

**VIA ELECTRONIC FILING**

March 26, 2025

Debbie-Anne A. Reese
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

**Re: Rosario Strait Tidal Energy Project, Project No. 15368-000
Notification of Intent and Draft Pilot License Application**

Dear Secretary Reese:

Orcas Power & Light Cooperative (OPALCO) is pleased to file its Notice of Intent (NOI) to File an Application for an Original License for a Hydrokinetic Project and Draft License Application (DLA) for the proposed Rosario Strait Tidal Energy Project (Project), Federal Energy Regulatory Commission (FERC or Commission) Project No. 15368. The proposed Project would be located on Rosario Strait in the Salish Sea, near the town of Eastsound, Washington. OPALCO submits its NOI and DLA pursuant to the Commission's Whitepaper on Licensing Hydrokinetic Pilot Projects (April 2008) and the Commission's regulations at 18 CFR Part 5.

In 2022, OPALCO was awarded a grant from the Washington Department of Commerce's Clean Energy Fund 4 (CEF4) to assess a preliminary design for a potential tidal energy project in Rosario Strait to support OPALCO's microgrid for its island service area. Funding from CEF4 supported a study to investigate the testing capacity of Rosario Strait for tidal power output and tidal turbine technology to generate electricity. In 2024, OPALCO was awarded a grant from the U.S. Department of Energy to investigate the feasibility of deploying a pilot project consisting of a singular Orbital Marine O2-X Floating Tidal device with two turbine rotors with a rated at 1.2 megawatts each in Rosario Strait. To demonstrate the commercial viability of this device and allow it to connect to OPALCO's existing electrical grid, the Project requires a FERC license. The Commission issued a preliminary permit to OPALCO on January 13, 2025 to study the feasibility of the Project. The preliminary permit preserves OPALCO's right to have the priority to apply for a license for the proposed Project.

In addition to the NOI and DLA, the attached documents also include a request for waiver of certain pre-filing requirements under FERC's Integrated Licensing Process (ILP), a justification explaining the Project's eligibility for the use of the pilot project licensing procedures, and a process plan and schedule for expedited review. In conjunction with this filing, and as provided in 18 C.F.R. § 5.5(e), OPALCO also requests designation as the Commission's non-federal representative for carrying out consultation pursuant Section 7 of the Endangered Species Act and Section 106 of the National Historic Preservation Act.



In accordance with the Commission's regulations at 18 C.F.R. § 5.5(c) and the Commission's Whitepaper, OPALCO is providing an electric copy of its NOI, DLA, and accompanying documents to appropriate federal, state, and local resource agencies, Indian tribes, and members of the public likely to be interested in the proceeding, as set forth on the attached Distribution List. OPALCO also has published notice of the filing in the Islands Weekly, the San Juan Journal, and the Islands Sounder on March 19th.

The preliminary Project design drawings included in Exhibit F of this DLA contain critical energy infrastructure information (CEII) and are filed with the Commission confidentially with the label "CUI/CEII INFORMATION—DO NOT RELEASE."

OPALCO looks forward to working with FERC staff, Indian tribes, and others to timely develop a final license application and supporting record that fully meets the Commission's regulatory requirements for licensing the pilot Project. If you have any questions regarding OPALCO's NOI, DLA, or accompanying documents, please contact me by telephone at (360) 376-3589 or by email at Rguerry@opalco.com.

Respectfully submitted,

Russell H. Guerry, P.E.
Manager of Engineering and Operations

cc: David Turner, FERC Division of Hydropower Licensing
Jeffrey Ackley, FERC Division of Hydropower Licensing



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Skokomish Tribe	Charles "Guy" Miller, Chair	North 80 Tribal Center Road Skokomish Nation, WA 98584 (360) 426-4232
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Washington State Department of Natural Resources (DNR)	Gabe Harder	Gabriel.harder@dnr.wa.gov
Notes: DAHP = Department of Archaeology and Historic Preservation; DNR = Department of Natural Resources; DOE = Department of Energy; Ecology = Department of Ecology; FERC = Federal Energy Regulatory Commission; OPALCO = Orcas Power & Light Cooperative; USCG = U.S. Coast Guard; USFWS = U.S. Fish and Wildlife Service		

Volume 1

Filing Requirements & Exhibit A
Rosario Strait Tidal Energy Project
San Juan Islands, Washington
FERC Project No. 15368



Federal Energy Regulatory Commission



Orcas Power & Light Cooperative (OPALCO)
183 Mount Baker Road
Eastsound, Washington 98245

26 March 2025



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ACRONYMS AND ABBREVIATIONS

BMP	Best Management Practice
BPA	Bonneville Power Administration
c.	circa
CEF4	Clean Energy Fund 4
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
Commission	Federal Energy Regulatory Commission (<i>also</i> FERC)
CWA	Clean Water Act
DAHP	Washington State Department of Archaeology and Historic Preservation
DC	Direct Current
DLA	Draft License Application
DNV	Det Norske Veritas company
DPS	distinct population segment
EFH	Essential Fish Habitat
EMF	electromagnetic frequency
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
FERC	Federal Energy Regulatory Commission (<i>also</i> Commission)
ft	foot/feet
ft/s	feet per second
ft ²	square feet
GHG	greenhouse gas(es)
GWh	gigawatt hour
HAPC	Habitat Areas of Particular Concern
ILP	Integrated Licensing Process
in.	inches
kg	kilogram
kg/m	kilogram per meter
km	kilometer
kV	kilovolt
lbs.	pounds
lbs./ft	pounds per foot
m	meter
mm	millimeter
m/s	meters per second
m ²	square meter
MW	megawatt
NEPA	National Environmental Policy Act



NMFS	National Marine Fisheries Service (<i>also</i> NOAA Fisheries)
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Oceanic and Atmospheric Administration Marine Fisheries Service (<i>also</i> NMFS)
NOI	Notice of Intent
OPALCO	Orcas Power & Light Cooperative
Orbital	Orbital Marine Power
Orbital O2-X	Orbital Marine O2-X Floating Tidal device
PAD	Pre-Application Document
PNGC	Pacific Northwest Generating Cooperative
PNNL	Pacific Northwest National Laboratory
Project	Rosario Strait Tidal Energy Project
RCW	Revised Code of Washington
s	second(s)
SCADA	supervisory control and data acquisition
SRKW	Southern Resident killer whale
TCPs	Traditional Cultural Places
TEAMER	Testing and Access to Marine Energy Research
U&A	Usual and Accustomed Area(s)
U.S.	United States
USC	United States Code
USFWS	United States Fish and Wildlife Service
UWAPL	University of Washington Applied Physics Lab
V	Volts
W	watt
WA	Washington State
WAC	Washington Administrative Code



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EXECUTIVE SUMMARY

Orcas Power & Light Cooperative (OPALCO) hereby submits a Notice of Intent and Draft License Application (DLA) for the proposed Rosario Strait Tidal Energy Project (Project), to be located on Rosario Strait in the Salish Sea in Washington State. OPALCO is a non-profit cooperative electric utility providing service in San Juan County, Washington. To prepare for expected near-term electrical capacity shortfalls and long-term load doubling, OPALCO has been exploring local power generation options to ensure resilience, reliability, and ability to support beneficial electrification and regulatory clean energy goals.

In 2022, OPALCO was awarded a grant from the Washington Department of Commerce's Clean Energy Fund 4 (CEF4) to investigate clean energy alternatives to help modernize the electrical grid. This award was to assess a preliminary design for a potential tidal energy project located in Rosario Strait of the San Juan Islands archipelago in Washington State. Funding from CEF4 supported a study to investigate the testing capacity of Rosario Strait for tidal power output and tidal turbine technology to generate electricity that supports OPALCO's microgrid for its island service area.

In 2024, OPALCO was awarded a grant from the United States (U.S.) Department of Energy to investigate the feasibility of deploying a pilot project demonstration of a singular Orbital Marine O2-X Floating Tidal device (Orbital O2-X) with two turbine rotors rated at 1.2 megawatts (MW) each in Rosario Strait. To demonstrate the commercial viability of this device and allow it to connect to OPALCO's existing electrical grid, the Project is required to be authorized by the Federal Energy Regulatory Commission (FERC or Commission). As such, OPALCO is seeking a license from FERC for this pilot hydrokinetic project.

This application is organized into the following sections, as required for a DLA for a pilot hydrokinetic project:

- Notice of Intent to File Application for an Original License for a Hydrokinetic Project
- Initial Statement
- Justification Statement
- Process Plan and Schedule
- Request for Waivers
- Request for Designation as FERC's Non-Federal Representative
- Exhibit A- Project Description and Mode of Operations
- Exhibit E- Draft Environmental Report
- Exhibit F- Design Drawings (CUI/CEII)
- Exhibit G- Project Boundary Maps
- Appendix A- Consultation Record
- Appendix B- Post-License Monitoring and Management Plans
- Appendix C- Site Assessments

Prior to preparing the DLA, multiple site assessment studies were conducted including a Testing and Access to Marine Energy Research (TEAMER™) Report, an Environmental Risk Register by Pacific Northwest National Laboratories (PNNL), physical oceanographic baseline data by the University of Washington Applied Physics Lab (UWAPL), and a bathymetric survey performed by Tetra Tech (Copping et al. 2021; PNNL 2024; Appendix C1; Appendix C2). These studies include geophysical surveys, bathymetry mapping, multiple velocity surveys, turbulence and wake measurements, a preliminary acoustic survey, and fish and wildlife monitoring. An in-depth synthesis of the information obtained during these studies and additional research is presented in Exhibit E.

In support of the sections outlined above, post-license monitoring and management plans have been prepared and will be reviewed in consultation with resource agencies and Tribal Nations to ensure



the safety of the public, the Project, and natural resources. They are ready for review by FERC staff and licensing participants, and are included in Appendix B. The plans include:

Appendix B Post-License Monitoring and Management Plans

1. Fish and Wildlife Monitoring Plan
2. Project and Facility Operations Monitoring Plan
3. Adaptive Management Plan
4. Project Removal, Site Restoration, and Financial Assurance Plan
5. Project and Public Safety Plan
6. Navigation Safety Plan
7. Emergency Shutdown Plan



NOTICE OF INTENT TO FILE APPLICATION FOR AN ORIGINAL LICENSE FOR A HYDROKINETIC PROJECT

Pursuant to 18 Code of Federal Regulations (CFR) § 5.5, Orcas Power & Light Cooperative (OPALCO) notifies the Federal Energy Regulatory Commission (FERC or Commission) of its intention to file an Application for an Original License for the Rosario Strait Tidal Energy Project (Project), FERC Project No. 15368. This application is being filed in accordance with the Commission's whitepaper, "*Licensing Hydrokinetic Projects*" (Hydrokinetic Whitepaper) and the Commission's regulations at 18 CFR Part 5. As part of the requirements for approval to use the Commission's expedited review process for hydrokinetic pilot projects, OPALCO is also filing: a request for waivers of certain pre-filing requirements under FERC's Integrated Licensing Process (ILP), a Justification Statement for how the proposed Project meets the Commission's criteria for a pilot project, a Request for Designation as FERC's Non-Federal Representative, a Process Plan and Schedule for expedited review, an Initial Statement, and a Draft License Application (DLA) for a pilot project.

The following information is provided pursuant to 18 CFR § 5.5:

1. Applicant Contact Information

The exact name and business address of the applicant is:

Orcas Power & Light Cooperative (OPALCO)
183 Mount Baker Road
Eastsound, WA 98245
(360) 376-3500

2. Project Number

This hydrokinetic pilot project application for the Rosario Strait Tidal Energy Project is being filed under the docket number for its existing preliminary permit, FERC Project No. 15368.

3. License Expiration Date

Not Applicable.

4. Unequivocal Statement of Intent:

OPALCO hereby states unequivocally its intent to file an application for an original hydrokinetic pilot project license for the proposed Rosario Strait Tidal Energy Project (FERC Project No. 15368).

5. Type of Principal Project Works to be Licensed

The Project would consist of the following:

- One Orbital Marine O2-X Floating Tidal device (Orbital O2-X) deployment in Rosario Strait with two turbine rotors for a total rated capacity of 2.4 megawatts (MW).
- One mooring and anchor system with four mooring lines and four anchors.
- One new 3.3-mile subsea cable from the Orbital O2-X to an existing shoreline conduit and facility on Blakely Island.
- Shore station containing all needed supervisory control and data acquisition (SCADA) and electrical interconnection equipment.

6. Project Location

The proposed Project would be located to the east of Blakely Island (approximately 48.5611°N, 122.7679°W) within Rosario Strait in San Juan County, Washington State.



7. Installed Capacity

The Project would have an installed capacity of approximately 2.4 MW.

8. Names and Mailing Addresses

- (i) **Every county in which any part of the Project is located, and in which any federal facility that is used or to be used by the Project is located:**

No federal facilities would be used by the proposed Project. The area proposed for the Project is located within one county:

San Juan County
350 Court Street
No. 7
Friday Harbor, WA 09250

- (ii) **Every city, town, or similar political subdivision:**

- (A) **In which any part of the Project, and any federal facility that would be used by the Project, would be located:**

No part of the Project, nor any portion of the Project boundary, would be located within the boundary of any city, town, or similar political subdivision. The Project would be used by:

Eastsound
183 Mount Baker Road
Eastsound, Washington 98245

No federal facilities would be used by the Project.

- (B) **That has a population of 5,000 or more people and is located within 15 miles of the Project dam:**

The proposed Project does not include a dam. There is one city with a population of 5,000 or more within 15 miles of the proposed Project:

Anacortes
City Hall Municipal Building
904 6th Street
Anacortes, Washington 98221

- (iii) **Every irrigation district, drainage district, or similar special purpose political subdivision:**

- (A) **In which any part of the Project, and any federal facilities that would be used by the Project, would be located:**

No federal facilities would be used by the proposed Project and there are no known irrigation districts, drainage districts, or political subdivisions within the proposed Project boundary.

- (B) **That owns, operates, maintains, or uses any Project facility or any federal facility that would be used by the Project:**

No federal facilities would be used by the proposed Project and there are no known irrigation districts, drainage districts, or political subdivisions that own, operate, maintain, or use any Project facility.

- (iv) **Every other political subdivision in the general area of the Project that there is reason to believe would likely be interested in, or affected by, the application:**

There are no known political subdivisions in the general area of the proposed Project.

- (v) **All Indian Tribes that may be affected by the Project:**



OPALCO has identified the following Indian Tribes that may have an interest in or may be affected by the proposed Project:

Confederated Tribes of the Umatilla
46411 Timine Way
Pendleton, OR 97801
Ph. (541) 276-3165

Jamestown S'Klallam Tribe
1033 Old Blyn Highway
Sequim, WA 98382
Ph. (360) 683-1109

Lummi Nation
2616 Kwina Road
Bellingham, WA 98226-9298
Ph. (360) 384-1489

Muckleshoot Indian Tribe
39015 172nd Ave SE
Auburn, WA 98092
Ph. (252) 939-3311

Nooksack Indian Tribe
PO Box 157
Deming, WA 98244
Ph. (360) 592-5176

Port Gamble S'Klallam Tribe
31912 Little Boston Rd NE,
Kingston, WA 98346
360-297-2646

Samish Indian Nation
PO Box 217
Anacortes, WA 98221
Ph. (360) 293-6404

Sauk-Suiattle Indian Tribe
5318 Chief Brown Lane
Darrington, WA 98241
Ph. (360) 436-0131

Skokomish Tribe
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Skokomish Nation, WA 98584
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PO Box 969
Snoqualmie, WA 98065
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Arlington, WA 98223-0277
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PO Box 498
18490 Suquamish Way
Suquamish, WA 98392-0498
Ph. (360) 598-3311

Swinomish Indian Tribal Community
11404 Moorage Way
La Conner, WA 98257
Ph. (360) 466-3163

Tulalip Tribes
6406 Marine Drive NW,
Tulalip, WA 98271
Ph. 1-800-869-8287

Upper Skagit Tribe
25944 Community Plaza Way
Sedro-Woolley, WA 98284
Ph. (360) 854-7090



INITIAL STATEMENT

The following information is provided pursuant to 18 CFR § 4.61(b):

1. Application for license

OPALCO applies to the Federal Energy Regulatory Commission for a pilot hydrokinetic project license for the Rosario Strait Tidal Energy Project (Project), FERC Project No. 15368 as described hereinafter.

2. Project Location

The location of the Project is:

State: Washington
County: San Juan County
Nearby Town: Eastsound
Body of Water: Rosario Strait in the Salish Sea

OPALCO's tidal energy Project would be located to the east of Blakely Island within Rosario Strait of Washington State, in the United States. The Project location is a relatively small portion of the greater Salish Sea, which is a large estuarine marine body of water inland of the Pacific Ocean. Rosario Strait is situated within the San Juan Islands archipelago between Blakely Island to the west and Cypress Island to the east, and it connects the Strait of Juan de Fuca with the northern portion of the Salish Sea, also known as the Strait of Georgia, within Canadian borders.

3. The exact name, address, and telephone number of the applicant are:

Orcas Power & Light Cooperative (OPALCO)
183 Mount Baker Road
Eastsound, WA 98245
(360) 376-3500

4. The exact name, address and telephone number of each person authorized to act as agent for the applicant in this application are:

Russell Guerry
c/o OPALCO
183 Mount Baker Road
Eastsound, Washington 98245
(360) 376-3500

Justin Klure
c/o Pacific Energy Ventures
11973 N Humphreys Way
Boise, Idaho 83714
(503) 475-2999

Sharon White
c/o Rock Creek Energy Group
1 Thomas Circle NW, Suite 700
Washington DC 20005
(202) 998-2775



5. The applicant is a member-owned, non-profit cooperative utility and is not claiming preference under Section 7(a) of the Federal Power Act.

6. i. *The statutory or regulatory requirements of the state(s) in which the project would be located that affect the project as proposed with respect to bed and banks and the appropriation, diversion, and use of water for power purposes, and with respect to the right to engage in the business of developing, transmitting, and distributing power and in any other business necessary to accomplish the purposes of the license under the Federal Power Act (18 CFR § 4.61(b)), are:*

OPALCO is an electric cooperative subject to RCW 24.06 and regulation by the Washington Department of Commerce. The regulatory requirements of the State of Washington, including the review process and authorization, are listed in **Table 1**.

Table 1. State of Washington Regulatory Requirements

Agency	Permit, Approval, or Consultation	Statute or Regulation ¹
Washington State Department of Natural Resources	Aquatic Lands Right-to-Entry Approval	WAC 332-30 (Aquatic Land Management) and RCW 79.105 (Aquatic Lands)
	Aquatic Lands Use Authorization	WAC 332-30 (Aquatic Land Management) and RCW 79.105 (Aquatic Lands)
Washington State Department of Ecology	Coastal Zone Management Consistency Determination, incorporating the Shoreline Management Act, Water Pollution Control Act, Clean Air Act, and Ocean Resources Management Act	RCW 90.58 RCW 90.48 RCW 70A.15 RCW 43.143; WAC 16 USC § 1451 et al., 15 CFR Part 930
	Clean Water Act (CWA) Section 401 Water Quality Certification	RCW 90.48 33 USC § 1341, 40 CFR Part 121
	CWA Section 402 National Pollutant Discharge Elimination System 1200-C Construction Stormwater General Permit	33 USC § 1342, 40 CFR Part 122
Washington Department of Archaeology and Historic Preservation	Section 106 of the National Historic Preservation Act	54 USC § 306101, 36 CFR Part 800
Washington State Fish and Wildlife	Hydraulic Project Approval	WAC 220-660 (Hydraulic Code Rules) and RCW 77.55 (Construction Projects in State Waters)



Notes: CFR = Code of Federal Regulations; CWA = Clean Water Act; RCW = Revised Code of Washington; USC = United States Code; WAC = Washington Administrative Code.

ii. *The steps which the applicant has taken or plans to take to comply with each of the laws cited above (18 CFR § 4.61(b)) are:*

OPALCO has been consulting with state agencies during the pre-filing process. Concurrent with the submittal of the Final License Application, OPALCO will apply for applicable state permits for the Project.

7. Brief Project Description

Washington State has established a mandated target to reduce overall greenhouse gas (GHG) emissions to 95 percent below levels from the year 1990, and to achieve net-zero GHG emissions by 2050 (RCW 70A.45.020). OPALCO is evolving to meet these pressing needs to decarbonize its energy grid and increase local energy resilience. To prepare for expected near-term electrical capacity shortfalls and long-term load doubling, OPALCO is exploring local generation options to ensure resilience, reliability, and ability to support beneficial electrification and meet clean energy goals.

OPALCO is applying to FERC for a 10-year pilot project license for the 2.4 MW Rosario Strait Tidal Energy Project (Project). The Project would involve installation of one Orbital Marine O2-X Floating Tidal device (Orbital O2-X) in Rosario Strait, part of the waters of the San Juan Islands archipelago in Washington State. The proposed Project would serve as a pilot project to test the capacity of Rosario Strait for tidal turbine electricity generation that supports OPALCO's microgrid. In Scotland, Orbital Marine Power (Orbital) technology is connected to the European Marine Energy Centre grid via subsea cable where it generates enough electricity for approximately 1,700 homes.

As the first project of this type in the United States, the goal is to emulate the current deployment of the Orbital floating tidal energy device in the Orkney Islands of Scotland. The marine conditions in Rosario Strait are similar, and there is an existing marine shoreline conduit and land-based shoreline conduit facility on nearby Blakely Island to connect into the OPALCO grid. The output would benefit a growing island community that seeks to strengthen its energy independence and improve livelihoods by divesting from the power supplied from mainland Washington State.

i. **Proposed installed generating capacity** would be approximately 2.4 MW.

ii. **Check the appropriate box:**

- Unconstructed dam
- Existing dam, major modified project
- Existing dam

Not applicable. The Project would be deployed in Rosario Strait and does not include a dam.

8. Lands of the United States affected (affected lands are shown in Exhibit G):

The Project will be located entirely in Washington State waters and would not include "lands of the United States" as defined in the Federal Power Act or any lands owned or occupied by Tribal Nations. The waters and seabed of Rosario Strait are governed by the U.S. Coast Guard's Captain of the Port Puget Sound with jurisdiction over the navigable waters of Puget Sound, including the San Juan Island archipelago and the Strait of Juan de Fuca. Thus, no public land survey or other identification of such lands is required.



9. Construction of the Project is planned to start within 12 months from the date of issuance of license and is planned to be completed within 24 months from the start date.

General Content Requirements pursuant to 18 CFR § 5.18(a).

1. **18 CFR § 5.18 (a)(1) Identify every person, citizen, association of citizens, domestic corporation, municipality, or state that has or intends to obtain and will maintain any proprietary right necessary to construct, operate, or maintain the Project:**

OPALCO is the only entity that has or intends to obtain and would maintain any proprietary rights necessary to construct, operate, or maintain the property.

2. Names and Mailing Addresses

- i. **Every county in which any part of the project, and any federal facilities that would be used by the project, would be located:**

No federal facilities would be used by the proposed Project. The area proposed for the Project is located within one county:

San Juan County
350 Court Street
No. 7
Friday Harbor, WA 09250

- ii. **Every city, town, or similar local political subdivision:**

- a. **In which any part of the project, and any federal facilities that would be used by the project, would be located:**

No part of the Project, nor any portion of the Project boundary, would be located within the boundary of any city, town, or similar political subdivision. The Project would be used by:

Eastsound
1323 Mount Baker Road
Eastsound, Washington 98245

No federal facilities would be used by the Project.

- b. **That has a population of 5,000 or more people and is located within 15 miles of the project dam:**

The proposed Project does not include a dam. There is one city with a population of 5,000 or more within 15-miles of the proposed Project:

Anacortes
City Hall Municipal Building
904 6th Street
Anacortes, Washington 98221



iii. Every Irrigation District, Drainage District, or Similar Special Purpose Political Subdivision:

a. In which any part of the project, and any federal facilities that would be used by the project, would be located:

No federal facilities would be used by the proposed Project, and there are no known irrigation districts, drainage districts, or political subdivisions within the proposed Project boundary.

b. That owns, operates, maintains, or uses any project facilities that would be used by the project:

No federal facilities would be used by the proposed Project, and there are no known irrigation districts, drainage districts, or political subdivisions that own, operate, maintain, or use any Project facility.

c. Every other political subdivision in the general area of the project that there is reason to believe would likely be interested in, or affected by, the application:

There are no known political subdivisions in the general area of the Project.

iv. All Indian Tribes That May Be Affected by the Project

To date, OPALCO has identified the following Indian Tribes that may have an interest in or be affected by the proposed Project:

Confederated Tribes of the Umatilla 46411 Timine Way Pendleton, OR 97801 Ph. (541) 276-3165	Jamestown S'Klallam Tribe 1033 Old Blyn Highway Sequim, WA 98382 Ph. (360) 683-1109
Lummi Nation 2616 Kwina Road Bellingham, WA 98226-9298 Ph. (360) 384-1489	Muckleshoot Indian Tribe 39015 172nd Ave SE Auburn, WA 98092 Ph. (252) 939-3311
Nooksack Indian Tribe PO Box 157 Deming, WA 98244 Ph. (360) 592-5176	Port Gable S'Klallam Tribe 31912 Little Boston Rd NE Kingston, WA 98346 360-297-2646
Samish Indian Nation PO Box 217 Anacortes, WA 98221 Ph. (360) 293-6404	Sauk-Suiattle Indian Tribe 5318 Chief Brown Lane Darrington, WA 98241 Ph. (360) 436-0131



Skokomish Tribe
 North 80 Tribal Center Road
 Skokomish Nation, WA 98584
 Ph. (360) 426-4232

Snoqualmie Indian Tribe
 PO Box 969
 Snoqualmie, WA 98065
 Ph. (425) 888-6551

Stillaguamish Tribe of Indians
 3322 236th Street NE
 Arlington, WA 98223-0277
 Ph. (360) 652-7362

Suquamish Tribe
 PO Box 498
 18490 Suquamish Way
 Suquamish, WA 98392-0498
 Ph. (360) 598-3311

Swinomish Indian Tribal Community
 11404 Moorage Way
 La Conner, WA 98257
 Ph. (360) 466-3163

Tulalip Tribes
 6406 Marine Drive NW,
 Tulalip, WA 98271
 Ph. 1-800-869-8287

Upper Skagit Tribe
 25944 Community Plaza Way
 Sedro-Woolley, WA 98284
 Ph. (360) 854-7090

The OPALCO team has been actively sharing and discussing information about the proposed Project with these Tribal Nations and intends to collaborate throughout the license term to study and develop measures to minimize and avoid effects to resources of importance to these Tribal Nations.

3. For a license (other than a license under section 15 of the Federal Power Act) state that the applicant has made, either at the time of or before filing the application, a good faith effort to give notification by certified mail of the filing of the application to:

(A) Every property owner of record of any interest in the property within the bounds of the project, or in the case of the project without a specific project boundary, each such owner of property which would underlie or be adjacent to any project works including any impoundments:

OPALCO is sending notification by certified mail to the Washington Department of Natural Resources, the only property owner of record with any interest in the property within the Project boundary.

(B) The entities identified in paragraph (a)(2) of this section, as well as any other Federal, state, municipal or other local government agencies that there is reason to believe would likely be interested in or affected by such application.

OPALCO is sending notification of the filing of the Draft License Application, Notification of Intent, and accompanying documents by certified mail to the entities identified in paragraph (a)(2) of this section and the Federal, state, municipal or other local government agencies that are likely to be interested in or affected by such application.



VERIFICATION STATEMENT

This Draft License Application is executed in the:

State of Washington,

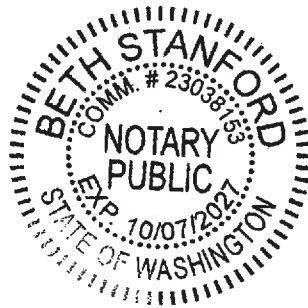
County of San Juan

By: Russell H. Guerry, P.E.
Manager of Engineering and Operations
Orcas Power & Light Cooperative
183 Mount Baker Road
Eastsound, WA 98245
Tel: (360) 376-3589
Email: Rguerry@opalco.com

Russell H. Guerry, being duly sworn, deposes and says that the contents of this Draft License Application of Orcas Power & Light Cooperative, for a Hydrokinetic Pilot Project License for the Rosario Strait Tidal Energy Project, are true and correct to the best of his knowledge and belief, and that this Draft License Application was signed on the 26th day of March, 2025.


Russell H. Guerry

Subscribed and sworn to before me, a Notary Public of the state of Washington, this 25 day of March, 2025.




Signature of Notary Public

Beth Stanford
Printed Name



JUSTIFICATION STATEMENT

OPALCO submits the following information demonstrating that the proposed Rosario Strait Tidal Energy Project (Project) meets the *Criteria for Using the Pilot Licensing Procedures* from Section III of the Federal Energy Regulatory Commission's (FERC or Commission) whitepaper titled "Licensing Hydrokinetic Pilot Projects," dated April 14, 2008. FERC's whitepaper describes how the Final License Application for a pilot project, including stakeholder and Tribal Nations' comments, would be evaluated using these criteria to determine if there is good cause for the Commission to grant the requested regulatory waivers needed to allow for the expedited review process proposed in OPALCO's Process Plan and Schedule (see page 12). OPALCO submits that the Project is a good candidate for the expedited licensing process for a pilot project as follows:

- 1. Pilot projects will be small.** *Though evaluated on a case-by-case basis, staff expects that pilot projects will be less than 5 megawatts (MW) and often will be substantially smaller. In addition to generating capacity, staff also will consider carefully the number of generating units and the project footprint in determining whether the proposal qualifies as a pilot project.*

The Orbital O2-X that is proposed for installation in Rosario Strait would have two turbine rotors rated at 1.2 MW each, for a total Project capacity of approximately 2.4 MW, well below the 5 MW threshold proposed by the Commission in its whitepaper.

- 2. The license will be short term.** *Though evaluated on a case-by-case basis, staff expects that pilot projects would have terms of five years.*

OPALCO seeks a pilot license with a 10-year term. Tidal energy technology, including the Orbital O2-X unit, is an emerging technology that requires substantial field demonstration, particularly in terms of maintenance and operations cycles, to fully inform future plans and deliver on the data requirements of the Project. OPALCO believes that fully evaluating plant operations and gathering the associated and required data will require multiple years of turbine operation. Because the license term must also allow time for procurement, construction, and potential removal of the turbines, a 10-year license term is appropriate. In addition, Commission regulations require that an application for a new license be filed at least two years prior to license expiration. Because pre-application proceedings can take three or more years to complete, a five-year license term would require OPALCO to begin relicensing proceedings almost before the Project begins operation.

- 3. Pilot projects will avoid sensitive locations.** *The applicant must describe potential areas of sensitivity in the proposed project area and indicate the reasons for the sensitivity. All stakeholders will have an opportunity both to comment on the applicant's description and to recommend that other areas be designated as sensitive. Commission staff will determine whether a potential use conflict makes the proposal inappropriate for an expedited review process. In many such cases, it will be possible for the applicant to pursue the project through a standard licensing process.*

The proposed Project area was selected to avoid sensitive habitats to the greatest extent possible. However, complete avoidance would not be possible due to the large area of some habitats such as designated critical habitats (described below). Mitigation measures would be identified and outlined after agency and Tribal Nation consultations occur.

Some sensitive environments do occur within Rosario Strait, including Essential Fish Habitat (EFH), critical habitat designated under the Endangered Species Act (ESA), and other protected areas (described below). In addition, the proposed Project Area is the traditional territory of several Tribal Nations who signed the Treaty of Point Elliott in 1855 and have Usual & Accustomed (U&A) Tribal



treaty fishing rights in the proposed Project vicinity. However, Rosario Strait is also a public space used for recreation, commercial vessel transit, and fishing, among other activities.

Endangered Species Act (ESA) Designated Critical Habitat

Under the ESA, critical habitat is defined as specific geographic areas that contain the physical or biological features essential to the conservation of a threatened or endangered species. The designation of critical habitat does not automatically restrict land use or activities, but federal agencies are required to consult with the U.S. Fish & Wildlife Service (USFWS) or the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS, also NOAA Fisheries) to manage potential effects to critical habitat.

The proposed Project area overlaps with the designated critical habitat of four ESA-listed species managed by NMFS (NMFS 2024a, 2024b):

- **Killer whale**, Southern Resident Distinct Population Segment (DPS) (SRKW [*Orcinus orca*])
- **Bocaccio rockfish** (Puget Sound-Georgia Basin DPS [*Sebastes paucispinis*])
- **Yelloweye rockfish** (Puget Sound-Georgia Basin DPS [*S. ruberrimus*])
- **Chinook salmon** (Puget Sound Evolutionarily Significant Unit (ESU) [*Oncorhynchus tshawytscha*]).

Of note, the entirety of the Salish Sea within the U.S. is designated critical habitat for the SRKW. Therefore, it would not be possible for the proposed Project area to avoid SRKW critical habitat. Given the depth at which the Project would be deployed, turbine rotor tips would not overlap with Chinook salmon critical habitat. Based on the design and limited scope of the proposed Project, OPALCO anticipates that the proposed Project will not adversely affect the four ESA-designated critical habitats identified above. This determination is explained in more detail in Exhibit E. The final determination will be confirmed in future consultation with NMFS.

Essential Fish Habitat (EFH)

Under the U.S. Magnuson-Stevens Fishery Conservation and Management Act (MSA), Essential Fish Habitat (EFH) is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, and/or growth to maturity. EFH is designated for federally managed fish species, including both commercially and recreationally important species, and covers all stages of the species' life cycle (e.g., eggs, larvae, juveniles, and adults).

The entirety of the Salish Sea within the U.S. is classified as EFH by NMFS for Pacific Coast Groundfish and Coastal Pelagic Species, inclusive of the proposed Project area in Rosario Strait (NMFS 2024b). Therefore, it would not be possible for the proposed Project area to completely avoid these habitats. EFH for Pacific Coast Salmon (Chinook [*Oncorhynchus tshawytscha*], Coho [*O. kisutch*], and Pink [*O. gorbuscha*]) also overlaps with the proposed Project area.

According to surveys conducted by Tetra Tech, Inc. in October 2024, reports, and tools available online, there are no Habitat Areas of Particular Concern (HAPC) within the Project area for any EFH species, including eelgrass beds or canopy kelp areas that support said species (Christiaen et al. 2022; DNR 2024; NMFS 2024b). Adverse effects on EFH may result from actions occurring within or outside EFH, and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR § 600.810). Based on this definition, and the design and scope of the proposed Project, OPALCO submits that it may adversely affect the EFH identified above by installing anchors and a subsea power cable on the seabed, and mooring chains in the water column. However, the effects would be minor, localized to the immediate project area, and temporary.



The effects of the proposed Project on EFH include benthic and pelagic habitat alteration due to the installation, and exposure to electromagnetic fields (EMF) from the presence of a subsea power cable. Best management practices (BMPs) and mitigation measures would be implemented to reduce or otherwise mitigate potential impacts, as detailed in Exhibit E. When the proposed Project components are recovered from the area, there would be no remaining or persistent adverse effects on the environment.

Marine Protected Areas

The San Juan County/Cypress Island Marine Biological Preserve encompasses the San Juan Islands archipelago. It is managed by the University of Washington Friday Harbor Laboratories.

The proposed Project area overlaps with the preserve. The anchoring and mooring lines of the proposed Project would affect the seabed due to the necessary slack in the lines incidentally sweeping the seabed when the tidal flow changes. Additionally, umbilical sweep on the seabed would occur where the new subsea cable connects to the Orbital O2-X vertically in the water column (i.e., the umbilical). Mitigation measures would be applied to minimize the impact on the seabed and, if deemed necessary, the area would be restored to original conditions when the license term is concluded.

Tribal Resources and Cultural Resources

Tribal Nations have Tribal interests, treaty rights, and Tribal resources in Rosario Strait. The term "Tribal resources" refers to the collective rights and access to traditional areas and times for gathering resources associated with a Tribe's sovereignty since time immemorial. It also includes inherent rights or formal treaty rights associated with U&A territories and lands formally ceded by the Tribes and bands under the treaty. Tribal resources may also include archaeological or historic sites, elements of the built environment, and Traditional Cultural Places (TCPs) associated with Tribal use, and sites considered sacred by Tribal Nations. OPALCO is coordinating with the affected Tribal Nations regarding anticipated Project activities in their U&A fishing area and soliciting their feedback on potential effects and mitigations. Coordination efforts have included meeting with technical staff, leadership, and representatives from the Tribal fishing community from several Tribal Nations. Determinations of significance, non-significance, and effects to Tribal treaty rights, interests, and Tribal resources will be conducted through engagement with the Tribal Nations and through government-to-government consultation between the Tribal Nations and FERC. Through preliminary engagement efforts, several Tribal Nations have indicated that the Project may have implications for treaty-protected resources and access, culturally important marine species, and traditional fishing grounds. A summary of the feedback and concerns shared by the Tribal Nations is included in Appendix A.

There are no previously recorded historic properties (i.e., cultural resources eligible for listing on the National Register of Historic Places) identified within the proposed Project Area. There is limited potential for submerged historic properties to be present.

During early coordination with DAHP, State Archaeologist Rob Whitlam recommended the formation of a working group including the Tribal Historic Preservation Officer's, DAHP, FERC, and OPALCO once compliance with Section 106 of the NHPA is initiated. OPALCO will work with the Tribal Nations and DAHP to bring together this working group in coordination with FERC early in the process.

- 4. Pilot projects will be subject to strict safeguards for the public and environmental resources potentially leading to project modification, shutdown, or complete removal. *Unacceptable risks to the public or the environment during the license period, as observed through monitoring protocols required by the license (or as otherwise becomes evident), will lead to project alteration, shut down, or removal followed by site restoration.***



In the unexpected event that Project shutdown and/or removal is required, OPALCO would be able to take such measures in short notice. The Orbital O2-X can be unattached from the subsea cable umbilical and mooring system and towed to a nearby harbor in Anacortes for maintenance or removal, and as soon as the appropriate equipment and vessel are available, the mooring lines and subsea cables would be removed. Anchors would be removed or left in place depending on feedback from relevant agencies in regard to what would be best for local species.

OPALCO is including the following proposed plans as appendices to this DLA in compliance with this criterion:

- Appendix A** Consultation Record
- Appendix B** Post-License Monitoring and Management Plans
 1. Fish and Wildlife Monitoring Plan
 2. Project and Facility Operations Monitoring Plan
 3. Adaptive Management Plan
 4. Project Removal, Site Restoration, and Financial Assurance Plan
 5. Project and Public Safety Plan
 6. Navigation Safety Plan
 7. Emergency Shutdown Plan
- Appendix C** Site Assessments
 1. Tetra Tech Survey Scope and Findings
 2. Resource Characterization Report: OPALCO site in Rosario Strait, WA (USA)

These plans are ready for review by FERC and the appropriate federal, state, and local agencies upon submittal of the DLA. OPALCO will work with resource agencies to finalize the proposed study plans in preparation for submittal with the Final License Application.

- 5. Pilot projects will be required to complete project removal and site restoration before the end of the license unless the licensee obtains a new license covering the pilot project site.** *Licenses for pilot projects will require that the project be removed and the site restored as directed by the Commission. If a pilot project licensee opts to apply for a standard license at the end of the pilot project license term, authorization of the build-out project will be evaluated in a full Commission proceeding with National Environmental Policy Act (NEPA) review and participation by all interested stakeholders. If build-out is licensed, there may be no need to remove the pilot devices.*

OPALCO has prepared a Project Removal, Site Restoration, and Financial Assurance Plan, which can be found in Appendix B. Unless OPALCO chooses to pursue a commercial license at the end of the pilot license term, all Project components would be removed by the end of the pilot license period. This includes one Orbital O2-X device, one anchoring system including four mooring lines and four anchors, and one subsea cable. The Orbital O2-X can be unhooked from the anchoring system and subsea cable, and it can be towed to a nearby harbor in Anacortes for maintenance or removal. The anchoring system and subsea cable can be removed as soon as teams with the necessary equipment and personnel can be scheduled on site to perform removal activities. While all anchors can be removed, discussions would be held with local regulatory agencies to determine whether removal or leaving anchors in place would be the best action for local marine species and habitats. All evidence suggests that given the nature of the seabed and anticipated impact of the proposed Project components, no restoration work would be required.

In addition, at least 90 days before commencing construction and installation of the Project described herein, OPALCO would file proof of the purchase of a surety bond, or equivalent financial assurance instrument, to cover the entirety of the costs of removing the Project in accordance with



the Project Removal, Site Restoration, and Financial Assurance Plan included in this application. Thereafter during the term of the license for the pilot Project, OPALCO would maintain the bond, or equivalent financial assurance. By January 1 of each license year, or as otherwise directed by FERC, OPALCO would file proof of the maintenance of the bond or equivalent form of financial assurance.

6. Pilot project draft applications must be submitted in a form sufficient to support environmental analysis. *The draft application must include a thorough description of the existing environment, incorporating a review of existing information and a description of the environmental baseline. The baseline should provide a characterization of site specifics (including items such as substrate type, a description of physical habitat, and wave patterns or flow velocity conditions, etc.). The effort may require basic pre-application surveys, measurements, or observations. The draft application should also include details of the project proposal, possible sensitive areas, potential user conflicts, and potential effects of the proposal. The information in the draft application should be sufficient to support the environmental analysis. The draft application also should include proposed plans for: (1) post-license monitoring to confirm or dismiss concerns regarding the potential effects of the project; (2) safeguarding the public and environmental resources, including performance measures, methods for modification, shutdown, or project removal should potential for an environmental harm be detected; and (3) assuring financing to remove the project and restore the site. Finally, it should include a consultation record indicating adequate consultation to date and distribution of the pre-filing materials to all potentially interested federal, state, and local resource agencies, Indian Tribes, non-governmental organizations, and members of the public.*

OPALCO's DLA complies with this criterion.

Multiple site assessment studies were conducted prior to preparing the DLA, including a Testing and Access to Marine Energy Research (TEAMER™) Report, an Environmental Risk Register by Pacific Northwest National Laboratories (PNNL), physical oceanographic baseline data by the University of Washington Applied Physics Lab (UWAPL), and a bathymetric survey performed by Tetra Tech (Copping et al. 2021; PNNL 2024; Appendix C1; Appendix C2). These studies include geophysical surveys, bathymetry mapping, multiple velocity surveys, turbulence and wake measurements, a preliminary acoustic survey, and fish and wildlife monitoring. An in-depth synthesis of the information obtained during these studies and additional research is presented in Exhibit E. The information provided in this DLA is sufficient to conduct an environmental analysis for the project as proposed.

This DLA also includes the following:

- Appendix A** Consultation Record
- Appendix B** Post-License Monitoring and Management Plans
 1. Fish and Wildlife Monitoring Plan
 2. Project and Facility Operations Monitoring Plan
 3. Adaptive Management
 4. Project Removal, Site Restoration, and Financial Assurance Plan
 5. Project and Public Safety Plan
 6. Navigation Safety Plan
 7. Emergency Shutdown Plan
- Appendix C** Site Assessments
 1. Tetra Tech Survey Scope and Findings
 2. Resource Characterization Report: OPALCO site in Rosario Strait, WA (USA)



PROCESS PLAN AND SCHEDULE

OPALCO proposes the following process plan and schedule for completing consultation, conducting additional pre-deployment field studies, and filing of the Rosario Strait Tidal Energy Project License Application. **Table 2** provides the timeframes for the process plan and schedule and provides stakeholders and Tribal Nations with the information to facilitate their participation in the licensing process for the Project.

Table 2. Process Plan and Schedule for the Rosario Strait Tidal Energy Project

Date	Days	Milestone / Activity Description
Pre-Filing Activity		
March 26, 2025		OPALCO files NOI and DLA with FERC
April 10, 2025	15 days from NOI	FERC issues public notice of pre-filing process and DLA filing
April 25, 2025	30 days from NOI	FERC initiates Tribal Consultation
May 25, 2025	30-60 days from NOI	All stakeholders file comments on DLA
June 9, 2025	15 days from close of initial comment period	FERC issues meeting notice (if needed)
July 9, 2025	30 days from meeting notice	Public meeting/Technical conference, if needed
July 24, 2025	15 days from technical conference or 30 days from close of initial comment period	FERC issues public notice concluding pre-filing process
July 24, 2025	15 days from technical conference or 30 days from close of initial comment period	FERC determination on request for waivers and process/plan schedule
Post-Filing Activity		
To be determined		OPALCO files Final License Application and Draft Biological Assessment with FERC
To be determined		OPALCO requests 401 water quality certification and Coastal Zone Management Act Consistency Determination (if needed)
To be determined	15 days from FLA filing	FERC issues public notice accepting application and Ready for Environmental Analysis (REA)
To be determined	15 days from FLA filing	FERC issues Biological Assessment (if appropriate)
To be determined	30 days from REA	Stakeholders file comments, interventions, recommendations, and conditions



Date	Days	Milestone / Activity Description
To be determined	60 days from REA response date	FERC issues Single Environmental Assessment (EA)
To be determined	30 days after EA	Comments on EA; 10(j) Resolution
To be determined		Application Ready for Commission Decision
Notes: DLA = Draft License Application; EA = Environmental Assessment; FERC = Federal Energy Regulatory Commission; REA = Ready for Environmental Analysis		

OPALCO would deploy the Orbital O2-X in Rosario Strait approximately 200 m (656 ft) to the east of Blakely Island in San Juan County, Washington State. The first installation of the technology, the original Orbital O2, was in July of 2021 in the waters near the Orkney Islands in Scotland, United Kingdom. The device has been successfully operating since then, and it is estimated to offset approximately 2,000 tons of carbon-dioxide per year, and to power about 1,700 homes. The first phase of the Rosario Strait Tidal Energy Project would be conducted for up to 10 years, and the performance of the Orbital O2-X system would be documented through environmental and system monitoring.

Under the pilot project license, the Project would consist of the following:

- One Orbital O2-X deployment in Rosario Strait for a total rated capacity of 2.4 MW.
- One mooring and anchor system with four mooring lines and four anchors.
- One new subsea cable from the Orbital O2-X to an existing shoreline conduit and facility on Blakely Island.
- Shore station containing all needed SCADA and electrical interconnection equipment.

OPALCO's experience under the pilot project license will inform whether it pursues a commercial FERC license.



REQUEST FOR WAIVERS

OPALCO, in accordance with FERC regulation 18 CFR § 5.29(f)(2), hereby requests that the Commission waive certain pre-filing requirements under the Integrated Licensing Process (ILP) to allow for expedited processing of this DLA for a pilot project. The Commission's whitepaper, *Licensing Hydrokinetic Projects* (Hydrokinetic Whitepaper), explains how proposed hydrokinetic projects seeking pilot licenses need to request a waiver of certain ILP regulations to expedite processing of license applications for pilot projects filed under 18 CFR § 5.18. Consistent with waiver requests approved by the Commission in other hydrokinetic pilot project licensing proceedings, OPALCO seeks waiver of the following ILP regulations:

- **§ 5.2(a) – Document Availability of Pre-Application Document (PAD):** Because OPALCO is seeking waiver of the Pre-Application Document under 18 CFR § 5.6 (see below), it also seeks waiver of § 5.2(a) requiring that the PAD be available for public inspection throughout the licensing process.
- **§ 5.6 – Pre-Application Document:** This content is included in the DLA for the pilot project.
- **§ 5.8 – Notice of Commencement of Proceeding and Scoping Document,** because the Commission will be implementing alternative public notice under the procedures outlined in the Hydrokinetic Whitepaper within 15 days of filing and does not include issuance of a scoping document at this phase of the pilot licensing process.
- **§ 5.9 – Comments on PAD and Information or Study Requests,** because the Commission will solicit public comment within 30–60 days and Environmental Study and Monitoring Plans have been included with this DLA for a pilot project.
- **§ 5.10 – Scoping Document 2,** since this is not envisioned to be a component of the pilot licensing process as framed by the Hydrokinetic Whitepaper.
- **§ 5.11 – Potential Applicant's Proposed Study Plan and Study Plan Meetings,** since the Hydrokinetic Whitepaper requires that this content be included in the DLA for a pilot project.
- **§ 5.12 – Comments on Proposed Study Plan,** since this requirement is not applicable given the requested waiver of § 5.11.
- **§ 5.13 – Revised Study Plan and Study Plan Development,** because this requirement is not applicable given OPALCO's requested waiver of § 5.11, and because the pilot licensing process does not require the filing of a Revised Study Plan.
- **§ 5.14 – Formal Study Plan Dispute Resolution Process,** because this requirement is not applicable given OPALCO's requested waiver of § 5.11.
- **§ 5.15 – Conduct of Studies,** as this requirement is not applicable given OPALCO's requested waiver of § 5.11.
- **§ 5.16 – Preliminary Licensing Proposal,** as this DLA for a pilot project provides this information and replaces the Preliminary Licensing Proposal.
- **§ 5.18(c) – Exhibit H,** as this exhibit is not a requirement for a license application for an original hydrokinetic pilot project.

OPALCO has prepared this DLA for a pilot project under the requirements of 18 CFR § 4.61, which governs applications for Major Water Power Projects less than 10 MW; therefore, this application includes Exhibits A, E, F, and G, as modified to include the specific information requested under the Commission's Whitepaper. OPALCO also requests that the Commission waive any additional components of the ILP regulations not listed above that are not applicable to hydrokinetic projects.



REQUEST FOR DESIGNATION AS FERC'S NON-FEDERAL REPRESENTATIVE

OPALCO requests designation as the FERC's non-federal representative to initiate informal ESA Section 7 consultation with the U.S. Fish and Wildlife Service (USFWS) and NMFS (collectively, the Services) and to hold discussions related to threatened and endangered species with other appropriate parties on behalf of FERC for the proposed Rosario Strait Tidal Energy Project.

OPALCO also requests designation as FERC's non-federal representative to initiate consultation under Section 106 of the National Historic Preservation Act with the Washington State Department of Archaeology and Historic Preservation (DAHP), potentially affected Tribes, and other interested parties on behalf of FERC for the proposed Project.



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APPLICATION FOR THE HYDROKINETIC PILOT PROJECT LICENSE

EXHIBIT A: PROJECT DESCRIPTION AND MODE OF OPERATIONS



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1.0 Summary of Description of Proposed Project

Orcas Power & Light Cooperative (OPALCO) is a non-profit cooperative electric utility providing service in San Juan County, Washington. To prepare for expected near-term electrical capacity shortfalls and long-term load doubling, OPALCO has been exploring local power generation options to ensure resilience, reliability, and ability to support beneficial electrification and regulatory clean energy goals.

Tidal energy is harnessed from the motion of tides turning turbines installed in the water column to convert into electricity. Unlike the variability in solar and wind conditions, tidal currents are a reliable and predictable form of energy potential. Areas with high tidal ranges and strong currents present the best potential for capturing tidal energy. Tidal energy could increase resilience and energy independence for island communities, particularly during winter months when solar microgrids have lower production.

In 2022, OPALCO was awarded a grant from the Washington Department of Commerce's Clean Energy Fund 4 (CEF4) to investigate clean energy alternatives to help modernize the electrical grid. This award was to assess a preliminary design for a potential tidal energy project located in Rosario Strait of the San Juan Islands archipelago in Washington State. Funding from CEF4 supported a study to investigate the testing capacity of Rosario Strait for tidal power output and tidal turbine technology to generate electricity that supports OPALCO's microgrid for its island service area.

In 2024, OPALCO was awarded a grant from the United States (U.S.) Department of Energy to investigate the feasibility of deploying a pilot project demonstration of a singular Orbital Marine O2-X Floating Tidal device (Orbital O2-X) with two turbine rotors rated at 1.2 megawatts (MW) each in Rosario Strait. To demonstrate the commercial viability of this device and allow it to connect to OPALCO's existing electrical grid, the Project is required to be authorized by the Federal Energy Regulatory Commission (FERC, also Commission).

As such, OPALCO is applying to FERC for an original hydrokinetic pilot project license for the proposed Rosario Strait Tidal Energy Project (Project). Pursuant to 18 CFR Part 5, OPALCO submits this Draft License Application, Exhibit A, for consideration. FERC issued a preliminary permit on January 13, 2025, Project No. 15368-000, which grants OPALCO the priority to apply for a license for the proposed Project.

1.1 Project Site

The proposed Project would be located in Rosario Strait of the Salish Sea, an estuarine inland sea comprising the waters from Olympia, Washington north to Campbell River, British Columbia, and west to Neah Bay, Washington, including the Strait of Georgia, Strait of Juan de Fuca, Puget Sound, and the archipelago of the San Juan Islands. Rosario Strait is situated within the San Juan Islands archipelago between Blakely Island to the west and Cypress Island to the east, connecting the Strait of Juan de Fuca with the Strait of Georgia.

Through a U.S. Department of Energy-funded Testing and Access to Marine Energy Research (TEAMER™) project, Pacific Northwest National Laboratory assessed five potential locations for a tidal energy project within the waters of Washington State's San Juan Islands archipelago (Copping et al. 2021). Based on multiple factors including tidal flow, threatened and endangered species information, suitable benthic habitat, and vessel traffic, Rosario Strait was identified as a tidal resource hotspot and considered an optimal location for deploying floating tidal turbine technology (Yang et al. 2021; Calandra et al. 2023).

The proposed Project area within Rosario Strait is located east of Blakely Island (at approximately 48.5611°N, 122.7679°W). Blakely Island is a small, sparsely populated island, approximately 2.4 kilometers (km) (1.5 miles) south of Orcas Island where OPALCO offices are located. The proposed



Project area is shown in **Figure 1**, and includes the locations for all proposed technology components: the floating tidal device (Orbital O2-X), mooring lines, anchors, and transmission lines (e.g., new subsea cable); as well as an existing marine shoreline cable conduit and existing land-based shoreline conduit facility at the southern end of Blakely Island (**Figure 2**).

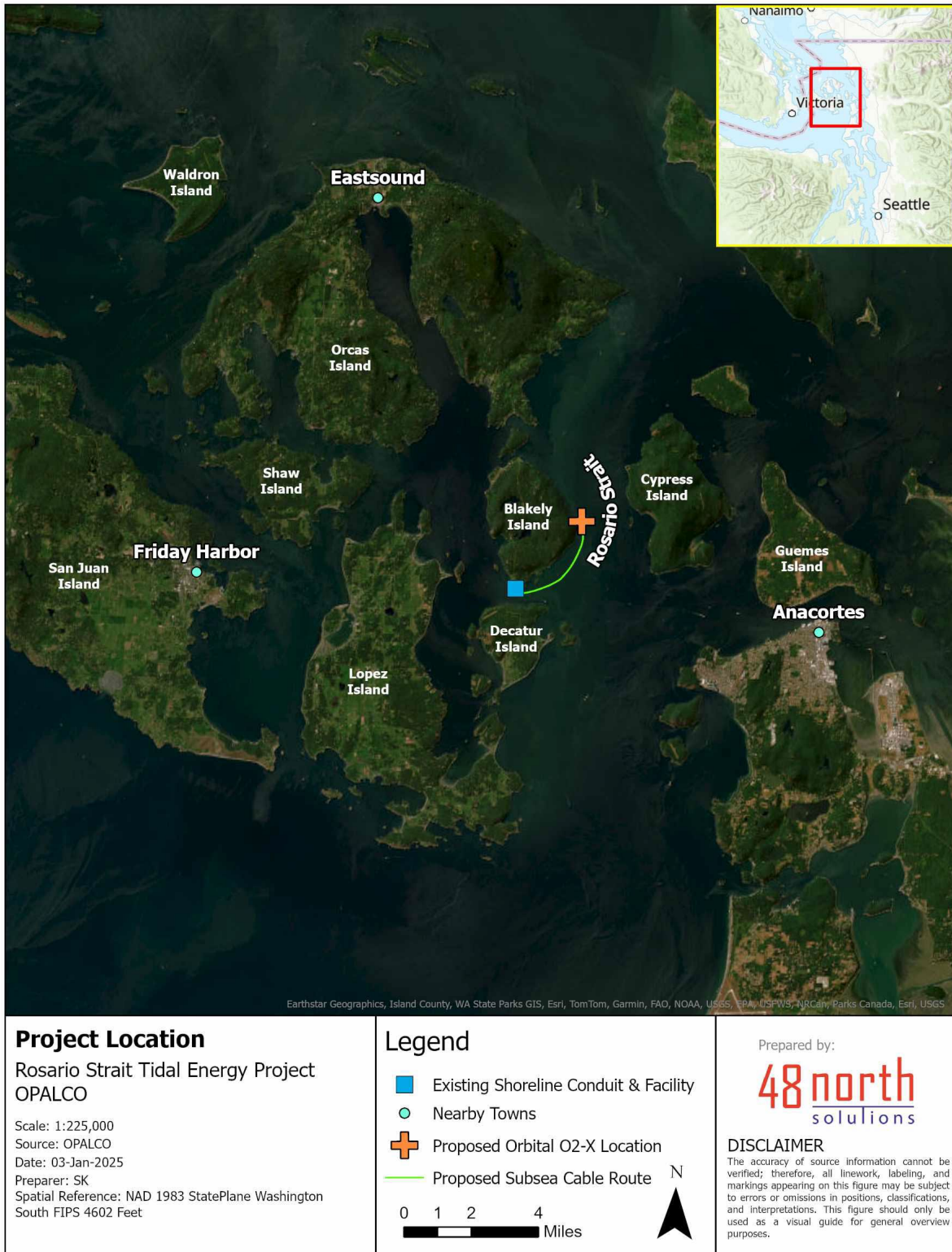


Figure 1. Project Location

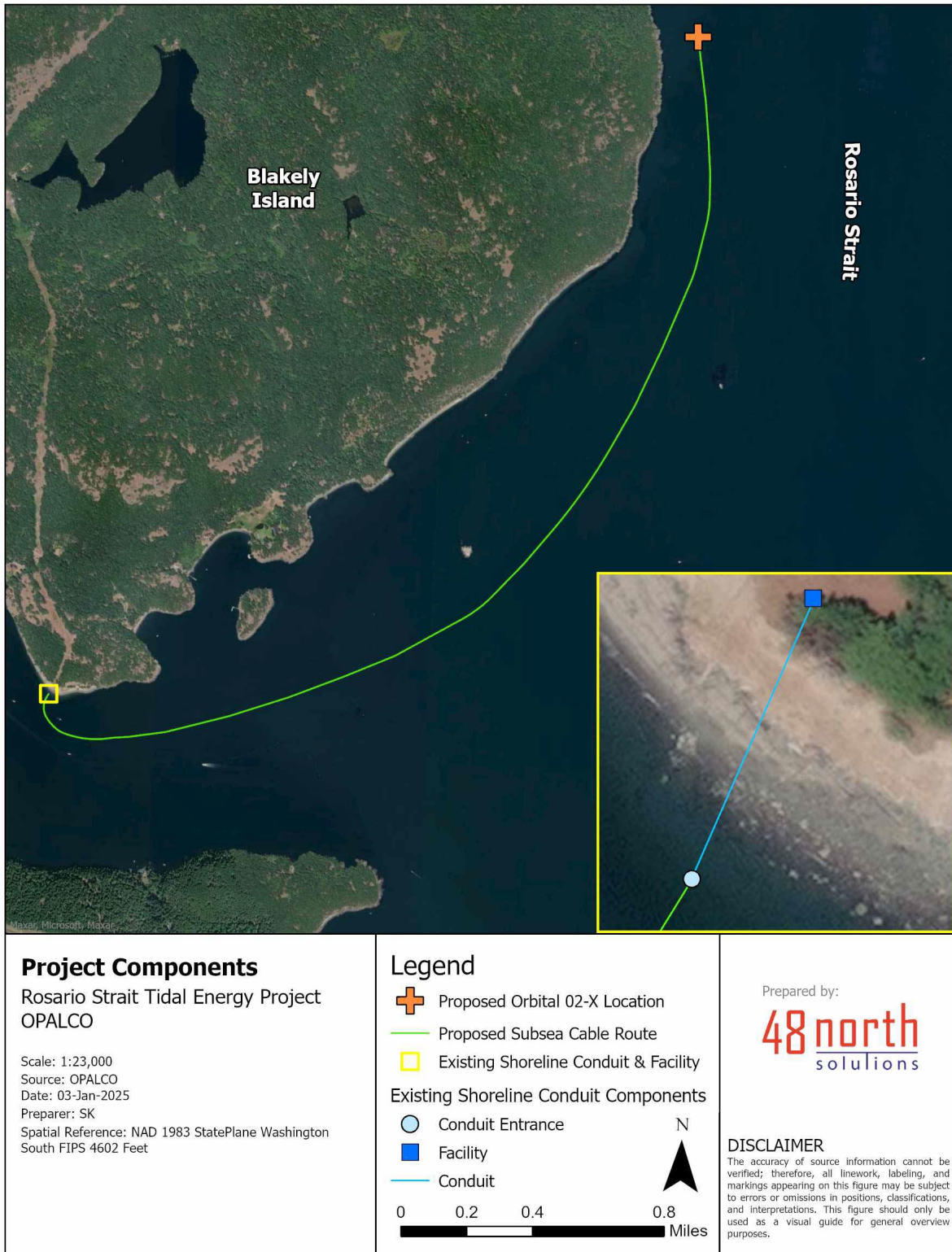


Figure 2. Project Components



1.2 Project Composition

Table 3. Summary Pursuant To 18 CFR § 4.61(c)(1)

18 CFR § 4.61(c)(1)		Description
(i)	The number of generating units including auxiliary units	One Orbital O2-X device that houses two rotor-powered generators (i.e., two turbines)
	- The capacity of each unit	1.2 MW per turbine (2.4 MW total)
	- Provisions, if any, for future units	None
(ii)	The type of each hydraulic turbines	Horizontal axis tidal turbines
(iii)	A description of how the plant is to be operated, manual or automatic	Automatic
	- Whether the plant is to be used for peaking	Not a peaking plant
(iv)	The estimated average annual generation in kilowatt-hours or mechanical energy equivalent	2.1 GWh per turbine (4.2 GWh total)
(v)	The estimated average head on the plant	2.1 m (6.9 ft)
(vi)	The reservoir surface area in acres and, if known, the net and gross storage capacity	Not applicable
(vii)	The estimated minimum and maximum hydraulic capacity of the plant (flow through the plant) in cubic feet per second	127 cubic feet per second (cfs) to 65,584 cfs
	- Estimated average flow of the stream or water body at the plant or point of diversion	Average flow through a single turbine is 20,728 cfs Average flow through Rosario Strait is 289,000 cfs
(viii)	Sizes, capacities, and construction materials, as appropriate, of pipelines, ditches, flumes, canals, intake facilities, powerhouses, dams, transmission lines, and other appurtenances	New subsea cable for the connection to OPALCO's power grid would be sized at a maximum capacity of 10 MW
(ix)	The estimated cost of the project	See Section 3.0
(x)	The estimated capital costs and estimated annual operation and maintenance expense of each environmental measure	See Section 7.0
Notes: cfs = cubic feet per second; ft = feet; GWh = gigawatt hours; m = meters; MW = megawatt		



1.2.1 Orbital Marine O2-X Floating Tidal Device (Orbital O2-X)

The Orbital O2-X is a floating tidal energy generator. It consists of a cylindrical floating steel superstructure that houses power conversion and auxiliary systems, and it provides stability for the attachment of two leg structures with nacelles mounted at their ends. A nacelle is a container that houses the generating components of a turbine. The leg structures have hinge attachments to the superstructure that can be lowered to position the nacelles and contra-rotating rotors (i.e., the turbines) in the optimal placement of the tidal stream to generate electricity. These structures can also be raised to bring the legs, nacelles, and rotors to the surface for servicing and towing the Orbital O2-X. A catenary mooring system (i.e., a type of mooring system that uses hanging lines to connect a floating unit to the seabed) consisting of rope tethers, four mooring chains, and anchors would connect to the Orbital O2-X hull at a single point, allowing for the system to slowly pivot 360 degrees with the tide (like a moored boat turning with the tide). Power is exported from the Orbital O2-X via a dynamic cable from the Orbital O2-X device to the seabed where a new subsea cable would traverse approximately 5.3 km (3.3 miles) to export power ashore to the existing shoreline conduit, connecting the tidal system to OPALCO's microgrid.

