

DESCRIPTIONS OF FERRY ROUTES AND TERMINALS

# Appendix 4

## Washington State Ferries

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# 1 INTRODUCTION

This section describes the routes and terminal regarding sensitivity to potential consequences and key inputs to the study.

The following key parameters were used to define the routes and terminals in this study, and are discussed in each of the following subsections of this report:

- Weather Conditions
- Shoreline Classification
- Population Estimates

Other information about routes and terminals is included in the descriptions for completeness, but such information generally is not carried forward in the analysis. It is supplied for contextual understanding only.

## WEATHER CONDITIONS

Average temperatures, humidity, and wind characteristics are provided for reference purposes, and were used to develop the consequence modeling basis. These conditions affect the behavior of LNG upon a release. Weather stations are chosen based on minimizing linear distance to the terminal locations. The topography is highly variable in Puget Sound and weather characteristics at shoreline may not be the same as at airports or the weather station being cited (1). Worst-case wind conditions are used for consequence analysis and are further described in Appendix 1 – Consequence Modeling Study Basis.

Figure 1-1 shows the locations of the weather stations in the study area. The weather stations located by an orange point are the stations chosen for the different terminals.

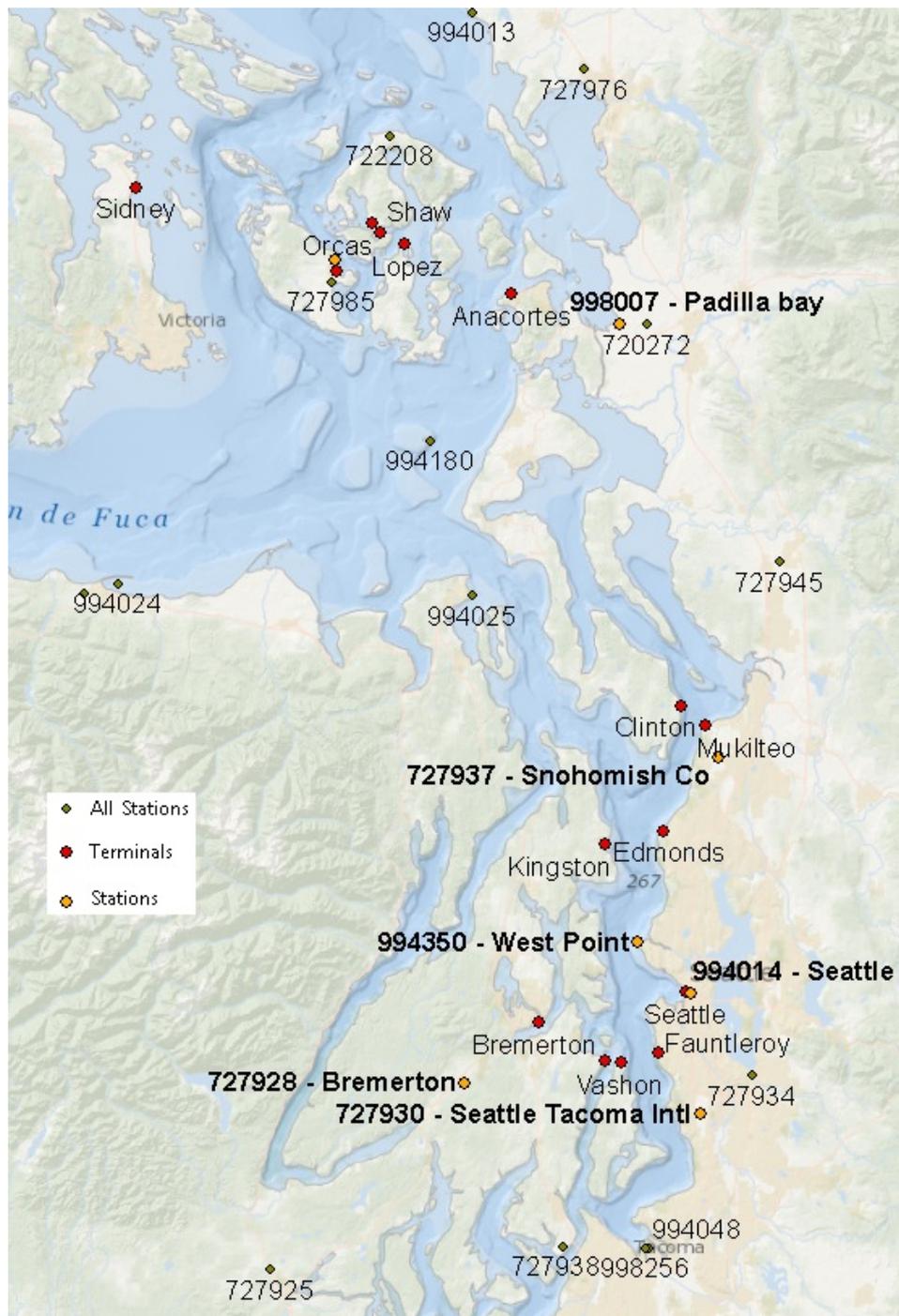


Figure 1-1 Map of Weather Stations Locations

## SHORELINE CLASSIFICATION

Shorelines in the Route and Terminal Descriptions are categorized in two ways

1. Shoreline Master Program categorizations as mandated by the State of Washington are used to classify the shorelines immediately around the terminal.
2. Environmental Sensitivity Index (ESI) is used to categorize all shorelines within 3 miles of the ferry routes. The ESI ranking system is developed to categorize the sensitivity of shorelines to oil spills. While the environmental sensitivities do not apply to an LNG spill, the ESI rankings are the most comprehensive and consistent shoreline rankings available and give indication about the types of shorelines near the ferry routes.

## SHORELINE MASTER PROGRAM CATEGORIZATION

The State of Washington Shoreline Master Program Guidelines (Chapter 173-26 WAC, Part III) requires shorelines to be classified as part of the Shoreline Master Program (SMP) (2). The SMP consists of eight elements:

1. Economic development element that considers the location and design of industries, industrial projects of statewide significance, transportation facilities, port facilities, tourist facilities, commerce, and other developments that are particularly dependent on shorelines of the state.
2. Public access element that considers public access to publicly owned land along shorelines of the state.
3. Recreational element that identifies recreational opportunities along shorelines, such as parks, tidelands, beaches, and recreational areas.
4. Circulation element that consists of the general location and extent of existing and proposed major thoroughfares, transportation routes, terminals, and other public utilities and facilities.
5. Land use element that considers the general distribution and location, as well as the extent of use on the shorelines and adjacent areas for housing, business, industry, transportation, agriculture, natural resources, recreation, education, public buildings and grounds, and other categories of public and private use of the land.
6. Conservation element that addresses the preservation of natural resources including, but not limited to, scenic vistas, aesthetics, and vital estuarine areas for fish and wildlife.
7. Historic, cultural, scientific and educational element that prevents the destruction of or damage to any site having historic, cultural, scientific, or educational value as identified by the appropriate authorities, including affected Tribes, and the state office of archaeology and historic preservation.
8. Flood hazard element that considers the prevention and minimization of flood damage (3).

Cities or counties have jurisdiction over specific segments of shorelines. Shoreline classifications vary from jurisdiction to jurisdiction. Table 1-1 shows the designations that apply to the shorelines adjacent to WSF terminals.

**Table 1-1 Shoreline Master Program Shoreline Designations**

Shoreline Designation	Shoreline Descriptions
Conservatory	Area where the existing natural character is maintained and protected from consumptive uses which would cause permanent adverse environmental impacts (4).
Conservatory Recreation	Area that is protected to conserve the shoreline for ecological, public safety, and recreation purposes. Includes areas with important shoreline ecological processes and functions, valuable historic and cultural features, flood and geological hazards, and recreational opportunities. Residential areas can also be designated as conservancy shorelines (3).
Rural	Area in which natural features predominate and where human activity results in only light modification of the natural environment (4).
Urban	Area of high intensity land use including residential, commercial and industrial development (4).
Urban Mixed Use	Area of high intensity land use including residential, commercial and industrial development
Urban Residential	Area with residential uses at urban densities, while allowing for non-residential uses that are consistent with the protection of the shoreline jurisdiction (3).
Urban Waterfront	Area of high-intensity, water-oriented commercial and recreational activities, transportation, and essential public facilities, and may also contain ecological functions (5).
Downtown Waterfront	Area with commercial designation that has view corridors of the water and encourages public access to the water in a variety of related to the water, multimodal transportation facilities, residential, mixed uses, increased building height, and pedestrian orientation (6).
Urban Harbor front	Area of economically viable water-dependent and water-related uses, waterborne commerce, public access and recreational uses, historic, ecological or cultural significance (2).
High Intensity	Area that provides high-intensity water-oriented commercial, transportation, and industrial uses (3).

ENVIRONMENTAL SENSITIVITY INDEX SYSTEM

Shoreline habitats are also characterized using the National Oceanic and Atmospheric Administration (NOAA) Environmental Sensitivity Index (ESI) system (8). The ESI system predicts the behavior and persistence of oil based on characteristics of the habitat. LNG, when spilled, will behave quite differently

than oil. The ESI shoreline classifications within a 5-mile radius of the route are provided to describe the habitat of the nearby shoreline and not the sensitivity of that shoreline to an LNG spill.

The ESI habitat characteristics are:

- Shoreline type (substrate, grain size, tidal elevation)
- Exposure to wave and tidal energy
- Ease of clean-up
- Biological productivity and sensitivity
- 

Table 1-2 defines the ESI shoreline classifications for habitats delineated for the Puget Sound area.

**Table 1-2 ESI Coastline Classification**

ESI Number	Shoreline Descriptions
1A	Exposed, rocky shores
1B	Exposed, solid man-made structures
2A	Exposed, wave-cut platforms in bedrock, mud or clay
3A	Fine-grained to medium-grained sand beaches
3B	Scarps and steep slopes in sand
4	Coarse-grained sand beaches
5	Mixed sand and gravel beaches
6A	Gravel beaches
6B	Riprap
6D	Boulder rubble
7	Exposed tidal flats
8A	Sheltered, rocky shores and sheltered scarps in bedrock, mud or clay
8B	Sheltered, man-made structures
8C	Sheltered riprap
9A	Sheltered tidal flats
9B	Vegetated low banks
10A	Salt-water and brackish-water marshes
10C	Freshwater swamps

[POPULATION ESTIMATES](#)



The populations near the routes and terminals were needed as input to allow an estimate of the number of people potentially exposed, which is required to estimate risk exposure to the public (societal risk). Populations near the terminals were estimated at two levels of detail:

1. WSF supplied detailed manning and capacity information for the ferry traffic, and were used directly for localized impacts. Census data by zip code are used for more general population estimates.
2. The 2010 U.S. Census was used to estimate population, which is expected to fluctuate day versus night based on an assumption that workers spend most daytime hours away from their residences. The total population (9) and the worker population (10) data were used to estimate the day and night populations. The worker population was assumed to be absent from their residence zip codes during the day, so subtracting the worker population from the total population provided an estimate of the population present during the day for a given zip code. The night population within a given zip code was assumed to be the same as the total population.

## 2 OVERVIEW OF THE ROUTES

Figure 2-1 is a wide-view ferry routes map to provide context to the smaller extent terminal and route maps in the remainder of this Appendix.



Figure 2-1 Map of Ferry Routes and Terminals

### 3 ANACORTES/SAN JUAN ISLANDS/SIDNEY

#### 3.1 Anacortes/San Juan Islands/ Sidney Routes

This ferry route connects Anacortes (approximately 80 miles northwest of Seattle), the San Juan Island ferry terminals (Friday Harbor, Orcas, Shaw and Lopez) and Sidney B.C. There are three separate runs:

1. Anacortes to Friday Harbor Service stopping at Orcas, Shaw and Lopez
2. Inter-Island Service between Friday Harbor, Orcas, Shaw and Lopez
3. International Service from Anacortes to Sidney, B.C., with stops at Orcas and Friday Harbor

The Anacortes to Friday Harbor and Inter-Island Service runs in all seasons. Figure 3-1, Figure 3-2 and Figure 3-3 show the Anacortes to Lopez and Inter-Island Service and the International Service ferry routes.



