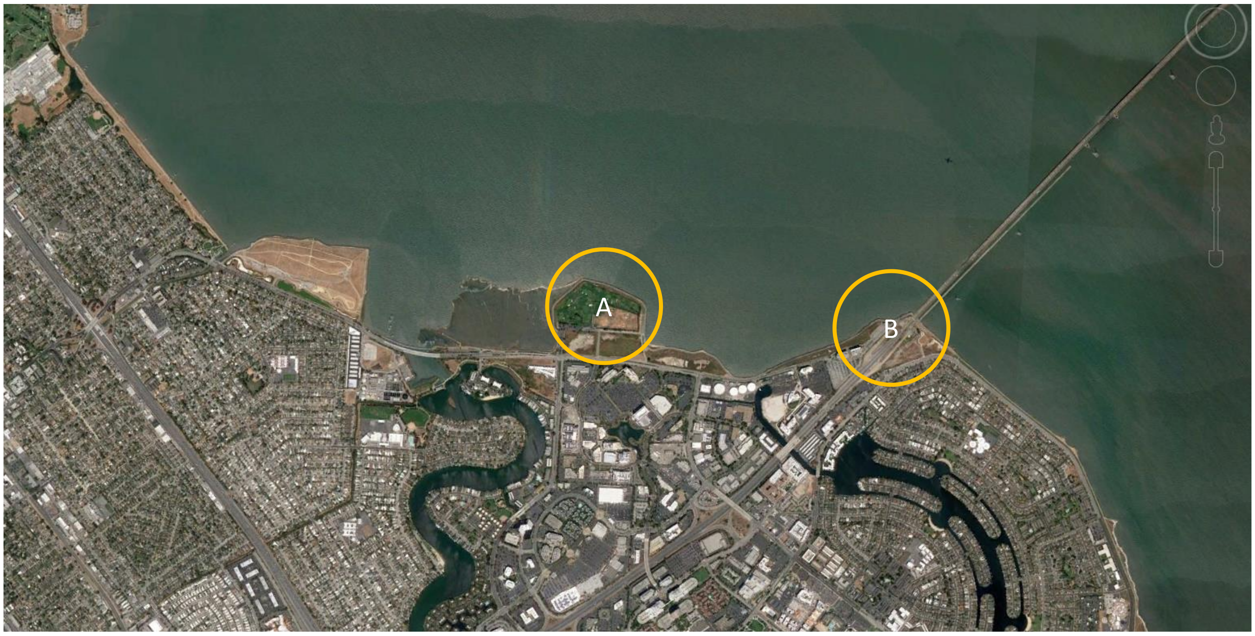

Figure 18. Foster City with Potential Hovercraft Sites Highlighted

6.1.11 West Dumbarton Bridge

Figure 19 shows an aerial photograph of the western terminus of the Dumbarton Bridge. There is a roadway that makes a U-turn underneath the bridge in this location that does have some limited vehicle parking. This area is not currently served by transit, so if a hovercraft terminal is to be developed here, some new infrastructure for bus or shuttle stops would also need to be developed.

Figure 19. West Terminus of the Dumbarton Bridge

Table 4 summarizes the expected capital cost of each terminal. These are preliminary cost figures and are not based on any specific design. They do serve to illustrate that the costs of a hovercraft terminal in most cases are fairly modest when compared to the cost of the hovercraft themselves, or the considerable cost of operations. Costs were sourced from a combination of AECOM construction project experience and recent construction costs from WETA's Richmond Terminal development.

Table 4. Terminal Capital Cost Summary

Unit Cost	$1,500,000	$1,000,000	$2,000,000	$500,000	$7,500,000	$5,000,000	
Terminal	Demolition of Shore Protection and Concrete Ramp	One Acre of New Parking (Some Reuse of Existing)	Two Acres of New Parking (All New)	New Transit Stop	Parking Garage (250-Stall Capacity)	Deep-Water Mooring Dock	Total Capital Cost
Martinez	X	X					$2,500,000
Antioch	X	X					$2,500,000
Hercules	X		X				$3,500,000
Richmond	X	X					$2,500,000
Berkeley	X		X				$3,500,000
West Alameda			X				$2,000,000
San Leandro	X				X		$9,000,000
San Francisco Downtown						X	$5,000,000
South San Francisco	X			X			$2,000,000
Foster City	X			X			$2,000,000
West Dumbarton	X			X			$2,000,000

Note that it is assumed here that the existing ramp in Richmond can be used, avoiding the need to construct a deep-water dock.

6.2 Maintenance and Overnight Storage Facility Needs and Capital Costs

In addition to day-to-day operations, a new hovercraft service would require a maintenance facility and overnight storage facility. Hovercraft are typically taken out of the water and parked on land when not in use. AECOM expects that this would take place near WETA's conventional ferry base on Alameda Island, near Seaplane Lagoon. WETA currently has a large maintenance facility in this area to support conventional ferry operations.

Based on a cursory analysis of maintenance needs, it would be necessary to secure a site with an area between 2 and 4 acres, depending on the level of service assumed. Bay Area waterfront property in a location such as Alameda is currently leasing for $1.7 million per acre, according to the City of Alameda. In addition to right-of-way acquisition expenses, the cost of equipment and other supportive structures could be as much as $8 million for a fully outfitted facility.

Some significant assumptions regarding hovercraft maintenance and storage needs include the following:

- Hovercraft must be taken out of the water every night, requiring a level paved concrete pad for each craft.
- Land is needed to accommodate overnight storage out of the water.
- Shore power, maintenance facilities, and spare part storage are necessities.
- Fueling can be done initially using delivery from fuel trucks, as is the case for the Isle of Wight service.
- A portable shelter could be used occasionally for heavy maintenance at the hovercraft facility.

- Heavy maintenance can be performed at one of WETA's existing facilities. The North Bay Facility on Mare Island is probably best equipped for this because there is room to add required infrastructure for hovercraft maintenance.
- Plinths are used for dry dock maintenance on the hovercraft skirts.
- A telehandler would be needed to lift the engines for maintenance and replacement.
- On-site storage is needed for spare propellers and skirts.
- Basic portable stairway/scaffolding is needed for on-site repairs of the hovercraft exterior.

A final large capital cost item for a hovercraft service is the need to purchase land for secure overnight storage out of the water for each hovercraft, ideally in Alameda near the maintenance facility. Each hovercraft owned by WETA would need about a half-acre of land for overnight storage. According to the City of Alameda, $1.7 million is a good order-of-magnitude estimate for an acre of land in Alameda, so each hovercraft purchased would require effectively $850,000 of capital cost for the land to store it overnight. This is further reflected in Section 6.3 below.

6.3 Hovercraft Purchase Capital Costs

Table 5 summarizes hovercraft purchase costs per route, assuming $10 million per craft, as well as $850,000 in land cost for overnight storage based on total purchase requirements, as explained above.

Table 5. Hovercraft Purchase Costs

Route	Craft Required for Peak Demand	Spares Required	Total Hovercraft Capital Cost ($ Millions)	Total Land Capital Cost ($ Millions)
Richmond-South San Francisco	4	1	$50	$4.25
Richmond-Foster City	4	1	$50	$4.25
Berkeley-Downtown San Francisco	4	1	$50	$4.25
Berkeley-South San Francisco	3	1	$40	$3.40
Berkeley-Foster City	4	1	$50	$4.25
Berkeley-West Dumbarton	2	1	$30	$2.55
Alameda-Foster City	2	1	$30	$2.55
Alameda-West Dumbarton	4	1	$50	$4.25
San Leandro-South San Francisco	4	1	$50	$4.25
Downtown San Francisco-West Dumbarton	3	1	$40	$3.40
Hercules-Downtown San Francisco	4	1	$50	$4.25
Martinez or Antioch-Downtown San Francisco	4	1	$50	$4.25

7. Certification Processes and Project Timelines

7.1 Staff Training and Certification

Information regarding crew training and certification requirements was obtained through interviews with US Coast Guard personnel. Both the crew physically on the hovercraft and the maintenance staff would have to be trained to operate and work on hovercraft, which would have a significant impact on overall costs and time frame before hovercraft ferry operations could commence.

Crew training, especially training for captains, would present a barrier to starting hovercraft ferry operations. The Coast Guard is responsible for certification of hovercraft captains, with the Regional Exam Center specifically handling all new licensing. The least time-consuming captain training option would involve hiring Navy veterans with Landing Craft Air Cushion (the military term for hovercraft) experience. These captains could then be certified to operate craft selected by WETA for operations, and in turn train new pilots on these crafts once they are certified themselves. Captains are typically trained for about 100 hours on each craft. The Akutan, Alaska hovercraft service hired Canadian veterans as instructors for their training program.

Some maintenance elements of hovercraft, particularly propellers, have more in common with aircraft than traditional catamarans. This means that either existing staff would have to be trained or new staff would have to be hired, both of which have maintenance cost impacts. The talent pool of aviation maintenance technicians would cost more than current WETA staff.

7.2 Craft Certification Process

The Coast Guard's process to certify a hovercraft would be the same as for any new craft construction. The first step of the process is to identify the construction company and have them send an application for inspection. The Coast Guard would begin its review during the construction process. Any novel construction issues that may not be covered by existing Coast Guard regulations are to be identified. This likely requires coordination with Coast Guard headquarters.

Once the craft is constructed, a physical inspection by the Coast Guard is required. This requires a short time frame, approximately a week, to complete.

Coast Guard certification would also be needed for terminals where any in-water landing pads would be needed (e.g., Downtown San Francisco).

7.3 Hovercraft Project Timeline

Many elements of developing a new hovercraft ferry service in the Bay Area would necessitate long lead times. This process would be like WETA's traditional projects. These include:

- Prior to commencement of the environmental review phase, WETA would coordinate with local jurisdictions to develop Memoranda of Understanding (MOUs) that outline the roles and responsibilities for respective agencies during the development process. The MOUs can be amended or updated during the process to further clarify roles and responsibilities during the development and operational phases of the project.
- WETA would need to begin working with regulators early in the process to ensure that both crafts and terminal locations would meet all regulatory requirements, particularly the Bay Conservation and Development Commission (BCDC) and CARB. WETA would initiate the environmental review phase. At least 2 years are required for the environmental review process. Preliminary concept designs would be developed during the environmental review phase.
- After the environmental review phase is completed, WETA would initiate the permitting processes with federal, state, and local environmental resource agencies. The permitting process takes at least 1 year to complete.

- WETA would coordinate with the local jurisdictions where hovercraft facilities would be located to address local permitting requirements and negotiation of property agreements with landowners.
- The hovercraft design process would likely require 6 months at minimum. Construction would take approximately a year. Therefore, the complete design and construction process would likely be at least 2 years overall, factoring in the need to interface with the Coast Guard to ensure their certification of any changes to designs.
- Once hovercraft are constructed and delivered, they have to be physically inspected by the Coast Guard. This may be a short process requiring about a week but can be substantially longer if issues are identified.
- Once a craft is certified for operation, crew training can begin. This would likely take several months to a year, to allow captains to gain at least 100 hours of experience in operating the hovercraft, in addition to classroom instruction.
- In parallel with the above-listed steps, WETA would need to begin design of a suitable floating landing pad for deep-water terminals, if needed—particularly for Downtown San Francisco—which would involve interfacing with the United States Army Corps of Engineers, which would be responsible for approving the design and determining whether navigational impacts are feasible.

Given the above-listed steps, AECOM estimates the minimum time frame between WETA's decision to go ahead with a hovercraft ferry service and the beginning of actual operations to be between 5 and 7 years, and likely longer. Although the best-case combination of the timeframes above could technically lead to a minimum project startup timeframe of 4 to 5 years, the unique nature of hovercraft and lack of local stakeholder and regulator experience with hovercraft makes this unlikely.

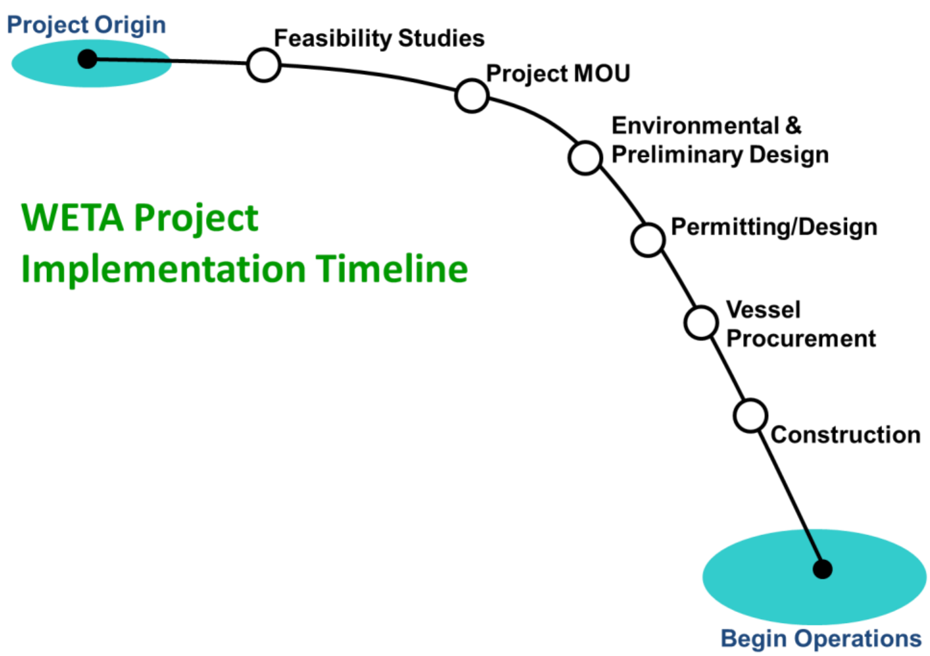

Figure 20. WETA Project Implementation Process

8. Funding and Financing Analysis

AECOM conducted research, stakeholder interviews, and financial modeling to determine how hovercraft services in the Bay Area could be paid for in the short and long term by a combination of public and private support. A range of public funding and financing sources was evaluated, including but not limited to federal discretionary grants; state bond revenues, transit assistance funds, and grant programs; and regional and local fees, assessments, and special districts. When evaluating these sources, AECOM considered their applicability to water transit, hovercraft routes under consideration, amount of potential funding, flexibility of the use of funds, equity implications, existing financial commitments, and competitiveness, among other considerations. The public and private sectors have a shared interest in partnering to develop a sustainable funding and financing roadmap in support of WETA service expansion. The high capital cost and low operating cost efficiency when compared to other transit modes may present challenges for securing conventional public transit funding. As a result, AECOM conducted further engagement focusing on how the private sector could play a role in initiating the hovercraft service.

The following findings apply the information and assumptions presented in this report related to capital and operating expenses, ridership, and environmental performance. It was beyond the scope of this funding and financing analysis to conduct a full benefit-cost analysis, comparing the performance of a hovercraft service relative to other potential investments, or to project any technological advancements of hovercraft services and resulting changes in financial feasibility.

8.1 Funding and Financing a Hovercraft Service

Public support for ferry service and emergency evacuation response has allowed WETA to secure funding to launch, operate, and expand ferry service in the San Francisco Bay Area. Current operations and projected capital needs are paid for by a variety of local, regional, state, and federal sources. These funding sources are already fully programmed for the next 10 years, as outlined in WETA's Short Range Transit Plan (2020), leaving no surplus funding to support a new hovercraft service without a shift in the agency's priorities.

To support a new hovercraft service, WETA would need to secure entirely new funding for both capital costs and ongoing operations and maintenance. Startup capital costs, driven by terminal construction and vessel procurement, are estimated to be approximately $62 million for one route. Meanwhile, annual operations and maintenance is estimated to be approximately $11 million per route. These costs are discussed in detail in Chapters 3 and 6. Assuming a 50 percent farebox recovery ratio, WETA would need to secure $5.5 million in additional revenue per route per year.

There are three core public funding buckets that traditionally fund transportation projects: federal and state grants, regional revenue sources, and local revenue sources. In each of these buckets, there are a variety of sources that WETA could pursue for a hovercraft service. Outside of public funding, private funding can play a role when traditional funding sources are not available or when there is incentive for private involvement. Although the public sector has access to a number of low-cost financing opportunities (e.g., the Transportation Infrastructure Finance and Innovation Act), guaranteed revenues are required to secure them; primary attention was therefore given to evaluating existing and new revenue generation tools.

When prioritizing which sources should be pursued for hovercraft, there are numerous criteria to consider, including but not limited to compatibility between the source and transportation service, WETA's existing funding needs and sources, ease of securing, revenue-generating potential, flexibility of the funds, administrative complexity, and equity implications. Table 6 summarizes the potential sources that were analyzed, their funding potential, and an overall assessment of applicability. A more detailed matrix is available in Appendix G, with more information supporting prioritization ranking, including key challenges, benefits, and considerations. This section discusses the most relevant public funding and financing sources for a hovercraft service, potential barriers to accessing those sources, and opportunities for private involvement. This section is followed by a review of relevant case studies that illustrate how private involvement has worked elsewhere.

Table 6. Funding and Financing Sources Evaluated

Funding Source	Funding Potential	Prioritization
Federal and State Grants		
Federal Transit Administration's (FTA's) Passenger Ferry Grant Program	**$$**	High priority
Private Sector Contributions	**$$-$$$**	High priority
California's Low Carbon Transit Operations Program (Discretionary Grant)	**$-$$**	Medium priority
California's Transit and Intercity Rail Capital Program	**$$-$$$**	Medium priority
Federal Emergency Management Agency's (FEMA) Transit Security Grant Program (TSGP)	**$$-$$$**	Medium priority
FTA's Capital Investment Grants - 5309; New Starts and Small Starts	**$$$**	Low Priority
Federal Highway Administration's (FHWA's) National Highway Performance Program (NHPP)	**$$$**	Low Priority
Local and Regional Revenue-Generating Mechanisms		
Farebox revenue	**$$**	High priority
New Sales Taxes (e.g., Faster Bay Area, Measure J in Contra Costa County, Measure A in San Mateo County)	**$$$**	High priority
Regional Measure 4	**$$-$$$**	Medium priority
Tax increment financing (Enhanced Infrastructure Finance District [EIFD])	**$-$$**	Medium priority
Mello-Roos Community Facility District	**$-$$**	Medium priority
Assessment District	**$-$$**	Low Priority
Development Impact Fees	**$-$$**	Low Priority
Ad Valorem Property and Parcel Taxes	**$$-$$$**	Low Priority
Other taxes: Business license tax, gross receipts tax/per employee tax, real estate transfer tax	**$-$$**	Low Priority

Note: Funding Potential correlates to the following: $= $1M or less, $$= $1M-$10M, $$$=Above $10M

8.2 Public Funding and Financing Opportunities

8.2.1 Federal and State Grants

Although federal and state grants can cover a significant portion (often up to 80 percent) of capital costs for transit projects, they are also highly competitive. For example, the Metropolitan Transportation Commission's "Plan Bay Area 2040" notes that there are 20 transit agencies in the Bay Area alone with more than $200 billion in future transit projects competing for the same federal and state grants. WETA would also have to consider the implications of pursuing grant funding for both its ferry service and a new hovercraft service, because the two services would likely be in direct competition for the same grant funding. Furthermore, although the long-term economic impacts of the COVID-19 pandemic on both mass transit and public revenues are still unknown, it is widely accepted that public budgets would be impacted in the coming years, which would likely increase competition for grants and may also reduce the amount of funding available.

Based on the findings of this analysis, the hovercraft service would face several challenges in securing public grant funding. The hovercraft vessels considered in this study are expected to host 75 passengers per trip and each vessel is expected to cost $10 million. Meanwhile, WETA's larger ferries can fit up to 450 passengers and costs around $23 million. Competitive federal and state grant applications often require a benefit-cost analysis, which quantifies benefits, such as travel time savings, operating cost savings, safety benefits, and emissions reduction benefits; and costs, such as capital expenditures and operational expenditures.[12] Although certain routes may provide between 30 percent and 70 percent travel time savings relative to driving in normal conditions during commute hours,[13] the hovercraft's cost, anticipated ridership, and expected environmental performance indicate that hovercraft service would not perform well in a benefit-cost analysis, especially when compared to other mass transit options.

The most applicable grants for the hovercraft service would be the Federal Transit Administration's Passenger Ferry Grant Program and California Department of Transportation's Transit and Intercity Rail Capital Program. These grants are specifically designed to modernize and expand urban mass transit projects, including water services. The Passenger Ferry Grant could provide enough capital to help build a terminal or vessel but is unlikely to provide a significant amount of funds as there is only $30 million available annually nationwide from this program. For both programs, the criteria indicate that projects with a positive cost-benefit ratio in the form of higher utility and mode shift, lower impacts to the environment, and more accessible fares, as mentioned above, are more competitive. WETA and its partners will need to consider how a hovercraft service would compete against high-capacity ferry services such as Seattle's, New York's, or the Bay Area's (including WETA's) existing ferry service. The Transit and Intercity Rail Capital Program is especially focused on projects that would lead to GHG emission reductions and that have significant ridership impacts compared to costs.

8.2.2 Regional Revenue Sources

WETA has had success in receiving political support at the state, regional, and local level for the inclusion of ferry projects in the Bay Area's regional bridge toll measure programs, which began in the late 1980s. The Regional Measure (RM) programs are designed to fund transportation improvements that relieve congestion on Bay Area bridge corridors, making WETA's regional trans-bay water transit services, including a new hovercraft service, a strong fit for the program. WETA, however, has already fully programmed its expected annual revenue from all three RM programs to support its existing services and planned expansion. Although RM 3 recently went into effect in 2019, it is possible that there would be an RM 4 in the future. There is therefore potential to lobby to receive a portion of that future revenue to support hovercraft service.

[12] United States Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, 2020.

[13] Peak hour commute times were averaged between the morning peak and evening peak, using estimated travel time from Google Maps. Estimates may be conservative because they were estimated after the start of COVID-19, though after traffic was reportedly back to three-quarters of it pre-COVID-19 levels. The time savings during commute hours, by percentage, are as follows: Richmond-South San Francisco: 57 percent, Richmond-Foster City: 51 percent, Berkeley-Downtown San Francisco: 34 percent, Berkeley-South San Francisco: 52 percent, Berkeley-Foster City: 47 percent, Berkeley-West Dumbarton: 61 percent, Alameda-Foster City: 36 percent, Alameda-West Dumbarton: 56 percent, San Leandro-South San Francisco: 31 percent, Hercules-Downtown San Francisco: 55 percent, Martinez-Downtown San Francisco: 70 percent, Downtown San Francisco-West Dumbarton: 57 percent. During nonpeak hours, driving is generally faster than the hovercraft routes.

Sales taxes have played an important role in supporting WETA's service expansion to date. A recent proposal to raise $100 billion from a nine-county, 40-year regional sales tax was planned to go to voters in 2020 under the FASTER Bay Area ballot measure proposal. This ballot measure was recently tabled due to the COVID-19 pandemic, but it is possible it would return to the ballot once the pandemic and its economic impacts have subsided. Marketing and planning documents for FASTER Bay Area indicate that WETA is slated to receive a portion of this revenue, making it a possible future source for hovercraft service. However, it is important to note that sales taxes are regressive, disproportionately impacting people with lower incomes. A regressive tax coupled with higher fares may pose political challenges.

8.2.3 Local Revenue Sources

To date, local funding has been leveraged to bring new ferry service to the funding jurisdiction's area, as is the case with Contra Costa County's Measure J and San Mateo County's Measure A, which are both local sales tax measures to support transportation expansion and improvements. In both instances, WETA is receiving a small portion of the overall revenue, and the funding is already fully programmed. WETA could collaborate with specific jurisdictions to receive revenue from future local sales tax measures, though timing would need to be considered because Alameda, Contra Costa, and San Mateo Counties all recently had transportation tax measures on their ballots. Considerations regarding regressive taxes would apply to local sales taxes, too.

At a more local level, there are a few financing district opportunities that could be explored near proposed hovercraft terminal sites. Many of these rely on the potential to capture the property value increase induced by the introduction of hovercraft service to the area and depend on local voter approval. Examples include special assessments, Mello-Roos Community Facility Districts (CFDs), and Enhanced Infrastructure Financing Districts (EIFDs). Ferry services have been found to increase property value within a 1-mile radius, with more notable increases occurring closer to the terminal, making value capture a relevant source of financing.[14] However, given the hovercraft's low ridership utility and higher fare prices, property owners may not agree that hovercraft terminal would be worth the extra tax or fee. Additionally, value capture mechanisms take time to accumulate usable funds and are heavily dependent on the land-use policies and market conditions around the terminal areas. More information on the potential terminal areas can be found in Appendix I.

8.2.4 Opportunities for Private Sector Participation

In the absence of sufficient grant funding and accessible revenue sources, nontraditional financial partnerships would be critical to launching a hovercraft service. WETA has focused on the importance of partnerships and the emergence of new private transportation options in its Strategic Plan (2016), and the hovercraft service is a key opportunity to do so. Analysis indicates that the hovercraft service would likely need private sector commitments to fund both capital start-up costs and ongoing operations. This section explores various forms that private participation could take, including annual financial contributions and private equity investment. Private sector participation in the overall service can range from limited involvement to directly hiring a private owner and operator. WETA and the private sector may find both ends of the range attractive for different reasons.

First, private equity could be used to directly finance a portion of design and construction, operation and maintenance, or both in the form of a public-private partnership (P3). This is both a financing strategy and a delivery model. This delivery model and others are discussed in more detail in Appendix H. The P3 model allows public agencies to use private money to fund large capital projects and transfers some of the risk of launching a new transit service, such as schedule delay or unmet ridership projections, to the private sector, thus shielding a cash-strapped public agency from financial impacts. For WETA, a benefit of the P3 model is that it would allow WETA to focus funding and/or operational resources to its existing ferry services, while allowing a private entity to take on the hovercraft service effort and its associated short- and long-term risks.