Cross sections and dimensions (in meters) of the Orbital O2-X are shown in **Figure 3** and **Figure 4**. **Table 4** lists the main design parameters. Dimensions may change based on the site-specific characteristics of the proposed Project location. While the hull of the device is a total of 4 m (13.1 ft) tall, approximately 1.5 m (4.9 ft) of the device always remains above water. When in operation mode, the minimum rotor tip depth is 3 m (9.8 ft), and the maximum rotor tip depth is 33 m (108 ft).

For more design drawings please see Exhibit F. OPALCO acknowledges that FERC's regulations require Exhibit F drawings to be depicted in feet. However, the preliminary Exhibit F drawings currently available from Orbital and included in this DLA are depicted in meters. OPALCO's final Exhibit F drawings to be submitted during or after the licensing process will include measurements in feet, as required by the Commission.

Table 4. Design Parameters of the Orbital O2-X

Summary of Device Characteristics	
Rated Power	c. 2.4 MW
Average Annual Energy Production	2.1 GWh per turbine (4.2 GWh total)
Dependable Capacity	0
Displacement	1,000 tonnes (2,204,623 lbs.)
Rated Current Speed	2.5 meters per second (m/s; 8.2 feet per second [ft/s])
Cut-In Current Speed	1 m/s (3.3 ft/s)
Shut Down Current Speed	5 m/s (16.4 ft/s)
Maximum Hull Length	85 m (279 ft)
Approximate Diameter of Hull Tube	4 m (13.1 ft)
Approx Depth to Uppermost Rotor Tip During Operation (Rotors Extended)	3 m (9.8 ft)
Approx Depth to Bottom of Rotor Tip (Deepest Point) During Operation (Rotors Extended)	33 m (108 ft)



Summary of Device Characteristics	
Maximum Depth of Platform Below Waterline	2.4 m (7.9 ft)
Height of Hull Tube Exposed Above Water Surface	1.6 m (5.2 ft)
Rated Rotor Speed	9.2 revolutions per minute
Maximum Rotor Speed	11.2 revolutions per minute
Maximum Rotor Diameter	30 m (98 ft) (each blade is 15 m [49 ft])
Maximum Rotor Swept Area	706 m ² (7,600 ft ²) (x 2)
Notes: ft = feet; ft/s = feet per second; GWh = gigawatt hours; lbs = pounds; m = meters; m/s = meters per second; MW = megawatt	
¹ A definitive average of annual energy production for this project has not yet been calculated, as the optimal rotor size and associated energy yield has not yet been determined.	

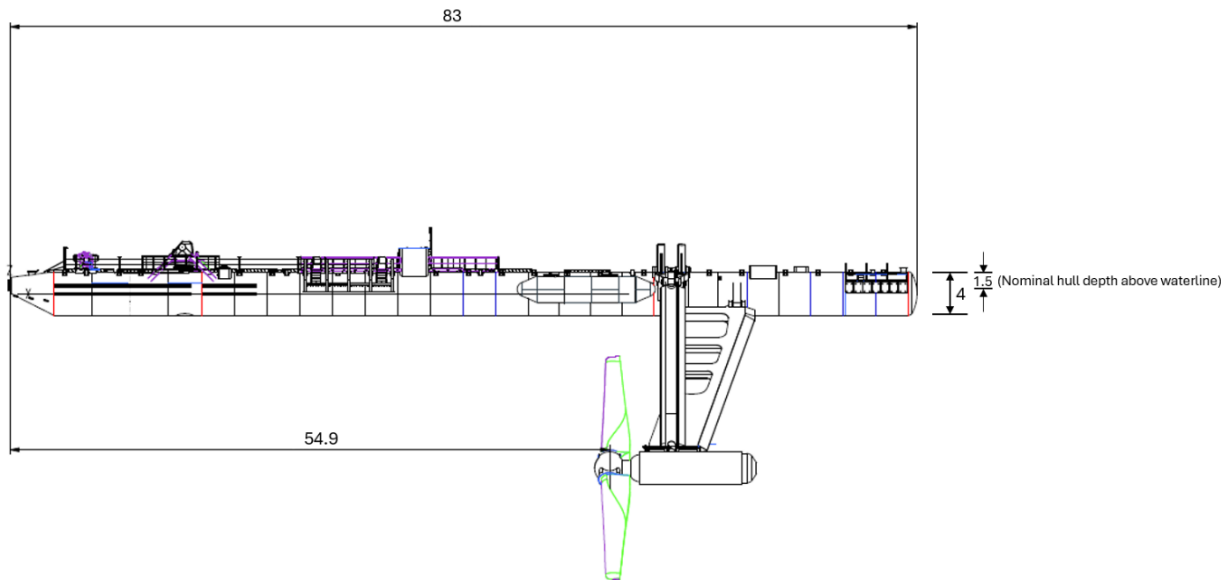


Figure 3. Orbital O2-X in Operation Mode (in meters)

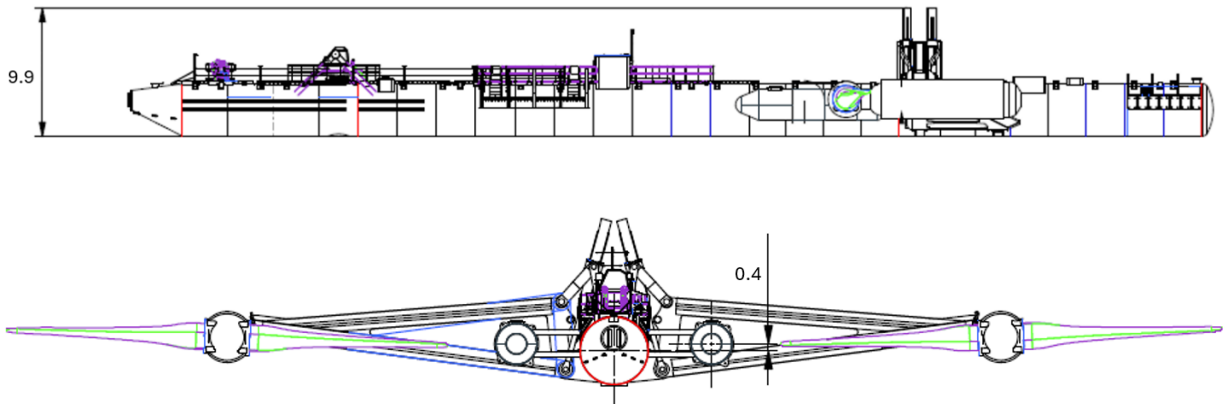


Figure 4. Orbital O2-X in Transport Mode (in meters)

Structure Platform

The Orbital O2-X platform consists of a main tubular section with conical ends comprised of corrosion-protected carbon steel (**Figure 5; Figure 6**). Attached to the outside of this is a deck structure, bollards (i.e., a short, sturdy post to which a rope can be secured), and fendering for vessel and personnel interaction. Inside the main tube, equipment such as converters, a transformer, switchgear, and industrial panels are mounted on a skid system. The structure is designed to provide sufficient buoyancy and hydrodynamic stability for the Orbital O2-X to function efficiently. The structure is not permanently staffed, but maintenance visits to this proposed Project are expected to occur every year in order to replace consumables, as needed.

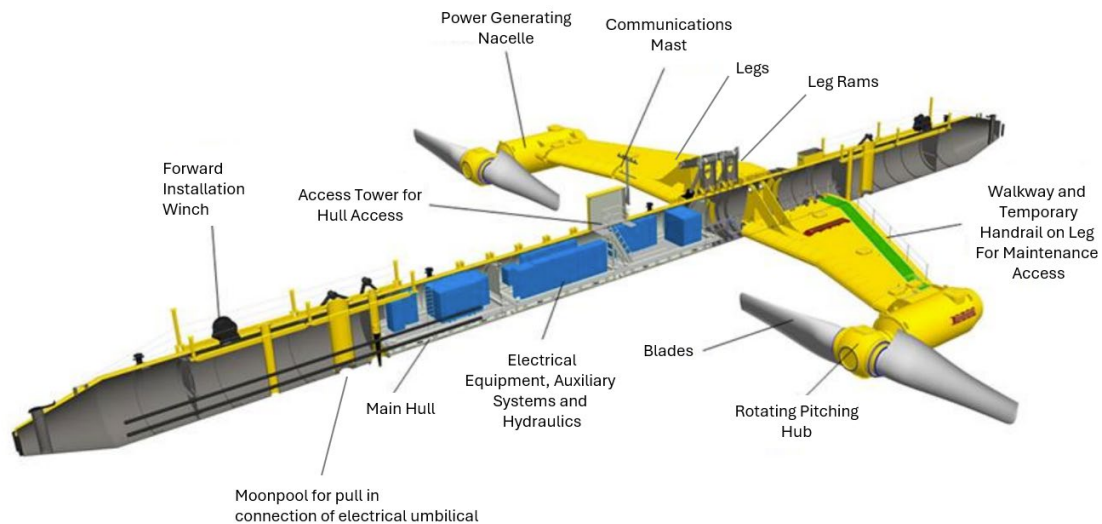


Figure 5. Main Internal Systems of Orbital O2-X



Figure 6. Orbital O2 Deployment in Orkney Islands, Scotland



The Orbital O2-X structural components are designed for a 25-year operational lifetime, although certain components within the device have a shorter lifetime. The design and construction of the structure adhere to the Det Norske Veritas (DNV) company and other relevant offshore design standards. The structure is designed to survive rare extreme environmental conditions that occur with a very low probability (e.g., a 1-in-100-year wave).

Nacelles

The Orbital O2-X has two nacelles, one at the end of each retractable leg, which are mounted below the floating hull. The nacelles house the gearbox, the high-speed shaft and brake, and the generator, and support the hub that carries the turbine blades. The nacelles are close to neutrally buoyant and can therefore be floated on and off the leg for in-water assembly and removal for through-life major overhaul or maintenance.

Pitch Unit and Rotors

The Orbital O2-X features two twin-bladed rotors with blades that are manufactured from glass-fiber reinforced epoxy. During operation, the rotors rotate in opposing directions to support platform stability. The rotor blades connect to a dry/non-flooded hub using a rotary pitch bearing, which allows for changing the blades' angle. Exterior and interior surfaces exposed to seawater are coated with appropriate antifouling coatings to avoid permanent build-up of marine growth.

Each Orbital O2-X rotor incorporates a pitching system to control the turbine power output by adjusting the angles of the four blades. The blades change angle to manage torque (force) loads on the Orbital O2-X in the range of 0–15 degrees. When the turbines are not generating power, the blades tilt 90 degrees, nearly parallel to the flow, to keep the blades from spinning and protect the turbine from damage.

1.2.2 Mooring Lines

The mooring system for the Orbital O2-X would be comprised of four catenary mooring lines, which would be moored to the seabed via four separate anchors, designed in accordance with Offshore Standard DNV-OS-E301 (DNV 2013).

There would be a single-point mooring connection at the forward end of the hull that spreads out to four anchoring points (**Figure 7**). During each tidal cycle, the system would slowly pivot its position in a 360-degree manner, like a moored boat during a tide change (**Figure 8**). During the tidal changes, the turbines would not operate due to insufficient tidal current to turn the turbines.



Figure 7. Single-Point Mooring Location on Orbital O2-X Hull

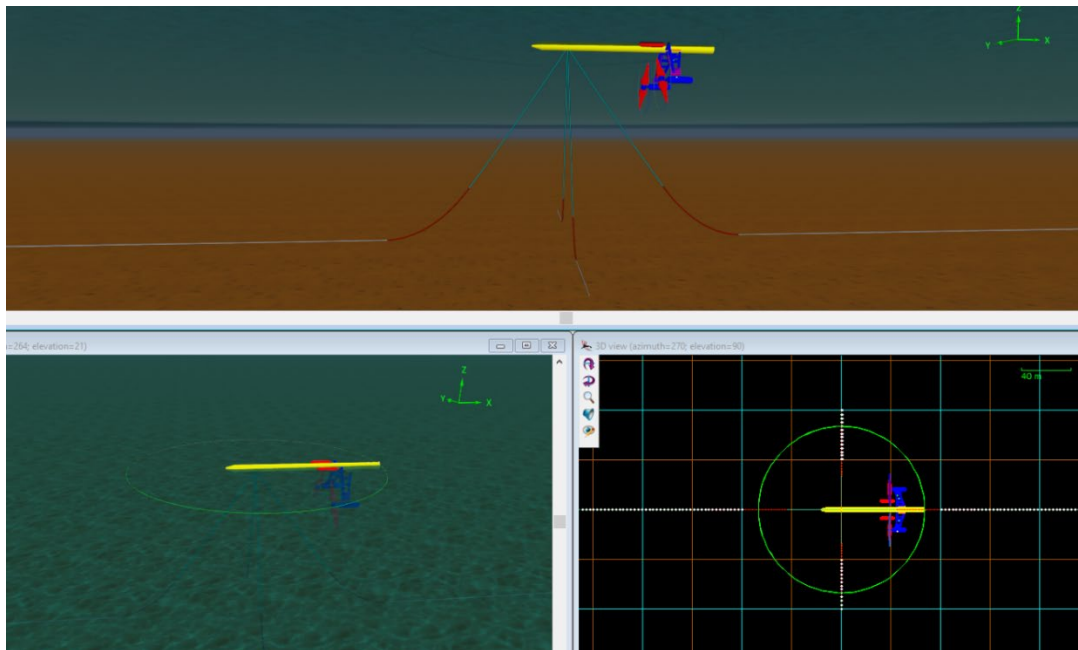


Figure 8. Mooring System and Pivot Radius

The mooring lines would be approximately 334 m (1,096 ft) in length. The average difference between high and low tide, or the tidal range, recorded at Rosario, Orcas Island near the proposed Project location is 2.4 m (7.9 ft) (NOAA 2024). During slack tide (the transition time between tides), a total length of approximately 246 m (807 ft) of each mooring line would be in contact with the seabed, which is represented by white dotted lines in **Figure 9** and **Figure 10**. The mooring lines remain slack when the Orbital O2-X rotates 180 degrees as the tide changes direction, and could range from a minimum of 280 m x 480 m (919 ft x 1,575 ft) to a maximum of 322 m x 552 m (1,056 ft x 1,811 ft), depending on the final deployment configuration.

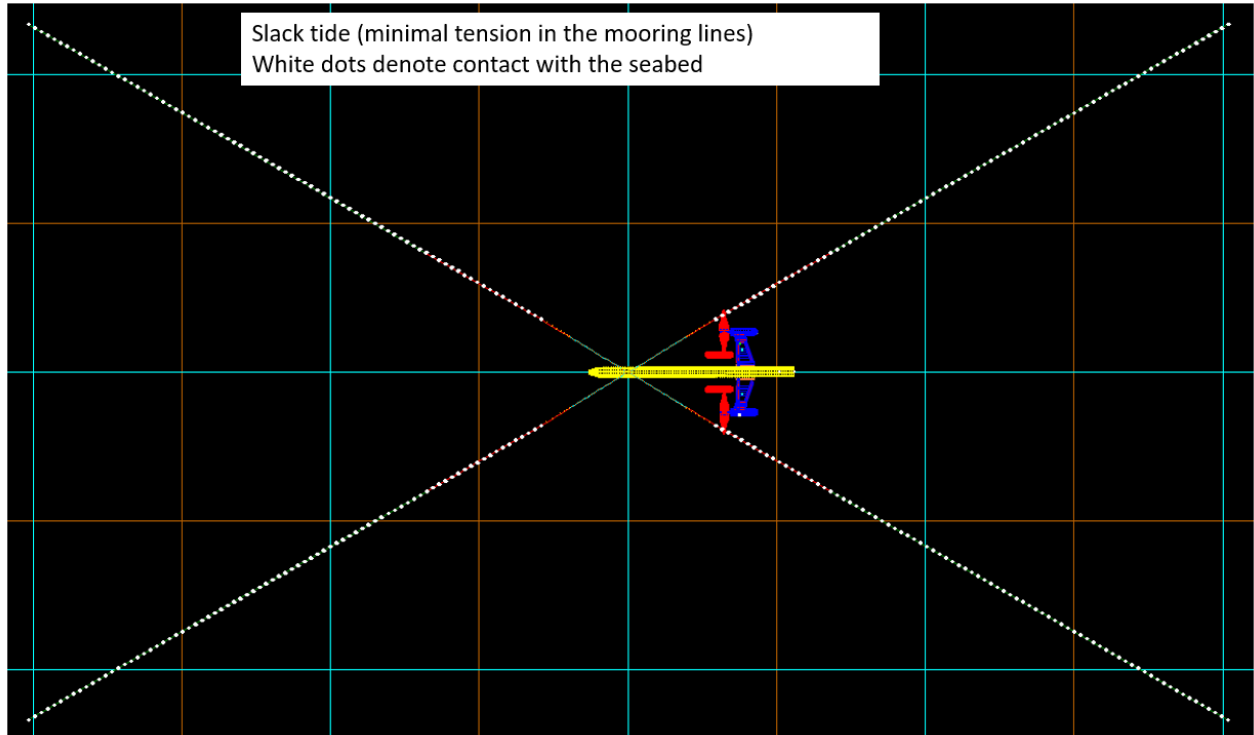


Figure 9. Mooring Lines at Slack Tide (above view)

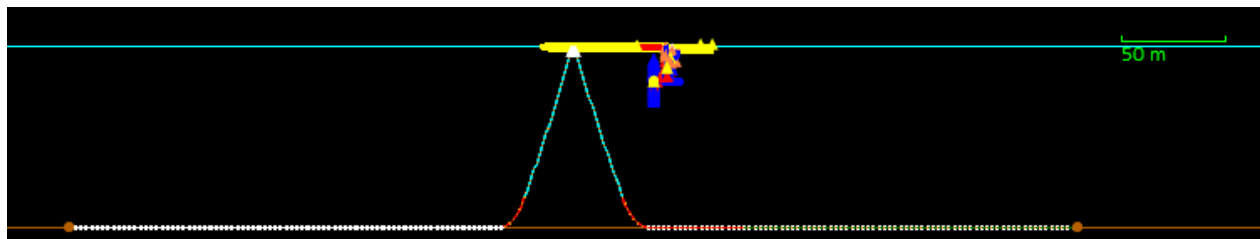


Figure 10. Mooring Lines at Slack Tide (side view)

When the mooring lines reach the position of rated power (when tidal currents are strong enough to turn the rotors), the mooring lines downstream of the Orbital O2-X would remain on the seabed while the mooring lines upstream of the Orbital O2-X would lift off the seabed (**Figure 11**). Even when the mooring lines are slack, less than 10 tonnes (22,046 pounds [lbs.]) of tension remains per line.

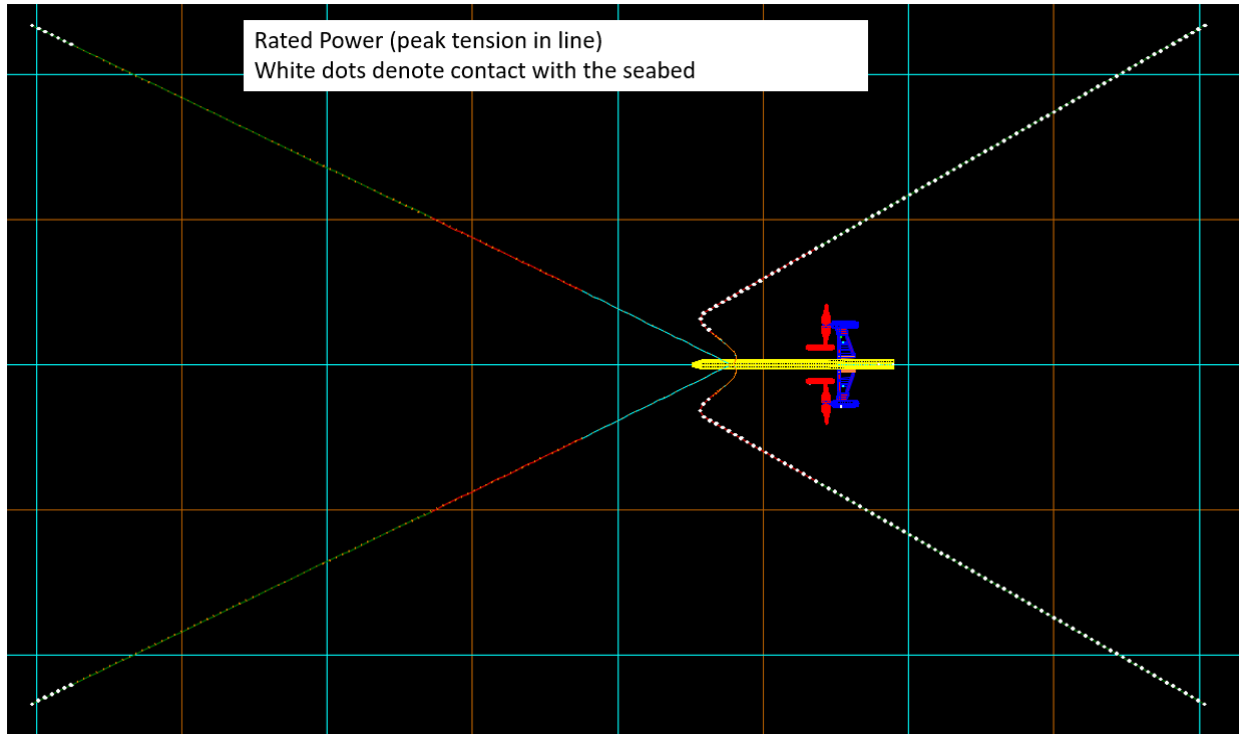


Figure 11. Mooring Lines at Rated Power

Previous deployments of the Orbital O2 exemplified that the mooring lines lift and are placed back down in approximately the same location amidst tidal cycles, showing a very narrow area of disturbance to the seabed. The width of the area where they are placed back down is less than 1 m (3 ft), so the total area of disturbance is approximately 246 m² (2,648 ft²) per line, or 984 m² (10,592 ft²) total for all four lines. There is one area along each mooring line where it is dragged over the seabed rather than lifted, and it is depicted in **Figure 12** by a small black outlined circle on the lower right line toward the center of the mooring spread. This area is approximately 10 m² (108 ft²) in size, totaling 40 m² (432 ft²) across the four lines, that would be disturbed by mooring lines dragging on the seabed.

In the highly unlikely event that a mooring line failed, any single remaining mooring line can hold the entire system. The mooring spread would cover an area of approximately 280 m x 480 m (918 ft x 1,575 ft). The mooring line system would consist of approximately 95 millimeter (mm) (3.7 inches [in.]) and 115 mm (4.5 in.) diameter studlink mooring chain. Synthetic or steel rope may be used in the lines as well but would be limited to the upper section of the mooring lines and would be jacketed polyester rope approximately 170 mm (6.7 in.) in diameter.

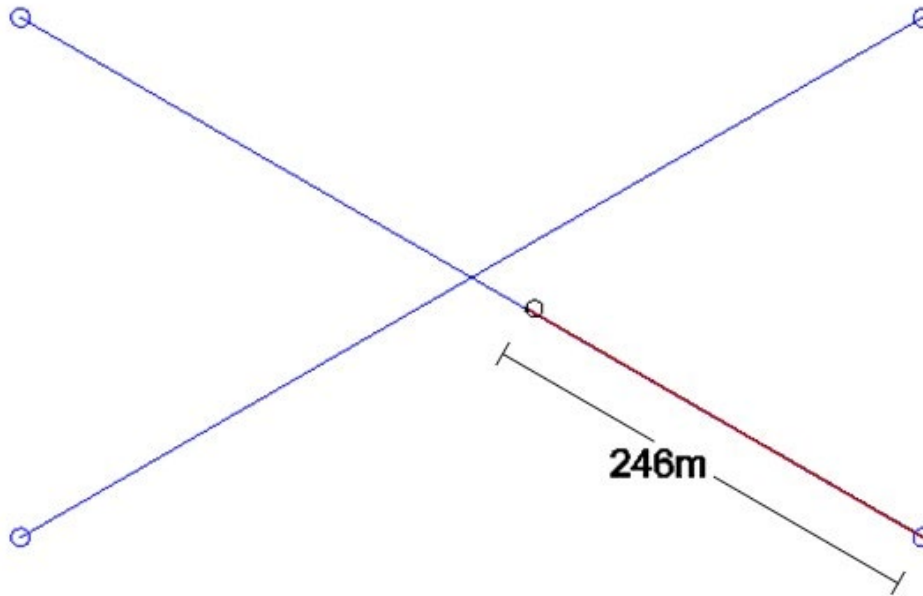


Figure 12. Mooring Line Configuration

1.2.3 Anchors

Four gravity anchors or four drilled rock bolt anchors would likely be used to anchor the Orbital O2-X, subject to seabed conditions. Gravity anchors would be composed of a “steel basket” filled with ballast (**Figure 13**). The anchor baskets would be approximately 11 m x 11 m x 2.5 m (36 ft x 36 ft x 8.2 ft) and weigh approximately 35 tonnes (77,200 lbs.). The ballast would consist of scrap steel chain (7.6 cm [3 in.] in diameter), steel modules approximately 5.5 m x 5.2 m x 2 m (18 ft x 17 ft x 6.6 ft), or cast concrete blocks.

Rock bolt anchors are steel vertical piles that are drilled into the seabed to keep the Orbital O2-X in its designated location in the water. Rock bolt anchors can either be grouted in place in the seabed or mechanically locked in place to prevent pull out (**Figure 14**). In a mechanically locked system, the “cutting fingers” of the drilling bit are expanded within the bolt hole to secure the anchor in place.

Four rock bolt anchors are proposed, each likely 6.1 m (20 ft) in vertical length and up to 58.4 centimeter (cm) (23 in.) in diameter. Each would be drilled into the seabed with its head protruding from the seabed with a specialized mooring connector.

Each mooring point would have a single rock bolt. The exact sizing would be subject to seabed conditions analysis and detailed design.

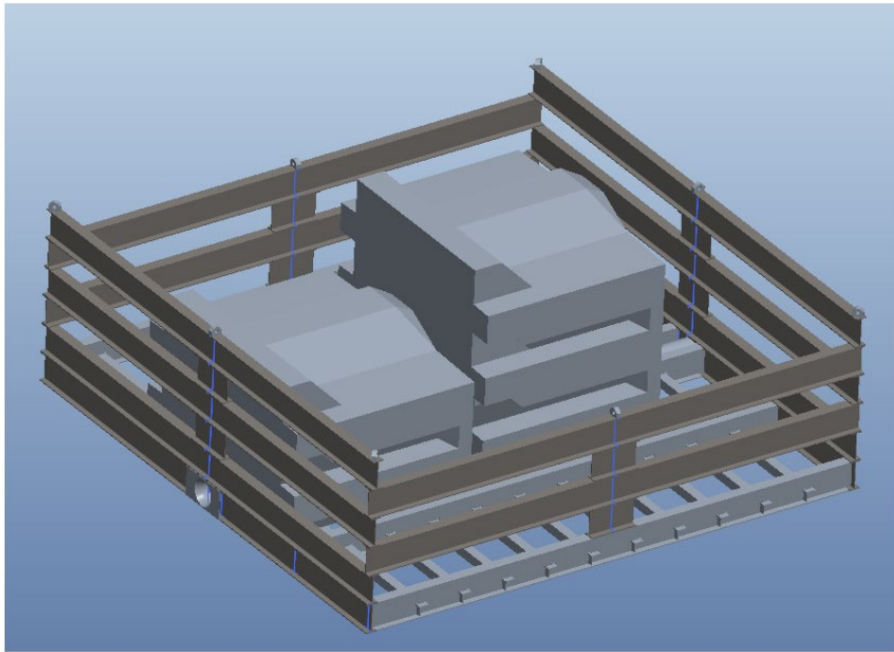


Figure 13. Anchor Basket with Ballast

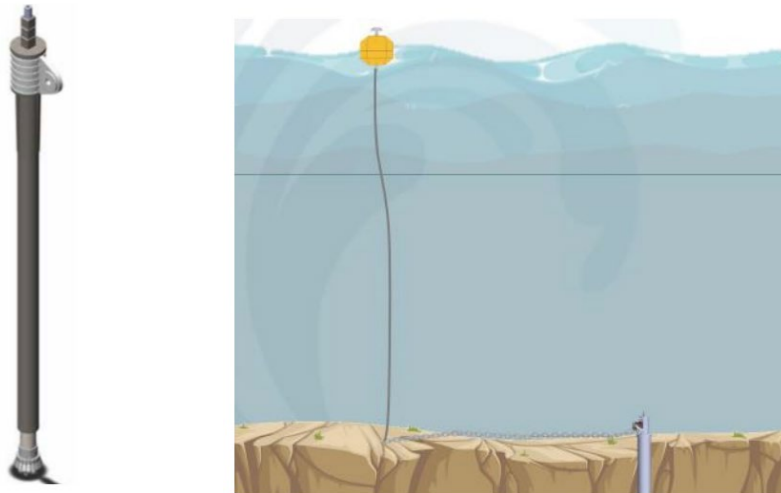


Figure 14. Example of a Rock Bolt Anchor

Mooring Connector

The mooring lines, attached to the anchors at the seabed, would terminate at a connector on the base of the Orbital O2-X (**Figure 15; Figure 8**). The connector has four places for mooring lines to attach, designed to allow the device to rotate 180 degrees with the changes of the tide, and has a full rotational range of 360 degrees.

During the Orbital O2-X installation and mooring line connection procedure, the connector would be situated on the seabed directly below the final proposed location for the Orbital O2-X device. There on the seabed, the four mooring lines would be attached to the connector. Once the anchors are

installed and the mooring lines attached, the connector would be lifted via chain to its final position in a receptacle in the hull of the Orbital O2-X via a winch system on the Orbital O2-X platform. A hydraulic system would lock the connector in position within the hull.

If the Orbital O2-X needs to be removed, first the electrical connections would be disconnected, then the connector and attached mooring lines would be released from the hydraulic system on the Orbital O2-X hull, and finally the on-platform winch system would lower the connector to the seabed. This connector, its chain, and the mooring lines would have sufficient mass to remain in place on the seabed until they are either reconnected to the Orbital O2-X or recovered when the project components are removed.

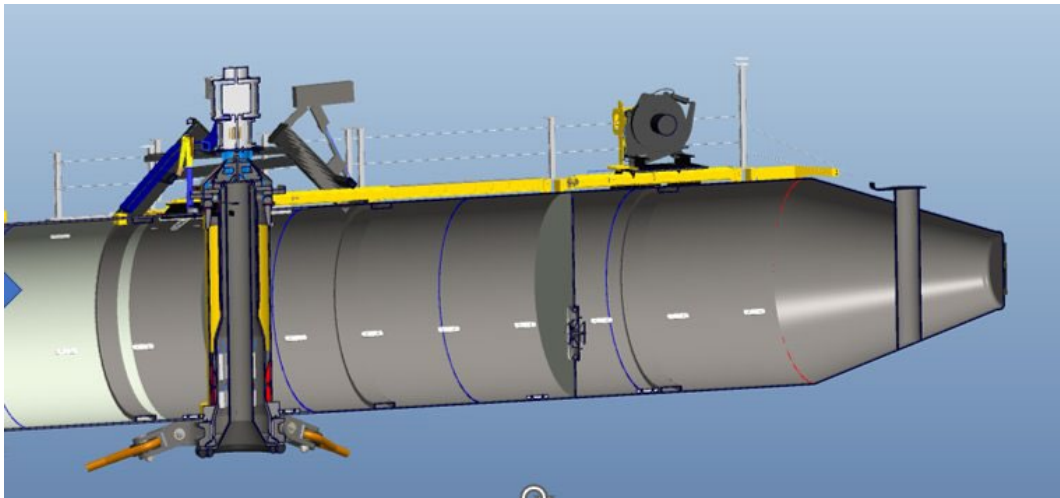


Figure 15. Mooring Connector

When the Orbital O2-X reaches its destination orientation during peak tidal currents, it would excuse (i.e., leave or deviate from) its 66 m (217 ft) radius watch circle. As the tidal current speed increases and the Orbital O2-X starts to generate power, it would slowly drift backwards outside of its watch circle radius by approximately 30 m (98 ft) over a period of 45 minutes to 1 hour. When the tidal current changes direction at slack tide, the Orbital O2-X would slowly turn 180 degrees with the tide, like a moored boat would, over a period of about 30 minutes. The Orbital O2-X would not generate power during this period, as the tidal speeds are too low to turn the rotors.

1.2.4 Transmission Lines

Subsea Power Cable

The proposed Project would incorporate a new one-cross-linked polyethylene subsea power cable with a voltage of 12.5 Kilovolts (kV). The cable would extend from the electrical port on the Orbital O2-X where it would travel down the umbilical portion of the cable (i.e., the portion that is vertical in the water column) to the seabed where it would traverse 5.3 km (3.3 miles) along the seabed and connect to OPALCO's electrical grid via an existing shoreline conduit at the south end of Blakely Island (**Figure 2**). The power cable would consist of multiple layers including conductor, insulation, and armoring. Depending on seabed survey results, the cable would be up to 17.8 cm (7 in.) in diameter and weigh up to 25 kilograms (kg) per m (kg/m) (16.8 lbs./ft) in water. A 2.3-m (7.5-ft) buffer area on either side of the cable would be reserved for placing the cable around sensitive habitat during deployment, if necessary.

The umbilical portion of the cable is 105 m (344 ft) long and reaches a depth of 87 m (285 ft) (**Figure 16**). Once installed, the umbilical would have a sweep area of approximately 314 m² (3,380 ft²) (**Figure 17**), though the cable would only be in contact or drag along the seabed at this location during slack tide. During peak tide when the Orbital O2-X is at rated power, the umbilical is taught and lifts entirely off of the seabed (**Figure 18**). The remainder of the new subsea cable is expected to remain in the location it was laid on the seabed for the duration of the Project.

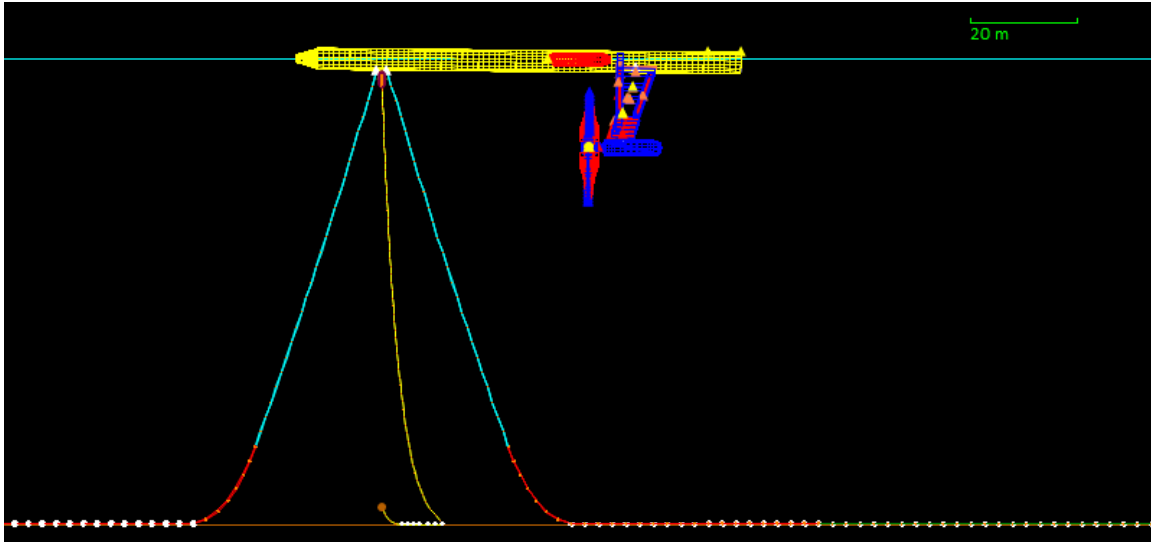


Figure 16. Umbilical Sweep Area During Slack Tide (side view)

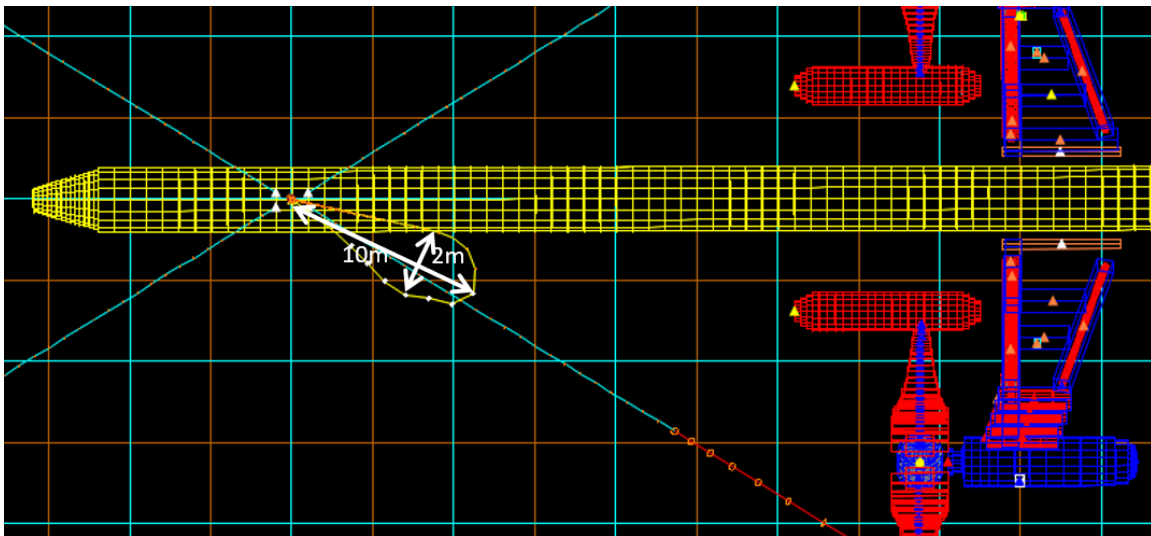


Figure 17. Umbilical Sweep Area During Slack Tide (above view)

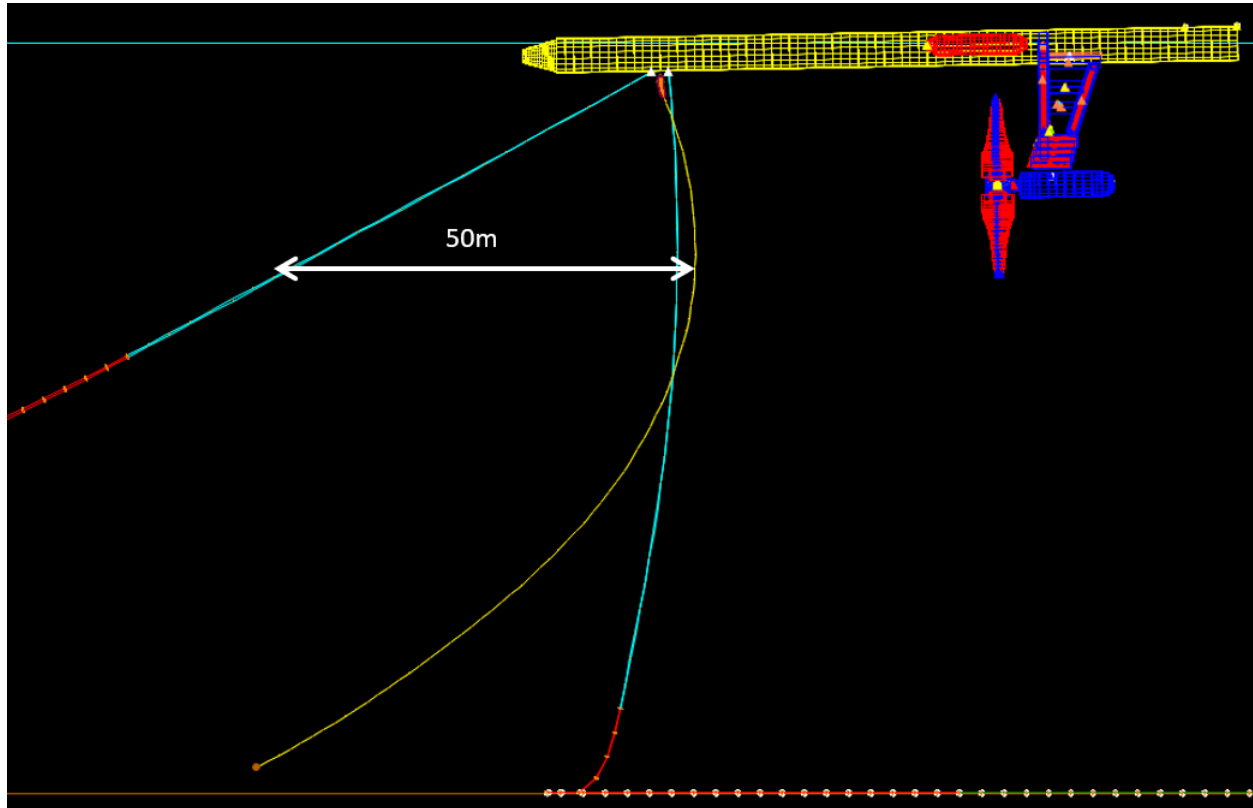


Figure 18. Umbilical During Peak Tide (side view)

Existing Shoreline Conduit

The interconnection between the Orbital O2-X and OPALCO's microgrid would be via the existing 45.7 cm (18 in.) shoreline conduit off the south shore of Blakely Island, which was installed by OPALCO in 2004. The conduit is buried in the slope of Blakely Island with an opening on land near OPALCO's substation, and the other end emerging underwater offshore Blakely Island. The subsea cable would be threaded through the existing shoreline conduit so that energy generated by the Orbital O2-X would be transmitted from the Orbital O2-X to OPALCO's transmission system and the surrounding islands along existing power cables. The onboard generation voltage would be nominally 690 volts (V), which would be transformed onboard to 12.47 kV before being transmitted over the new subsea cable.

2.0 Purpose of Proposed Project

As an island community, San Juan County is at risk of unreliable electricity. The vast majority of OPALCO's power is transported using submarine cables connected to the power grid on mainland Washington. When service is disrupted, San Juan County can be subjected to long wait times as repairs are beyond its control. OPALCO is committed to implementing local energy generation resources and microgrids that strengthen the resilience of infrastructure and increase safety and reliability for its service area while keeping rates affordable.

Washington State has established a mandated target of reducing overall GHG emissions to 95 percent below levels from the year 1990, and achieving net-zero GHG emissions by 2050 (RCW 70A.45.020). The OPALCO grid is evolving to meet the pressing needs to decarbonize and increase local energy resilience. To prepare for expected near-term electrical capacity shortfalls, and long-



term load doubling, OPALCO has been exploring local generation options to ensure resilience, reliability, and ability to support beneficial electrification and regulatory clean energy goals.

While solar power is minimal in the winter in the Pacific Northwest, tidal power is strong and predictable year-round. Notably, it can also be farmed within a fraction of the surface area that solar requires. This Project would serve as a pilot to test the capacity of the Rosario Strait site and tidal turbine technology to generate electricity that supports OPALCO's microgrid for its island service area.

3.0 Estimated Cost of Preparing License Application

The cost of developing this DLA for a pilot Project to date is approximately \$1.8M. This figure represents the costs for consultation and outreach, studies, development of management plans and the DLA from April 2024 through the filing date of March 26, 2025. Prior funding for environmental monitoring associated with the OPALCO Rosario Strait Tidal Energy Project is not included in the above cost.

4.0 On-Peak and Off-Peak Power Values

OPALCO has an existing power and transmission contract with the Bonneville Power Administration (BPA). The power contract is managed by Pacific Northwest Generating Cooperative (PNGC). These contracts have mechanisms for peak demand yet no specific rates during peak times. All power contract rates are based on OPALCO's non-coincidental peak on the BPA system. The transmission contract does contain a marginal coincidental demand rate for BPA transmission system coincidental peaks.

5.0 Estimated Increase or Decrease in Power Generation Due to Change in Project Operations

Not applicable to this Project.

6.0 Remaining Undepreciated Net Investment in Project

Not applicable to this Project.

7.0 Annual Operation and Maintenance Expenses

OPALCO calculations of annual operation and maintenance expenses in this DLA are preliminary and subject to change in the process of developing a Final License Application. Currently, estimated capital costs are \$611,000 (total O&M and insurance), and the estimated cost of annual operations and maintenance over a ten-year pilot license period is \$65,000 to \$95,000. However, these are just estimates at this time, as the primary objective of conducting the pilot project is to understand and determine accurate annual operation and maintenance expenses associated with the Project.

8.0 Detailed Single Line Electrical Diagram

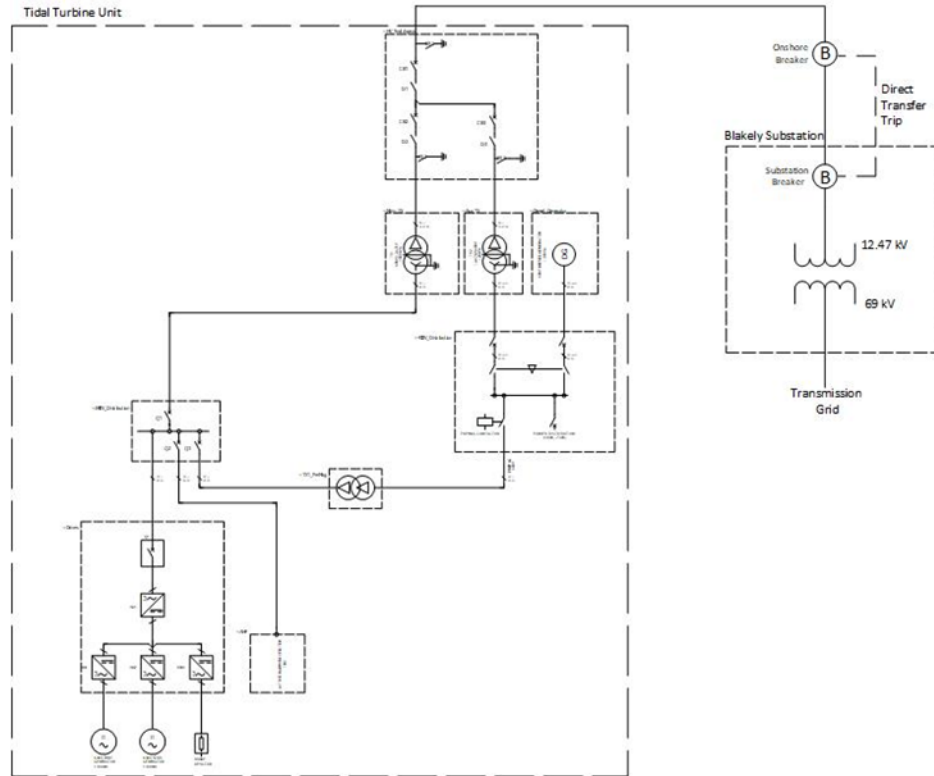


Figure 19. Tidal Generator Interconnection Diagram

9.0 Measures Planned to Ensure Safe Management, Operation and Maintenance of the Project

To ensure safe management, operation, maintenance, and decommissioning of the Project, OPALCO will implement the follow Post-License Monitoring and Engagement Plans in Appendix B:

1. Fish and Wildlife Monitoring Plan
2. Project and Facility Operations Monitoring Plan
3. Adaptive Management Plan
4. Project Removal, Site Restoration, and Financial Assurance Plan
5. Project and Public Safety Plan
6. Navigation Safety Plan
7. Emergency Shutdown Plan



10.0 References

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- Yang, Z., Wang, T., Branch, R., Xiao, Z., and Deb, M. 2021. Tidal stream energy resource characterization in the Salish Sea. *Renewable Energy* 172: 188–208.

Consultation Record

Appendix A

Rosario Strait Tidal Energy Project

San Juan Islands, Washington

FERC Project No. 15368



Federal Energy Regulatory Commission



Orcas Power & Light Cooperative (OPALCO)

183 Mount Baker Road

Eastsound, Washington 98245

26 March 2025

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**ACRONYMS AND ABBREVIATIONS**

BPA	Bonneville Power Administration
CZMA	Coastal Zone Management Act
DLA	Draft License Application
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
GWh	Gigawatt hours
NHPA	National Historic Preservation Act
NWPPA	Northwest Public Power Association
OPALCO	Orcas Power & Light Cooperative
Orbital O2-X	Orbital Marine O2-X Floating Tidal Device
PNGC	Pacific Northwest Generating Cooperative
PNNL	Pacific Northwest National Laboratory
Project	Rosario Strait Tidal Energy Project
TEAMER	Testing Expertise and Access for Marine Energy Research
THPO	Tribal Historic Preservation Officer
U&A	Usual and Accustomed
USACE	U.S. Army Corps of Engineers
UW	University of Washington
WRECA	Washington Rural Electric Cooperative Association



1. Agency Consultation Record

Table 1 outlines the prior consultations with federal, state, and local regulatory agencies regarding the installation of the Orbital O2-X in Rosario Strait that have occurred. Early coordination with the following regulatory agencies were conducted to introduce the Rosario Strait Tidal Energy Project (Project) and to understand the relevant regulatory processes.

Table 1. Agency Consultation Record

Date	Agency	Contact	Email	Subject
03/27/2023 07/01/2024 08/06/2024	Federal Energy Regulatory Commission	John Matkowski David Turner Stephan Bowler	John.matkowski@ferc.gov David.turner@ferc.gov Stephen.bowler@ferc.gov	Pilot Project draft license application (DLA) process.
02/14/2023	National Marine Fisheries Service	Don Huber Mary Bhuthimethee	donald.hubner@noaa.gov mary.bhuthimethee@noaa.gov	Endangered Species Act (ESA) ESA-listed species.
11/18/2024	San Juan County Environmental Stewardship Team	Kendra Smith Frances Robertson	kendras@sanjuancountywa.gov francesr@sanjuancountywa.gov	Project deployment.
12/14/2022	U.S. Coast Guard	Tim Westcott Rob Nakama Peter McAndrew	Timothy.L.Westcott@uscg.mil Robert.Nakama@uscg.mil Peter.J.McAndrew@uscg.mil	Navigational needs.
03/20/2024	U.S. Department of Energy	Yana Shininger Elaine Buck David Oonk Josh King	yana.shininger@ee.doe.gov elaine.buck@ee.doe.gov david.oonk@colorado.edu Josh.King@science.doe.gov	Review of Project progress.
11/02/2022 01/29/2025	U.S. Fish and Wildlife Service	Ryan McReynolds Mitch Dennis	ryan_mcreynolds@fws.gov mitchell_dennis@fws.gov	ESA- listed-species.
02/27/2025	Washington State Department of Archaeology and Historic Preservation	Rob Whitlam Catherin Oberheim	Rob.Whitlam@dahp.wa.gov catherine.oberheim@dahp.wa.gov	Section 106 of the NHPA.
12/04/2022	Washington State Department of Ecology	Loreé Randall Teresa Pucylowski Casey Dennehy Meg Bommarito Chad Yunge Brittany Flittner	Lora461@ecy.wa.gov teressa.pucylowski@ecy.wa.gov casey.dennehy@ecy.wa.gov meg.bommarito@ecy.wa.gov chad.yunge@ecy.wa.gov Brittany.Flittner@ecy.wa.gov	CZMA and Section 401.
11/01/2024	Washington State Department	Timothy Stapleton Marcus Reaves Jessica Pyle Beth Tate	Timothy.stapleton@dfw.wa.gov Marcus.reaves@dfw.wa.gov Jessica.pyle@dfw.wa.gov Elizabeth.tate@dfw.wa.gov	Washington State’s fish



Date	Agency	Contact	Email	Subject
	of Fish and Wildlife			and wildlife resources.
10/01/2024	Washington State Department of Natural Resources	Gabe Harder	Gabriel.harder@dnr.wa.gov	Aquatic Land Use authorization.
Notes: CZMA = Coastal Zone Management Act; DLA = draft license application; ESA = Endangered Species Act; NHPA = National Historic Preservation Act.				



2. Stakeholder Communication Record

Table 2 outlines prior communication with stakeholders regarding the proposed Rosario Strait Tidal Energy Project.

Table 2. Stakeholder Communication Record

Organization	Name	Contact Information	Contact Tracking
San Juan Island Community Organizations, Businesses, and Elected Officials			
Economic Development Council	Victoria Compton	victoria@sanjuansedc.org	Invited to 12/04/2024 meeting.
Friday Harbor Port	Todd Nicholson	toddn@portfridayharbor.org	Attended 12/04/2024 meeting.
Friends of the San Juans	Val Veirs	friends@sanjuans.org	Attended Town Hall 1/21/2025 meeting.
Friends of the San Juans	Eva Schulte	eva@sanjuans.org	Attended Town Hall 1/21/2025 meeting.
Friends of the San Juans	Tina Whitman	tina@sanjuans.org	Attended Town Hall 1/22/2025 meeting.
Friends of the San Juans	Ayn Gailey	friends@sanjuans.org	Attended Town Hall 1/22/2025 meeting.
Kwiáht	Russell Barsh	info@kwiaht.org	Invited to 12/04/2024 meeting.
Lopez Chamber	Andrea Huss	lopezchamber@lopezisland.com	Invited to 12/04/2024 meeting.
Lopez Family Resource Center	Barbara Schultheiss	barbara@lifrc.org	Invited to 12/04/2024 meeting.
Lopez Island Port	Rick Hoffman	rhoffman@portoflopez.com	Invited to 12/04/2024 meeting.
OPALCO Board of Directors	Mark Madsen	contacttheboard@opalco.com	Attended Town Hall



Organization	Name	Contact Information	Contact Tracking
			1/21/2025 meeting.
OPALCO Board of Directors	Jerry Whitfield	contacttheboard@opalco.com	Attended Town Hall 1/21/2025 meeting.
OPALCO Board of Directors	Vince Dauciunas	contacttheboard@opalco.com	Attended Town Hall 1/21/2025 meeting.
Orcas Community Resource Center	Erin O'Dell	erin@orcascrc.org	Attended 12/04/2024 meeting.
OPALCO Elections Governance Committee	Bill Severson	bill.fairhope@gmail.com	Invited to 12/04/2024 meeting.
OPALCO Elections Governance Committee	Bill Appell	appellb@aol.com	Invited to 12/04/2024 meeting.
OPALCO Elections Governance Committee	Doug Rowan	drowan519@gmail.com	Invited to 12/04/2024 meeting.
OPALCO Elections Governance Committee	Rick Christmas	rickxmas@msn.com	Invited to 12/04/2024 meeting.
OPALCO Elections Governance Committee	Rick Fant	rickfant@gmail.com	Invited to 12/04/2024 meeting.
OPALCO Elections Governance Committee	Rob Thesman	robthesman@gmail.com	Invited to 12/04/2024 meeting.
Orcas Island Chamber	Carey Eskridge	carey@orcasislandchamber.com	Invited to 12/04/2024 meeting.
Orcas Island Community Foundation	Lindsay Jennings	lindsay@oicf.us	Attended 12/04/2024 meeting.
Orcas Island Community Foundation	Angela and Jeremy Foster	mima1@me.com	Invited to 12/04/2024 meeting.



Organization	Name	Contact Information	Contact Tracking
Orcas Island Port	Chip Long	manager@portoforcas.com	Invited to 12/04/2024 meeting.
Salish Current	Toby Cooper	salishcurrent@gmail.com	Attended Town Hall 1/22/2025 meeting.
San Juan Chamber	Becki Day	becki@sanjuanisland.org	Invited to 12/04/2024 meeting.
San Juan Community Foundation	Amy Saxe	amy@sjicf.org	Invited to 12/04/2024 meeting.
San Juan County Communications	Erin Andrews	erina@sanjuancountywa.gov	Invited to 12/04/2024 meeting.
San Juan County Council	Kari McVeigh	karim@sanjuancountywa.gov	Invited to 12/04/2024 meeting.
San Juan County Council	Justin Paulsen	justinp@sanjuancountywa.gov	Attended 12/04/2024 meeting.
San Juan County Council	Jane Fuller	janef@sanjuancountywa.gov	Invited to 12/04/2024 meeting.
San Juan County Manager	Jessica Hudson	Jessicah@sanjuancountywa.gov	Invited to 12/04/2024 meeting.
San Juan County Sheriff	Eric Peter	ericp@sanjuanco.com	Invited to 12/04/2024 meeting.
San Juan Family Resource Center	Jennifer Armstrong	jennifera@jlsfrc.org	Invited to 12/04/2024 meeting.
San Juan Land Bank	Lincoln Borman	sjclandbank@sjclandbank.org	Invited to 12/04/2024 meeting.
San Juan Preservation Trust	Angela Anderson	info@sjpt.org	Invited to 12/04/2024 meeting.