Figure 3-1 Anacortes to San Juan Islands Ferry Route Segment (5)

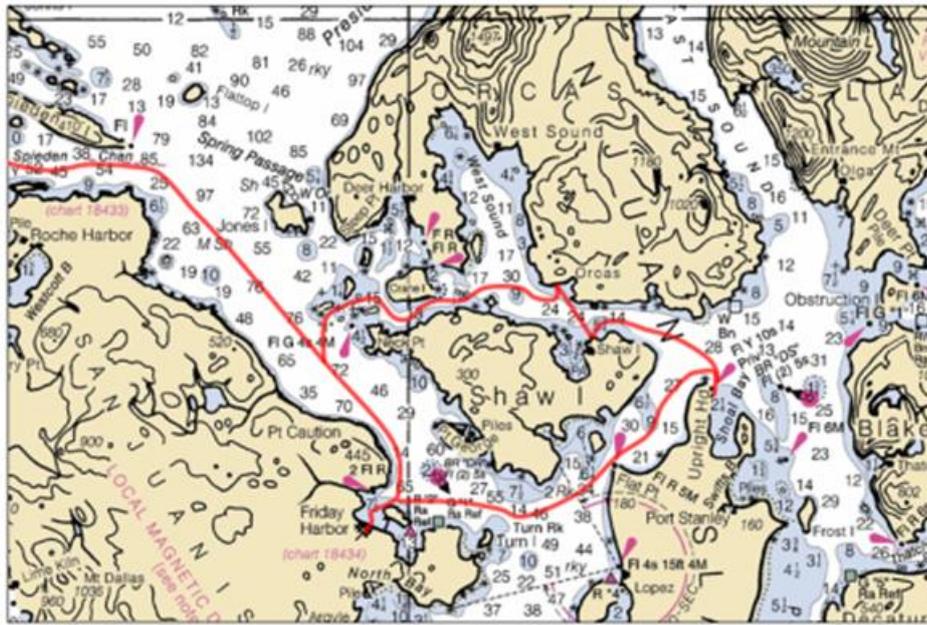


Figure 3-2 San Juan Islands Ferry Routes (11)

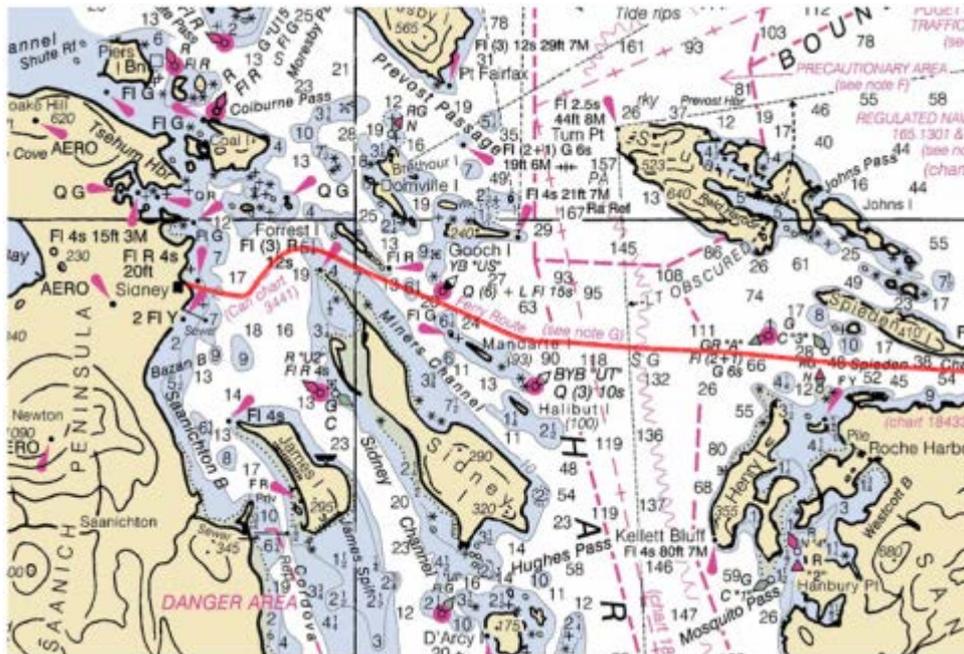
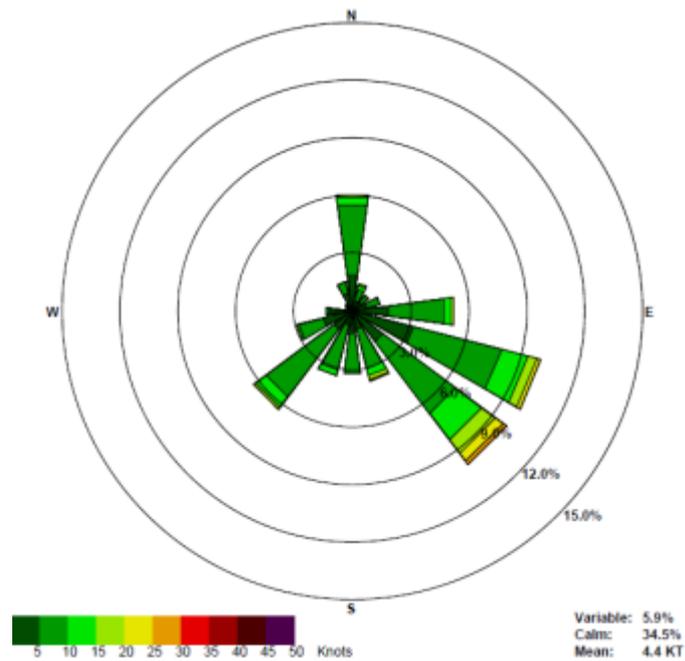


Figure 3-3 Friday Harbor/Sidney Ferry Route (11)

The area near the Anacortes to Lopez, Inter-Island and International ferry routes is represented by Weather Station # 994015 at Friday Harbor (12). Characteristic weather conditions and the wind rose are shown in Table 3-1 and Figure 3-4, respectively.

**Table 3-1 Characteristic Weather Conditions San Juan Islands (12)**

Average annual temperature (°C)	9.5
Average annual wind speed (knots)	6.8
Percentage of calm wind (0 knots)	34%
Average annual humidity	80%



**Figure 3-4 Wind Rose San Juan Islands (13)**

Mixed sand and gravel beaches – Type 5 and Exposed, Rocky Shores – Type 1A are the predominate ESI shoreline classification within 3 miles of the ferry route segment, 31% and 22%, respectively. Figure 3-5 shows the ESI classifications and Table 3-2 shows the percentage of the shoreline in each classification (14).

**Table 3-2 ESI Coastline Classifications San Jan Islands (14)**

Color Code	ESI Number	Shoreline Descriptions	% of Shoreline Near the Ferry Route Segment
	5	Mixed sand and gravel beaches	31%
	1A	Exposed, rocky shores	22%
	6A	Gravel beaches	11%
	2A	Exposed, wave-cut platforms in bedrock, mud or clay	10%
	7	Exposed tidal flats	9%
	4	Coarse-grained sand beaches	4%
	8A	Sheltered, rocky shores and sheltered scarps in bedrock, mud or clay	4%
	10A	Salt-water and brackish-water marshes	3%
	8C	Sheltered riprap	2%
	9A	Sheltered tidal flats	2%
	6B	Riprap	1%
	9B	Vegetated low banks	1%
<b>Total Hard Shorelines</b>			51%
<b>Total Soft Shoreline</b>			49%

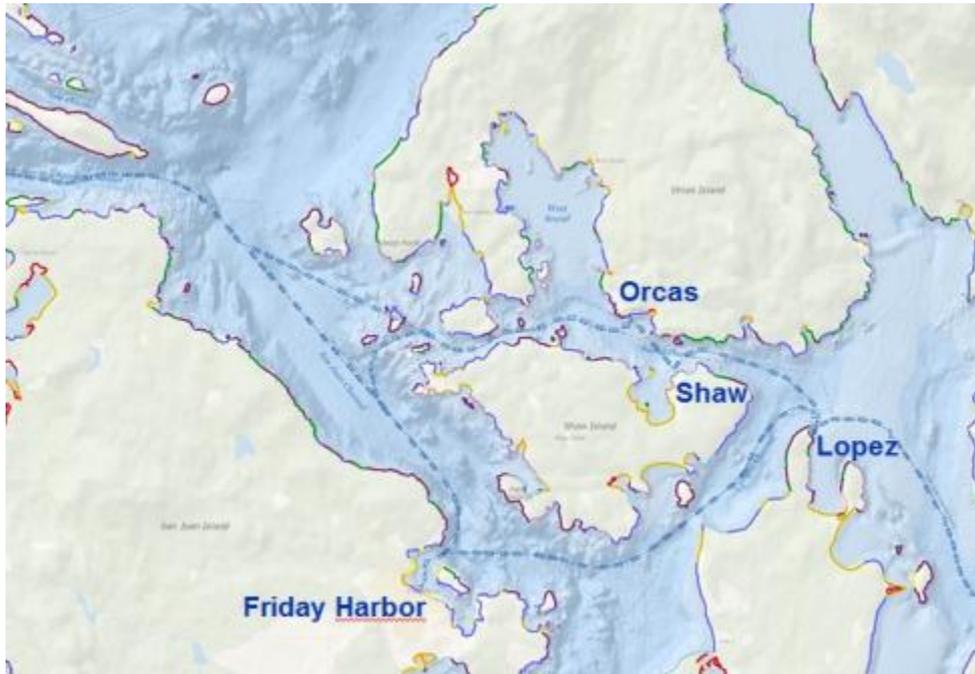


Figure 3-5 ESI Shoreline Classifications San Juan Islands (8)

## 3.2 Anacortes to Friday Harbor and Inter-Island Service

The Anacortes to Friday Harbor Service is made up of four segments:

1. Anacortes to Lopez
2. Lopez to Shaw
3. Shaw to Orcas
4. Orcas to Friday Harbor (identical to Segment 2 of the International Service)

The Inter-Island Service is made up of four segments:

1. Lopez to Shaw (identical to Segment 2 of the Anacortes to Friday Harbor Service)
2. Shaw to Orcas (identical to Segment 3 of the Anacortes to Friday Harbor Service)
3. Orcas to Friday Harbor (identical to Segment 2 of the International Service)
4. Friday Harbor to Lopez

### 3.2.1 Anacortes/Lopez

The segment connecting Anacortes and Lopez enters the Rosario Strait just north of Shannon Point at the mouth of Guemes Channel. The Guemes Channel is approximately 0.5 miles wide and ranges from 8 to 18 fathoms deep. Localized magnetic disturbances can cause as much as 140 in variation. Current velocities can exceed 5 knots. Shannon Point is low to the water edge.

The segments extends west-northwest across the Rosario Strait south of Reef Point of Cypress Island. Cypress Island extends approximately 1500 feet out of the water with steep lower slopes. Reef Point is the southwestern tip of Cypress Island and has a shoal extending 0.4 miles south.

The segment continues through Thatcher Pass with Blakely Island to the north and Decatur Island to the south. Thatcher Pass is 0.5 miles wide at its narrowest and is deep (15), approximately 25 fathoms (11). Lawson Rock is midchannel approximately 0.4 miles north of Faunteroy Point, the northernmost point on Decatur Island. Current velocities in Rosario Strait and Thatcher Pass can reach 3 knots to 7 knots (15).

The segment continues northwest through Lopez Sound. It passes east of Frost Island along the western shore of Blakely Island. The segment passes east of the mouth of Shoal Bay reaches Lopez Terminal on the eastern bank of Upright head.

### 3.2.2 Lopez/Shaw

The segment connecting Lopez and Shaw extends west around Upright Head, passes north of the mouth to Upright Channel and enters the Harney Channel with Shaw Island to the south and Orcas Island to the north. The Shaw Terminal is on the northern bank of Shaw Island.