The P3 model can take several forms. In a more traditional P3 arrangement, a private entity would use private equity to finance the design and build-out of the hovercraft service, including constructing

[14] New York City Economic Development Corporation's Feasibility Study, 2013.

terminals and purchasing vessels. Another form would be to have the private entity also operate and maintain the hovercraft service for a set period before handing operations to WETA. During this period, WETA would pay back the private entity, plus their agreed-upon return on investment, using one of its revenue-generating funding sources. The Denver Eagle P3 project, which is discussed Appendix J, used this model. Although private equity can provide up-front financing, it does not generally provide the entirety of the up-front costs and thus cannot ensure that a project would happen sooner. Private equity would be just one, albeit important, funding source.

Private sector companies that would benefit from the hovercraft service are prime for partnerships with WETA. In the absence of a single, efficient regional transportation network that connects East Bay communities with the Peninsula, many large companies on the Peninsula offer private commuter services to their thousands of employees, primarily in the form of shuttles for longer commutes and last-mile connections. Many of these companies, including Facebook, Oracle, Sony, Electronic Arts, and Genentech, are indicated in Figure 21. A hovercraft service offers the potential for these private companies to reduce their service to East Bay communities and realize cost savings. These cost savings could then be reallocated to support a hovercraft service operated by WETA.

One caveat, however, is that private companies' contributions would need to cover more than their employees' fares to have an impact on reducing the service's funding gap. Contributions from several large companies may be required to close the funding gap and provide opportunity to subsidize user fares. Private sector contributions may include service provision requirements, such as specific terminal locations to minimize last-mile barriers, frequency of service to a particular terminal, or lower fares for their employees, that may change how WETA would otherwise run a public transit service. If this is the case, private-sector companies might consider launching and operating a hovercraft service on their own, most likely through a separate private entity.

Figure 21. Example Large Employers in Hovercraft Terminal Areas

Another form of private contributions to a hovercraft service could occur via a Transportation Management Agreement (TMA), a contract between a private company and transportation service provider to provide transportation for the company's employees. Such agreements are becoming increasingly prevalent in the Bay Area. A TMA could be formed between a group of co-located private companies and a hovercraft service provider to provide a hovercraft service that is entirely operated by the TMA and designed to service the companies' area. The TMA would be designed to account for partner companies' preferences (e.g., their interest in directly owning vessels versus hiring a third party to own and operate the service on their behalf). In this instance, roles would be reversed, with the private companies being the primary funder and sole operator and WETA or its partner agencies providing a subsidy to ensure that the broader public can access the service. This type of implementation model is an example of private transportation innovation that has the potential to expand water transit service in the region. If private companies prioritize this initiative, a delivery model where the private sector takes the lead could expedite the implementation of hovercraft services in the region, given the public sector's existing commitments and obligations.

Private companies in South San Francisco's Oyster Point already share private transit services (currently led by Genentech), so a TMA could be forthcoming. Given its location on the water and limited accessibility to mass transit, Oyster Point and its businesses are prime targets for partnership discussions. The forthcoming development near the West Dumbarton terminal location, which is adjacent to the Facebook headquarters, could create similar partnership opportunities. Of course, companies' level of interest would be determined by their return-to-work policies once the COVID-19 pandemic has subsided. A case study in the following section illustrates how this would work, wherein private companies are the primary funders of a service, with public agencies providing some subsidies.

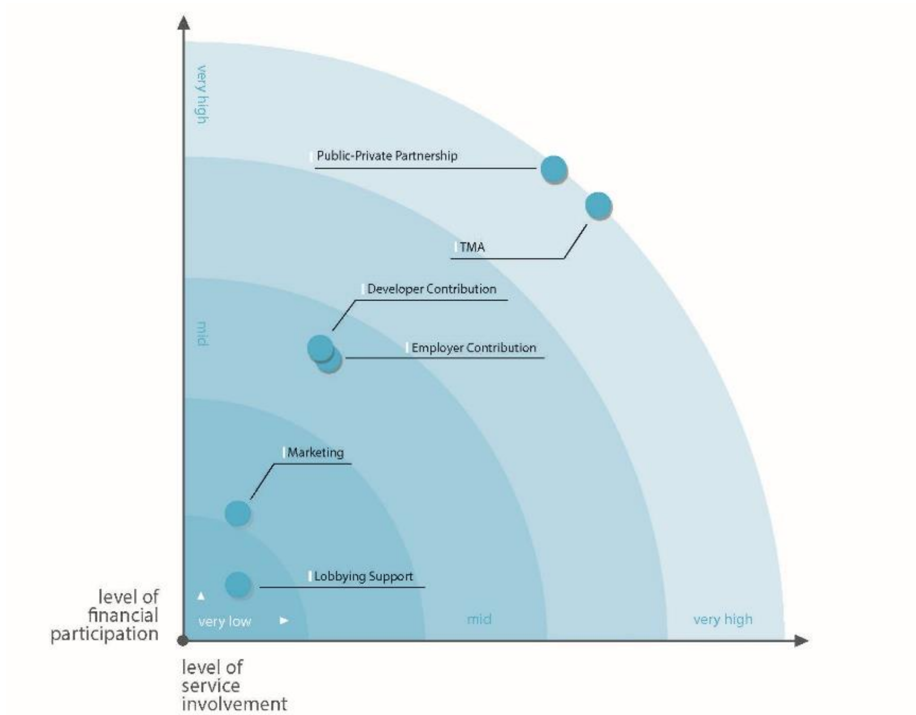

Figure 22. Level of Service Involvement versus Level of Financial Participation

Developer contributions are a common funding source for transit infrastructure projects. In potential hovercraft terminal locations where there is planned development, including Menlo Park, Alameda, and San Leandro, the developers could finance a hovercraft terminal and potentially construct the terminal if it coincides with the developer's project. This type of contribution was recently deployed with the development of the Treasure Island ferry terminal, which was both funded and constructed by private developers. This involvement would be offered to ensure that the service connects to their location and would reduce WETA's startup capital expenditure cost burden. Transit access increases the attractiveness of areas around stations/terminals, leading to increased property values and higher rents. Ferry terminals have proven to be a catalyst for new development, helping to bring transit to underserved or isolated waterfront communities, as was the case in New York City and South San Francisco. For these reasons, a developer may determine that a financial contribution to the hovercraft service would be a worthwhile investment. These same developers may also consider making direct annual contributions to the service, which would then be passed down to tenants, to ensure that hovercraft service connects to their development. AECOM, however, has not spoken with developers to confirm potential interest. Further discussion on terminal area development is provided in Appendix I.

Hovercraft could also receive some, albeit limited, revenue from marketing. Depending on WETA's policies, both the exterior and interior of the vessels could be branded. Likewise, on-board services, like WIFI and food services, offer opportunities for sponsorship. Again, private companies adjacent to terminal locations are prime candidates for these partnerships because the hovercraft service would benefit their employees and hypothetically reduce their transit expenditures.

Conversations with local stakeholders indicate that there may be widespread support for a hovercraft service from local coalitions and membership organizations that represent both private and public entities. The Bay Area is a world-class location and attractive business location, but it must still strive to improve the extent and quality of its public services to maintain its competitive edge. A hovercraft service has the potential to help close the Bay Area's transit gaps, making it easier for employers and their employees to do business. Support from local organizations and jurisdictions could take the form of lobbying, coalition building, and fundraising, all of which have the potential to bolster broader funding efforts.

8.3 Case Studies of Public-Private Partnerships in Public Transit Delivery

Partnerships with the private sector are increasingly prevalent in public infrastructure projects across the United States. The growing demand and competition for public funding—coupled with, in some cases, limited tax revenue—forces public agencies to identify alternative funding sources, which the private sector may provide to varying degrees. P3 agreements are especially effective tools in metropolitan areas with robust private sector economies, which is the case in the Bay Area.

The following case studies depict P3 agreements that are relevant to WETA's evaluation of the feasibility of leveraging private participation to develop a hovercraft service. In these cases, private sector stakeholders include joint ventures and private companies. Additional case studies with other private sector stakeholders, such as economic development corporations, are provided in Appendix J. These case studies also depict varying levels of public versus private participation in the provision of services. In some cases, the service is funded by the private sector and run by the public sector; in other cases, the services is financed and operated by the private sector, with minimal contributions from the public sector. The following details, where publicly available, shall be discussed with regard to each case study: financial and capital expenses incurred by each stakeholder, private funding sources as a proportion of total project expenses, and contract design.

8.3.1 Cross-Bay Ferry, Tampa

In November 2017, the Cross-Bay Ferry commenced seasonal ferry service between the Tampa Convention Center in Tampa, Florida, and the Vinoy Yacht Basin in St. Petersburg, Florida. The cities of St. Petersburg and Tampa, Pinellas County, and Hillsborough County entered a P3 agreement through a joint venture consisting of HMS Ferries, Schifino Lee, and Akerman LLP, to operate, manage, and finance the trial run of the service from November 2016 through April 2017.[15] The 6-month pilot project carried more than 39,000 passengers, and the 2017-2018, 2018-2019, and 2019-2020 seasons recorded steady ridership increases.[16] Each 6-month season has required government subsidies of $600,000, which are split evenly between the four local governments. Other funding and financing sources for the trial service are pooled together through the joint venture and are not publicly available.[17]

With ridership exceeding projections, a renewed joint venture between HMS Ferries and Akerman LLC is working alongside the Hillsborough Area Regional Transit Authority (HART) to establish year-round ferry service, with Akerman LLC covering capital costs and HMS Ferries covering subsequent operating costs with no further government subsidy.[18] Under this arrangement, HMS Ferries shall retain all profits once service commences. Project scope consists of the development of several year-long weeknight and weekend routes between Downtown Tampa, St. Petersburg, Williams Park (in Southern Hillsborough County), and MacDill Air Force Base.[19]

HMS Ferries and HART envision commencement of these services by 2022, given a $104 million financial pledge over a 20-year period from HMS Ferries to cover operating, maintenance, and repair costs. In addition, a one-time public investment of $35 million shall finance capital costs for ferry terminals, docks, and vessels; although this source has yet to be secured. The joint venture is currently investigating potential sources to cover capital costs, including BP Oil recovery funds, Hillsborough County transportation charter sales tax revenues, contributions from other local governments, and state matching funds.[20]

8.3.2 Reverse-Commuter Service on Metra, Chicago

In April 2018, Metra, the Chicago metropolitan area's primary commuter rail system, studied ways to improve reverse-commuter service on the Milwaukee District North Line that connects Downtown Chicago with Lake County, Illinois. Metra aimed to improve reverse-commute service between Chicago's central

15 Cross Bay Ferry, Mission and Purpose, 2020.
16 Tampa Bay Times, Cross-Bay Ferry ridership nearly doubles, but leaders disagree on what's next, 2020.
17 Florida Politics, Local governments consider two more seasons of Cross Bay Ferry service, 2019.
18 Plan Hillsborough, High speed ferry on the horizon.
19 Cross Bay Ferry, Permanent Passenger Ferry Service Plan, 2019.
20 Cross Bay Ferry, Permanent Passenger Ferry Service Plan, 2019.

business district and its northern suburbs to more effectively recruit and retain suburban employment among central Chicago residents, reduce pollution and roadway congestion, and improve worker productivity and satisfaction.[21]

In October 2018, given insufficient public funding sources, Metra pursued a P3 agreement with Lake County Partners, an economic development corporation affiliated with local businesses and governments, to evaluate the feasibility of increased reverse-commute service. Lake County Partners consists of several public and private employers that have chosen to participate in the P3 agreement given their proximity to the Milwaukee District North Line. AbbVie, Horizon Pharma, Trustmark Insurance, Tenneco, Northwestern Lake Forest Hospital, Lake County government, the city of Lake Forest, and the village of Deerfield participated in the partnership.

The P3 agreement included the following two phases: Phase 1, which divided the $1.4 million operation and maintenance costs of one new reverse-commuter train during each AM/PM rush period over a 1-year trial period; and Phase 2, which split the $4.75 million installation costs of universal crossover switches near Lake Forest, Lake County, to create additional opportunities for enhanced commuter rail service.[22] For Phase 1, Metra funded $0.7 million of operating costs, more than half of which originated from fare box recovery, and the remainder originated from regional sales taxes and a partial state match.[23] The reverse-commute pilot began service on March 4, 2019, and included two daily services: one Lake Forest Station bound train in the morning and one Chicago Union Station bound train in the evening.

Should Phase 1 of the program meet ridership projections, stakeholders agreed to divide the $4.75 million capital costs for Phase 2 as follows: the economic development corporation will contribute $2.75 million, Metra will contribute $1 million, and local governments will contribute $1 million.[24] Overall, the $2 million government share of capital costs associated with Phase 2 shall be funded through federal, state, and local subsidies, although these sources have not yet been secured.[25]

Phase 1 of the pilot program exceeded its ridership goal, with 550 new daily passenger trips on the Milwaukee District North Line in the fourth quarter of 2019, exceeding the 300 daily passenger goal set for the first year of service.[26] Should new daily passenger trips reach 600 during 2020, the second year of service, Metra and Lake County Partners would resume talks to install universal crossover switches near Lake Forest.[27] Although the project was solely funded by external private sources, Metra served as the single project manager.

8.3.3 Mountain View Community Shuttle, Mountain View

The City of Mountain View and Google partnered in 2014 to provide a community shuttle service to improve mobility for Mountain View's residents and combat traffic. The City of Mountain View identified Google as a singular source of funding for the P3 because it is headquartered in Mountain View and has a significant regional presence. Nonetheless, the shuttle system does not serve Google offices, instead aiming to connect residents with various places of employment and commercial areas.

In developing the shuttle service, the City of Mountain View aimed to create its own local shuttle system to complement Valley Transportation Authority (VTA)'s existing service along major thoroughfares.[28] Google financed the operation and maintenance of the free 2-year community shuttle test-run from 2015 to 2017. Initially set to expire in 2017, Google continued to fund the program from 2017 to 2019, and again from 2019 to 2024. Overall, the community shuttle costs $2 million annually to operate and, with the service's two extensions, Google is projected to have paid a total of $20 million from 2015 to 2024.[29] By

[21] Metra Rail, New reverse-commute service to Lake County begins March 4, 2019.
[22] Chicago Business, Metra to test reverse-commute service in Lake County, 2018.
[23] Metra Rail, The Case for Capital Funding, 2020.
[24] The Chicago Tribune, New reverse-commute Metra trains for Lake County workers to begin next week, 2019.
[25] Metra Rail, Schedule Service Notification, 2019.
[26] Metra Rail, Ridership Trends Annual Report, 2019.
[27] Metro Magazine, Metra's reverse-commute service exceeding first-year goal, 2020.
[28] Silicon Valley Business Journal, Google buses for commoners? Company to fund free public shuttles in Mountain View, 2014.
[29] Patch.com, Google Recommits Funding to Mountain View Shuttle, 2019.

2024, the City of Mountain View aims to take more control over the service and integrate it into the VTA network.[30]

According to the Mountain View Community Shuttle website, the system operates four all-electric, 16-seat shuttle vehicles with a total of 50 stops in a loop network throughout Mountain View.[31] Since 2015, annual ridership totals have increased steadily, which has pushed Google to continue its funding through 2024. Annual ridership increased from 97,079 in 2015 to 223,496 in 2019.[32]

The Mountain View Community Shuttle P3 agreement is unique in its single private funding source and serves as evidence of the potential for the private sector to fund smaller-scale public transportation projects in full.

8.4 Funding and Financing Scenario Modeling

To better understand the financial feasibility of launching and operating a hovercraft service, AECOM conducted high-level financial modeling of three routes. Relevant data developed for this feasibility report, including ridership projections, capital cost estimates, operations and maintenance cost estimates, and potential dollar amounts for each of the potential sources, were incorporated into a financial sketch planning tool developed by AECOM. The tool accounts for expected funding sources, such as grants and local revenue sources, and then illustrates the remaining financial support needed from new dedicated sources, such as a new tax mechanisms or private equity. For these new potential sources, the tool provides details on required taxation rates, service debt on bonds, provides sufficient internal rate of return on private equity, and examines the impact of uncertainty in factors beyond the immediate control of the transit agency.

The financial analysis is relatively high-level, incorporating math for a representative single year rather than a year-by-year cash flow and addressing 1) typical annual operations and maintenance costs and revenues; and b) annualized capital costs and funding. This sketch planning approach was considered appropriate, given that the actual entity for issuing debt is not identified, the implementation years are not established, and progress has not been made toward securing most of the revenue streams addressed.

For this analysis, the sketch planning tool was used to illustrate the role that public grant and tax dollars play in financing the hovercraft service, how the sources interact with one another, and how the service might be financed in the absence of public funding. Although financial modeling describes the financial feasibility of a project, it is agnostic as to utility, political feasibility, and societal and environmental impacts, so the findings presented here should not be considered out of context. The scenarios presented in the following sections indicate that a hovercraft service in the Bay Area is financially feasible, but they do not illustrate the complications of securing these sources, as discussed in depth in prior sections.

8.4.1 Scenarios

All the scenarios that were modeled assumed that only the three routes with the highest predicted ridership would be included in the first phase of network build out; scenario modeling to include all the proposed routes was not part of the analysis, given that routes have not yet been selected. These routes are Richmond to South San Francisco, Alameda to West Dumbarton, and San Leandro to South San Francisco. Combined, these routes have a total capital cost of $176 million and combined annual operations and maintenance costs of $33 million (in 2020 dollars). Although the Berkeley to San Francisco route is predicted to have high ridership, this route was not included because of other existing mass transit options that already exist between these two destinations (i.e., Bay Area Rapid Transit [BART] and Transbay bus services).

[30] Mountain View Voice, Google to fund free shuttles through 2024, 2019.
[31] Mountain View Community Shuttle, About.
[32] Mountain View Community Shuttle, Statistics.

Several findings were consistent across all the scenarios.[33] First, the modeling confirmed that the hovercraft service would need entirely new funding streams. FASTER Bay Area has a higher revenue potential than an RM 4; however, a FASTER regional sales tax may mitigate public support for a local sales tax. In many scenarios, both a regional revenue source and a local revenue source are needed. Local assessments, such as CFD or EIFDs, would have a relatively small impact in funding the hovercraft service on their own but have the potential to close a funding gap when other larger sources are employed. Next, private contributions offer the same benefits to the overall financing strategy as grants. If the hovercraft service can cover most of its startup costs through grants or private contributions, then bonds would not have to be issued to fund startup costs. The burden on revenue-generating sources would then be less and they would primarily support operations and maintenance costs rather than servicing the bond debt. Finally, without grant funding, private contributions, or a regional revenue stream, the hovercraft service would need support from multiple local sales taxes.

8.4.2 Scenario 1: Public Grants and Regional Funding Source

This scenario mimics WETA's traditional way of funding its service expansion. It assumes that the hovercraft service would receive some grant funding ($54 million) from various sources discussed earlier and that a regional revenue source, such as FASTER Bay Area or an RM 4, would dedicate funding to it. Findings indicate that, with grant funding, a regional revenue source would be able to provide funding for 50 to 70 percent of the remaining capital costs if a bond were issued. Because of debt service coverage requirements for the bond, the issuing entity would receive additional revenue from the regional revenue source to fully cover the operating shortfall (operations and maintenance costs less fare revenue). The remaining capital costs would need to be covered by local sales taxes or assessment districts. If split evenly between San Mateo and Alameda Counties, this amount would be about $30 million per county, which is similar to the amounts WETA has previously received from these counties.

8.4.3 Scenario 2: Private Equity

This scenario illustrates the role of a P3 in delivering the hovercraft service. It assumes that the hovercraft would receive some grant funding ($32 million), the private equity partner would contribute 15 percent of capital costs and require a 12 percent return on investment, and a regional revenue source would allocate funding to the new service. Findings indicate that a regional revenue source could pay for 35 to 60 percent of the remaining capital costs (by issuing a bond) plus the private equity partner's return; the remaining shortfall would be filled by local sales taxes and/or assessment districts, which, again, would be within range of recent allocations to WETA from local sources. The operating shortfall would also be covered by the additional revenues to support the bond's debt coverage requirement.

8.4.4 Scenario 3: Regional Funding Source and Private Sector Contributions

This scenario assumes that the hovercraft service would receive no grant funding, but a regional revenue source would allocate funding to it. The findings indicate that a single regional revenue source does not have the capacity to finance the service on its own. Combined, however, FASTER Bay Area and RM 4 do have the capacity. If there is only one regional revenue source allocated to the service, then local sales taxes would need to fund 40 to 60 percent of the remaining costs.

Private sector contributions in the form of a direct payment or subsidy would reduce the demand on the local and regional revenue sources. Similar to Scenario 1, a $26 million contribution, for example, would allow a regional revenue source to fund 50 to 70 percent of the remaining capital costs through a bond issuance. The remaining amount would be funded by local taxes or assessments, and this amount would be in line with previous allocations from local sources.

[33] The scenarios included the following assumptions: 1) WETA would receive 1 percent of sales tax revenue generated by FASTER Bay Area, based on review of existing FASTER Bay Area literature; 2) WETA would receive 8 percent of toll revenue from a RM 4, similar to its current allocation from other RMs; 3) FASTER Bay Area and RM 4 would not occur at the same time; and 4) the local sales taxes would be a one-cent increase and WETA would receive 5 percent of the total revenues.

8.4.5 Scenario 4: County Funding Sources and Private Sector Contributions

Finally, this scenario assumes that the hovercraft service would receive no grant funding and no allocations from a regional revenue service. Instead, the hovercraft service would receive $26 million from private entities as a one-time up-front capital contribution. Findings indicate that two county sales tax initiatives, one in Alameda and one in San Mateo, could fully fund the remaining cost of the service; and that the tax rate for both sales taxes would need to be less than one-half cent. The operating shortfall would be fully funded by the additional revenues to support the debt coverage requirement.

8.4.6 Social Equity in Paying for Public Transit Services

WETA receives public dollars in the form of toll and tax revenue and public grants to build and operate a public ferry service. When developing a funding and financing strategy for public transit, the decision-making framework must consider more than just farebox recovery and efficiency and effectiveness of the funding sources; it must also consider equity to ensure that all groups have equal access to the benefits of service. Equity in public transit service is understood in terms of service provision over various geographies, to ensure that the transit service is distributed equally among communities. Equity in terms of funding and financing that service is understood in terms of ensuring that those who are paying for the transit subsidies are also able to access that service, and that spending results in the same accessibility outcomes for all groups.[34] An equitable funding and financing strategy should be structured to account for differences in income and to ensure that everyone has access to service regardless of their income level.

[34] Brian Taylor, Geography of Urban Transportation Finance. In Genevieve Guiliano and Susan Hanson's *The Geography of Urban Transportation,* 2005.

9. Acknowledgements

This study includes feedback from numerous individuals and agencies who provided valuable feedback throughout the study. Participants included:

Frank Strom, United States Coast Guard
Lloyd Diaz, United States Coast Guard
Jennae Cotton, United States Coast Guard
Lucas Mancini, United States Coast Guard
Matt Maloney, Metropolitan Transportation Commission
Raleigh McCoy, Metropolitan Transportation Commission
Ethan Lavine, San Francisco Bay Conservation and Development Commission
Chris Marks, Alameda County Transportation Commission
Rachel Hiatt, San Francisco County Transportation Authority
Scott Haywood, Santa Clara Valley Transportation Authority
Peter Engel, Contra Costa Transportation Authority
Jonathan Spencer, Napa Valley Transportation Authority
Brent Rosenwald, Solano Transportation Authority
Dominic Moreno, Port of San Francisco
Heather Salem, Genentech
Kelly Obranowicz, Bay Area Council
Felix Sargent, HOVR
Simeon Jewell, HOVR
Pam Young, Audubon Society
Whitney Grover, Audubon Society
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Nick MacLeod-Ash, Griffon Hoverwork
Adrian Went, Griffon Hoverwork
Mark Downer, Griffon Hoverwork
Brian Holt, East Bay Parks
Gail Raabe, Citizens Committee to Complete the Refuge
Brian McGuire, City of Alameda
Denee Evans, City of Richmond
Lori Reese-Brown, City of Richmond
Christina Fernandez, City of South San Francisco
Dante Hall, City of Foster City
Nelson Lam, City of Berkeley
Alexandra Endress, City of Berkeley
Roger Miller, City of Berkeley
Dominic Moreno, City of San Francisco
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Nina Rannells, WETA
Taylor Rutsch, WETA
Chad Mason, WETA
Kevin Connolly, WETA
Keith Stahnke, WETA

Appendix A – WETA Recent Operating Costs

As part of our study, AECOM developed a cost model to analyze various hypothetical hovercraft routes. The study included gathering unit costs and inputs for the cost model. For background into this model, AECOM analyzed recent operating costs for WETA's existing ferry operations. WETA provided detailed data on operations from 2019. WETA sorts operating costs into five main categories:

1. Vessel Expenses, which include crew costs, as well as vessel maintenance parts and labor.
2. Non-Vessel Expenses, which include services such as ticketing and customer service.
3. Fixed-Contract Operator Fees, which are fees for third parties used to operate elements of WETA's system.
4. WETA Direct Expenses, which include administration costs, insurance, facility maintenance, and advertising.
5. Fuel.

Figure 23 summarizes the percentage of 2019 operating cost that fell into each major category.