Organization	Name	Contact Information	Contact Tracking
Town of Friday Harbor	Ray Jackson	rayj@fridayharbor.org	Invited to 12/04/2024 meeting.
San Juan Island Environmental Organizations / Businesses / Elected Officials			
Friends of San Juans	Eva Schulte	eva@sanjuans.org	Briefed on 12/02/2024.
Friends of San Juans	James McCubbin	James@sanjuans.org	Briefed on 12/02/2024.
Marine Resources Committee San Juan County	Kendra Smith	kendras@sanjuancountywa.gov	Briefed on 11/18/2024.
Marine Resource Committee San Juan County	Sam Whitridge	samw@sanjuancountywa.gov	Briefed 1/9/2024.
San Juan Conservation District	Paul Andersson	paul@sjicd.org	Attended 12/04/2024 meeting.
SeaDoc	Joe Gaydos	jkgaydos@gmail.com	Briefed on 11/18/2024.
UW Labs – Friday Harbor	Diana Pieples	dpieples@uw.edu	Invited to 12/04/2024 meeting.
Whale Museum	Jennifer Smith	info@whalemuseum.org	Invited to 12/04/2024 meeting.
Regional Environmental Organizations and Related Businesses			
Orca Conservancy	Shari Tarantino Ryan Ono	shari@orcaconservancy.org	Attended Town Hall 1/21/2024.
Orca Network	Susan Berta	https://www.orcanetwork.org/	Emailed 2/14/2025.
BPA	John Hairston	mmjackson@bpa.gov	Emailed Melanie 2/13/25.
City of Anacortes	Emily Schuh	emilys@anacorteswa.gov	Emailed 2/14/25.
NWPPA	Connie Philibert	connie@nwppa.org	Emailed 2/13/25.



Organization	Name	Contact Information	Contact Tracking
Port of Anacortes	Brett Greenwood	brett.greenwood@portofanacortes.co	Emailed 2/14/2025.
Port of Bellingham	Rob F	RobF@portofbellingham.com	Emailed 2/14/2025.
PNGC	Andrew Barter	abarter@pngcpower.com	Emailed 2/14/2025.
Washington State Ferries	Steve Nevey	206-464-6400	Messaged through website 2/14/2025.
WRECA	To be determined	To be determined	Will be contacted when new Executive Director hire is confirmed.
Regional Elected Officials			
State Representative	Alex Ramel	alex.ramel@leg.wa.gov	Emailed 2/13/2025.
WA State Governor	Bob Ferguson	360-902-4111	Messaged through website 2/13/2025.
State Representative	Debra Lekanoff	debra.lekanoff@leg.wa.gov	Emailed 2/13/2025.
State Senate	Liz Lovelett	liz.lovelett@leg.wa.gov	Emailed 2/13/2025.
US Senator	Maria Cantwell	maria@cantwell.senate.gov	Emailed 2/13/2025.
US Senator	Patty Murray	patty@murray.senate.gov	Emailed 2/13/2025.
US Representative	Rick Larsen	lauren.gros@mail.house.gov	Emailed 2/13/2025.
Notes: BPA = Bonneville Power Administration; NWPPA = Northwest Public Power Association; OPALCO = Orcas Power & Light Cooperative; PNGC = Pacific Northwest Generating Cooperative; UW = University of Washington; WRECA = Washington Rural Electric Cooperative Association.			



3. Tribal Engagement Record

Table 3. Summary of Tribal Engagement Activities

Tribal Nation	Date	Summary of Tribal Engagement Activities	Outreach Type
Confederated Tribes of the Umatilla			
Confederated Tribes of the Umatilla	26-Sep-24	Letter to Tribal chairperson discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Mailed letter
Confederated Tribes of the Umatilla	27-Sep-24	Email to Tribal chairperson discussing plans to explore tidal energy through a pilot Project, requesting a meeting to introduce the concept and technology, and providing additional context and documentation for review.	Email
Confederated Tribes of the Umatilla	27-Sep-24	Email to department technical staff discussing plans to explore tidal energy through a pilot Project, requesting a meeting to introduce the concept and technology, and providing additional context and documentation for review.	Email
Jamestown S'Klallam Tribe			
Jamestown S'Klallam Tribe	26-Sep-24	Letter to Tribal chairperson discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Mailed letter
Jamestown S'Klallam Tribe	27-Sep-24	Email to Tribal chairperson discussing plans to explore tidal energy through a pilot Project, requesting a meeting to introduce the concept and technology, and providing additional context and documentation for review.	Email
Jamestown S'Klallam Tribe	27-Sep-24	Email to department technical staff discussing plans to explore tidal energy through a pilot Project, requesting a meeting to introduce the concept and technology, and providing additional context and documentation for review.	Email
Lummi Nation			
Lummi Nation	17-Jul-22	Letter to Tribal chairperson discussing plans to explore tidal energy turbines in Rosario Strait, requesting a meeting to introduce the concept and technology, and providing additional context and documentation for review.	Mailed letter
Lummi Nation	26-Aug-22	Email to department technical staff discussing plans to explore tidal energy turbines in Rosario Strait, requesting a meeting to introduce the concept and technology, and providing additional context and documentation for review.	Email
Lummi Nation	7-Sep-22	Emails exchanged with department technical staff offering to meet in person or virtually to introduce the Project, suggesting specific dates for both options, and asking for a preference to finalize the arrangements.	Email
Lummi Nation	23-Sep-22	Meeting with department technical staff to introduce the Project, concept and technology, and provide additional context and documentation for review.	Meeting
Lummi Nation	5-Oct-22	Email request to department technical staff to schedule meeting.	Email
Lummi Nation	19-Mar-24	Email to department technical staff providing an update on OPALCO's tidal energy feasibility study, announcing Phase 1 funding from the U.S. Department of Energy, and requesting a meeting to discuss Phase 1 plans, new information, and preferred engagement methods.	Email



Tribal Nation	Date	Summary of Tribal Engagement Activities	Outreach Type
Lummi Nation	29-Apr-24	Meeting with department technical staff to provide an update on OPALCO's tidal energy feasibility study, announcing Phase 1 funding from the U.S. Department of Energy, and requesting a meeting to discuss Phase 1 plans, new information, and preferred engagement methods.	Meeting
Lummi Nation	1-May-24	Email to department technical staff thanking them for their time and questions, and providing more details about the Orbital Marine technology and website.	Email
Lummi Nation	9-Jul-24	Email to department technical staff about the draft timeline for the Phase 1 tidal energy grant process, the need to file a preliminary application with FERC, and requesting a meeting in August to discuss the timeline, key milestones, and the intersection of the Department of Energy and FERC processes.	Email
Lummi Nation	28-Aug-24	Email to department technical about scheduling a meeting to discuss OPALCO's Phase 1 tidal energy grant process and FERC aspects, as well as sharing a timeline and milestones.	Email
Lummi Nation	27-Sep-24	Email to department technical staff about scheduling a meeting to discuss the Department of Energy grant and its intersection with the FERC process, informing about OPALCO's preliminary permit application for the Rosario Strait Tidal Energy Project, and providing additional context and access to the application document online.	Email
Lummi Nation	3-Oct-24	Email to department technical staff requesting availability to schedule a meeting to discuss the Phase 1 timeline, FERC submittals, the intersection with the Department of Energy process, and how to obtain feedback.	Email
Lummi Nation	7-Nov-24	Email to department technical staff with additional information about OPALCO's tidal energy Project, including a PowerPoint presentation and timeline, explaining key processes associated with the FERC Pilot license and Department of Energy grant, and requesting feedback and a meeting in early December to discuss further details and updates.	Email
Muckleshoot Indian Tribe			
Muckleshoot Indian Tribe	5-Dec-24	Letter to Tribal chairperson discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Mailed letter
Muckleshoot Indian Tribe	11-Dec-24	Email to department technical staff discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Email
Nooksack Indian Tribe			
Nooksack Indian Tribe	5-Dec-24	Letter to Tribal chairperson discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Mailed letter
Nooksack Indian Tribe	11-Dec-24	Email to department technical staff discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Email
Port Gamble S'Klallam Tribe			
Port Gamble S'Klallam Tribe	17-Dec-24	Letter to Tribal chairperson discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Mailed letter



Tribal Nation	Date	Summary of Tribal Engagement Activities	Outreach Type
Port Gamble S'Klallam Tribe	19-Dec-24	Email to department technical staff discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Email
Samish Indian Nation			
Samish Indian Nation	21-Jul-22	Letter to Tribal chairperson discussing plans to explore tidal energy turbines in Rosario Strait, requesting a meeting to introduce the concept and technology, and providing additional context and documentation for review.	Mailed letter
Samish Indian Nation	26-Aug-22	Email to department technical staff discussing plans to explore tidal energy turbines in Rosario Strait, requesting a meeting to introduce the concept and technology, and providing additional context and documentation for review.	Email
Samish Indian Nation	13-Oct-22	Email to department technical staff following up on a previous email, sharing new figures of the proposed tidal turbine location, and requesting a meeting to introduce the Project and seek initial feedback.	Email
Samish Indian Nation	26-Oct-22	Response from department technical staff sharing availability for a meeting to discuss the Project.	Email
Samish Indian Nation	29-Nov-22	Meeting with department technical staff to introduce the Project, concept and technology, and provide additional context and documentation for review.	Meeting
Samish Indian Nation	20-Mar-24	Email to Tribal Councilmember and department technical staff providing an update on OPALCO's tidal energy feasibility study, announcing Phase 1 funding from the U.S. Department of Energy, and requesting a meeting to discuss Phase 1 plans, new information, and preferred engagement methods.	Email
Samish Indian Nation	1-Apr-24	Email response from department technical staff that Samish Tribal Council is developing a position statement on tidal energy in their traditional territory and will schedule a virtual meeting once ready to discuss their thoughts and concerns.	Email
Samish Indian Nation	9-Jul-24	Email to department technical staff that OPALCO is preparing to kick off Phase 1 of the Department of Energy grant, needs to file a preliminary application with FERC, and is requesting a meeting to discuss the Phase 1 timeline, the intersection with FERC's process, and key milestones for feedback.	Email
Samish Indian Nation	9-Jul-24	Email from department technical staff expressing interest in the timeline and impact analysis process for the U.S. Department of Energy grant, requesting to schedule a meeting, and suggesting the inclusion of Samish Council Member in the discussions.	Email
Samish Indian Nation	10-Jul-24	Follow-up voicemail to department technical staff regarding scheduling a meeting.	Phone call
Samish Indian Nation	4-Sep-24	Meeting with department technical staff to provide an update on OPALCO's tidal energy feasibility study, announcing Phase 1 funding from the U.S. Department of Energy, and requesting a meeting to discuss Phase 1 plans, new information, and preferred engagement methods.	Meeting
Samish Indian Nation	4-Sep-24	Email to department technical staff with a PowerPoint presentation, more detailed timeline, and commitment to follow up with Project description and schematic drawing.	Email



Tribal Nation	Date	Summary of Tribal Engagement Activities	Outreach Type
Samish Indian Nation	27-Sep-24	Email to Tribal Council member and department technical staff with an update that OPALCO filed the preliminary permit application with FERC, and hard copies were mailed to the Tribal office and can be reviewed online.	Email
Samish Indian Nation	21-Oct-24	Meeting with department technical staff to discuss the Project description and Project updates.	Meeting
Samish Indian Nation	12-Nov-24	Email from department technical staff to discuss the potential for a kelp pilot restoration site near the proposed tidal energy Project.	Email
Samish Indian Nation	9-Jan-25	Meeting with department technical staff to discuss the potential for a kelp pilot restoration site near the proposed tidal energy Project.	Meeting
Sauk-Suiattle Indian Tribe			
Sauk-Suiattle Indian Tribe	5-Dec-24	Letter to Tribal chairperson discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Mailed letter
Sauk-Suiattle Indian Tribe	11-Dec-24	Email to department technical staff discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Email
Skokomish Tribe			
Skokomish Tribe	5-Dec-24	Letter to Tribal chairperson discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Mailed letter
Skokomish Tribe	11-Dec-24	Email to department technical staff discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Email
Snoqualmie Indian Tribe			
Snoqualmie Indian Tribe	5-Dec-24	Letter to Tribal chairperson discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Mailed letter
Snoqualmie Indian Tribe	11-Dec-24	Email to department technical staff discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Email
Stillaguamish Tribe of Indians			
Stillaguamish Tribe of Indians	5-Dec-24	Letter to Tribal chairperson discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Mailed letter
Stillaguamish Tribe of Indians	11-Dec-24	Email to department technical staff discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Email
Suquamish Tribe			
Suquamish Tribe	21-Jul-22	Letter to Tribal chairperson discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Mailed letter
Suquamish Tribe	26-Aug-22	Email to department technical staff discussing plans to explore tidal energy turbines in Rosario Strait, requesting a meeting to introduce the concept and technology, and providing additional context and documentation for review.	Email



Tribal Nation	Date	Summary of Tribal Engagement Activities	Outreach Type
Suquamish Tribe	13-Oct-22	Email to department technical staff following up on a previous email, sharing new figures of the proposed tidal turbine location, and requesting a meeting to introduce the Project and seek initial feedback.	Email
Suquamish Tribe	26-Apr-24	Email response from department technical staff with interest in scheduling a briefing.	Email
Suquamish Tribe	29-May-24	Meeting with department technical staff to provide an update on OPALCO's tidal energy feasibility study, announcing Phase 1 funding from the U.S. Department of Energy, and requesting a meeting to discuss Phase 1 plans, new information, and preferred engagement methods.	Meeting
Suquamish Tribe	4-Jun-24	Email from USACE on behalf of department technical staff with request regarding permit conditions for surface marker buoy related to initial Phase 1 feasibility studies.	Email
Suquamish Tribe	9-Jul-24	Email to department technical staff discussing the draft timeline for the Phase 1 tidal energy grant process, proposing a preliminary application filing with FERC, and suggesting an August meeting to review the timeline and key milestones.	Email
Suquamish Tribe	16-Jul-24	Email to department technical staff coordinating on availability to schedule a Project briefing.	Email
Suquamish Tribe	28-Aug-24	Meeting with technical staff to provide a detailed update on the U.S. Department of Energy funding and intersection with FERC process and next steps; and to understand how best to engage at specific milestones over the next 12 months.	Meeting
Suquamish Tribe	28-Aug-24	Email to department technical staff with a PowerPoint presentation, more detailed timeline, and commitment to follow up with Project description and schematic drawing.	Email
Suquamish Tribe	27-Sep-24	Email to Tribal Council member and department technical staff with an update that OPALCO filed the preliminary permit application with FERC, and hard copies were mailed to the Tribal office and can be reviewed online.	Email
Suquamish Tribe	3-Oct-24	Email to department technical staff with the Project description for review.	Email
Suquamish Tribe	28-Oct-24	Email to department technical staff with a reminder about the Project description for review.	Email
Suquamish Tribe	29-Oct-24	Meeting with department technical staff to discuss the Project description and Project updates.	Meeting
Suquamish Tribe	4-Dec-24	Meeting with department technical staff to discuss the Tribal Fish Committee feedback.	Meeting
Suquamish Tribe	18-Feb-25	Email to department technical staff offering a meeting to discuss an update on the FERC DLA process and timing for FERC consultation, and requesting any new information from the Fish Committee.	Email
Suquamish Tribe	19-Feb-25	Email response from department technical staff reiterating previously shared feedback from the Fish Committee and proposing a meeting at the end of March.	Email
Swinomish Indian Tribal Community			
Swinomish Indian Tribal Community	21-Jul-22	Letter to Tribal chairperson discussing plans to explore tidal energy turbines in Rosario Strait, requesting a meeting to introduce the concept and technology, and providing additional context and documentation for review.	Mailed letter



Tribal Nation	Date	Summary of Tribal Engagement Activities	Outreach Type
Swinomish Indian Tribal Community	26-Aug-22	Email to department technical staff discussing plans to explore tidal energy turbines in Rosario Strait, requesting a meeting to introduce the concept and technology, and providing additional context and documentation for review.	Email
Swinomish Indian Tribal Community	29-Aug-22	Response from department technical staff sharing availability for a meeting to discuss the Project.	Email
Swinomish Indian Tribal Community	9-Sep-22	Meeting with department technical staff to introduce the Project, concept and technology, and provide additional context and documentation for review.	Meeting
Swinomish Indian Tribal Community	18-Sep-22	Email from department technical staff requesting map of siting location, providing feedback on PNNL document, and sharing names of environmental organizations.	Email
Swinomish Indian Tribal Community	22-Sep-22	Email to department technical staff with draft location map with the tidal facility's estimated size and scale, update that the team is working on a more detailed map, expressing appreciation for feedback on the PNNL document.	Email
Swinomish Indian Tribal Community	10-Oct-22	Email response from department technical staff requesting a more detailed map of the tidal turbine's scale at the proposed location, inquiring about grant details and next steps, and asking about plans for a broader community conversation, with a potential meeting with the Swinomish Senate.	Email
Swinomish Indian Tribal Community	10-Oct-22	Email to department technical staff committing to checking with the team on a response to questions and a more detailed map.	Email
Swinomish Indian Tribal Community	14-Nov-22	Email with department technical staff providing figures with more detail; clarification of deliverables under the grant; an update that the team is engaging with regional Tribes for early feasibility discussions before broader community engagement; and that the team is gathering additional figures and images for a follow-up conversation. Another call was suggested to discuss further.	Email
Swinomish Indian Tribal Community	23-Jan-23	Email from department technical staff introducing additional staff to coordinate with moving forward.	Email
Swinomish Indian Tribal Community	23-Jan-23	Email to department technical staff with an update on feasibility studies and early outreach/engagement efforts.	Email
Swinomish Indian Tribal Community	30-Jan-23	Email from department technical staff suggesting availability for a time to connect.	Email
Swinomish Indian Tribal Community	31-Jan-23	Email to department technical staff coordinating on availability to schedule a Project briefing.	Email
Swinomish Indian Tribal Community	14-Feb-23	Email from department technical staff proposing to reschedule briefings.	Email
Swinomish Indian Tribal Community	15-Feb-25	Email to department technical staff coordinating on availability to schedule a Project briefing.	Email
Swinomish Indian Tribal Community	6-Mar-23	Meeting with department technical staff to introduce the Project, concept and technology, and provide additional context and documentation for review.	Meeting
Swinomish Indian Tribal Community	9-Mar-23	Email to department technical staff sharing registration link for Tidal Workshop.	Email



Tribal Nation	Date	Summary of Tribal Engagement Activities	Outreach Type
Swinomish Indian Tribal Community	19-Mar-24	Email to department technical staff with an update on OPALCO's tidal energy feasibility study, announcing Phase 1 funding from the U.S. Department of Energy, and requesting a meeting to discuss Phase 1 plans, new information, and preferred engagement methods.	Email
Swinomish Indian Tribal Community	19-Mar-24	Email response from department technical staff expressing interest in an update on the feasibility study.	Email
Swinomish Indian Tribal Community	4-Apr-24	Meeting with department technical staff to provide a detailed update on the U.S. Department of Energy funding and next steps and to understand how best to engage moving forward.	Meeting
Swinomish Indian Tribal Community	9-Jul-24	Email to department technical staff with a Project update and requesting a meeting to review the timeline, propose milestones, and explain the process in more detail.	Email
Swinomish Indian Tribal Community	8-Aug-24	Meeting with department technical staff to provide a detailed update on the U.S. Department of Energy funding and intersection with FERC process and next steps; and to understand how best to engage at specific milestones over the next 12 months.	Meeting
Swinomish Indian Tribal Community	27-Sep-24	Email to Tribal Council member and department technical staff with an update that OPALCO filed the preliminary permit application with FERC, and hard copies were mailed to the Tribal office and can be reviewed online.	Email
Swinomish Indian Tribe	3-Oct-24	Email to department technical staff sharing the detailed Project description for review.	Email
Swinomish Indian Tribal Community	29-Oct-24	Email from department technical staff with Tribal Community's comments on the preliminary permit application.	Email
Swinomish Indian Tribal Community	30-Oct-24	Email to department technical staff thanking them for their feedback, suggesting another meeting to seek feedback on the Project description, provide an update on feasibility studies, and confirming preference for who to engage with.	Email
Swinomish Indian Tribal Community	6-Nov-24	Email to department technical staff to schedule a meeting and sharing previously distributed materials.	Email
Swinomish Indian Tribal Community	13-Dec-24	Email to department technical staff with a letter responding to comments provided on the preliminary permit application, expressing appreciation for the thoughtful review and detailed comments, and suggesting a meeting.	Email
Swinomish Indian Tribal Community	18-Feb-25	Email to department technical staff suggesting a meeting to discuss how best to engage moving forward and to provide an update on the proposed Project.	Email
Tulalip Tribes			
Tulalip Tribes	21-Jul-22	Letter to Tribal chairperson discussing plans to explore tidal energy turbines in Rosario Strait, requesting a meeting to introduce the concept and technology, and providing additional context and documentation for review.	Mailed letter
Tulalip Tribes	26-Aug-22	Email from OPALCO to department technical staff discussing plans to explore tidal energy turbines in Rosario Strait, requesting a meeting to introduce the concept and technology, and providing additional context and documentation for review.	Email



Tribal Nation	Date	Summary of Tribal Engagement Activities	Outreach Type
Tulalip Tribes	13-Oct-22	Email to department technical staff following up on a previous email, sharing new figures of the proposed tidal turbine location, and requesting a meeting to introduce the Project and seek initial feedback.	Email
Tulalip Tribes	25-May-23	Email to department technical staff about scheduling a meeting to discuss the proposed tidal energy Project, introduce the concept and technology, provide an overview of tidal energy potential in the San Juan Islands, and review PNNL's feasibility studies.	Email
Tulalip Tribes	26-May-23	Email to department technical staff to coordinate scheduling a Project briefing.	Email
Tulalip Tribes	15-Jun-23	Email to department technical staff to share background materials ahead of briefing.	Email
Tulalip Tribes	16-Jun-23	Meeting with department technical staff to introduce the Project, concept and technology, and provide additional context and documentation for review.	Meeting
Tulalip Tribes	19-Mar-24	Email to department technical staff expressing appreciation for collaboration on the tidal energy feasibility study, and proposing a meeting to discuss Phase 1 plans, new information, and preferred communication methods.	Email
Tulalip Tribes	9-Jul-24	Email to department technical staff about kicking off Phase 1 of the proposed Project, filing preliminary documentation with FERC, and scheduling an August meeting to discuss the timeline and milestones.	Email
Tulalip Tribes	25-Jul-24	Email to department technical staff requesting availability to schedule a meeting to discuss the proposed Project.	Email
Tulalip Tribes	5-Sep-24	Meeting with department technical staff to provide a detailed update on the U.S. Department of Energy funding and intersection with FERC process and next steps; and to understand how best to engage at specific milestones over the next 12 months.	Meeting
Tulalip Tribes	6-Sep-24	Email to department technical staff with a PowerPoint presentation, more detailed timeline, and commitment to follow up with Project description and schematic drawing.	Email
Tulalip Tribes	27-Sep-24	Email to Tribal Council member and department technical staff with an update that OPALCO filed the preliminary permit application with FERC, and hard copies were mailed to the Tribal office and can be reviewed online.	Email
Tulalip Tribes	3-Oct-24	Email to department technical staff with detailed Project description for their review.	Email
Upper Skagit Tribe			
Upper Skagit Tribe	5-Dec-24	Letter from OPALCO to Tribal chairperson discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Mailed letter
Upper Skagit Tribe	11-Dec-24	Email from OPALCO to department technical staff discussing plans to explore tidal energy, including a feasibility study and a pilot Project, and requesting a meeting to discuss the Project.	Email
Notes: DLA = Draft License Application; FERC = Federal Energy Regulatory Commission; OPALCO = Orcas Power & Light Cooperative; PNNL = Pacific Northwest National Laboratory; USACE = U.S. Army Corps of Engineers.			

**Table 4.** Summary of Feedback Received from Tribal Nations

Tribe	Issue/Concern	Date Received
Early Activities		
Samish Indian Nation	Tribe would like to see the data and reports included in TEAMER Report that assessed the marine mammal frequency, particularly orca whale presence and abundance. Noted that the Tribe regularly sees orca whales at this location and that scientific observations in the TEAMER Report are from whale watching boats/scientists who primarily study the west of San Juan Island.	11/29/2022
Suquamish Tribe	Tribal fish committee meeting will be in November 2024.	10/29/2024
Swinomish Indian Tribal Community	Buoys used during the site characterization study (conducted at the proposed Project area in Fall 2024) need as much visual identification as possible to minimize effects to Tribal fishing. Fishers should be aware of buoys and scientific instruments. Confirmed that the Tribe's fish commission was engaged and provided feedback on the Nationwide Permit application.	8/8/2024
Swinomish Indian Tribal Community	Requests that OPALCO engage directly with Swinomish Tribal Historic Preservation Officer (THPO) since that is not being coordinated by Environmental Policy team.	8/8/2024
Swinomish Indian Tribal Community	Inquired if the site characterization will include passive acoustics.	8/8/2024
Swinomish Indian Tribal Community	Inquired if the Exhibit E - Environmental Report document is as rigorous as an Environmental Impact Statement and if there is a separate comment period for the Tribal Nations on the DLA.	8/8/2024
Swinomish Indian Tribal Community	Requested 30 days or more for the Tribe to review the Project description and conceptual design schematic. The Tribe's fish commission does not meet on a regular schedule, and the next step is to share these materials with commission to get input on whether it should be elevated to the Tribal Senate.	8/8/2024
Tulalip Tribes	Inquired if early studies identified locations where salmon, orca whales, and gray whales were less abundant.	9/05/2024
Tulalip Tribes	Provided information on small hydrokinetic project near Vancouver Island that might have useful data for this Project.	9/05/2024
Tulalip Tribes	Noted that studies and research have been done in the San Juan Islands on kelp locations and juvenile salmon use along shorelines. Inquired if the tag receiver on the site characterization buoy will pick up all tags. Noted it would be important to find out migratory routes of salmon in the vicinity of the deployment location.	9/05/2024



Tribe	Issue/Concern	Date Received
Tulalip Tribes	Critically important that other Tribes are contacted frequently. Suggested contacting Tribes that are involved when the OPALCO team is approaching milestones.	9/05/2024
Construction		
Lummi Nation	Inquired if any upland work would be needed to connect to the OPALCO system.	9/22/2022
Tulalip Tribes	Documentation in future applications and studies need to include how installation from intertidal area to device will affect boat access.	6/16/2023
Construction & Operations		
Suquamish Tribe	Inquired about construction, installation, and length of subsea cable. Impacts from subsea cable expected. Discussed diameter of subsea cable.	5/29/2024
Suquamish Tribe	The Tribe needs to understand entire physical footprint of the Project including any potential exclusion zones. This includes temporary zones needed by construction barges and safety zones during operations. Requests that this be provided early in the process so impacts can be understood/analyzed.	8/28/2024
Tulalip Tribes	Concern about steelhead smolts that migrate at a shallow depth in the area where a submarine cable will be located.	6/16/2023
Tulalip Tribes	Working to understand how much fishing is done by Tribal fisherman on southeast side of Blakely Island. Noted that the Tribe fishes for all species of salmon in that area. Need to understand if this affects fisherpeople because it is important to the Tribe not to lose fishing access.	6/16/2023
Tulalip Tribes	May be an important forage fish area, and potentially a sand lance spawning area on sand flats in the vicinity where submarine cable could be located.	6/16/2023
Tulalip Tribes	Inquired about data on existing device in the Orkney Islands and information on interactions with gray whales.	9/05/2024
Operations		
Lummi Nation	Requested confirmation that OPALCO was only planning for one device and requested PDFs of technology from Orbital's website. Confirmed that understanding the operation and technology is needed so the Tribe's fisheries committee can be briefed.	4/29/2024
Samish Indian Nation	Inquired about the cumulative effects of noise from a tidal device combined with noise from ships and ferries.	11/29/2022
Samish Indian Nation	The device proposed for this Project is nearly 243 feet in length. By comparison, a Boeing 747 jet is 250 feet long. Each	4/5/2024



Tribe	Issue/Concern	Date Received
	of the two turbines has rotors with a diameter of 65 feet or roughly the length of two school buses turning in the water. This represents large, on-water footprints in areas that are frequented by commercial, recreational, and Tribal vessels.	
Samish Indian Nation	In the San Juans, areas of high tidal influence are also areas where kelp forests occur. Kelp forests are both ecological and cultural keystone habitats that are experiencing alarming declines in the Salish Sea. We need to be shown that placement of these generators will not adversely affect current kelp areas and areas where kelp may be restored.	4/5/2024
Samish Indian Nation	Samish THPO also has concerns regarding the disturbance of cultural resources and sacred sites in the vicinity of this Project. These concerns will need to be addressed, preferably before Section 106 consultation is triggered by the permit application process.	4/5/2024
Samish Indian Nation	The waters of Rosario Strait where the pilot Project is proposed to be located is an area where numerous whale species such as gray, minke, and humpbacks regularly transit during their journeys north and south. In addition, the area is frequented by Southern Resident orcas, which are already in decline and the salmon they feed on to survive. Yet no studies appear to be underway or completed that show no impact of tidal turbines on their behavior or ability to find food. We are concerned that they will block areas of transit and are concerned that the noise created will be detrimental to these protected and culturally significant species.	4/5/2024
Samish Indian Nation	Concern that the drive for renewable energy has outpaced the best available science, and these projects are being pushed ahead prior to having the pertinent information with regards to environmental impacts.	4/5/2024
Samish Indian Nation	Requested more detail on how the device will be secured in place and types of anchoring being considered.	9/04/2024
Samish Indian Nation	Inquired about difference in tidal device or turbine blades needing to reposition during changes to tidal cycle. Also inquired about footprint of device on water surface compared to the footprint on the seafloor.	11/29/2024
Swinomish Indian Tribal Community	The pre-Project application mentions a single 2.4 MW floating tidal turbine being deployed for up to 10 years under FERC's pilot process. The possibility of scaling the Project to three separate units in the final design was mentioned.	10/29/2024
Swinomish Indian Tribal Community	The deployment of anchors and mooring systems will likely have a significant impact on the benthic environment. The description of anchors includes both gravity and drilled rock anchors.	10/29/2024



Tribe	Issue/Concern	Date Received
Swinomish Indian Tribal Community	The installation of the 3.3-mile-long subsea cable to transmit energy from the tidal unit to the onshore conduit connection site presents another area of concern. Submarine cables can impact the marine environment by disturbing the seabed and sediment transport.	10/29/2024
Swinomish Indian Tribal Community	Section 4.3 of the Project description mentions the use of gravity and rock anchors to stabilize the tidal turbine. The use of gravity anchors, which will be connected to the tidal turbine by steel chain mooring lines, poses additional risks as they are likely to drag along the seafloor during slack tide. The proposed four rock bolt anchors (steel vertical piles) are to be drilled into the seabed, with each proposed anchor measuring 20 feet long by 23 inches in diameter. These anchoring systems raise concerns about potential long-term damage to benthic habitats critical to ESA-listed species, such as Chinook salmon and rockfish, as well as other Tribally important species.	10/29/2024
Tulalip Tribes	Noted that available reports show noise value of device may be low enough not to affect orca whales, but subsea cable noise could be higher and have impact.	6/16/2023
Tulalip Tribes	Inquired if current data show sea lions or seals hauling out on the structure.	6/16/2023
Tulalip Tribes	Concern if salmon with low visibility and orca whales can see the technology. The Tribe will be more open to a project that does not hinder fish and whale migration and has proper monitoring.	6/16/2023
Tulalip Tribes	On-site data will need to be collected to inform their review.	6/16/2023
Tulalip Tribes	Documentation in future applications and studies needs to include the depth the turbines will operate at.	6/16/2023
Tulalip Tribes	Documentation in future applications and studies needs to include how velocities impact cable and how to protect that, what kind of drag it has, etc.	6/16/2023
Tulalip Tribes	Want to see what types of monitoring equipment will be used for the pilot Project, including specific equipment needed to address biological impacts, including physical presence and timing of species.	9/05/2024
Tulalip Tribes	Inquired how fast the technology is advancing and the capacity the turbine is being designed for.	9/05/2024
Maintenance		
Samish Indian Nation	Inquired about schedule and inspections on the anchoring and cables for the device. Concern about adding more anchors/cables as the originals age instead of the removal or replacement of the aging original anchoring equipment because of the depths in this location making it inaccessible to divers to maintain. Shared that the Tribe has spent a	11/29/2022



Tribe	Issue/Concern	Date Received
	tremendous amount of time dealing with a net pen collapse that occurred and is concerned if the tidal turbine breaks loose.	
Samish Indian Nation	Infrastructure in the Salish Sea needs frequent and extensive maintenance to maintain function and safety. We would need to know the expected life span, maintenance schedules, and chemicals/ lubricants used for infrastructure such as this.	4/5/2024
Suquamish Tribe	Inquired about hazardous materials that would be used.	5/29/2024
Tulalip Tribes	Requests a list of chemicals needed for ongoing maintenance.	6/16/2023
General		
Samish Indian Nation	Concerned about displacement of habitat and orca whales.	11/29/2022
Samish Indian Nation	Inquired when deployment could occur and how “short-term deployment” is defined and what happens when it concludes.	9/04/2024
Samish Indian Nation	Samish Nation is in support of green energy, but it cannot be at the expense of culturally significant resources.	9/04/2024
Samish Indian Nation	Provided preliminary bull kelp location data.	10/17/2024
Suquamish Tribe	Not all effects on U&A treaty fishing rights can be mitigated.	8/28/2024
Suquamish Tribe	Effects to U&A treaty fishing rights are independent of the type of structure; the structure itself creates an impact.	10/29/2024
Suquamish Tribe	Initial feedback from the Suquamish Tribal Fish Committee includes concerns about the device affecting the Tribal treaty U&A rights; the Tribe is coordinating internally and planning to provide additional information on types of fishing and methods in Q1 of 2025.	12/4/2024
Swinomish Indian Tribal Community	Not all effects on U&A treaty fishing rights can be mitigated.	9/9/2022
Swinomish Indian Tribal Community	The Tribe is particularly concerned about the potential disruption to Tribal fishing rights in the Salish Sea. The Rosario Strait area is not only culturally significant but also home to important ESA-listed salmon populations that have sustained the Tribe’s cultural lifeways since time immemorial.	10/29/2024
Swinomish Indian Tribal Community	The deficiency letter from FERC highlighted the need to engage with additional Tribal Nations potentially impacted by the Project.	10/29/2024



Tribe	Issue/Concern	Date Received
Swinomish Indian Tribal Community	Page 11 of the preliminary application indicates that the annual energy production is estimated at 5.7 GWh, representing only 2.4 percent of OPALCO’s total energy needs. Given that this is a relatively small percentage of power output for such a significant undertaking, the Tribe questions whether the potential effects on treaty resources, the environment, and the overall cost of the Project justify the trade-offs.	10/29/2024
Swinomish Indian Tribal Community	We are interested in understanding OPALCO’s ultimate goal with the Project. While the initial pilot Project will focus on one turbine, the discussion of possibly expanding to three units raises concerns about the scalability and potential for greater environmental impact.	10/29/2024
Swinomish Indian Tribal Community	Marine mammals on the federal ESA list, including the endangered Southern Resident killer whale and the threatened humpback whale, frequent the waters around the Project area. These and other marine mammal species are highly vulnerable to both acoustic disturbances and habitat degradation.	10/29/2024
Swinomish Indian Tribal Community	It is unclear what specific plans are in place to mitigate the environmental impacts of this Project.	10/29/2024
<p>Notes: DLA = Draft License Application; ESA = Endangered Species Act; FERC = Federal Energy Regulatory Commission; GWh = Gigawatt hours; OPALCO = Orcas Power & Light Cooperative; TEAMER = Testing Expertise and Access for Marine Energy Research; THPO = Tribal Historic Preservation Officer; U&A = Usual and Accustomed.</p>		

Monitoring and Safeguard Plans

Appendix B

Rosario Strait Tidal Energy Project

San Juan Islands, Washington

FERC Project No. 15368



Federal Energy Regulatory Commission



Orcas Power & Light Cooperative (OPALCO)

183 Mount Baker Road

Eastsound, Washington 98245

26 March 2025



This appendix presents seven sub-appendices, each outlining a specific Monitoring and Safeguard Plan. Together, these plans provide a framework for ensuring compliance, mitigating risks, and maintaining operational standards. These draft plans will be finalized in consultation with the relevant agencies, Tribal Nations, and stakeholders.

Appendix:

- B1 - Fish and Wildlife Monitoring Plan**
- B2 - Project and Facility Operations Monitoring Plan**
- B3 - Adaptive Management Plan**
- B4 - Project Removal, Site Restoration and Financial Assurance Plan**
- B5 - Project and Public Safety Plan**
- B6 - Navigation Safety Plan**
- B7 - Emergency Shutdown Plan**

Fish and Wildlife Monitoring Plan

Appendix B1

Rosario Strait Tidal Energy Project

San Juan Islands, Washington

FERC Project No. 15368



Federal Energy Regulatory Commission



Orcas Power & Light Cooperative (OPALCO)

183 Mount Baker Road

Eastsound, Washington 98245

26 March 2025

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ACRONYMS AND ABBREVIATIONS

Annual Report	Annual Operations and Monitoring Report
Committee	Adaptive Management Committee
DLA	Draft License Application
DNR	Washington Department of Natural Resources
DPS	Distinct Population Segment
Eagle Act	Bald and Golden Eagle Protection Act of 1940
Ecology	Washington State Department of Ecology
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
FERC	Federal Energy Regulatory Commission
MBTA	Migratory Birds Treaty Act of 1918
MMPA	Marine Mammal Protection Act of 1972
NMFS	NOAA’s National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWI	National Wetlands Inventory
OPALCO	Orcas Power & Light Cooperative
Orbital O2-X	Orbital Marine O2-X Floating Tidal Device
PHS	Priority Habitats and Species
Project	Rosario Strait Tidal Energy Project
SRKW	Southern Resident Killer Whale
USFWS	United States Fish and Wildlife Service
UWAPL	University of Washington Applied Physics Laboratory
WDFW	Washington Department of Fish and Wildlife



1 Introduction

This Draft Fish and Wildlife Monitoring Plan outlines the monitoring efforts that Orcas Power & Light Cooperative (OPALCO) would undertake for the proposed Rosario Strait Tidal Energy Project (Project). This plan is designed to monitor the potential effects of the Project on local fish and wildlife populations and habitats during its installation, operation, and removal. It would be reviewed by relevant federal, state, and local agencies, as well as Tribal Nations, and filed for approval by the Federal Energy Regulatory Commission (FERC) at least 90 days prior to on-site construction or installation activities begin.

Agencies to be consulted include, but are not limited to, the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), Washington Department of Natural Resources (DNR), Washington Department of Fish and Wildlife (WDFW), and Washington State Department of Ecology (Ecology). Tribal Nations in the region will also continue to be consulted with, including the Lummi Nation, Samish Indian Nation, Suquamish Tribe, Swinomish Indian Tribal Community, and Tulalip Tribes, for which engagement and coordination has been ongoing since early 2022.

This monitoring plan focuses on species protected under the Endangered Species Act (ESA), Migratory Birds Treaty Act of 1918 (MBTA), Bald and Golden Eagle Protection Act of 1940 (Eagle Act), Marine Mammal Protection Act of 1972 (MMPA), Washington State Priority Habitats and Species (PHS), as well as other fish, seabird, and invasive species.

2 Methodology and Objectives

Specific monitoring objectives will be identified in consultation with regulatory agencies and Tribal Nations. Consultations may include reviewing fish and wildlife data, making necessary adjustments to monitoring methods based on annual data results (i.e., adaptive management), and developing and implementing mitigation measures to limit any impacts on species.

Monitoring as part of this proposed Project would be focused on: (1) acoustic monitoring, (2) benthic habitat monitoring, and (3) the monitoring of mooring lines, anchors, and the subsea umbilical for potential entanglement of derelict gear.

For each monitoring focus (discussed below), the following would be determined:

- (1) Baseline environmental conditions analysis.
- (2) Monitoring objectives and implementation strategies.
- (3) Analysis of monitoring results.
- (4) Mitigation responses.
- (5) An implementation schedule.
- (6) Performance metrics and success criteria.

2.1 Acoustic Monitoring

Acoustic monitoring is intended to collect data about underwater and aerial noise disturbance associated with the Project. Noise generation is expected during the following Project activities:

- Vessel presence during Project installation, operation, maintenance, and removal.
- Powertrain energy conversion during operation and maintenance.
- Rock-drilled anchor installation and removal (if this anchor option is selected).

Hydrophones will be mounted on the Orbital Marine O2-X floating tidal device (O2-X) for regular monitoring of noise generated by the device during operation.



Physical oceanographic baseline data, including baseline acoustic data, was collected by the Applied Physics Laboratory of the University of Washington Applied Physics Lab (UWAPL) from October 2024 through December 2024 (Appendix C2). Acoustic data would be collected for the duration of the Project in order to assess the noise levels associated with Orbital Marine O2-X Floating Tidal device (Orbital O2-X) operations listed above.

To date, no noise tests have been conducted for the Orbital O2-X device while in operation; however, noise levels are expected to be below the threshold level that could impact local marine species (e.g., harassment or injury) (NMFS 2024a). Acoustic noise thresholds would be developed to assess the extent that noise levels associated with the Project may affect fish and wildlife in the proposed Project area.

2.2 Benthic Habitat Monitoring

Benthic habitat impacts may occur during the following Project activities:

- Installation, operation, and removal of Project components including anchors and scour protection, mooring lines and umbilical cable, and new subsea power cable.

Before deployment and after removal of Project components, seabed surveys would be conducted to monitor changes in the benthic habitat surrounding the anchoring systems of the Orbital O2-X. While in operation, surveys would occur annually to evaluate the short- and long-term impacts of the anchor presence and mooring line sweep areas on the seafloor.

2.3 Derelict Gear Monitoring

If derelict (i.e. lost or discarded) fishing gear became entangled in Project components, marine species could become entangled in it, which can result in injury or death. Derelict gear could become entangled during the following Project activities:

- O2-X in operation (mooring lines, anchors, and subsea cable umbilical in place).

The O2-X would be equipped with onboard and in-water cameras to routinely survey its condition. The information received from these cameras would be regularly reviewed to confirm no debris has snagged on the device.

Once per year (i.e., on an annual basis), drop cameras, or equivalent, would be used to assess the anchoring system (i.e. mooring lines, anchors) and the subsea cable umbilical for entanglement of derelict gear. The likelihood of entanglement is anticipated to be very low. Drop camera footage of the mooring lines would be reviewed to look for evidence of derelict gear entanglement. If an entanglement event occurs, it would be evaluated for risk to protected resources and an appropriate response would be determined.

3 Identified Fish and Wildlife Species

The objective of this monitoring would be to collect data about fish and wildlife species around the O2-X device. Fish and wildlife data would be collected for the duration of the proposed Project, including ESA-listed species (**Table 1**) (NMFS 2024b; USFWS 2024a), avian species (including those under the MBTA and Eagle Act) (**Table 2**) (Larsen 2004; WDFW 2008; USFWS 2010, 2024a, 2024b), Washington PHS (**Table 3**) (WDFW 2008, 2024a), marine mammals from the MMPA (**Table 4**), and invasive species (WDFW 2024b). Four aquatic invasive species have also been identified for opportunistic observation: European green crab (*Carcinus maenas*), zebra mussels (*Dreissena polymorpha*), quagga mussels (*Dreissena bugensis*), and northern pike (*Esox lucius*) (WDFW 2024b).



The lists of species included in this plan are preliminary, determined by a desktop study using publicly available data, and are not intended as the final determination of the Project’s monitoring objectives. These preliminary species lists are not considered exhaustive, and final lists of species identified for monitoring will be determined in consultation with relevant resource managers after submission of this DLA.

Table 1. Threatened and Endangered Species That May Occur in the Proposed Project Area

Common Name (<i>Scientific Name</i>)	ESA Status	Jurisdiction	Critical Habitat in Proposed Project Area
Marine Mammals			
Killer Whale, Southern Resident DPS (<i>Orcinus orca</i>)	Endangered	NMFS	Yes
Humpback Whale, Mexico DPS (<i>Megaptera novaeangliae</i>)	Threatened	NMFS	No
Humpback Whale, Central America DPS (<i>M. novaeangliae</i>)	Endangered	NMFS	No
Fishes			
Bocaccio, Puget Sound-Georgia Basin DPS (<i>Sebastes paucispinis</i>)	Endangered	NMFS	Yes
Yelloweye Rockfish, Puget Sound-Georgia Basin DPS (<i>S. ruberrimus</i>)	Threatened	NMFS	Yes
Chinook Salmon, Puget Sound ESU (<i>Oncorhynchus tshawytscha</i>)	Threatened	NMFS	Yes
Steelhead, Puget Sound DPS (<i>O. mykiss</i>)	Threatened	NMFS	No
Eulachon, Southern DPS (<i>Thaleichthys pacificus</i>)	Threatened	NMFS	No
Green Sturgeon, Southern DPS (<i>Acipenser medirostris</i>)	Threatened	NMFS	No
Bull Trout, Coterminous U.S. Population (Coastal Recovery Unit) (<i>Salvelinus confluentus</i>)	Threatened	USFWS	No
Birds			
Marbled Murrelet (<i>Brachyramphus marmoratus</i>)	Threatened	USFWS	No
Yellow-billed Cuckoo ¹ (<i>Coccyzus americanus</i>)	Threatened	USFWS	No
Northern Spotted Owl ¹ (<i>Strix occidentalis caurina</i>)	Threatened	USFWS	No
Echinoderms			
Sunflower Sea Star (<i>Pycnopodia helianthoides</i>)	Proposed Threatened	NMFS	None Designated
Insects			



Common Name (<i>Scientific Name</i>)	ESA Status	Jurisdiction	Critical Habitat in Proposed Project Area
Monarch Butterfly ¹ (<i>Danaus plexippus</i>)	Proposed Threatened	USFWS	None Designated
<p>Notes: DPS = Distinct Population Segment; ESA = Endangered Species Act; ESU = Ecologically Significant Unit; NMFS = National Marine Fisheries Service; USFWS = U.S. Fish and Wildlife Service</p> <p>1. The species is considered <u>extremely</u> unlikely to occur within the project area, but does appear in agency databases (e.g., USFWS’s Information for Planning and Consultation [IPaC]) (Forsman et al. 2002; Carroll and Johnson 2008; USFWS 2011; Pyle 2015; Wiles and Kalasz 2017; Western Association of Fish and Wildlife Agencies 2019; 79 FR 59992).</p> <p>Source: NMFS 2024b; USFWS 2024a</p>			

Table 2. Avian Species That May Be Present Within the Proposed Project Area

Common Name (<i>Scientific Name</i>)	San Juan Island NWR Common Nesting Species ¹	Located on Blakely Island and/or Offshore Proposed Project area ²	Elevated Probability of Presence (USFWS)	Breeding Season Across Entire Range
Eagles				
Bald Eagle (<i>Haliaeetus leucocephalus</i>)	No	Blakely Island	Resident (year-round)	Mar. 1 to Aug. 31
Golden Eagle (<i>Aquila chrysaetos</i>)	No	Blakely Island	Early- to Mid-Apr.	Mar. 1 to Aug. 31
Migratory and Seabirds				
Ancient Murrelet (<i>Synthliboramphus antiquus</i>)	No	Blakely Island	Mid-Nov. to Early-Jan; Early-May	Mar. 10 to Sept. 10
Black Oystercatcher (<i>Haematopus bachmani</i>)	No	Blakely Island	Resident (year-round)	Apr. 15 to Oct. 31
Black Swift (<i>Cypseloides niger</i>)	No	Blakely Island	Mid-Sept.	June 15 to Sept. 10
Black Turnstone (<i>Arenaria melanocephala</i>)	No	Blakely Island	Early- to Mid-March; End-July to Mid-Apr.	Breeds elsewhere
Brandt’s cormorant (<i>Phalacrocorax penicillatus</i>)	No	Blakely Island	Mid-Oct. to Early-Jan; Early-Mar. through Apr.; Early-July; Mid-Aug. to Mid-Sept.	Apr. 15 to Sept. 15



Common Name (<i>Scientific Name</i>)	San Juan Island NWR Common Nesting Species ¹	Located on Blakely Island and/or Offshore Proposed Project area ²	Elevated Probability of Presence (USFWS)	Breeding Season Across Entire Range
California Gull (<i>Larus californicus</i>)	No	Blakely Island	Mid-July to Mid-Nov.; Early-Mar., Apr, and May	Mar. 1 to July 31
Chestnut-backed Chickadee (<i>Poecile rufescens rufescens</i>)	No	Blakely Island	Resident (year-round)	Mar. 1 to July 31
Common Loon ³ (<i>Gavia immer</i>)	No	Blakely Island, Offshore Proposed Project area	Early Mar. to End-May; Early Oct.	Apr. 15 to Oct. 31
Common Murre (<i>Uria aalge</i>)	No	Blakely Island, Offshore Proposed Project area	End-Oct. to End-Jan.; Early Mar. to End-April; End-July through Sept.	Apr. 15 to Aug 15. ¹
Double-crested Cormorant (<i>Phalacrocorax auritus</i>)	Yes	Blakely Island, Offshore Proposed Project area	Early Mar. to End-Apr; Early-July; Mid-Aug. to Early Jan.	Apr. 20 to Aug. 31
Evening Grosbeak (<i>Coccothraustes vespertinus</i>)	No	Blakely Island	Early-May; June	May 15 to Aug. 10
Lesser Yellowlegs (<i>Tringa flavipes</i>)	No	Blakely Island	Early-May and Early-Aug.	Breeds elsewhere
Long-tailed Duck (<i>Clangula hyermalis</i>)	No	Blakely Island, Offshore Proposed Project area	Early Mar. to End-April; Dec.	Breeds elsewhere
Marbled Godwit (<i>Limosa fedoa</i>)	No	Blakely Island	Early-Sept.	Breeds elsewhere
Marbled Murrelet ^{3,4} (<i>Brachyramphus marmoratus</i>)	No ⁵	Blakely Island, Offshore Proposed Project area	Apr to mid-May; End-June to End-Oct.	Breeds elsewhere
Olive-sided Flycatcher (<i>Contopus cooperi</i>)	No	Blakely Island	Mid-May to Mid-Aug.	May 20 to Aug. 31
Red-breasted Merganser (<i>Mergus serrator</i>)	No	Blakely Island, Offshore Proposed Project area	Early Dec. to End-April; Early Oct.	Breeds elsewhere
Red-necked Phalarope (<i>Phalaropus lobatus</i>)	No	Blakely Island, Offshore Proposed Project area	End-July to Early-Sept.	Breeds elsewhere



Common Name (<i>Scientific Name</i>)	San Juan Island NWR Common Nesting Species ¹	Located on Blakely Island and/or Offshore Proposed Project area ²	Elevated Probability of Presence (USFWS)	Breeding Season Across Entire Range
Red-throated Loon (<i>Gavia stellata</i>)	No	Blakely Island, Offshore Proposed Project area	Early-Mar. to Mid-April; Early-Dec.	Breeds elsewhere
Ring-billed Gull (<i>Larus delawarensis</i>)	No	Blakely Island, Offshore Proposed Project area	Early-Jan.; Early-Aug. to Early-Oct; End-Nov.	Breeds elsewhere
Rufous Hummingbird (<i>Selasphorus rufus</i>)	No	Blakely Island	End-March to Early-Aug.	Apr. 15 to July 15
Short-billed Dowitcher (<i>Limnodromus griseus</i>)	No	Blakely Island	Mid-July to Mid-Aug.	June 1 to Aug. 10
Surf Scoter (<i>Melanitta perspicillata</i>)	No	Blakely Island, Offshore Proposed Project area	End-Nov. to End-Apr.; Early-July; Mid-Sept. to Mid-Oct	Breeds elsewhere
Tufted Puffin ³ (<i>Fratercula cirrhata</i>)	Yes	Blakely Island, Offshore Proposed Project area	End-June	Breeds elsewhere
Western Grebe ³ (<i>Aechmophorus occidentalis</i>)	No	Blakely Island	End-Sept., Oct., Nov., Dec., and Jan.	Jun 1 to Aug. 31
Western Gull (<i>Larus occidentalis</i>)	No	Blakely Island	End-Jan.; Mid-Apr.; Early-Mid Aug.	Apr. 21 to Aug. 25
Western Screech-owl (<i>Megascops kennicotti cardonensis</i>)	No	Blakely Island	End-May and Early-Aug.	Mar. 1 to June 30
White-winged Scoter (<i>Melanitta fusca</i>)	No	Blakely Island, Offshore Proposed Project area	Early- to Mid-Dec.	Breeds elsewhere

Notes: NWR = National Wildlife Refuge

1. There are additional San Juan Islands NWR common nesting species that do not appear in this table, but may be present within the project area, including the following: rhinoceros auklet (*Cerorhinca monocerata*), pigeon guillemot (*Cepphus columba*), pelagic cormorant (*Phalacrocorax pelagicus*), and glaucous-winged gull (*Larus glaucescens*). These species may be present and/or nest in the San Juan Islands, or within the Salish Sea more generally, but they do not appear when reviewing agency databases (e.g., USFWS’s IPaC and WDFW Priority Habitat or Species [PHS] range mapper) on Blakely Island or the offshore project area.
2. Some species were identified as being located on Blakely Island, but not offshore (and vice versa), using USFWS’s IPaC planning tool (USFWS 2024a, 2024b). Species located on Blakely Island may potentially occur within the offshore Project area (e.g., ancient murrelets) while foraging or migrating to and from Blakely Island and other areas.
3. Species is also listed as a Priority Habitat or Species (PHS) (Larsen et al. 2004; WDFW 2008).
4. Species is also protected under ESA.
5. Marbled murrelets are not observed on San Juan Island NWR islands, but forage in waters around refuges (USFWS 2010).

Sources: Larsen 2004; WDFW 2008; USFWS 2010, 2024a, 2024b



Table 3. Washington State PHS That May be in the Proposed Project Area

Occurrence Name (<i>Scientific Name</i>)	State Status	Site Name	Sensitive Location
Pandalid Shrimp (family <i>Pandalidae</i>)	N/A	Not Given	No
Pinto Abalone (<i>Haliotis kamtschatkana</i>)	Endangered	Orcas and Blakely Islands, Lawson Rock (Thatcher Pass)	No
Townsend’s Big-eared Bat (<i>Corynorhinus townsendii</i>)	Candidate	Not Given	Yes
Estuarine and Marine Wetland (NWI Wetlands)	N/A	N/A	No
Notes: N/A = Not applicable; NWI = National Wetland Inventory, PHS = Priority Habitat and Species Source: WDFW 2024a			

In addition to the PHS listed in **Table 3** and avian species in **Table 2**, there are other priority avian species that may occur within or near the proposed Project area due to their known presence in or near San Juan County, but do not have information specific to the area around Blakely Island: Cassin’s Auklet (*Ptychoramphus aleuticus*), Short-tailed Albatross (*Phoebastria albatrus*), Great Blue Heron (*Ardea Herodias*), Harlequin Duck (*Histrionicus histrionicus*), cavity-nesting ducks (e.g., Wood Duck [*Aix sponsa*], Barrow’s Goldeneye [*Bucephala islandica*], Common Goldeneye [*B. clangula*], Bufflehead [*B. albeola*], and Hooded Merganser [*Lophodytes cucullatus*]), Snow Goose (*Chen caerulescens*), Trumpeter Swan (*Cygnus buccinator*), Tundra Swan (*C. columbianus*), Western High Arctic Brant (*Branta bernicla*), Band-tailed Pigeon (*Columba fasciata*), Vaux’s Swift (*Chaetura vauxi*), and Oregon Vesper Sparrow (*Poocetes gramineus affinis*) (Larsen et al. 2004; WDFW 2008).

Table 4. Protected Marine Mammals in the Salish Sea

Common Name (<i>Scientific Name</i>)	Protection	Presence in Proposed Project Area
Whales		
Humpback Whale, Mexico and Central America DPSs (<i>M. novaeangliae</i>)	ESA, MMPA	Uncommon
Gray Whale (<i>Eschrichtius robustus</i>)	MMPA	Uncommon
Minke Whale (<i>Balaenoptera acutorostrata</i>)	MMPA	Uncommon
Dolphins and Porpoises		
Killer Whale, Southern Resident DPS (<i>Orcinus orca</i>)	ESA, MMPA	Uncommon



Common Name (<i>Scientific Name</i>)	Protection	Presence in Proposed Project Area
Bigg's (Transient) Killer Whale (<i>Orcinus rectipinnus</i>)	MMPA	Uncommon
Short-finned Pilot Whale (<i>Globicephala macrorhynchus</i>)	MMPA	Uncommon
Dall's Porpoise (<i>Phocoenoides dalli</i>)	MMPA	Uncommon
Harbor Porpoise (<i>Phocoena phocoena</i>)	MMPA	Common
Pacific White-sided Dolphin (<i>Lagenorhynchus obliquidens</i>)	MMPA	Uncommon
Pinnipeds		
California Sea Lion (<i>Zalophus californianus</i>)	MMPA	Common
Harbor Seal (Washington Inland Waters Stock) (<i>Phoca vitulina</i>)	MMPA	Common
Northern Elephant Seal (<i>Mirounga angustirostris</i>)	MMPA	Uncommon
Steller Sea Lion (<i>Eumetopias jubatus</i>)	ESA ¹ , MMPA	Uncommon
Key: ESA = Endangered Species Act; MMPA = Marine Mammal Protection Act; DPS = Distinct Population Segment Notes: 1. The Steller Sea Lion is split into two populations: Eastern DPS (not ESA-listed) and Western DPS (endangered). The Eastern DPS is the population east of 144 °W, however, Western DPS Steller Sea Lions do also occur east of 144 °W. NMFS (Alaska Region) offers guidance on the occurrence of Western and Eastern DPSs east of 144 °W (2020), but these occurrences primarily occur within Alaska and are not within the proposed Project area, San Juan Islands, or Salish Sea (NMFS 2020). Therefore, the Western DPS (endangered) of the Steller Sea Lion is not considered to be present within or anywhere near the proposed Project area.		

In **Table 4**, the federally threatened southern sea otter (*Enhydra lutris nereis*)—also protected under the MMPA—is not included because its range is predominantly coastal and lies outside of the Salish Sea (Hale et al. 2022). The North American river otter (*Lontra canadensis*), while abundant throughout the Salish Sea and San Juan Islands, is not included because it is primarily a terrestrial animal not protected under the MMPA and is not expected to occur within the offshore Project area.

4 Data Results

Wildlife data that may be collected on the nearfield behavior of listed species include fish, diving birds, and other marine species (e.g., sunflower sea star) in the vicinity of the device. The collected data will be submitted annually to FERC in the Annual Operations and Monitoring Report (Annual Report) by December 31 each year. Prior to filing the Annual Report, OPALCO would provide the data results to the agencies and Tribal Nations for comment.



5 Implementation Schedule

The implementation schedule for fish and wildlife monitoring is outlined in **Table 5**. This schedule is preliminary until specific monitoring objectives are identified in consultation with regulatory agencies and Tribal Nations.

Construction of the Project is planned to start within 12 months of the date of issuance of license and is planned to be completed within 24 months from the start date. The exact timing of the initiation of the implementation schedule is subject to the timing of the submittal of the Final License Application, the issuance of the license and local weather conditions required to operate installation machinery.

Table 5. Implementation Schedule

Monitoring Type	Monitoring Frequency	Effort
Pre-Deployment		
Benthic Habitat	One time	<ul style="list-style-type: none"> A seabed survey will be completed prior to Project deployment.
Wildlife Observations	During Vessel Activities	<ul style="list-style-type: none"> The crews of all Project vessel activities will monitor for protected resources.
Deployment		
Acoustic	Continuous	<ul style="list-style-type: none"> Hydrophones mounted on the Orbital O2-X will collect acoustic data for the duration of the Project deployment. Maintenance of hydrophones will occur as necessary.
Benthic Habitat	Annual	<ul style="list-style-type: none"> A seabed survey will be completed each year of Project deployment. The time of year of the survey has yet to be determined.
Derelict Gear	Annual	<ul style="list-style-type: none"> Drop camera footage of anchors and mooring lines will be collected and reviewed each year of Project deployment. After reviewing the footage, procedures to remove potentially tangled gear would be completed as necessary.
Wildlife Observations	Throughout Deployment	<ul style="list-style-type: none"> Wildlife data may be collected on the nearfield behaviour of listed species in the vicinity of the device. Frequency and type of monitoring procedure will be determined in consultation with regulatory agencies and Tribal Nations.
Post-Removal		
Benthic Habitat	One Time	<ul style="list-style-type: none"> A seabed survey will be completed following the removal of all Project components.
Wildlife Observations	During Vessel Activities	<ul style="list-style-type: none"> The crews of all Project vessel activities will monitor for protected resources.