### 3.2.3 Shaw/Orcas

Shaw and Orcas are connected by a straight segment that directly crosses Harney Channel. This segment does not pass any potential targets or navigational challenges.

### 3.2.4 Orcas/Friday Harbor

The segment connecting Orcas and Friday Harbor leaves the Orcas Terminal and extends west across the mouth of West Sound into Wasp Passage. It continues between Crane Island (to the north) and the northern shore of Shaw Island (to the south). Then it goes between some islands that are unnamed and



turns south-southeast into the San Juan Channel. Passes the western shore of Shaw Island to the northeast. The segment continues around Point Caution into Friday Harbor. The segment passes north of Brown Island before it reaches the Friday Harbor Terminal.

### 3.2.5 Friday Harbor/Lopez

The segment connecting Friday Harbor and Lopez exits Friday Harbor north of Brown Island and turns east into the San Juan Channel. The segment rounds the southern point of Shaw Island and enters Upright Channel. It passes between Flat Point on Lopez Island and an unnamed island south of Shaw Island. The segment rounds upright head and enters Lopez Terminal.

### 3.3 International Service

The International Service has a 2.5-hour crossing time between Anacortes and Sidney, B.C. The International services runs in the spring, summer and fall. The run is made up of three segments:

1. Anacortes to Orcas
2. Orcas to Friday Harbor
3. Friday Harbor to Sidney

#### 3.3.1 Anacortes/Orcas

The segment connecting Anacortes and Orcas enters the Rosario Strait just north of Shannon Point at the mouth of Guemes Channel. The Guemes Channel is approximately 0.5 miles wide and ranges from 8 to 18 fathoms deep. Localized magnetic disturbances can cause as much as 140 in variation and current velocities can exceed 5 knots. Shannon Point is low to the water edge.

The segments extends west-northwest across the Rosario Strait south of Reef Point of Cypress Island. Cypress Island extends approximately 1500 feet out of the water with steep lower slopes. Reef Point is the southwestern tip of Cypress Island and has a shoal extending 0.4 miles south.

The segment continues through Thatcher Pass with Blakely Island to the north and Decatur Island to the south. Thatcher Pass is 0.5 miles wide at its narrowest and is deep (15), approximately 25 fathoms (11). Lawson Rock is midchannel approximately 0.4 miles north of Faunteroy Point, the northernmost point on Decatur Island. Current velocities in Rosario Strait and Thatcher Pass can reach 3 knots to 7 knots (15).

The segment continues northwest through Lopez Sound. It passes east of Frost Island along the western shore of Blakely Island. Blakely Island is privately owned and maintained but is available to the public.

The segment passes east of the mouth of Shoal Bay and turns west just past Upright Head. Upright Head is the northernmost point of Lopez Island and rises 260 feet out of the water. The segment passes north of the mouth to Upright Channel and enters the Harney Channel with Shaw Island to the south and Orcas Island to the north. The Orcas Terminal is on the western end of the Harney Channel on the northern shore.

#### 3.3.2 Orcas/Friday Harbor

The segment is described in the Anacortes to Friday Harbor service segment descriptions.

#### 3.3.3 Friday Harbor/Sidney

The segment connecting Friday Harbor and Sidney exits Friday Harbor north of Brown Island and turns northwest around Point Caution into the San Juan Channel. The segment follows the San Juan channel around the northern point of San Juan Island and enters Spieden Channel headed west. The segment continues across the Haro Strait toward Mandarte Island. The segment passes between Mandarte Island (to the south) and Forrest Island (to the north) into Miners Channel. The segment round the northern tip of Sidney Island and crosses the Sidney Channel before reaching Sidney Terminal.

### 3.4 Anacortes Terminal

The Anacortes Terminal (48°30'26"N 122°40'30"W) is in Guemes Channel and Ship Harbor, a tributary of Rosario Strait (16). It has two overhead passenger loading and two additional tie-up slips. The facility is located in Skagit County (17) and leased from Port of Anacortes (16). The shoreline immediately surrounding the terminal is designated Urban (18).

The terminal employs 10 staff (19) and has a capacity for 450 vehicles onsite (17). Nearby off-site land is primarily undeveloped and has a mixture of public and private ownership and includes a wetland and a residential area to the east; a wetland, forests and residences to the west; and businesses and residences to the south (16). Figure 3-6 shows the terminal and estimated population centers near the terminal.

The terminal is adjacent to a low density population zone. In the adjacent zip code, 98221, there is a population density of 368 people per square mile during the day and 385 people per square mile at night.

<p style="text-align: center;"><b>Anacortes Terminal</b></p> <p><b>Location:</b> 48°30'26"N 122°40'30"W</p> <p><b>Number of Slips:</b> 2+</p> <p><b>Water Body:</b> Guemes Channel</p> <p><b>Shoreline Designation:</b> Urban</p>
---



**Figure 3-6 Anacortes Terminal**

### 3.5 Lopez Terminal

<b>Lopez Terminal</b>
<b>Location:</b> 48°33'13"N 122°51'35"W
<b>Number of Slips:</b> 1
<b>Water Body:</b> Harney Channel
<b>Shoreline Designation:</b> Conservancy

The Lopez Terminal (48°33'13"N 122°51'35"W) is a single-slip facility in Harney Channel. The facility is in San Juan County and owned by the State of Washington (17). The shoreline immediately surrounding the terminal is designated Conservancy (20).

The terminal is operated by private contractors and has a capacity for 88 vehicles onsite (17). Nearby offsite populations include private residential areas to the north, west and south and the Department of Natural Resources to the east. Figure 3-7 shows the terminal.

The terminal is adjacent to a low density population zone. In the adjacent zip code, 98261, there is a population density of 72 people per square mile during the day and 80 people per square mile at night.



Figure 3-7 Lopez Terminal

### 3.6 Shaw Terminal

The Shaw Terminal (48°35'87"N 122°55'40"W) is a single-slip facility in Harney Channel. The facility is in San Juan County and owned by the State of Washington. The shoreline immediately surrounding the terminal is designated Rural (20).

The terminal is operated by private contractors and has a capacity for 22 vehicles onsite (17). Nearby off-site populations include some commercial activity associated with the ferry terminal. The remaining portion of the surrounding land is generally undeveloped. Figure 3-8 shows the terminal.

The terminal is adjacent to a low density population zone. In the adjacent zip code, 98261, there is a population density of 72 people per square mile during the day and 80 people per square mile at night.

<p style="text-align: center;"><b>Shaw Terminal</b></p> <p><b>Location:</b> 48°35'87"N 122°55'40"W</p> <p><b>Number of Slips:</b> 1</p> <p><b>Water Body:</b> Harney Channel</p> <p><b>Shoreline Designation:</b> Rural</p>
---



Figure 3-8 Shaw Terminal

### 3.7 Orcas Terminal

<b>Orcas Terminal</b>
<b>Location:</b> 48°35'51"N 122°56'33"W
<b>Number of Slips:</b> 1
<b>Water Body:</b> Harney Channel
<b>Shoreline Designation:</b> Urban

The Orcas Terminal (48°35'51"N 122°56'33"W) is a single-slip facility in Harney Channel. The facility is in San Juan County and owned by the State of Washington. The shoreline immediately surrounding the terminal is designated Urban (20).

The terminal is operated by private contractors and has a capacity for 120 vehicles onsite (17). Nearby off-site populations include:

- Restaurants and office buildings both sides of the terminal entrance, indicated by 1 in Figure 3-9
- Hotel across the street from the terminal entrance, indicated by 2 in Figure 3-9

Figure 3-9 shows the terminal and estimated population centers near the terminal. The numbers on the figure correspond to the population centers described above.



**Figure 3-9 Orcas Terminal and Population Centers**

The terminal is adjacent to a low density population zone. In the adjacent zip code, 98245, there is a population density of 118 people per square mile during the day and 114 people per square mile at night.

### 3.8 Friday Harbor Terminal

The Friday Harbor Terminal (48°32'10"N 123°00'50"W) is a single-slip facility in Harney Channel. The facility also has a single tie-up slip. The facility is in San Juan County and owned by the Washington Department of Transportation (2). The shoreline immediately surrounding the terminal is designated Urban (20).

The terminal shares facilities with Friday Harbor. The terminal is operated by private contractors and has a capacity for 136 vehicles onsite (17). Nearby off-site populations include:

- Restaurant/commercial areas to the east and west of terminal entrance, indicated by 2 in Figure 3-10
- A marina to the west, indicated by 2 in Figure 3-10

<p style="text-align: center;"><b>Friday Harbor Terminal</b></p> <p><b>Location:</b> 48°32'10"N 123°00'50"W</p> <p><b>Number of Slips:</b> 1+</p> <p><b>Water Body:</b> Friday Harbor</p> <p><b>Shoreline Designation:</b> Urban</p>
--

Figure 3-10 shows the terminal and estimated population centers near the terminal. The numbers on the figure correspond to the population centers described above.



**Figure 3-10 Friday Harbor Terminal and Population Centers**

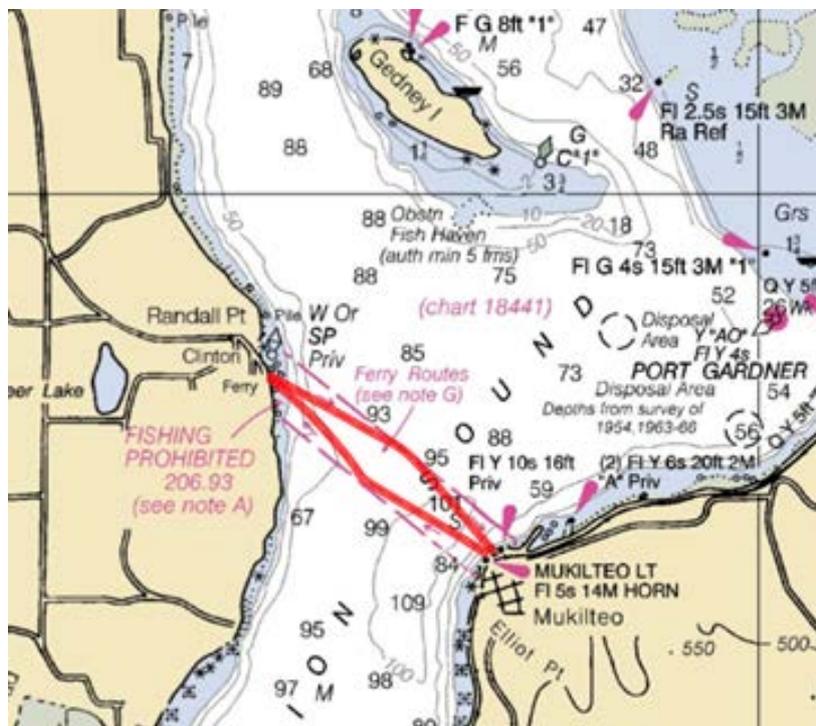
The terminal is adjacent to a low density population zone. In the adjacent zip code, 98250, there is a population density of 117 people per square mile during the day and 123 people per square mile at night.

## 4 MUKILTEO/CLINTON

### 4.1 Mukilteo/Clinton Route

The route has a single segment that connects Mukilteo (approximately 25 mi north of Seattle) and Clinton (Randall Point on Whidbey Island). This run is a main route providing access for commuters from the south end of Whidbey Island to the greater Seattle/Everett metropolitan area. The segment spans the Possession Sound and has a crossing time of approximately 20 minutes (17). The segment is traversed 26,770 times annually (1).

Water depths along the 3-mile route vary from 84 fathoms to 101 fathoms. Figure 4-1 shows the water depths along the segment in fathoms. The segment runs south of Gedney Island. A shoal less than 5 fathoms deep extends southeast from the Island for approximately 0.8 mi (15).