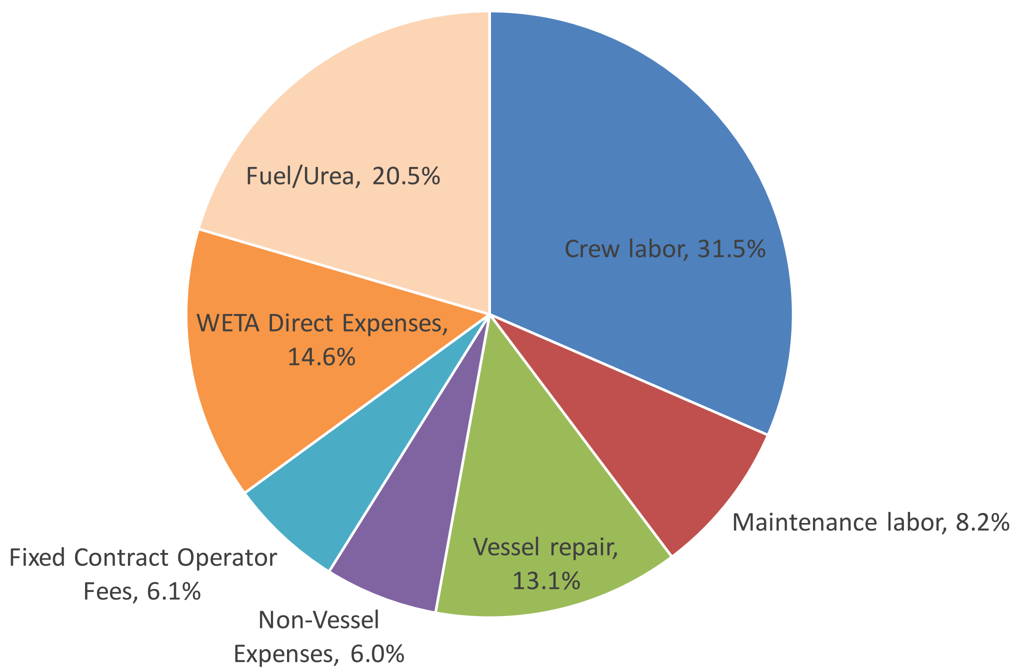

Figure 23. WETA 2019 Operating Cost Summary

As Figure 23 shows, approximately 70 percent of WETA's operating cost is directly tied to the vessels and the remaining 30 percent consists of overhead-type costs that are not directly tied to the operation of a particular vessel.

It is also important to note that the direct costs vary considerably based on the characteristics of the route. Figure 24 shows the ratio of the two largest individual cost categories—fuel and crew labor—for each of the five primary WETA routes. All of these routes are linked with San Francisco, except for South San Francisco, which is linked with Oakland/Alameda.

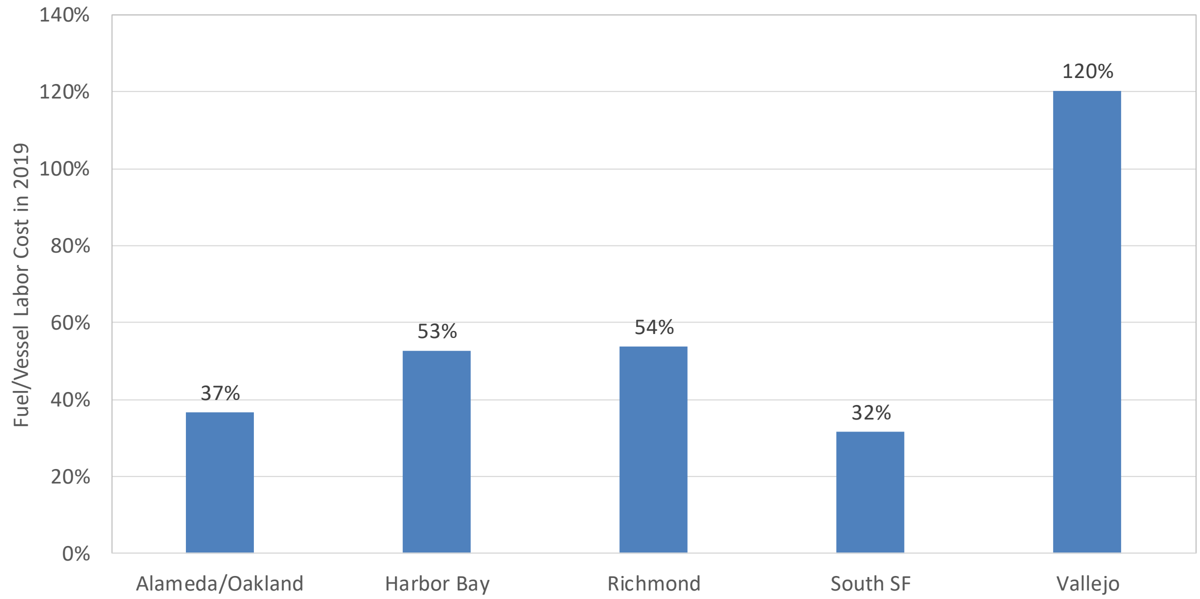

Figure 24. Ratio of Fuel to Vessel Crew Labor Costs in 2019 by Route

Figure 24 shows that in four of five routes, crew labor cost was double to triple the cost of fuel. In the Vallejo route, the cost of fuel was greater than the cost of crew labor. This is because Vallejo to San Francisco is much longer than the other routes, and vessels spend a greater fraction of time operating at high speed as opposed to low-speed travel or being tied up to a dock. The boats used on the Vallejo route are also the fastest, and therefore least fuel-efficient, in the WETA fleet.

AECOM used a combination of top-down or bottom up approaches to develop our hovercraft specific cost model according to the following categories:

- Labor cost was analyzed on a per-route basis, using simulation to project the number of trips that can be made for a given route in a single labor shift. WETA has estimated that a typical labor shift of eight hours will allow for 6.5 hours of vessel operations, with the remaining 1.5 hours of pre-departure inspection, cleaning, and reporting at the vessel home base location (currently at Central Bay Operations and Maintenance at Alameda Point). Crew changes typically take place at the home base location, so vessels must deadhead from and to this location at the start and end of the labor shift, respectively.
- Fuel cost was analyzed on a per-route basis and refined with simulation analysis considering fuel consumption versus speed. Different levels of fuel use were analyzed for mid-speed (35 knots [kn]) and high-speed (38 kn) operations. Engines are expected to be turned off during passenger unloading and loading activity.
- Maintenance costs were based on combination of maintenance data from Griffon and WETA recent operating data, with WETA data being used as a benchmark to ensure that the overall maintenance per operating hour for hovercraft is rational, considering that it is widely acknowledged that hovercraft have higher maintenance costs than catamarans.
- For the costs not directly tied to vessel operation, AECOM used a top-down approach to modeling. In consultation with WETA, we effectively pro-rated overhead type costs on a per-operating-hour basis.

Appendix B – Initial Long List of Routes in Phase 1

AECOM first developed the long list of potential hovercraft terminal locations by considering the following criteria that influence operating feasibility and potential ridership interest:

- Replacement of existing ferry routes was not considered, nor was implementation of any route that can be served by a traditional catamaran without dredging, due to the fact that traditional catamarans are more cost-effective than hovercraft.
- Routes and regions that are not currently served or are underserved by ferries are appealing, especially the South Bay.
- Routes with minimal speed restrictions would be most appealing in terms of both total travel time (and thus rider appeal) and overall economics.
- Routes that result in shorter distances over water than land are appealing from an overall travel time perspective (e.g., Richmond or Berkeley to South San Francisco).
- Proximity to employment centers would be critical to capturing ridership.
- The primary goal of hovercraft services would be to provide San Francisco/North Bay to South Bay linkages that are currently underserved.
- Terminals near transit connections or that can be served by connecting shuttle services would be most appealing.

Using these criteria, AECOM and the Water Emergency Transportation Authority (WETA) developed the long list of potential terminal locations given in the following section, in collaboration with stakeholder input from the first workshops.

The full list of sites considered in the first phase of the hovercraft study are as follows:

North *(Shallow in italics)*:

1. Vallejo
2. *Martinez/Antioch (Carquinez Straight)*
3. *Hercules/Pinole*
4. Richmond
5. *Berkeley*
6. Oakland/Alameda
7. Downtown San Francisco
8. *San Francisco Airport*
9. *Oakland Airport*
10. *San Leandro*

South *(Shallow in italics)*:

11. *South San Francisco*
12. *Foster City*
13. *East side of Dumbarton Bridge*
14. *West side of Dumbarton Bridge*
15. *East Palo Alto (Cooley Landing)*
16. *Mountain View*
17. *Alviso*
18. *Coyote Creek*

The following sections describe some of the pros and cons of each proposed location and whether or not they were considered in the Phase 2 of the study.

B.1 Vallejo

Vallejo is appealing because it has a high ridership demand already, and it a regional attractor for North Bay commuters to access San Francisco. There are also parcels that might be developed into standard concrete landing pads rather than more expensive floating landing platforms.

However, Vallejo also has some downsides that would impede potential financial viability. As with traditional catamarans routes serving Vallejo today, any viable destination terminal to connect to Vallejo would require a long travel distance, which made initial operating cost comparisons for Vallejo unfavorable in comparison to other routes under consideration. Additionally, hovercraft may have to travel at slow speeds (~10 knots [kn] or less) for a long distance in the restricted channel. While wake restrictions would not be an issue for hovercraft, there are safety issues with maneuvering hovercraft in channels with other vessels, as hovercraft do not maneuver easily and there may be risk of collision. Ultimately any speed restrictions in the channel approaching the existing Vallejo terminal would be determined by local law enforcement entities, and even without speed restrictions assumed, operating costs for Vallejo were unfavorable due to the long route distances. The long travel distance and time to any potential connecting terminals means very few round trips can be made per hovercraft.

Vallejo was not considered in Phase 2.

B.2 Martinez/Antioch (Carquinez Strait)

The Martinez waterfront terminal location is 1/2 mile from the Martinez Amtrak station, which serves Capitol Corridor and other Amtrak lines, and is also a transit hub for several bus agencies connecting to Contra Costa County and other regional destinations. The station was built in the early 2000s and serves commuters between Sacramento and San Jose.

Both cities expressed interest in a service along the strait (e.g., Martinez to Antioch) to serve users with destinations not near Bay Area Rapid Transit (BART). This specific option did not make the refined list for analysis due to concerns over a potentially limited user base willing to pay the high fares required for this service, but a route from Martinez to Downtown San Francisco was analyzed in more detail. Results from this were used to bracket potential performance to Antioch as well, which, being a longer distance from San Francisco, would be more expensive to operate. There is strong local support for a service in these cities.

Martinez/Antioch were considered in Phase 2.

B.3 Hercules/Pinole Area

The shallow draft in Hercules which would require dredging for access by a traditional catamaran was one of the impetuses behind the original 2011 Hovercraft Feasibility Study. Hovercraft are likely both technically and environmentally feasible to operate in the Hercules/Pinole area. Downsides to serving this area via hovercraft include the fact that parallel BART services exist in nearby cities, and that overall route distances via water would be greater than land travel distances, impeding overall financial viability.

Hercules/Pinole were considered in Phase 2.

B.4 Richmond

The Richmond Ferry Terminal was considered appealing for several reasons:

- There is high existing ridership demand.
- The facility could be a regional attractor for commuters to the South Bay were connections added using hovercraft.
- Currently, traditional catamarans must travel at slow speeds when exiting the Richmond Ferry Terminal until they have passed Brooks Island traveling west. Hovercraft may be able to take advantage of their ability to travel in shallow waters and instead exit the terminal to the east at high speeds. This would reduce overall route time and make economics more appealing.

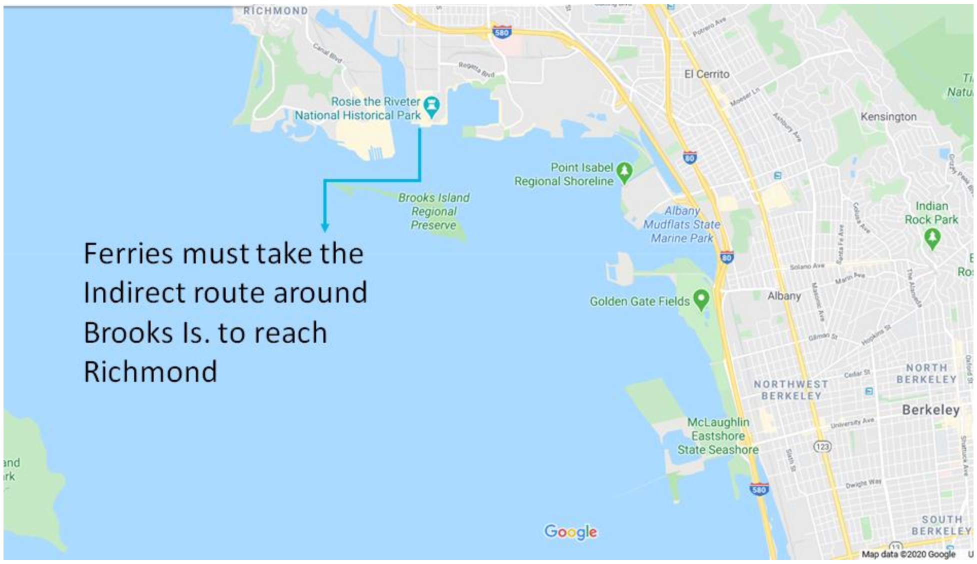

Figure 25. Richmond Ferry Terminal and Brooks Island

Richmond was considered in Phase 2.

B.5 Berkeley

Berkeley also has shallow draft issues that could make use of hovercraft appealing. Private ferry services (e.g., Genentech) currently access Berkeley using the public marina with small boats, but larger traditional catamarans requiring deeper draft will not be feasible without dredging. Although this area is less environmentally sensitive than much of the South Bay, there are potential hovercraft habitat and noise impacts at sites in Berkeley that would need to be considered.

Berkeley was considered in Phase 2.

B.6 Oakland/Alameda

There are multiple potential sites of interest for a hovercraft terminal in Oakland and Alameda. One such location is to add floating landing platform infrastructure to the existing Jack London Square ferry pier, shown in Figure 26.

Figure 26. Jack London Square Ferry Pier

The upside to this location is excellent existing transit connection and high existing ridership demand; the downside is that, like catamarans today, hovercraft would have to travel at slow speeds through the Oakland Inner Channel and may be challenging to maneuver in the congested waterways in the channel.

See Figure 27, which shows the long channel that hovercraft would have to traverse at slow speeds (10 kn or less) to access Jack London Square.

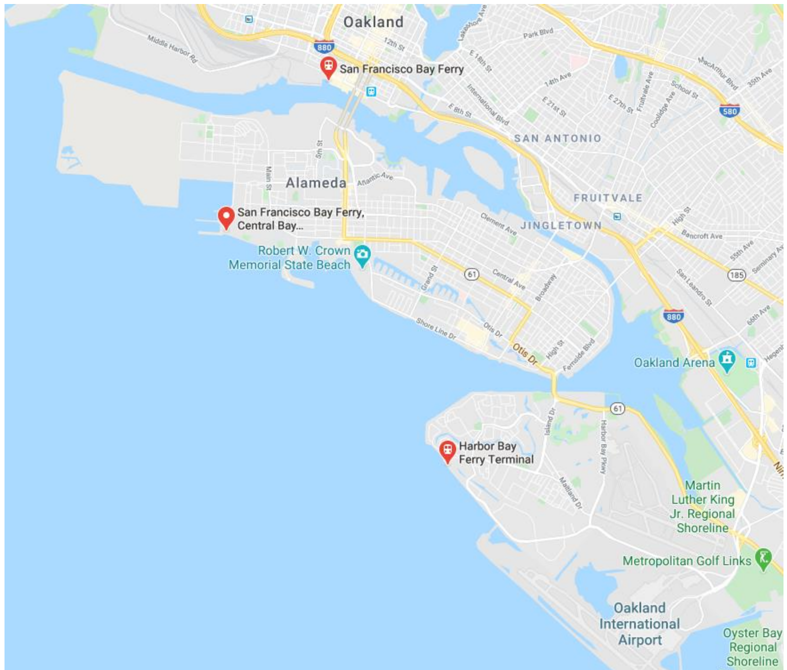

Figure 27. Oakland and Alameda

Seaplane Lagoon and Harbor Bay are both options for Alameda. Southeast Alameda was considered originally due to its appealing geography, but it would require using space that is currently a public beach, which would not be approved by the Bay Conservation and Development Commission (BCDC).

Sites in Oakland were not considered in Phase 2, but Alameda was included.

B.7 Downtown San Francisco

Downtown San Francisco is an obviously attractive location for any passenger ferry service, with clear ridership appeal. There are some challenges with bringing hovercraft into San Francisco, however. Because there is no available location to add a landing pad, a floating landing platform would need to be added, likely to an existing pier if possible. The most likely configuration is to add floating platform infrastructure to the end of an existing pier, so it can dock nose-first and passengers can board and disembark from the front of the craft.

Spray while maneuvering into a pier and during lift off may present a challenge, but keeping hovercraft floating landing platforms at the ends of piers may minimize this, as can sliding doors. Figure 28, Figure 29, and Figure 30 show example images of existing downtown piers and ferry gates.

Using the end of Gate G for hovercraft docking may be technically feasible, but it may present public acceptability concerns due to the popular public Pier 14 alongside, which is used for fishing and sightseeing. There would be both noise and spray impacts to the public pier if using Gate G.

Figure 28. Public Pier 14 (right) and ferry Gate G (left)

Gate F is likely a better possibility, because it is separated from Pier 14 by Gate G, and its end may be sufficiently far from the Ferry Building to prevent spray impacts.

Figure 29. Gate G (right) and Gate F (left)

Similarly, Gate B may also be a better possibility, because it allows for hovercraft to be kept somewhat more distant from the shore and the ferry building.

Figure 30. Gate B

Downtown San Francisco was considered in Phase 2.

B.8 San Francisco and Oakland Airports

The two airport locations have the same major downside in terms of potential rider appeal: a cost-competitive train service with minimal air quality and greenhouse gas impacts already exists in BART. Although both airports have a large employee commuter base, most airport employees are likely to continue using BART or other modes or transit that would have much lower costs than a hovercraft fare.

Comments from stakeholders indicated that airports could be served indirectly, with a San Leandro terminal serving Oakland Airport and a South San Francisco route serving San Francisco Airport. Both San Leandro and South San Francisco were considered in Phase 2, with ridership modeling including demand to and from the airports.

B.9 South San Francisco

South San Francisco is a very appealing potential hovercraft terminal location for several reasons:

- There are appealing shallow waters south of the existing marina near the Genentech campus that can be served by hovercraft without dredging.
- There is available land not designated as environmentally protected that can be used to develop concrete landing pads.
- There are no significant speed restrictions around potential terminal locations to impede route turn times, and overall route distances are short to the most appealing connecting terminals (e.g., Alameda, Berkeley).
- There is potential for significant rider demand in this area due to local employers such as Genentech.
- There is already a private ferry service offered by Genentech at this location. If a parallel service were offered by WETA, likely Genentech would encourage employees to use this instead and stop their private service. Therefore, some ridership demand certainly exists here with a base of riders accustomed to using ferry services.

- There are partnering options with employers like Genentech to support such a service.

South San Francisco was considered in Phase 2.

B.10 San Leandro

The most promising area in San Leandro appears to be at or near the San Leandro Marina. There is a golf course just east of the marina that would be a consideration for noise relative to a specific terminal location. That said, this location appears to be in the flight path of the Oakland Airport, so there are already regular sources of noise from the marina and airport.

San Leandro was considered in Phase 2.

B.11 Foster City

Foster City has several appealing characteristics that favor it as a location for a hovercraft terminal:

- The city contains less environmentally protected waterfront than sites further to the south (see Figure 42).
- Locations are fairly close to existing transit and convenient to housing and employer bases.
- The city is enthusiastic about a potential hovercraft ferry service and pointed to the site highlighted in Figure 31 as suitable for a landing pad.

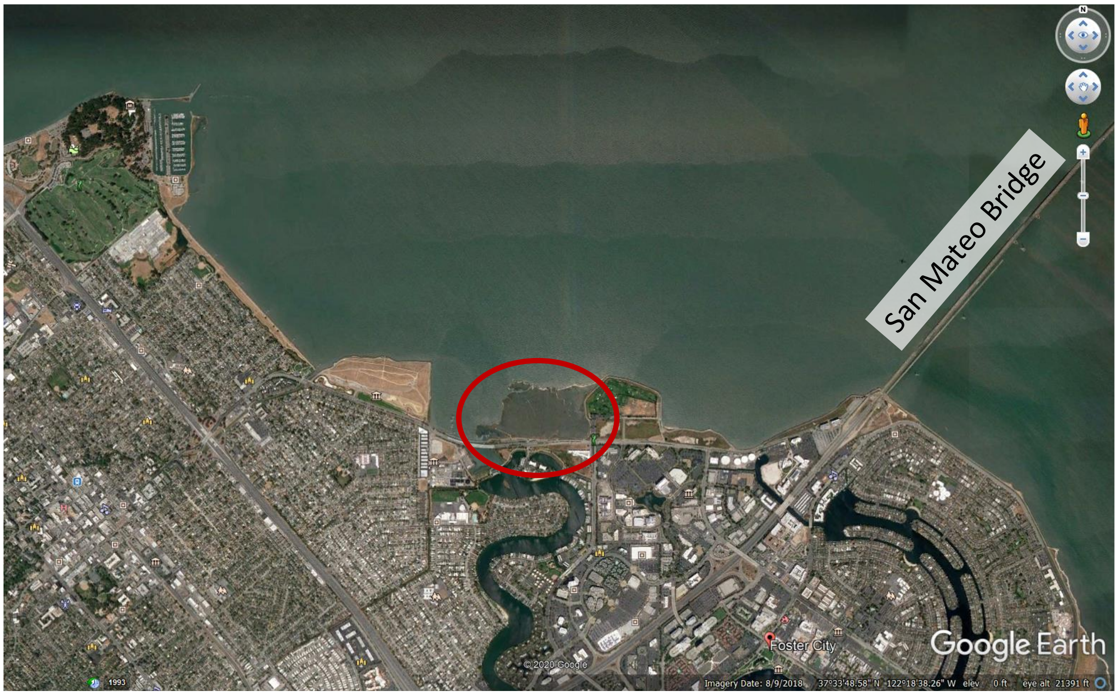

Figure 31. Potential Foster City Hovercraft Terminal

Foster City was considered in Phase 2.

B.12 East Dumbarton Bridge

Some routes from the East Dumbarton Bridge area may be appealing, particularly to South San Francisco. There may be significant ridership demand from people who live near the Dumbarton Bridge or further into the South Bay. As can be seen in Figure 32 below, a hovercraft terminal would necessarily be somewhat remote from transit connections. This option would likely require a companion transit connection, such as a parking area near the base of the bridge with a regular shuttle to and from the terminal.

Figure 32. Dumbarton Bridge in Google Earth Noting Likely Hovercraft Terminal Location

A terminal location north of the bridge would be more appealing in terms of travel time than south of the bridge.

Due to its remote location, the East Dumbarton Bridge was not considered in Phase 2.

B.13 West Dumbarton Bridge and Cooley Landing

Figure 33. East Dumbarton Bridge Area

Three potential sites near the Dumbarton Bridge were considered:

- **North of the bridge near Facebook Headquarters.** This site was eliminated from consideration because it is operationally and environmentally infeasible to traverse the Ravenswood Slough.
- **Base of the Dumbarton Bridge in East Palo Alto.** This location is more environmentally feasible and has appealing route times, especially if the hovercraft terminal could be located north of the bridge. This location also likely requires a connecting shuttle service to facilitate commutes.
- **Cooley Landing in East Palo Alto.** Similar to the base of the Dumbarton Bridge, this location is appealing in terms of environmental feasibility. A major downside to this site is that it requires traversing the Dumbarton rail bridge, which would entail slowing down considerably. Additionally, should service via the rail bridge restart, access to Cooley Landing would be cut off.

The West Dumbarton Bridge is included in Phase 2, but Cooley Landing was not due to its position past the Dumbarton rail bridge.

B.14 Mountain View Area

The Mountain View area has significant constraints, both environmentally and operationally. The Charleston Slough (yellow arrow on the left in Figure 34) has a tide gate at northern end of slough. It is currently mud flat habitat with heavy bird forge use, and BCDC would require mitigation in the area to restore it to tidal marsh. Use of this slough is infeasible. Similarly, the arrow on the right in Figure 34 is the Mountain View Slough/Permanente Creek. Its constraints include a narrow width (from 60 to 10 feet) with fringe marsh on both sides. There are also ongoing restoration sites on both sides and burrowing owl sites nearby.

Figure 34. Mountain View Area

This area is also past the Dumbarton rail bridge, so if service is restarted via this bridge, access to the area would be cut off. Finally, initial economic calculations for these routes were not favorable due to long route distance, and the need to travel at very slow speeds down any slough.

The Mountain View area was eliminated from further consideration in Phase 2.

B.15 Alviso

As with the Mountain View area, Alviso presents significant challenges both environmentally and operationally. The Alviso Slough, shown in yellow in Figure 35, has fringe marsh on both sides of slough with sensitive wildlife and restoration ponds. This meandering path is also unfavorable for hovercraft operations and would take a very long time to traverse in the unlikely event this were to be approved for use. This area is also past the Dumbarton rail bridge, so if service is restarted via this bridge, access to the area would be cut off.

Figure 35. Alviso Slough

Alviso was eliminated from further consideration in the Phase 2.

B.16 Coyote Creek/Mud Slough

Like many of the other South Bay channels, Coyote Creek is near protected habitat/restoration areas. There are also harbor seal haul outs in the area, which would be an additional concern relative to vessel speed and noise. There is a railroad easement that crosses the channels between the bay and locations that could serve as a terminal. However, based on Google Earth images, it does not appear that the rail crossing would allow passage by a hovercraft. There is no obvious good location for a terminal in this region. Even if it were possible to get past the railroad crossings, it would be a slow, meandering path to developed landward areas.