6 Vessel Incident Reporting Procedures

In the highly unlikely event of a vessel strike with a marine mammal during vessel transit or installation, maintenance, and/or removal activities, the vessel operator must document the conditions at the time of the incident, including the following:

- A. Latitude and longitude of the vessel at the incident location.
- B. Date and time of the incident.
- C. Speed and bearing of the vessel at the time of the incident.
- D. Approximate size of the animal (length) and **take a photo** if possible.
- E. Condition of the animal (alive, dead, wounded, bleeding, etc.).
- F. Environmental conditions at the time of the incident, including wind speed and direction, swell height, visibility in miles, percent cloud cover, and presence or absence of precipitation or fog.
- G. The names of the vessel, vessel operator, vessel owner, and captain or officer in charge of the vessel at the time of the incident.

If a collision occurs, the vessel must stop if it is safe to do so and attempt to evaluate the condition of the animal for reporting purposes. All vessel strikes will be reported immediately by telephone communications to NOAA's West Coast Region Marine Mammal Stranding Network:

West Coast Region Marine Mammal Stranding Hotline: **1 (866) 767-6114**

7 Annual Report

OPALCO will file with FERC an Annual Operations and Monitoring Report (Annual Report) by December 31 each year, and a copy will be provided to relevant agencies and Tribal Nations. The Annual Report will contain monitoring results, adaptive management thresholds, and mitigation actions taken during monitoring at the Project site.

Comments from Agencies and Tribal Nations, and OPALCO's response to those comments, would be included with the Annual Report. Documentation of consultation with agencies and Tribal Nations would also be included, as well as specific description of how the agencies' and Tribes' comments are addressed by the Fish and Wildlife Monitoring Plan.

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Project and Facility Operations Monitoring Plan

Appendix B2

Rosario Strait Tidal Energy Project

San Juan Islands, Washington

FERC Project No. 15368



Federal Energy Regulatory Commission



Orcas Power & Light Cooperative (OPALCO)

183 Mount Baker Road

Eastsound, Washington 98245

26 March 2025

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ACRONYMS AND ABBREVIATIONS

Annual Report	Annual Operations and Monitoring Report
DLA	Draft License Application
DNR	Washington State Department of Natural Resources
Ecology	Washington State Department of Ecology
FERC	Federal Energy Regulatory Commission (<i>also Commission</i>)
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Marine Fisheries Service, <i>also NMFS</i>
NMFS	National Marine Fisheries Service, <i>also NOAA Fisheries</i>
OPALCO	Orcas Power & Light Cooperative
Orbital O2-X	Orbital Marine O2-X Floating Tidal device
Project	Rosario Strait Tidal Energy Project
USFWS	United States Fish and Wildlife Service
UWAPL	University of Washington Applied Physics Laboratory
WDFW	Washington State Department of Fish and Wildlife



1 Introduction

This Project and Facility Operations Monitoring Plan is one of three monitoring and adaptive management plans prepared for Orcas Power & Light Cooperative (OPALCO) to ensure that the Orbital Marine O2-X floating tidal device (O2-X) for the proposed Rosario Strait Tidal Energy Project (Project) operates efficiently, safely, and in accordance with environmental, regulatory, and technical standards. This plan would be reviewed by relevant federal, state, and local agencies, as well as Tribal Nations, and filed for approval by the Federal Energy Regulatory Commission (FERC) at least 90 days prior to on-site construction or Project component installation activities.

2 Methodology

Specific monitoring objectives will be identified by OPALCO in consultation with Orbital Marine. Consultations may include reviewing monitoring results, making necessary adjustments to monitoring methods based on annual data (i.e., adaptive management), and, if needed, developing and implementing mitigation measures.

For each monitoring focus (discussed below), the following would be determined:

- (1) Baseline system conditions analysis.
- (2) Monitoring objectives and implementation strategies.
- (3) Analysis of monitoring results.
- (4) Mitigation responses.
- (5) An implementation schedule.
- (6) Performance metrics and success criteria.

3 Monitoring

3.1 SCADA System

The Project's subsea cable will be routed to shore facilities near existing grid infrastructure, with remote and/or local control capabilities in place 24 hours a day. This supervisory control and data acquisition (SCADA) system uses computers, network communication, and graphics to transmit the real-time status of the O2-X to OPALCO staff members.

If needed, OPALCO staff can initiate an electrical brake equipped on the Project's turbines that can cease power generation and slow turbine rotation within seconds. In the event of loss of transmission and control capabilities, the brake engages automatically.

3.2 Derelict Gear Monitoring

If derelict (i.e. lost or discarded) fishing gear became entangled in Project components, this can result in malfunction of the device and/or disruption of service. Derelict gear could become entangled during the following Project activities:

- O2-X in operation (mooring lines, anchors, and subsea cable umbilical in place).

The O2-X would be equipped with onboard and in-water cameras to routinely survey its condition. The information received from these cameras would be regularly reviewed to confirm no debris has snagged on the device.

Drop cameras, or equivalent, would be used on an annual basis to assess the anchoring system (i.e. mooring lines, anchors) and the subsea cable umbilical for entanglement of derelict gear. The likelihood of entanglement is anticipated to be very low. Regular drop camera footage of the mooring



lines would be reviewed to look for evidence of derelict gear entanglement. If an entanglement event occurs, it would be evaluated for risk, and an appropriate response would be determined.

3.3 Data Results

The monitoring data collected will be reviewed regularly by OPALCO and shared annually with the Adaptive Management Working Group established as part of this proposed Project. Results would also be submitted to FERC in the Annual Operations and Monitoring Report (Annual Report) by December 31 each year.

If results show that the O2-X is operating as expected, no action will be taken. If results show that a response is warranted, OPALCO will develop an appropriate action, which may include changes to monitoring methods, Project operations, and/or mitigation actions, as appropriate.

4 Annual Report

OPALCO will file with FERC an Annual Report by December 31 each year, and a copy will be provided to relevant agencies and Tribal Nations. The Annual Report will contain monitoring results, adaptive management thresholds, and any mitigation actions implemented at the Project site.

Comments from Agencies and Tribal Nations, and OPALCO's response to those comments, would be included with the Annual Report. Documentation of consultation with agencies and Tribal Nations would also be included, as well as specific description of how the agencies and Tribal Nation's comments are accommodated by the Project and Facility Operations Monitoring Plan.

Adaptive Management Plan

Appendix B3

Rosario Strait Tidal Energy Project

San Juan Islands, Washington

FERC Project No. 15368



Federal Energy Regulatory Commission



Orcas Power & Light Cooperative (OPALCO)

183 Mount Baker Road

Eastsound, Washington 98245

26 March 2025

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**ACRONYMS AND ABBREVIATIONS**

AMP	Adaptive Management Plan
Annual Report	Annual Operations and Monitoring Report
CEF4	Washington Department of Commerce’s Clean Energy Fund 4
DLA	Draft License Application
FERC	Federal Energy Regulatory Commission
Group	Adaptive Management Working Group
MW	megawatt
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
OPALCO	Orcas Power & Light Cooperative
Orbital O2-X	Orbital Marine O2-X Floating Tidal device
Project	Rosario Strait Tidal Energy Project
U.S.	United States
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington State Department of Fish and Wildlife
WDNR	Washington State Department of Natural Resources



1 Introduction

This Draft Adaptive Management Plan (AMP) outlines how Orcas Power & Light Cooperative (OPALCO) will research and respond to data that is collected over the duration of the proposed Rosario Strait Tidal Energy Project (Project). The AMP also serves as the foundation for monitoring and science-based decision-making required under the Pilot License. The AMP will be finalized after soliciting input from relevant regulatory agencies, stakeholders, and Tribal Nations.

Adaptive management is a flexible approach to managing projects over time. This approach involves making decisions based on new information becoming available, and adjusting management strategies as needed. FERC and other agencies promote the use of adaptive management as a tool to resolve uncertainties regarding environmental effects of a project, and have actions in place to respond to environmental stressors from hydrokinetic energy projects throughout their lifespan.

For the purposes of this proposed Project, the AMP is intended to (1) provide a foundation for the monitoring and adaptive management associated with specific risks (outlined in the Fish and Wildlife Monitoring Plan and Project Facility and Operations Monitoring Plan), and (2) use the adaptive management strategy to modify operations and monitoring methods based on each prior year's monitoring results. The AMP also provides a means for the broader regulatory and stakeholder communities to stay informed and provide input on the proposed Project monitoring and mitigation.

OPALCO will file with FERC an Annual Operations and Monitoring Report (Annual Report) by December 31 each year, and a copy will be provided to relevant agencies and Tribes. The Annual Report will contain monitoring results, adaptive management thresholds, and mitigation actions taken during monitoring at the Project site.

2 Adaptive Management Working Group

An Adaptive Management Working Group (Group), comprising regulatory agencies and Tribes with relevant resource management responsibilities for the proposed Project area, will be formed to support the Project. Anticipated members of the Group include the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), Washington State Department of Fish and Wildlife (WDFW), Washington State Department of Natural Resources (WDNR), Swinomish Indian Tribal Community, Lummi Nation, and other interested Tribes. The Group will act in an advisory role to provide the following key functions:

1. Review studies and monitoring results from the previous year.
2. Evaluate studies and monitoring results, and reference additional resources as needed, to inform potential changes in operations and/or monitoring procedures.
3. Evaluate proposed changes to plans made by OPALCO in response to monitoring results.
4. The working group will provide input on recommended measures to avoid, minimize, or mitigate the effects.

The final composition and membership of the Group will be determined through consultation prior to the submission of the Final License Application.

3 Adaptive Management Objectives

The overall objective of OPALCO's adaptive management strategy is to maintain or improve the efficiency of the Project, mitigate short-term impacts as needed, ensure that the work remains consistent with the pilot project license, and that the targets and objectives set forth in the monitoring plans are met.

The strategy will be implemented to adapt and optimize Project activities (i.e., installation and operation) to account for lessons learned from work conducted at early stages of the Project, new



information, changing conditions, any new or innovative technologies, results from initial studies, and additional opportunities that may present over the duration of the Project.

This entails: (1) providing the Annual Report to the appropriate resource managers and Tribes detailing the results of the prior year's monitoring activities, (2) holding an annual meeting with the Group to discuss the results, (3) OPALCO will make recommendations on necessary modifications to the environmental monitoring plans to the Adaptive Management Working Group for review and comment, and (4) submitting information from this meeting to FERC with any proposed modifications to the monitoring plans or Project operations.

OPALCO will file with FERC the feedback, comments, and recommendations from the Group on the proposed modifications, and a specific description of how the comments are accommodated. If a Group member disagrees with a recommendation or proposes something different, OPALCO will explain its decision whether or not to adopt the alternative proposal in its submittal to FERC.

Where appropriate, OPALCO will seek FERC approval before implementing a plan or other required actions. In cases where minor modifications to the monitoring plans are necessary and prior FERC approval has not been obtained, OPALCO proposes to proceed with the change if all consulted entities agree. In such instances, OPALCO will submit a description of the modifications, along with the consultation records, within the required reports for the affected monitoring plans.

3.1 Thresholds and Responses

Adaptive management thresholds will be created with input from relevant federal, state, and local agencies, as well as Tribes and stakeholders, after submittal of the DLA. These thresholds will be used by the Group to review monitoring results. If data results indicate that thresholds have been exceeded, OPALCO will coordinate with the Group to develop an appropriate response, which may include changes to monitoring methods, Project operations, and/or mitigation actions as needed. If results indicate the Project operations are in compliance with the thresholds, no action will be required.

4 Recommendations and Review Process

4.1 Annual Reporting

The Annual Report will be provided to the Group every year by December 31 to be reviewed at their annual meeting. The Annual Report would include a description of the monitoring objectives, the monitoring methods and results from the previous 12 months, identify any mitigation actions taken to date, and summarize plans for any future actions.

The OPALCO will allow a minimum of thirty days the relevant agencies and Tribes to comment, provide feedback, and make recommendations before filing the report with FERC. The report will contain documentation of consultation with the relevant agencies and Tribes, copies of comments, feedback, and recommendations on the completed report after it has been prepared and provided to the relevant agencies and Tribes and a specific description of how the comments are accommodated by the report.

4.2 Meeting Provisions

The annual meeting of the Group will be facilitated by OPALCO. There, the Group will assess the monitoring data and OPALCO's proposed modifications to the environmental monitoring plans or Project operations. The timing for the meeting will be determined in future consultation with regulatory agencies and Tribes following submittal of the DLA.



The Group's review process will be established in coordination with the relevant resource managers after submittal of the DLA. Members will compile recommendations for the current monitoring data collection and mitigation processes.

The Group will also evaluate technical issues and data interpretation associated with monitoring, where appropriate. This evaluation will include: the sufficiency and adequacy of the information acquired through monitoring, the monitoring results, and possible adjustments to improve subsequent monitoring.

Project Removal, Site Restoration and Financial Assurance Plan

Appendix B4

Rosario Strait Tidal Energy Project

San Juan Islands, Washington

FERC Project No. 15368



Federal Energy Regulatory Commission



Orcas Power & Light Cooperative (OPALCO)

183 Mount Baker Road

Eastsound, Washington 98245

26 March 2025

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ACRONYMS AND ABBREVIATIONS

DLA	Draft License Application
FERC	Federal Energy Regulatory Commission
OPALCO	Orcas Power & Light Cooperative
Orbital O2-X	Orbital Marine O2-X Floating Tidal device
Project	Rosario Strait Tidal Energy Project
U.S.	United States of America



1 Introduction

This *Project Removal, Site Restoration, and Financial Assurance Plan* is one of four Safeguard Plans that outline the procedures that Orcas Power & Light Cooperative (OPALCO) would employ to safeguard the public and the natural environment that may be affected by the proposed Rosario Strait Tidal Energy Project (Project). This plan was developed as a component of the Draft License Application (DLA) and would be reviewed by relevant local, state, and federal agencies, as well as Tribal Nations. It will be filed for Federal Energy Regulatory Commission (FERC) approval, at least 120 days prior to Project deployment.

2 Overview

Conditions requiring removal of Project components include an emergency, a FERC order, or the expiration of the pilot project license without the issuance of a standard license. This plan includes the protocols for removing Project components in any of these scenarios. It is expected that the removal process of all Project components would take approximately 2-3 weeks to complete.

3 Project Components

The following Project components would be installed and removed as part of the proposed Project:

- One Orbital Marine O2-X floating tidal device (Orbital O2-X).
- One mooring and anchor system which includes four mooring lines and four anchors.
- One new subsea cable from the Orbital O2-X to an existing shoreline conduit and facility on Blakely Island.

4 Removal Process

The Project removal and restoration process is expected to begin within the final six months of the license term, or earlier if necessary due to an emergency or a FERC order requesting removal. Before any decommissioning activities begin, OPALCO will create detailed method statements, which will include a specific analysis of potential environmental effects, in accordance with the company's health and safety policy. These plans will be shared with the relevant regulatory agencies and Tribal Nations for review and approval before any work is carried out.

The scope of the removal and restoration activities would be determined closer to the end of the license term, based upon the condition of the site and equipment at the time of removal. A summary of the Project removal process is shown in **Table 1**.

The following provides a summary of the main decommissioning activities:

- A Notice to Mariners would be issued by the United States (U.S.) Coast Guard detailing the nature and timing of the decommissioning activities.
- The electrical cable connection for the platform would be unlocked and capped, weighted, and released to the seabed, then marked with a pick-up buoy for recovery (see below).
- The mooring connections at the aft of the Orbital O2-X platform would be unlocked from the device and released to the seabed, then marked with a pick-up buoy for recovery.
- The Orbital O2-X would be towed off-site using a multi-cat vessel and taken to an appropriate harbor or sheltered location in Anacortes for temporary mooring.
- Each of the mooring shackles connecting to the mooring lines would then be released to the seabed with navigation/pick-up buoys attached to enable recovery.
- Each of the anchor cages and ballasts would then be recovered, including the mooring lines.
- It is expected that the anchor components would be returned to a local pier for reuse, recycling, or disposal.



- Project removal would be undertaken at slack tide; the Orbital O2-X device would be removed within 1 to 2 days, and all anchors, mooring lines, and the subsea cable within six months.
- All operations would be confined to the Project area and would be undertaken in safe working conditions of wind and sea state.
- Once all Project components are removed from the Project area, any marking buoys would be recovered and the area would once again become navigable to vessel traffic.

Post-removal seabed surveys would be conducted to ensure that all equipment, including the cable, has been removed from the site. The survey would also record any potential impacts on the seabed at the anchoring points and the mooring lines’ sweep areas. Environmental restoration measures are unlikely to be needed due to the geomorphology of the seabed and the anticipated minimal level of impact, unless determined by monitoring data collected during Project deployment or as part of the Adaptive Management Working Group process.

Table 1. Summary of Project Removal Process

Activity Type	Effort
Pre-removal	<ul style="list-style-type: none"> • Complete an environmental effects analysis for occupational health and safety.
Removal of Project Components	<ul style="list-style-type: none"> • Remove the cable connection and mooring connection of the platform. • Tow Orbital O2-X off-site and store at an appropriate harbor or sheltered bay location.
Removal of Platform	<ul style="list-style-type: none"> • Remove the mooring shackles to the seabed with navigation/pick-up buoys attached to enable recovery. • Recover the anchor cages and ballasts, including mooring lines, if using gravity anchors. • Remove the mooring lines connected to the anchors and leave anchors on seabed, if using rock bolt anchors. • Recycle, reuse, or dispose of old parts.
Post-removal	<ul style="list-style-type: none"> • Complete post-decommissioning seabed surveys. • Complete site restoration work to the seabed, if necessary.

5 Monitoring Provisions

The Orbital O2-X would be equipped with onboard and in-water cameras to enable surveying its condition. Footage from these cameras would be routinely reviewed to observe any interactions between fish and wildlife species and the device, as well as to ensure no debris has become caught on it.

At the time of Project removal, OPALCO will consult with the appropriate regulatory agencies and Tribal Nations to obtain recent information on federally listed threatened and endangered species. To minimize impacts, removal activities will follow recommendations from these entities, such as scheduling work outside of seasonal migration periods.



6 Removal Implementation Schedule

It is expected that the removal process of all Project components would take approximately 2-3 weeks to complete. An estimated schedule for the removal of the proposed Project is presented below in **Table 2**.

Table 2. Proposed Project Component Removal Schedule

Activity	Approximate Duration
Subsea Cable and Mooring Line Disconnection	2 days
Orbital O2-X Tow to Harbor	3 days
Mooring Line Removal	3 days
Subsea Cable Disconnection from Shoreline Conduit and Removal	4 days
Anchor Removal	6 days
Total:	18 days
Note: Component removal will comply with direction provided by relevant agencies. The above estimates are based on industry assumptions of timelines and are subject to change.	

7 Financial Assurance Plan

Should it be necessary to relocate or remove the Orbital O2-X completely, OPALCO commits to the financial and operational responsibility for full site restoration. OPALCO assures that, at least 90 days before commencing construction and installation of the Project, it will file proof of the purchase of a surety bond, or equivalent financial assurance instrument (e.g., insurance, corporate guarantee, letter of credit, fully funded trust fund, etc.) to cover the entirety of the costs of removing Project facilities and restoring the Project area in accordance with the Project Removal and Site Restoration Plan required by the pilot license and included in the pilot project license application. During the term of the pilot project license, OPALCO will maintain the bond, or equivalent financial assurance for the removal of the installed Project facilities and restoration of the site. By January 1 of each license year, or as otherwise directed by FERC or its authorized representative, OPALCO will file proof of the maintenance of the bond or equivalent financial assurance.

Project and Public Safety Plan

Appendix B5

Rosario Strait Tidal Energy Project

San Juan Islands, Washington

FERC Project No. 15368



Federal Energy Regulatory Commission



Orcas Power & Light Cooperative (OPALCO)

183 Mount Baker Road

Eastsound, Washington 98245

26 March 2025

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**ACRONYMS AND ABBREVIATIONS**

ADCP	Acoustic Doppler Current Profile
Annual Report	Annual Operations and Monitoring Report
AIS	Automatic Identification System
BMPs	Best Management Practices
DLA	Draft License Application
DNV	Det Norske Veritas company
ESA	Engendered Species Act
FCC	Federal Communications Commission
FERC	Federal Energy Regulatory Commission
GPS	Global Positioning System
GSM	Global System for Mobile Communications
HVAC	Heating, Ventilation, and Air Conditioning
kV	Kilovolts
LAN	Local Area Network
MMPA	Marine Mammal Protection Act
MMSI	Maritime Mobile Service Identity
MRU	Motion Reference Unit
OPALCO	Orcas Power & Light Cooperative
Orbital O2-X	Orbital Marine O2-X Floating Tidal device
PLC	Programmable Logic Controller
Project	Rosario Strait Tidal Energy Project
SCADA	supervisory control and data acquisition system
SMS	Short Message/Messaging Service
UPS	Uninterruptible Power Supply
U.S.	United States
USCG	U.S. Coast Guard
V	Volts



1 Introduction

This Project and Public Safety Plan outlines the procedures that Orcas Power & Light Cooperative (OPALCO) would undertake to safeguard the public from interaction with the proposed Rosario Strait Tidal Energy Project (Project). Specifically, the purpose of the plan is to describe: (1) procedures to ensure the safety of the public near the Project area; (2) ways in which the Project will be monitored to determine if there is an emergency; (3) procedures taken during an emergency; (4) procedures for reporting the emergency to local, state, and federal agencies; (5) contingency measures to modify operations or to implement the Project removal plan; (6) procedures for the annual testing of emergency equipment, and (7) procedures for annually coordinating with response agencies. This plan was developed as a component of the Draft License Application (DLA), and would be reviewed by relevant local, state, and federal agencies, as well as Tribal Nations, and would be filed for Federal Energy Regulatory Commission (FERC) approval, at least 90 days prior to Project deployment.

Overall, due to the selected Project location, the device's designs, and the types of marine activities that typically occur in the area, the proposed Project is not expected to create any significant hazards to public safety.

1.1 Project Components

The following Project components would be installed and removed as part of the proposed Project:

- One Orbital Marine O2-X floating tidal device (Orbital O2-X).
- One mooring and anchor system which includes four mooring lines, four anchors and concrete mattresses or rock aggregate bags.
- One new subsea cable from the O2-X to an existing shoreline conduit and facility on Blakely Island.

Of these, the public is most likely to see the O2-X yellow hull floating in the Project area (**Figure 1; Figure 2**) and, occasionally, the O2-X legs when they are raised to the water's surface for maintenance. The mooring lines, anchors, and new subsea cable would be out of sight underwater.

2 Marine Activities

The proposed Project is located in Marine Area 7, identified by the Washington Department of Fish and Wildlife, where recreators take part in activities such as SCUBA, freediving, kayaking, boating, camping, fishing, and whale watching. The Project area is located outside of major shipping and ferry lanes (**Figure 3**).



Figure 1. Orbital O2-X Deployment in Orkney Islands, Scotland (Wings Up - Standby)



Figure 2. Orbital O2-X Deployment in Orkney Islands, Scotland (Wings Down – Operation)

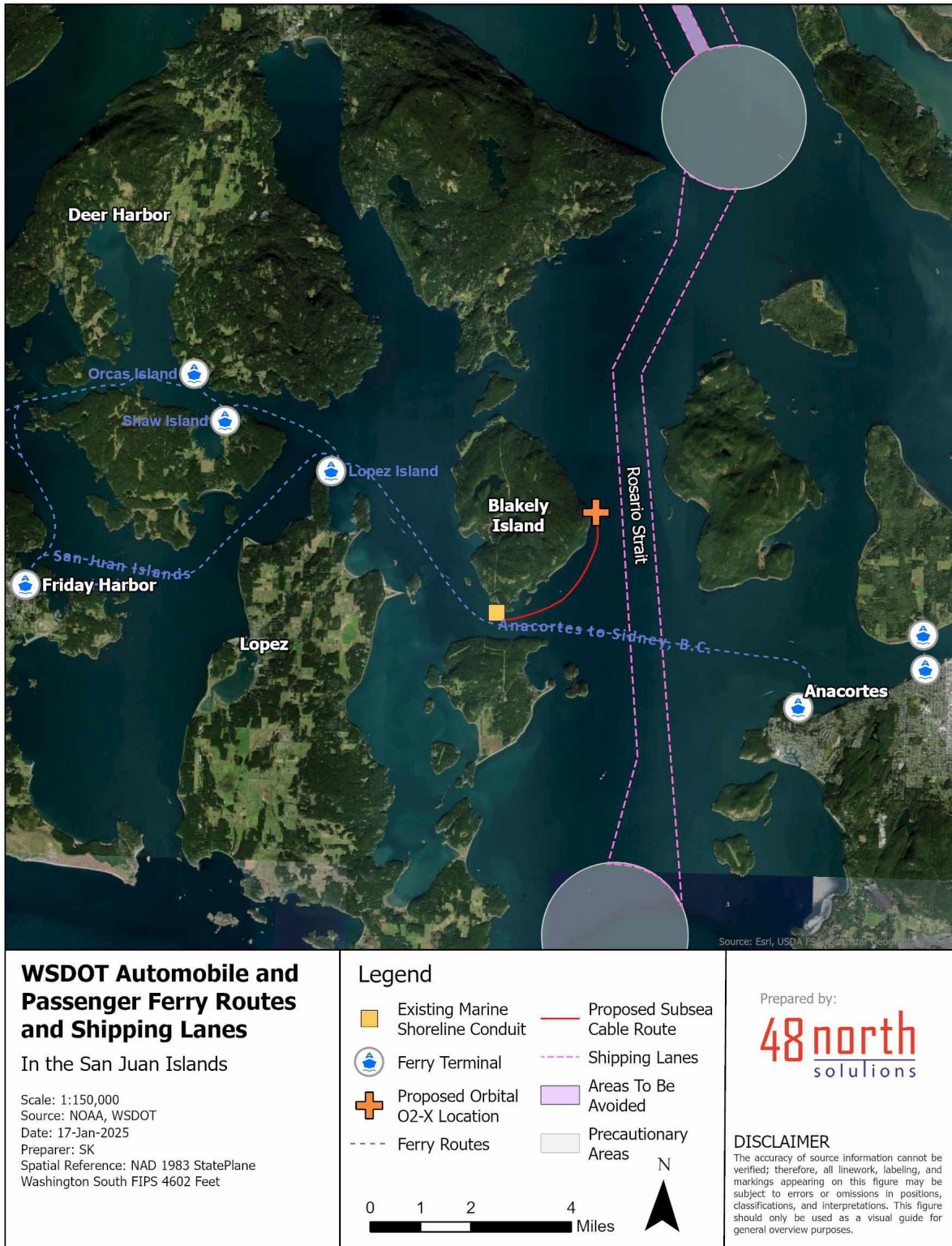


Figure 3. Vessel Traffic Near the Project Area



3 Safety Procedures and Operations

During proposed Project installation, operation, and removal activities, a Notice to Mariners would be submitted to the U.S. Coast Guard (USCG). Additionally, charts and Automatic Identification Systems (AIS) would be updated to display accurate information about the Project area. Navigational charts will also be updated with the USCG and the National Oceanic and Atmospheric Administration (NOAA).

Safety lighting (i.e., two flashing amber lights and a radar cross-section) and a physical Automated Identification System (AIS) transmitter mounted on the Orbital O2-X would be used to indicate the in-water Project facilities. AIS is a maritime navigation safety and communications tool which allows each vessel's information to be broadcast, including identity, type, position, course, speed, and navigational status. Vessels and shore stations receive and display this information, increasing situational awareness. The Orbital O2-X would be equipped with an AIS registered with the Federal Communications Commission (FCC) and assigned a Maritime Mobile Service Identity (MMSI), ensuring all marine vessel traffic will be aware of its location. It will be marked as a structure, not a vessel, so as not to confuse other boaters.

Additional marking devices may include fog signals, low-intensity navigation marking lights, regulatory marking buoys (e.g., white can buoys that indicate special restrictions in regulated navigation areas), and the yellow color of the Orbital O2-X device above water which will ensure safety of the public and project facilities as well as consider the aesthetic resources surrounding the Project area.

The Orbital O2-X would contain a 24-volt (V) battery system to power the instrumentation and control systems. This ensures that the lights installed on the device for visibility will always be lit.

Final decisions about the extent of the Project area and its markings would be determined in consultation with USCG, and consider feedback from relevant local, state, and federal agencies, as well as Tribal Nations.

4 Monitoring

Data on the status of the O2-X would be collected for the duration of the proposed Project and would include using a supervisory control and data acquisition (SCADA) system to alert the on-duty operator of disruptions in service.

4.1 Project Maintenance

The Orbital O2-X components, including the platform, rotors, and mooring systems, are designed for regular maintenance to keep the device operating safely and effectively.

Sensors would be integrated with the main control system to provide feedback from several parts of the system. As part of the control system, certain parameters would be monitored solely for the safe and reliable operation of the Orbital O2-X, including:

- Hydraulic pressure, temperature, and reservoir levels.
- Cooling water temperature.
- Equipment space temperature/humidity.
- Generator temperature.
- Generator voltage and current.
- Bilge level alarms.



4.2 Instrumental and Control Systems

The control system for the Orbital O2-X is designed to be fully automated through an embedded computer-based system, with an on-duty controller available to manage the entire device if needed. The controller will monitor the device's operating state by reviewing data from its various sensors and components, using that information to ensure the system stays within its specified operational limits.

The system will be remotely monitored and controlled via a SCADA (Supervisory Control and Data Acquisition) system, which will be continuously running on a dedicated computer located onshore at OPALCO's office in Eastsound, Washington. The SCADA system would generate information about the general status of the system, alarms, and reports. Operators will review this information, receive and acknowledge warnings or alarms, choose an appropriate response, and circulate reports when needed.

Integrated with the main control system, several instruments would gather important data on the real-time operation of the Orbital O2-X and assess the performance of the system. In addition to the main sensors that provide feedback from several parts of the system, the following instrumentation would assist with safety:

- **Acoustic Doppler Current Profiler (ADCP) to Measure Tidal Speed:** This would be used during operation to control power generation and to make safety decisions.
- **Motion Reference Unit (MRU):** Gives information about turbine motion.
- **Global Positioning System (GPS):** Monitors the position of the device. Geo-fencing alarms would be set.
- **Rotor Variables (Torque, Speed, Thrust):** Sensors give information that would be used to control generation and work within safety limits.
- **Load Shackles:** These would measure the tension on the mooring lines for safe operation.
- **Structural Forces:** Strain gauges would be installed at critical locations on the structure of the device to detect stress.
- **Hydraulic Pressure:** Pressure sensors in several parts of the hydraulic and cooling systems would monitor the adequate operation of those systems. These would be used to detect possible leaks in the systems.
- **Temperature Sensors:** These would ensure that the equipment is working within limits and that the Orbital O2-X is safe for personnel access if needed.
- **Fire and Gas System:** This system would inform OPALCO about fire and gas alarms, ensuring that operation and access are safe.
- **Bilge Pumps:** The bilge system would detect any potentially dangerous water levels and start the bilge pumps and warn the operators.

4.3 Testing Emergency Equipment

OPALCO would conduct annual, or as needed, testing of emergency equipment (i.e. SCADA system alarms, fire detection, etc.). They would also test the emergency shutdown system to ensure it is working effectively to respond to an emergency if it were to occur. Additionally, the battery systems that power the emergency systems would be tested annually and replaced if needed.



5 Emergency Response

5.1 Types of Emergencies

The following types of potential emergencies in Orbital O2-X operation have been identified:

- Vessel collision with Orbital O2-X.
- Inadvertent release of subsea anchoring system from seabed.
- Damage to subsea transmission cable.
- Excessive currents.
- Rotor damage.
- Impacts on protected species or habitats.
- Oil spill from auxiliary Project vessel.

While these types of emergencies are possible, preventative measures, Best Management Practices (BMPs), and responses would reduce the likeliness of these incidents. These measures will be developed in consultation with relevant local, state, and federal agencies, as well as Tribal Nations. If preventative measures fail and an emergency occurs, then the emergency shutdown, removal procedures, and/or communication and reporting would be immediately implemented.

5.2 Emergency Equipment

The Orbital O2-X includes a 24-V battery system to power emergency systems. These emergency systems include fire detection, lighting, control system, and power supply to generator variable speed drives, which control the speed and torque of the generator's motor.

5.2.1 Auxiliary System

The auxiliary systems onboard the Orbital O2-X include all equipment and piping related cooling, firefighting, and detection systems. They are designed in accordance with DNV-OS-D101 (DNV 2021a) and DNV-GL-ST-0164 (DNV 2021b) guidance for Marine and Machinery Systems and Equipment.

- **Cooling Water System** - This includes cooling pumps, piping, keel cooler heat exchangers, and any other equipment necessary for the onboard cooling system.
- **Internal and External Lighting** - Lighting systems are provided for internal lighting in each compartment fed from battery-backed supplies including the fire exit/escape route bulkhead lighting, navigational lighting, and above-surface deck lighting for use during maintenance (i.e., walkway lighting).
- **Heating, Ventilation, and Air Conditioning (HVAC)** - To limit maintenance and reduce potential failure modes, active cooling systems are kept to a minimum; where possible, systems that rely on passive cooling and components designed for the marine environment are used. Equipment that is sensitive to damp environments is provided with anti-condensation heating when required. These include main generators and variable speed drive cabinets.
- **Fire Detection/Fighting System** - A fixed fire detection and firefighting system would be installed. A fixed smoke detection system, with suitable points, and fixed fire suppression systems would be fitted to all major active systems. Additionally, a range of portable manual fire extinguishers would be installed close to the appropriate systems, for example foam extinguishers near hydraulic systems and dry powder new electrical systems.
- **Charging/Black Start Connector** - The Orbital O2-X has an external connector to allow charging of internal batteries, such as from a diesel generator or vessel supply, while the device is off-grid. This allows maintenance and testing of onboard systems without draining the batteries. This would also allow the Orbital O2-X to be restarted in the case of a long-term loss of the main power supply.



5.2.2 Corrosion Protection

The corrosion protection strategy for all splash zone surfaces would involve cathodic protection in accordance with DNV-RP-B401 (DNV 2021c) and suitable paint/coatings in accordance with DNV-OS-C401 (DNV 2013).

5.3 Emergency Shutdown

Shutdown may occur for a variety of scenarios in order to protect the safety of the Project and the public. This would be fully automated via the SCADA system, and can also be triggered manually by an on-duty operator. Shutdown scenarios and procedures include:

- Based on environmental information detected by the O2-X, an automatic emergency shutdown would cause the device to retract its legs.
- If the device detects a hazard, it would go into 'emergency stop' mode, whereby the device would automatically stop the rotors, disable the drives, and trip any other equipment involved in the movement of the rotors, applying the brakes and waiting for the operator to decide what to do next.
- The electrical brake would engage on the device. The electrical brake is capable of ceasing turbine rotation immediately, and generation ceases at this time as well.

There are several different shut down processes, depending on the circumstances of the shutdown outlined below:

- **Manual:** In this case, the operator decides to cease turbine operation or decides what state they want the Orbital O2-X to be in (e.g., transport mode during maintenance operations).
- **Automated:** Based on environmental information, the turbine control system decides if it can keep generating or not and whether to go into a controlled stop stage.
- **Emergency Shutdown:** The device, again based on environmental information, determines that it is dangerous to operate and shuts down automatically, going into survival mode (legs up).
- **Emergency Stop:** The device detects a risky or dangerous situation and stops the rotors, disables the drives, and trips any other equipment involved in the movement of the rotors, applying the brakes, and waiting for the operator to decide what to do next.

5.4 External Communication and Reporting

Procedures for reporting any emergencies to local, state, and federal agencies include:

- Phoning the FERC Office Director, Project stakeholders, state and federal agencies, and Tribal Nations.
- Within 24 hours, OPALCO would report any project-related conditions that cause or may cause injury or mortality to any federally listed threatened or endangered species under the Endangered Species Act (ESA) or Marine Mammal Protection Act (MMPA), or the environment, life, health, or property of the public.
- OPALCO would consult with the FERC Office Director and the notified entities about the immediate course of action to take to prevent injury or minimize or eliminate the threat to the extent possible.
- OPALCO would also propose to the Office Director immediate measures, based on consultation with the agencies and Tribal Nations, and implement such immediate measures as the Office Director so directs, which may include immediate shutdown of all project operations.



- No later than 7 days after becoming aware of any such threat or incident, or on any alternative schedule specified by the Office Director, OPALCO would file with the FERC and submit to the aforementioned agencies and Tribal Nations, a written report on the condition and results on those affected.

6 Annual Coordination with Response Agencies

OPALCO will coordinate annually with response agencies to ensure public and Project safety, keeping them informed of any updates to emergency response procedures. As part of this effort, OPALCO can share the results of yearly testing and organize a consultation session with local officials. This session would review emergency protocols, address any concerns, and ensure alignment between response agencies and Project operations.



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Navigation Safety Plan

Appendix B6

Rosario Strait Tidal Energy Project

San Juan Islands, Washington

FERC Project No. 15368



Federal Energy Regulatory Commission



Orcas Power & Light Cooperative (OPALCO)

183 Mount Baker Road

Eastsound, Washington 98245

26 March 2025

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**ACRONYMS AND ABBREVIATIONS**

AIS	Automatic Identification System
Circular	United States Coast Guard’s Navigation and Vessel Circular No. 02-07
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea
DLA	Draft License Application
FERC	Federal Energy Regulatory Commission
ft	feet
km	kilometer
m	meters
NM	nautical mile(s)
NOAA	National Oceanic and Atmospheric Administration
OPALCO	Orcas Power & Light Cooperative
Orbital O2-X	Orbital Marine O2-X Floating Tidal device
Project	Rosario Strait Tidal Energy Project
TSS	Traffic Separation Scheme
U&A	Usual and Accustomed
U.S.	United States
VTS	Vessel Traffic Service
WSDOT	Washington State Department of Transportation



1 Introduction

This Draft Navigation Safety Plan outlines the procedures for Orcas Power & Light Cooperative (OPALCO) to protect the public and Rosario Strait Tidal Energy Project (Project) Project facilities from events such as collisions between commercial and recreational vessels and in-water Project facilities; entanglement of fishing gear, anchors, dredging equipment, or other underwater devices that may damage or become entangled with Project transmission, anchoring, and mooring lines; and electrocution. This plan was developed as a component of the Draft License Application (DLA). It will be reviewed by the U.S. Coast Guard (USCG) and relevant local, state, and federal agencies, and Tribal Nations, and be filed for Federal Energy Regulatory Commission (FERC) approval, at least 120 days prior to Project deployment.

Additionally, this Navigation Safety Plan is consistent with the USCG Navigation and Vessel Circular No. 02-07 (the “Circular”), which provides guidance on USCG policy for offshore renewable energy installations. The Circular outlines: (1) Navigation risk assessments should describe the installation’s effects on visual navigation and collision avoidance, and communications, radar, and positioning systems; (2) Project documents should describe plans for marine navigational marking of the project and surrounding area. Both are included below.

2 Proposed Project Area

The proposed Project area within Rosario Strait is located east of Blakely Island (at approximately 48.5611°N, 122.7679°W). Blakely Island is a small, sparsely populated island, approximately 2.4 kilometers (km) (1.5 miles) south of Orcas Island where OPALCO offices are located.

The proposed Project location is shown in **Figure 1** and the approximate locations of proposed Project components are presented in **Table 1**.

Table 1. Approximate Location of the Proposed Project Components

Project Component	Latitude (°N)	Longitude (°W)
Orbital Marine O2-X Floating Tidal Device	48.561136	-122.767907
North Point – New Subsea Cable Corridor	48.561142	-122.767909
South Point – New Subsea Cable Corridor	48.531458	-122.809621
Existing Marine Shoreline Conduit	48.531466	-122.809625
Existing Land-Based Conduit Facility	48.531896	-122.809359

Notes: Coordinates determined using Projected Coordinate System NAD 1983 StatePlane Washington South FIPS 4602 [U.S. Feet]

2.1 Marine Traffic

As shown in **Figure 2**, existing shipping and ferry lanes are outside of the proposed Project area in Rosario Strait. Vessels often pass by the proposed Project area, including the Washington State Department of Transportation (WSDOT) passenger ferries that run between Anacortes, Lopez Island, Shaw Island, Orcas Island, and San Juan Island multiple times per day.

Rosario Strait is open for commercial fishing and is within the usual and accustomed (U&A) fishing areas of several Tribal Nations. Recreational vessels including kayakers, recreational power boaters, whale watching vessels, and sail boats also transit Rosario Strait.



DLA Navigation Safety Plan – Rosario Strait Tidal Energy Project

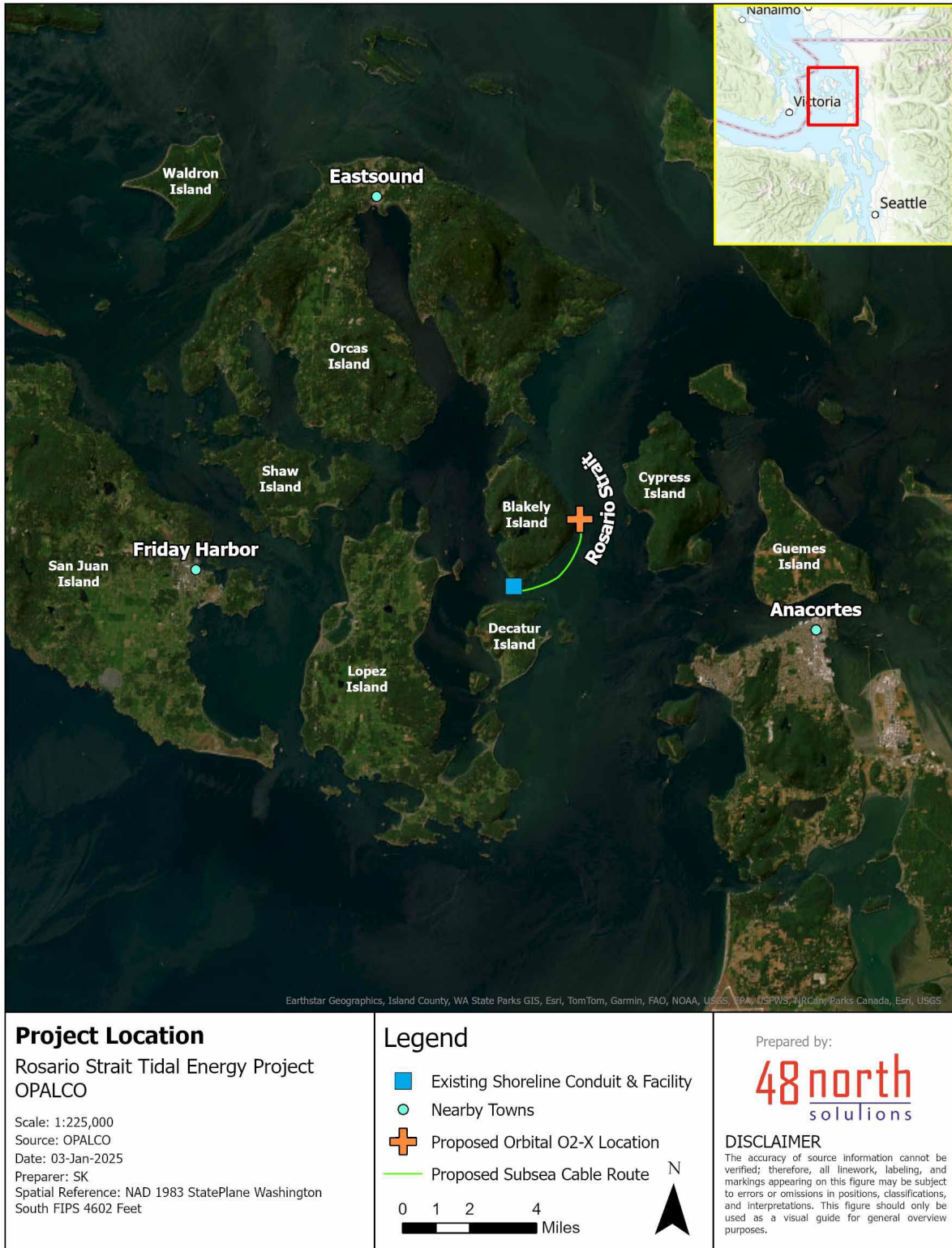


Figure 1. Project Location

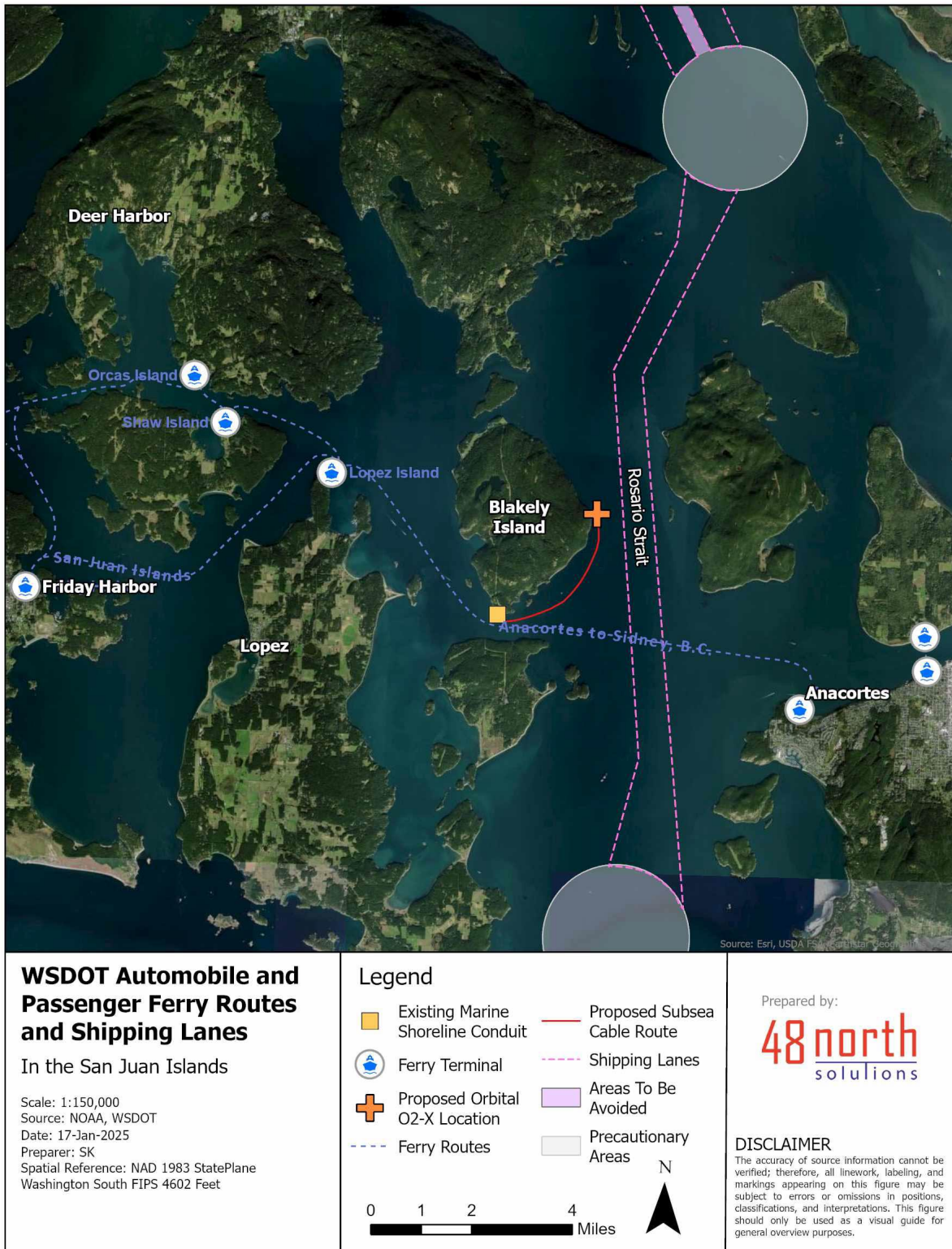


Figure 2. Shipping and Ferry Lands near the Proposed Project Area

3 Project Components

The proposed Project consists of the following components:

- One Orbital Marine O2-X floating tidal device (Orbital O2-X).
- One mooring and anchor system which includes four mooring lines, four anchors and concrete mattresses or rock aggregate bags.
- One new subsea cable from the Orbital O2-X to an existing shoreline conduit and facility on Blakely Island.

Of these, the Orbital O2-X would be visible above the waterline to passing vessel passengers, while the new subsea cable and the mooring and anchoring system would be out of sight underwater. For a cross-sectional view of Project components in the water column, see **Figure 3**.

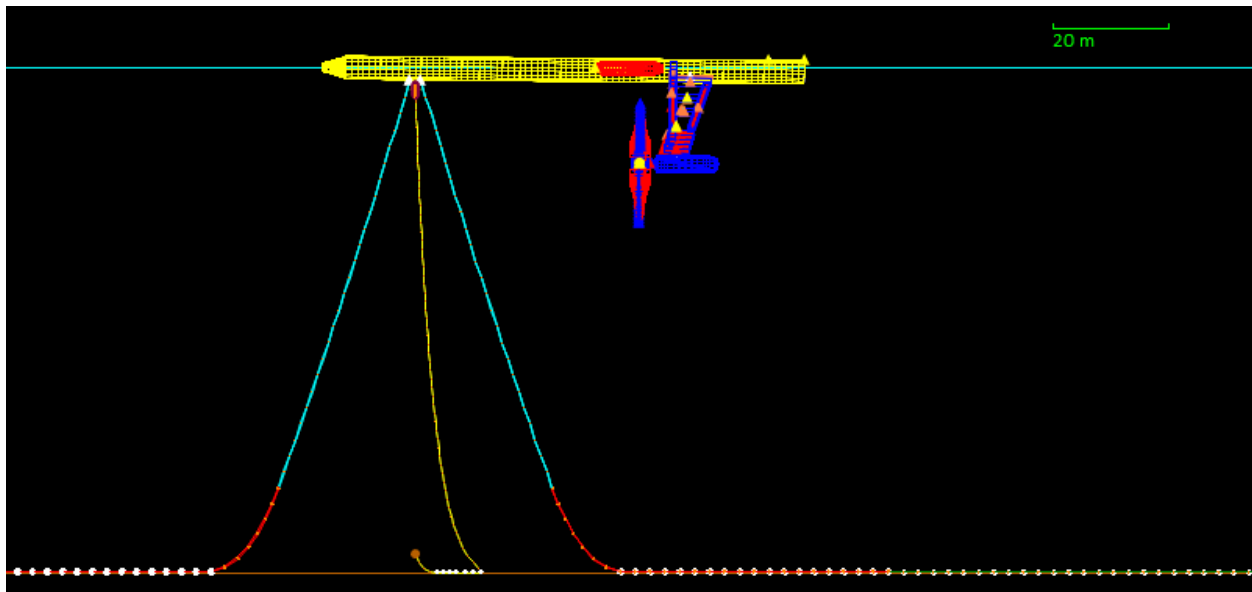


Figure 3. Cross-section View of Project Components (slack tide)

4 Navigation Safety

4.1 Project Component Marking

The Orbital O2-X would have lighting systems that are situated in each compartment within the device. These internal lights are fed from battery-backed power supplies and include fixtures such as fire exit and escape route bulkhead lighting, navigational lighting, and surface deck walkway lighting for use during maintenance. Additionally, the Orbital O2-X device will have a marking and lighting schedule to make its location highly visible 24-hours a day to vessels that may transit the region. The device will be yellow in color above the water line and lit by two amber lights that display synchronized flashing once every three seconds. These flashing lights have a nominal range of 3 nautical miles (NM) and would be mounted a minimum of 3 meters (m) (10 feet [ft]) above the waterline.



4.2 Project Area Marking

4.2.1 Current Marking

The lighting buoys and beacons currently in use near the proposed Project area include lighted buoys at Lawson Rock, Black Rock, and the outcrop north of Black Rock. The Blakely Island light beacon is located at the submarine cable landing on the south end of the island.

4.2.2 New Marking

Safety lighting (i.e., two flashing amber lights and a radar cross-section) and a physical Automated Identification System (AIS) transmitter mounted on the Orbital O2-X would be used to indicate the in-water Project facilities. AIS is a maritime navigation safety and communications tool which allows each vessel's information to be broadcast, including identity, type, position, course, speed, and navigational status. Vessels and shore stations receive and display this information, increasing situational awareness. The Orbital O2-X will be marked as a structure, not a vessel, so as not to confuse other boaters. Navigational charts will also be updated with the U.S. Coast Guard and the National Oceanic and Atmospheric Administration (NOAA).

Additional marking devices may include fog signals, low-intensity navigation marking lights, regulatory marking buoys (e.g., white can buoys that indicate special restrictions in regulated navigation areas), and the yellow color of the Orbital O2-X device above water which will ensure safety of the public and project facilities as well as consider the aesthetic resources surrounding the Project area.

Final decisions about the extent of the Project area and its markings would be determined in consultation with USCG, and consider feedback from relevant local, state, and federal agencies, as well as Tribal Nations.

4.3 Maintenance Vessel Presence in Project Area

Turbine and cable installation, maintenance, and removal will require barge, multi-cat, and other vessels to accomplish. All vessels would comply with the Convention on the International Rules for Preventing Collisions at Sea (COLREGS) in markings and operation. Barges could reach a maximum size of 84 m by 23 m (275 ft by 74 ft), and all such vessel operations shall be coordinated with the Puget Sound Vessel Traffic System (VTS).

5 Potential Changes to Navigation Safety

Contingency measures for changes in navigation, vessel traffic, and recovery of device components will be managed by OPALCO.

FERC reserves the right to require changes to this plan. Project construction and installation shall not begin until the licensee is notified by FERC that the plan is approved. Upon FERC approval, the licensee shall implement the plan, including any changes as required by FERC.

Emergency Shutdown Plan

Appendix B7

Rosario Strait Tidal Energy Project

San Juan Islands, Washington

FERC Project No. 15368



Federal Energy Regulatory Commission



Orcas Power & Light Cooperative (OPALCO)

183 Mount Baker Road

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**ACRONYMS AND ABBREVIATIONS**

Annual Report	Annual Operations and Monitoring Report
BMPs	Best Management Practices
DLA	Draft License Application
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
GPS	Global Positioning System
GSM	Global System for Mobile communications
LAN	Local Area Network
MMPA	Marine Mammal Protection Act
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
Office Director	Director, Office of Energy Projects
OPALCO	Orcas Power & Light Cooperative
Orbital O2-X	Orbital Marine O2-X Floating Tidal Turbine Device
Project	Rosario Strait Tidal Energy Project
SCADA	Supervisory Control and Data Acquisition System
SMS	Short message/messaging service
UPS	Uninterruptible Power Supply
U.S.	United States of America
V	volt
WDFW	Washington State Department of Fish and Wildlife



1 Introduction

This Draft Emergency Shutdown Plan outlines the protocol that Orcas Power & Light Cooperative (OPALCO) would follow to shut down the proposed Rosario Strait Tidal Energy Project (Project) for the protection of the environment or the public if an emergency were to occur. This plan was developed as a component of the Draft License Application (DLA), would be reviewed by relevant local, state, and federal agencies, and Tribal Nations, and be filed for Federal Energy Regulatory Commission (FERC) approval, at least 90 days prior to Project deployment.

If necessary, FERC's Director of the Office of Energy Projects (Office Director), could order Project operations to halt in order to protect the environment or the life, health, and/or property of the public. The following steps describe the scenarios and procedures for preparedness, shutdown, removal, communication, and reporting if an emergency incident were to occur during the pilot license term.

Device shutdown would be fully automated. There would be four shutdown scenarios:

1. Planned at the end of each tidal cycle.
2. Planned at cut-out tidal velocity (the velocity above which generation of power is stopped due to the increased loads and strain on the structure and control system).
3. Survival shutdown of rotor above critical sea state.
4. In case of an emergency.

2 Emergency Preparedness

2.1 Project Maintenance

The Orbital Marine O2-X floating tidal device (O2-X) components, including the platform, rotors, and mooring system, are designed for low-cost maintenance with easy access for annual servicing requirements. The legs, nacelles, and rotors can be raised to the water's surface for servicing onsite.

As a floating device, scheduled and unscheduled maintenance operations on electrical, control, and hydraulic systems can be carried out onboard the device by transferring personnel from a small vessel onto the hull of the Orbital O2-X. Personnel can enter the hull to access the equipment. Throughout deployment, regular maintenance would be performed as needed to maintain structural integrity and ensure continuous operation with minimal disruptions. Skilled technicians and engineers would be recruited and trained to carry out planned maintenance of the device. A stock of appropriate spare parts would be available and maintained close to the site for necessary maintenance. Typical operation and maintenance for the Orbital O2-X is outlined in **Table 1**.

Regular maintenance would be conducted once per month using a variety of survey systems such as cameras installed on the device, side scan and multibeam sonar, and inspections of anti-biofouling coatings to ensure they remain intact. Sensors would also be integrated with the main control system to provide feedback from several parts of the system.

An operation and maintenance checklist would be developed to ensure potential sources of sensor malfunction or damage are not overlooked. As part of the control system, certain parameters would be monitored solely for the safe and reliable operation of the Orbital O2-X, including:

- Hydraulic pressure, temperature, and reservoir levels.
- Cooling water temperature.
- Equipment space temperature/humidity.
- Generator temperature.
- Generator voltage and current.
- Bilge level alarms.



For more significant maintenance operations or when weather conditions preclude a personnel transfer, the Orbital O2-X can be disconnected from its mooring and towed to a maintenance location. Once disconnected from its mooring and the rotor legs are retracted, the low transport draught of the Orbital O2-X allows for towing off-site to an appropriate harbor or sheltered bay location.

Table 1. Frequency of Operational Maintenance Service Tasks

Maintenance Type	Frequency	Effort
Mooring Survey	Periodically	<ul style="list-style-type: none"> Checking the integrity and conditions of the moorings and anchors.
Orbital O2-X Inspection at Site	12 months	<ul style="list-style-type: none"> Cleaning with high-pressure water/steam cleaner. Inspect corrosion protection. Visual inspection of all rotors, blades, etc. Check lube oil level, magnetic plugs, take samples. New lube oil filling.
Orbital O2-X Overhaul	5–8 years	<ul style="list-style-type: none"> Inspection and exchange of worn parts. Test runs after assembly. Refurbishment of corrosion protection system.
Platform Inspection	12 months	<ul style="list-style-type: none"> Checking and cleaning the platform hull and structures. Repairs and replacement carried out as required.
Electrical Inspection at Site	6 months	<ul style="list-style-type: none"> Check ventilation system/changing ventilator mats. Inspect critical electronics installations. Inspection for corrosion. Optical inspection.
Major Inspection	5 years	<ul style="list-style-type: none"> Inverter inspection and maintenance.
Automatic Condition Monitoring System (i.e., Mechanical monitoring and early fault detection)	Continuous	<ul style="list-style-type: none"> Automatic data recording. Frequent reports. Alarm if defined threshold values are exceeded.

2.2 Supervisory Control and Data Acquisition System

During operations, outputs from the Orbital O2-X would be monitored by on-call local staff through a 24/7 on-duty manager system. The supervisory control and data acquisition (SCADA) system can be configured with alarms that are transmitted by email, automated phone call, and/or text message. All parameters of the system can be monitored through the SCADA, including setting limits or ranges and alerts if those parameters are exceeded.



A stationing verification system would allow the device to be monitored with control system alerts to the duty manager. Using global positioning systems (GPS), this function would observe the movement of the device and alert if the system strays from the predefined operational area. Once the installation team has ensured that all systems are working safely and effectively, the Orbital O2-X would transition to automated operation.

2.3 Emergency Equipment

The Orbital O2-X includes a 24-volt (V) battery system to power emergency systems. These emergency systems include fire detection, lighting, control system (i.e. programmable logic controllers, actuators) and a power supply to the generator variable speed drives, which control the speed and torque of the generator's motor.