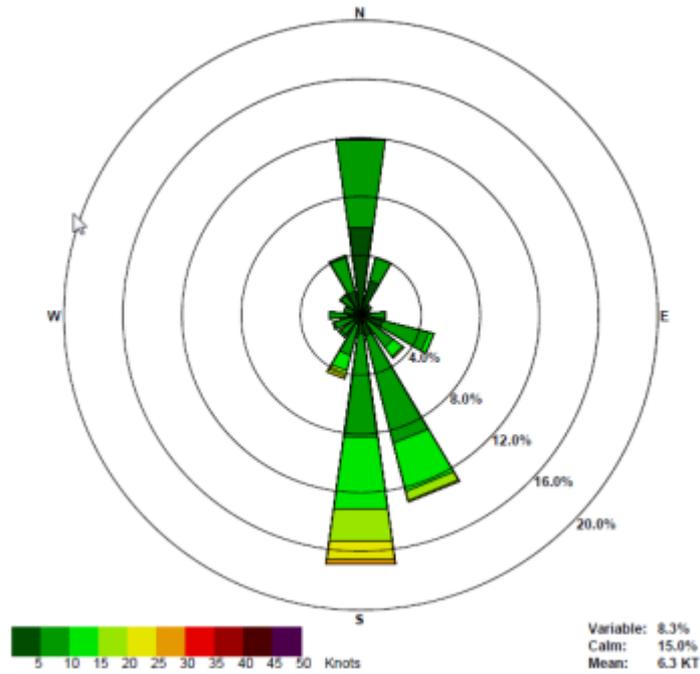


**Figure 4-1 Mukilteo/Clinton Ferry Route (11)**

The area near the ferry route segment is represented by Weather Station # 727937 in Snohomish County (12). Characteristic weather conditions and the wind rose are shown in Table 4-1 and Figure 4-2, respectively.

**Table 4-1 Characteristic Weather Conditions Mukilteo/Clinton Ferry Route (12)**

Average annual temperature (°C)	9.8
Average annual wind speed (knots)	7.4
Percentage of calm wind (0 knots)	15%
Average annual humidity	78%

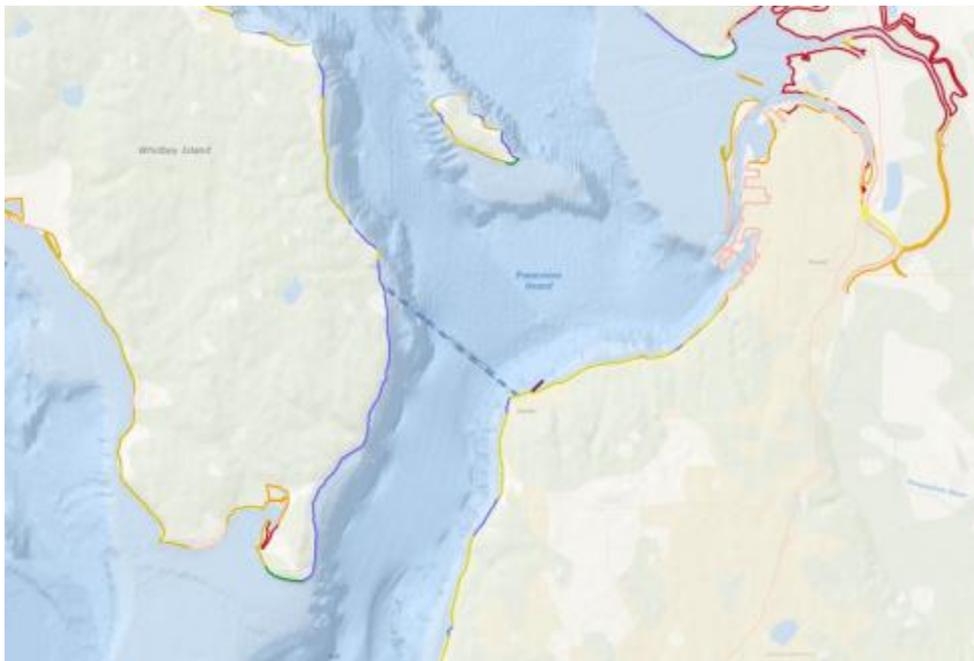


**Figure 4-2 Wind Rose Mukilteo/Clinton Ferry Route (13)**

Mixed sand and gravel beaches – Type 5 is the predominant ESI shoreline classification near the ferry route segment, 40% of the shoreline within 3 miles of the ferry route segment. Table 4-2 tabulates the percentage of the shoreline in each classification and Figure 4-3 shows the shoreline classifications graphically (8).

**Table 4-2 ESI Coastline Classifications Mukilteo/Clinton Ferry Route (8)**

Color Code	ESI Number	Shoreline Descriptions	% of Shoreline Near the Ferry Route Segment
	5	Mixed sand and gravel beaches	40%
	6B	Riprap	33%
	7	Exposed tidal flats	19%
	1B	Exposed, solid man-made structures	3%
	6A	Gravel beaches	2%
	9B	Vegetated low banks	1%
	9A	Sheltered tidal flats	1%
	4	Coarse-grained sand beaches	1%
	<b>Total Hard Shorelines</b>		<b>38%</b>
	<b>Total Soft Shoreline</b>		<b>62%</b>



**Figure 4-3 ESI Shoreline Classifications Mukilteo/Clinton Ferry Route (8)**

## 4.2 Mukilteo Terminal

The Mukilteo Terminal (47°57'00"N 122°18'12"W) is a single-slip terminal east of Elliot Point in Possession Sound (17). The facility is located in a commercial district in Snohomish County. The shoreline immediately surrounding the terminal is designated Urban Waterfront (5).

The terminal is dedicated to ferry traffic. The Port of Everett is north of the terminal and contains a wharf for deep draft vessels and a naval port.

Figure 4-4 shows the terminal and estimated population centers near the terminal. The terminal employs 8 staff (19) and according to the WSF Route Reference Book, has the capacity for 240 vehicles on-site (17).

Nearby off-site populations include:

- Hotel on east side of terminal entrance, indicated by 1 in Figure 4-4
- Restaurants and commercial area on the southeast side of terminal, indicated by 2 in Figure 4-4
- Privately owned condos southwest of terminal, indicated by 3 in Figure 4-4.

**Mukilteo Terminal**

**Location:** 47°57'00"N 122°18'12"W

**Number of Slips:** 1

**Water Body:** Possession Sound

**Shoreline Designation:** Urban Waterfront

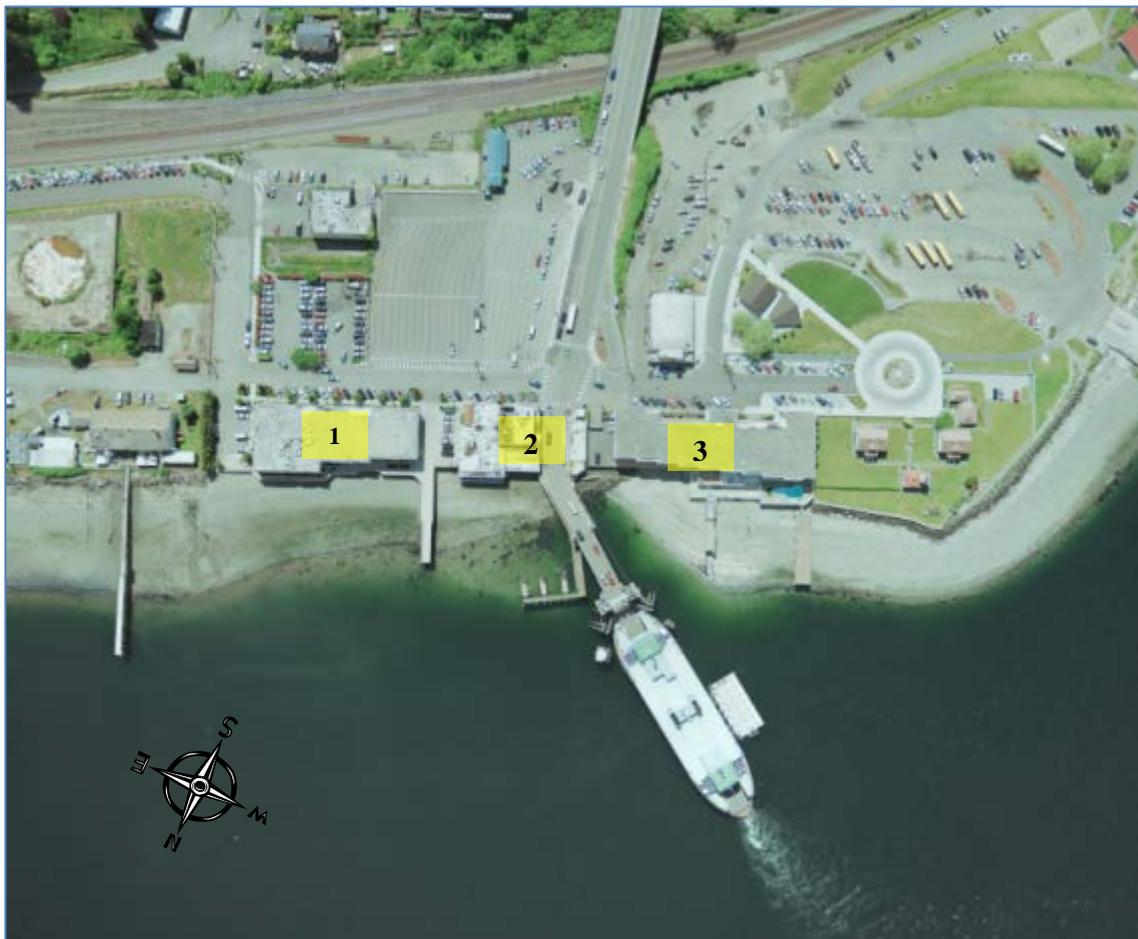


Figure 4-4 Mukilteo Terminal and Population Centers



The numbers on the figure correspond to the population centers described above.

The terminal is adjacent to medium density population zones. In the adjacent zip code, 98275, there is a population density of 2,623 people per square mile during the day and 2,654 people per square mile at night. The 98203 zip code begins just up the shoreline from the terminal. It is more densely populated: 2,953 people per square mile during the day and 3,209 people per square mile at night.

### 4.3 Clinton Terminal

#### Clinton Terminal

**Location:** 47°58'30"N 122°21'11"W

**Number of Slips:** 2

**Water Body:** Possession Sound

**Shoreline Designation:** High Intensity

The Clinton Terminal (47°58'30"N 122°21'11"W) is a two-slip facility off Randall Point off Whidbey Island in Possession Sound. The shoreline immediately surrounding the terminal is designated High Intensity (22).

The terminal is dedicated to ferry traffic. The Port of South Whidbey occupies the adjacent property north and south of the terminal (15), shown in Figure 4-5. Most of the adjacent land is dedicated to public park and light commercial use. The terminal employs 5 staff (19) and has a capacity for 190 vehicles onsite (17).



**Figure 4-5 Clinton Terminal**

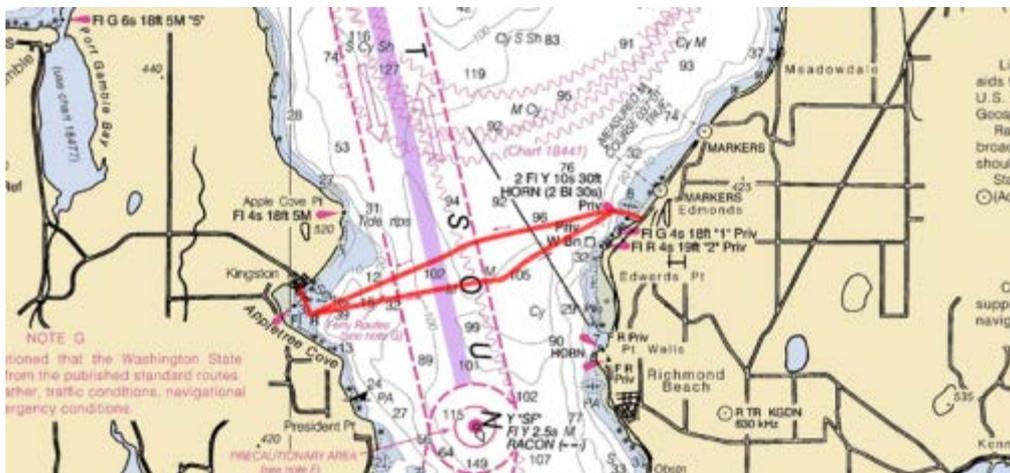
The terminal is adjacent to a low density population zone. In the adjacent zip code, 98236, there is a population density of 181 people per square mile during the day and 246 people per square mile at night.