Coyote Creek and Mud Slough were eliminated from further consideration in the Phase 2.

Appendix C – Ridership Model Validation and Initial Forecasts

C.1 2010 Validation

The first step of the base (2010) year validation was to compare the base scenario model assumptions with 2010 schedules. The comparison showed that there were some differences between the assumptions and the schedules. The model assumptions were updated accordingly. One significant change was to the Alameda/Oakland to Ferry Building headway, which was updated from 30 minutes to 65 minutes.

After the schedule changes were made, the model was run, and the model-generated boardings were compared to the observed boardings. The observed ridership numbers from the previous model report (*WETA Ridership Forecasting and Model Update Report*, December 2012) were used for comparison purposes. In general, the boardings estimated in the model were lower than those observed for the ferry routes. A closer look at the model coding showed that the connections between Ferry Building and the Bay Area Rapid Transit (BART) station, and walk connections to some stations, were missing. These were coded into the model. After these adjustments, the model-estimated boardings were close to the observed boardings. Table 7 shows a comparison of the model boardings and observed boardings for the base year scenario.

Table 7. Base Year (2010) Comparison of Model with Observed Boardings

				From Schedule*			Observed Ridership[1]	Model Boardings (initial)			Difference		Model (adjusted)			Model Boardings (after model adjustments)			Difference	
		Headway (min)			Headway (min)									Headway (min)						
Line	Runtime (min)	Peak	Offpeak	Runtime (min)	Peak	Offpeak		Peak	Off-Peak	Total	Model - Counts	Percent	Runtime (min)	Peak	Offpeak	Peak	Off-Peak	Total	Model - Counts	Percent
Vallejo																				
94_VALFB	55	30	90	60	30	90		1,684	6	1,690			60	60	90	1,621	7	1,628		
94_FBVAL	55	60	90	60	60	90		2	0	2			60	60	90	2	0	2		
94_FBFWVL	55		180	80		180	1624	0	33	33			58		180	0	32	32		
Subtotal							1,624	1,686	39	1,725	101	6%				1,623	39	1,662	38	2%
Alameda/Oakland																				
90_FBOKAL	40	30	120	30	65	120		122	48	170			27	65	65	178	64	242		
90_OKALFB	30	30	120	30	65	70	1187	523	157	680			27	65	65	677	188	865		
Subtotal							1,187	645	205	850	-337	-28%				855	252	1,107	-80	-7%
Harbor Bay																				
90_HBFB	23	60		25	60			79	0	79			20	60		557	0	557		
90_FBHB	23	60		25	60		579	8	0	8			20	60		34	0	34		
Subtotal							579	87	0	87	-492	-85%				591	0	591	12	2%

C.2 2020 Validation

The model updates from the base year were carried forward to the 2020 scenario, and the 2020 model was run. Observed boardings from February 2020 were used for San Francisco ferries and October 2019 ridership for Blue & Gold fleet was used for comparison. An initial comparison was made between the model boardings and the observed boardings, and this showed that the model was estimating higher boardings. The Alameda County Transportation Commission (ACTC) model population and employment were compared to American Community Survey (ACS) and Plan Bay Area data. The comparison showed that the population for San Francisco County in the model was higher by about 9 percent, and that employment was higher by about 6 percent. The model's person-trips to and from San Francisco County were adjusted accordingly.

The 2020 model was run after the trip table adjustments, and ferry boardings were compared with the observed boardings. The comparison showed that the model was estimating higher boardings than the observed counts. The following minor adjustments to the model were made by adjusting the headways and run times for the ferry routes.

- The model was estimating higher boardings on the Vallejo to Ferry Building route, so the headway was adjusted to 60 minutes from 30 minutes.

- The run time for Alameda/Oakland was increased by 2 minutes, and the run time for the Harbor Bay ferry was decreased by 5 minutes.

After the model adjustments, the overall model boardings looked closer to the observed boardings.

Table 8 compares the boardings from the model and the observed boardings for the opening year.

Table 8. Opening Year (2020) Comparison of Model with Observed Boardings

									2020 Model Run (initial)					2020 Scenario (with model adjustments)							
	Model				From Schedule (Nov 2019)			Observed Counts	Model volume			Difference		After Model Adjustments			Model volume			Difference	
			Headway (min)			Headway (min)									Headway (min)						
Line	Mode	Runtime (min)	Peak	Off-Peak	Runtime (min)	Peak	Off-Peak	Daily	Peak	Off-Peak	Total	Model - Counts	Percent	Runtime (min)	Peak	Off-Peak	Peak	Off-Peak	Total	Model - Counts	Percent
Vallejo*																					
94_VALFB	94	55	30	90	60	30	90		4,861	18	4,879			60	60	90	3,747	25	3,772		
94_FBVAL	94	55	60	90	60	60	90		5	0	5			60	60	90	10	0	10		
94_FBFWVL	94	55		180	80		180		0	61	61			80		180	0	43	43		
Subtotal								3,493	4,866	79	4,945	1,452	42%				3,757	68	3,825	332	10%
Alameda/Oakland*																					
90_FBOKAL	90	40	30	120	30	30	120		321	107	428			32	30	120	111	24	135		
90_OKALFB	90	30	30	120	30	30	70		3,216	1,010	4,226			32	30	70	3,196	649	3,845		
90_FWALOK	90	40		60	40		60							70		60	0	24	24		
Subtotal								3,758	3,537	1,117	4,654	1,091	31%				3,307	697	4,004	246	7%
Harbor Bay*																					
90_HBFB	90	23	60		25	60			1,554	0	1,554			20	60		1,697	0	1,697		
90_FBHB	90	23	60		25	60			40	0	40			20	60		24	0	24		
90_OPHB	90	25	180	Oct	25	180								25	180		52	0	52		
Subtotal								1,839	1,594	0	1,594	205	15%				1,721	0	1,721	-118	-6%
South San Francisco (Oyster Point)*																					
90_OPJLS	90	31	120		35	120			7	0	7			35	60		184	0	184		
90_JLSOP	90	31	60		35	40			179	0	179			35	40		461	0	461		
Subtotal								663	186	0	186	-477	-72%				645	0	645	-18	-3%
Richmond-San Francisco Ferry Building*																					
90_RMDFB	90	29	60		35	75		828	5,815	0	5,815			35	75		752	0	752		
Subtotal								828	5,815	0	5,815	4,987	602%				752	0	752	-76	-9%
Total								19,412	24,096	2,412	26,508	7,741	40%				18,301	1,811	20,112	700	4%

* Observed Ridership from February 2020

[1] Observed ridership is estimated from Oct 2019 monthly ridership converted to daily ridership with a conversion factor of 25

C.3 Initial Forecasts

The proposed hovercraft service assumptions were input into the 2020 and 2040 model scenarios. Analyzing the single-trip fare and monthly fares for the existing ferry services showed that, on average, the monthly passes provided about 30 percent discount on the single-trip fares. Average monthly pass fares were estimated using the average of high and low fare and assuming a 30 percent discount on proposed single-trip fares. The model uses fares in 1990 dollars; these fares were converted accordingly and input into the model. Table 9 shows assumptions for the proposed services in the model.

One of the other key assumption for the proposed services related to the drive catchment for the new terminals. Data from the 2017 San Francisco Ferry Passenger Survey were analyzed to estimate the drive catchment radius**.** Because the Water Emergency Transportation Authority (WETA) survey was not geocoded, drive distance was roughly estimated using the city of origin in the survey record and the boarding terminal. Based on that, an average of 4 miles drive catchment was assumed for those routes that serve the Ferry Building (Berkeley, Hercules, and Dumbarton); for all other routes, 9 miles was used.

Table 10 shows the average estimated weekday boardings. A 5 percent variation was used to estimate ”low” and “high” estimates of boardings.

Using the observed time-of-day boarding counts, average peak hour factors were estimated. From these factors, peak hour ridership estimates were developed. Table 11 shows the average weekday peak-hour estimates for hovercraft services.

Table 9. Hovercraft Service Assumptions

						Fares		
Service _ID	Origin Terminal	Destination Terminal	Service Type	One-way or Two-way	Runtime (min)	Model Year (in cents) (1990$)	Current Year (in cents) (2020$)	Non Discounted (2020$)
Berkeley								
90_BERFB	Berkeley	Ferry Building	Ferry	One-way	25	238	467	
Subtotal								
90_BERFB_HC	Berkeley	Ferry Building	Hovercraft	One-way	22	275	540	$ 8
90_BERSSF	Berkeley	South San Francisco	Hovercraft	One-way	35	477	936	$ 13
90_BERFC	Berkeley	Foster City	Hovercraft	One-way	39	585	1,147	$ 16
90_BERWDB	Berkeley	W Dumbarton	Hovercraft	One-way	52	800	1,569	$ 22
Subtotal								
Hercules								
95_HERSF	Hercules	Ferry Building	Ferry	One-way	42	586	1,150	
Subtotal								
90_HERSF_HC	Hercules	Ferry Building	Hovercraft	One-way	41	595	1,167	$ 17
Subtotal								
Foster City								
90_BERFC	Foster City	Berkeley	Hovercraft	One-way	39	585	1,147	$ 16
90_ALSLFC	Foster City	Alameda Seaplane Lagoon	Hovercraft	One-way	29	386	757	$ 11
90_RMDFS	Foster City	Richmond	Hovercraft	One-way	43	605	1,188	$ 17
Subtotal								
Alameda Sea Lagoon								
90_ALSLFB	Alameda Seaplane Lagoon	Ferry Building	Ferry	One-way	20	238	467	
Subtotal								
90_ALSLFC	Alameda Seaplane Lagoon	Foster City	Hovercraft	One-way	29	386	757	$ 11
90_ALSLWDB	Alameda Seaplane Lagoon	W Dumbarton	Hovercraft	One-way	38	581	1,140	$ 16
Subtotal								
Richmond								
90_RMDFB	Richmond	Ferry Building	Ferry	One-way	35	350	687	
Subtotal								
90_RMDOP	Richmond	South San Francisco	Hovercraft	One-way	39	584	1,147	$ 16
90_RMDFS	Richmond	Foster City	Hovercraft	One-way	43	605	1,188	$ 17
Subtotal								
Martinez								
90_MTZFB	Martinez	Ferry Building	Hovercraft	One-way	54	1,099	2,156	$ 31
Subtotal								
W Dumbarton								
90_DWBFB	W Dumbarton	Ferry Building	Hovercraft	One-way	45	616	1,208	$ 17
90_BERWDB	W Dumbarton	Berkeley	Hovercraft	One-way	52	800	1,569	$ 22
90_ALSLWDB	W Dumbarton	Alameda Sea Lagoon	Hovercraft	One-way	38	581	1,140	$ 16
Subtotal								
San Leandro								
90_SLOP	San Leandro	South San Francisco	Hovercraft	One-way	26	372	730	$ 10
Subtotal								
South San Francisco								
90_OPJLS	South San Francisco	Oakland JLS	Ferry	One-way	34			
Subtotal								
90_BERSSF	South San Francisco	Berkeley	Hovercraft	One-way	35	477	936	$ 13
90_RMDOP	South San Francisco	Richmond	Hovercraft	One-way	39	584	1,147	$ 16
90_SLOP	South San Francisco	San Leandro	Hovercraft	One-way	26	372	730	$ 10
Subtotal								

Table 10. Average Weekday Boardings for the Hovercraft Service

Service _ID	Origin Terminal	Destination Terminal	Service Type	One-way or Two-way	Average Weekday Boardings 2020	2040
Vallejo						
94_VALFB	Vallejo	Ferry Building	Ferry	Two-way	3,869	3,776
94_FBFWVL	Ferry Building	Vallejo	Ferry	Two-way	61	77
Subtotal					3,930	3,853
Alameda						
90_FBOKAL	Ferry Building	Alameda	Ferry	One-way	490	603
90_OKALFB	Oakland	Ferry Building	Ferry	One-way	3,869	2,586
90_FWALOK	Fishers Wharf	Oakland	Ferry	One-way	190	220
90_OKALFW	Oakland	Fishers Wharf	Ferry	One-way	526	664
90_JLSOP	Oakland JLS	South San Francisco	Ferry	One-way	2,129	4,606
Subtotal					7,204	8,679
Harbor Bay						
90_HBFB	Harbor Bay	Ferry Building	Ferry	One-way	1,775	800
90_FBHB	Ferry Building	Harbor Bay	Ferry	One-way	81	100
90_OPHB	South San Francisco	Harbor Bay	Ferry	Two-way	390	768
Subtotal					2,246	1,668
Ferry Building						
90_BERFB	Ferry Building	Berkeley	Ferry	One-way	-	-
95_HERSF	Ferry Building	Hercules	Ferry	One-way	-	-
90_ALSLFB	Ferry Building	Alameda Seaplane Lagoon	Ferry	One-way	116	192
90_RMDFB	Ferry Building	Richmond	Ferry	One-way	102	177
90_BERFB_HC	Ferry Building	Berkeley	Hovercraft	One-way	185	225
90_HERSF_HC	Ferry Building	Hercules	Hovercraft	One-way	563	560
90_MTZFB	Ferry Building	Martinez	Hovercraft	One-way	165	191
Subtotal					1,131	1,345
Berkeley						
90_BERFB	Berkeley	Ferry Building	Ferry	One-way	-	-
Subtotal					-	-
90_BERFB_HC	Berkeley	Ferry Building	Hovercraft	One-way	4,251	4,571
90_BERSSF	Berkeley	South San Francisco	Hovercraft	One-way	418	1,436
90_BERFC	Berkeley	Foster City	Hovercraft	One-way	645	880
90_BERWDB	Berkeley	W Dumbarton	Hovercraft	One-way	372	389
Subtotal					5,686	7,276
Hercules						
95_HERSF	Hercules	Ferry Building	Ferry	One-way	-	-
Subtotal					-	-
90_HERSF_HC	Hercules	Ferry Building	Hovercraft	One-way	5,637	7,241
Subtotal					5,637	7,241
Foster City						
90_BERFC	Foster City	Berkeley	Hovercraft	One-way	419	666
90_ALSLFC	Foster City	Alameda Seaplane Lagoon	Hovercraft	One-way	140	230
90_RMDFS	Foster City	Richmond	Hovercraft	One-way	129	212
Subtotal					681	1,108
Alameda Sea Lagoon						
90_ALSLFB	Alameda Seaplane Lagoon	Ferry Building	Ferry	One-way	1,355	1,272
Subtotal					1,355	1,272
90_ALSLFC	Alameda Seaplane Lagoon	Foster City	Hovercraft	One-way	1,220	2,253
90_ALSLWDB	Alameda Seaplane Lagoon	W Dumbarton	Hovercraft	One-way	1,150	1,762
Subtotal					2,370	4,015
Richmond						
90_RMDFB	Richmond	Ferry Building	Ferry	One-way	2,510	2,700
Subtotal					2,510	2,700
90_RMDOP	Richmond	South San Francisco	Hovercraft	One-way	665	2,357
90_RMDFS	Richmond	Foster City	Hovercraft	One-way	469	908
Subtotal					1,134	3,265
Martinez						
90_MTZFB	Martinez	Ferry Building	Hovercraft	One-way	1,178	1,377
Subtotal					1,178	1,377
W Dumbarton						
90_DWBFB	W Dumbarton	Ferry Building	Hovercraft	One-way	1,035	1,513
90_BERWDB	W Dumbarton	Berkeley	Hovercraft	One-way	933	1,568
90_ALSLWDB	W Dumbarton	Alameda Sea Lagoon	Hovercraft	One-way	254	827
Subtotal					2,222	3,908
San Leandro						
90_SLOP	San Leandro	South San Francisco	Hovercraft	One-way	927	1,453
Subtotal					927	1,453
South San Francisco						
90_OPJLS	South San Francisco	Oakland JLS	Ferry	One-way	616	873
Subtotal					616	873
90_BERSSF	South San Francisco	Berkeley	Hovercraft	One-way	1,516	1,676
90_RMDOP	South San Francisco	Richmond	Hovercraft	One-way	262	366
90_SLOP	South San Francisco	San Leandro	Hovercraft	One-way	1,074	1,231
Subtotal					2,852	3,273

Table 11. Average Peak-Hour Boardings for Hovercraft Services

Service _ID	Origin Terminal	Destination Terminal	Service Type	One-way or Two-way	Peak Hour Factor	2020 Low Forecast	2020 High Forecast	2040 Low Forecast	2040 High Forecast
Berkeley									
90_BERFB	Berkeley	Ferry Building	Ferry	One-way					
Subtotal									
90_BERFB_HC	Berkeley	Ferry Building	Hovercraft	One-way	57%	2,290	2,530	2,470	2,720
90_BERSSF	Berkeley	South San Francisco	Hovercraft	One-way	40%	140	210	550	610
90_BERFC	Berkeley	Foster City	Hovercraft	One-way	52%	310	380	420	510
90_BERWDB	Berkeley	W Dumbarton	Hovercraft	One-way	52%	160	240	170	250
Subtotal						2,900	3,360	3,610	4,090
Hercules									
95_HERSF	Hercules	Ferry Building	Ferry	One-way					
Subtotal									
90_HERSF_HC	Hercules	Ferry Building	Hovercraft	One-way	40%	2,140	2,370	2,750	3,040
Subtotal						6,540	7,230	7,230	8,000
Foster City									
90_BERFC	Foster City	Berkeley	Hovercraft	One-way	40%	140	210	240	300
90_ALSLFC	Foster City	Alameda Seaplane Lagoon	Hovercraft	One-way	40%	50	70	80	120
90_RMDFS	Foster City	Richmond	Hovercraft	One-way	40%	50	70	70	110
Subtotal						240	350	390	530
Alameda Sea Lagoon									
90_ALSLFB	Alameda Seaplane Lagoon	Ferry Building	Ferry	One-way					
Subtotal									
90_ALSLFC	Alameda Seaplane Lagoon	Foster City	Hovercraft	One-way	40%	470	520	860	950
90_ALSLWDB	Alameda Seaplane Lagoon	W Dumbarton	Hovercraft	One-way	40%	440	490	680	750
Subtotal						910	1,010	1,540	1,700
Richmond									
90_RMDFB	Richmond	Ferry Building	Ferry	One-way					
Subtotal									
90_RMDOP	Richmond	South San Francisco	Hovercraft	One-way	57%	340	420	1,270	1,410
90_RMDFS	Richmond	Foster City	Hovercraft	One-way	52%	200	300	430	530
Subtotal						540	720	1,700	1,940
Martinez									
90_MTZFB	Martinez	Ferry Building	Hovercraft	One-way	40%	450	500	530	580
Subtotal						450	500	530	580
W Dumbarton									
90_DWBFB	W Dumbarton	Ferry Building	Hovercraft	One-way	57%	570	620	820	900
90_BERWDB	W Dumbarton	Berkeley	Hovercraft	One-way	52%	440	540	780	870
90_ALSLWDB	W Dumbarton	Alameda Sea Lagoon	Hovercraft	One-way	52%	110	170	400	480
Subtotal						1,120	1,330	2,000	2,250
San Leandro									
90_SLOP	San Leandro	South San Francisco	Hovercraft	One-way	52%	440	540	730	800
Subtotal						440	540	730	800
South San Francisco									
90_OPJLS	South San Francisco	Oakland JLS	Ferry	One-way					
Subtotal									
90_BERSSF	South San Francisco	Berkeley	Hovercraft	One-way	52%	760	840	840	930
90_RMDOP	South San Francisco	Richmond	Hovercraft	One-way	52%	110	170	160	240
90_SLOP	South San Francisco	San Leandro	Hovercraft	One-way	52%	540	600	620	680
Subtotal						1,410	1,610	1,620	1,850

Appendix D – Noise Analysis

This section describes the preliminary noise (unwanted sound) analysis for the Hovercraft Feasibility Study. Findings have been left in general distances from the craft, to be applicable to each route.

D.1 Airborne Sound

The methodology used was that of a moving point source, based on the sound levels at a reference distance and computation of the decrease in sound level with distance. This provides a maximum sound level at any distance. To determine the reference level, trusted measurement data from hovercraft were reviewed. The reference craft was an AP.1-88 that can carry more than 24 passengers, as well as 16,000 pounds of other weight such as cargo. The AP.1-88 is 40 feet wide by 70 feet long and weighs about 56,000 pounds empty. It has four marine engines—two for lift (Deutz, Model BF10L413FC, 390 horsepower [hp]) and two for propulsion (Deutz, Model BF10L413FC, 500 hp). Figure 36 shows the results computed from the reference distance of 50 feet to more than 1 mile (6,400 feet) for cruise, pass-by sound levels. Also shown as a point is the level that was measured from a SUNA-X craft that was included in the April 2011 study.[35] It can be seen that the level measured from the SUNA-X matches well with the calculations of this study.

To put the expected noise levels into perspective, a time-energy-averaged sound level was also computed. This was based on a cruising speed of 40 kilometers per hour and two hovercraft passing a fixed point each hour. This was assumed to be a worst-case scenario, but the calculation method, like the maximum level calculation, is included in a spreadsheet to allow quick changes to input such as speed and number of passbys. Figure 37 shows the hourly equivalent (average) sound levels that could be expected for varying distances in meters.

These two metrics, maximum sound level on an A-weighted scale and the hourly average sound level on an A-weighted scale, provide two key parameters: what is the loudest noise level that will occur, and how does this compare to established criteria?

Not included in this preliminary analysis are differences in sound levels due to modes and directivity of the sound, such as when approaching or departing a dock area. Further study is needed in this area if specific routes and terminal sites are planned for development of a hovercraft service.

D.2 Possible Impacts of Airborne Noise

Noise codes as they apply to each individual selected terminal location would need to be reviewed in future studies when detailed site-specific analysis becomes relevant (e.g., if a specific route and terminal location are deemed to be feasible to move forward with a hovercraft service). For example, a review of the San Francisco Police Code Noise Guideline [36] was conducted initially. The review shows that only vehicle source repairs are explicitly included. This is expected because transportation noise is usually controlled by federal criteria. However, some generalities can be applied. For example, in Section 2909(c), it is stated that noise generated from a source on public property, such as a park or public plaza, may be 10 A-weighted decibels (dBA) above the ambient at a distance greater than 25 feet from the noise source. This provides a quick reference to compare to the hovercraft noise while near shore.[37] The key to this statement is the ambient or background noise level. The minimum ambient, as listed in Appendix A of the police code, is 45 dBA. This would provide a very conservative estimate of a 55 dBA limit. The maximum sound level emitted from the craft would be above this value, and the average level would not be experienced farther than 250 feet from the craft. Short-term maximum levels could possibly be an impact during docking, depending on nearby land uses. Insignificant impacts would be expected using the time-energy-averaged sound levels.

[35] URS, Final Hovercraft Feasibility Study, San Francisco, CA, April 20, 2011.

[36] San Francisco Police Code Article 29: Regulation of Noise, Guidelines for Noise Control Ordinance Monitoring and Enforcement, December 2014 Guidance.

[37] Maximum allowable cumulative level of noise produced from any combination of mechanical device(s) and implied sound systems(s) originating on a public property.

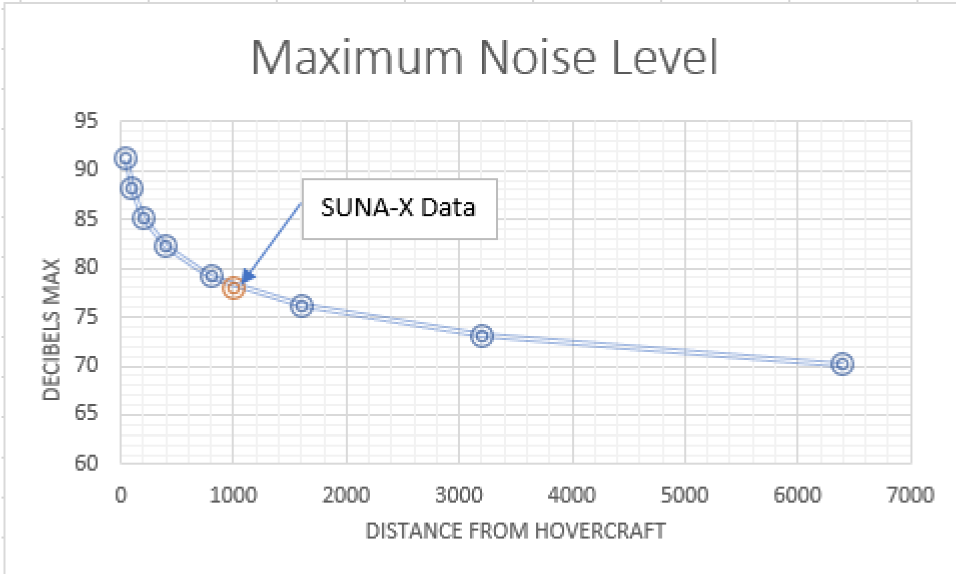

Figure 36. Maximum Noise Levels Computed with Distance from Hovercraft, in Meters

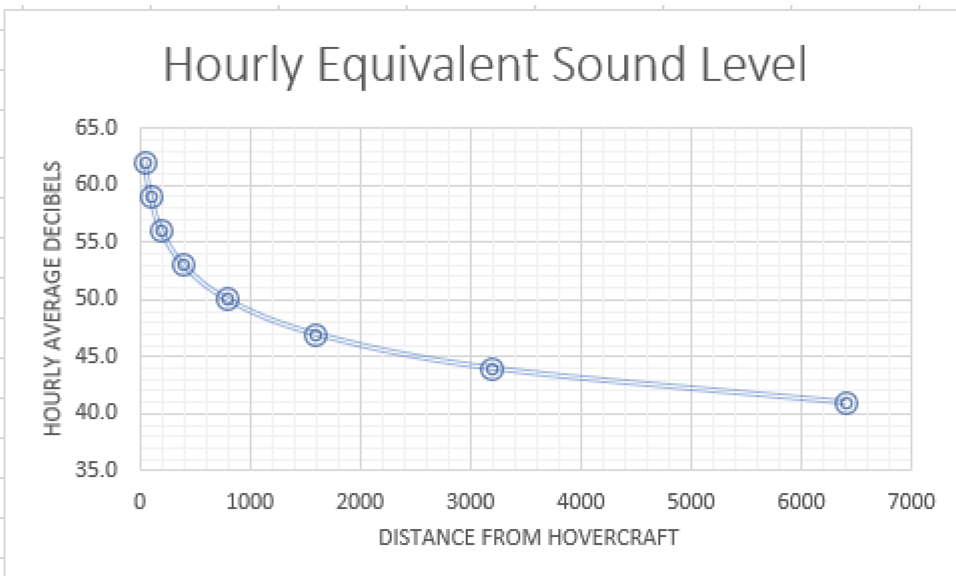

Figure 37. Hourly Average Sound Levels for 40 Kilometers per Hour and Two Passbys per Hour

In reality, the ambient level for an urban area is generally well above 45 dBA. Figure 38. from a United States Environmental Protection Agency (USEPA) report, shows what could be expected for different development areas. Of note is that these are 24-hour average levels, with a 10 dBA penalty added to each hour from 10 PM to 7 AM. Although older, this reference is still thought to be valid. As shown, the ambient noise is expected to be approximately 60 dBA. In this case, the energy-averaged level would not cause a significant impact, but the maximum sound level would produce a sound that could be heard for short durations.