2.4 Emergency Equipment Testing

OPALCO would conduct annual, or as needed, testing of emergency equipment (i.e. SCADA system alarms, fire detection, programmable logic controller, control system). It would also test the emergency shutdown system to ensure it is working effectively. Additionally, the battery systems that power the emergency systems would be tested annually, and replaced if needed.

2.5 Types of Emergencies

The following types of potential emergencies in Orbital O2-X operation have been identified:

- Vessel collision with Orbital O2-X.
- Inadvertent release of subsea anchoring system from seabed.
- Damage to subsea transmission cable.
- Excessive Currents.
- Rotor damage.
- Impacts on protected species or habitats.
- Oil spill due to auxiliary Project vessel(s).

While these types of emergencies are possible, preventative measures, Best Management Practices (BMPs), and responses would reduce the likeliness of these incidents. These measures will be developed in consultation with relevant local, state, and federal agencies, as well as Tribal Nations. If preventative measures fail and an emergency occurs, then the emergency shutdown (**Section 4**), and/or emergency removal procedures (**Section 5**), and emergency communication and reporting (**Section 6**) would be implemented.

2.6 Monitoring

Regular monitoring supports OPALCO's ability to anticipate and prepare for emergency scenarios, and act proactively to reduce opportunities for those to occur. Project and environmental data would be collected for the duration of the proposed Project, including results from the SCADA system, acoustic monitoring, benthic habitat monitoring, and derelict gear monitoring. Monitoring data collected would be reviewed annually by the Adaptive Management Working Group and submitted to FERC in the Annual Operations and Monitoring Report (Annual Report) by December 31 each year.

3 Emergency Shutdown Plan

Shutdown may be required at times during O2-X operation. This is fully automated via the SCADA system, and can also be triggered manually by an on-duty operator. Shutdown scenarios and procedures include:

- Based on environmental information detected by the device, an automatic emergency shutdown of the device would cause the device to go into survival mode (i.e., legs up).



- If the device detects a risky or dangerous situation, it would go into ‘emergency stop’ mode, whereby the device would automatically stop the rotors, disable the drives, and trip any other equipment involved in the movement of the rotors, applying the brakes and waiting for the operator to decide what to do next.
- The electrical brake would engage on the device. The electrical brake is capable of ceasing turbine rotation immediately, and generation ceases at this time as well.
- OPALCO could implement these measures remotely from the SCADA system which operates the control system for the Orbital O2-X.

There are several different shut down processes, depending on the circumstances of the shutdown outlined below:

- **Manual:** In this case, the operator decides to cease turbine operation or decides what state they want the Orbital O2-X to be in (e.g., transport mode during maintenance operations).
- **Automated:** Based on environmental information, the turbine control system determines if it can keep generating or not and whether to go into a controlled stop stage.
- **Emergency Shutdown:** The device, again based on environmental information, decides that it is dangerous to operate and shuts down automatically, going into survival mode (legs up).
- **Emergency Stop:** The device detects a risky or dangerous situation and stops the rotors, disables the drives, and trips any other equipment involved in the movement of the rotors, applying the brakes, and waiting for the operator to decide what to do next.

4 Emergency Removal Plan

If it becomes necessary for the Orbital O2-X to be removed from the proposed Project area due to an emergency, OPALCO would begin the decommissioning process at the earliest feasible opportunity. The following provides a summary of the main decommissioning activities:

- A Notice to Mariners would be issued by the U.S. Coast Guard detailing the nature and timing of the decommissioning works.
- The electrical cable connection for the platform would be unlocked and capped, weighted, and released to the seabed, then marked with a pick-up buoy for recovery (see below).
- The mooring connections at the aft of the Orbital O2-X platform would be unlocked from the device and released to the seabed, then marked with a pick-up buoy for recovery.
- The Orbital O2-X would be towed off-site using a multi-cat vessel and taken to an appropriate harbor or sheltered location for temporary mooring.
- Each of the mooring shackles connecting the mooring lines would then be released to the seabed with navigation/pick-up buoys attached to enable recovery.
- Each of the anchor cages and ballasts would then be recovered, including the mooring lines.
- It is expected that the anchor components would be returned to a local pier for re-use, recycling, or disposal.
- Project removal would be undertaken at slack tide; the Orbital O2-X device would be removed in approximately 18 days.
- All operations would be confined to the Project area and would be undertaken in safe working conditions of wind and sea state.

Table 2 below outlines the approximate schedule for removal of each proposed Project component.

**Table 2.** Proposed Project Component Removal Schedule

Activity	Approximate Duration
Subsea Cable and Mooring Line Disconnection	2 days
Orbital O2-X Tow to Harbor	3 days
Mooring Line Removal	3 days
Subsea Cable Disconnection from Shoreline Conduit and Removal	4 days
Anchor Removal	6 days
Total:	18 days
Note: Component removal will comply with direction provided by relevant agencies. The above estimates are based on industry assumptions of timelines and are subject to change.	

Post-removal seabed surveys would be conducted to ensure that all equipment, including the cable, has been removed from the site. The survey would also document any potential impacts on the seabed at the anchoring points and the mooring lines' sweep areas. Environmental restoration measures are unlikely to be needed due to the geomorphology of the seabed and the anticipated minimal level of impact, unless determined by monitoring data collected during Project deployment, or as part of the Adaptive Management Working Group process.

5 Emergency Communication and Reporting

5.1 Communication Systems

Communication systems would be in place to inform emergency situations. The communications system may consist of one or more of these systems:

- **Radio Frequency Link:** This is a remote but short distance link that is used to perform some actions on the device without the need for on-board personnel.
- **Wireless Local Area Network (LAN):** This link connects the Orbital O2-X with the router installed on shore via long range access points.
- **Wired Ethernet LAN:** This link uses a fiber optic connection to shore. This would be the main communications link.
- **3G:** There would be at least one 3G (or 4G) modem installed in the Orbital O2-X that can be used as a back-up communication route in case of a failure in the main links.
- **Global System for Mobile Communications (GSM):** A GSM system allows the Orbital O2-X to send and receive Short Message/Messaging Service (SMS) texts. This system would be used to alarm the duty managers (the onshore people responsible for remotely overseeing operations) about safety-related issues in the event of a failure of the internet connection and can receive commands from the duty managers to perform actions on the system. The GSM system is backed up by an Uninterruptible Power Supply (UPS) to ensure that it remains operational in the event of a power failure.



5.2 External Communication and Reporting

OPALCO will report any Project-related conditions that result in or may result in injury or mortality to federally listed threatened or endangered species under the Endangered Species Act (ESA), marine mammals protected under the Marine Mammal Protection Act (MMPA), and/or any other safety incidents affecting the environment or the public as soon as feasible, but no later than 24 hours after becoming aware of the threat or incident. OPALCO will report by telephone to the Director of FERC’s Office of Energy Projects, as well as the relevant agencies and Tribal Nations (a preliminary list of identified emergency contacts is presented in **Table 2**). The contact list shall be determined in consultations prior to the Final License Application, and reviewed and updated on an annual basis.

Table 3. Preliminary Emergency Contact List

Resource Manager	Contact Information
FERC Director, Office of Energy Projects	Hydropower: (202) 502-8700
National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS)	Enforcement Hotline: 1-800-583-1964
U.S. Fish and Wildlife Service (USFWS)	Emergency Hotline: 1-844-397-8477
National Response Center (Operated by U.S. Coast Guard)	Available 24/7: 1-800-424-8802
Washington State Department of Fish and Wildlife (WDFW)	Wildlife Emergency Hotline: 1-877-933-9847
Swinomish Tribal Community	Environmental Program: (360) 466-7245
Lummi Nation	Natural Resources Department: (360) 384-2222

Upon initial notification, OPALCO will consult with the Office Director and the notified entities to determine the appropriate immediate course of action necessary to prevent injury, minimize risks, or eliminate the threat to the extent practicable. In consultation with the relevant agencies and Tribal Nations, OPALCO will propose immediate remedial measures to the Office Director and implement any such measures as directed, which may include the immediate shutdown of Project operations.

No later than seven days after becoming aware of the threat or incident, or on an alternative schedule specified by the Office Director, OPALCO will file a written report to FERC, the relevant agencies, and the affected Tribal Nations on the condition affecting the ESA-listed or MMPA-protected species, other environmental resources, the public, or property. In addition to any information required by the Office Director at the time of initial contact, this report shall include:

- (a) The location, date, time, and known causes of the condition;
- (b) A description of any unusual occurrences or operating conditions preceding the event;
- (c) An account of measures taken to immediately address the condition;
- (d) A detailed description of any injuries or mortalities of ESA-listed or MMPA-protected species, or any adverse effects on other environmental resources, the public, or property as applicable;
- (e) A detailed description of the measures recommended by the agencies and Tribe(s); and
- (f) A detailed description of measures or actions to be taken to prevent future occurrences.

Site Assessments

Appendix C

Rosario Strait Tidal Energy Project

San Juan Islands, Washington

FERC Project No. 15368



Federal Energy Regulatory Commission



Orcas Power & Light Cooperative (OPALCO)

183 Mount Baker Road

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26 March 2025

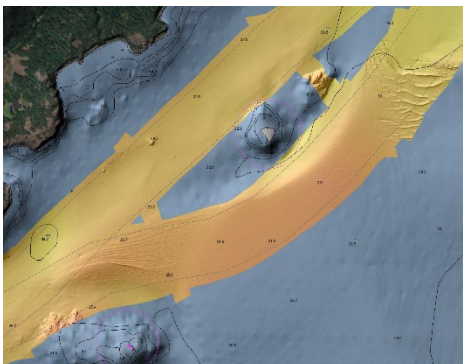
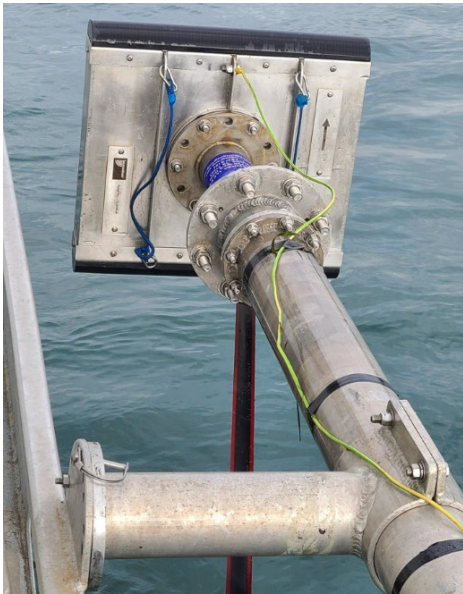
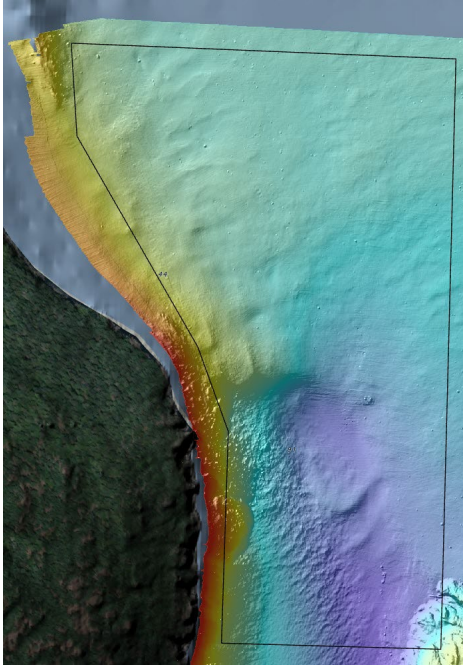


This appendix presents two sub-appendices, each including a report of a site assessment that have taken place at the Rosario Strait Tidal Energy Project proposed location.

Appendix:

C1 - Tetra Tech Survey Scope and Findings

C2 - Resource Characterization Report: OPALCO Site in Rosario Strait, WA (USA)



FINAL

Rosario Strait Tidal Energy Project

Hydrographic and Geophysical Survey

Survey Report

Prepared for



Orcas Power & Light Cooperative



Submitted by:



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19803 North Creek Parkway
Bothell, WA 98011

February 10, 2025

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1. INTRODUCTION

Orcas Power & Light Cooperative (OPALCO) issued a General Consulting services contract for a Hydrographic and Geophysical Survey in Rosario Strait and off Blakely Island, Washington to Tetra Tech on August 19, 2024. A Contract Modification was issued on September 10, 2024, before works commenced, to update the survey area and preliminary cable route, and add a Desktop Study (DTS). A second modification was added on October 23, 2024, during survey operations, to add an additional day of multibeam echosounder (MBE) bathymetry data collection.

Tetra Tech understands that Orbital Marine Power (Orbital) and OPALCO are working to install an Orbital O2 2MW tidal turbine as part of a demonstration project. The turbine will be installed off the southeastern coast of Blakely Island in the Rosario Strait of Puget Sound, Washington (Figure 1-1). The hydrographic and geophysical survey data are required to support the feasibility assessment and future installation of the floating tidal turbine and its constituent submarine cable.

This report summarizes the hydrographic and geophysical survey effort, quality control (QC) procedures, data acquired and the project deliverables. The deliverables include a north-up hill-shaded relief chart, digital data including ASCII format DTM, MBE backscatter imagery, significant targets and interpreted profiles of Sub-Bottom Profiler (SBP) data. The desktop study report is provided in Appendix A.

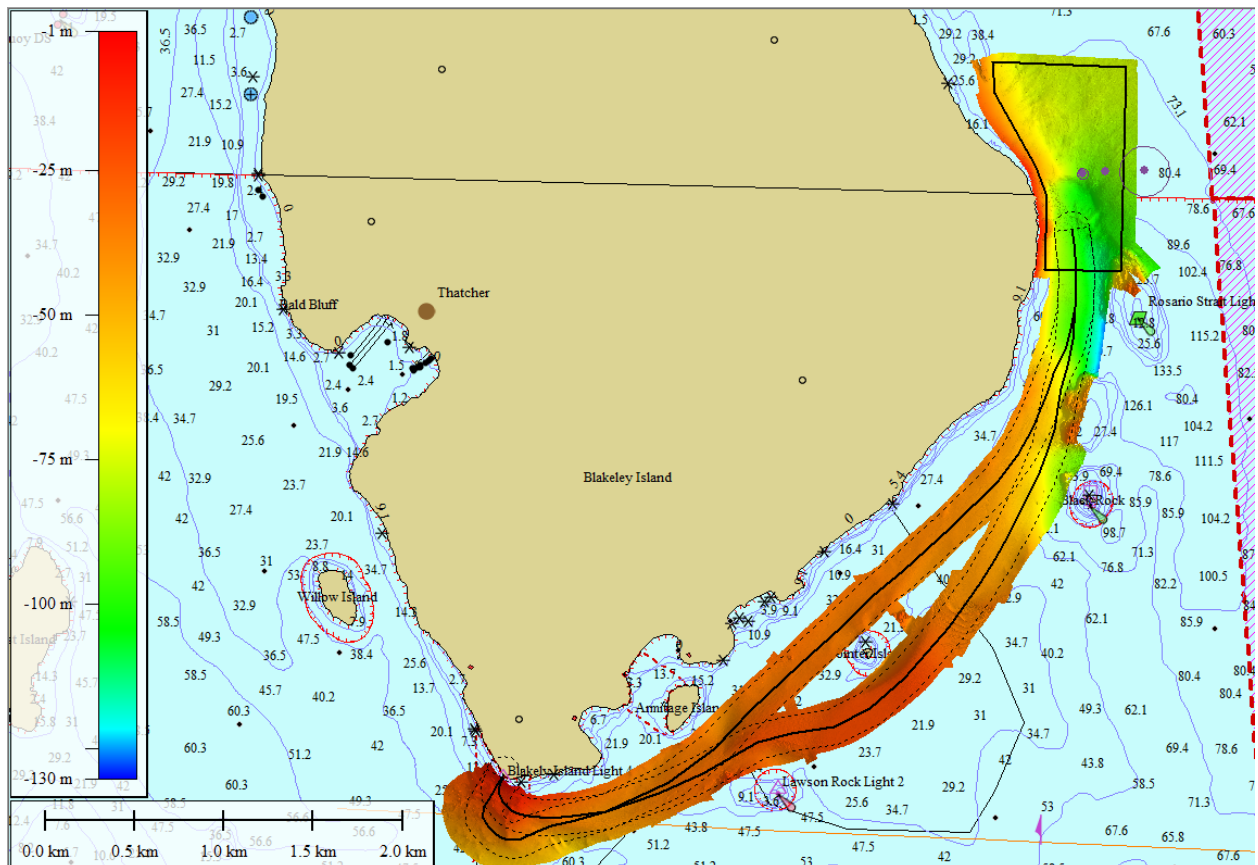


Figure 1-1. Survey Area off Blakely Island.

2. TECHNICAL APPROACH

2.1 Floating Turbine Area and Submarine Cable Route

The floating turbine area and cable route were modified based on a project kick-off call on August 28, 2024. Tetra Tech reviewed the revised survey area and anticipated weather conditions and proposed a survey plan based on OPALCO and Orbital requirements. The contract cable route was modified by Tetra Tech prior to the start of survey activities based on initial desktop review of existing seabed data. Following review of preliminary bathymetric data along the contract route and noting bedforms across the corridor, an additional cable route was proposed by Tetra Tech to provide potential route options. Both the contract route and the additional route were proposed to and approved by OPALCO prior to being surveyed.

The floating turbine area was located just off the east coast of Blakely Island. The area was roughly 0.3 miles (mi) (0.4 km) to 0.5 mi (0.8 km) across and 0.7 mi (1.1 km) in length. The approximately 3.4 mi (5.5 km) long submarine cable route will connect to terrestrial infrastructure at the southern end of Blakely Island and extend to the floating turbine area. A 328 foot (ft) (200 meter [m]) wide corridor centered on both route options was surveyed.

2.2 Hydrographic and Geophysical Survey Narrative

The project survey timeline is presented in Table 2-1. The MBES bathymetric survey and sub-bottom profiler (SBP) geophysical surveys were conducted between October 14, 2024, and October 26, 2024. Vessel and equipment mobilization and demobilization were conducted at Tetra Tech's warehouse in Woodinville, WA and at the Cap Sante marina in Anacortes, WA. Daily safety tailgate meetings were conducted prior to vessel departure on all survey days.

Table 2-1. Project Timeline.

Date	Activity	Note
28 August 2024	Pre-Survey Kick-Off Meeting	
14 October 2024	MBES mobilization and calibration commence in Anacortes, WA	Safety orientation and review of Incident Prevention Plan held for all on-signers.
15-25 October 2024	Survey Operations	Daily Safety Tailgate meeting prior to departure
26 October 2024	Demobilize personnel, equipment and research vessel from Anacortes, WA	

2.3 Personnel

Key project personnel and roles are listed in Table 2-2.

Table 2-2. Key Project Personnel.

Role	Name
Client Manager	Robert Feldpausch
Project Manager, Principal Marine Geologist	Joanna Hobson
Deputy Project Manager, Geologist	Marcus Osmaston

Role	Name
USCG-Certified Captain	Guy Piercey
Field Lead, Hydrographer	Cory Graves
Hydrographer, WA State PLS	Ben Churchwell
Geophysicist	Chris Kenyon

2.4 Survey Equipment

The equipment used to complete the survey efforts is summarized in Table 2-3, and survey software packages used for data acquisition and processing are summarized in Table 2-4.

Table 2-3. Survey Equipment.

Equipment	System(s)	Details
Multibeam Echosounder	R2Sonic 2026	170-450 kilohertz (kHz) (selectable) 0.45 x 0.45° beamwidth and TruePix enabled
Sub-Bottom Profiler	Innomar medium-100	4-100kHz (selectable HF/LF) Range resolution up to 5 cm
Heading and Motion Reference System	SBG Ekinox 2-D	Pitch, roll, and heading (yaw) accuracy of <0.02°. Heave accuracy of 5 centimeters or 5%, whichever is greater for period of 20 seconds or less.
Sound Velocity Profiler	YSI Castaway CTD	Conductivity, temperature, depth, and sound velocity
Sound Speed Sensor for MBE	Valeport, MiniSVS	Direct velocity measurement
RTK Rover QC	Trimble R10	Connected to Washington State Reference Network

Table 2-4. Survey Software.

Requirement	Software
MBE Acquisition and Processing	QPS QINSy
Multibeam Echosounder Processing (soundings and GNSS data)	QPS Qimera, SBG Qinertia
SBP Acquisition	SESWin
SBP Processing (interpretation of horizons)	Chesapeake SonarWiz
Data Deliverables, Production, QC	Surfer, ArcGIS, custom software as necessary.

2.5 Survey Vessels

The 27-foot survey vessel, *Streak*, shown in Figure 2-1, was mobilized to Anacortes, WA. Calibrations, including a multibeam patch test, were completed before commencing the hydrographic and geophysical surveys.



Figure 2-1. Tetra Tech Survey Vessel.

2.6 Geodesy

The project geodesy is presented in Table 2-5.

Table 2-5. Survey Geodesy.

Parameter	Setting
Projection	State Plane
Zone	Washington North (FIPS 4601)
Horizontal Datum	NAD83 (2011)
Vertical Datum	NAVD88 (Geoid18)
Distance Unit	U.S. Survey Feet
Depth Unit	Feet
Geoid Model	2018-CONUS

2.7 Survey Control and Validation

Vertical and horizontal positioning were achieved using a high-accuracy global navigation satellite system (GNSS) with real-time kinematic (RTK) corrections from the Washington State Reference Network (WSRN) utilizing a single station/mount point located on San Juan Island. Radio Technical Commission for Maritime Services (RTCM) corrections were received via cellular data network from station “SANJ.”

Prior to the start and again at the end of the survey effort, the QC point located in Anacortes, WA (Figure 2-2) was occupied with the RTK GNSS Rover and the measured position compared to the

published position shown in Table 2-6. The GNSS Rover was later used to QC the positioning derived from the navigation and data acquisition systems aboard the survey vessel. The offsets between the measured and recorded positions are provided in Table 2-7. These QC efforts documented that the GNSS system provided positional accuracy of better than 0.1 feet horizontal and 0.2 feet vertical, which was within positioning tolerance for the system and survey effort.



Figure 2-2. Survey Control Point.

Table 2-6. Survey Control Point.

Control Points	Northing (feet)	Easting (feet)	Elevation (NAVD88/feet)
Monument ID: 2488	556705.078	1209215.311	18.563

Table 2-7. GNSS QC Results.

Trimble R10 Rover RTK QC	Northing (US ft)	Easting (US ft)	Elevation (NAVD88/ ft)	Delta North. (feet)	Delta East. (feet)	Delta Elev. (feet)
GPSQC-10142024	556705.096	1209215.347	18.451	-0.018	-0.036	0.112
GPSQC-10252024	556705.092	1209215.357	18.459	-0.014	-0.046	0.104

2.8 Survey Vessel Offsets and Validation

An Inertial Measurement Unit (IMU) was used to define the origin and orientation of the X, Y, and Z axes of the vessel’s local reference frame. The offsets, measured in feet, used for the QINSY hydrographic survey software and hardware setup are provided in Table 2-8. These measurements were also used in the Qimera hydrographic data processing software Vessel Configuration File (VCF) during processing of the multibeam data.

Table 2-8. Streak Sensor Offsets (in feet).

Sensor	Across (Starboard Positive)	Along (Forward Positive)	Vertical (Down Negative)
R2Sonic 2026 Tx	-1.503	2.195	-5.810
Innomar medium-100 acoustic center	-10.21	-1.46	-6.270
Motion Sensor / Navigation (SBG Ekinox 2-D)	0	0	0

2.8.1 MBE Quality Control Procedures

2.8.1.1 MBE Positional Check

Positional quality control procedures were performed while the vessel was static on the trailer to confirm vessel offsets and geodetic parameters were correctly calculated (Figure 2-3 and Table 2-9). The parameters were then entered into the vessel navigation and multibeam acquisition software. This procedure comprised comparing independent RTK GNSS Rover shots on the acoustic center of the sonar to the positions being reported at the acoustic center of the sonar by the vessel navigation and multibeam acquisition software.

**Figure 2-3. MBE Positional Quality Control.****Table 2-9. Streak Sensor Offsets.**

Sensor	Northing (US ft)	Easting (US ft)	Vertical (feet)
Rover RTK at R2Sonic 2026 Acoustic Center	283734.946	1315799.830	135.839
Qinsy Vessel Acquisition Software at R2Sonic 2026 Acoustic Center	283734.870	1315799.910	134.930
Difference between Rover AC and Vessel AC	-0.076	0.080	0.091

2.8.1.2 MBE Bar Check

A MBE Bar Check test was conducted to verify the operation and accuracy of the MBE sonar. A Bar Check is completed by suspending a reflective metal plate at a known depth below the sonar head. A measurement was taken using the survey software, correcting for the measured distance of the sonar below the water surface. The sonar depth was determined by measuring the depth of a defined point on the sonar mount, then adding the known vertical offset between the point position and the sonar acoustic center. This offset was then added to the depth reported by the sonar and compared to the depth of the acoustic target. The bar checks verified that the sonar was accurately measuring depths (Table 2-10).

Table 2-10. Vessel Bar Check Results.

Date	QINSy Measured Depth	Sonar Draft	Total Draft (feet)	Bar Depth (feet)	Delta (feet)
14-October	6.89	3.02	9.91	10	0.089

2.8.2 MBE Patch Test

A standard MBE patch test, also known as an installation calibration test, was carried out to calculate and resolve the angular offsets between the MBE and the motion reference unit (MRU). The installation calibration process consists of running a series of parallel and reciprocal lines over distinct features and is used to derive the roll, pitch, and yaw angular offsets between the multibeam sonar and the local reference frame defined by the MRU's IMU (Figure 2-4). The installation calibration tests are also used to determine latency in the positioning equipment. The sonar, positioning system, and data collection computer are all time-synchronized to GPS Coordinated Universal Time (UTC), which should result in a zero-position latency (Table 2-11).

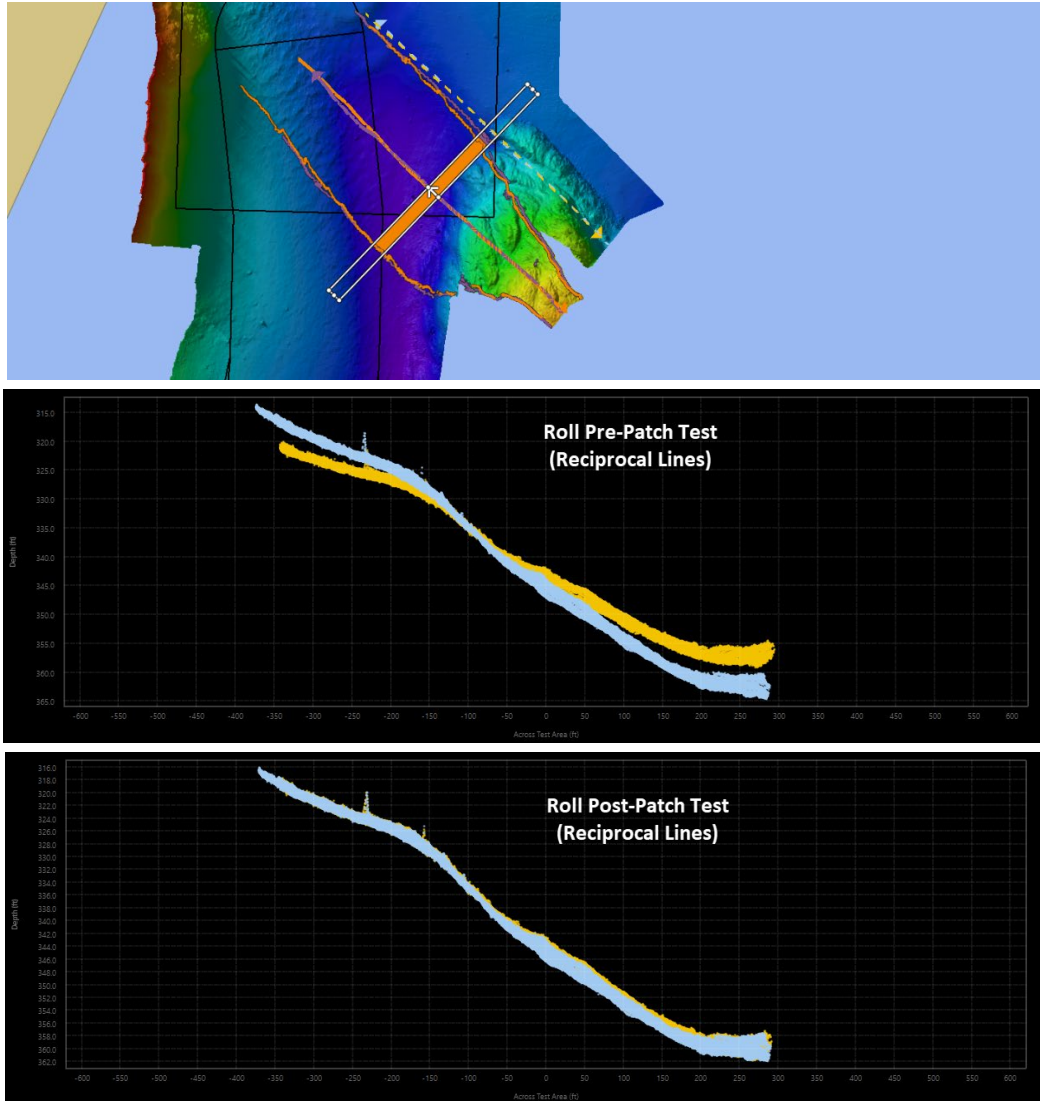


Figure 2-4. Patch Test: Top – 2D view of test location showing area of comparison (orange). Middle – Pre-Patch comparison of two lines, yellow and blue showing offset. Lower – Post-Patch comparison with yellow and blue in good alignment.

Table 2-11. MBE Patch Test Calibration Results.

Device	Date	Latency (seconds)	Roll (degrees)	Pitch (degrees)	Yaw (degrees)
R2Sonic 2026	15-October	0.00	-0.420	2.36	2.890

2.8.3 Sound Speed Casts

Changes in sound speed through the water column affect the MBE’s individual beams in both the angle and distance calculated from the propagation times. To compensate for these effects, data processing must model the effects as a function of beam launch angle and time. To implement these

calculations, sound speed profiles were recorded through the water column using conductivity, temperature, depth (CTD) sensors from which sound speeds versus depths are derived. Sound velocity casts were performed using a CastAway-CTD device at the start and end of data collection each day, minimum, and additionally as needed. Nine sound speed casts were taken during the Blakely Island survey. Cast results are shown in Figure 2-5, plotting sound speed in ft/s against depth.

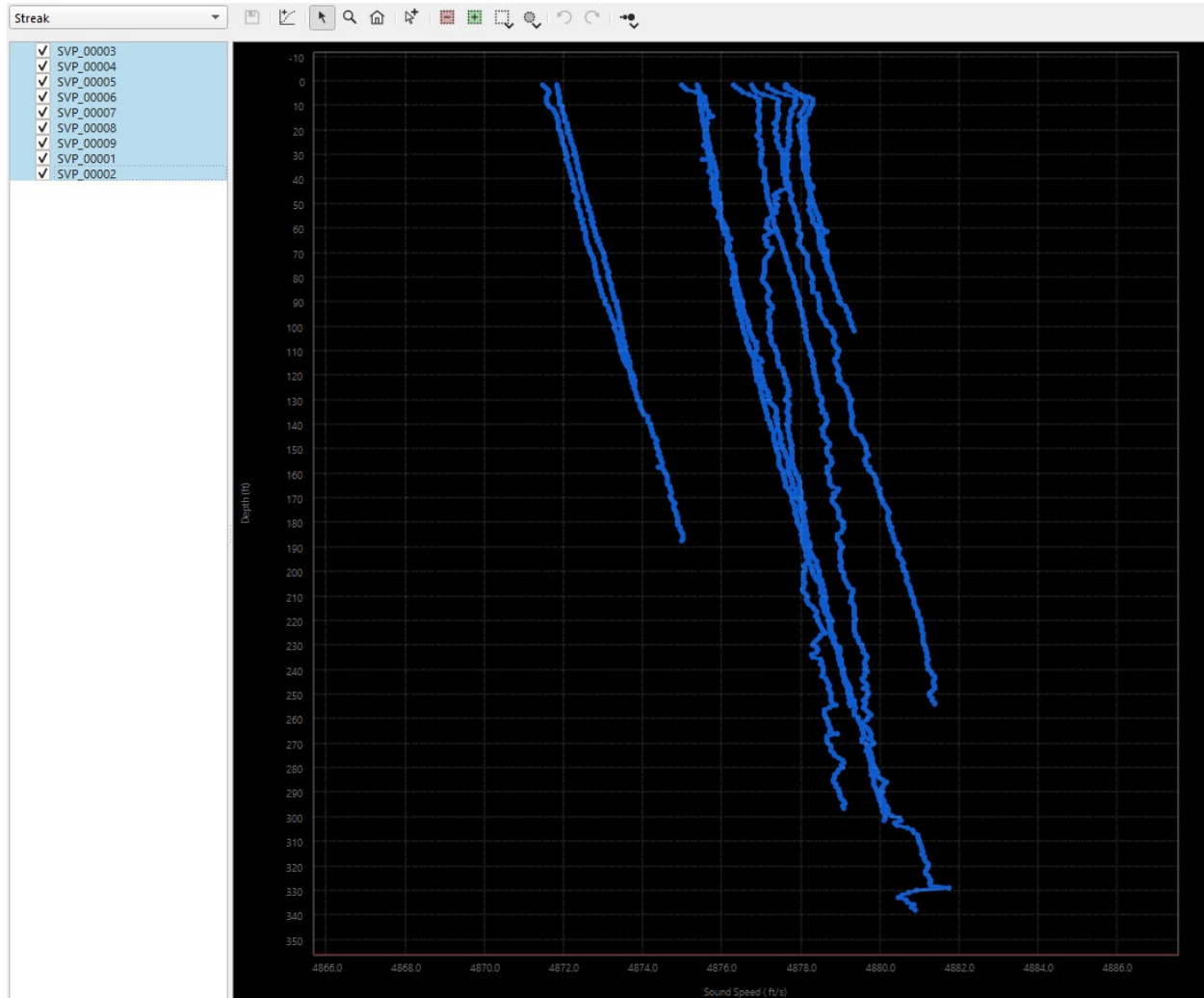


Figure 2-5. Sound Speed Casts.

2.8.4 MBE Data Processing

An SBG Ekinox 2-D inertial navigation system with RTK corrections from the WSRN, station SANJ, were used for real time horizontal and vertical positioning of the survey data. Following the survey, the real-time inertial navigation data were post-processed using the base station RINEX files to improve accuracy using SBG Qinertia software. The post processed positioning and attitude solution was applied to the data in Qimera and the sounding data were then filtered and reviewed to remove clearly erroneous soundings.

Accuracy and precision are a function of the positioning and attitude measurement errors, timing errors, water depth, and sound speed profiles through the water column. To confirm accuracy and precision, Tetra Tech performed additional QC measures after the data were post processed. This method compares the final surface to a processed data cross line that provides a statistical analysis to confirm the effort met or exceeded project specifications based on International Hydrographic Organization and US Army Corps of Engineers (USACE) EM 1110-2-1003 standards. Blakely Island MBES data passes IHO S-44 ‘Special Order’ requirements, the second most stringent standard for hydrographic data. A crossline statistical analysis produced in the Qimera software is provided as Figure 2-6.

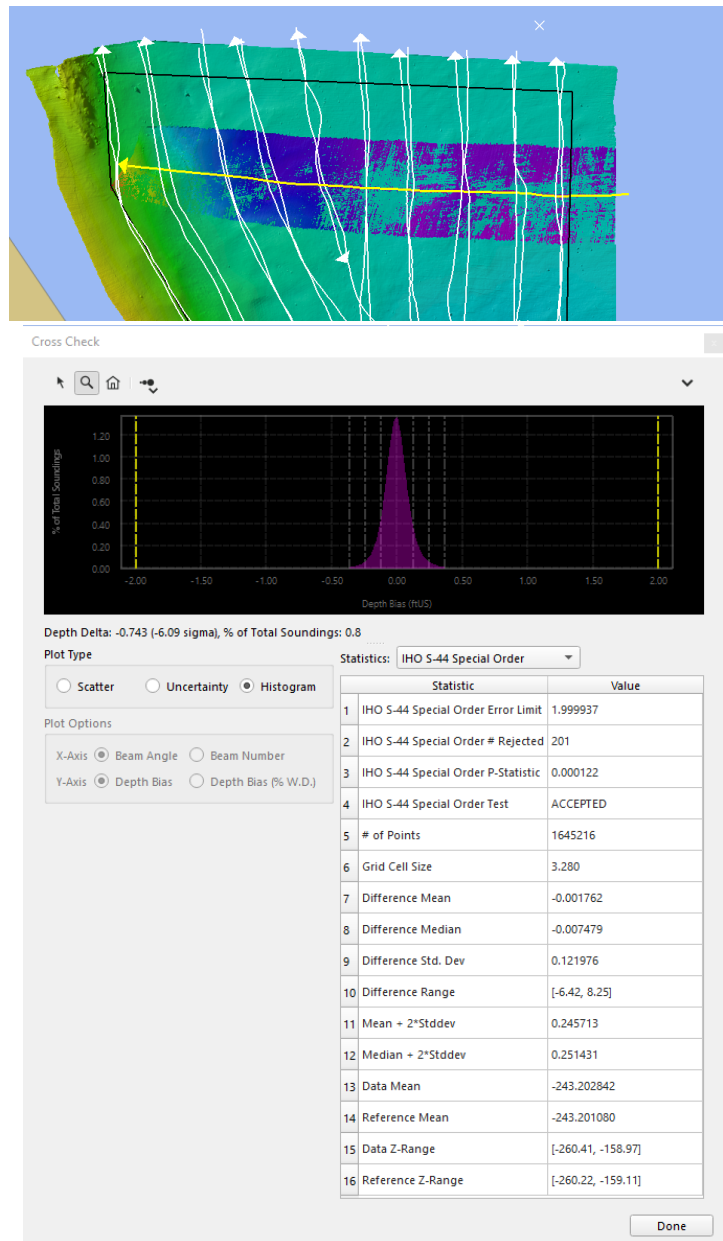


Figure 2-6. Crossline Statistical Analysis on MBE Data.

2.9 Geophysical Data Acquisition

The shallow subsurface investigation was conducted in the turbine area using an Innomar SBP to assess sediment stratigraphy and, if possible, depth to bedrock. Data were collected along east-west transects spaced nominally at 100 ft (30 m) intervals, with three north-south crosslines (Figure 2-7). Additional SBP transects were run along the two route options during testing of the SBP and to assess stratigraphy along the routes. These transects were not part of the scope of work and the data were not processed fully but the data are available and can be fully processed at some point later in the project with additional funding from OPALCO, if needed.

As part of the mobilization, test data were collected with the Innomar SBP using various settings to determine which configuration provided the highest quality data in the project area. Multiple frequencies, from 6 kHz to 15 kHz, were tested in both shallow and deep-water areas. A frequency of 10kHz was determined to provide an optimal balance between seabed penetration and resolution and this setting was used on all lines in the survey area.

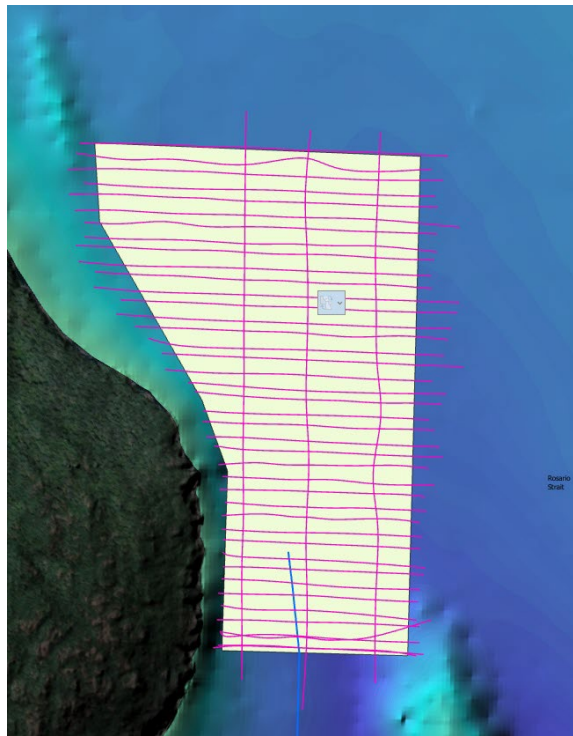


Figure 2-7. SBP Transects in the Turbine Area.

2.9.1 Multipulse Method

In the deepest water, a method called “multipulse” was used to improve sample rate and resolution. The multipulse setting transmits multiple pings without having to wait for each return ping, and is therefore useful in deep water situations which might otherwise reduce ping rate and along-track data density. This method was used to maintain a consistent sample rate during the SBP survey. Multipulse methods were only used in water depths greater than approximately 148 ft (45 m). Due to the

limitations of multipulse, which are most suitable in water depths >3 times the recording window, this mode was not used in shallow water to avoid “cutting out” data from sub-bottom depths of interest.

2.9.2 Geophysical Data QC

Data quality review and interpretation were conducted in SonarWiz software. Reflectors in the subsurface stratigraphy indicate a boundary between sediments with different properties (e.g., sediment grain size, density, porosity, etc.). Crosslines were run throughout the survey area to QC the accuracy and repeatability of depth soundings and reflector detections. The two crosslines run in the route area showing good correlation with a surface feature and its subsurface reflectors.

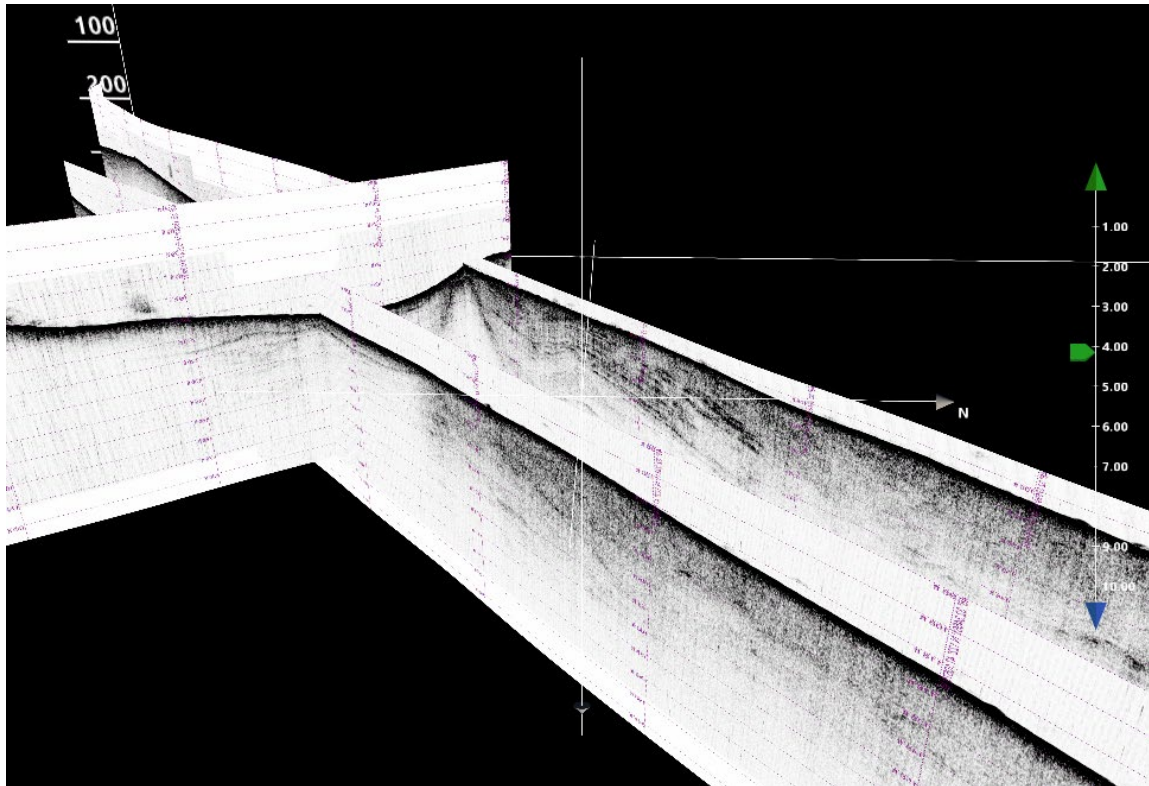


Figure 2-8. SBP Crossline QC.

3. DATA INTERPRETATION

3.1 Significant Features and Targets

The multibeam bathymetry and backscatter data were assessed for significant features such as potential anthropogenic debris, wrecks, sediment bedforms, and other features. While no anthropogenic debris, such as wrecks or fishing debris, were detected, and therefore no specific targets were identified for tabulation, some significant features were detected in the MBE data that will need to be considered during cable route design.

Sediment bedforms were observed on the contract route near Lawson Rock and Point Island (Figure 3-1, eastern route) that were not visible in the background bathymetry. These sediment waves indicate sediment movement in the cable corridor which could impact cable safety and therefore should be avoided, if possible. Following review of the preliminary MBE data, OPALCO approved a contract modification to collect MBE data along an additional route to the west (Figure 3-1, western route). The sediment waves do not extend across the additional data and therefore the additional data provides safer route options for the cable.

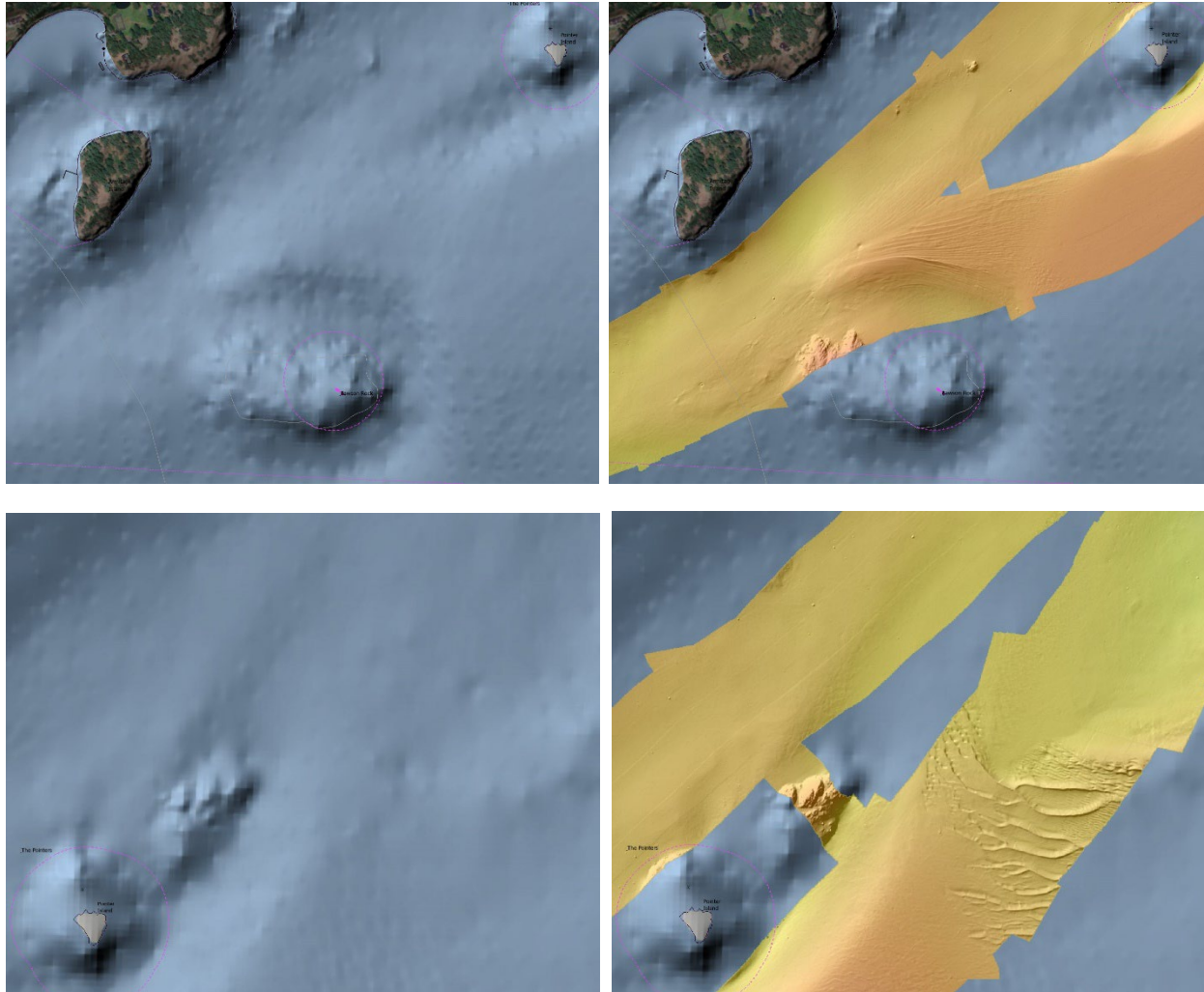


Figure 3-1. Sediment Waves Not Visible in Background Bathymetry (left) Were Detected in MBE Data (right).

Numerous boulders assumed to be glacial erratics were detected throughout the survey area. These features ranged in size from a few feet to nearly 50 feet, with the greatest concentration near the submarine cable landing in Thatcher Pass. These features were clearly visible in the MBE bathymetric data and presented as dark, discrete targets in the backscatter data (Figure 3-2). Further to the north

along the cable route and in the turbine area these features were more widely scattered. The cable route has been revised to avoid the glacial erratics, where possible.

Also visible in the bathymetric and backscatter data collected at the cable landing were furrows interpreted to be two existing submarine cables running from the cable landing to the southwest towards Decatur Island (Figure 3-2). The end of the conduit and other cable information provided by OPALCO was overlaid on the bathymetry (right panel of Figure 3-3) Figure 3-3. It is likely that the “Unknown cable” detected in the bathymetry data is the actual location of the de-energized transmission cable provided by OPALCO. The in-service transmission cable with telecom aligns well with the nearby furrow observed in the data. Tetra Tech was told a submarine telecommunications cable owned by Century Link also makes landfall at this location, however this cable was not detected in the survey data and no as-laid listing was provided by Century Line during this study.

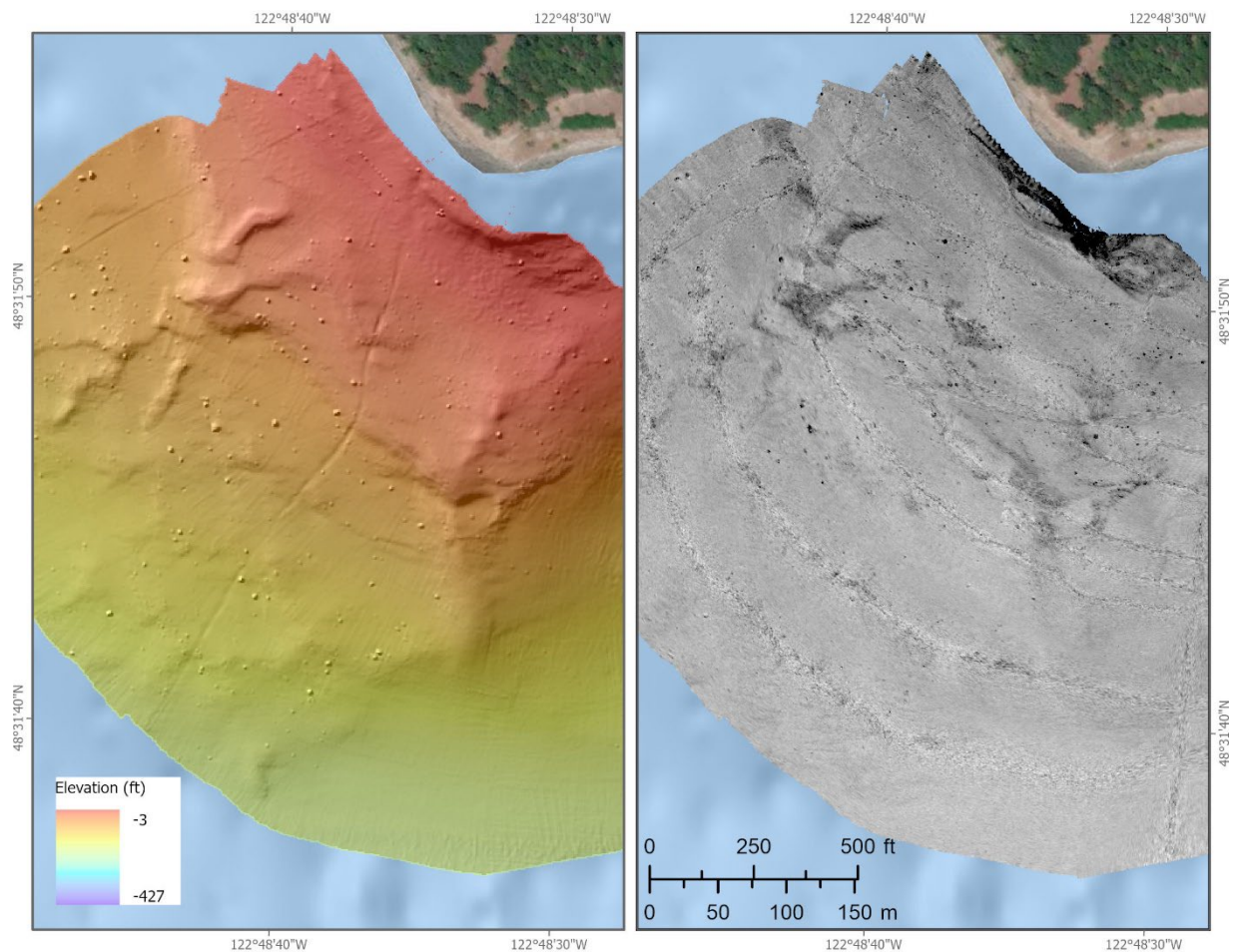


Figure 3-2. Glacial Erratics at the Cable Landing.

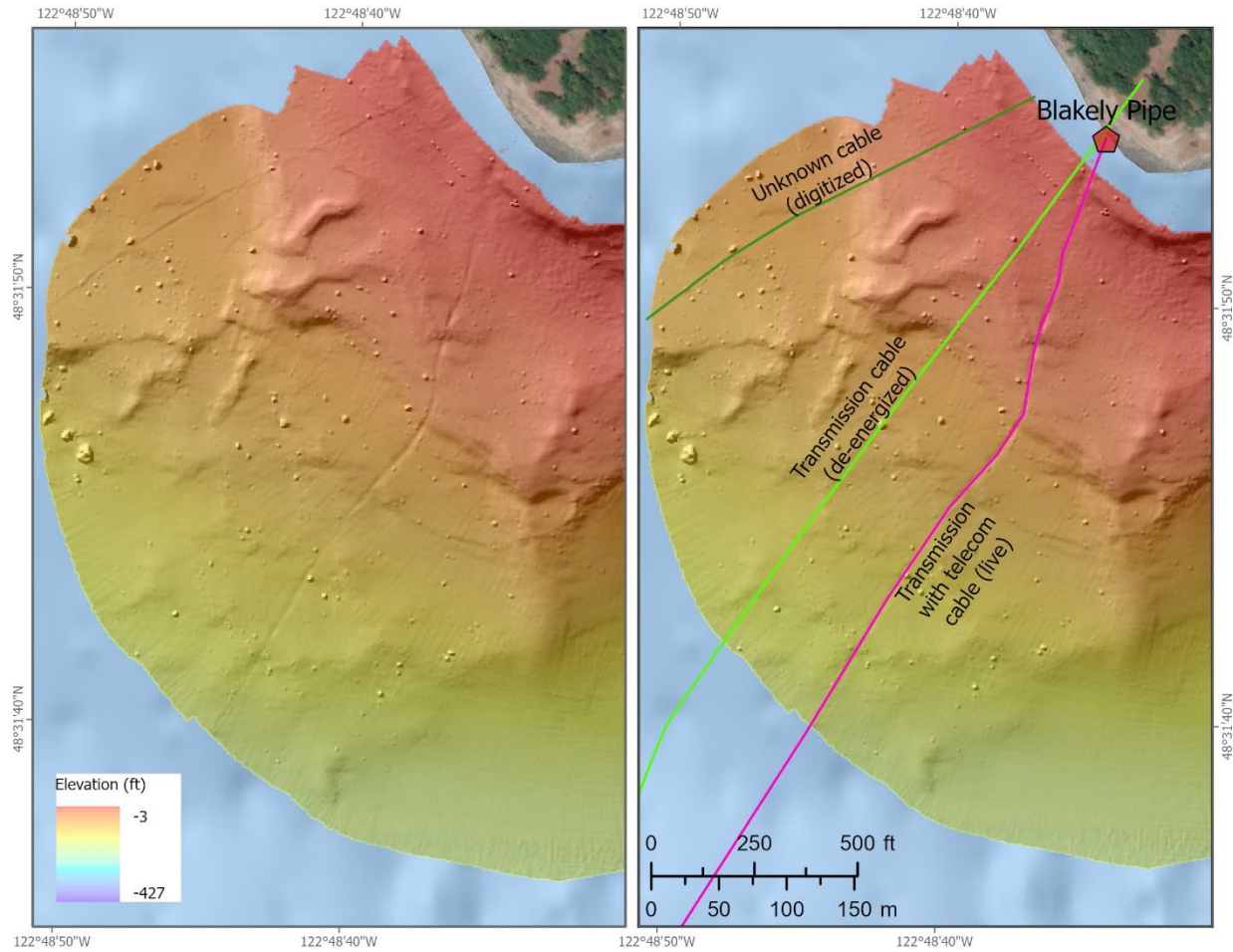


Figure 3-3. Existing Cables at the Cable Landing.

3.2 Sea Grasses and Area Notes

The cable landing area was assessed for the presence of seagrass during field operations and in the bathymetric data. No seagrass was observed or detected.

Commercial fishing activities were noted along the cable route at 48° 32 2.7235' N, 122° 47.16.0925' W. Activities consisted of 5 sets of double buoys, as seen in Figure 3-4.



Figure 3-4. Commercial Fishing Gear Noted Along Cable Route.

3.3 Sub-Bottom Interpreted Profiles

Reflectors in the subsurface stratigraphy indicated a boundary between sediments with different properties (e.g., sediment grain size, density, porosity, etc.). In the turbine area, there were few visible subsurface reflectors and penetration into the sediments was poor, suggesting a uniform hard bottom such as glacial till. It is likely that strong currents in the area scour and prevent the accumulation of fine-grained sediments over the hard layer of gravels and glacial deposits. A sub-bottom profile across the floating turbine area is shown in Figure 3-5. This profile was typical for the turbine area, where a thick hard scatter surface likely indicated a hard rocky bottom with very thin sedimentation. In comparison, Figure 3-6 shows a SBP transect located just south of the floating turbine area. Towards the south, the SBP record shows sediment layers. Towards the north end of the transect the sediments appear to have been removed, possibly scoured away by strong current activity in the turbine area.