## 5 EDMONDS/KINGSTON

### 5.1 Edmonds/Kingston Route

This route has a single segment that connects Edmonds (approximately 18 mi north of Seattle) and Kingston (located on the Kitsap Peninsula) (Figure 5-1). This run is a main route providing commuter and recreational access from the Kitsap and Olympic Peninsulas to Edmonds and the greater Seattle area beyond. It also provides a freight route for a significant amount of trucking traffic. Crossing time between Edmonds and Kingston is approximately 30 min. The segment is traversed 17,052 times annually (21).

Water depths along route vary from 3 fathoms to 105 fathoms. Figure 5-1 shows the water depths along the segment in fathoms (11).

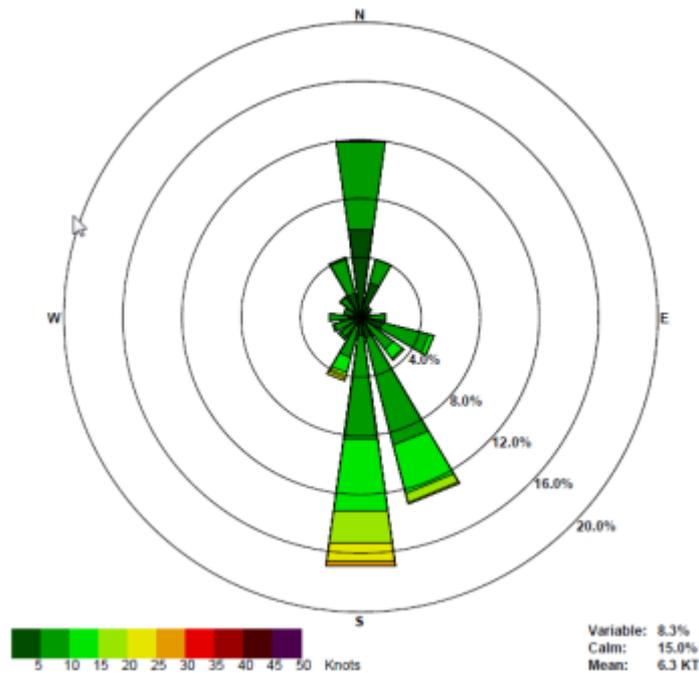


**Figure 5-1 Edmonds/Kingston Ferry Route (11)**

The area near the ferry route segment is represented by Weather Station # 727937 in Snohomish County (12). Characteristic weather conditions and the wind rose are shown in Table 5-1 and Figure 5-2, respectively.

**Table 5-1 Characteristic Weather Conditions Edmonds/Kingston Ferry Route (12)**

Average annual temperature (°C)	9.8
Average annual wind speed (knots)	7.4
Percentage of calm wind (0 knots)	15%
Average annual humidity	78%

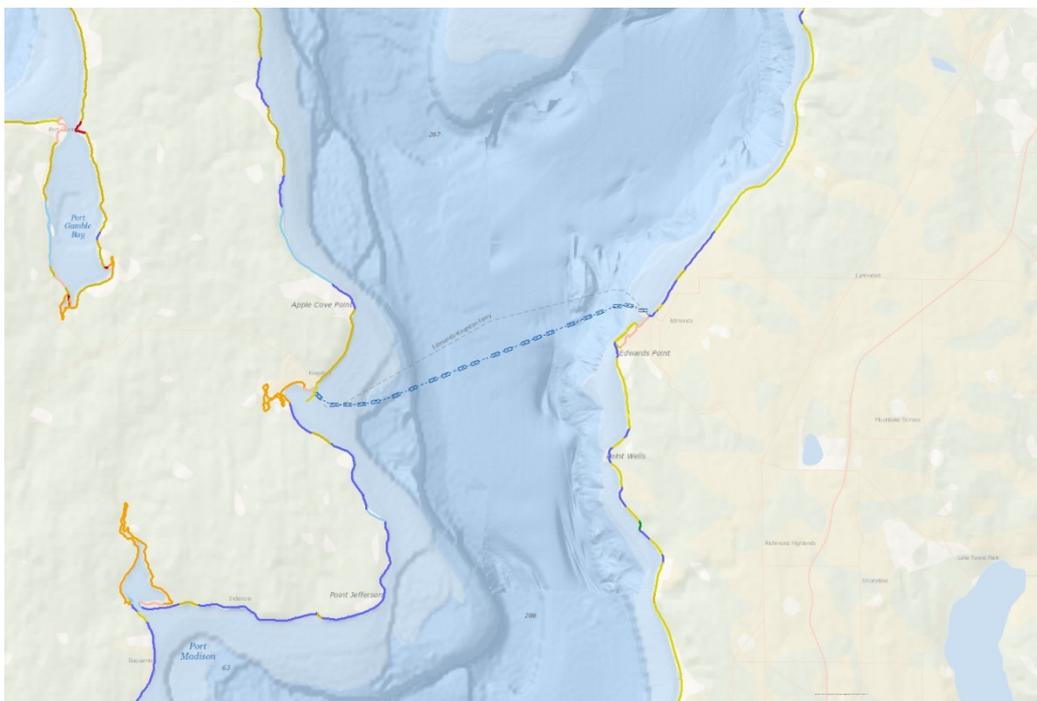


**Figure 5-2 Wind Rose Edmonds/Kingston Ferry Route (13)**

Mixed sand and gravel beaches – Type 5 is the predominant ESI shoreline classification near the ferry route segment, 34% of the shoreline within 3 miles of the ferry route segment. Table 5-2 tabulates the percentage of the shoreline in each classification and Figure 5-3 shows the shoreline classifications graphically (8).

**Table 5-2 ESI Coastline Classifications Edmonds/Kingston Ferry Route (8)**

Color Code	ESI Number	Shoreline Descriptions	% of Shoreline Near the Ferry Route Segment
	5	Mixed sand and gravel beaches	34%
	6B	Riprap	27%
	9B	Vegetated low banks	12%
	4	Coarse-grained sand beaches	10%
	7	Exposed tidal flats	10%
	8B	Sheltered, man-made structures	4%
	8C	Sheltered riprap	2%
	9A	Sheltered tidal flats	2%
	<b>Total Hard Shorelines</b>		<b>33%</b>
	<b>Total Soft Shoreline</b>		<b>67%</b>



**Figure 5-3 ESI Shoreline Classifications Edmonds/Kingston Ferry Route (8)**

## 5.2 Edmonds Terminal

### Edmonds Terminal

**Location:** 47°48'47"N 122°23'04"W

**Number of Slips:** 1

**Water Body:** tributary of Admiralty Inlet **Invalid source specified.**

**Shoreline Designation:** Urban Mixed Use

The Edmonds Terminal (47°48'47"N 122°23'04"W) is a single-slip facility approximately 18 miles north of Seattle and 1 mile northeast of Edwards Point in the Puget Sound. The facility is located on a ferry right-of-way in Snohomish County. The shoreline immediately surrounding the terminal is designated Urban Mixed Use II (23).

The Port of Edmonds operates a small boat basin and marina just south of the ferry landing. Figure 5-4 shows the terminal and estimated population centers near the terminal. The numbers on the figure correspond to the population centers described above.

The terminal employs 7 staff (19) and has a capacity for 174 vehicles onsite (17). Nearby off-site populations include:

- Restaurants and commercial areas on both sides of the terminal entrance, indicated by 1 in Figure 5-4.
- Public park south of the terminal, indicated by 2 in Figure 5-4
- Designated dive park north of the terminal, indicated by 3 in Figure 5-4
- Office building and senior center south of the park, indicated by 4 in Figure 5-4



Figure 5-4 Edmonds Terminal and Population Centers



The terminal is adjacent to medium density population zones. In the adjacent zip code, 98020, there is a population density of 2,769 people per square mile during the day and 3,539 people per square mile at night. The 98026 zip code begins inland of the terminal is similarly populated, 2,682 people per square mile during the day and 3,852 people per square mile at night.

### 5.3 Kingston Terminal

The Kingston Terminal (47°47'36"N 122°24'44"W) is a two-slip facility on Kitsap Peninsula extending in the north side of Appletree Cove, a tributary of Puget Sound. The 4-acre facility is leased from the Port of Kingston in Kitsap county (16). The shoreline immediately surrounding the terminal is designated High Intensity (24).

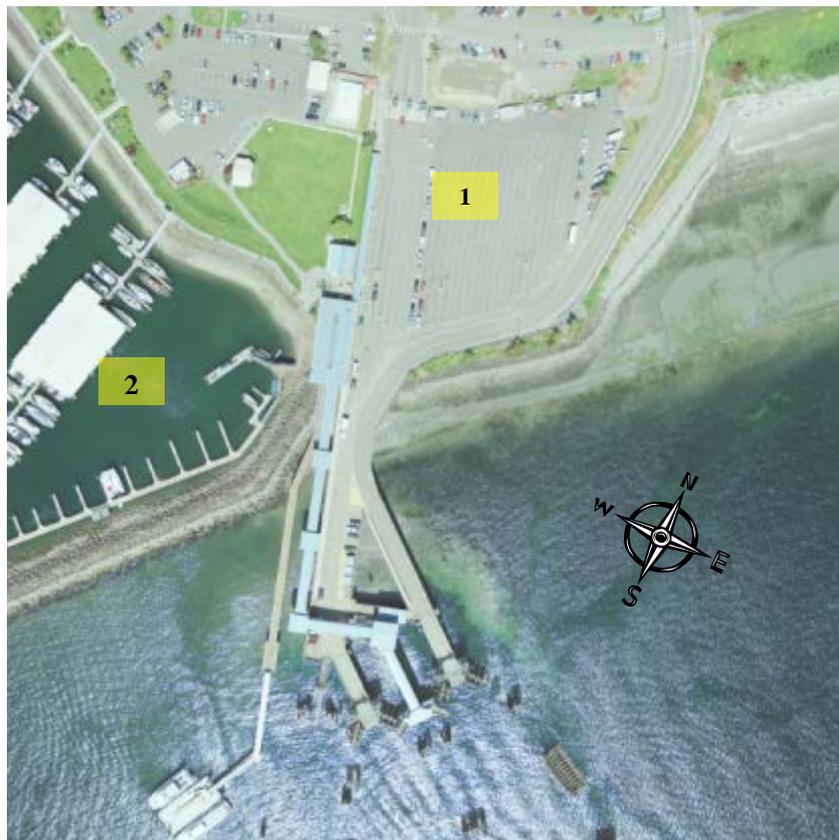
The terminal is located within a harbor shared with the remainder of the Port of Kingston. The harbor basin is protected by a 340-yard breakwater southwest of the ferry pier. The Port of Kingston is frequented by tugs, fishing boats and pleasure craft. It has permanent and guest moorage for 275 small craft and a public fishing pier (16).

The terminal employs 7 staff (19) and has a capacity for 288 vehicles onsite (17). Nearby off-site populations include:

- Parking and public park at the entrance to the terminal, indicated by 1 in Figure 5-5
- Marina with private boat storage west of the terminal, indicated by 2 in Figure 5-5.

Figure 5-5 shows the terminal and estimated population centers near the terminal. The numbers on the figure correspond to the population centers described above.