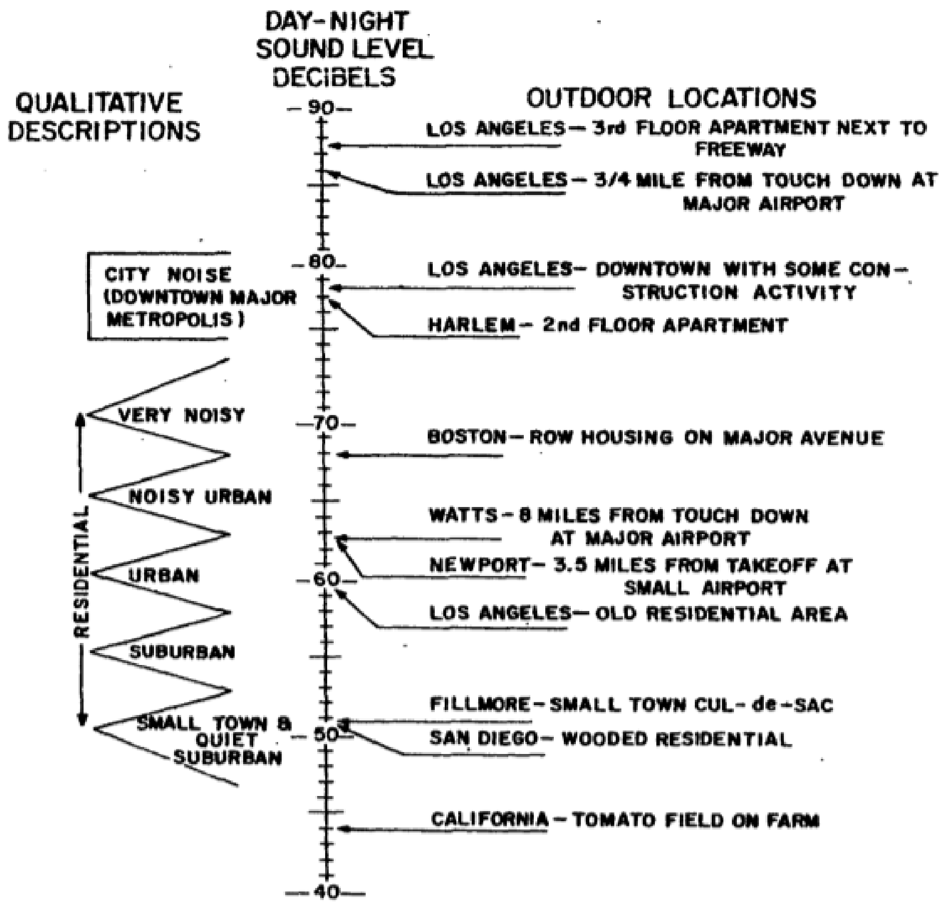

Figure 38. Day-Night Levels from Different Land Uses [38]

Comparing to other forms of transit, criteria could also put the expected noise levels into perspective. As described by the Federal Transit Administration[39] (FTA), the Department of Housing and Urban Development defines a day-night average sound level (L_{dn}) of 65 as the onset of a normally unacceptable noise zone (a moderate impact for FTA) in its environmental noise standards.[40] The Federal Aviation Administration considers residential land uses to be incompatible with noise environments where L_{dn} is greater than 65 dBA.[41] Figure 39 shows the FTA impact criteria. It can be seen from all these criteria that the expected impact of the project would not be significant, with the possible exception of landing areas, depending on nearby land use.

[38] USEPA, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, Report No. 550/9-74-994, Office of Noise Abatement and Control, March 1974.
[39] FTA, Transit Noise and Vibration Impact Assessment Manual, Report No. 0123, September 2018.
[40] U.S. Department of Housing and Urban Development, "Environmental Criteria and Standards", Vol. 12, July 1979; amended by 49 Federal Register 880, 6 January 1984 (24 CFR part 51).
[41] U.S. Department of Transportation, Federal Aviation Administration, "Federal Aviation Regulations Part 150: Airport Noise Compatibility Planning," January 1981.

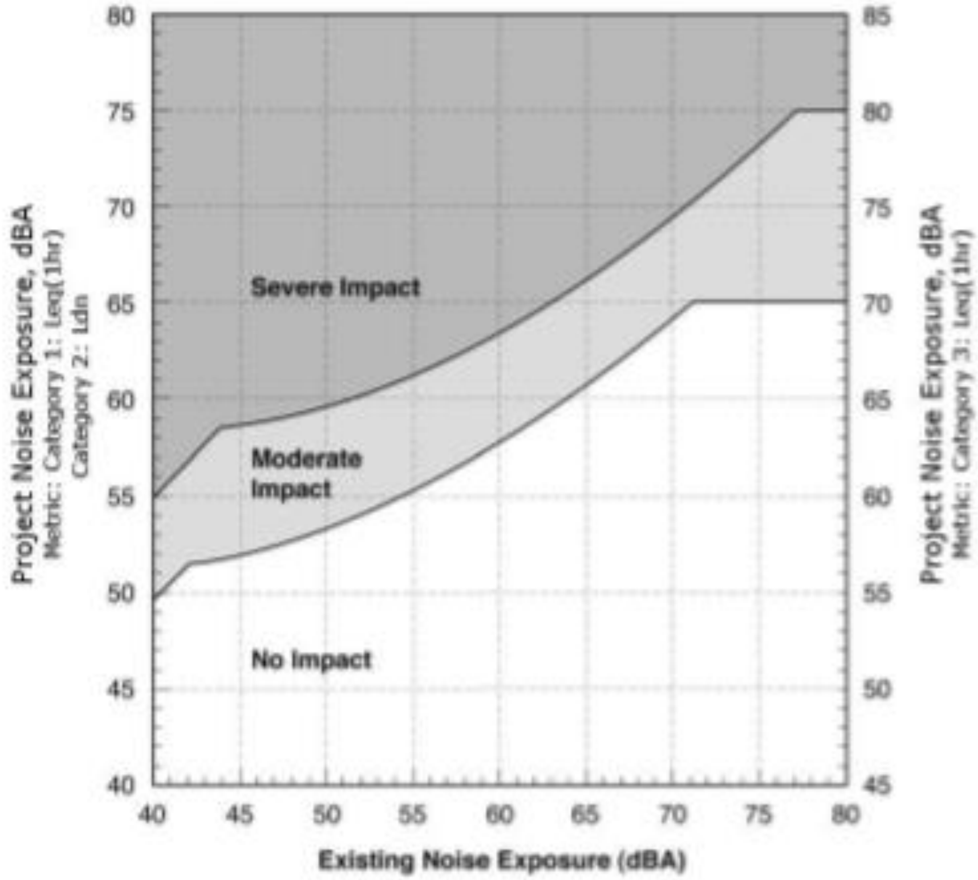

Figure 39. Noise Impact Criteria for Transit Projects [42]

D.3 Underwater Sound

Sounds underwater are not directly comparable to the sound levels in air. Additionally, the propagation of the sound is quite different underwater. Because any impact that would occur would be to marine life and not to humans, at this time only a preliminary study has been accomplished, to provide some benchmarks for future analysis. Figure 40 shows the underwater sound pressure levels from the AP.1-88 hovercraft, compared two snowmobiles at different distances (48 and 78 feet), from a study conducted in Alaska for the Postal Service.[43]

D.4 Effects on Birds

The airborne sound levels described in this report were given in dBA. Use of dBA is not the most useful measure for determining the effects of noise on bird hearing, and not all birds hear the same. For the purpose of determining the effects of noise on bird hearing, it is generally reported that the relevant measure is the spectrum level of noise (defined as the energy level for each frequency in the sound) in the frequency region where birds vocalize most and hear best: typically, around 2 to 4 kilohertz (kHz). Therefore, the overall level in dBA is a very conservative estimate of the effects on communication in birds. More work may be needed to determine the sound pressure level in the octave band between 2 and 4 kHz or the use of other sound metrics. Use of these spectrum levels and possibly other metrics may help in determining whether the noise would cause interference with local bird populations. Further discussion of potential impacts on specific species and locations, including noise impacts, are described in Appendix E.

[42] Maximum allowable cumulative level of noise produced from any combination of mechanical device(s) and implied sound systems(s) originating on a public property.

[43] Fleming, G.G., and C.J. Roof, Hovercraft Underwater Noise Measurements in Alaska, Report No. DTS-34-VX015-LR1. John A. Volpe National Transportation Center, April 2, 2001.

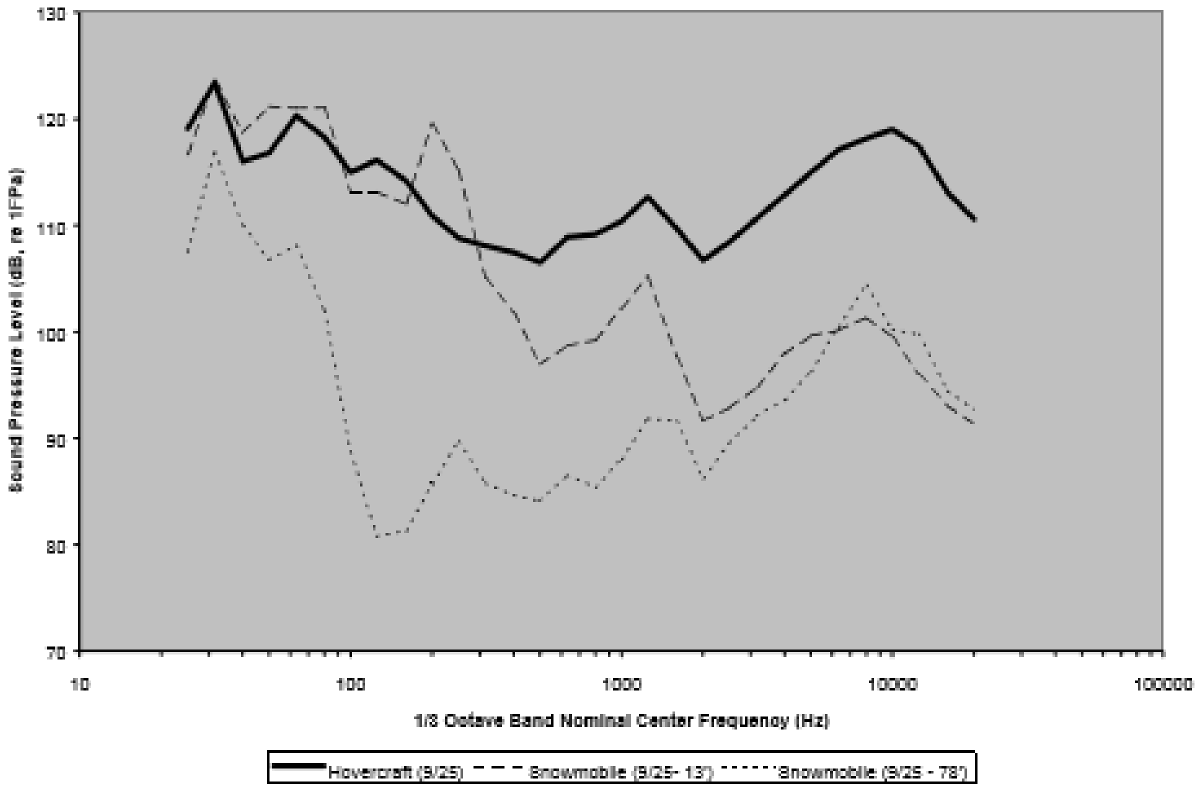

Figure 40. Comparison of Underwater Sound Spectra of a Hovercraft (AP.1-88) and Two Snowmobiles[44]

D.5 Hydroacoustic Threshold Criteria for Fish Species

On June 12, 2008, the Fisheries Hydroacoustic Working Group (FHWG)—whose members include the National Marine Fisheries Service's (NMFS's) Southwest and Northwest Divisions; the California, Washington, and Oregon Departments of Transportation; the California Department of Fish and Wildlife (CDFW); and the Federal Highway Administration—issued an agreement for establishment of interim threshold criteria to determine the effects of high-intensity sound on fish. These criteria were established after extensive review of the most recent analysis of the effects of underwater noise on fish from pile driving in water. The agreed-on threshold criteria for noise to have an injury effect on fish was set at 206 decibels (dB) peak sound pressure level, 187 dB cumulative sound exposure level (cSEL) for fish over 2 grams (0.07 ounce), and 183 dB cSEL for fish less than 2 grams (0.07 ounce).[45] The FHWG determined that noise at or above these levels can cause damage to auditory tissues and temporary threshold shift in fish.

Continuous in-water noise sources, like those generated by a hovercraft, do not have a criterion on which the FHWG regulates impacts. However, although it is not in the interim criteria, NMFS and the United States Fish and Wildlife Service (USFWS) have set a 150 dB root mean square (rms) as a guideline for underwater sound pressure levels that may result in behavioral (i.e., subinjury) effects to fish. The 150 dB rms guideline for potential behavioral effects may be considered in some consultations, depending on location and the time of year the work is occurring. More research and discussions would be needed for a better understanding of the behavioral component of the thresholds. Sound pressure levels in excess of 150 dB rms are expected to cause temporary behavioral changes, such as elicitation of a startle response, disruption of feeding, or avoidance of an area. Depending on site-specific conditions, project

44 U.S. Department of Transportation, Federal Aviation Administration, "Federal Aviation Regulations Part 150: Airport Noise Compatibility Planning," January 1981.

45 Fisheries Hydroacoustic Working Group, Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving Activities, 2008.

timing, project duration, species life history, and other factors, exposure to these levels may cause behavioral changes that rise to the level of "take." Those levels are not expected to cause direct permanent injury, but may indirectly affect the individual (such as impairing predator detection).

D.6 Hydroacoustic Threshold Criteria for Marine Mammals

In-water noise sources are typically divided and defined as either Impulsive (i.e., sounds that are transient, brief, and consist of high peak pressure with rapid rise and decay time [e.g., impact pile driving], or nonimpulsive (i.e., sounds that may be broadband, narrowband or tonal, brief or prolonged, continuous or intermittent) and typically do not have a high peak sound pressure, with rapid decay or rise time seen in impulse sounds. Hovercraft noise would be considered a nonimpulsive mobile sound source. NMFS has compiled, interpreted, and synthesized the scientific literature to produce thresholds for onset of temporary (TTS) (e.g., temporary effect or loss of hearing) and permanent threshold shifts (PTS) (e.g., permanent physical damage to hearing). These thresholds are different for species groups and are regulated by NMFS Office of Protected Resources for nonlisted marine mammals and through the USFWS and NMFS for listed species. Potential noise impacts both in air and in water are considered here in the NMFS criteria.

Table 12. In-Water Acoustic Thresholds[46]

Criterion	PTS Onset (Received Level)	
Level A: Hearing Groups	Impulsive	Nonimpulsive
Low-Frequency Cetaceans (LF)	PK: 219 dB SELcum: 183 dB	SELcum: 199 dB
Mid-Frequency Cetaceans (MF)	PK: 230 dB SELcum: 185 dB	SELcum: 198 dB
High-Frequency Cetaceans (HF)	PK: 202 dB SELcum: 155 dB	SELcum: 173 dB
Phocid Pinnipeds (PW)	PK: 218 dB SELcum: 185 dB	SELcum: 201 dB
Otariid Pinnipeds (OW)	PK: 232 dB SELcum: 203 dB	SELcum: 219 dB
Criterion	Criterion Definition	Threshold
Level B	Behavioral disruption for impulsive noise (e.g., impact pile driving)	160 dB rms
Level B	Behavioral disruption for continuous noise (e.g., vibratory pile driving, drilling)	120* dB rms

Notes:

Level A:

Dual Thresholds (impulsive): Use one resulting in large effect distance (isopleth).

SELcum thresholds incorporate weighting functions.

Level B:

All decibels referenced to 1 micro Pascal (re: 1 uPa). Note: all thresholds are based on root mean square (rms) levels.

*The 120 dB threshold may be slightly adjusted if background noise levels are at or above this level.

46 Endangered Species Act Section 7 Consultation Tools for Marine Mammals on the West Coast. Available at: https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/esa-section-7-consultation-tools-marine-mammals-west.

Table 13. Current In-Air Acoustic Thresholds

Criterion	Criterion Definition	Threshold
Level A	PTS (injury) conservatively based on TTS	None established
Level B	Behavioral disruption for harbor seals	90 dB rms
Level B	Behavioral disruption for non-harbor seal pinnipeds	100 dB rms

Appendix E – South Bay Environmental Constraints

Figure 41 and Figure 42 show two key references highlighting environmentally constrained regions in the San Francisco Bay Area, particularly in the South Bay.

Figure 41 shows the Bay Plan 2012 Land uses. Any territory outlined in red is designated as “Wildlife Refuge” in the Bay Plan and therefore is unlikely to be considered a suitable location for a hovercraft terminal by regulatory agencies; this designation encompasses most of the far southern end of the bay.

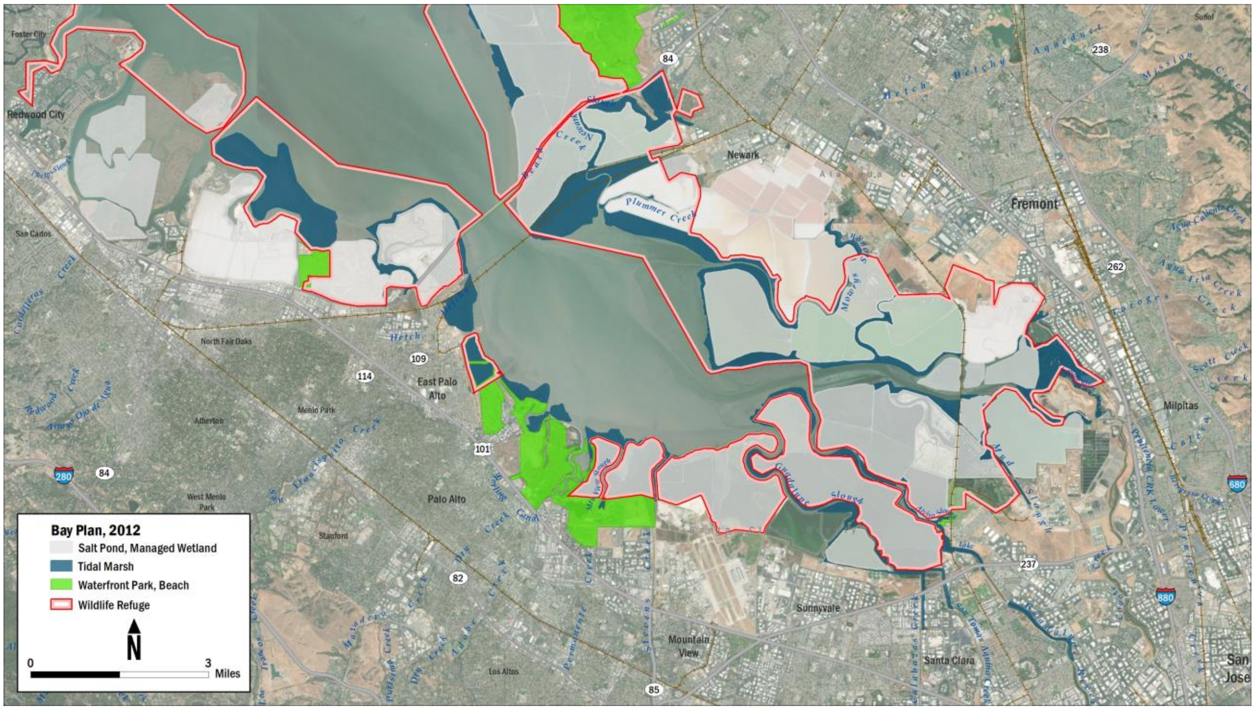

Figure 41. Bay Plan 2012 Land Uses

Figure 42 shows protected lands in the South Bay, including the Don Edwards National Wildlife Refuge and other lands managed to preserve or restore environmentally sensitive areas. Such designated land uses, which again encompass most of the far southern end of the bay, would not likely be compatible with siting for a hovercraft terminal. Although the hovercraft terminal itself would not be cited on protected lands, it would have to traverse a long distance through narrow, serpentine sloughs directly adjacent to protected lands. Furthermore, these long, slow speed transits in south bay sloughs reduce the cost feasibility of routes on the far south bay, because they reduce the number of round trips a single craft can make in a single labor trip. Hovercraft are also not adept at maneuvering in such waterways at slow speeds, making it preferable to travel in a generally straight line, which in turn makes operations here difficult.

Environmental impact and regulatory approval considerations, in conjunction with a number of operational factors detailed in Appendix B, led to the elimination of routes and terminals south of the Dumbarton rail bridge from further consideration following Phase 1 of the study.

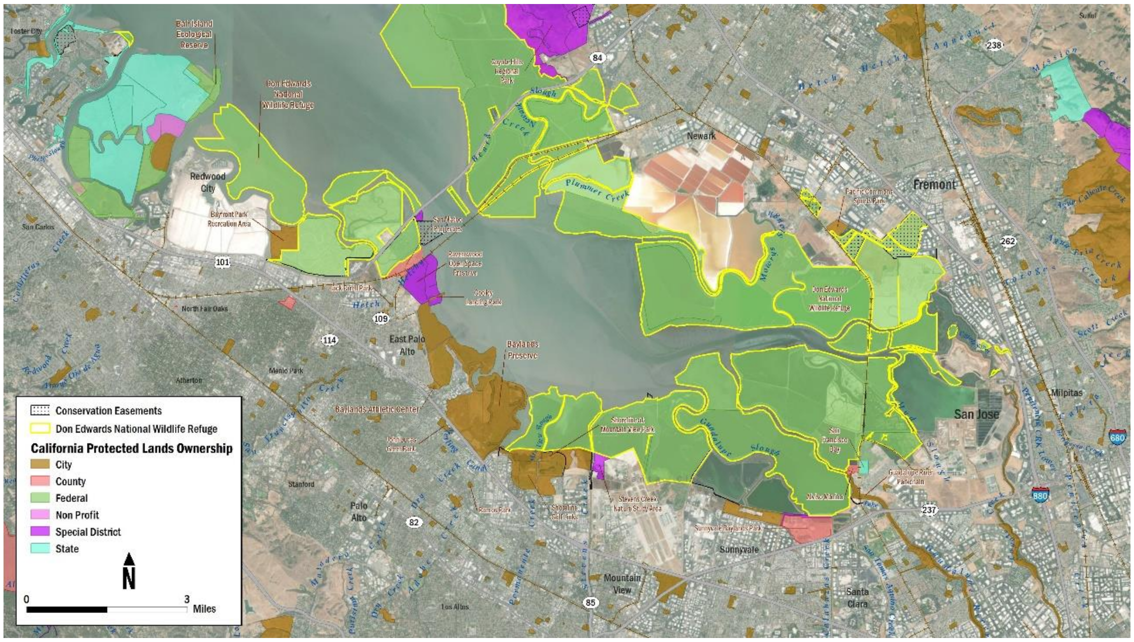

Figure 42. Protected Lands

E.1 Site Specific Environmental Constraints: Protected Species and Habitat

Slough channels at all considered sites in the South Bay are surrounded by fringe marsh habitat. Upland from the sloughs and fringe marshes are levees that surround United States Fish and Wildlife Service (USFWS) Don Edwards National Wildlife Refuge ponds. Sloughs and the surrounding fringe marsh at all South Bay locations considered provide habitat for federally listed Ridgeway's Rail (*Rallus longirostris obsoletus*), salt marsh harvest mouse (*Reithrodontomys raviventris*), California least tern (*Sterna antillarum browni*), California Central Coast steelhead (*Oncorhynchus mykiss*), and green sturgeon (*Acipenser medirostris*). Longfin Smelt (*Spirinchus thaleichthys*) is a federal candidate species and a state-listed species that has potential to occur anywhere in the Bay. The adjacent ponds provide habitat for federally listed Western snowy plover (*Charadrius alexandrinus*). California Fish and Game Code Sections 3511, 4700, 5050, and 5515 provide fully protected status for specific species, and no permits can be issued to allow incidental injury or killing of these species; salt marsh harvest mouse is included as a Fully Protected species. The use of these ponds by species that are not state- or federally listed is greatly diverse. Ridgeway's rail, California least tern, and Western snowy plover would be considered sensitive receptor species that would be potentially impacted by increased in-air noise levels from hovercraft. Fish species are regulated by the California Department of Fish and Wildlife (CDFW) and the National Marine Fisheries Service (NMFS) under guidance provided by the Fisheries Hydroacoustic Working Group.