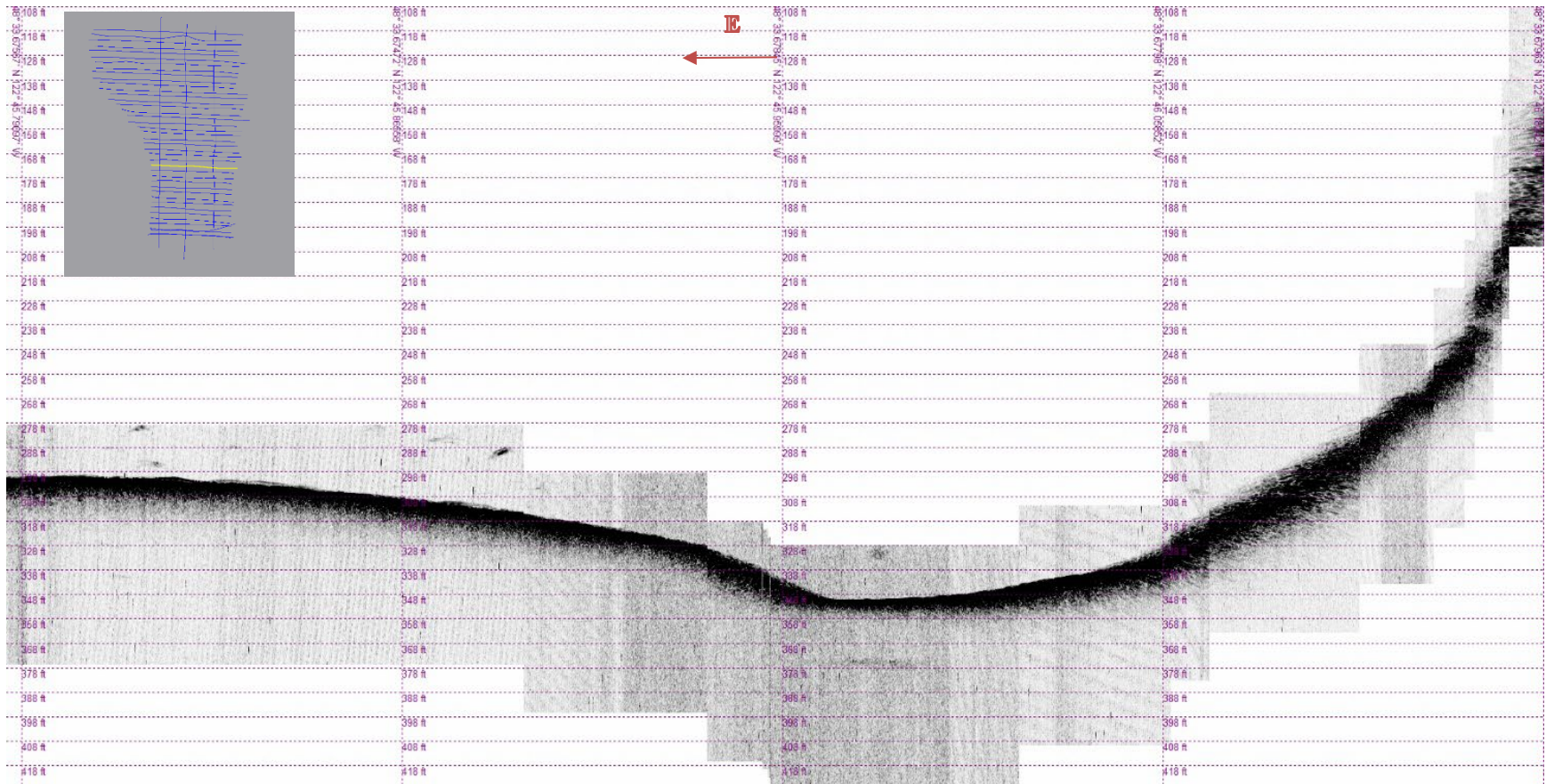


Figure 3-5. SBP Profile in Turbine Area.

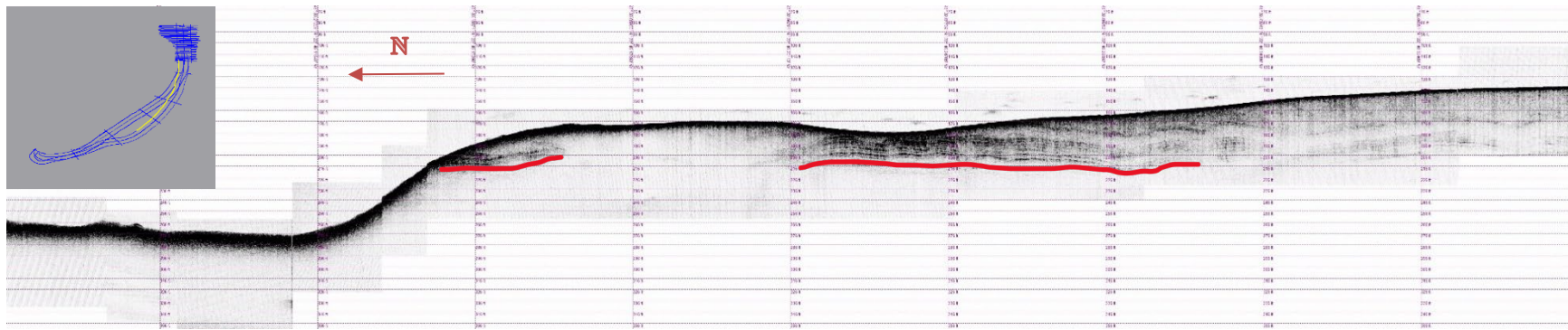


Figure 3-6. SBP Profile on Cable Route.

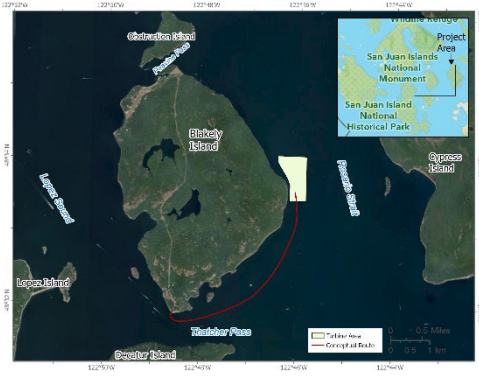
4. DATA DELIVERABLES

The survey data were incorporated into the digital project deliverables which include the following:

1. North-up hill-shaded relief chart in .pdf format (Appendix B).
2. Gridded Digital Terrain Model (DTM) in ASCII format (3-ft grid, or as appropriate for the water depths in the survey areas) (Appendix C).
3. MBE backscatter imagery in GeoTIF format (3-ft grid or as appropriate for the water depths) (Appendix D).

Significant targets detected in the MBE data were discussed in Section 3.1 and interpreted SBP profiles in areas of interest were provided in Section 3.3.

APPENDIX A: DESKTOP STUDY



FINAL

Rosario Strait Tidal Energy Project

Submarine Cable Route Desktop Study



Prepared for



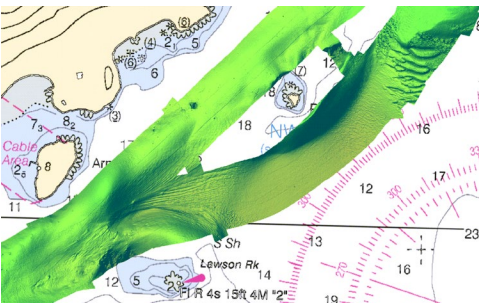
Orcas Power & Light Cooperative



Submitted by:



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February 10, 2025

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APPENDIX A: Bathymetric Profiles

Acronyms and Abbreviations

AIS	Automatic Identification System
CoNED	Coastal National Elevation Database
DNR	Department of Natural Resources
DTS	Desktop Study
ft	feet
HAPC	Habitat of Particular Concern
ICPC	International Cable Protection Committee
JdF	Juan de Fuca
km	kilometer
m	meters
MA	million years ago
MBE	Multibeam Echosounder
mi	mile
NOAA	National Oceanic and Atmospheric Administration
OPALCO	Orcas Power and Light Company
Orbital	Orbital Marine Power, Ltd.
SJI	San Juan Islands
SBP	Sub-bottom Profiler
USGS	United States Geological Survey
WA	Washington
WA DNR	Washington Department of Natural Resources

1.0 INTRODUCTION

Tetra Tech understands that Orcas Power & Light Cooperative (OPALCO) was awarded a grant through the Department of Energy to explore the feasibility of tidal energy generation in San Juan County. OPALCO is exploring tidal power as a clean, renewable source to help meet future power needs and provide resiliency for the San Juan Islands. OPALCO selected a project location in Rosario Strait off Blakely Island that will include the tidal turbine mooring area and a submarine cable that connects the turbine to existing onshore infrastructure at the southern end of Blakely Island (Figure 1-1). The tidal turbine technology being considered by OPALCO is a floating stream device developed by Orbital Marine Power Ltd (Orbital) that is currently in service in Scotland’s Orkney Islands (Figure 1-2).

OPALCO issued a contract to Tetra Tech on August 19, 2024, to perform hydrographic and geophysical surveys of the turbine area and a 656 ft (200 m) wide corridor centered on the submarine cable route. A contract modification was issued on September 10, 2024, prior to the start of survey operations to expand the turbine area. At this time a Desktop Study (DTS) was added to include gathering and review of existing environmental data and preliminary cable route siting. An additional contract modification was issued on October 23, 2024, during the bathymetric survey, to collect supplementary bathymetric data along an additional route developed during the DTS and survey based on review of the preliminary bathymetric data. The updated survey area, including the two potential submarine cable routes, is shown in Figure 1-3.



Figure 1-1. Project Location.



Source: (Orbital)

Figure 1-2. Orbital Floating Tidal Energy Turbine (Photo from Orbital).

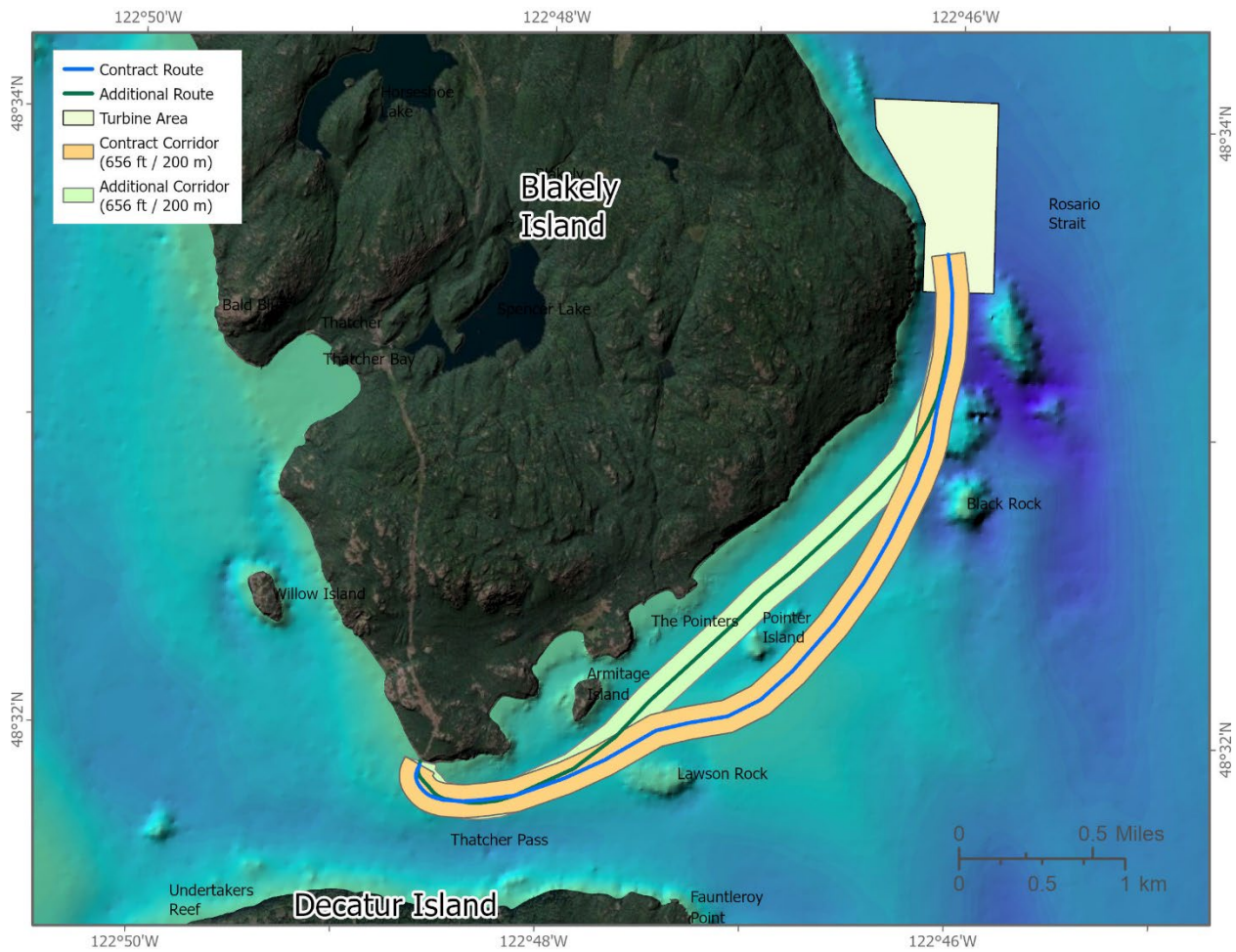


Figure 1-3. Proposed Tidal Turbine Area and Submarine Cable Route.

2.0 STUDY AREA

Blakely Island is part of the San Juan Islands, located between the U.S. State of Washington and Vancouver Island, British Columbia, Canada (Figure 2-1). Blakely Island is separated from Cypress Island to the east by Rosario Strait, from Decatur Island to the south by Thatcher Pass, from Lopez Island to the west by Lopez Sound, and from Orcas Island to the north by Peavine Pass and Obstruction Island.



Source: (By Pfly - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=15730665>)

Figure 2-1. San Juan Islands Location.

3.0 ROUTE AND LANDING SITE APPROACH

Cable route siting at this stage of a project involves compiling public domain data into a mapping system to allow the route engineer to place the planned cable following industry best practices, generally to International Cable Protection Committee (ICPC) specifications, while maximizing the overall safety and long-term survivability of the submarine cable. Survey data were also used to site the routes presented in this DTS.

The DTS was awarded just before the survey operations began, so time was focused on developing a preliminary route based primarily on publicly available bathymetry data. The United States

Geophysical Survey (USGS) Coastal National Elevation Database (CoNED) recently (2020) compiled a 1-meter topobathymetric digital elevation model (DEM) for Puget Sound based on the best available multi-source topographic and bathymetric elevation data (OCM Partners 2024). While this DEM was based on the best available bathymetric data, the resolution in the project area was fairly low. The seabed appears smooth, with only the larger bathymetric features being visible and not well-defined. National Oceanic and Atmospheric Administration (NOAA) Electronic Navigation Chart (ENC) data were overlain on the bathymetry to provide additional constraints information while developing the survey route.

The survey route descended the slope from the landing and turned towards the east-northeast, passing between Lawson Rock and Pointer Island and on to a smooth shoal, reaching a minimum depth of approximately 72 feet. The route then turned northeasterly, descending perpendicular to the slope to a depth of approximately 220 feet before turning to the north to run along a side slope, passing west of Black Rock and two other prominent rocky outcrops before entering the turbine area from the south (Figure 3-1).

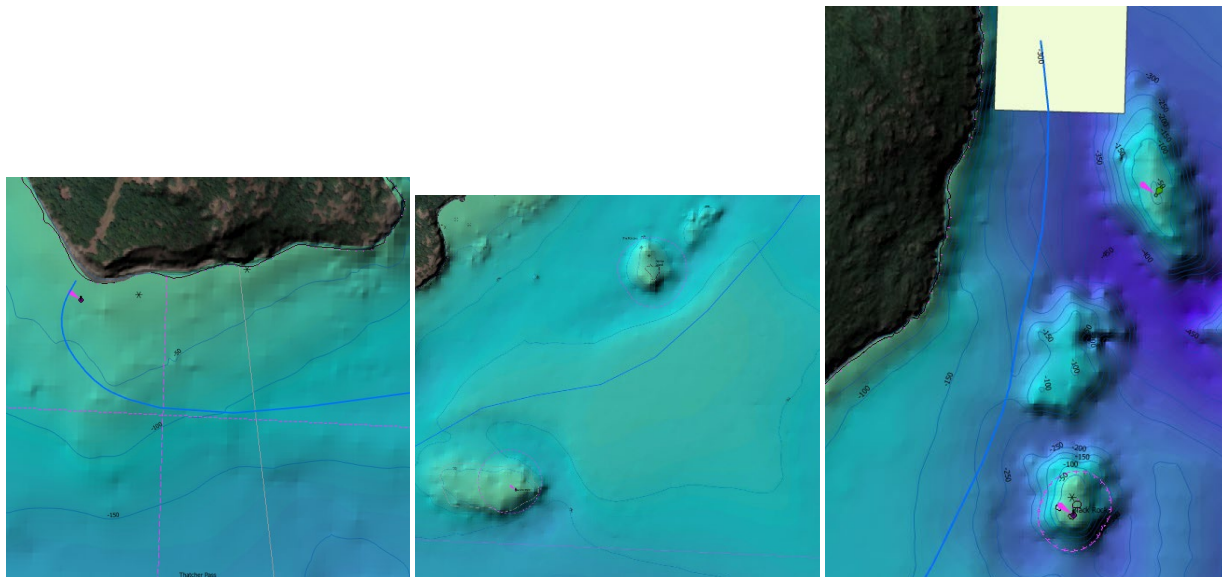


Figure 3-1. Bathymetric Data Used to Develop Survey Route.

Following acquisition of high-resolution multibeam echosounder (MBE) bathymetric data, seabed features were much better-defined showing that the original survey route crossed through areas of sandwaves that indicated sediment movement (Figure 3-2). Following review of the preliminary MBE data, Tetra Tech proposed to collect additional MBE data along a different route to the west, closer to Blakely Island, and OPALCO agreed. The additional bathymetry showed an alternate route that avoided the areas of sandwaves.

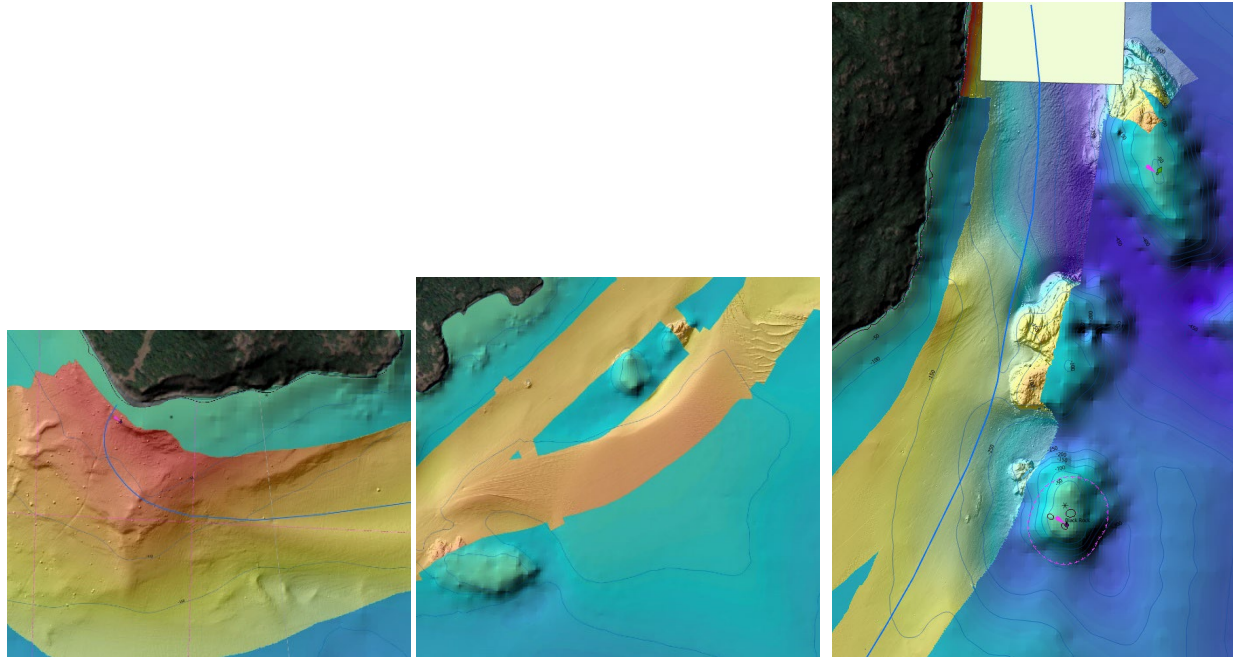


Figure 3-2. Bathymetric Data from Tetra Tech’s Survey.

The CoNED bathymetry from the turbine area suggested that the seabed was featureless and descended steeply to the south. The MBE survey data showed that there was a distinct change in seabed texture that occurs where the turbine area wraps around the easternmost point on Blakely Island (Figure 3-3). To the north, the seabed is relatively smooth with some undulations that suggest bathymetric features overlaid by a relatively thin layer of sediment. To the south the overlying sediment layer has been scoured away, revealing a textured hard bottom that extends between and around the outcrops north of Black Rock. Inshore of Black Rock, the seabed again appears to be smooth and sedimented. Sub-bottom profiler (SBP) data collected during the geophysical survey indicated that while the northern part of the turbine area appears sedimented, this sediment layer is likely very thin.

The survey data were used to microsite two potential route options within the two survey corridors, a preferred route and an alternate route. While the lengths are similar, the inshore (Western) route was selected as preferred because it avoids the sandwave fields present on the alternate route. Both routes are shown on the bathymetry chart provided in Appendix B of the Survey Report, and on the figures provided in the later sections of this DTS. Route lengths are provided in Table 3-1 and bathymetric profiles are provided in Appendix A.

Table 3-1. Route Option Statistics.

Name	Length (mi)	Length (km)
Preferred rev0	3.2	5.1
Alternate rev0	3.3	5.4

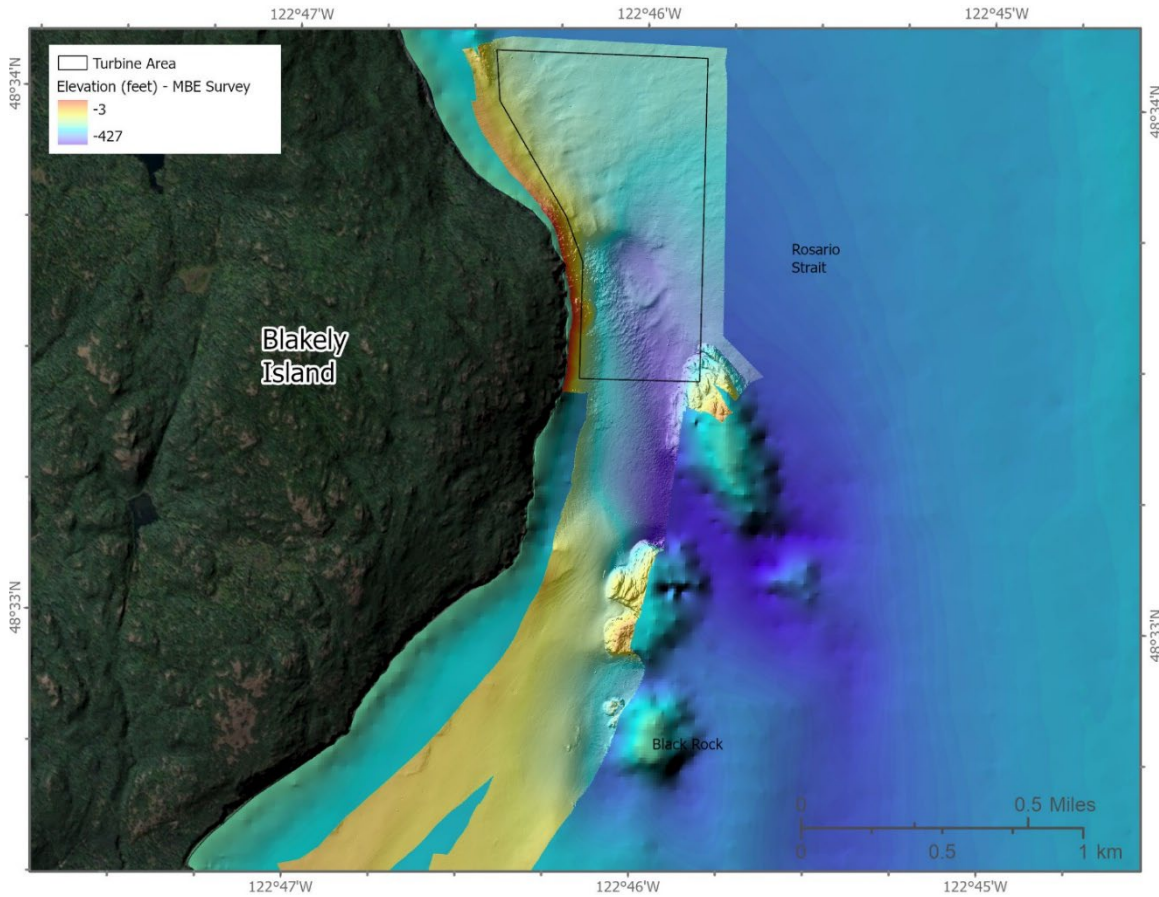
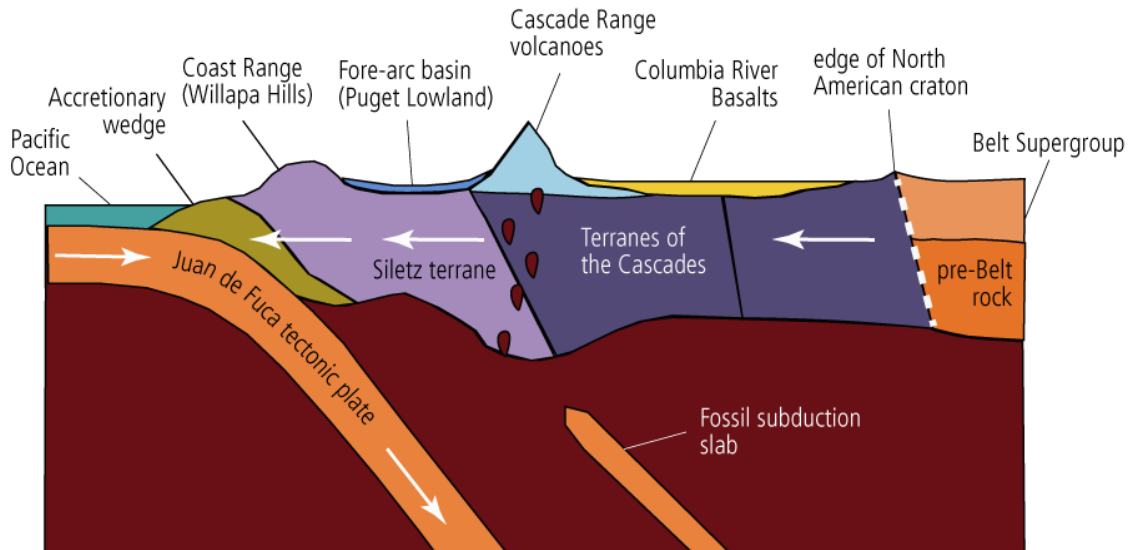


Figure 3-3. MBE Data Collected in the Turbine Area.

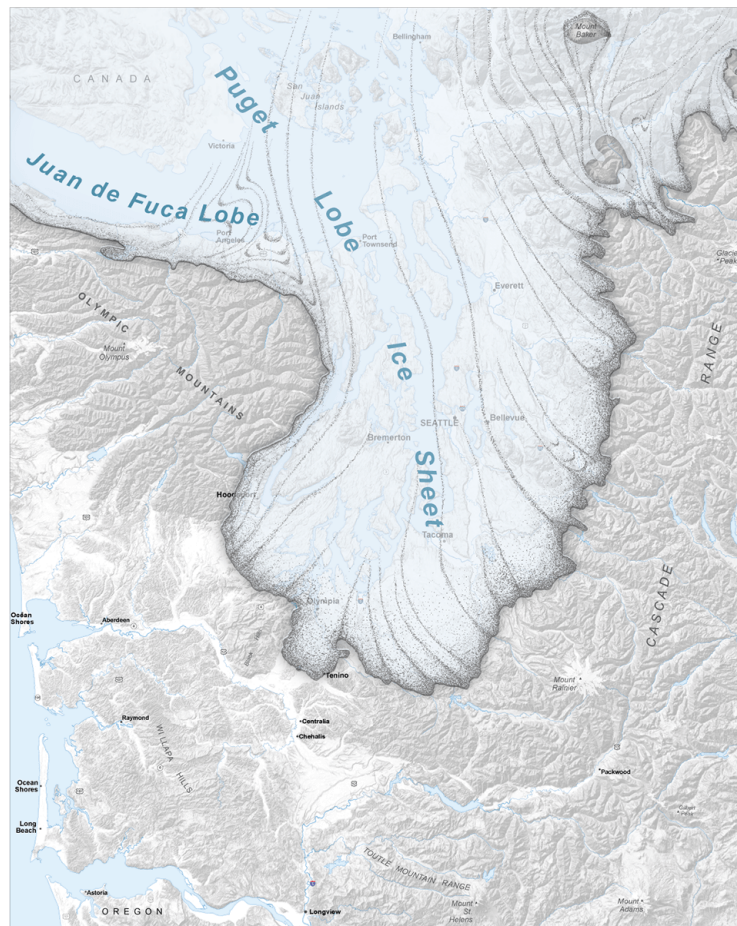
4.0 GEOLOGIC SETTING

The San Juan Islands (SJI) are considered part of the Puget Lowland Formation, a wide, low-lying area between the Cascade Range to the east and the Olympic Mountains to the west and from the San Juan Islands in the north to the southern end of Puget Sound. This area is low-lying relative to other parts of Washington for two main reasons. First, the region is in the fore-arc basin between the Cascadia subduction zone and the Cascade volcanic arc (Figure 4-1). As the Juan de Fuca (JdF) tectonic plate moves eastward and subducts beneath the North American tectonic plate, the area between is stretched and drops. The Cascadia subduction zone is a major seismic hazard for the entire Pacific Northwest and is discussed further in Section 5.2. The second reason for the low-lying situation of the Puget Lowland Formation is due to repeated continental glaciations which occurred between 30,000 and 12,000 years ago. There were at least four glacial advance/retreat sequences over the last two million years. The latest advance, the Fraser glaciation, occurred roughly 15,000 to 12,000 years ago when the Puget lobe of the Cordilleran continental ice sheet covered the Puget Sound region (Figure 4-2), with the area of modern-day Seattle being covered by 3,000 ft of ice (Washington Department of Natural Resources [WA DNR] 2017). The whole region, pushed down by the massive weight of the ice sheet, began to rebound as the glacier receded. The rate of rebound has decreased over time but is still ongoing.



Source: WA DNR 2024a

Figure 4-1. Puget Lowland Location in the Fore-arc Basin, Cascadia Subduction Zone, Washington.

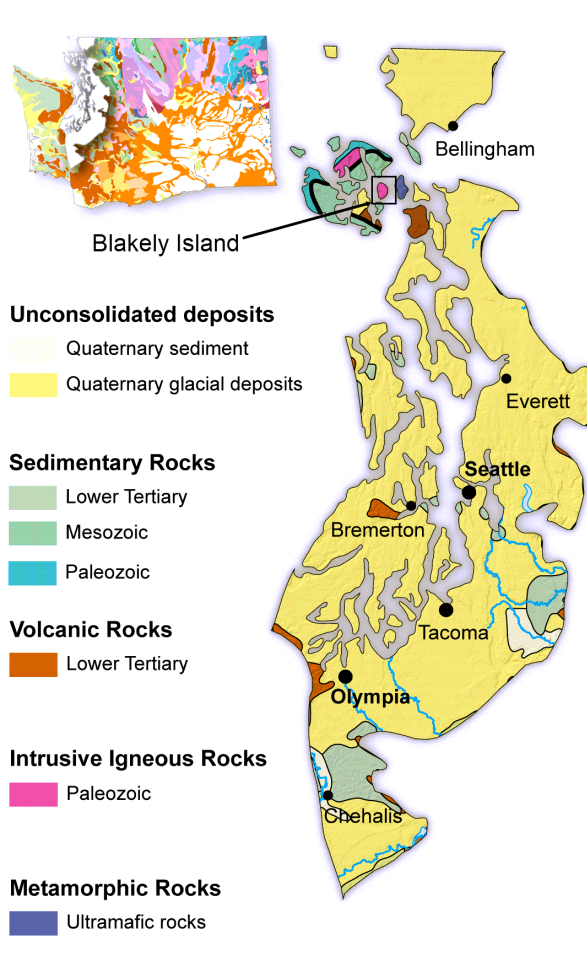


Source: <https://www.dnr.wa.gov/programs-and-services/geology/explore-popular-geology/geologic-provinces-washington/puget-lowland#glacial-features.1>

Figure 4-2. Extent of Puget Lobe During the Last Glaciation.

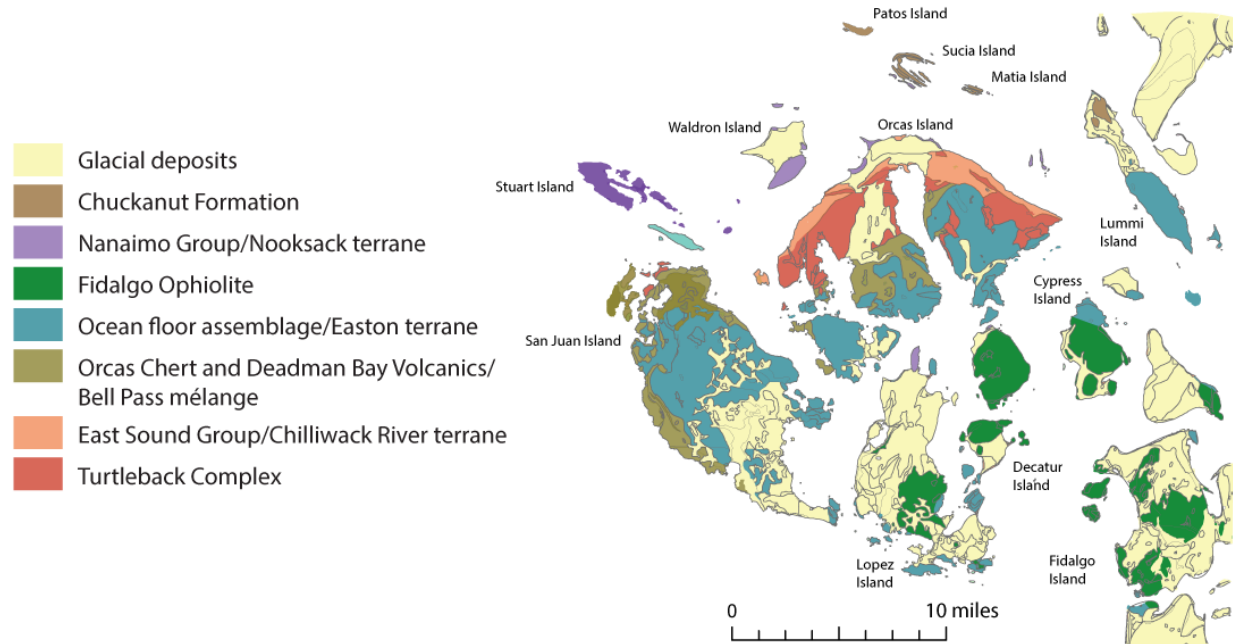
The most abundant and widespread geologic units found today in the Puget Lowland are unconsolidated sediments deposited by glaciers as they receded (Figure 4-3). Other rock types in the Puget Lowland include volcanic rocks similar to the Cascade volcanoes and metamorphic rocks. The SJI are comprised of different rocks than other areas of the Puget Lowland. They are terranes, pieces of tectonic plates that have migrated with the JdF plate and have stitched themselves to the North American plate (~100 MA). The islands survived the abrasion of glaciation because they were made up of sturdier metamorphic and volcanic rock.

Blakely Island is composed of ophiolite, which is oceanic crust that has been obducted, or thrust, onto the land rather than being subducted in a subduction zone (Figure 4-4). Ophiolite is a layered complex comprised of rocks from the upper mantle, typically green peridotite on the bottom. The middle layers include igneous rocks like gabbro and sheeted dikes. The top of the ophiolite sequence includes pillow basalts which erupted onto the seafloor, cooled quickly in the seawater to form rounded mounds. The top layers include mudstones and sandstones derived from deep sea sediment.



Source: <https://www.dnr.wa.gov/programs-and-services/geology/explore-popular-geology/geologic-provinces-washington/puget-lowland#geology.1>

Figure 4-3. Rock Types in the Puget Lowland.



Source: <https://wa100.dnr.wa.gov/north-cascades/subduction-and-accretion>

Figure 4-4. Simplified Geologic Map of the San Juan Islands.

5.0 GEOLOGIC HAZARDS

The preferred and alternate submarine cable routes traverse the seabed between the landing point on the south end of Blakely Island and the proposed tidal turbine area off the east side of the island. One of the primary goals of the DTS and hydrographic and geophysical surveys was to identify a safe and installable submarine cable route that minimizes interaction with geologic conditions and processes that could pose a potential risk to the cable. The Pacific Northwest is a geologically active region and seismic events are inevitable. These seismic events could impact a submarine cable by triggering landslides and turbidity flows on steep slopes, especially in areas with a high sediment supply, liquefaction in low-lying areas near cable landings, and tsunamis that could flood onshore cable infrastructure. Other potential hazards include steep slopes, irregular/rocky seabed and hard bottom that could cause cable spans, strumming, and abrasion, particularly in areas of strong currents.

5.1 Bedforms and Hard Bottom

Bedforms such as megaripples, sandwaves, and furrows can indicate areas of potential risk for submarine cables. Megaripples, sandwaves, and sand banks occur where currents are shifting granular sediment, posing a hazard to cables by alternately burying and unburying a cable causing excessive overburden on a cable, and increased risk of abrasion and cable spans. If possible, sediment wave fields should be avoided, but where these fields are unavoidable, other mitigation strategies, such as cable armoring, mattressing, rock dumping, or burial should be considered.

No bedforms were observed in the project area in the CoNED bathymetry data. However, the higher resolution MBE data collected during the survey showed two areas of sandwaves present across the

original route corridor near Lawson Rock and Pointer Island. Additional MBE data collected west of Pointer Island showed improved seabed with fewer bedforms (Figure 5-1).

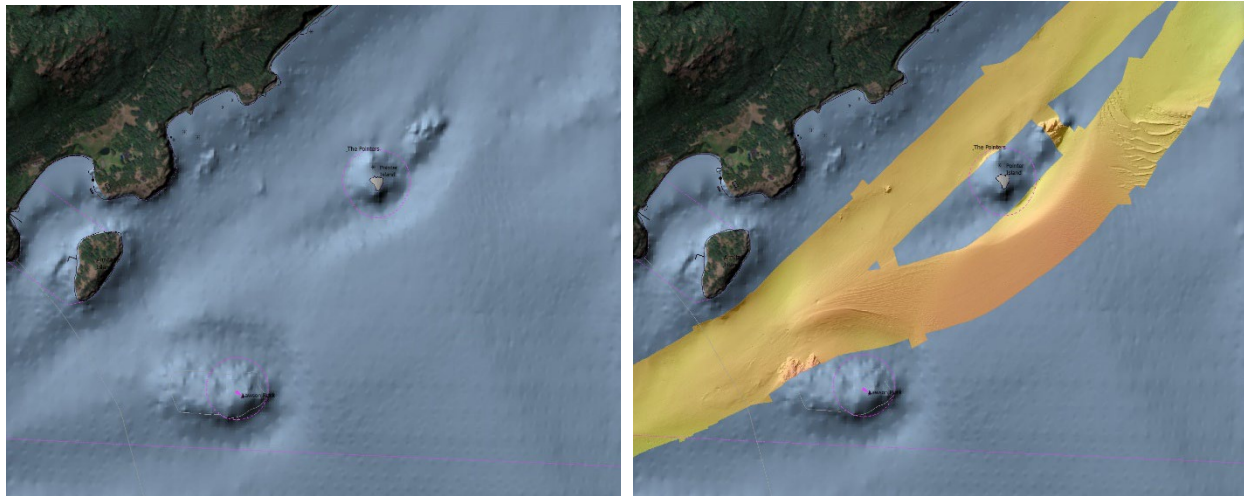


Figure 5-1. Sandwaves Detected Across Corridor on Contract Route in the MBE Data.

Furrows in the seabed could indicate presence of trawl fisheries or other fishing activity in the area, iceberg scour, anchor drag, or existing utilities on the seabed, all of which are potential hazards to submarine cables. While no furrows were visible in the CoNED bathymetry, two furrows observed in the MBE data off the cable landing were interpreted to show the presence of at least two existing submarine cables. Please refer to Section 6.3 for a discussion of known submarine cables in the project area.

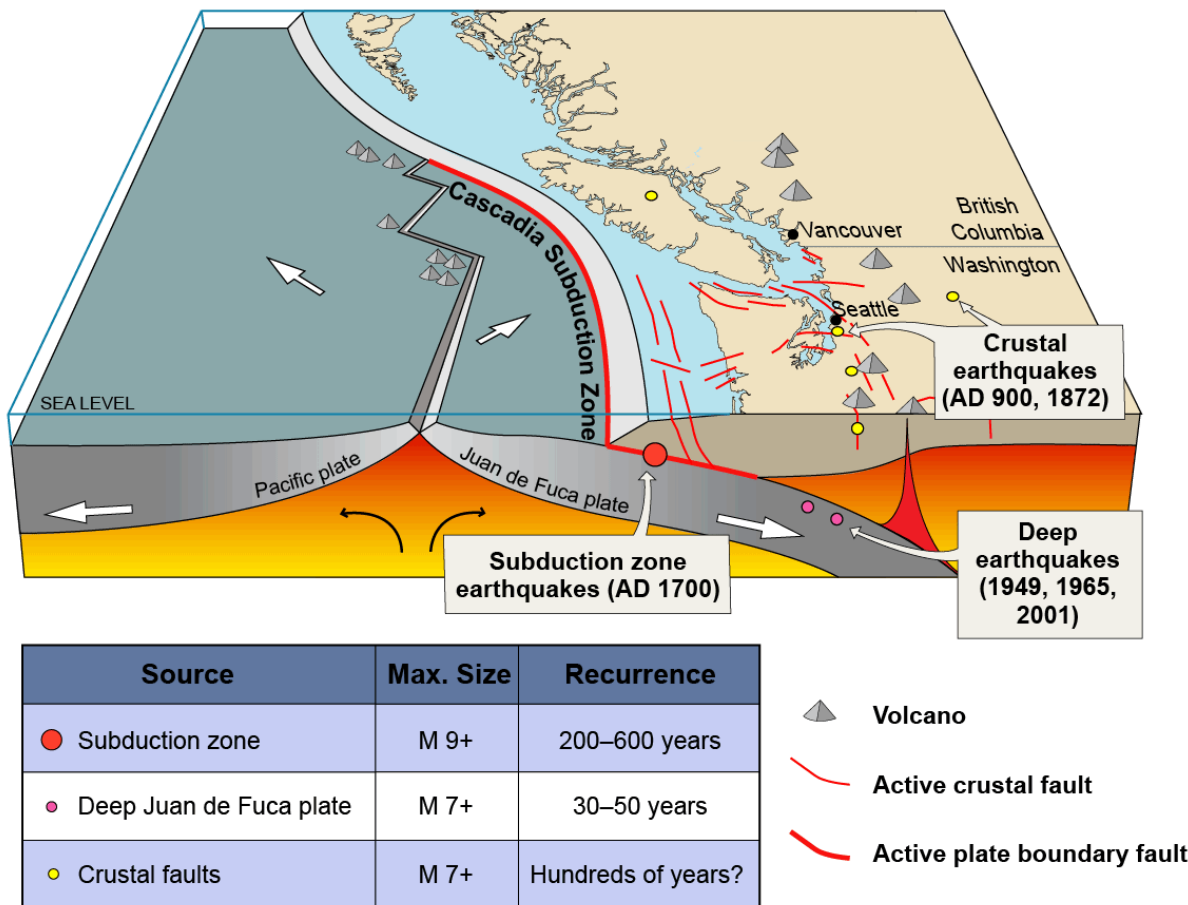
5.2 Earthquakes and Faulting

Due to the geologic setting of the Pacific Northwest, the San Juan Islands area is at risk from subduction earthquakes along the Cascadia Subduction Zone, deep earthquakes along the descending plate boundary, and shallow crustal earthquakes along surface faults and fault systems (Figure 5-2). The Cascadia Subduction Zone is the largest active fault in the Pacific Northwest region and produces infrequent but very strong earthquakes and with the potential for associated tsunamis that would impact the entire region.

Earthquakes occur nearly every day in Washington State along a network of interrelated faults. Most of these earthquakes are too small to be felt or cause damage but rare large earthquakes do occur and can cause widespread damage. Not all faults are currently active, as shown in Figure 5-3, where active faults are shown as red lines and inactive faults are shown as black lines (Czajkowski and Bowman 2014). While most of the faults around the San Juan Islands are considered inactive, the area may still be affected by seismic activity along nearby active faults. Faults are considered active by the Washington Geological Survey if they show evidence of movement within the last 12,000 years and inactive if they have an indeterminate age or have not shown movement during the Quaternary (approximately the last two million years). Faults shown in orange, blue, and purple have shown movement during the Quaternary, but not within the last 12,000 years. Washington has dozens of active faults and faults zones, including five faults/fault systems located in the Puget Lowland

geologic province and in proximity to the San Juan Islands. These systems, along with their USGS fault zone number, are shown on Figure 5-3 as follows from north to south: Darrington-Devil’s Mountain fault zone (574), Strawberry Point fault zone (571), Utsalady Point fault scarps (573), Southern Whidbey Island fault zone (572), and Seattle fault zone (570). The complete map for the state of Washington, along with a more detailed description of the data and the colors, can be found on the full chart referenced in Section 8.

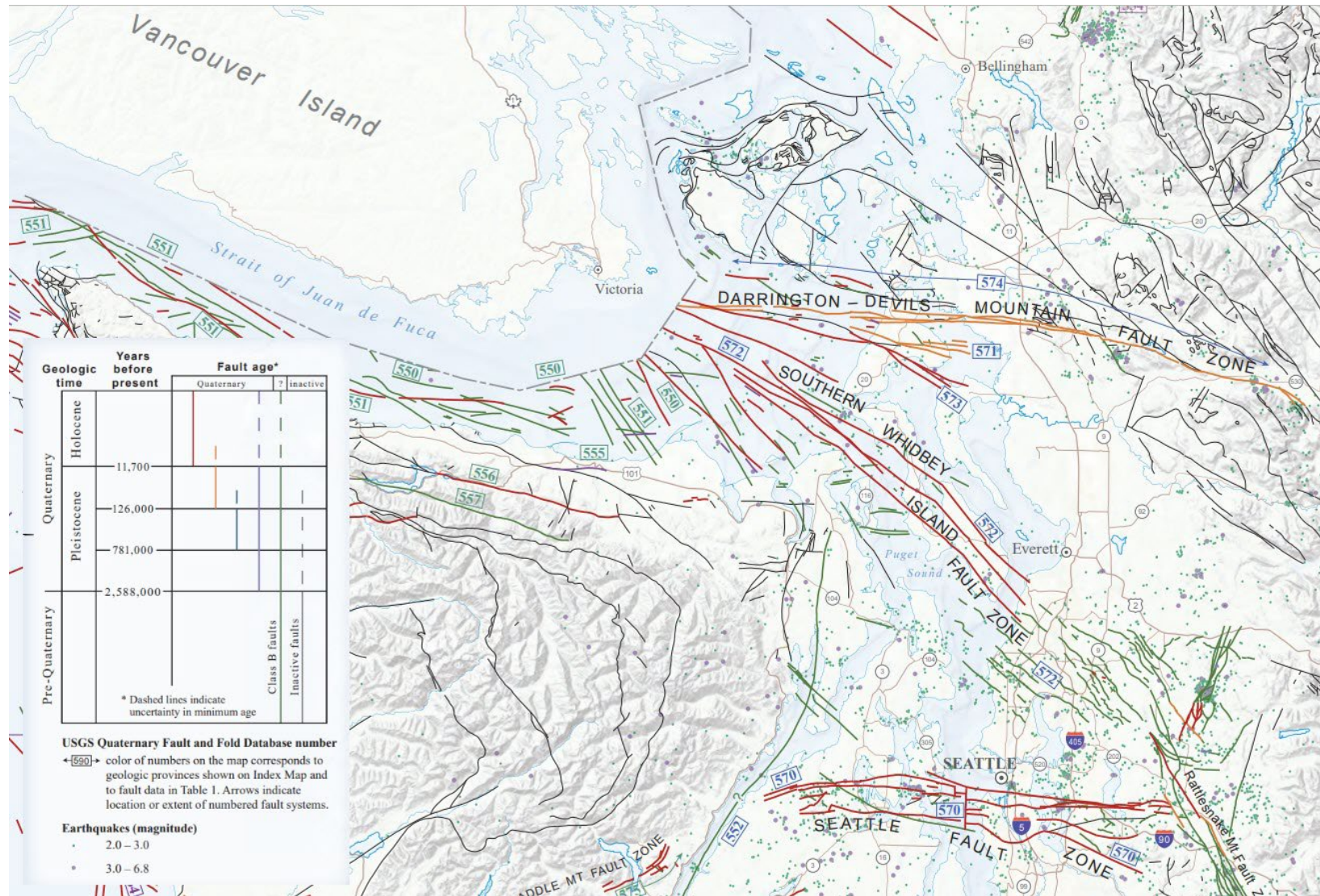
The Skipjack Island fault zone to the north of the San Juan Islands (Figure 5-4) has quite recently been shown to be undergoing active deformation. The Skipjack Island fault zone is interpreted to be the northern boundary of the San Juan Archipelago with the Devils Mountain fault zone being the southern boundary. Potential seismicity of the Skipjack Island fault zone and its proximity to the steep unstable northeastern side of Orcas Island and the southern front of the Fraser River Delta poses a geohazards problem in the form of earthquakes, landslides, submarine slides, and tsunamis (Greene and Barrie 2020).



*figure modified from USGS Cascadia earthquake graphics at <http://geomaps.wr.usgs.gov/pacnw/pacnweq/index.html>

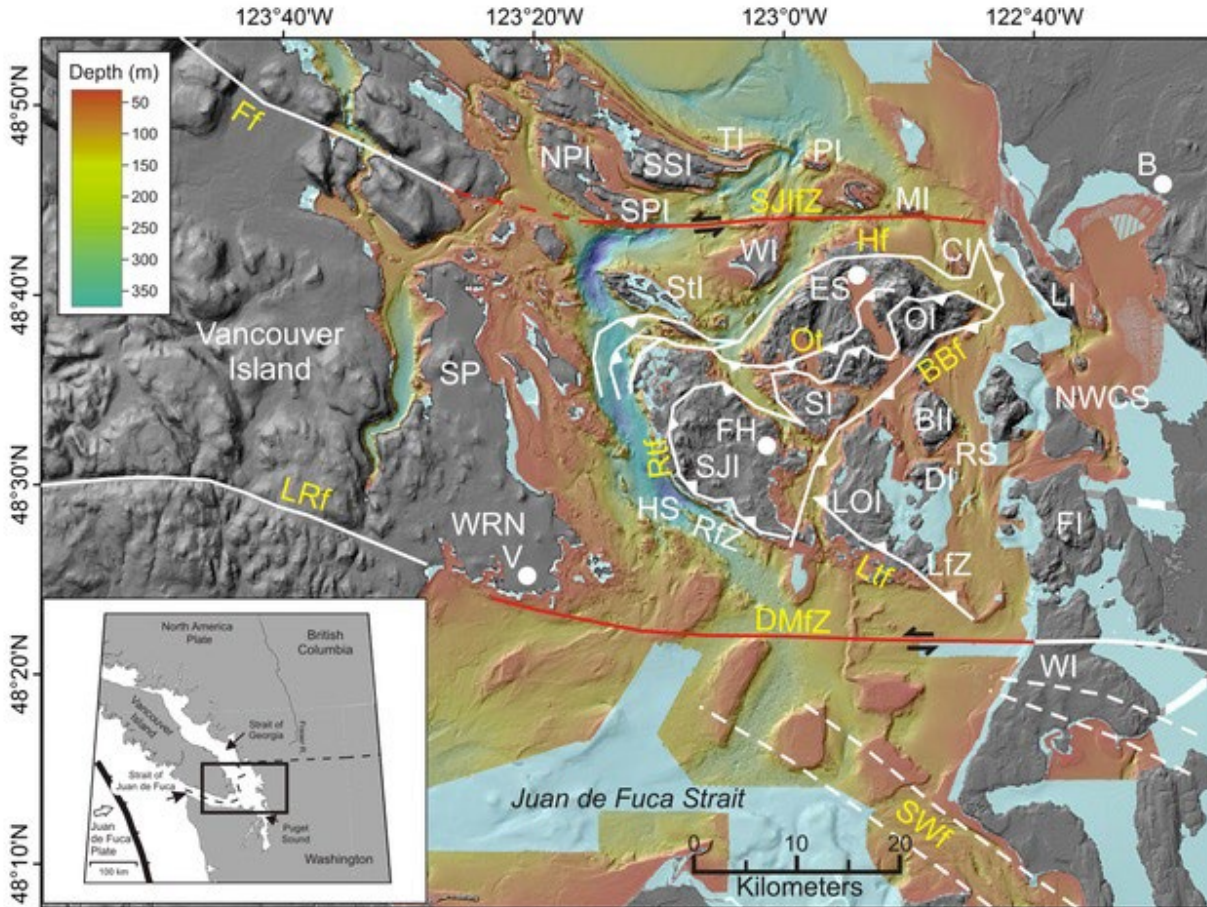
Source: [Earthquakes and Faults | WA - DNR](#)

Figure 5-2. Washington State Tectonic Setting.



Source: Czajkowski and Bowman 2014

Figure 5-3. Faults and Fault Zones Near San Juan Islands, including USGS Fault Number.



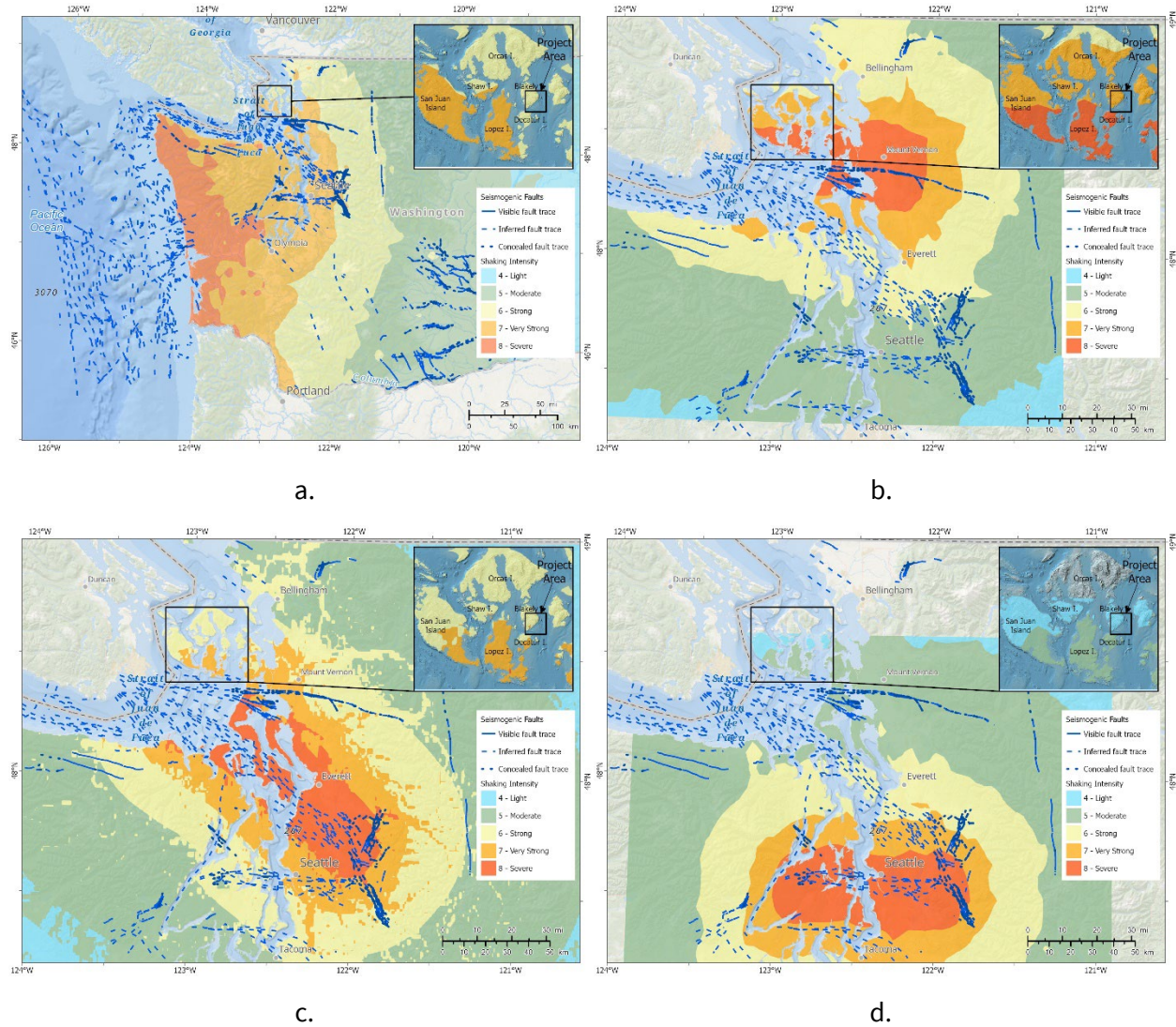
Source: Greene and Barrie 2020

Figure 5-4. Tectonic Map of San Juan Archipelago.

White lines with yellow labels are faults constructed from mapping on the San Juan Islands and other islands; red lines represent seafloor bounding faults of the Archipelago including the recently mapped Skipjack Island fault zone (SJIz) and the previously mapped Devils Mountain fault zone (DMfZ). Other faults include LfZ = Lopez fault zone or Ltf = Lopez thrust fault; Ff = Fulford fault on Vancouver Island, BBf = Buck Bay fault, Rtf = Rosario thrust fault or RfZ = Rosario fault zone, Ot = Orcas thrust fault, and Hf = Haro fault. Islands include DI = Decatur Island, LOI = Lopez Island, SJI = San Juan Island, SI = Shaw Island, BII = Blakely Island, LI = Lummi Island, CI = Clark Island, WI = Waldron Island, StI = Stewart Island, PI = Patos Island, and MI = Matia Island.

The WA DNR has developed seismic scenarios for major faults/fault zones in Washington State to show reasonable estimates of earthquake shaking across the state that would occur with a seismic event on these faults ([Seismic Scenarios | WA - DNR](#)). Each scenario assumes a particular magnitude, location, and fault-rupture geometry for an earthquake to show predicted shaking intensity in the area. The summary report for each scenario also provides information on other hazards associated with the seismic events, such as the risk of tsunamis, liquefaction, and landslides. Seismic scenarios have been conducted for the Cascadia Fault, Darrington-Devils Mountain Fault Zone, Southern Whidbey Island Fault Zone and the Seattle Fault Zone; quakes on these faults/fault zones would mostly likely impact the San Juan Islands. These seismic scenarios are shown, along with seismogenic faults (faults capable of producing earthquakes), in Figure 5-5.

The strength and duration of earthquake ground shaking are affected by the following factors: the type of rock and sediment layers, the dimensions and orientation of the fault, and the depth of the rupture below the surface. The risk to submarine cables from earthquakes is not typically from the shaking, but rather from landslides, turbidity currents, and liquefaction triggered by the earthquake (ICPC 2025).



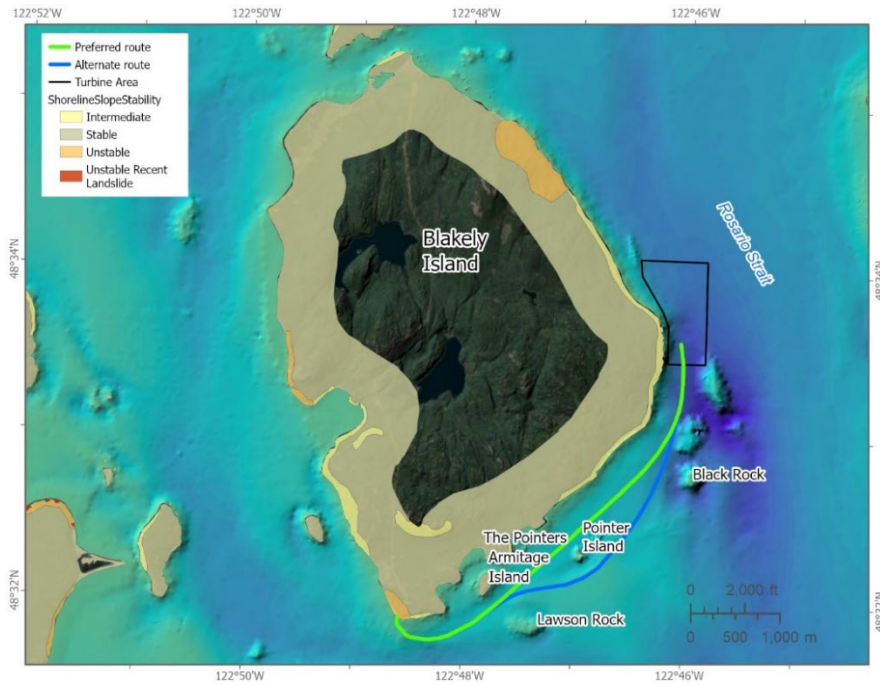
Source: Washington Geological Survey 2017

Figure 5-5. Seismic Scenarios for Earthquakes in the Following Areas: M9.0 Cascadia Subduction Zone; b. M7.4 Western Section Darrington-Deville Mountain Fault Zone; M7.4 Southern Whidbey Island Fault Zone; and M7.2 Seattle Fault Zone.