<p style="text-align: center;"><b>Kingston Terminal</b></p> <p><b>Location:</b> 47°47'36"N 122°24'44"W</p> <p><b>Number of Slips:</b> 2</p> <p><b>Water Body:</b> Appletree Cove</p> <p><b>Shoreline Designation:</b> High Intensity</p>
--



**Figure 5-5 Kingston Terminal and Population Centers**

The terminal is adjacent to a low density population zone. In the adjacent zip code, 98346, there is a population density of 285 people per square mile during the day and 337 people per square mile at night.

## 6 SEATTLE/BREMERTON

### 6.1 Seattle/Bremerton Route

The route has two segments connecting Seattle (Colman Dock) to both Bainbridge Island and Bremerton. Only the segment connecting Seattle and Bremerton is under consideration for the LNG-fueled passenger ferry passage. The segment requires approximately 60 minutes of transit time. The segment is traversed 10,585 times annually (21).

An overview of the route segment is shown in Figure 6-1. Detailed portions of the segment are shown from Figure 6-2 to Figure 6-5.

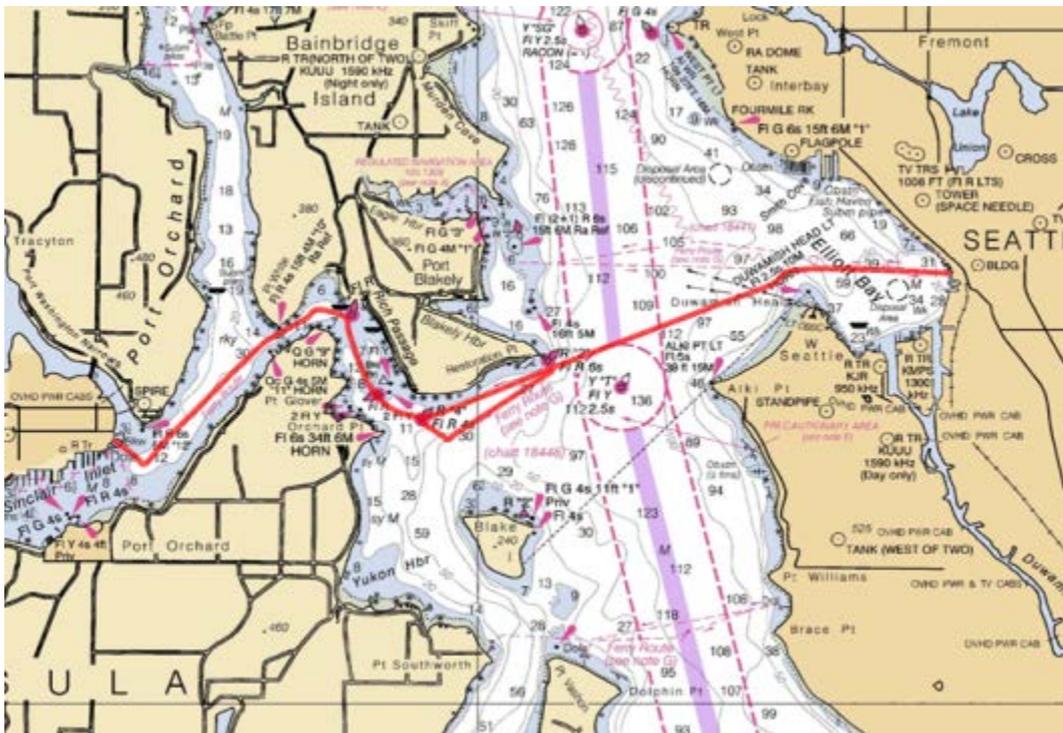
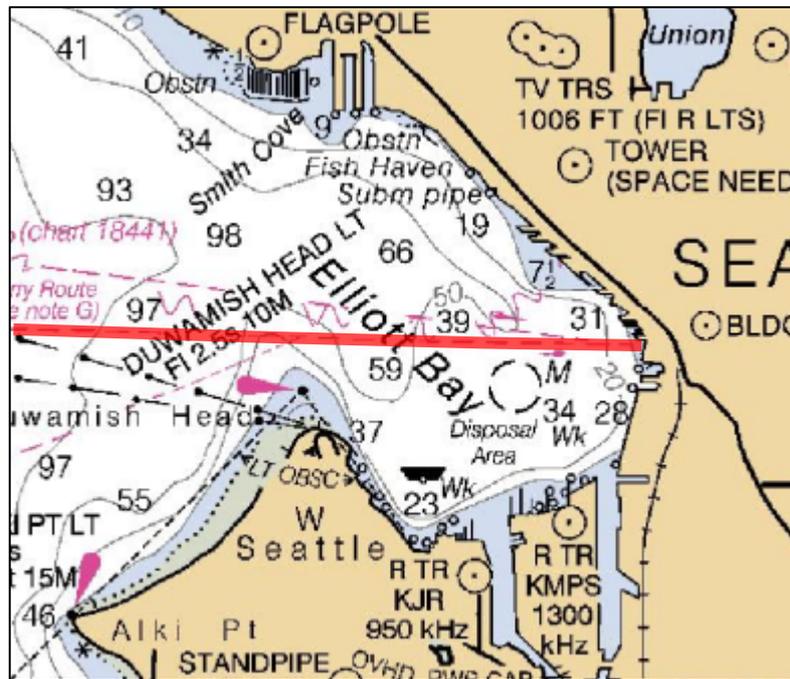


Figure 6-1 Seattle/Bremerton Ferry Route Segment Overview (11)

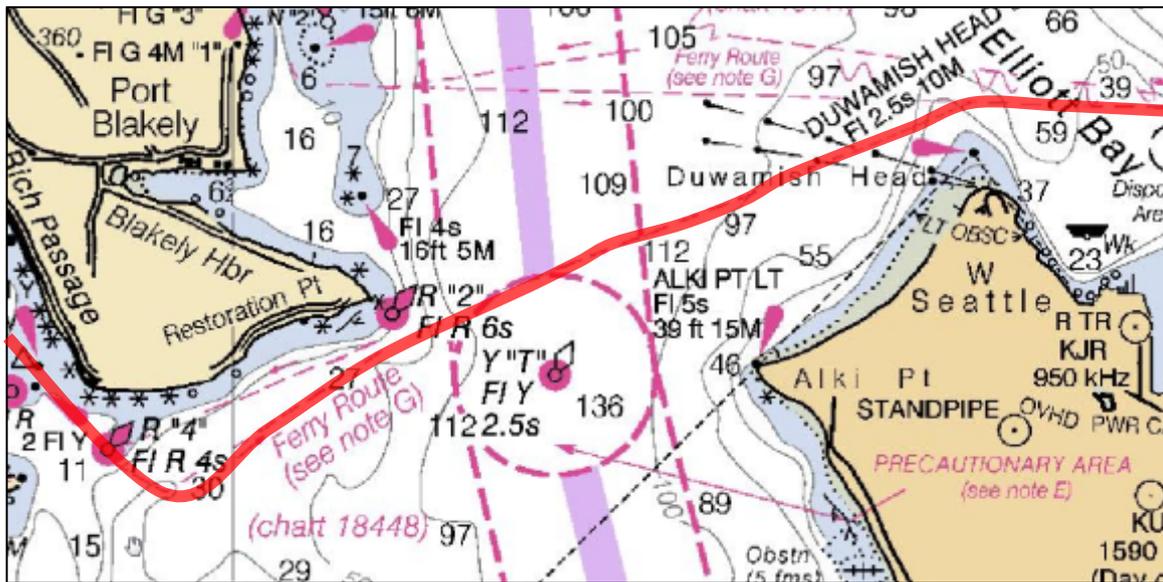
The segment extends west across Elliot Bay toward the Duwamish Head, represented by the red line Figure 6-2. Elliot Bay is about 2 miles wide at the mouth and extends about 2 miles inland. The depth ranges from 30 fathoms to approximately 70 fathoms at mean low water. The shoreline of Duwamish Head has a mixture of single-family private homes and multi-family dwellings, each with a rough average of 30 units facing the shoreline. A shoal extends north from Duwamish Head for approximately 0.2 miles.



**Figure 6-2 Seattle/Bremerton Ferry Route Segment Detail: Elliot Bay and Duwamish Head (11)**

The segment continues west-southwest across Puget Sound crossing both the north and south major shipping lanes and south around Restoration Point on Bainbridge Island, reference Figure 6-3. Restoration point is a flat about 10 feet above water for about 300 yards and rises abruptly to a wooded residential knoll about 100 feet out of the water. The southern shore of Bainbridge Island has private residences lining the shore. There is a single community pool near the shoreline. Decatur Reef is partially visible and extends about 300 yards east of Restoration point (15).

Large volumes of traffic move through Elliot Bay south to Tacoma (21).



**Figure 6-3 Seattle/Bremerton Ferry Route Segment Detail: Puget Sound and Restoration Point (11)**

The segment continues north of Orchard Point on the Great Peninsula and northeast through the Rich Passage. Rich Passage is about 3 miles long. Orchard Point marks the entrance to the Rich Passage and serves as general anchorage. The south side of the point is a naval restricted area. Orchard Rocks extends for the first 400 yards on the north side of the Rich Passage channel and is partially visible. There is also a reef extending north from Point Glover on the Great Peninsula. Rich Passage is about 3 miles long and takes a sharp bend near the west end between Waterman Point (to the south) and Point White (to the north). The passage narrows to approximately 0.2 miles at the western outlet (15).

The U.S. Coast Pilot 7 (15) describes the Rich Passage as an area with large traffic volumes due to activities at the Puget Sound Naval shipyard, the U.S. Coast Pilot does not define the size of a “large traffic volume” and DNV has not been able to find any standard definition in the U.S. Coast Pilot that supports any size definition of a “large traffic volume”. Deep-draft vessels making the turn at the western end of the Rich Passage often end up on the eastern shore and must pass other vessels starboard-to-starboard (15).

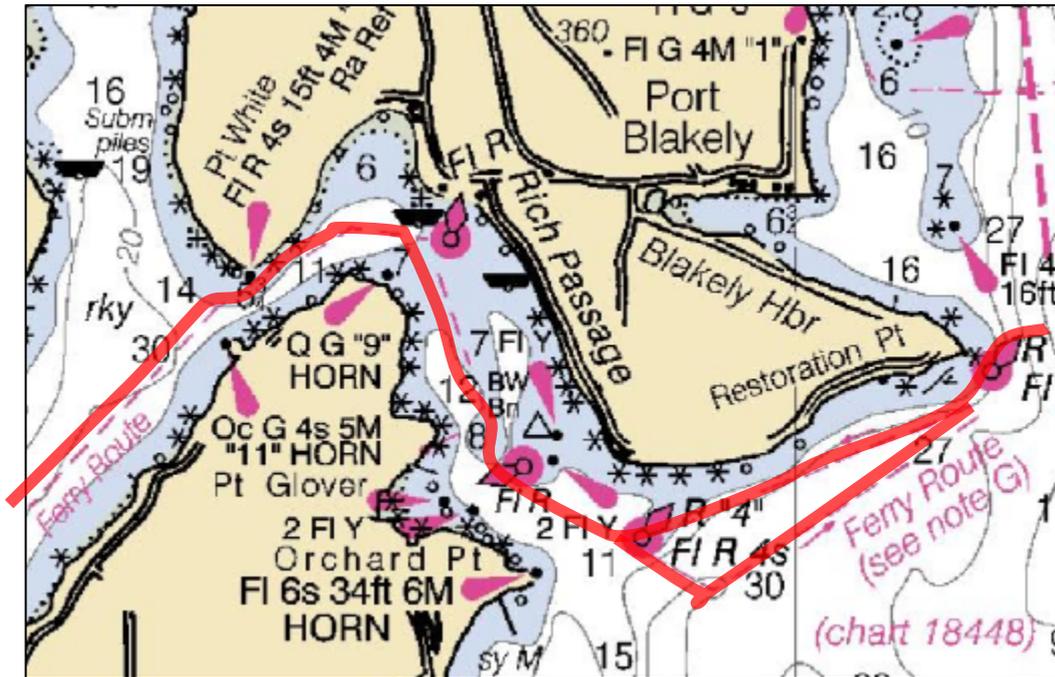
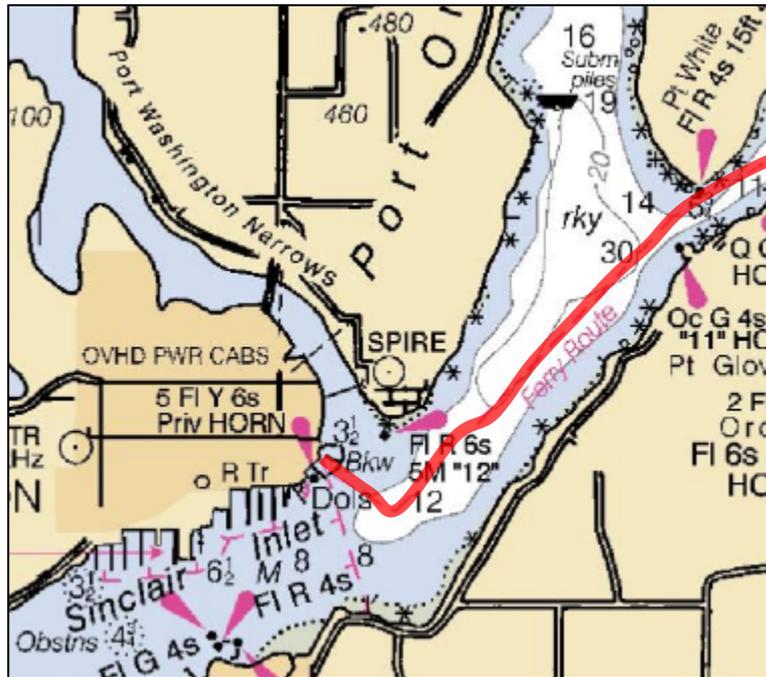