The South Bay includes use by marine mammals that are protected under the Marine Mammal Protection Act. Southern sea otter (*Enhydra lutris*) and harbor seal (*Phoca vitulina richardsi*) have a historic presence in the South Bay.[47] However, all hearing groups of cetaceans and pinnipeds (Table 14) could be present and are potentially impacted by in-water noise while foraging. Pinnipeds could also be affected by noise when using haul-out sites.

Special-status bird species and pinnipeds could also occur near other routes and terminal locations considered in Phase 2 of this study; however, for these locations, it may be possible for hovercraft to main sufficient distance from sensitive areas for most of the travel route to minimize potential airborne noise impacts on these species. In the southern extent of the South Bay, the contiguous shorebird habitat and location of known haul-out sites immediately adjacent to the narrow sloughs that hovercraft would need to travel would make it difficult to largely avoid these sensitive habitat areas.

[47] Baylands Ecosystem Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife Species and Community Profiles. Available at: https://baylandsgoals.org/wp-content/uploads/2015/10/2000Species_and_Community_Profiles.pdf.

Table 14. Hearing Ranges of Cetaceans and Pinnipeds Groups [48]

Hearing Group	Generalized Hearing Range*
Low-frequency (LF) cetaceans (baleen whales)	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans (true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*)	275 Hz to 160 kHz
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (OW) (underwater) (sea lions and fur seals)	60 Hz to 39 kHz

* Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall et al. 2007) and PW pinniped (approximation).

48 *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0).* Page 3, Table ES1. Available at: https://www.fisheries.noaa.gov/webdam/download/75962998.

Appendix F – Emissions Analysis

F.1 Emissions Methodologies

The California Air Resources Board (CARB)-promulgated Emissions Estimation Methodology for Commercial Harbor Craft Operating in California was used to compute the emissions assessment for hovercraft and catamarans.[49] The following equation was used to calculate emissions of nitrogen oxides (NO_X), particulate matter less than 10 microns in aerodynamic diameter (PM_{10}), particulate matter less than 2.5 microns in aerodynamic diameter ($PM_{2.5}$), reactive organic gases (ROG), and carbon monoxide (CO).

$$E = EF_0 \times F \left(1 + D \times \frac{A}{UL}\right) \times HP \times LF \times Hr$$

Where:

E is the amount of emissions of a pollutant (ROG, CO, NO_X, or PM) emitted during one period (g/one-way trip);

EF_0 is the model year, horsepower, and engine use (propulsion or auxiliary) specific zero-hour emission factor (when engine is new);

F is the fuel correction factor that accounts for emission reduction benefits from burning cleaner fuel;

D is the horsepower and pollutant-specific engine deterioration factor, which is the percentage increase of emission factors at the end of the useful life of the engine;

A is the age of the engine when the emissions are estimated;

UL is the vessel type and engine use specific engine useful life;

HP is rated horsepower of the engine;

LF is the vessel type and engine use specific engine load factor;

Hr is the number of operating hours of the engine.

Emissions factors for these five pollutants from the CARB Commercial Harbor Craft methodology were used for representative vessel types assumed in the analysis.

Both sulfur oxides (SO_X) and carbon dioxide equivalent (CO_2e) emissions from vessels are a result of the chemistry of the fuel used, and therefore fuel-based emissions factors provide the most accurate results. Using the CARB Commercial Harbor Craft methodology, the SO_X emissions factor assumes ultra-low sulfur fuel with 15 parts per million (ppm). The emission factors for SO_X assume all sulfur in the fuel is converted to SO_2. CO_{2e} emissions factors from CARB and the United States Environmental Protection Agency (USEPA) mandatory greenhouse gas (GHG) reporting programs were used (Source: 40 Code of Federal Regulations [CFR] 98 Tables C-1 and C-2.).[50] Stochiometric burns are assumed for CO_2.

[49] https://ww3.arb.ca.gov/msei/chc-appendix-b-emission-estimates-ver02-27-2012.pdf.
[50] https://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&SID=be77ce6e756f0befaa0dd95743e3342e&tpl=/ecfrbrowse/Title40/40cfr98_main_02.tpl.

F.2 Emissions Assumptions

Hovercraft load factors were derived from the power estimated provided by Griffon and shown on Figure 43.

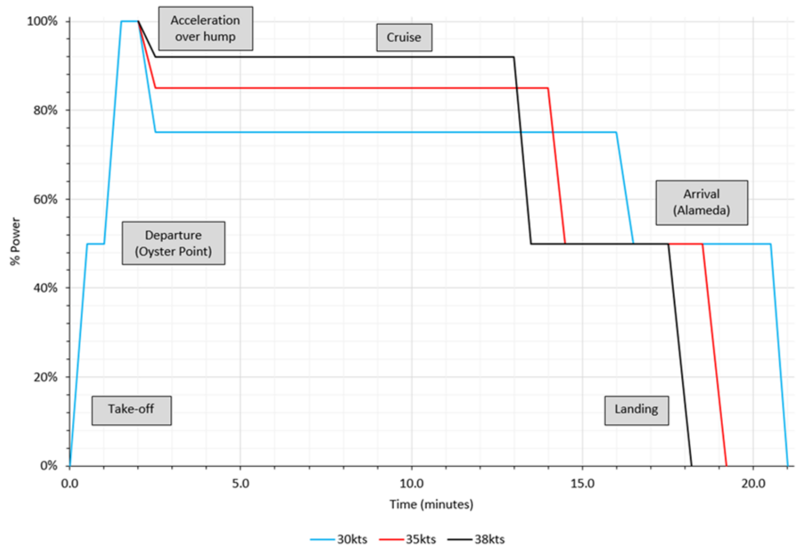

Figure 43. 12000TD Hovercraft Power Curve

The Griffon 12000TD specifications listed in Table 15 were used to estimate hovercraft emissions.

Table 15. Hovercraft Specification for Emissions Analysis

Hovercraft Specifications	
Engine Type	Tier 4
Power per engine (kw)	793
Minimum Crew	2
Passengers	75
Max payload (metric tons)	12
Standard Endurance (hours at most economical speed)	5
Speed at full payload	45
Engine Type	2 × MAN

Catamaran emissions were estimated using CARB default factors as well as the Vessel Type Gemini, which has two 1,410-horsepower engines, estimated to use 120 gallons of diesel per hour, and can carry 225 passengers.

Table 16 highlights the assumed ridership, based on existing information from Water Emergency Transportation Authority (WETA) and Griffon.

Table 16. Ridership Inputs for Emissions Analysis

Mode	Estimated Passengers Per Vehicle Trip	Ridership Assumptions
Hovercraft	53	70%
Catamaran	113	50%

F.3 Emissions Results

Figure 44 through Figure 50 provide a comparison of hovercraft and catamarans for each of the pollutants in the analysis. The comparison is provided in emissions per one-way passenger trip to account for differences in catamaran and hovercraft passenger capacity.

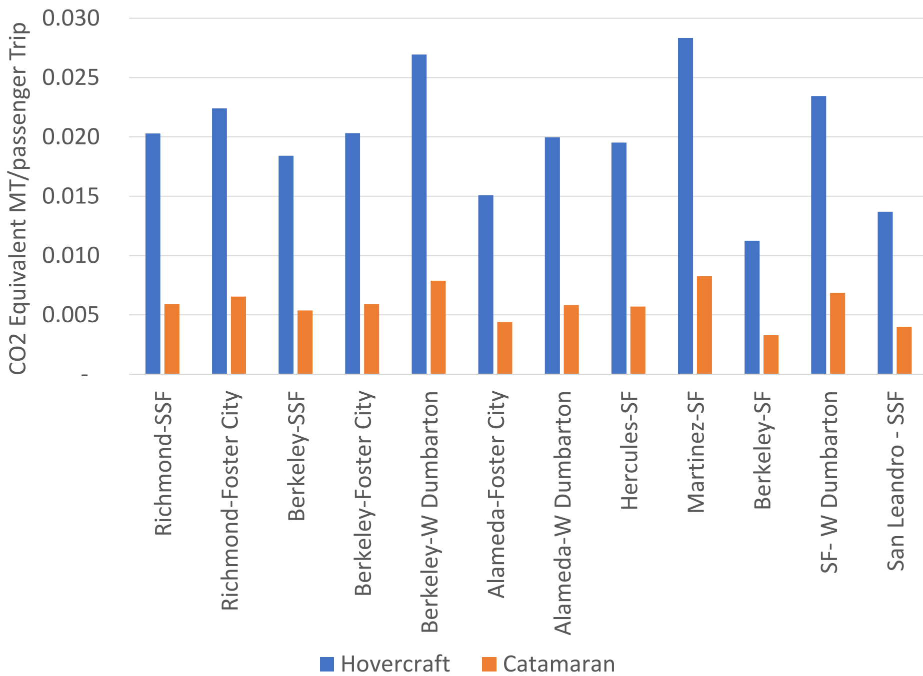

Figure 44. CO_2e Emissions Comparison

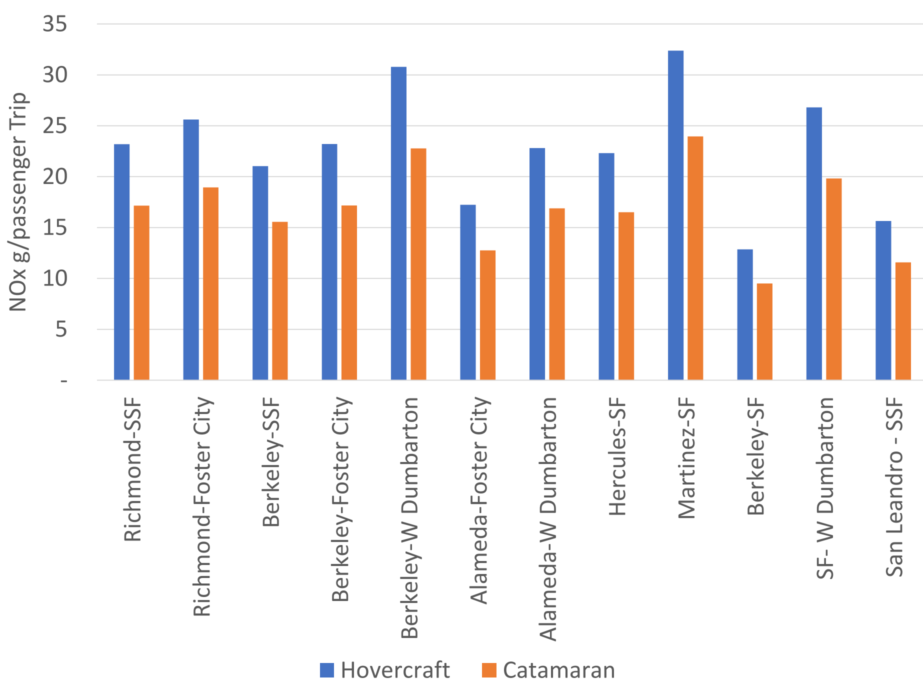

Figure 45. NO_x Emissions Comparison

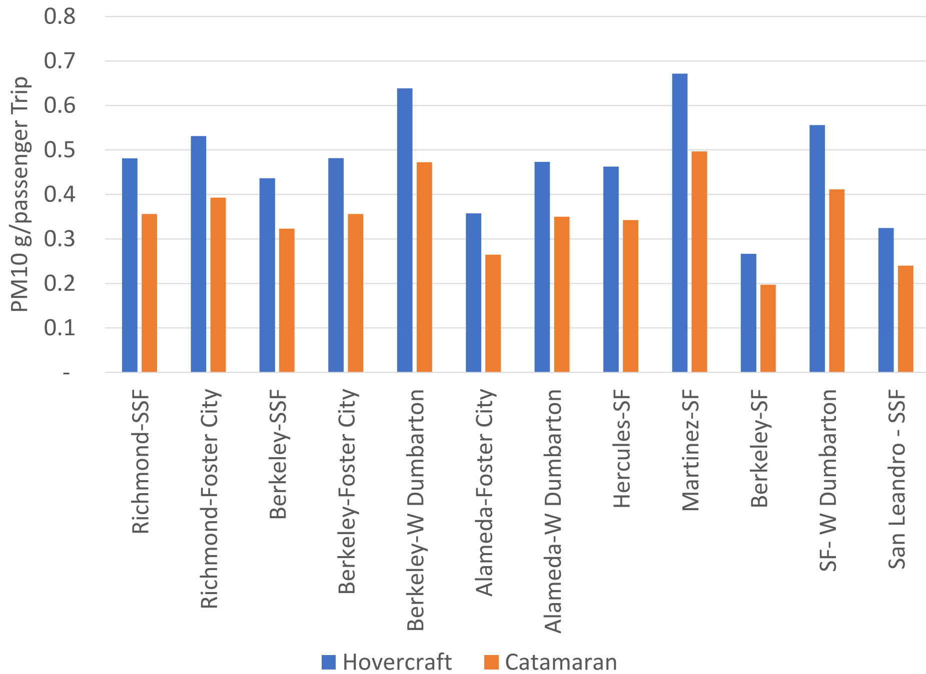

Figure 46. PM_{10} Emissions Comparison

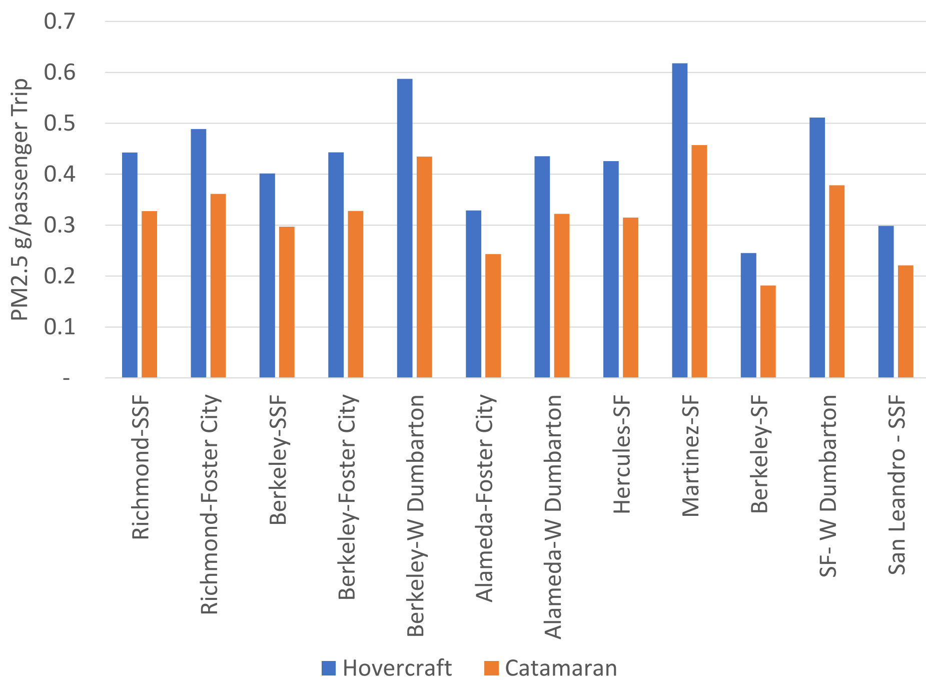

Figure 47. $PM_{2.5}$ Emissions Comparison

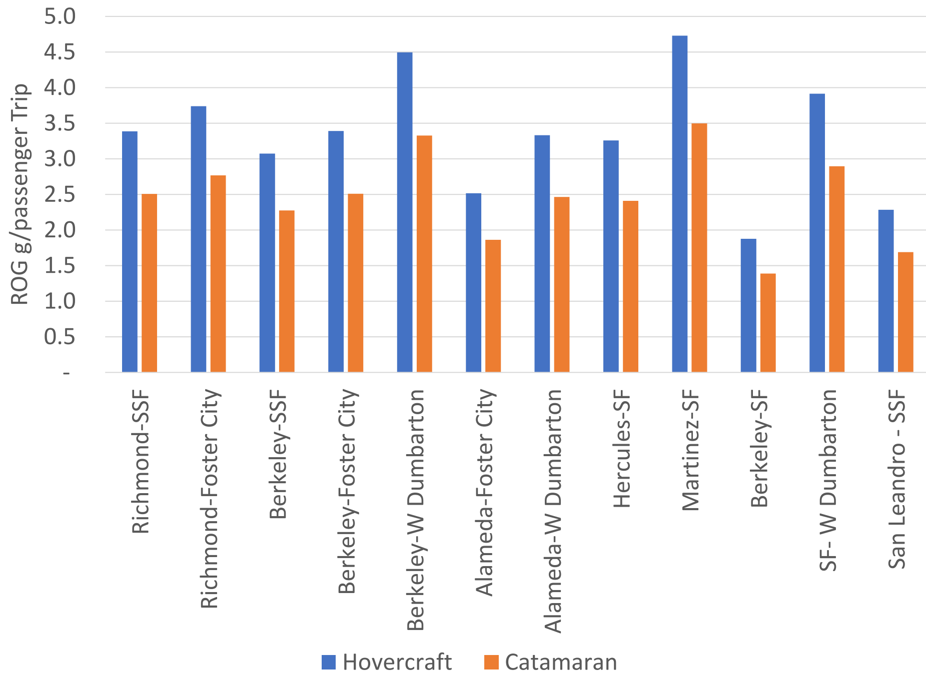

Figure 48. ROG Emissions Comparison

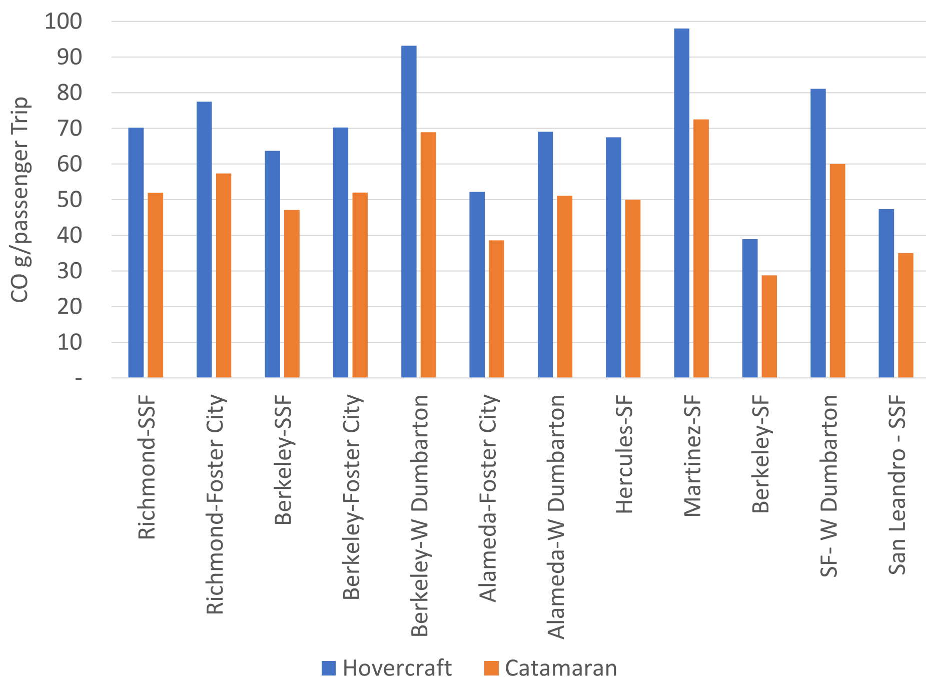

Figure 49. CO Emissions Comparison

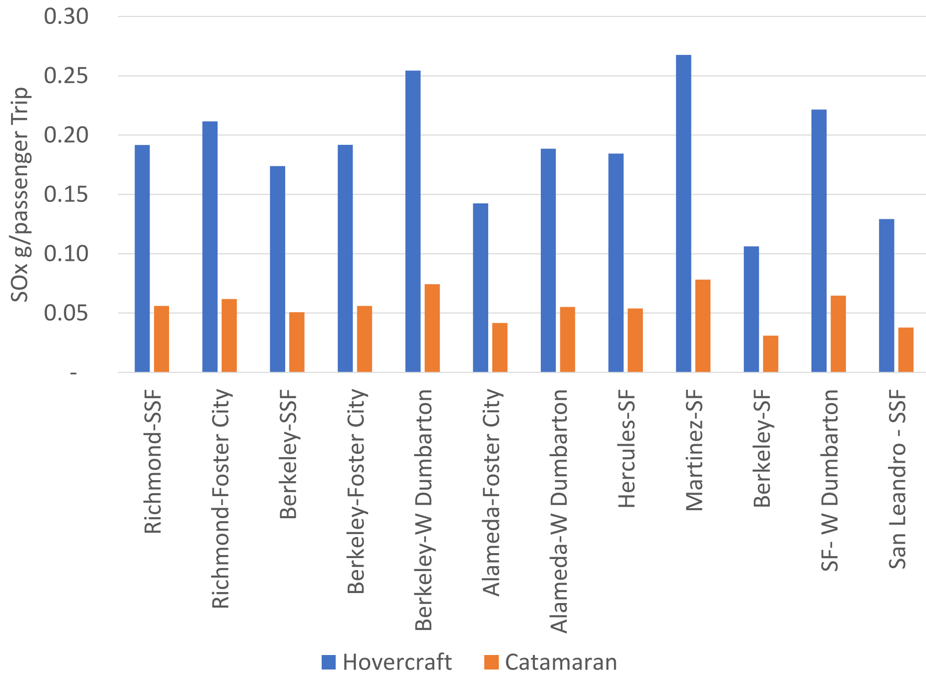

Figure 50. SO_X Emissions Comparison

Appendix G – Funding and Financing Matrix

Appendix G is provided as an attachment to this study.

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Appendix G - Funding & Financing Matrix for Hovercraft Feasibility Study

When prioritizing which sources WETA should pursue for hovercraft, there are numerous criteria to consider, including but not limited to: compatibility between the source and transportation service, WETA's existing funding needs and sources, ease of securing, revenue generating potential, flexibility of the funds, administrative complexity, and equity implications. These criteria determined the rankings for each potential funding source.