5.3 Landslides

Earthquake shaking can cause landslides on land and underwater. Onshore landslides can impact shore-based infrastructure, particularly where the ground is water-saturated or has been modified (for example, by the removal of stabilizing vegetation). Steeper slopes are most susceptible, but old, deep-seated landslides may be reactivated, even where gradients are as low as 15%. Destabilization

of slopes and generation of turbidity currents may directly impact cables. Cable routing best practice in seismically active areas prone to landslides is to avoid, if possible, areas of high sediment accumulation that could be susceptible to generating turbidity flows and to minimize side slope exposure, where practical, by routing the cable downslope into deeper water before turning, such as at the approach to the cable landing. The shoreline around Blakely Island generally stable, with areas considered intermediate and unstable (Figure 5-6). The terrestrial slope at the cable the landing is very steep and considered unstable and subject to erosion and landslides (Figure 5-7).



Source: Washington Department of Ecology 2023

Figure 5-6. Shoreline Stability, Blakely Island.



Source: Tetra Tech 2024

Figure 5-7. Cliff at Submarine Cable Landing, South Blakely Island.

5.4 Turbidity Currents and Debris Flows

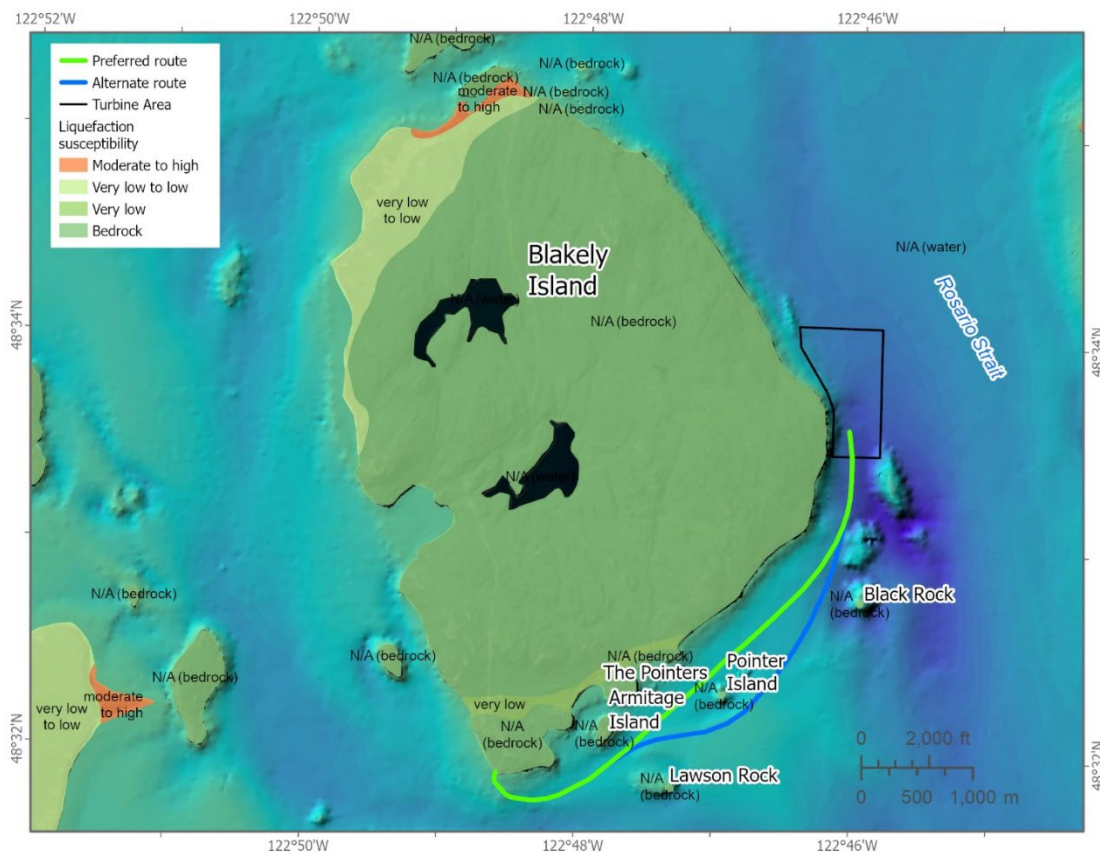
Catastrophic debris flows can move water-saturated materials rapidly and for long distances, mostly in mountainous regions and underwater in areas of sediment buildup on deltas or steep slopes.

No evidence of potential turbidity currents and debris flows was observed in the bathymetric data in the vicinity of the submarine cable route, but sediment movement is possible along the steep, coastlines of the island.

5.5 Liquefaction

If unconsolidated fine-grained sediments such as silt, sand and gravel are water-saturated, strong shaking can disrupt the grain-to-grain contacts, causing the sediment to lose its strength. Sediment in this condition is liquefied and behaves as a fluid. Buildings on such soil can sink and topple, and foundations can lose strength, resulting in severe damage or structural collapse. Pipes, tanks, and other structures that are buried in liquefied soils will float upwards to the surface.

Artificial fills, tidal flats, and stream sediments are often poorly consolidated and tend to have high liquefaction potential. While the majority of Blakely Island is comprised of bedrock, there are isolated areas of potential liquefaction on the north and south ends of the island that could impact terrestrial infrastructure (Figure 5-8).



Source: WA DNR 2010

Figure 5-8. Liquefaction Susceptibility, Blakely Island.

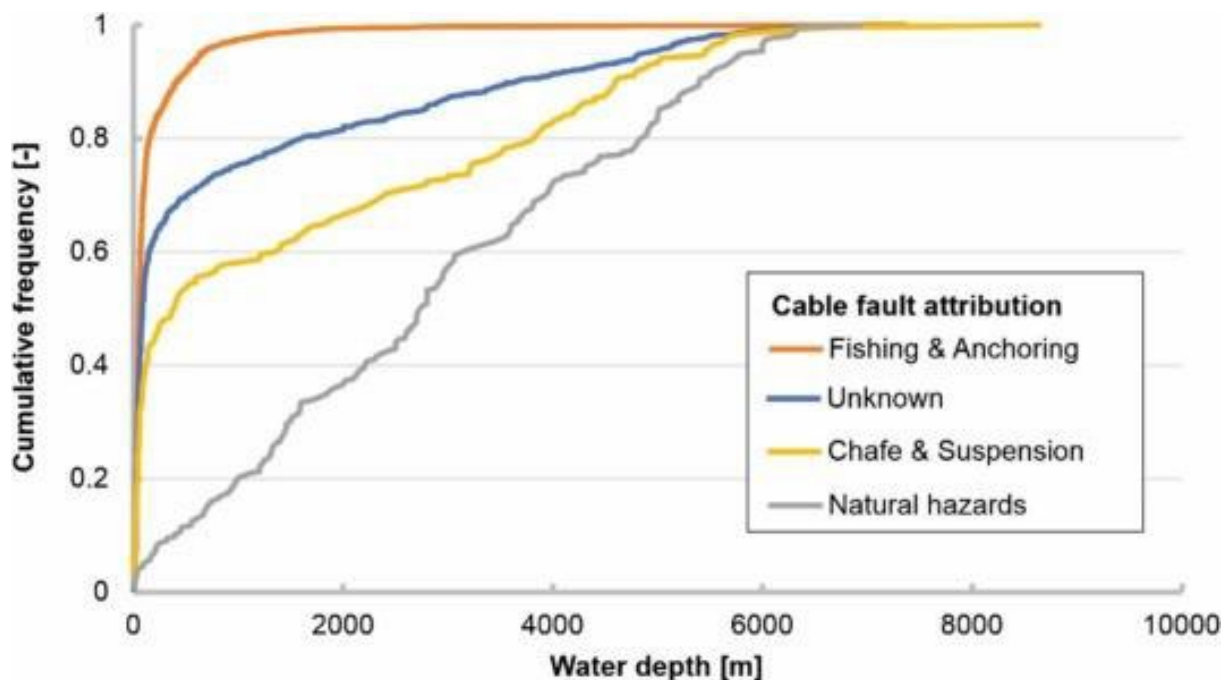
5.6 Tsunamis

A M9.0 Cascadia subduction zone earthquake is expected to generate a massive tsunami that will reach the Pacific coast of Washington within 20 to 30 minutes of the earthquake and may continue for the next 12 to 24 hours (Washington Geological Survey 2017). A simulation showing the potential impact of a M9 Cascadia earthquake on the southern San Juan Islands prepared by the WA DNR can be viewed online at <https://youtu.be/yhQeRny07vc?si=xOhhjhwZl9jUwDbL>. Earthquakes on the crustal faults in Puget Sound may also cause a tsunami if the rupture is at or near the ground surface and offsets the seafloor. Delta failures and landslides caused by the shaking may also create or amplify tsunami waves. Geological and historical evidence shows that landslides and failures of the sediments in river deltas have generated tsunamis within Puget Sound in the past (Washington Geological Survey 2017).

Tsunamis could impact the submarine cable through inundation of shore-based facilities or destabilization of the cliff face at the cable landing.

6.0 COMMERCIAL HAZARDS AND RESTRICTED AREAS

In addition to the geologic hazards discussed in Section 4, non-geologic considerations such as shipwrecks, derelict fishing gear, marine vessel traffic and anchor drag can also present a potential risk to a submarine cable. In fact, while geological hazards such as volcanic eruptions, earthquakes and associated phenomenon can have a catastrophic impact over a wide area, studies of submarine cable faulting show that human activities, such as fishing and vessel anchoring, are the primary culprit of cable damage, and primarily in shallow waters (Figure 6-1).



Source: ICPC 2025

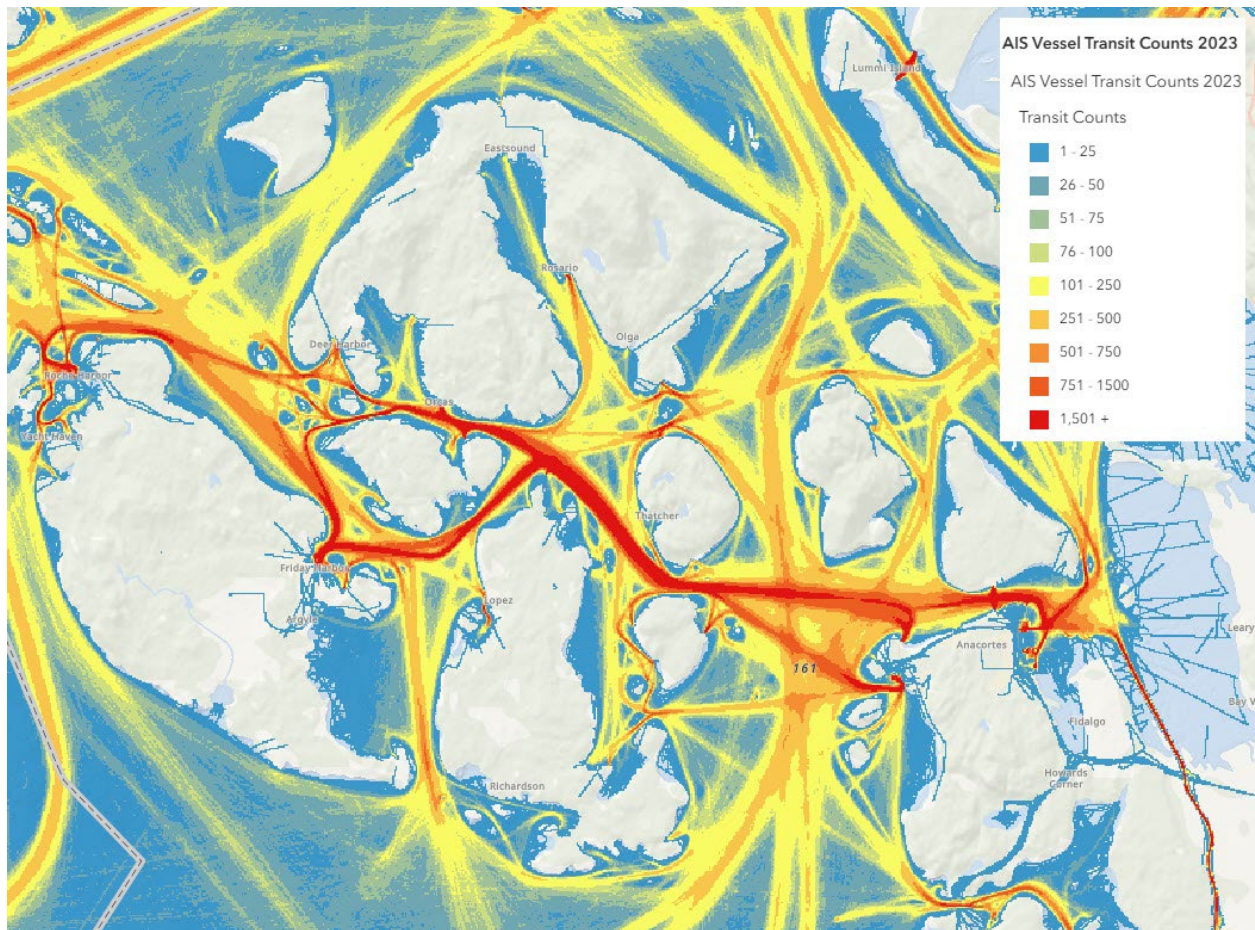
Figure 6-1. Cumulative Frequency of Plot Faults Relative to Water Depth and Attributed to Different Causes.

6.1 General Shipping Patterns and Channels

NOAA ENC charts were added to the ArcGIS project and reviewed in the project area. Charted areas that impact the project are described below and shown in

6.1.1 Thatcher Pass Ferry Route

Thatcher Pass is a very busy ferry route between Anacortes and the San Juan Islands and the ferries were observed and avoided frequently during the marine survey. The ferries were displayed on the survey vessel’s Automatic Information System (AIS), giving the survey team ample time to break offline to give way. Ferry traffic will be a consideration during future survey work and cable installation and maintenance operations. Mariners should be aware the WA State Ferries may deviate from published standard routes due to inclement weather, traffic conditions, navigational hazards, or other emergency conditions. Monitoring ferry traffic on the AIS is highly recommended. Figure 6-2 shows vessel traffic, including ferries, around the San Juan Island in 2023 (NOAA 2024).



Source: NOAA Marine Cadastre National Viewer 2024

Figure 6-2. Marine Traffic Through San Juan Islands – 2023.

6.1.2 Rosario Strait – Two-way Traffic Scheme

The closest approach of the main north-south shipping lane through Rosario Strait is located approximately 0.25 mi (0.4 km) from the east side of the turbine area (Figure 6-3).

6.1.3 Cable Protection Area

There is a charted Cable Protection Area in place between Blakely Island and Decatur Island that encompasses the cable landing site on Blakely Island (Figure 6-3).

6.1.4 Lighted Buoys and Beacons

Lighted buoys are present at Lawson Rock, Black Rock, and on the outcrop north of Black Rock. The Blakely Island Light beacon is located at the submarine cable landing (Figure 6-3).

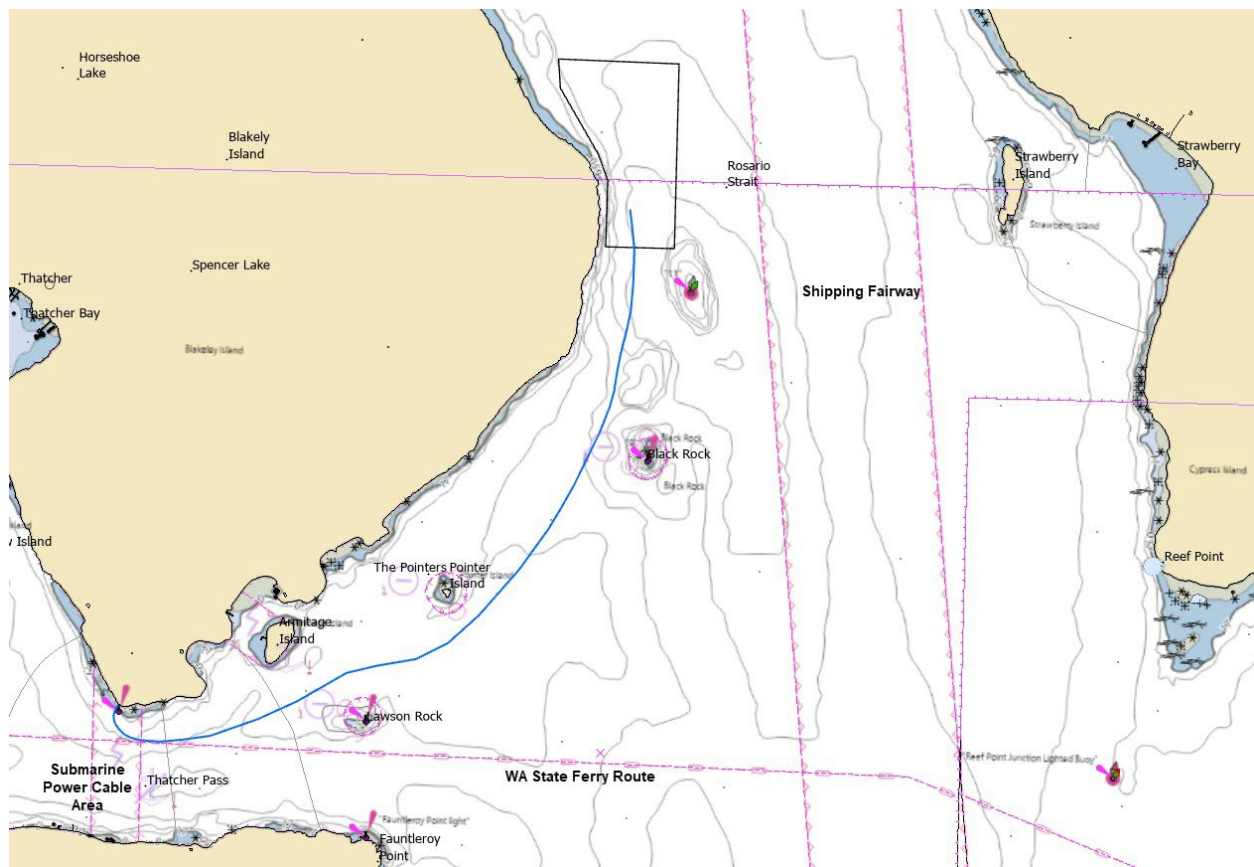


Figure 6-3. Relevant NOAA ENC Charted Areas.

6.2 Restricted Areas

There are no charted restricted areas in the project area.

The waters of Puget Sound are a regulated navigation area per 33 CFR § 165.1303 which limits tank vessel size.

6.3 Existing Submarine Cables

OPALCO provided information for two existing submarine cables at the cable landing that extend from Blakely Island to Decatur Island. One of the cables was a retired transmission cable and the other a live transmission cable that includes a telecommunications line.

OPALCO provided coordinates for the end of the existing empty conduit on the beach that is available for the new submarine cable, labeled “Blakely Pipe” on charts and figures in this report. The conduit ascends the bluff through a horizontal directionally drilled (HDD) bore that ties into terrestrial infrastructure on the island. This conduit end point was used as an end point for the proposed route options and for the existing live transmission line. It is not known at this time if the new cable will need to cross the existing cable at the shoreline. It is also not known at this time if there are additional live cables in this area that will need to be negotiated.

The new MBE data collected by Tetra Tech revealed two distinct furrows leading from the cable landing down the slope towards Decatur Island that likely indicate the location of two submarine cables. Tetra Tech slightly modified the position of the live cable file provided by OPALCO to align with one of these furrows (pink line in Figure 6-4). The second furrow is located approximately xx ft (xx m) northwest of the retired transmission cable location provided by OPALCO. As no seabed feature was detected in the location of the OPALCO-provided line, the second furrow may represent the location of this retired cable. The furrow has been digitized as an “Unknown cable (digitized)” shown in dark green on charts and figures in this report along with the OPALCO-provided line (light green).

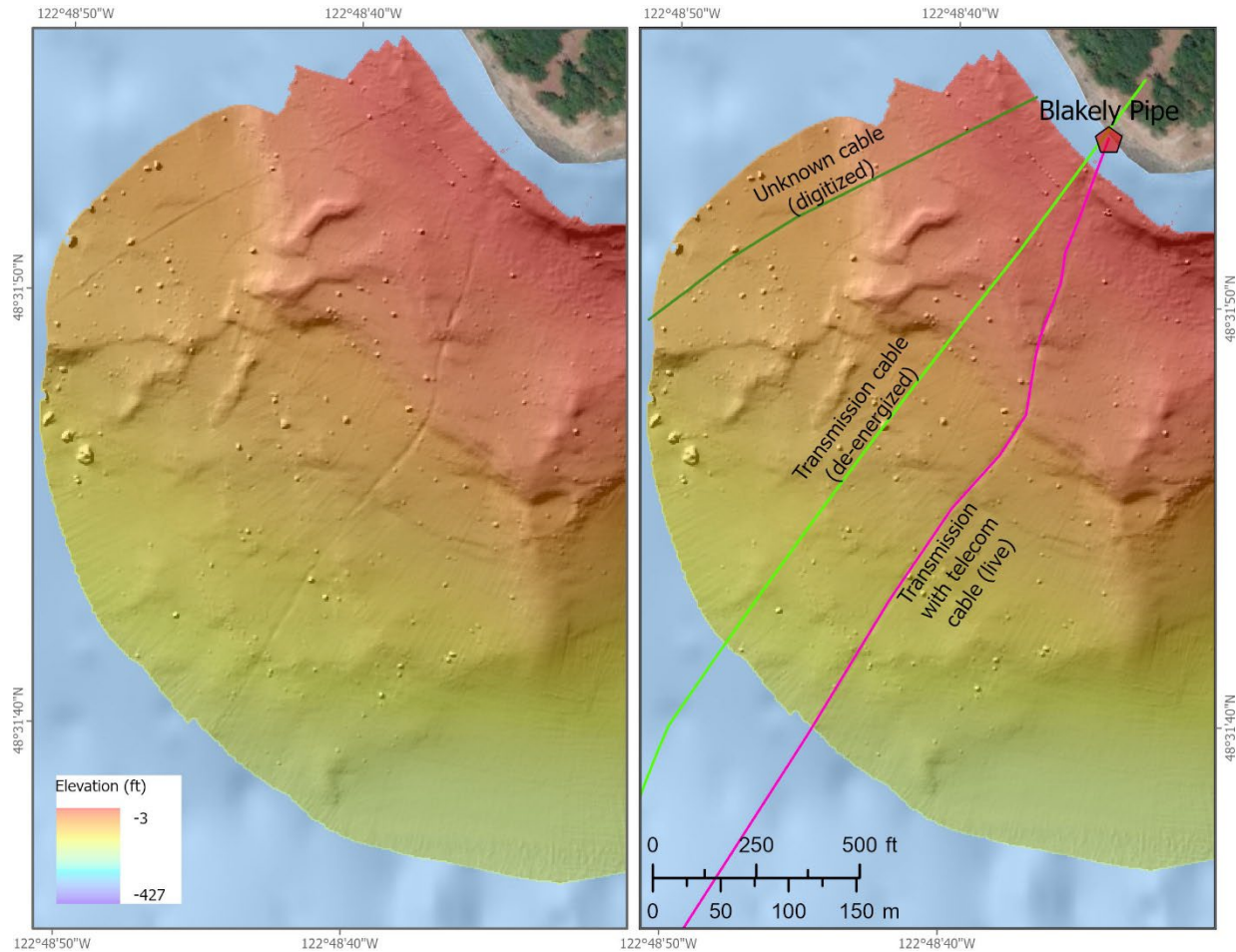


Figure 6-4. Furrows in MBE Data May Represent Existing Cables on the Seabed.

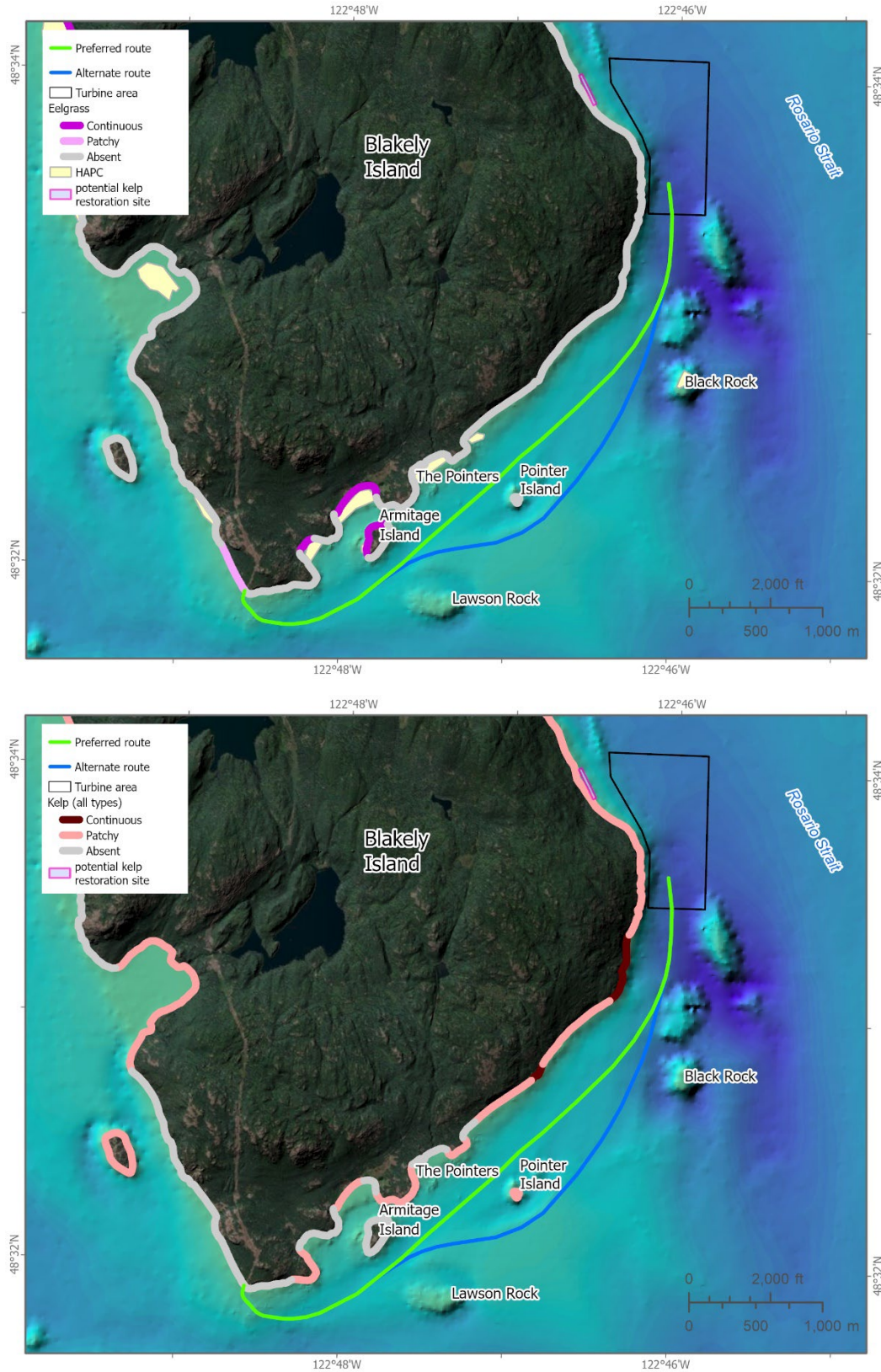
7.0 BIOLOGICAL FACTORS

Extensive review of biological factors has been done by others for this project. This section highlights the seagrass and kelp beds, critical habitat and marine protected areas.

7.1 Seagrass Beds

The WA DNR has mapped eelgrass and kelp beds in the greater Puget Sound area since 2000. Spatial data for eelgrass and kelp beds were downloaded from the WA DNR WA State ShoreZone Inventory catalog (WA DNR 2024b). While eelgrass presence at the cable landing has been designated as “Patchy”, no eelgrass was detected in the MBE data or observed during survey operations. The Pacific Fishery Management Council designated Habitat Areas of Particular Concern (HAPC) for seagrasses along the Blakely Island coastline where eelgrass beds are continuous. Patchy and continuous kelp beds are also present along the Blakely Island coastline but not near the cable landing (Figure 7-1).

A bull kelp restoration project has been proposed off the eastern coast of Blakely Island between the coastline and the proposed turbine area. As discussed during a meeting with representatives from the Samish Indian Nation on January 9, 2025, the potential project would be in approximately the 20 to 40 ft water depth range, as shown in Figure 7-1.

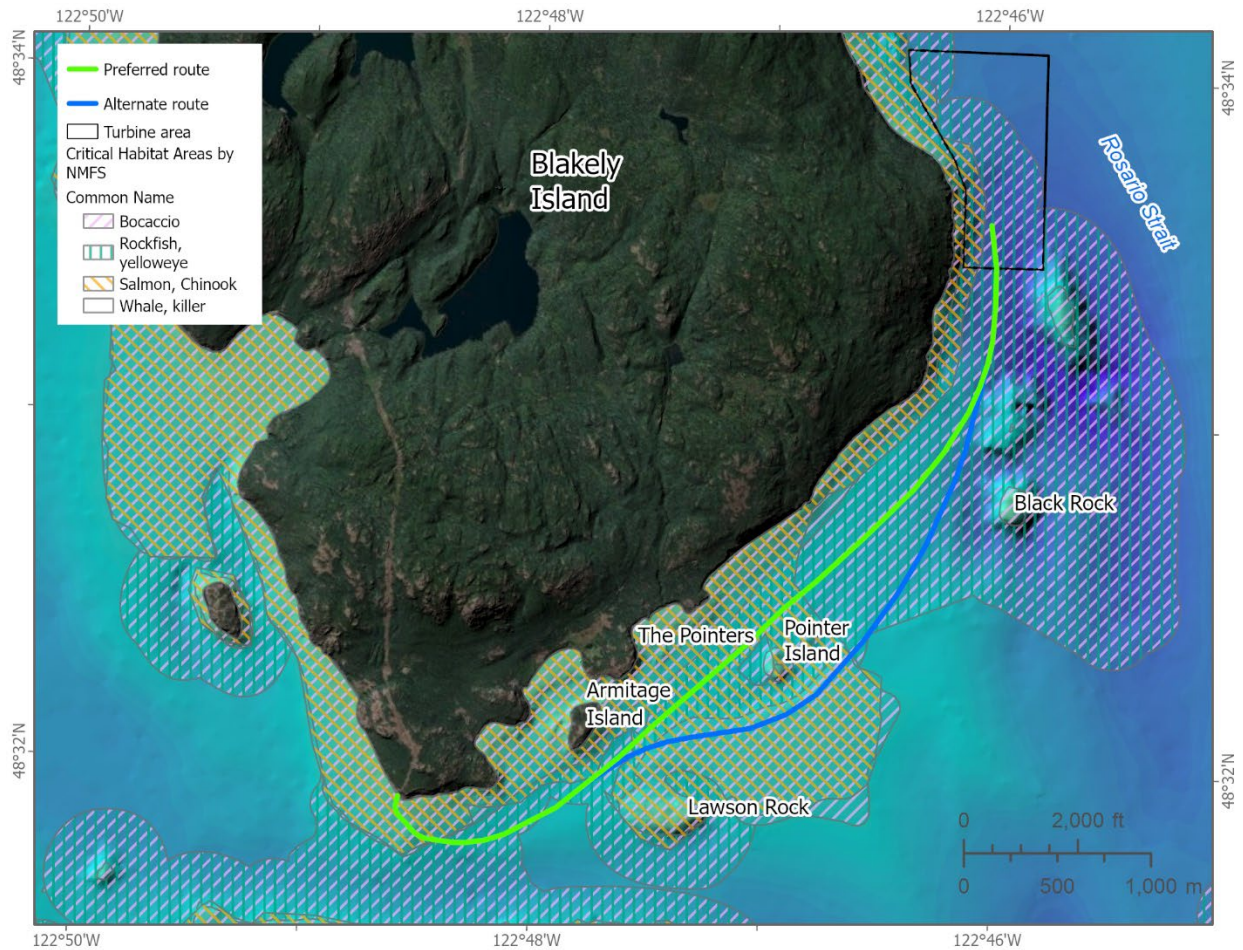


Source: <https://www.dnr.wa.gov/programs-and-services/aquatics/aquatic-science/nearshore-habitat-inventory>

Figure 7-1. Eelgrass (top) and Kelp (bottom) Beds on the Blakely Island Shoreline.

7.2 Critical Habitat Areas

The southeast coast of Blakely Island contains areas designated by NOAA Fisheries as Critical Habitat for Orca whales, Chinook Salmon, Yelloweye Rockfish, and Bocaccio. Critical habitat contains features or areas essential for the conservation and recovery of species listed under the Endangered Species Act and may be a consideration during the permitting process. The designated areas are shown in Figure 7-2. Note that the “Whale, killer” area encompasses the entire chart area.



Source Data: NOAA Marine Cadastre, <https://hub.marinecadastre.gov/>

Figure 7-2. Critical Habitat Areas.

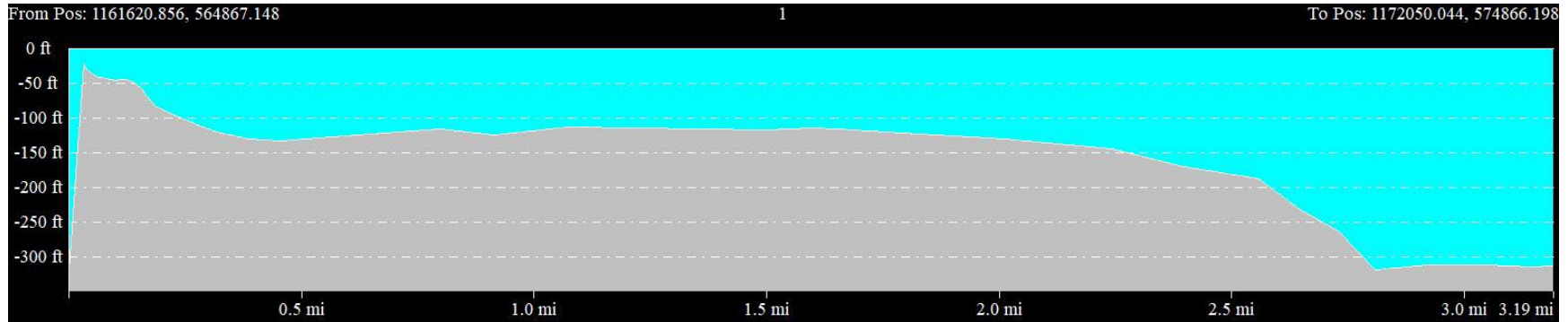
7.3 Marine Protected Areas

The San Juan Islands are encompassed by the San Juan County/Cypress Island Marine Biological Preserve and the San Juan Islands National Monument.

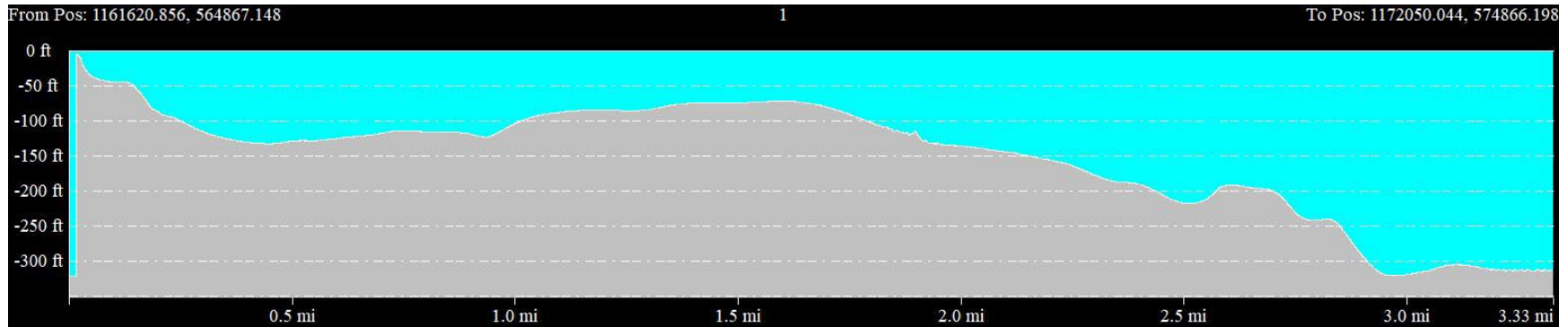
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APPENDIX A: BATHYMETRIC PROFILES

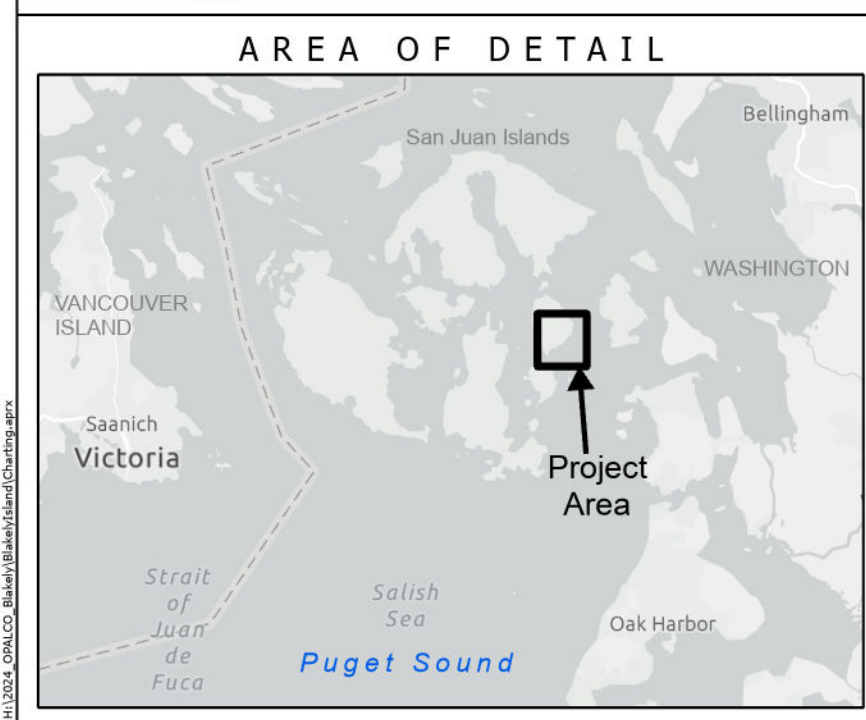
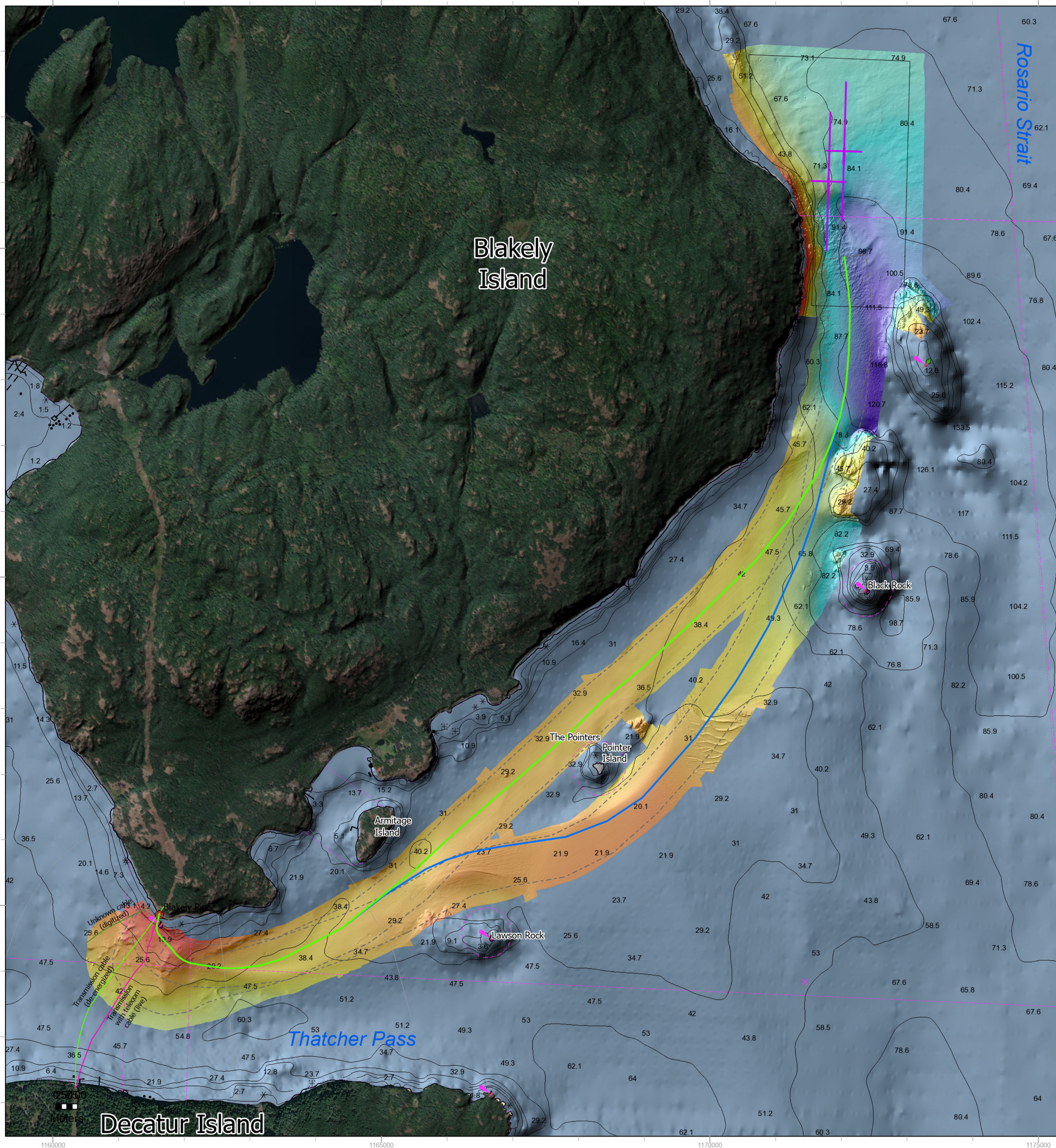


Bathymetric profile along the Preferred route. Profile runs from the landing to the turbine area.



Bathymetric profile along the Alternate route. Profile runs from the landing to the turbine area.

APPENDIX B: NORTH-UP HILL SHADED CHART



LEGEND

- End of conduit (OPALCO)
- Preferred route
- Alternate route
- Potential turbine location
- Contract survey corridor (656 ft / 200 m)
- Existing transmission with telecom cable
- Existing transmission cable
- Unknown cable (digitized)
- Vessel routing measures
- Traffic Lane & Two-Way Route
- Aids to Navigation
- Elevation (feet) - MBE Survey (Note ENC spot elevations in feet)
- 3
- 427

Background data source:
 NOAA Chart Service- https://encdirect.noaa.gov/arcgis/rest/services/encdirect/enc_harbour/MapServer
 ENC Soundings in meters
 Background imagery source:
 National Oceanic and Atmospheric Administration (NOAA) Digital Coast Data Access Viewer, Charleston, SC
 NOAA Office for Coastal Management, Accessed Oct 10, 2024 at <https://coast.noaa.gov/dataviewer/>

NOT FOR CONSTRUCTION

GEODETTIC PARAMETERS

Horizontal Datum ... NAD83 (2011)
 Projection State Plane
 Zone Washington North (FIPS 4601)
 Horizontal Units U.S. Survey Feet
 Vertical Datum NAVD88
 Vertical Units Feet
 Geoid Model 2018-CONUS

SURVEY NOTES

Survey Dates October 2024
 Vessel Streak

BATHYMETRY NOTES

Bathymetry displayed from Tetra Tech 2024
 The bathymetry data represents conditions in the survey area at the time of collection. Bedforms and bottom depths are expected to change over time.

0 0.25 0.5 Miles
 0 0.25 0.5 Kilometers

OPALCO Co-op Run. Community Powered. **ORBITAL** MARINE POWER

Rosario Strait Tidal Energy Project

TETRA TECH Bathymetry and Cable Routes

Revision No.	Date	Description	Prepared by:	Checked by:
01	11/27/2024	Draft	JH	MO
02	02/07/2025	Final	JH	MO

Filename: Charting\ BathyChart_LAYOUT Size: 17x22 Chart Number: 001

APPENDIX C: GRIDDED DTM IN ASCII FORMAT

(DELIVERED ELECTRONICALLY)

APPENDIX D: MBE BACKSCATTER IMAGERY (GEO TIFF)

(DELIVERED ELECTRONICALLY)

Award DE-EE0011264, Deliverable D.2.1,
Resource Characterization Report,
OPALCO site in Rosario Strait, WA (USA)

Jim Thomson, Chris Bassett, Brian Polagye
Applied Physics Lab., Univ. of Washington

March 20, 2025

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1 Introduction

This report presents a resource characterization of the tidal currents at a proposed site for power generation in Rosario Strait, WA (USA). Acoustic Doppler Current Profilers (ADCPs) were deployed to measure tidal currents, turbulence, and surface waves at the site. The measurements followed established technical specifications (IEC 62600-201) and were informed by previous work at other tidal power sites in the region. All work was completed from the Research Vessel (R/V) Jack Robertson, which is owned and operated by Applied Physics Laboratory, University of Washington (APL-UW).

The site is centered just east of Blakely Island on the western edge of Rosario Strait at 48.56114°N , -122.76792°W . As shown in Figure 1, the site is north of the fixed navigation light at Black Rock and north of the G-11 buoy. The site was selected based on the results of the FVCOM numerical circulation model from Pacific Northwest National Laboratory (PNNL), as detailed in Calandra et al. [2023]. That modeling study noted that the tidal resource is highly localized near Blakely Island, where the currents are much stronger (up to 3.6 m/s) than in the center of the Rosario Strait. The only known prior measurements are from NOAA current survey station PUG 173 in 2019 toward the middle of the channel, and from an APL-UW collaboration with NREL in 2017 at eastern edge of Rosario Strait [McVey et al., 2025].

Water depths are 80-95 m at the site. There is steep bathymetry close to Blakely Island, and this resource characterization study included a stand-off distance of 100 m from the shore. This was both for the safety of the vessel and to ensure room for the moorings of the proposed Orbital Marine Power ‘O2’ turbine. The O2 turbine is surface-deployed and therefore resource characterization focuses on the upper portion of the water column.

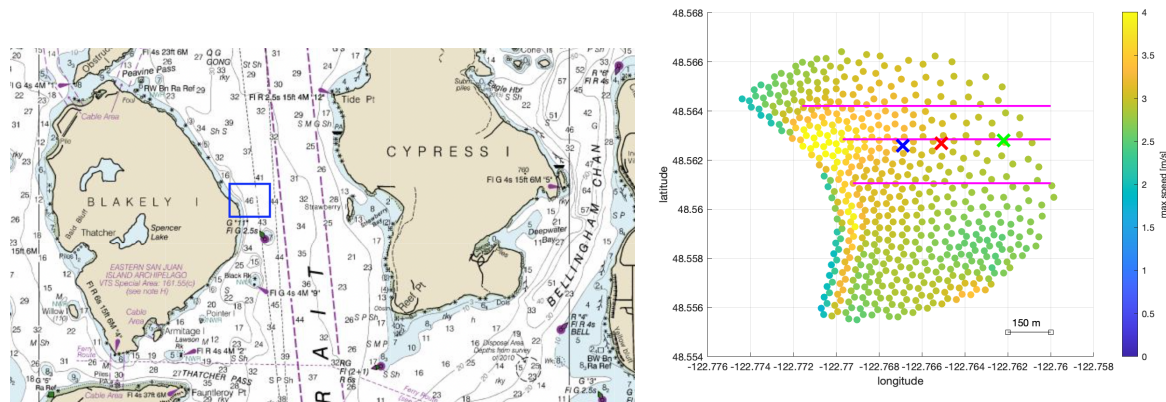


Figure 1: Left: NOAA chart of Rosario Strait (WA, USA) with depth in fathoms and OPALCO tidal site outlined in blue box. Right: maximum current speeds predicted by PNNL FVCOM model within the site. Magenta lines are mobile survey grid, and X's are stationary measurement platforms.

2 Methods

The site survey consisted of spatially-resolved, mobile measurements collected from R/V Robertson and temporally-resolved, stationary measurements from three platforms. The use of multiple platforms for the stationary measurements mitigated some of the risks in data collection, while also increasing spatial coverage.

2.1 Mobile survey

The mobile survey was conducted on 1 Oct 2024 with a down-looking RDI 300 kHz ADCP mounted beneath the R/V Robertson. This information was used to make the final selection of points for the stationary ADCP

deployments. The mobile survey followed three east-west lines (Figure 3), which were repeated 7 times (i.e., 7 laps) during the morning ebb tide and 5 times (i.e., 5 laps) during the afternoon flood tide. The ADCP was set to ping continuously at 2 Hz, with bottom tracking enabled as the preferred reference velocity (to convert observed currents to the fixed-earth reference frame). A bin size of 5 m was selected to reduce Doppler noise [Brumley et al., 1991], and ensembles of 30 seconds duration were mapped to gridded positions to produce current maps for each phase of the tide. These data were also used to create pseudo-time series at each prospective mooring site, following the methods of Palodichuk et al. [2013].

2.2 Stationary measurements

Stationary measurements of tidal currents were collected from 2 Oct 2024 to 13 Jan 2025 (total duration: 103 days). This duration is sufficient to determine at least 20 tidal constituents using classic tidal harmonic analysis [Pawlowicz et al., 2002], and it is also sufficient to determine a purely statistical description of the tidal currents [Polagye and Thomson, 2013]. The analysis that follows emphasizes the statistical approach, while also including the harmonic analysis.

The measurements used ADCPs on three different platforms: a Sea Spider seafloor tripod (SS), a stable-moor (STBM) subsurface mooring, and a surface buoy (SB) mooring. The sea spider tripod measurements alone are sufficient for resource characterization. The additional measurements were included for risk mitigation, spatial context, and informing future revisions to IEC 62600-201.



Figure 2: Sea Spider seafloor tripod and Stablemoor sub-surface buoy just before deployment. The shoreline of Blakely Island at the end of survey line 3 is just behind the vessel (100 m stand-off distance).

The Sea Spider (SS) is a fiberglass sea floor tripod. It has 272 Kg of lead ballast distributed at three feet, plus another 91 Kg on the frame. This platform has been used extensively at the nearby Admiralty Inlet, where the ballast was sufficient to maintain position in a rock/cobble seabed with currents up to 4 m/s [Thomson et al., 2012, Polagye and Thomson, 2013, Guerra and Thomson, 2017]. An up-looking Nortek Signature 250 ADCP made full-depth profiles of the tidal currents. The Sea Spider is bottom-mounted and thus has no watch circle. However, the beam angle of the Signature 250 is 20 deg, and this creates a cone with a 35 m radius at the surface in a water depth of 92 m. Transformation of along-beam velocity components to geographic east-north-up components requires the assumption of homogeneous currents over this cone. Based on the mobile survey, this is reasonable assumption at the site. This type of seafloor mount is ideal for resource characterization; however, it requires a lower frequency ADCP (250 kHz) to span the full depth (92 m). The use of a lower frequency increases Doppler noise in the measurements (when maintaining the 1 m bin size required in IEC 62600-201) and usually precludes the measurement of surface waves. The Sea Spider also provided a platform of opportunity for ancillary environmental measurements. Specifically,

hydrophones, a porpoise click detector, and fish tag receiver were deployed alongside the Sig250 ADCP.

The Stablemoor mooring (STBM) is a subsurface platform with a streamlined shape designed to minimize drag. The Stablemoor was suspended in the middle of the water column, with a pair of down-looking and up-looking Nortek Signature 500 ADCPs. The mid-water location enabled the use of 500 kHz instruments with reduced Doppler noise (i.e., improved precision) relative to the 250 kHz on the Sea Spider. The up-looking Sig500 also provided surface wave measurements via acoustic surface tracking. The up- and down-looking Sig500 measurements are combined to form full-depth profiles of currents and turbulence. Stablemoor moorings have previously been used in strong tidal currents throughout Puget Sound [Harding et al., 2017, Kilcher et al., 2017] and Arctic environments [Brenner et al., 2021]. In strong currents, the mooring is pushed downward by drag forces (up to 15 m, in this deployment). This has a minimal effect on the measurements, because the Stablemoor remains trim and level during mooring blow-down, and results in a mooring watch circle with a radius of 30 m. Combined with the 25 deg beam angle of the Sig500 producing an effective ADCP cone with 21 m radius, the total footprint of the stablemoor measurements is a radius of 51 m. The Stablemoor also provided a platform of opportunity for a Conductivity, Temperature, and Depth (CTD) sensor to characterize variations in temperature and salinity (and thereby infer stratification).

The Surface Buoy (SB) mooring was a tribal government requirement to provide a visual marker to help subsistence fisherman avoid entanglement with the nearby subsurface Stablemoor mooring. The surface buoy supported an additional down-looking ADCP (Nortek Aquadopp 1 MHz) to make opportunistic measurements near the surface. This filled a known gap in near-surface measurements from the other up-looking ADCPs, which have surface reflections that obscure velocities for $z > d \cos(\theta)$, where d is the depth of the water, θ is the angle of the beam relative to the vertical, and z is the distance above the seafloor [Lentz et al., 2022]. The SB mooring watch circle has a radius of 140 m.

The three stationary platforms were deployed from the R/V Robertson on 2 Oct 2024. The deployed locations were verified upon recovery on 13 Jan 2025, with horizontal accuracy of ± 5 m. Figure 3 shows the layout of the stationary platforms.

Table 1: ADCP configurations

Platform	ADCP kHz (look)	Bins	Profile, z	Ensembles	$\langle \sigma_N \rangle$	Ping rate	σ_N
Sea Spider	Sig 250 (up)	1 m	0 to 86 m	2 of 10 min	0.027 m/s	1 Hz	0.210 m/s
Stablemoor	Sig 500 (up)	1 m	45 to 82 m	2 of 10 min	0.010 m/s	1 Hz	0.073 m/s
Stablemoor	Sig 500 (down)	1 m	0 to 45 m	2 of 10 min	0.010 m/s	1 Hz	0.073 m/s
Surface buoy	AQD 1000 (down)	1 m	70 to 86 m	2 of 10 min	0.006 m/s	1 Hz	n/a
Robertson	WH 300 (down)	5 m	0 to 100 m	30 s	0.017 m/s	2 Hz	n/a

When using ADCP measurements to characterize tidal sites, IEC 62600-201 specifies a vertical resolution of 1 m (i.e., bin size), ensemble averages calculated over at least 2 minutes out of every 10 minutes, and ensemble precision $\langle \sigma_N \rangle$ less than 0.05 m/s. Table 1 presents the ADCP configurations designed around these requirements, with the additional step of staggering the sampling to avoid cross-contamination of the acoustic signals between ADCPs in close proximity. The staggered approach limits the overall duty cycle of a single instrument, but still meets the required 2 minutes out of every 10 minutes.

It is well-known that single-ping velocity profiles have large uncertainties in velocity, sometimes referred to as Doppler noise. This is quantified with the standard deviation of velocity caused by noise, σ_N . For broadband Doppler systems, this can be calculated *a priori* from the acoustic frequency and the bin size [Brumley et al., 1991]. The values in the table come from the manufacturer software. Velocity uncertainty is reduced by creating ensemble averages of the data, denoted with brackets $\langle \rangle$, for which the uncertainty is reduced by factor $1/\sqrt{2n}$, where n is the number of pings included in the ensemble. This study uses $n = 120$ for all stationary measurements.

Single-ping uncertainties σ_N can be large (especially when using 1 m bins on a 250 kHz ADCP), and this noise must be removed when estimating turbulence statistics. Following Thomson et al. [2012], the turbulent

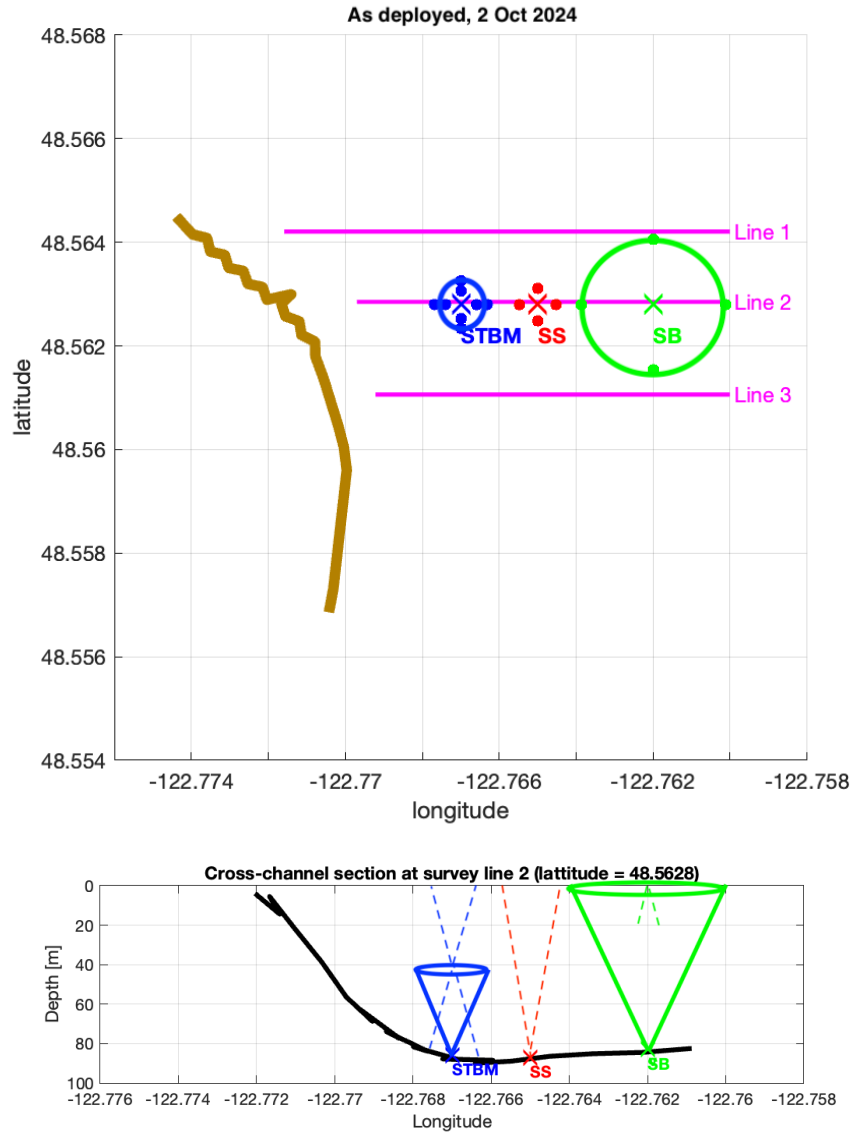


Figure 3: Plan view (top) and side view (bottom) of the stationary platforms, including watch circles (solid lines) and ADCP beam cones (dashed lines). The brown curve is the shoreline, and the black curve is the seafloor.

intensity is calculated as

$$TI = \frac{\sqrt{\sigma_u^2 - \sigma_N^2}}{\langle U \rangle}, \quad (1)$$

which assumes that the variance caused by Doppler noise is independent of the true turbulent fluctuations (i.e., no cross-terms in the variance). The standard deviation of the observed currents σ_u is calculated within each ensemble using a horizontal speed $U = \sqrt{u^2 + v^2}$. The full velocity components are determined from the five beams of each ADCP in a coordinate transform that returns eastward (u), northward (v), and upward (w).