Figure 6-4 Seattle/Bremerton Ferry Route Segment Detail: Rich Passage (11)

The segment enters the Sinclair Inlet from the Rich Passage. The Sinclair Inlet extends west-southwest for approximately 3.5 miles. The segment passes south of Port Herron and the entrance to the Port Washington Narrows where the community of East Bremerton is located. The village of Annapolis is located directly across the inlet from Port Herron. The Bremerton Terminal is located on the northern shore just past the Port Washington Narrows adjacent to the Puget Sound Naval Shipyard (15).



**Figure 6-5 Seattle/Bremerton Ferry Route Segment Detail: Sinclair Inlet (11)**

Weather at the Seattle terminal is represented by Weather Stations # 994014 and # 994014 in Seattle (12). Characteristic weather conditions and the wind rose are shown in Table 6-1 and Figure 6-6, respectively. Weather at the Bremerton terminal is represented by Weather Stations # 727928 in Bremerton (12). Characteristic weather conditions and the wind rose are shown in Table 6-1 and Figure 6-7, respectively.

**Table 6-1 Characteristic Weather Conditions Seattle Ferry Terminal and Bremerton Ferry Terminal (12)**

	Seattle Ferry Terminal	Bremerton Ferry Terminal
Average annual temperature (°C)	11.3	9.3
Average annual wind speed (knots)	5.0	7.2
Percentage of calm wind (0 knots)	10.7%	30.7%
Average annual humidity	80.5%	74.6%

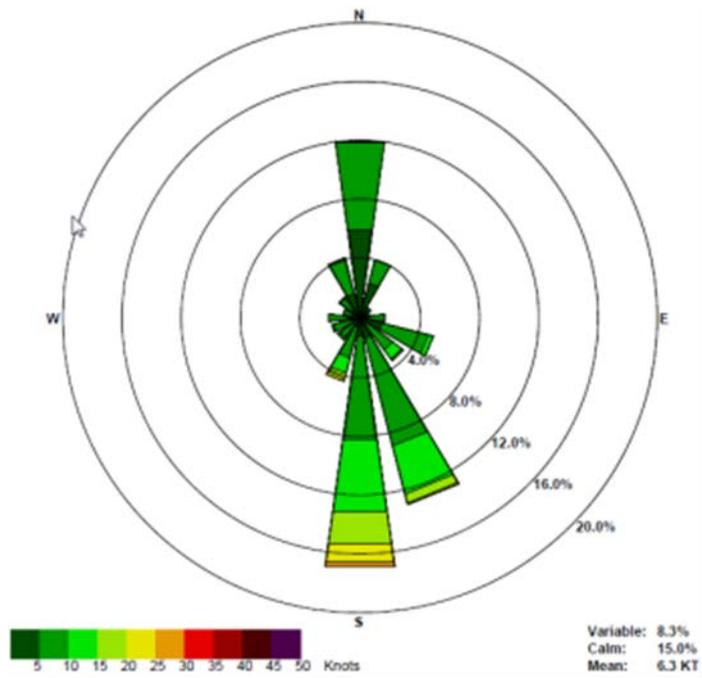


Figure 6-6 Wind Rose Seattle Ferry Terminal (13)

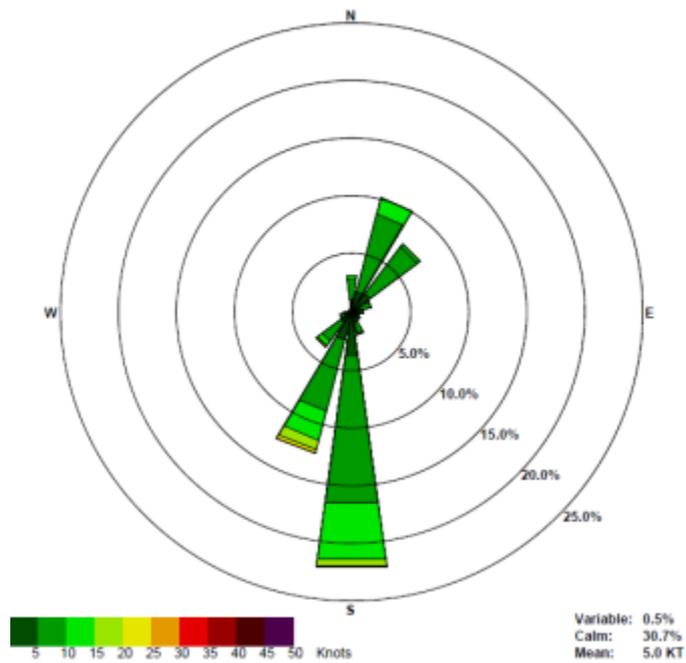


Figure 6-7 Wind Rose at Bremerton Ferry Terminal (13)



Mixed sand and gravel beaches – Type 5 and Riprap – Type 6B are the predominant ESI shoreline classification within 3 miles of the ferry route segment, 28% and 20%, respectively. Figure 6-8 shows the ESI classifications and Table 6-2 shows the percentage of the shoreline in each classification (14).

**Table 6-2 ESI Coastline Classifications Seattle/Bremerton Ferry Route (8)**

Color Code	ESI Number	Shoreline Descriptions	% of Shoreline Near the Ferry Route Segment
	5	Mixed sand and gravel beaches	28%
	6B	Riprap	20%
	8B	Sheltered, man-made structures	12%
	8C	Sheltered riprap	9%
	9B	Vegetated low banks	7%
	7	Exposed tidal flats	7%
	9A	Sheltered tidal flats	5%
	1B	Exposed, solid man-made structures	4%
	1A	Exposed, rocky shores	2%
	2A	Exposed, wave-cut platforms in bedrock, mud or clay	2%
	3A	Fine-grained to medium-grained sand beaches	1%
	10A	Salt-water and brackish-water marshes	1%
	4	Coarse-grained sand beaches	1%
<b>Total Hard Shorelines</b>			<b>50%</b>
<b>Total Soft Shoreline</b>			<b>50%</b>



Figure 6-8 ESI Shoreline Classifications Seattle/Bremerton Ferry Route (8)

## 6.2 Seattle-Coleman Dock Terminal

### Seattle-Colman Dock Terminal

**Location:** 47°36'9"N 122°20'17"W

**Number of Slips:** 3

**Water Body:** Elliot Bay

**Shoreline Designation:** Urban Harborfront

The Seattle-Colman Dock Terminal (47°33'44"N 122°20'17"W) (21) is a three-slip facility in Elliot Bay (17). The shoreline immediately surrounding the terminal is designated Urban Harborfront (2).

The terminal employs 14 (19) staff and has a capacity for 650 vehicles onsite (17). Nearby off-site populations include:

- Commercial vendors on the terminal property, indicated by 1 in Figure 6-9
- East of the property is an elevated roadway and multi-level mixed use buildings, indicated by 2 in Figure 6-9
- Municipal fire station, indicated by 3 in Figure 6-9

The terminal is adjacent to high density populations in the downtown portion of the City of Seattle. In the adjacent zip code, 98104, there is a population density of 93,500 people per square mile during the day and 16,900 people per square mile at night. The 98101 zip code begins just up the shoreline from the terminal at Spring St and is more densely populated, 221,400 people per square mile during the day and 19,700 people per square mile at night.

Figure 6-9 shows the terminal and estimated population centers near the terminal. The numbers on the figure correspond to the population centers previously described.



Figure 6-9 Seattle Coleman Dock Terminal and Population Centers

## 6.3 Bremerton Terminal

<p style="text-align: center;"><b>Bremerton Terminal</b></p> <p><b>Location:</b> 47°33'44"N 122°37'11"W</p> <p><b>Number of Slips:</b> 2</p> <p><b>Water Body:</b> Sinclair Inlet</p> <p><b>Shoreline Designation:</b> Downtown Waterfront</p>
--

The Bremerton Terminal (47°33'44"N 122°37'11"W) (1) is a two-slip facility in the Sinclair Inlet. The facility is located in the Port of Bremerton on state lands in Kitsap County adjoining the Puget Sound Naval Shipyard. The shoreline immediately surrounding the terminal is designated Downtown Waterfront (6),

The terminal employs 5 staff (19) and has a capacity for 230 vehicles onsite (17). The Kitsap Multimodal transit center is located directly above the terminal. The transit center includes small food vendors, bars, a restaurant, and a parking facility (16).

Nearby off-site populations include:

- Kitsap Conference Center and adjacent hotel to the north-northeast of the property, indicated by 2 in Figure 6-10
- Everest College north of property, not shown in Figure 6-10
- Puget Sound Naval Museum and Puget Sound Naval Ship Yard adjacent to the southwest, indicated by 1 and 3, respectively in Figure 6-10

The terminal is adjacent to medium density population zones. In the adjacent zip code, 98337, there is a population density of 8,327 people per square mile during the day and 6,415 people per square mile at night. The naval base is located southwest of the terminal in the 98314 zip code. The naval base has a daytime population density of 5,721 people per square mile and a nighttime population density of 5,769 people per square mile.

Figure 6-10 shows the terminal and estimated population centers near the terminal. The numbers on the figure correspond to the population centers previously described.