Local Revenue-Generating Mechanisms

Strategy	Strategy Category	Strategy Description	Key Benefits	Key Challenges	Other Considerations	Potential Applicable Funding Range	Cost Burden / Lead Agency	Use of Funds	Strategy Prioritization
Farebox revenue	Fares	Revenue from ticket sales/ridership.	• Easy to administer. • Directly billed to service users.	• If assuming 50% farebox recovery, then revenue will not cover all O&M costs.	• Dependent on ridership, which is dependent on the economy. • Annual and seasonal fluctuations. • Lifeline rates. • 50% farebox recovery means fares will be $16 to $30, which may be inaccessible for many.	$4 - $5 million per route	Riders	Operations & Maintenance	**High priority**
New Sales Taxes (e.g. Faster Bay Area, Measure J in Contra Costa County, Measure A in San Mateo County)	Special or General Tax	Fixed increase in sales tax rate for a defined term.	• Regional tax measure has the potential to raise significant amount of funds. • Could bond against future revenues. • Can be used for capital or operating expenses.	• Regressive. • Requires WETA to find a replacement funding source when sales taxes sunset. • Revenues will shrink during economic downturns.	• WETA already mentions a new potential sales tax as a source of funding in their 2020 SRTP, which indicates funding is needed for existing ferry services. •Sales tax revenue is earmarked a variety of projects - not just one - so WETA would have to collaborate with counties/cities that are in need of increased revenue. • San Mateo, Contra Costa, and Alameda recently had transportation sales tax measures on their ballots. • If/when Faster Bay Area becomes a priority again, WETA could negotiate to receive funding from this source. • Typically general taxes at the local level require a simple majority to be levied, while dedicated taxes require two-thirds vote.	$10 - $60 million	Consumers	Both	**High priority**
Regional Measure 4	Tolls	One dollar increase in regional bridge tolls.	• No time limit on the toll increase. • Potential to raise a significant amount of funds. • Can be used for capital or operating expenses. • Could bond against future revenues. • Measures are familiar to Bay Area citizens. • Cost is assigned to the party that creates the negative externality (drivers; congestion and greenhouse gas emissions).	• Regional Measure 3 was very recently passed in 2018 and will implement additional fare hikes in 2022 and 2025. A potential RM4 would likely not garner voter support for many years.	• WETA would likely pursue either a regional tax initiative, such as FASTER, or a Regional Measure, but not both, at least in the initial years of service. • Collaborating with MTC, local jurisdictions and transit agencies to get this initiative on the ballot takes time and resources. • Negotiations would be required with partner agencies to determine how much of the total revenue WETA would be able to secure.	$5 - $20 million per year	Drivers	Both	**Medium priority**
Tax increment financing (Enhanced Infrastructure Finance District (EIFD))	Property Tax Increment	A city or other governing jurisdiction can allocate tax increment revenues for up to 45 years to fund the planning, design, improvement, construction, or rehabilitation of assets with an estimated life of 15 years or longer. These properties include but are not limited to highways, transit, water systems, sewer projects, flood control, and parks.	• Not subject to Proposition 13 limitations. • Process has been done elsewhere and is understood. • Geographic boundaries are flexible. • Could bond against future revenues (although fees may be higher due to risk of fluctuations).	• Issuance of bond requires 55% voter approval in district. • Requires redirecting future property tax revenue. • Dependent on anticipated increases in value, which is limited for highly built-out areas, particularly under Prop. 13 • Affected taxing entities (e.g. cities, special districts) must voluntarily agree to contribute funds. • Amount raised depends on the amount of new development; EIFDs work best when coupled with policies that increase density (primarily due to the limitations posed by Prop 13); limits geographic scale	• District could be designed for a long time horizon (45 year cap). • Most applicable for landing areas where there is significant development potential.	$200k - $5 million per year	Property owners	Capital	**Medium priority**
Mello-Roos Community Facility District	Special Tax	A special taxing district where a special tax on real property, on top of the basic property tax, is imposed on taxable property within the district. The special tax can fund the planning, design, construction, or improvement of public infrastructure and some public services. Rate of tax determines potential revenue amount.	• Low approval thresholds needed where there is new development. • Boundaries do not need to be contiguous. • Flexibility in tax rate formula - could be based on distance from stations. • Flexible use for capital and some maintenance. • Process has been done elsewhere and is understood. • CFDs already exist in certain landing areas (Alameda). • District could be designed for a long time horizon. • Could bond against future revenues.	• If more than 12 registered voters, requires two-thirds approval of district's registered voters. • Dependent on property owners supporting the service and willingness to ensure that the service connects to their area. • Need to consider existing property tax limit(s). • Given voter requirements, geographic scale may be limited to areas with development potential.	•Likely most applicable for landing area improvements such as landscaping, streetscape, and lighting. • Most applicable for landing areas where there is significant development potential.	$200k - $10 million per year	Property owners	Both	**Medium priority**
Assessment District	Assessment	A charge imposed on property owners in a specified geographic area or district to fund specific projects or services that provide direct benefits to properties in that district. For transit related benefit districts, the district boundary is typically one half mile radius from the transit station. Fee rate determines potential revenue amount.	• Not subject to Proposition 13 limitations. • Lower voter approval thresholds than special taxes. • Could bond against future revenues.	• Must demonstrate that the cost of the assessment directly correlates with benefit received by the parcel owner. • Dependent on property owners supporting the service and willingness to ensure that the service connects to their area. • Assessment districts for transportation typically only include properties up to a half mile radius of the new station, which will limit the amount of potential revenue, particularly in the proposed landing locations where there are few existing parcels. • Bonds paid back by benefit assessments can be more expensive due to increased risk associated with property value changes.	• An Assessment District would be easier to implement in a location where there is significant development potential. Developers may support this effort if it would ensure that a terminal is co-located near their development site. • Overall, this mechanism has the potential to create only a modest sum of money so WETA would need to make a strategic decision about whether it would be worth pursuing.	$200k - $10 million per year	Property owners	Both	**Low Priority**
Development Impact Fees	Fee	A type of non-property-related fee and that can be imposed by local governments to pay for infrastructure and public services expansion. Fee rate determines potential revenue amount.	• No voter approval required. • Process has been done elsewhere and is understood. • Requires developers to pay for the expected burden to public infrastructure, such as congestion, that their new development will cause.	• Tied to market conditions which are often cyclical and difficult to forecast. • Geographic scale limited to areas with development potential.	• Requires new development / major redevelopment to generate significant funding. • Commonly used example: Transportation Impact Fee.	$1 - $15 million	Developers / Property Owners	Capital	**Low Priority**
Ad Valorem Property and Parcel Taxes	General obligation bond approval requirements similar to special tax	Taxes based on property value. There are two components of ad valorem property taxes in California: 1) a 1% tax based on a property's assessed value that is a general tax that can fund any public purpose and potentially 2) additional tax for voter-approved debt repayments, typically for general obligation bonds for local infrastructure. Parcel taxes are a special tax based on a fixed amount of tax per parcel of land, rather than on the value of the land. Can fund a variety of local government services and can be imposed as a flat rate. Potential revenue amount is determined by the geography and the rate.	• Can be used for capital or operating expenses. • Could bond against future revenues.	• Requires two-thirds voter approval of those within the target jurisdiction or district (may require simple majority if levied by publicly sponsored special tax initiatives). • Dependent on property owners within the target area supporting the service and willingness to ensure that the service connects to their city.	• General Obligation Bond may be a better route, but would depend on jurisdiction's debt capacity. •Generally used to fund things that benefit the entire district or jurisdiction (water, sewage, emergency response, street lighting); the only exception is schools. • Flat rate is regressive so the ad valorem tax is likely the preferred route.	$1 - $50 million	Property owners	Both	**Low Priority**
Other taxes: Business license tax, gross receipts tax / per employee tax, real estate transfer tax	Special or General Tax	These taxes are levied at the city-level and are, generally, fees for doing business in that jurisdiction. These fees are either collected annually or at the time of a transaction.	• Can be used for capital or operating expenses. • Tax can be structured to apply different rates to different transactions/business size/etc.	• Most of the cities with proposed landing areas already have these taxes so WETA would instead have to pursue raising or restructuring the tax rate in order to generate new revenue. • Not a strong nexus between these taxes and the service. • Typically general taxes at the local level require a simple majority to be levied, while dedicated taxes require two-thirds vote. • Revenue generating potential is low.	• These taxes would likely only occur at the city-level so WETA would have to work with target jurisdictions (e.g. cities where landing terminals will be located) to create a tax proposal and then get it approved. • Voter support will depend on public's perception of the new service.	$50k - $5 million	Variable	Both	**Low Priority**

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Appendix G - Funding & Financing Matrix for Hovercraft Feasibility Study

When prioritizing which sources WETA should pursue for hovercraft, there are numerous criteria to consider, including but not limited to: compatibility between the source and transportation service, WETA's existing funding needs and sources, ease of securing, revenue generating potential, flexibility of the funds, administrative complexity, and equity implications. These criteria determined the rankings for each potential funding source.

Grants

Strategy	Strategy Category	Strategy Description	Key Benefits	Key Challenges	Other Considerations	Potential Applicable Funding Range	Cost Burden / Lead Agency	Use of Funds	Strategy Prioritization
Federal Transit Administration's Passenger Ferry Grant Program, 5307	Federal Grant	The Passenger Ferry Grant program (49 U.S.C. 5307(h)) provides competitive funding for projects that support passenger ferry systems in urbanized areas. These funds constitute a core investment in the enhancement and revitalization of public ferry systems in the nation's urbanized areas. Funds are awarded based on factors such as the age and condition of existing ferry boats, terminals and related infrastructure; benefits to riders, such as increased reliability; project readiness; and connectivity to other modes of transportation	• Will fund up to 80% of capital costs. • Limited "strings attached".	• Highly competitive since there is only one FTA grant program specific to ferries. • Program has approximately $30 million, so WETA would need to apply for funding for only a portion of its capital costs. • WETA has received this grant for 2020 and anticipates needing it in the near future to fund ferry service needs. • Requires projects to be part of the RTPs and State Transportation Improvement Program (STIP). • Requires completion of the National Environmental Protection Act (NEPA) process.	• In 2020, their grants ranged between $1 and $5M. This would be a good source for landing site development costs.	$2 - $6 million	FTA	Capital	**High priority**
Private Sector Contributions	Private investment	Private sector contributions involve one or more parties bringing new financial resources to the table in order to support needed capital investments, operating subsidies or ancillary improvements that help to build patronage to sustainable levels. For example, a developer may choose to make contributions to the proposed hovercraft service to ensure that the service connects to their development. Other private sector entities, such as a large employer, may choose to provide contributions to the hovercraft service in order to reduce its private transit offerings for employees.	• "Free" money. • Contributions can take many forms and include varying levels of private sector involvement, which can create flexibility and opportunities for WETA. • Depending on the proximity of the terminal to the development, a developer may be able to build the terminal, which would remove the burden from WETA. • Developer contributions are a strong indication of future ridership.	• Contributing organizations may want more control over service, including route and timing, which could impact the level of service provided to the general public. • Several companies will likely need to contribute in order to make an impact on the overall funding shortfall. Aligning interests between private companies can be challenging.	• In the absence of available grants and revenue sources, at least in the near future, private sector contributions could be critical to making a hovercraft service financially feasible. • Interviews with stakeholders indicate that there is private sector interest in financially participating in a future hovercraft system.	$1 - $20 million each	Private Sector	Both	**High priority**
California's Low Carbon Transit Operations Program (Discretionary Grant)	State Grant	This program provides operating and capital assistance for transit agencies to reduce greenhouse gas emissions and improve mobility. The funding program is part of the state's Greenhouse Gas Reduction Fund. A portion of the LCTOP funds are allocated to operators based on the State Transit Assistance (STA) Revenue-Based formula. LCTOP funds can to be used to support capital and operating expenses that enhance transit service and reduce greenhouse gas (GHG) emissions. These funds can also be used to support new or expanded transit services, or expanded intermodal facilities and equipment, fueling, and maintenance for those facilities.	• This money is already allocated to WETA. • Provides fare subsidies for transit	• The hovercraft system may not be an ideal candidate for these funds given its estimated GHG emissions.	• The hovercraft system may not be a great candidate to receive funds for capital purposes, however, LCTOP funds could be used to subsidize fares for lower-income individuals. Grants for fare reduction range up to $2M/year. The fund gave out up to $3M for capital projects in 2019.	$100k - $5 million	Caltrans	Both	**Medium priority**
California's Transit and Intercity Rail Capital Program	Grants	This program was created by Senate Bill (SB) 862 to provide grants from the Greenhouse Gas Reduction Fund (GGRF) to fund transformative capital improvements that will modernize California's intercity, commuter, and urban rail systems and bus and ferry transit systems to significantly reduce greenhouse gas emissions, vehicle miles traveled, and congestion. Assembly Bill (AB) 398 extended the Cap and Trade Program that supports the TIRCP from 2020 through 2030. WETA assumes use of $6.9 million in TIRCP funds to support the construction of new vessels over the ten-year planning period.	• Projects that are funded by this program receive between $5 and $100M so there's potential to receive a lot of money.	• New evaluation criteria require that the proposed project show how it will create GHG reductions and have significant ridership impacts relative to project cost. These criteria indicate that the hovercraft may not be a highly rated project. • WETA is already expected to receive money from this fund for new vessels in the next 10 years. • Currently, this program is scheduled to sunset in 2030.	• While the hovercraft system may not be as highly rated as other competing projects, it may still be a candidate for some capital funding as it meets many of the secondary criteria. • This Program provides funding for fare subsidies for lower-income populations. This funding could make fares more accessible for more people. However, grants are only provided on an annual basis.	$5 - $100 million	Caltrans	Capital	**Medium priority**
Federal Emergency Management Agency's (FEMA) Transit Security Grant Program (TSGP)	Federal Grant	The TSGP provides funds to eligible public transportation systems (which include intra-city bus, ferries, and all forms of passenger rail) to protect critical transportation infrastructure and the travelling public from terrorism, and to increase transportation infrastructure resilience. TSGP identifies the following areas as priority areas: 1) Enhancing cybersecurity; 2) Enhancing the protection of soft targets/crowded places; and 3) Addressing emerging threats (e.g., transnational criminal organizations, weapons of mass destruction [WMD], unmanned aerial systems [UASs], etc.)	• Can fund a significant amount of capital costs. • Hovercraft offers an alternative to roadway and rail travel and does not have fixed guideway infrastructure that would be impacted by some sort of shock (e.g. disaster event or attack).	• Competitive application and hovercraft may have a difficult time winning this grant because WETA would be seeking grant funding for capital expenses that are different from the Program's priorities.	• Although the TSGP has a significant amount of funding ($355M), it's unclear whether the hovercraft system would be a good candidate for it. Further exploration would be required.	$10 - $50 million	FEMA	Capital & operations	**Medium priority**
FTA's Capital Investment Grants - 5309; New Starts and Small Starts	Federal Grant	The CIG funds nearly $2.3B each year for light rail, heavy rail, commuter rail, streetcar and bus rapid transit projects. The New Starts program funds projects that cost $300M+ or are looking for over $100M in funding. The Small Starts program funds new projects or extensions to existing projects that are less than $300M or are seeking less than $100M. These grants are typically made available to rail or fixed guideway projects.	• Opportunity to receive significant funding.	• Highly competitive. • A water transit service is unlikely to receive funding. • Would need to demonstrate significant mode shift benefits. • Federal grants can add significant time to projects and contractors often charge a premium to work on federally funded projects. • Federal grant requirements, such as the Buy American act, could threaten hovercraft eligibility.	• Currently the CIG program is not funding any ferry services. • To receive the grant, there must be a local financial commitment. FTA states that it prefers that the local "overmatch". WETA would have to consider whether STA would be able to provide enough of a match, or if another matching source is needed. • Unclear if the project will meet its evaluation and cost effectiveness requirements. • Federal oversight poses risks to timeline. • If awarded, likely to receive a lot of money. Grant can fund up to 80% of capital costs.	$10 - $90 million	FTA	Capital	**Low Priority**
Federal Highway Administration's (FHWA) National Highway Performance Program (NHPP)	Federal Grant	The FAST Act continues the NHPP, which provides support for the condition and performance of the National Highway System (NHS), for the construction of new facilities on the NHS, and to ensure that investments of Federal-aid funds in highway construction are directed to support progress toward the achievement of performance targets established in a State's asset management plan for the NHS. Estimated funding for 2020 is $24.2B. NHPP grants are granted to each state and then the state divides to specific programs. The NHPP may be used to fund ferry services.	• Opportunity to receive significant funding.	• Highly competitive. • A water transit service is unlikely to receive funding. • Would need to demonstrate benefits to the highway system, likely in the form of congestion reduction. • Federal grants can add significant time to projects and contractors often charge a premium to work on federally funded projects. • Federal grant requirements, such as the Buy American act, could threaten hovercraft eligibility.	• Eligibility requirements focus on project related directly to highway construction and maintenance. • Ferry operation must be on a public road not designated on the Interstate System.	$10 - $50 million	FTA	Capital	**Low Priority**

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Appendix H - Delivery Model Matrix for Hovercraft Feasibility Study

Strategy	Description	Key Benefits	Key Challenges	Other Considerations
Public Private Partnerships (P3)	A cooperative arrangement between one or more public and private sectors that can take different forms such as private entity financing, building, and/or managing a project in return for a promised stream of payments from a government agency over the projected life of the project. Government agencies elect to pursue P3s as a strategy to secure upfront funds for capital projects that they cannot fund alone.	•This model would minimize the number of grants and local revenue streams. • In the context of limited public funding, a P3 would allow WETA to deliver the project soon rather than later. • A private entity could purchase the fleets and operate the system, thus removing near-term financial risk and operational burden from WETA. • Private operators have the reputation for being able to move more quickly and operate more efficiently.	• Public agencies have mixed views on the success of P3s. • Could be more expensive compared to the G.O. Bond market. • Could require redirecting future public revenue (depending on contract design), which creates potential for political pushback. • Takes time to set up contract. Contract would need to have specific guidelines around fares and service to ensure that the systems operates, overall, as a public good	• This project is a good candidate for the P3 model because riders would pay fares, which is attractive to private partners. Unfortunately, fares do not fully cover OpEx, which make it more complex for the private partner to earn their required return. • Process has been done elsewhere and is understood. • Could provide significant upfront capital, especially given competition for state and federal grants. • Appealing for public agencies with limited debt capacity • Although it is complex during startup, it is easy to manage once in operations mode.
Transportation Management Agreement	A TMA is an agreement between a service operator and private entities to provide transportation services. The operator owns and operates the fleet, while the private entities determine and pay for the service.	• There are multiple ways that a TMA could be used to run a potential hovercraft system. One scenario would be that WETA owns and operates the fleet while a group of private companies directly pay for some or all of the service. This would reduce operating expenses for WETA. • This scenario removes financial risk from WETA and leverages private dollars. • Another scenario would be that a private entity funds and operates the service separate from WETA. This would remove the burden of financing the project from WETA and allow it to operate its core service.	• A TMA would require multiple private companies to join together and, if they come to the table, negotiations could be protracted. • There is risk that a TMA would create more benefits for high-income earners (or those that work at the private entities who are part of the TMA) than for the general public. It could be perceived as private service operated by a public agency. • Private entities would have no obligation to serve the general public.	• If WETA were able to ensure that the agreement would allow WETA to still provide a public mass transit service, then this model could be feasible.
Traditional Design-Bid-Build	This delivery model is considered the "traditional" model and is the most widely used in the United States. It is often considered the "baseline" model to which other delivery models are compared. Project financing in this option is provided solely by public agencies, which is created by various sources, generally bonds and taxes. The public agencies contract with private firms to design and build the project. The public agencies directly purchase and operate their fleets.	• This model is known to WETA so there would be no start-up "friction" that might be associated by a P3. • A public agency is more equipped and motivated to run the service as a public good. • Tax revenue dollars stay within the public realm rather than being paid to a private entity.	• WETA must have enough capital to cover start-up costs, which can be hard to collect when there is limited public funding available.	• WETA would have to weigh the pros and cons of doing a P3 to determine if it would prefer to pursue a traditional delivery model.

Appendix H – Delivery Model Matrix

Appendix H is provided as an attachment to this study.

Appendix I – Terminal Area Detail

AECOM researched the current market conditions of the proposed hovercraft terminal locations to better understand potential tax or fee revenue-generating opportunities and identify potential partners that could assist Water Emergency Transportation Authority (WETA) in launching a hovercraft service. Terminal areas were evaluated using commuter and demographic data from the United States Census,[51] office and multifamily real estate market reports from CoStar,[52] and various local land use planning documents from the relevant municipalities. Real estate market trends give insight into current and projected economic conditions of the terminal areas; commuter characteristics help in understanding current travel behaviors and can indicate which areas may be more receptive or in need of new transit projects. Existing and planned density and compatible uses near the proposed terminal locations are strong indicators of ridership potential. Although the COVID-19 pandemic has impacted real estate submarkets in all the terminal areas, increasing vacancy rates and putting downward pressure on asking rents, the markets are expected to mostly recover by the time hovercraft would come online. Terminal areas with high and low potential are discussed first, following a more detailed discussion for each terminal location that includes real estate market analysis, commuter characteristics, and land use conditions. Terminal areas are divided into two categories: 1) those with immediate or near-term potential to support hovercraft service in terms of ridership, revenue generation potential, and partnership opportunities; and 2) those with medium- to long-term potential to support hovercraft service.

I.1 Immediate and Near-Term Potential

The South San Francisco, West Dumbarton/Menlo Park, and Foster City/Redwood Shores terminal locations are each characterized by dense office space, large anchor institutions (e.g., Genentech, Stripe, Oracle, Sony, Gilead Life Sciences, Electronic Arts, and Facebook), and planned development near the waterfront. Although the residential offerings in these locations are lower, this factor is mitigated by the number of workers commuting to these locations from other places in the Bay Area. Furthermore, each location has limited access to mass transit options, particularly Foster City and Menlo Park/West Dumbarton. South San Francisco has more mass transit options, including a Bay Area Rapid Transit (BART) and Caltrain stop, but the eastern area, where there is increasing office density, is not well served by these options. With many of these large employers offering private transit options to their employees, a hovercraft service would likely be a welcome opportunity to shift some of their employees from their private service to a public one. This potential creates a strong opportunity for partnership.

Downtown San Francisco offers both the density and land use mix to make it an attractive terminal location. However, it is already well serviced by BART, Caltrain, and Transbay bus services. WETA's goal with the hovercraft service is to service areas that are not currently accessible and would benefit from increased transit access.

On the other side of the Bay, Berkeley, Alameda, and San Leandro offer dense housing near the proposed terminal locations. All three cities have large residential populations commuting to San Francisco and the Peninsula via public transportation and private shuttles. Efforts are already underway in each city to make their waterfronts more accessible, as characterized by the planned opening of the Berkeley Pier and ferry service, development of the Naval Air Station at Alameda Point, and the City of San Leandro's forthcoming development of its shoreline. Alameda and San Leandro are also home the Cost Plus and Ghirardelli Chocolate Company headquarters, respectively. These investments, coupled with a large residential base, indicate that demand for a new Transbay mass transit option would be high and the cities and their counties may be willing to explore financing options to support the hovercraft service.

Finally, Hercules in Contra Costa County has broken ground on several mixed-use housing developments on the shoreline. These developments are part of a larger effort to develop the waterfront and bring ferry service to the Hercules, as part of the Waterfront District Master Plan. This level of effort and commitment by the City of Hercules to create ridership potential makes Hercules a strong location for hovercraft

[51] Longitudinal Employer-Household Dynamics (LEHD) OnTheMap, 2017.
[52] CoStar submarket reports, accessed July-August 2020.

service, too. Hercules lack the housing and business density of other proposed terminal locations, however, so it may be some time before the ridership numbers are comparable to those of other routes. Furthermore, routes serving more distant locations like Hercules, while providing accessibility benefits, generate higher operating costs, which require greater funding support. A highly motivated city like Hercules, however, may eventually provide the ridership and revenue to bring hovercraft in a later phase.

I.2 South San Francisco

Real Estate Information

South San Francisco is known as “The Industrial City” and, as that name implies, is generally friendly toward businesses. Heavy industrial uses have, over time, been replaced with biotech campuses, office parks, and housing developments. This city has one of the largest biotech clusters in the Bay Area and even the nation. The Genentech headquarters alone employs 11,000 people. Other large firms such as Amgen, Theravance, Fluidigm Corporation, Rigel Pharmaceuticals, and Verily also have major presences in this market. South San Francisco’s affordability, accessibility, tax advantages, and new office development have attracted new high-tech tenants in recent years. Notably, Stripe, a payment processing tech company with 2,500 employees, is relocating its headquarters from the City of San Francisco to this area. Overall, the office vacancy rate remains low, at 7.3 percent. This area is well serviced by public transit, with a Caltrain station, a ferry terminal, and a BART stop. It is expected that commercial development will continue in this area, especially with multinational life sciences companies continuing to show interest in leasing large office spaces in South San Francisco. Currently, 400,000 square feet of new office space in the Oyster Point Development is under construction and will be completed in the third quarter of 2021.

Although this submarket encourages the development of office buildings, multifamily housing remains challenged by restrictive zoning and dense preexisting development in this area. Demand for housing in the area has been increased due to the presence of major employers such as Genentech and YouTube just south in San Bruno, but housing development has not kept pace, resulting in a low vacancy rate of 4.8 percent and pricing that is above the metro average in recent sales transactions. However, landlords have recently begun to lower asking rents in response to the COVID-19 pandemic. Market rents are forecast to continue to decline through 2020, with recovery expected in 2022.

Business/Commuter Information

In a 1-mile radius from the proposed South San Francisco Ferry Terminal, there are 271 businesses, employing 3,678 people. The residential population of the same area is 141. In a 3-mile radius, there are 4,211 businesses employing 49,273 people. The residential population of the same area is 53,043. In all South San Francisco, more than 36,000 residents are employed, of which nearly 13 percent remain in the Industrial City for their work. Nearly one third commute to San Francisco, about 3 percent to Redwood City, and nearly 1 percent to San Leandro. More than 57,000 are employed in South San Francisco, 8.2 percent of which also live in the city. Nearly 20 percent commute from San Francisco, and fewer than 2 percent come from Redwood City, San Leandro, and Alameda each. Most workers from South San Francisco rely on passenger vehicles for their commute, and more than 14 percent use public transportation.

Land Use Changes/Recent Development

South San Francisco currently has several commercial developments underway, the most notable of which are the Oyster Point Redevelopment by Kilroy Realty, and the Gateway of Pacific business park by BioMed Realty. The Oyster Point development will yield about 1.7 million square feet of office and research and development space, along with common spaces, including publicly accessible plazas, an amphitheater, a network of new bicycle lanes, a new beach, picnic, and barbeque areas. Additionally, the waterfront of Oyster Point, near the proposed ferry terminal is eligible for Priority Development Area (PDA) designation in 2020, classified as “Transit-Rich Outside High Resource Area.” The Gateway of the Pacific is partially complete, but new phases are underway to add more laboratory and office space, with expected delivery in late 2020.

I.3 Foster City/Redwood Shores

Real Estate Information

Foster City and the surrounding area have attracted several large tech company headquarters, such as Oracle and Electronic Arts, as well as early-stage start-ups in recent years. It is also home to Sony, Electronic Arts, and Gilead Life Sciences. Early stage start-ups are attracted to this market for its cheaper rents relative San Francisco and Palo Alto. This area is not well serviced by regional public transit because it is too far south to be accessible via BART, and a few Caltrain stops to the east of the area. However, this area is at the intersection of Highways 101 and 92, which are both heavily trafficked by commuters. The mid-peninsula location is desirable for its quick access to the San Mateo Bridge and accessibility to commuters from San Francisco, Silicon Valley, and the East Bay. Neither the office nor the multi-family residential markets in Foster City are expected to grow much in upcoming years, because there are no construction projects underway that are expected to be completed within the next 5 years, and vacancy rates are already low, at around 11 percent for offices and 4.5 percent for multi-family units.

Business/Commuter Information

In a 1-mile radius from the proposed ferry terminal near Vintage Park in Foster City, there are 493 businesses employing 14,193 people. The residential population of the same area is 3,984. In a 3-mile radius, there are 5,989 businesses employing 83,816 people. The residential population of the same area is 116,694.

Land Use Changes/Recent Development

The Port of Redwood City Board of Port Commissioners recently approved a long-term strategic “Vision Plan for the Port Lands,” which outlines the strategy for future port development. Approved in January of 2020, the Vision Plan includes the diversification of maritime and commercial businesses, infrastructure improvements, and environmental protections. This Vision Plan prioritizes industrial uses of the port, and the commercial area currently includes small office uses, dry boat storage, a launch ramp, a conference center, a sailing school, a recreational public marina, a membership yacht club, a guest dock, and public access assets such as a shoreline promenade and fishing pier. This commercial area is left out of the Priority Use Area that is the main focus of the Vision Plan. This document indicates that industrial uses are a higher priority for the Port than commuter services.