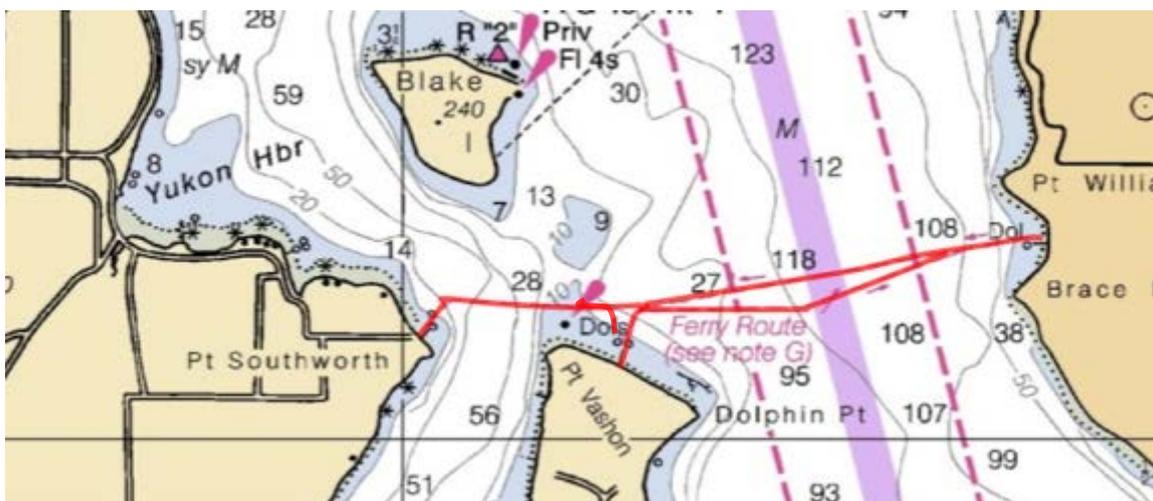


**Figure 6-10 Bremerton Terminal and Population Centers**

## 7 FAUNTLEROY/VASHON/SOUTHWORTH

### 7.1 Fautleroy/Vashon/Southworth Route

The route contains three segments connecting Fautleroy (approximately 8 miles south of Seattle), Vashon (on the northern end of Vashon Island) and Southworth (located on the Kitsap Peninsula). This run is a main route providing connections both from south Kitsap County via Southworth and from Vashon Island to the greater Seattle metropolitan area. The route also supplies freight and service access to Vashon Island.



**Figure 7-1 Fautleroy/Vashon/Southworth Ferry Route (11)**

The segment that connects Fautleroy and Vashon requires approximately 20 minutes of travel time and is traversed 23,705 times annually. The segment extends directly from the Fautleroy terminal across the main shipping lanes (both northbound and southbound) of Puget Sound to Vashon on the northern end of Vashon Island. Water depths along the route vary from 25 to 120 fathoms (11).

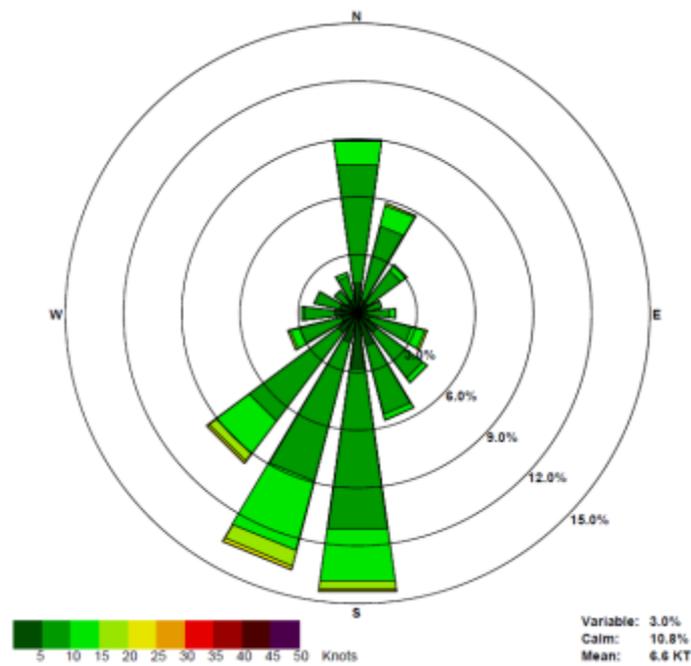
The segment that connects Southworth and Vashon is traversed in 10 minutes 15,572 times annually. The segment extends north from the Vashon Terminal on Point Vashon, turns west and crosses at the northern mouth of the Colvos Passage to the Southworth Terminal.

The segment connecting Southworth and Fautleroy extends east across the mouth of the Colvos Passage past Point Vashon and crosses both major shipping lanes (northbound and southbound) in the Puget Sound. The crossing time between Fautleroy and Southworth is approximately 40 minutes and is traversed 17,951 times annually.

The area near the ferry route is represented by Weather Station # 727930 at Seattle Tacoma International Airport (12). Characteristic weather conditions and the wind rose are shown in Table 7-1 and Figure 7-2, respectively.

**Table 7-1 Characteristic Weather Conditions Fauntleroy/Vashon/Southworth Ferry Route (12)**

Average annual temperature (°C)	10.8
Average annual wind speed (knots)	7.3
Percentage of calm wind (0 knots)	11%
Average annual humidity	78%

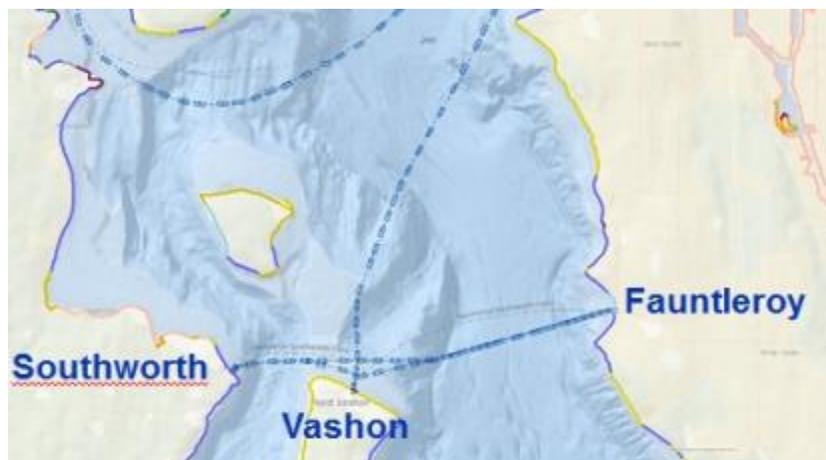


**Figure 7-2 Wind Rose Fauntleroy/Vashon/Southworth Ferry Route (13)**

Mixed sand and gravel beaches – Type 5 and Riprap – Type 6B are the predominant ESI shoreline classification within 3 miles of the ferry route segment, 39% and 29%, respectively. Figure 7-3 shows the ESI classifications and Table 7-2 shows the percentage of the shoreline in each classification (14).

**Table 7-2 ESI Coastline Classifications Fautleroy/Vashon/Southworth Ferry Route (8)**

Color Code	ESI Number	Shoreline Descriptions	% of Shoreline Near the Ferry Route Segment
	5	Mixed sand and gravel beaches	39%
	6B	Riprap	29%
	7	Exposed tidal flats	11%
	8B	Sheltered, man-made structures	7%
	8C	Sheltered riprap	7%
	4	Coarse-grained sand beaches	6%
	9A	Sheltered tidal flats	1%
<b>Total Hard Shorelines</b>			<b>50%</b>
<b>Total Soft Shoreline</b>			<b>50%</b>



**Figure 7-3 ESI Shoreline Classifications Fautleroy/Vashon/Southworth Ferry Route (8)**

## 7.2 Fauntleroy Terminal

The Fauntleroy Terminal (47°31'24"N 122°23'37"W) is a single-slip facility in Fauntleroy Cove of Puget Sound. The facility is amid residential and state park lands. (17) The shoreline immediately surrounding the terminal is designated Urban Residential and Conservancy Recreation (2).

The terminal employs 7 staff (19) and has a capacity for 84 vehicles onsite (17). Nearby off-site populations consist of private residential areas starting on either side of the terminal entrance, indicated by 1 and 2 in Figure 7-4. The Barton Street Pump station is adjacent to the north terminal entrance (16). Figure 7-4 shows the terminal and estimated population centers near the terminal.

The terminal is adjacent to medium density population zones. In the adjacent zip code, 98136, there is a population density of 3,939 people per square mile during the day and 6,425 people per square mile at night. The 98126 zip code begins inland of the terminal is similarly populated, 4,841 people per square mile during the day and 6,731 people per square mile at night. The 98146 zip code begins down the coast from the terminal is also similarly populated, 3,586 people per square mile during the day and 5,573 people per square mile at night.

Fauntleroy Terminal	
<b>Location:</b>	47°31'24"N 122°23'37"W
<b>Number of Slips:</b>	1
<b>Water Body:</b>	Fauntleroy Cove/Puget Sound
<b>Shoreline Designation:</b>	Urban Residential Conservancy Recreation



Figure 7-4 Fauntleroy Terminal and Population Centers

### 7.3 Vashon Terminal

The Vashon Terminal (47°30'32"N 122°27'46"W) is a two-slip facility off of Point Vashon on the north end of Vashon Island. In addition to the two main slips, the facility has a passenger-only slip and a tie-up slip. The facility is located in King County (17). The shoreline immediately surrounding the terminal is designated Rural (3).

The terminal employs 7 staff and has a capacity for 80 vehicles onsite (17). Areas immediately surrounding the facility are wetlands protected by the State of Washington (15). Nearby off-site populations consist of private residential areas starting on the west side of the terminal entrance, indicated by 1 in Figure 7-5; a public restaurant on the east side of the terminal entrance, indicated by 2 in Figure 7-5 and the King County Passenger Ferry Terminal, indicated by 3 in Figure 7-5. Figure 7-5 shows the terminal and estimated population centers near the terminal.

The terminal is adjacent to a low density population zone. In the adjacent zip code, 98070, there is a population density of 252 people per square mile during the day and 288 people per square mile at night.

<p style="text-align: center;"><b>Vashon Terminal</b></p> <p><b>Location:</b> 47°30'32"N 122°27'46"W</p> <p><b>Number of Slips:</b> 2+</p> <p><b>Water Body:</b> Puget Sound</p> <p><b>Shoreline Designation:</b> Rural</p>
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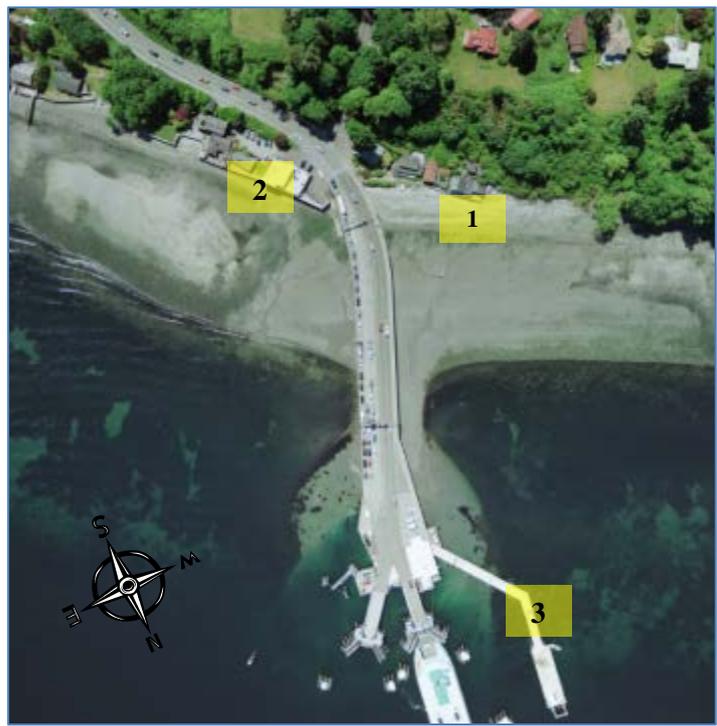


Figure 7-5 Vashon Terminal and Population Centers

## 7.4 Southworth Terminal

<b>Southworth Terminal</b>
<b>Location:</b> 47°30'46"N 122°29'42"W
<b>Number of Slips:</b> 1
<b>Water Body:</b> Colvos Passage
<b>Shoreline Designation:</b> High Intensity

The Southworth Terminal (47°30'46"N 122°29'42"W) is a single-slip facility in Colvos Passage. The facility is owned by Washington State Department of Transportation (17). The shoreline immediately surrounding the terminal is designated High Intensity (24).

The terminal employs 4 staff (19) and has a capacity for 160 vehicles onsite (17). Nearby off-site populations consist of private residential areas on both sides of the terminal entrance, indicated by 1 and 2 in Figure 7-6. Figure 7-6 shows the terminal and estimated population centers near the terminal.

The terminal is adjacent to a medium density population zone. In the adjacent zip code, 98366, there is a population density of 1,377 people per square mile during the day and 1,478 people per square mile at night.



Figure 7-6 Southworth Terminal and Population Centers

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