I.4 West Dumbarton/Menlo Park

Real Estate Information

Menlo Park is situated along Highway 101 and Interstate (I) 280, between San Francisco and San Jose, making it a convenient location for both offices and residences. Most of the office inventory is in the area along El Camino Real, which is a north/south roadway about 3 miles west of the bay waterfront. Although zoning laws in Menlo Park restrict the size of office development (most office tenants occupy less than 5,000 square feet), the city and the area west of the Dumbarton Bridge are eligible for PDA designation in 2020, classified as a “Connected Community Outside High Resource Area.” East Palo Alto, the area immediately east of the Dumbarton bridge, is already designated as a PDA. More than 500,000 square feet of new office space along Constitution Drive near the proposed hovercraft landing area will be completed by the end of 2020. Facebook’s headquarters are situated on the waterfront adjacent to the Dumbarton Bridge. The vacancy rate for offices is low, at 5.8 percent, and nearly 800,000 square feet of new office space is expected to be completed by the end of 2020. In the multifamily market in the same area, the COVID-19 pandemic has increased vacancy and put downward pressure on asking rents of -4 percent. Vacancy is still relatively low, at 7.7 percent.

Business/Commuter Information

In a 1-mile radius from the proposed West Dumbarton ferry terminal, there are seven businesses employing 204 people. The residential population of the same area is 85. In a 3-mile radius, there 1,321 businesses employing 25,228 people. The residential population of the same area is 50,208. The working residents of Menlo Park rely heavily on cars as their mode of transportation to work, with only approximately 6 percent of workers using public transportation.

Land Use Changes/Recent Development

For the last few years, Facebook has been exploring the possibility of funding the construction of a rail line across the Dumbarton Bridge to better connect its headquarters to Fremont and other East Bay locations. However, in light the COVID-19 pandemic, the tech giant is considering pulling back its support for the project to fund other efforts. This comes after an announcement from the company that it would allow their workers to work remotely permanently, should they choose to do so. Even if Facebook does decide to withdraw their support for the project, the Plenary Group, an investor and developer of public infrastructure, has stated that they would still be interested in continuing the project, citing significant need and growing support for the reactivation of the Dumbarton Rail Corridor. Menlo Park and the area west of the Dumbarton Bridge is eligible for PDA designation in 2020, classified as a “Connected Community Outside High Resource Area.”

I.5 Downtown San Francisco

Real Estate Information

The Financial District in San Francisco is already well connected by transit via BART, the ferry service, Muni, Caltrain, and several regional bus lines. The entirety of Downtown San Francisco, along with much of the rest of the city, is designated as a PDA. Office vacancy rates are currently under 10 percent in both the north and south of Market street submarkets of the Financial District. However, vacancy rates could face upward pressure in 2020 from the economic effects of the COVID-19 pandemic, which is driving some businesses to pivot to remote work, while others are at risk of going bankrupt or leaving San Francisco and the Bay Area in search of lower business costs and living expenses. Because of this, asking rents are projected to continue to decrease into 2021. However, significant projects in the pipeline will provide approximately 1.3 million square feet of new office space in South Financial district in the second quarter of 2023. Residents of San Francisco are less reliant on cars for transportation to work than are residents of other Bay Area cities and counties, with more than one-third of working residents relying on various forms of public transit for their commute.

Business/Commuter Information

In a 1-mile radius from the Downtown San Francisco Ferry Terminal, there are 16,993 businesses employing 211,229 people. The residential population of the same area is 52,301. In a 3-mile radius, there are there are 38,586 businesses employing 443,742 people. The residential population of the same area is 348,398. In San Francisco County, about 40 percent of commuters rely on vehicles. Public transit is used heavily by commuters in San Francisco, with 34 percent of workers using various modes of public transit to get to their workplace.

I.6 Alameda

Real Estate Information

In the past few years, the office submarket in Alameda has seen the addition of some large new tenants, including Cost Plus moving their headquarters in 2016 and Exelixis leasing 57,000 square feet in 2017. Office vacancy on the island of Alameda is currently about 8.4 percent, which is below the 10-year historical average. However, this figure could likely change soon due to the economic fallout and widespread shift to remote work caused by the COVID-19 pandemic. Currently, 225,000 square feet of new office space are under construction and expected to be completed in the fourth quarter of 2022. Although multi-family residential development has been historically slow, due in part to opposition from local politicians and community groups, pressure from the state and California’s Sustainable Communities and Climate Protection Act of 2008 is driving Alameda to open its market to new development to reduce the reliance on cars as the primary means of transit on the island.

Business/Commuter Information

In a 1-mile radius from the proposed Seaplane Lagoon Ferry Terminal in Alameda, there are 226 businesses employing 2,114 people. The residential population of the same area is 9,366. In a 3-mile radius, there are there are 7,571 businesses employing 85,992 people. The residential population of the same area is 92,681. Of an estimated 40,000 employed Alameda residents, only 13 percent remain on the island for their jobs. About 21.1 percent commute to San Francisco, 17.5 percent to Oakland, 2.7 percent commute to San Leandro, and 1.2 percent to South San Francisco. Most workers, about 68 percent, rely on cars as their primary mode of transportation for commuting to work; about 17 percent use public transportation. Alternatively, 18.8 percent of workers live in Alameda; 16.1 percent commute from Oakland, 6.3 percent from San Francisco, and 4.9 percent from San Leandro to work in Alameda.

Land Use Changes/Recent Development

Alameda Island currently has two PDAs: one in the area of the Naval Base development, from the Seaplane Lagoon and the areas surrounding Main Street, Fifth Street, and Atlantic Avenue; and another along the waterfront, from the Fruitvale Railroad Bridge to the Fortman Marina. The most significant development underway in Alameda is the redevelopment of a former Naval Air Station on Alameda Point, the westernmost end of the island. The Alameda Point development also includes Site B, a large 82-acre site approved for commercial development, for which a developer has not yet been selected. The project is oriented toward transit and mixed-use development, including a new ferry terminal in the Seaplane Lagoon, about 600,000 square feet of commercial and office, and 800 housing units, 200 of which will be affordable. Multiple other ongoing developments to the Alameda waterfront will add thousands of new homes to the island, including 589 units in the Encinal Terminals and 670 units in the Alameda Marina.

I.7 Berkeley

Real Estate Information

Berkeley’s office space is mainly concentrated in the downtown area near the Downtown Berkeley BART station, which is also just a few blocks west of UC Berkeley. Office vacancy has steadily decreased over the last couple of years and is currently low, at 6.1 percent. The COVID-19 pandemic will likely slow the demand for office leasing due to job losses and economic uncertainty. There are no new office projects expected to be completed in the near future. In the multifamily market, students from UC Berkeley supply a steady stream of renters, resulting in some of the highest asking rents in the metro area. However, the COVID-19 pandemic is expected to put downward pressure on rents and upward pressure on vacancy rates, with the UC system pivoting to online learning. Nearly 500 new units are currently under construction, mostly in the downtown area. However, developers are also targeting the western side of Berkeley for its bay views and other neighborhood amenities, seeing this as a desirable residential market for families and other type of households in addition to students.

Business/Commuter Information

In comparison to other cities selected for this analysis, working Berkeley residents rely less on cars and more on public transportation as their mode of transit to their place of work. In the other terminal areas analyzed, 70 to 80 percent of workers rely on cars and only 1 to 2 percent walk. In Berkeley, about 38 percent of workers rely on cars, with 23.6 percent using public transportation and 18.3 percent able to walk; remaining workers bicycle, use taxis or rideshare services, or work from home. Nearly 17 percent of workers in Berkeley also live in the city. More than 17 percent come from Oakland, 6 percent come from Richmond, and another 6 percent come from San Francisco. Alternatively, nearly 24 percent of employed Berkeley residents work in San Francisco, and 23 percent remain in Berkeley. About 13 percent commute a short way to Oakland.

Land Use Changes/Recent Development

The Berkeley Marina is currently used as open recreational space, with amenities for boaters and nonboaters. The City of Berkeley is currently conducting paving work on University Avenue and is in the planning phase for reopening the Berkeley Pier to the public. in the vicinity of the proposed hovercraft terminal, the corridors near the Berkeley Amtrak station along University and San Pablo Avenues are designated PDAs. The immediate waterfront is eligible for PDA designation and is currently classified as “Transit-Rich Outside High Resource Area.”

I.8 San Leandro

Real Estate Information

San Leandro is relatively well connected via transit, with a BART station and access from the I-880 and I-580 freeways, and is situated just east of the Oakland International Airport. Most of the office buildings with large rentable square footage are concentrated in the small Downtown San Leandro area, with new office development primarily occurring near the BART station. Recent CoStar submarket reports suggest that San Leandro has limited supply risk for offices, and it is expected that market fundamentals should remain relatively sound in this area, even when considering the threat of economic fallout from the COVID-19 pandemic. The office vacancy rate is currently 8.6 percent, which is expected to lower after recent leasing activity. No significant construction of new office space is forecast in the upcoming 5-year period.

Business/Commuter Information

In a 1-mile radius from the San Leandro Marina, there are 231 businesses employing 2,837 people. The residential population of the same area is 6,481. In a 3-mile radius, there are there are 3,686 businesses employing 40,608 people. The residential population of the same area is 69,339. In San Leandro, it is estimated that 47,000 residents are employed. Only 11.1 percent of employed residents also work in the city; 17 percent travel to Oakland for work and 14.4 percent to San Francisco. There are about 50,000 workers employed in San Leandro, 10.4 percent of whom also live in the city; 12.5 percent of workers commute from Oakland, and 3.4 percent from San Francisco. Most working residents of San Leandro rely on passenger vehicles as their primary mode of transportation to their work, with only 13 percent using public transportation.

Land Use Changes/Recent Development

The City of San Leandro is currently working to develop 75 acres of its publicly owned shoreline, known as the Shoreline Project. During a meeting in late February 2020, the City Council approved a development agreement with the developer Cal-Coast, along with amendments to the General Plan and Zoning map. The current project proposal includes a hotel and restaurant; single-family, and multifamily residences (a total of 485 units); a new library; a golf course; and recreational amenities, including plazas, parks, promenades, bicycle lanes, and a boat launch area. The waterfront area is eligible for PDA designation in 2020 and is classified as a “Connected Community Outside High Resource Area.”

I.9 Martinez

Real Estate Information

The Martinez/Hercules submarket does not have a robust office market. In total, there are about 2 million square feet of rentable office space with a mixture of smaller tenants. Vacancy is very low, at 3.7 percent. A couple of new buildings are expected to be completed in the third quarter of 2020 and the first quarter of 2021, which will add a modest 19,000 square feet combined. The multifamily submarket in the area includes the city of Richmond. This area in the northwestern boundary of the East Bay Metro has similar characteristics—a combination of industrial cities and bedroom residential communities. Heading into 2020, vacancy rates were below the 10-year historical average, but the COVID-19 pandemic and associated economic impacts has put upward pressure on vacancy rates and downward pressure on asking rents. Currently, the vacancy rate for multifamily dwellings is 5.9 percent. Investment activity for multifamily residential development is also expected to experience a significant slowdown as investors and lenders reassess the market, given widespread uncertainty. The cities in this submarket, which are grouped in CoStar due to their similarities and proximity, are home to four oil refineries. These oil refineries employ about 3,000 workers, and their industrial building inventory is growing, particularly in Richmond, to accommodate increasing demand and a growing workforce. Richmond, Albany, and El Cerrito all have BART stations, and Richmond has a ferry station with a route to San Francisco, but Martinez and Hercules are not well connected to the rest of the bay area via public transit.

Business/Commuter Information

The Martinez waterfront terminal location is 1/2 mile from the Martinez Amtrak station, which serves Capitol Corridor and other Amtrak lines, and is also a transit hub for several bus agencies connecting to Contra Costa County and other regional destinations. The station was built in the early 2000s and serves commuters between Sacramento and San Jose. In a 1-mile radius from the Martinez Marina, there are 414 businesses employing 4,570 people. The residential population of the same area is 4,144. In a 3-mile radius, there are there are 1,977 businesses employing 23,462 people. The residential population of the same area is 35,863. Of nearly 20,000 employed Martinez residents, 10.5 percent remain in the area for their job; 10.2 percent commute to San Francisco, 9.1 percent to Concord, and nearly 1 percent to San Leandro. The rest travel to a variety of other areas outside of the proposed hovercraft network, with no specific destination receiving a large share of workers from Martinez. Of those employed in Martinez, only 9.4 percent also live in the city. Most workers come to Martinez from other locations in the East Bay, and only 1.4 percent commute from San Francisco.

Land Use Changes/Recent Development

The Martinez Planning Commission recently approved the “Marina Trust Land Use Plan,” which aims to preserve public access and enjoyment of the waterfront lands. The Plan aims to improve access to the waterfront, preserve existing habitats and resources, and integrate the land into the fabric of the City. A commuter ferry service is identified as a possible use for this land, along with a shuttle service and bicycle/scooter rentals to increase connectivity from the Marina to downtown Martinez and other commercial centers. Dredging is cited as one of the more costly elements of operation and maintenance of the Marina, indicating that hovercraft, which can operate in shallow waters, could have some appeal over a ferry service. Downtown Martinez, the area immediately south of the marina and north of Susana Street, is designated as a PDA.

Medium to Longer-Term Potential

Martinez in Contra Costa County also has plans to develop the waterfront near the proposed terminal location, but currently lacks dense housing and office. Martinez recently approved its Marina Trust Land Use Plan to improve access to the waterfront. There are three large employers in the city. As the County seat, Martinez's largest employer is Contra Costa County, with more than 10,000 employees. Most of those jobs are located in downtown close to the waterfront. Kaiser and PBF (formally Shell) are two additional major employers. The Martinez waterfront terminal location is 1/2 mile from the Martinez Amtrak station, which serves Capitol Corridor and other Amtrak lines, and is also a transit hub for several bus agencies connecting to Contra Costa County and other regional destinations. The station was built in the early 2000s and serves commuters between Sacramento and San Jose. Once the waterfront development plan is realized, Martinez will offer more ridership and tax revenue potential to ensure successful hovercraft service there. There are no large employers in the city. Until the waterfront development plan is realized, Martinez does not offer the ridership nor tax revenue potential to ensure that the hovercraft service will make it to their shore. Martinez will face the same challenges associated with higher operating costs and needing to secure funding support for the service.

I.10 Hercules

Real Estate Information

As stated above, the Martinez/Hercules submarket does not have a robust office market. Hercules has a population of more than 25,000 and an employment rate of 66.5 percent. However, the city is supportive of new development, and multiple mixed-use developments are planned for both the near and long term.

Business/Commuter Information

In a 1-mile radius from the proposed Hercules Ferry Terminal, there are 216 businesses employing 1,446 people. The residential population of the same area is 10,778. In a 3-mile radius, there are 1,668 businesses employing 16,224 people. The residential population of the same area is 71,931. Of nearly 12,700 employed Hercules residents, only 4.1 percent remain in the area for their job; 18.3 percent commute to San Francisco, 10.8 percent to Oakland, and nearly 3 percent commute to Martinez. The rest travel to a variety of other areas outside of the proposed hovercraft network, with no specific destination receiving a large share of workers from Hercules. Of those employed in Hercules, about 11 percent also live in the city. Most workers come to Hercules from other locations in the East Bay, and only a small percentage come from San Francisco. The majority of Hercules commuters use cars to get to work, and less than 10 percent use public transportation.

Land Use Changes/Recent Development

The land in Hercules near the proposed ferry terminal is currently under development in accordance with the Waterfront District Master Plan, which was approved and published in 2008. This planning document envisions the Hercules Bayfront as a transit-oriented, pedestrian-friendly, mixed-use neighborhood project. This plan aims to add approximately 1,400 residential units, 90,000 square feet of retail, and 250,000 square feet of office and other flexible commercial uses. In the waterfront, a high-density housing project called “The Village” is currently under construction and connects to other projects, such as the Regional Intermodal Transportation Center, also under construction. The Regional Intermodal Transportation Center is envisioned to encompass a train station, a ferry terminal, and bus service. A PDA surrounds the proposed ferry terminal, flanked by San Pablo Avenue, Santa Fe and Hercules Avenues, and the campus of Bio-Rad Life Sciences.

Appendix J – Additional Case Studies

J.1 Emery Go-Round, Emeryville

Established in 1995, Emery Go-Round is a fare-free shuttle service available to all Emeryville residents, shoppers, visitors, and employees, connecting the MacArthur Bay Area Rapid Transit (BART) Station in Oakland to various employment and retail centers in the city of Emeryville.[53] The Emeryville Transportation Management Association (ETMA)—a nonprofit, governed by representatives of property owners in the improvement district, that provides various transportation services in Emeryville and surrounding communities[54]—has operated the service since its inception in 1995 and is responsible for reviewing improvements and activities, in addition to coordinating with City of Emeryville staff.[55]

From 1995 to 2001, the service was funded by the City of Emeryville; given increases in ridership, homeowners voted to establish an improvement district to continue shuttle operations over a 5-year trial period. The Emeryville City Council approved the Property-Based Improvement District (PBID), a citywide transportation assessment district, in 2001, and renewed it in 2006 and 2015. The PBID provides for the levy and collection of assessments on properties within a geographically defined area, consisting of parcels in Emeryville that are within one-quarter mile walking distance to an Emery Go-Round shuttle stop. Assessment revenue collected from benefitting properties pays the shuttle service's capital, operations, and maintenance costs.[56]

The PBID assigns Special Benefits Points to properties based on two property characteristics: a parcel's proximity to a stop and land-use classifications. These two factors are multiplied to calculate a parcel's Special Benefits Points, which are then used to calculate taxes levied on each property. In 2015 to 2016, the PBID generated assessment revenue totaling $3,409,869, which is nearly 90 percent of the Emery Go-Round's annual operating budget. The remaining funding was sourced from City General Fund contributions, grants, donations, fees for service contracts for nonassessable property within the service area, and in-kind donations. Table 17 shows PBID assessment revenue compared to other contributions in aggregate.

Table 17. Total Revenue Financial Report (First Quarter 2018)

Description	Amount
PBID Revenue	
Net PBID Revenue	$3,476,248
Non-PBID Revenue	
City – General Benefit Contribution	$547,397
ETMA Billed Revenue	$98,369
BGTMA (Net Balance of WBS Revenue)	$45,000
Other Revenue	$3,000
Subtotal Non-PBID Revenues	$693,765
Total First Quarter 2018 Cost Estimate Budget	$4,170,013

Source: Emeryville Transportation Management Association, 2018

The PBID was renewed on July 1, 2015, and shall continue to collect assessments from PBID parcels through June 30, 2030, at which point it may be terminated if not renewed by Emeryville City Council.[57]

53 National Public Radio, How a Free Bus Shuttle Helped Make a Small Town Take Off, 2013.
54 Emery Go-Round, About Us.
55 City of Emeryville, Citywide Property and Business Improvement District Management District Plan, 2015.
56 City of Emeryville, Citywide Property and Business Improvement District Management District Plan, 2015.
57 City of Emeryville, Citywide Property and Business Improvement District Management District Plan, 2015.

J.2 Hovertravel, Portsmouth, UK

Hovertravel Ltd. operates a privately owned hovercraft service between Southsea Common, Portsmouth, on the English mainland and Ryde Transport Interchange on the Isle of Wight. The privately owned hovercraft service is owned by the Bland Group Ltd, a private company made up of 15 small and medium-sized operating companies.[58] According to the Hovertravel website, the service is the only year-round commercial hovercraft in Europe and provides the fastest transport service across the Solent, the channel between the English mainland and the Isle of Wight, with a travel time of 10 minutes. Riders consist of both daily commuters and leisure travelers.

The Hovertravel ferry company has daily operations morning to evening, with service every 30 minutes at most. Moreover, the hovercraft service hosts 22,000 trips annually, with consistent ridership of 800,000 passengers annually over the past 5 years. Passenger fares vary depending on package deals, but typically cost £18.90 (approximately $24.50) for a single one-way ticket and £24.60 (approximately $31.90) for a round-trip ticket. Limited information is available on whether fares are subsidized by the government. Hovertravel Ltd. does not qualify as a public-private partnership but is indicative of the potential for sole private management of a transit system. [59]

J.3 IKEA Water Taxi, New York

In 2008, IKEA launched a universal free water taxi service to win public support for the construction of the big-box retail store that many critics thought would congest the streets of Red Hook, Brooklyn. Operated by the New York Water Taxi, the IKEA Express Ferry operates daily ferry services between Pier 11 – Wall Street, Manhattan and the IKEA store in Red Hook, Brooklyn.

Launched on June 18, 2008, the ferry transports 15,000 passengers each week, well over initial service projections of 5,000 passengers per week. In turn, the New York Water Taxi increased weekend operations to include an additional two to three vessels during peak weekend hours to accommodate higher ridership.[60]

The service was initially free to all riders, but water taxis quickly exceeded the 75- or 150-person vessel capacities, with several customers waiting on the dock while leisure travelers crossed the East River to Red Hook. In response, IKEA set up a two-tier congestion pricing scheme in which all Red Hook-bound passengers were hand-stamped to put them at the head of the line for the return trip to Manhattan if they shopped at IKEA.[61] In August 2009, IKEA commenced a paid ticketing system to further mitigate congestion, in which riders were charged $5 if they did not spend $10 worth of goods from the IKEA store.[62] The round-trip ticket is free for passengers who make a purchase at the store. As a service sponsor, IKEA continues to operate a two-tiered pricing system to finance water taxi service. Additional funding and financing details about this service are not publicly available.

J.4 Denver Eagle P3 Project, Denver

The Denver Regional Transportation District operates a bus and rail system throughout the Denver metropolitan area. In 2004, voters approved the FasTracks transit program, which aimed to expand Regional Transportation District transit networks throughout the region via the construction of three commuter rail systems:[63]

To finance the $2.04 billion project, which would construct 36 miles of new commuter rail, the Regional Transportation District secured several private funding sources. In 2007, the Regional Transportation District pursued a public-private partnership to reduce the agency's need for upfront cash for the construction of the three transit segments. By 2010, the Regional Transportation District entered a single concession contract with Denver Transit Partners, a joint venture that consists of construction, financing,

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58 HoverTravel, About the Bland Group.
59 HoverTravel, Times & Tickets.
60 New York Post, Hook Rocks IKEA Boat, 2008.
61 Brooklyn Paper, It's Apar-tide! IKEA Sets Up Two-Tier System for Ferry Rides, 2008.
62 Brooklyn Paper, IKEA to Start Charging for Ferry Service to Hook Superstore, 2009.
63 RTD Denver, Eagle P3 Project At A Glance.

and transportation companies, including the following core contractors: Alternate Concepts, Inc., Ames, Aberdeen Assets, Balfour Beatty, Hyundai-Rotem, and John Laing Group.[64] In addition, two sponsoring partners, Fluor Enterprises Inc. and Macquarie Capital Group Limited, helped fund the initiative. The 34-year contract, called Design-Build-Finance-Operate-Maintain, requires Denver Transit Partners to operate and maintain the three segments, with the Regional Transportation District making annual payments to Denver Transit Partners based on its performance in meeting service standards.[65] Overall, $450 million of the $2.04 billion project originated from private financing, consisting of equity and private activity bonds. Capital costs and operation and maintenance costs are outlined in Table 18.[66] [67]

Table 18. Capital and Operation and Maintenance Costs for the Construction of Regional Transportation District Commuter Rail

Cost	Amount
Capital Costs	
Equity	$54,300,000
Private Activity bonds	$396,000,000
Transportation Infrastructure and Innovation Act (TIFIA) loans	$280,000,000
RTD sales tax revenue	$128,000,000
Operation and Maintenance Costs	
Full Funding Grant Agreement	$1,030,000,000
Other federal grants	$57,000,000
Revenue bond proceeds	$57,000,000
Local/CDOT/other contributions	$40,300,000

Source: United States Department of Transportation Federal Highway Administration, 2011

J.5 Additional Case Studies

In addition to these case studies, there are several other transportation agencies in the United States that have established public-private partnership agreements to construct, operate, fund, and maintain transit networks, which may merit further research:

- The New York City Economic Development Corporation, in partnership with Hornblower Cruises, operates five ferry routes throughout New York City boroughs, similar to the Water Emergency Transportation Authority's (WETA's) contract with Blue and Gold Fleet.
- The Maritime Transport Authority of Puerto Rico contracted with a private company to improve and modernize the municipal ferry services and to add routes between principal cities.
- MVgo shuttle service contracted with the Mountain Transportation Association to operate four shuttle routes to connect tech companies with the city of Mountain View (not to be mistaken with the Mountain View Community Shuttle).
- Maryland Transit Administration contracted with Purple Line Transit Partners to construct a 16-mile light rail line from Bethesda, Maryland, to New Carollton, Maryland.
- Los Angeles International Airport contracted with LAX Integrated Express Solutions to construct an electric train system on an elevated guideway to connect airport terminals.
- Massachusetts Bay Transportation Authority partnered with STV Inc. to extend the Framingham/Worcester commuter rail line to Boston Landing Station.

[64] Denver Transit Partners, Who We Are.
[65] RTD FasTracks, RTD Board selects Denver Transit Partners for Eagle P3, FasTracks' single largest contract, 2010.
[66] United States Department of Transportation, Federal Highway Administration, Project Profile: Eagle Project.
[67] Eno Center for Transportation, Denver Eagle P3 Begins Operations, 2016.