Many other turbulence parameters can be estimated with single-ping ADCP data, including dissipation rate Wiles et al. [2006], shear [Bassett et al., 2013], turbulent spectra [Thomson et al., 2012], and Reynolds stresses [Guerra and Thomson, 2017]. These are omitted in this initial characterization, though they can be readily calculated from the collected data.

A relevant metric for tidal turbine performance is the kinetic power density incident on the rotor (i.e., the kinetic energy flux per unit rotor area)

$$\frac{P_{in}}{A} = \frac{1}{2} \rho U^3 \quad (2)$$

where ρ is the water density.

2.3 Modeled Turbine Performance

Polagye and Thomson [2013] defined a simple model for the power produced P by a turbine with three operating regimes as

$$\begin{aligned} P(t) &= 0, & U_{hub} < U_c \\ P(t) &= \frac{1}{2} \rho \pi R^2 U_{hub}^3 C_p, & U_c \leq U_{hub} \leq U_r \\ P(t) &= \frac{1}{2} \rho \pi R^2 U_r^3 C_p, & U_{hub} > U_r \end{aligned} \quad (3)$$

where U_c is the cut-in speed, U_r is the rated speed, C_p is an efficiency coefficient (“water-to-wire”), and R is the turbine radius.

The observed time series is used to estimate the Annual Energy Production (AEP) as

$$AEP = \frac{T_{year}}{T} \int_0^T P(t) dt, \quad (4)$$

where T is the duration of observations (103 days) and T_{year} is the length of a year in the same units. This assumes that the duration is sufficient to capture a representative statistic distribution of current speeds at the site, which is true for durations > 90 days at most tidal sites. This study uses $T = 103$ days and $dt = 10$ minutes, with the following representative values to approximate the Orbital Marine Power ‘O2’ turbine: $U_c = 0.7$ m / s, $U_r = 2.25$ m/s, $C_p = 0.39$, $R = 13.5$ m. These are the values for a single turbine; the ‘O2’ turbine actually has a pair of turbines, and thus the reported AEP values are doubled. The ‘O2’ turbine is designed to be deployed from the surface, with a hub depth $d_{hub} = R + 3.5$ m (i.e., the rotor tip is 3.5 m below the water surface at every stage of the tide).

Alternatively, tidal harmonic analysis of the observations can be used to determine amplitudes and phases of known tidal constituent frequencies, and then these can be used to estimate a full year of $P(t)$. This year-long predicted timeseries is then integrated to determine AEP without the $\frac{T_{year}}{T}$ factor in Eq. 4. The IEC 62600-201 specification is for harmonic analysis to resolve a minimum of 20 tidal constituents and demonstrate a reconstruction of the observations that captures at least 95% of the variance. This study uses v1.5b of the T-Tide software in Matlab [Pawlowicz et al., 2002] to resolve 35 constituents of the u, v tidal

currents (as complex-valued input to T-tide) and captures 96% of the variance. The details are included in an appendix.

A second performance metric is the capacity factor,

$$CF = \frac{\int_0^T P(t)dt}{TP_{rated}}, \quad (5)$$

which indicates how much the of the full capacity of the turbine is utilized. Here, the capacity factor is based on a rated power of $P_{rated} = 1.3MW$. For tidal sites, this number is often much lower than 0.5 (i.e., half capacity), because the natural tidal cycles have weak currents (slack) between each ebb and flood. In Puget Sound, capacity factors are further reduced by a diurnal inequality (i.e., two ebb and flood cycles per day, but of uneven strength).

3 Results

3.1 Mobile survey

Figure 4 shows the currents surveyed during the peak ebb and peak flood on 1 Oct 2024. The headland intensification predicted by the model is evident (larger arrows to the north of the headland than in the main channel on ebb), as is a strong back-eddy near shore (small arrows to the south of the headland on ebb). This region of separated flow causes an intense lateral shear that is prominent in section views (lower panels of Figure 4), where the currents change from 2 m/s to under 0.5 m/s within 100 m. This is also a region of intense turbulence, which was visually apparent from the deck of the vessel and noted repeatedly by the vessel operator.

The final choice of sites for the stationary measurements avoided this region of separated flow, both as a risk mitigation for the deployed platforms and as practical limit on the seabed slope feasible for deployments.

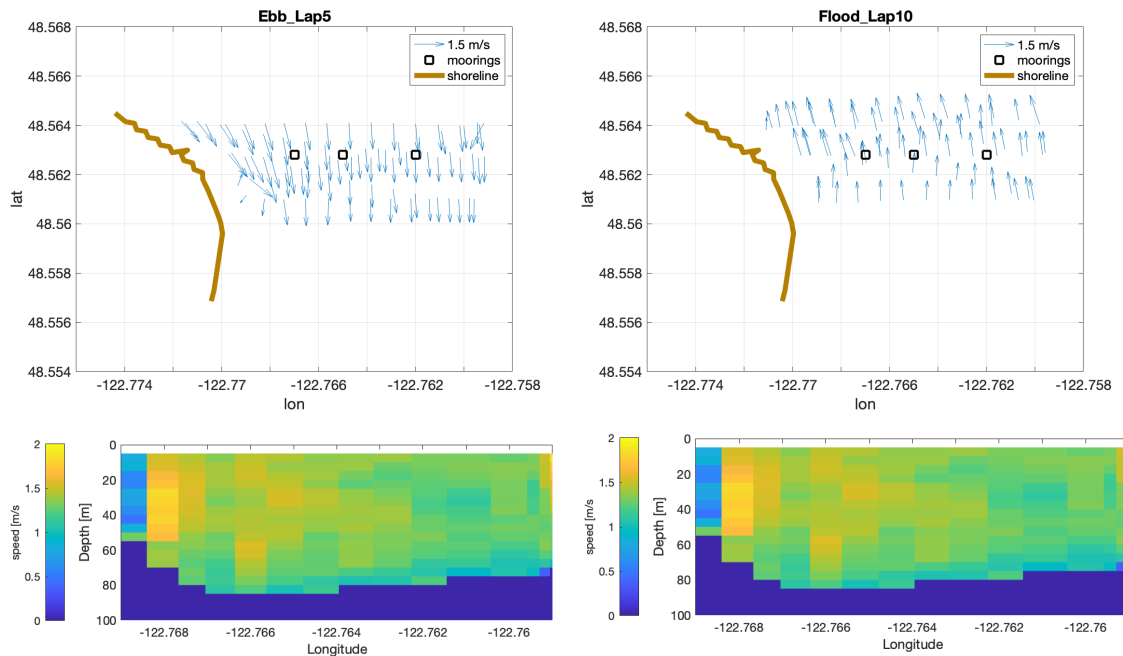


Figure 4: Maps of currents from mobile ADCP survey, with section views below.

3.2 Stationary measurements

The stationary measurements use a vertical coordinate z , which is meters above the local seafloor ($z = 0$ m) at the location of each platform. Where necessary, the depth d below the water surface is also used (e.g., to determine the hub-depth of the turbine). The z is fixed; the d is relative to the surface at each stage of the tide. All directions are reported relative to magnetic north, using coordinate transformations based on instrument magnetometers with factory calibrations. All data use UTC timestamps.

3.2.1 Sea Spider tripod

The Signature 250 on the Sea Spider platform provided extremely clean data and is most conventional; the results that follow emphasize these data. The quality control and quality assurance checks are included as an appendix. The depth profiles of horizontal current speed are shown in Figure 5, along with the elevation of the water surface from the integrated pressure gauge. The maximum tidal elevation range is 4.0 m. The

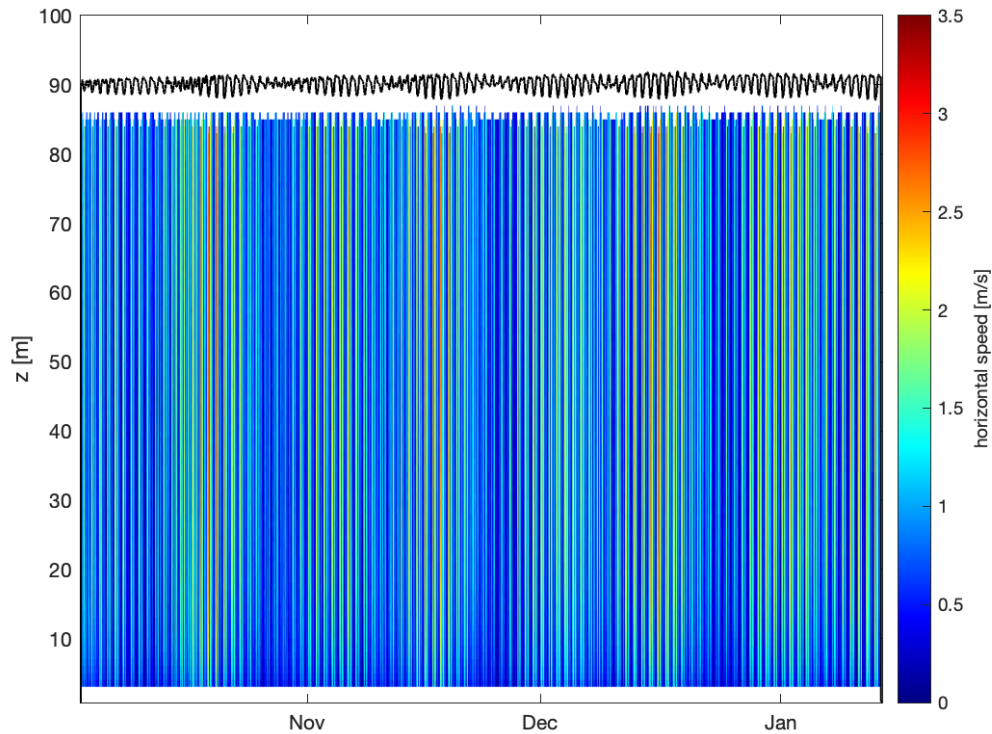


Figure 5: Sea Spider tripod Sig250 profiles of horizontal speed.

region of acoustic reflections near the surface was removed from the ADCP as part of the quality control. The data show the strong spring-neap cycle and diurnal inequality of the tides in the Pacific Northwest. The strongest tides are observed near the winter solstice, as expected.

The horizontal components are plotted together in Figure 6 to present the shape of the tidal ellipse and the principal axes of the flow. The flow veers slightly with depth, such that flows are aligned 305° Magnetic at the surface and 315° Magnetic near the seafloor. The ebbs (toward the southeast) are slightly stronger than the floods (toward the northwest). The increased scatter on the ebb is probably related to flow separation and eddy shedding from the headland.

The time-average vertical profiles are shown in Figure 7, along with horizontal lines to indicate turbine hub height and rotor sweep. The red areas are the data removed because of acoustic reflections from the surface. The speed and power profiles have familiar logarithmic (or power law) shapes, and the principal-axis profile has a modest amount of veering. The profiles indicate minimal velocity variation over the proposed rotor depth, and thus support the usage of a simple $U_{hub}(t)$ in Eq. 3 (as opposed to an integral of $U(t, z)$ over the turbine radius). Calandra et al. [2023] found this approximation to be accurate unless significant vertical shear is present, which typically only occurs for smaller rotors in closer proximity to the seabed.

The current speed at hub depth U_{hub} is determined for each ensemble by selecting the bin 17 m below the measured surface (from the depth given by the pressure sensor). A histogram of U_{hub} is shown in Figure 8, along with a histogram of the resulting power from the model turbine (Eq. 3). The velocity histogram is mostly smooth, with a shape that resembles a chi-squared distribution. The power histogram has an expected spike at the rated power of 1400 kW, because this value is repeated for any conditions with $U_{hub} \geq U_r$.

The single ping data from the Sig250 are used to calculate the turbulence statistics of the horizontal

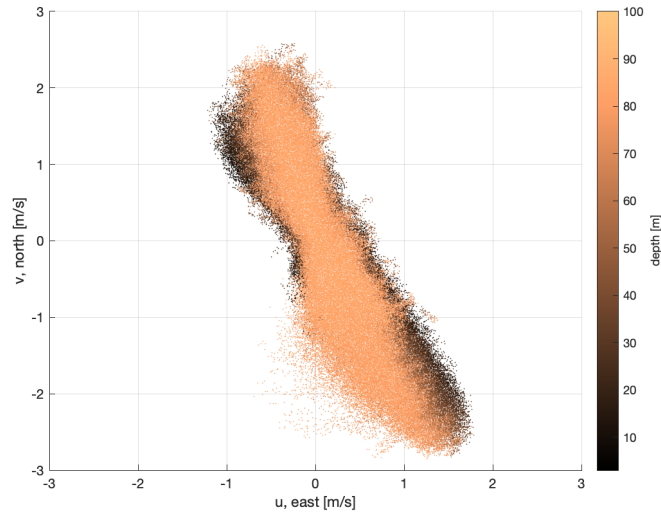


Figure 6: Sea Spider tripod Sig250 horizontal components and principal axes. Color is height of each bin above the seafloor, z .

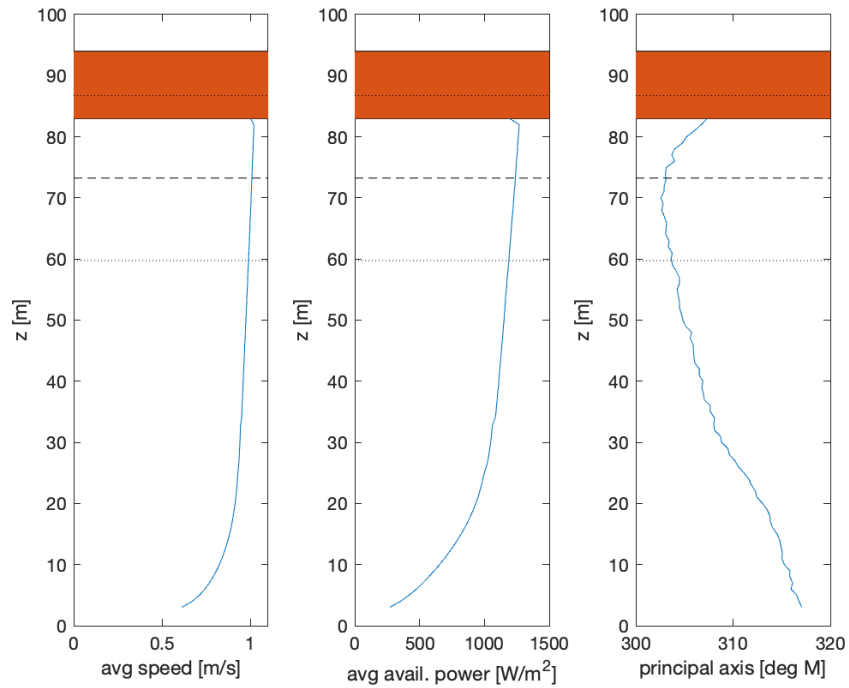


Figure 7: Sea Spider tripod Signature 250 profiles of average speed, available power density, and principal axes.

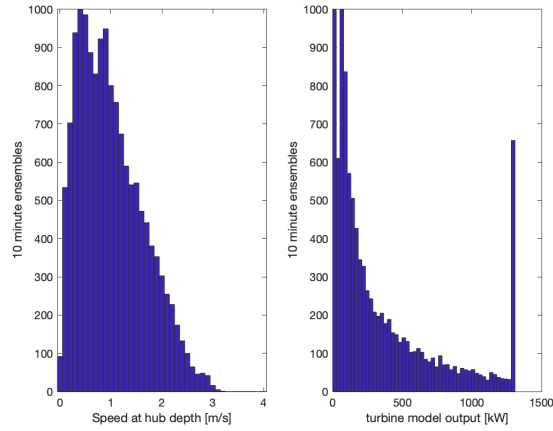


Figure 8: Histograms of hub-depth speed and power production from Sea Spider tripod.

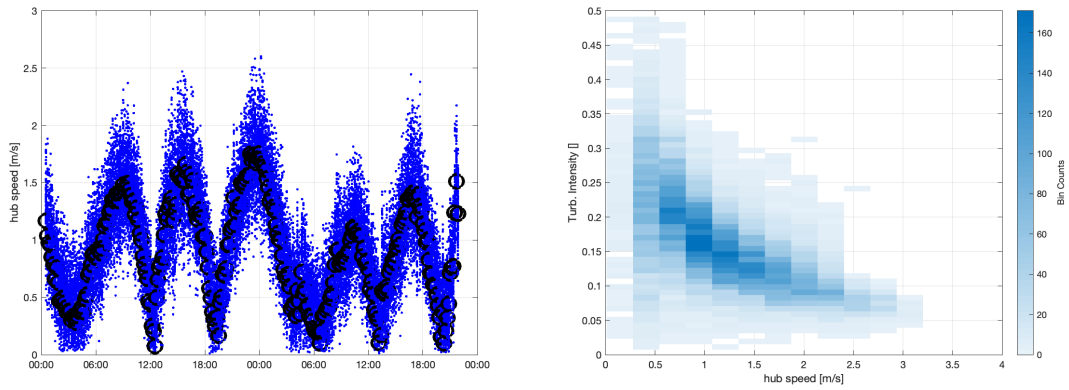


Figure 9: Sea Spider tripod Sig250 example raw time series (left) and turbulent intensity versus speed (right). The blue dots are single-ping data every 1 second, and the black circles are ensembles every 10 minutes.

speeds at hub depth for each ensemble (Eq. 1). Figure 9 shows an example 2-day time series with single-ping data and ensemble values, along with the TI results from the entire 103-day deployment as a function of hub speed. The TI results are consistent with many previous studies, in which TI converges to 10% at the higher inflow speeds. The data are of sufficient quality for determining other turbulence metrics, such as TKE spectra, dissipation rate, and Reynolds stresses, but these are left for a future stage of characterization.

3.2.2 Stablemoor

The Sig500s on the Stablemoor provided excellent data, with reduced Doppler noise σ_N achieved at the expense of slight motion contamination from the mooring. Figure 10 shows the scalar speed profiles from the up- and down-looking Sig500s merged into a single dataset. The profiles shift up and down with the tide, and with the mooring ‘blow-down’ caused by drag. This can create artifacts (sampling bias) when averaging in fixed height bins z , but only for bins that periodically lack data near the surface. This does not affect the portion of each profile relevant to the turbine. A gridded product is also included in the MHKDR data submission (which looks similar).

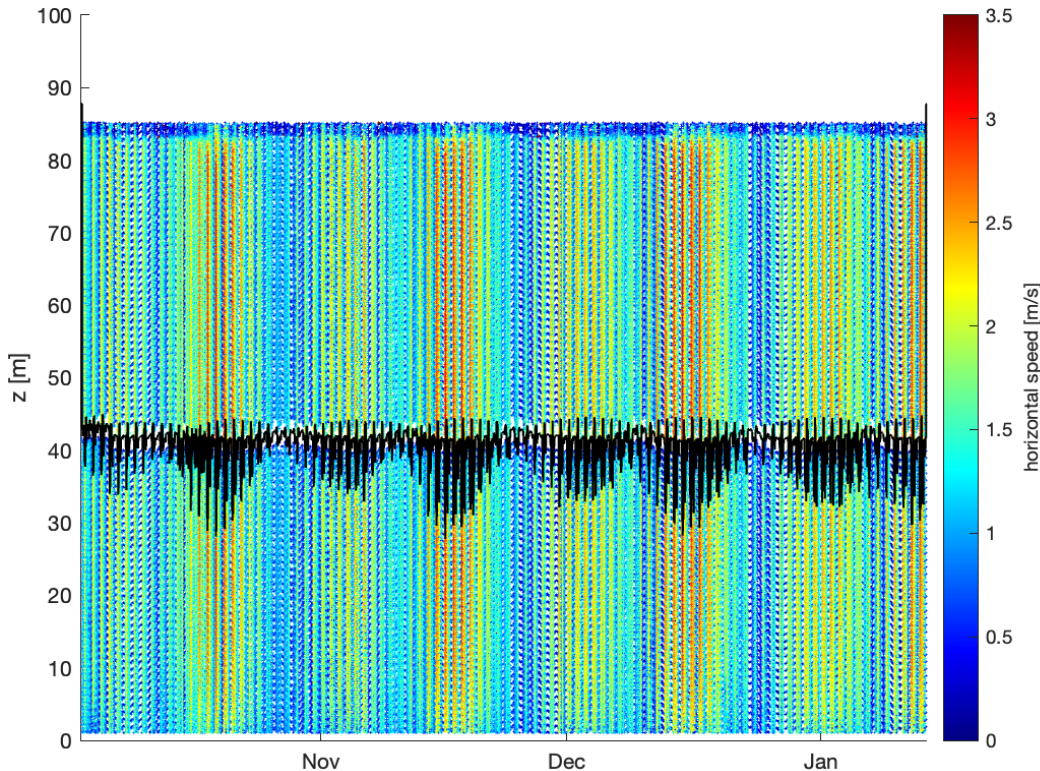


Figure 10: Horizontal speed measured by the Signature 500s on the Stablemoor. The black curve shows the depth of the Stablemoor, which decreases during strong flows.

Figure 11 shows the horizontal components of velocity measured by the Stablemoor, which have a principal axis that is similar to the measurements from the Sea Spider. There is more scatter in the Stablemoor measurements, which probably the result of lingering platform motion and possibly the result of large eddies shed close to the shore. The Stablemoor was the closest platform to the back-eddy and, so, potentially more affected.

Figure 12 shows the average profiles of speed, power, and principal axes measured by the Stablemoor. These are again similar to the Sea Spider measurements, with almost constant values over the depth range of the proposed O2 turbine (dashed lines). The red regions should the data with surface reflections that was removed during quality control.

The current speed at hub depth U_{hub} is determined for each Stablemoor ensemble by selecting the bin 17

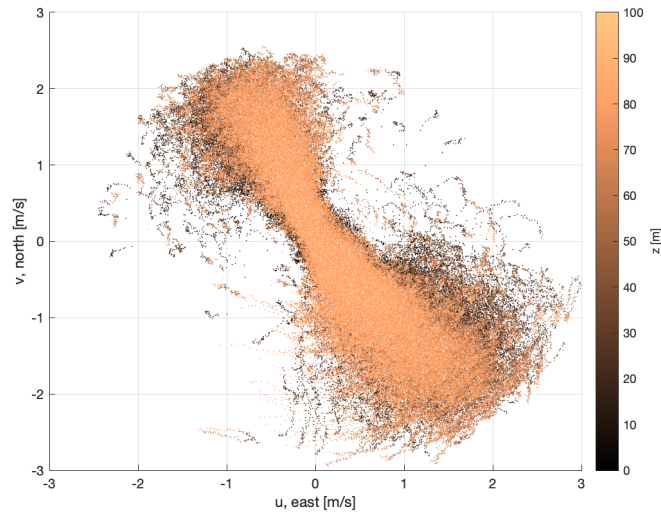


Figure 11: Stablemoor Sig500 horizontal components and principal axes. Color is height of each bin above seafloor z .

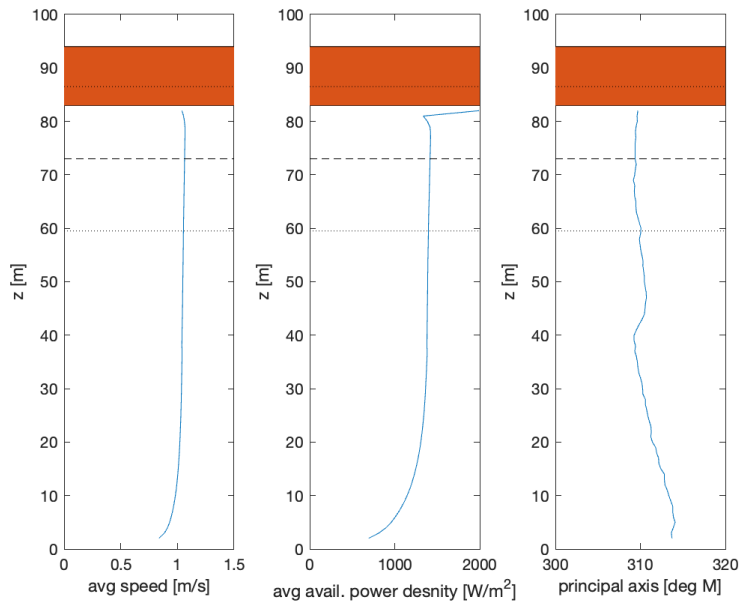


Figure 12: Stablemoor profiles of average speed, available power density, and principal axes. Profile are from merging the up- and down-looking Sig500s.

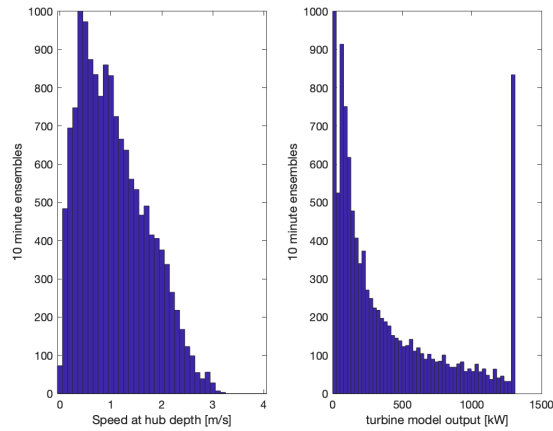


Figure 13: Histograms of hub-depth speed and power production from the Stablemoor.

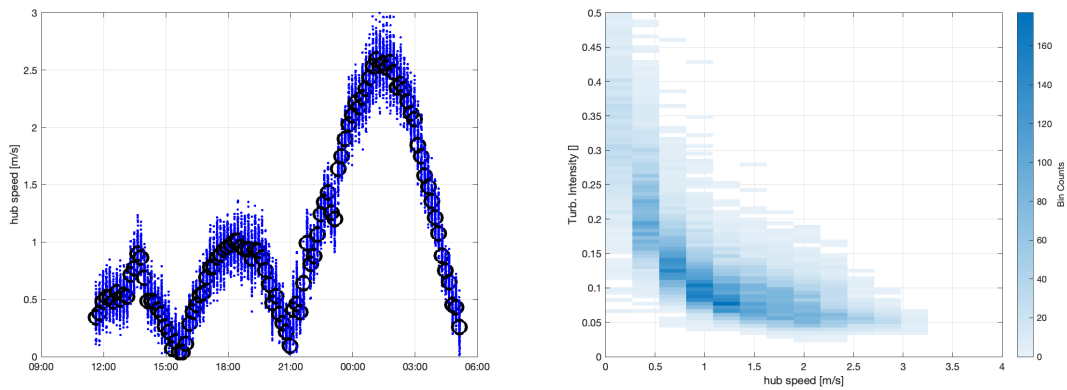


Figure 14: Stablemoor Sig500 example raw time series (left) and turbulent intensity versus speed (right). The blue dots are single-ping data every 1 second, and the black circles are ensembles every 10 minutes.

m below the measured surface (from the depth given by the pressure sensor). A histogram of U_{hub} is shown in Figure 13, along with a histogram of the resulting power from the model turbine (Eq. 3). Both are similar to the Sea Spider results.

The single ping data from the up-looking Sig500 are used to calculate the turbulence statistics of the horizontal speeds at hub depth for each ensemble (Eq. 1). Figure 14 shows an example 2-day time series with single-ping data and ensemble values, along with the TI results from the entire 103-day deployment as a function of hub speed. The Stablemoor TI levels are slightly lower than the Sea Spider results, with values as low as 5% at the higher ensemble speeds. This suggests that either 1) the Doppler noise correction (Eq. 1) used for the Sea Spider results underestimates the apparent variation from Doppler noise, or 2) the motion of Stablemoor filters some of the turbulence.

3.2.3 Surface Buoy

The down-looking Aquadopp mounted to the surface buoy was a measurement-of-opportunity, and the data are lower quality relative to the other platforms. Recall that the primary purpose of the surface buoy was to mark the site and alert tribal fishermen to the presence of the sub-surface Stablemoor nearby. The surface buoy was found with significant amounts of kelp around it during recovery, which may account for some of the reduction in data quality. The kelp was not present during two prior inspection visits in October and November.

The Aquadopp is a much older instrument, with only 3 beams (instead of 5) and narrowband processing (instead of broadband). Thus, there are no extra beams for determine east-north-up velocity components when a beam is obscured, and there are no acoustic correlation values to use in diagnosing bad data. The Aquadopp was mounted with beam 3 always downstream as the mooring aligned with the currents; it appears this beam was contaminated by kelp and possibly bubbles shed by the mooring line (see Appendix). With the third beam questionable, a different approach was used to estimate the horizontal flow speeds using only beams 1 and 2. Beams 1 and 2 faced obliquely upstream and appear to be uncontaminated (see Figure C3). First, the velocity data were transformed to beam coordinates. Assuming the buoy was orientated streamwise, the buoy tilt (mooring angle) was inferred from the apparent vertical component of velocity (i.e., for a level buoy, the vertical velocity should be near zero). Using this angle and the lateral spread of beams 1 and 2, a new estimate of horizontal streamwise speed was obtained. This approach is similar to the two-beam estimate of the horizontal flow made by river ADCPs [Forbush et al., 2016].

Figure 15 shows the resulting horizontal component of speed. Note that this is shown as a function of depth below the surface d , rather than height above the seabed z . Some of the deeper measurements have been removed during quality control because of low acoustic backscatter. The profiles have more noise than the data from the other platforms, but reveal the same patterns of diurnal inequality and spring-neap cycles. Figure 15 also shows the average profiles, which barely reach to hub depth (dashed line) because of the range limitation in the 1000 kHz ADCP. Despite the reduced data quality, these average profiles show the same uniformity with depth and support the usage of a speed at the hub-depth as representative of the full turbine rotor sweep.

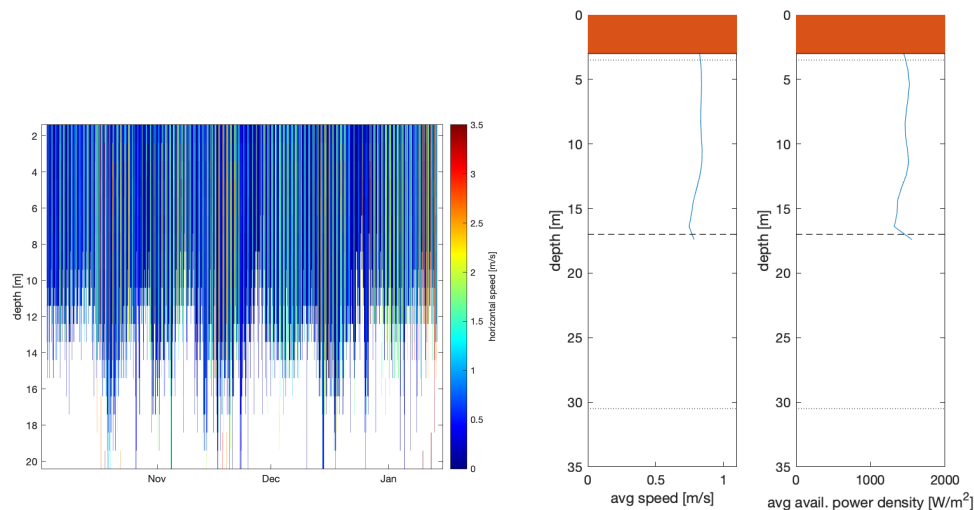


Figure 15: Horizontal speed measured by the Aquadopp on the Surface Buoy (left), and profiles of time-averaged speed and available power density (right).

3.3 Annual Energy Production (AEP) and Capacity Factor (CF) estimates

The stationary observations are used to estimate the AEP and CF following Eqs. 4 and 5. These are presented in Table 2 and compared with results from the FVCOM model of Calandra et al. [2023]. Results are similar using a full annual time series reconstructed using a tidal harmonic analysis of the u, v observations at hub depth. The tidal harmonic analysis is included as an appendix, including exceedance curves and joint probabilities of the velocity components.

Data source	Latitude	Longitude	AEP	Max ensemble speed	CF
Stablemoor	48.56260	-122.76690	5.0 GWh	3.2 m/s	0.22
PNNL FVCOM model	48.5626	-122.7669	5.0 GWh	3.2 m/s	0.22
Sea Spider tripod	48.56270	-122.76510	4.4 GWh	3.2 m/s	0.19
PNNL FVCOM model	48.5628	-122.7650	4.6 GWh	3.1 m/s	0.20
Surface buoy	48.56280	-122.76220	4.0 GWh	3.0 m/s	0.17
PNNL FVCOM model	48.5628	-122.7620	4.0 GWh	2.9 m/s	0.17

Table 2: Annual Energy Production estimates

The reported values are the total for the ‘O2’ device, which consists of two turbines. Note that FVCOM output was for Apr-May 2017 and that a comparable analysis using the output for June-July 2017 gives similar results. The modeled and measured AEP show excellent agreement and demonstrate the extent of spatial variability in the current resource across the mooring locations.

3.4 Surface Waves

Surface waves were measured by the uplooking Sig500 on the Stablemoor using acoustic surface tracking of the vertical beam [Pederson et al., 2007, Thomson, 2020, Brenner et al., 2023]. Only bulk statistics are shown here, but hourly spectra are included in the NHKDR data submission. There is a data gap from 21-29 Nov 2025, when a raw binary file was corrupted on the instrument for unknown reasons. This affects the wave measurements, not the currents or turbulence.

Figure 16 shows the time series of surface wave heights and peak wave periods. As expected from the limited fetch distances for wave generation and the minimal propagation of swell to the protected site, the waves are relatively small in height and short in period, as compared to open ocean conditions. The largest waves observed were $H_s = 1.8$ m on 14 Dec 2024. This was a historic storm with significant regional impact and can be interpreted as an extreme event.

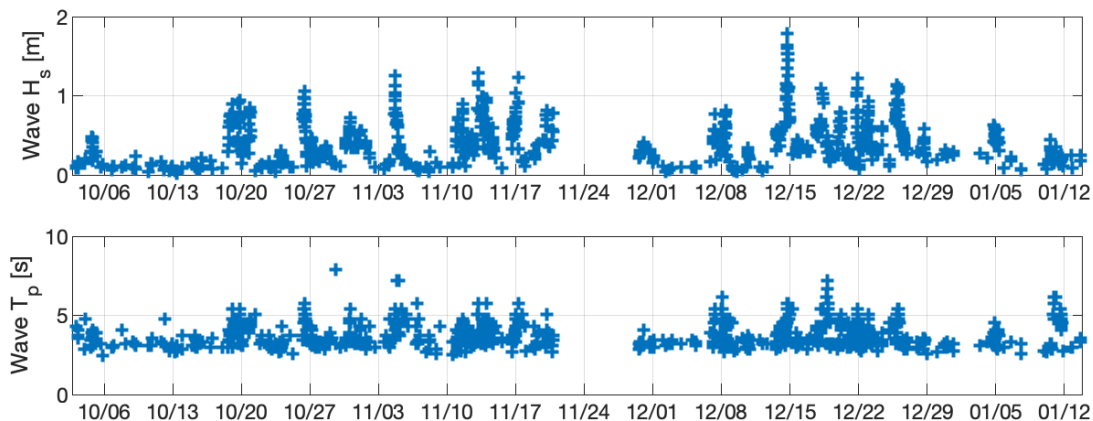


Figure 16: Time series of surface wave heights and peak periods measured from the Stablemoor.

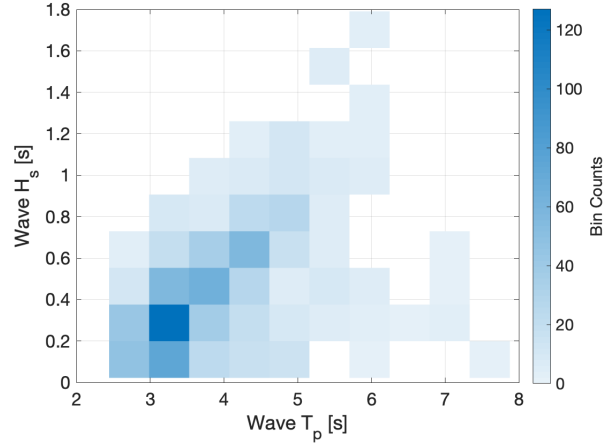


Figure 17: Joint histogram of surface wave heights and peak periods measured from the Stablemoor.

Figure 17 shows a joint histogram of surface wave heights and peak periods. The correlation of H_s, T_p is expected based on both fetch-limited wave evolution [Dobson et al., 1989, Thomson and Rogers, 2014] and the steepness limitation of deep-water waves [Schwendeman et al., 2014, Schwendeman and Thomson, 2015]. The rare observations of small H_s and longer T_p may be small amounts of swell energy refracting to the site, but the effect is minimal.

These wave observations are consistent with prior wave climatology studies in the region [Gemrich and Pawlowicz, 2020, Yang et al., 2019]. These studies indicate that this resource characterization spans the portion of the annual cycle with the most storm activity (i.e., fall and winter). The other seasons are expected to have less wave activity. Given the short periods and rapid depth attenuation of such waves, the wave climate is unlikely to be a significant concern for the operation of a tidal turbine at this site. For the extreme condition of $H_s = 1.8$ m, $T_p = 5.8$ s on 14 Dec 2025, the orbital velocities are ≈ 1 m/s at the surface and ≈ 0.12 m/s at hub depth (wavelength is 51 m for $T_p = 5.8$ s).

3.5 Ambient sound levels

Ambient noise measurements were carried out using two Loggerhead Snap recording hydrophones. The units are equipped with High Tech, Inc. (HTI) 96-min hydrophones (serial numbers 4371090 and 4371088) with nominal sensitivities of approximately -170 dB $1V/\mu\text{Pa}$, including internal preamplifiers. The units were programmed with an additional 11.1 dB gain applied by the analog to digital converter prior to data storage. Underwater noise was recorded for 30 seconds every 10 minutes throughout the deployment at a sampling rate of 44.1 kHz. Comparison between co-temporal measurements showed good agreement and all results presented here are based on results from a single hydrophones.

Several data products were produced for each recording. These included pressure spectral densities and several sound pressure level calculations. All of these products were derived from frequency-domain analysis of each recording. The 30-second .wav files were split into one-second windows with 50% overlap. Each window was demeaned and tapered using a Hann window prior to taking the discrete Fourier transform and calculating the pressure spectral density (PSD). To minimize additional storage requirements, variable band merging was applied following Martin et al. [2021]. Each window was independently processed before averaging the 59 windows to produce the PSD curve.

Pressure spectral density curves were integrated to calculate sound pressure levels according to

$$SPL = 10 \log_{10} \left(\int_{f_1}^{f_2} 10^{\frac{PSD(f)}{10}} df \right) \quad (6)$$

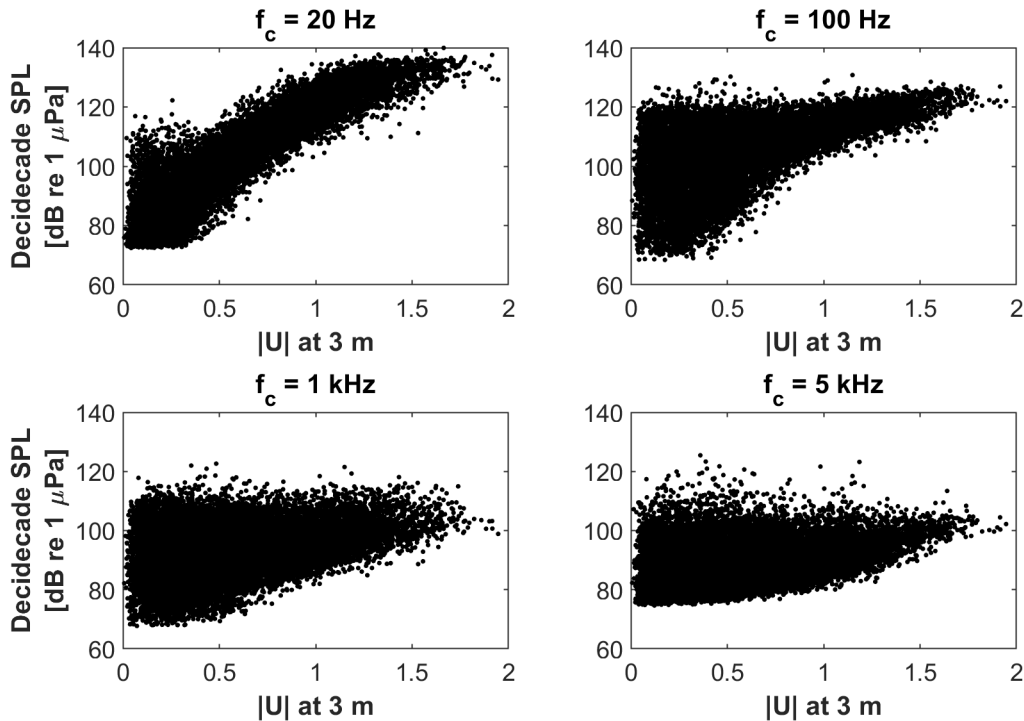


Figure 18: Distributions of decade SPLs at four frequencies as a function of frequency. All plots show that for currents below 0.4 m/s the upper and lower limits of measured noise do not change, suggesting flow noise is minimal.

where f_1 and f_2 are arbitrary lower and upper frequency integration limits, SPL has the units of dB re $1\mu\text{Pa}$ and PSD has the units of dB re $1\mu\text{Pa}^2/\text{Hz}$. Broadband sound pressure levels were calculated over two different frequency bands (10-22004 Hz and 500-22004 Hz). The more restricted frequency range was calculated to limit the impacts of flow noise for periods when currents are relatively strong. In addition, decade SPLs for center frequency bands 11 Hz to 17.8 kHz were calculated following the standard definitions.

Given that flow noise can contaminate acoustic measurements, particularly at low frequencies [Bassett et al., 2014], additional processing was carried out to identify ambient noise distributions at the site after removing data contaminated by flow noise. By plotting decade SPLs against inflow conditions measured by the ADCP at the closest bin to the hydrophone (3 m above the seabed), a threshold for removal of data of 0.4 m/s was identified. Below this threshold there is no apparent relationship between the lowest noise levels measured and the inflow conditions (Figure 18). The distributions in Figure 18 also indicate that the overall impact of flow noise at frequencies greater than 500 Hz is relatively small.

A time series of broadband sound pressure levels (500 Hz to 20 kHz) is shown in Figure 19. Throughout the deployment, SPLs on the order of 85 dB re $1\mu\text{Pa}$ were recorded regularly while the maximum broadband SPL that was recorded was approximately 134 dB re $1\mu\text{Pa}$. Noise level did exhibit some dependence on velocity that was not clearly attributed to flow noise as demonstrated by the distributions in Figure 18 and in Figure 19c. This may be attributed to sediment generated noise [Bassett et al., 2013], bubbles entrained due to turbulence, and other unidentified noise sources. To provide a conservative estimate of soundscape variability, further presentations of ambient noise statistics focus on measurements below the 0.4 m/s threshold. This corresponds to 5256 individual recordings or approximately 35.4% of the data.

A shorter timeseries (one day) of current speed and broadband SPLs is shown in Figure 20. While increases in inflow speed do result in a higher noise floor, the highest levels of ambient noise that are

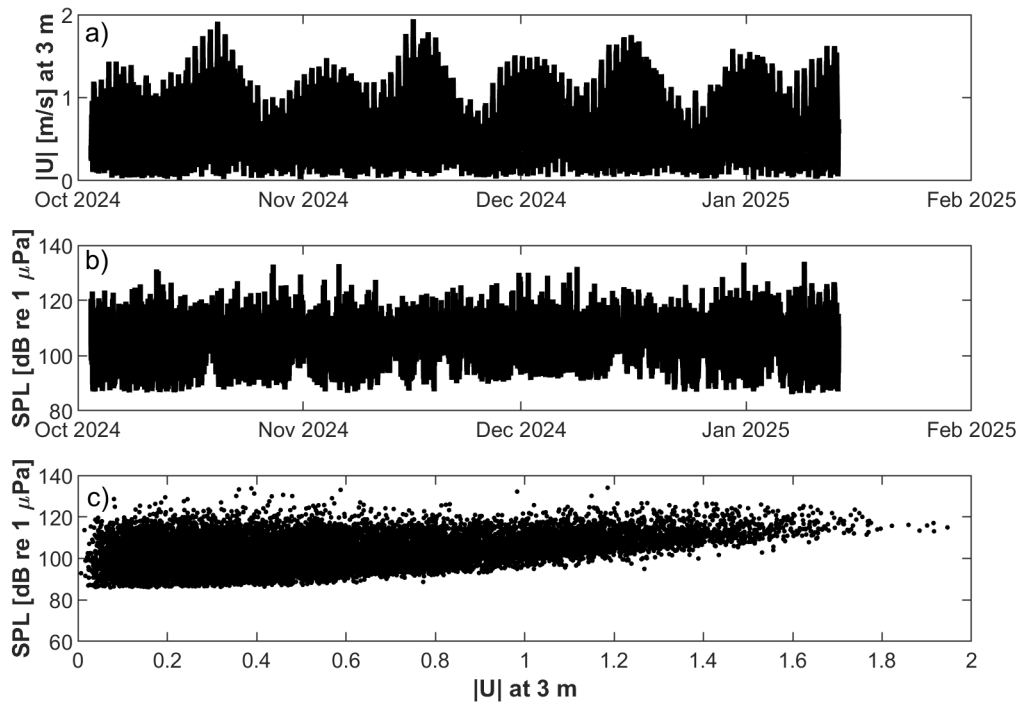


Figure 19: (a) Current speed at 3 m above the seabed. (b) Broadband sound pressure levels (500 Hz to 20 kHz). (c) Broadband sound pressure levels as a function of current speed.

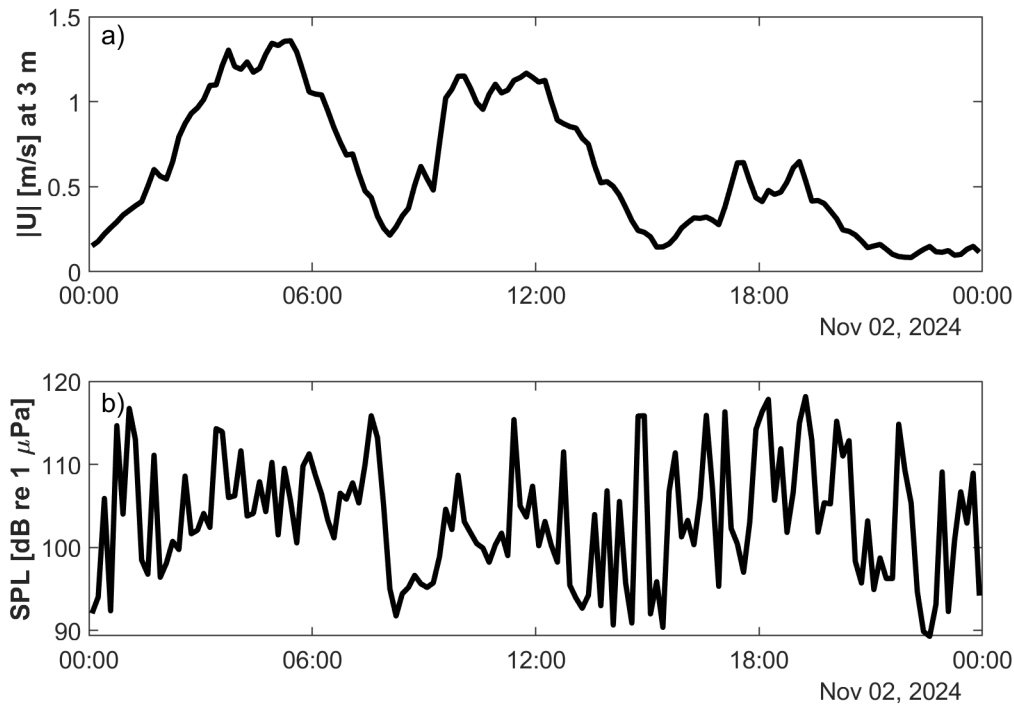


Figure 20: Time series data similar for a single day.

observed are not correlated with the inflow conditions. Noise measurements were made every ten minutes and Figure 20 shows broadband SPLs regularly changed substantially during these periods. While this reveals that the variability in the soundscape was under-resolved at short time scales, we hypothesize that over the multi-month sampling period, the broader statistics likely capture the full distribution of noise at the site.

Broadband (10 Hz to 22 kHz) SPL distributions for measurements below the velocity threshold are shown in Figure 21. The mean broadband SPL calculated for low speeds throughout the deployment was 120.3 dB re $1 \mu\text{Pa}$ while the median value was 110.2 dB re $1 \mu\text{Pa}$. The impact of the high intensity levels on the mean is clear in the ECDF, which shows that although the mean broadband SPL is approximately 120 dB re $1 \mu\text{Pa}$, SPLs are lower than the mean approximately 78% of the time (during low flow periods). These are relatively noisy conditions that are consistent with prior observations in the Salish Sea, which attribute elevated SPLs primarily to vessel traffic [Bassett et al., 2012].

Empirical probability density functions for spectral levels at frequencies between 10 Hz and 20 kHz are shown in Figure 22. The highest pressure spectral densities that are regularly observed occur below 100 Hz and are likely attributed to vessel traffic in Rosario Strait. The distribution of observed noise levels generally decreases with frequency with the highest probability pressure spectral densities occurring between approximate 70-90 dB re $1 \mu\text{Pa}^2/\text{Hz}$ around 100 Hz, 60-80 dB re $1 \mu\text{Pa}^2/\text{Hz}$ around 1000 Hz and between 45-55 dB re $1 \mu\text{Pa}^2/\text{Hz}$ around 10 kHz. At frequencies near 10 kHz, frequency-dependent patterns are present in the data. This is likely attributed to self-noise from either the hydrophone or ADCP side bands on the Sea Spider platform. Decade noise statistics are presented in Figure 23 and reflect the broader trends identified in the statistics for PSDs.

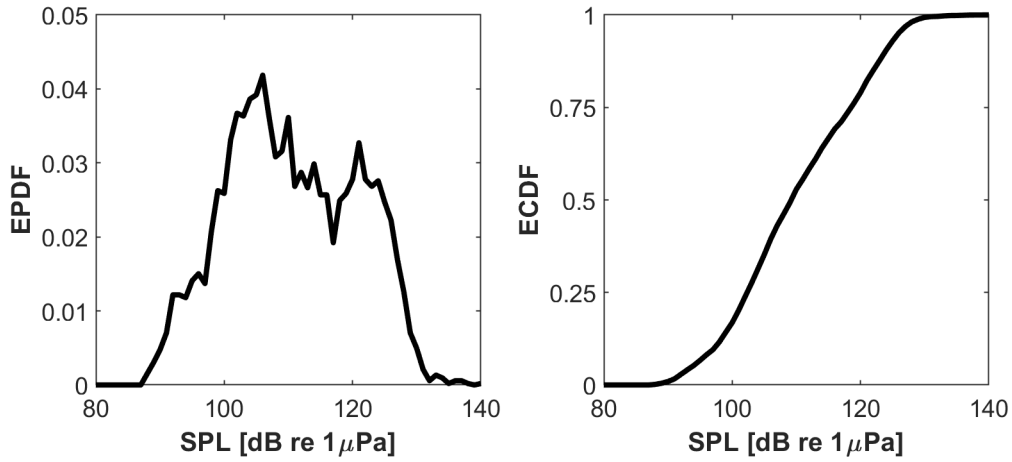


Figure 21: (a) Empirical probability density functions and (b) empirical cumulative distribution functions for broadband noise at low current speeds.

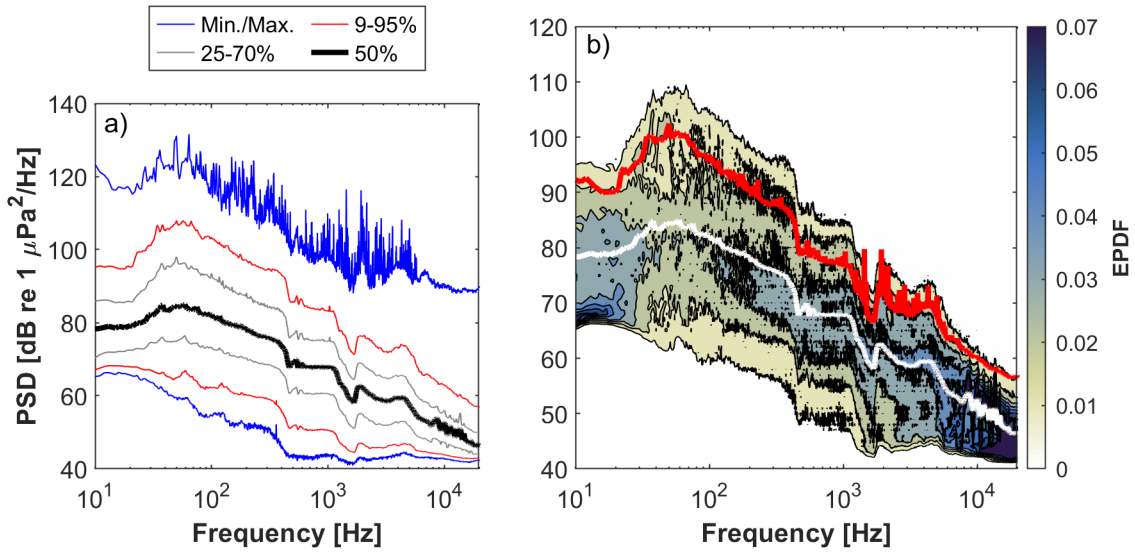


Figure 22: (a) Pressure spectral density statistics. (b) A contour plot of empirical probability density functions of pressure spectral densities. The white and red lines show the median and mean pressure spectral densities, respectively. Both figures are calculated using only data with current speeds below 0.4 m/s.

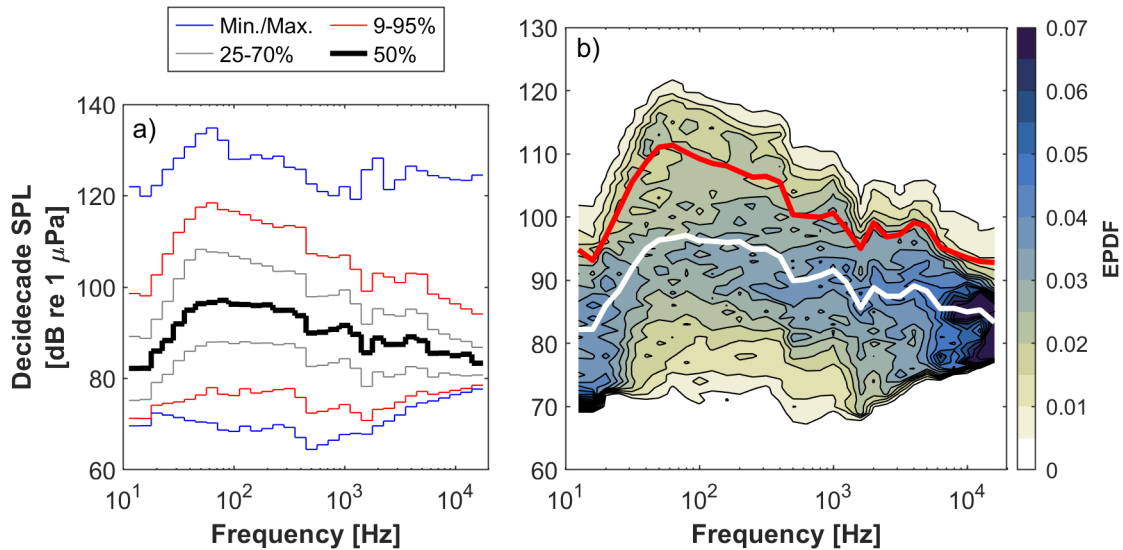


Figure 23: (a) Decidecade SPL statistics. (b) A contour plot of empirical probability density functions of decidecade SPLs. The white and red lines show the median and mean values, respectively. Both figures are calculated for data with current speeds below 0.4 m/s.

3.6 Stratification

The San Juan Islands of Washington State are known to have stratification and estuarine circulations in addition to strong tidal flows [MacCready and Geyer, 2010]. Stratification is monitored at repeat stations throughout the region by the WA State Dept. of Ecology. Typical values are a few PPT salinity change and a few deg C change over 50-200 m depth. The associated estuarine circulations are weak, relative to the tidal currents, and are most prominent during neap tidal cycles [Deppe et al., 2017]. Thus, seasonal variations in stratification at this site are not expected to have a significant effect on the currents or the *AEP* estimates. Figure 24 shows the data from a CTD (conductivity, temperature, depth) sensor mounted on the Stablemoor (RBR Concerto). These are typical variations for a tidal channel in this region. The clusters, or stripes, in this figure are mixing lines along which water masses are evolving while advecting through the region.

The temperature data from the stationary measurements (Figs. A1 and B1) show tidal variations in the early autumn, then well-mixed conditions (i.e., no variations) in the late fall and early winter. This is expected as autumn storms drive mixing of the full water column, coincident with a lack of solar radiation to provide surface warming.

3.7 Fish tags and porpoise clicks

Opportunistic measurements for tagged fish were included using a Vemco receiver on the Sea Spider tripod. No tagged fish were detected.

Additional opportunistic measurements used ‘C-POD’ (Chelonia) click detectors with automated onboard processing to listen for marine mammal echolocation and record the details of the click trains associated with each echolocation event. Figure 25 shows detections by species class reported by the manufacturer software. Each click event is assigned a certainty value based on its acoustic characteristics, with subsequent analysis restricted to events with ‘Hi(gh)’ and ‘Mod(erate)’ certainties. Click events are statistically represented through ‘detection positive minutes’ (DPM) (i.e., a minute with at least one click event at a given certainty level). As shown in Figure 25, the only species with routinely high certainty classifications are harbor porpoises. The ‘low’ certainty click events mirror those with ‘Mod’ certainty. ‘Dolphin’ click events, which

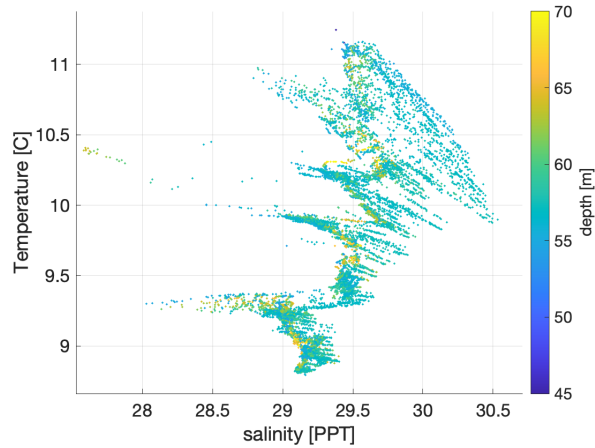


Figure 24: Temperature versus salinity measured on the Stablemoor.

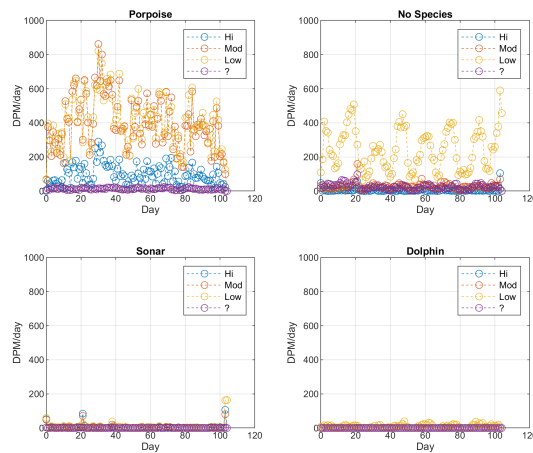


Figure 25: CPOD detections by certainty level and click event type.

would be indicative of killer whale echolocation, are generally absent in the data (only possible classifications are low certainty). Sonars are intermittently detection with moderate to high certainty, potentially associated with subsistence fishing or deployment/retrieval operations by the R/V Robertson. The “No Species” click events are all low certainty and, given the roughly 14-day oscillations may be “clicks” associated with sediment transport during periods with stronger currents [Bassett et al., 2013].

4 Discussion

Other than the region of separated flow close to shore (i.e., the back eddy in Figure 4), the site is well suited for the placement of tidal turbines. The current profiles have minimal shear over the rotor span of the intended O2 turbines, and the turbulent intensity is moderate. The water depths (80-90 m) are feasible for moorings and other in-water work. The wave climate is relatively benign. The principal axes of ebb and flood are almost reciprocal, which is particularly beneficial for the O2 turbine design. The speed histograms are smooth, and the mixed tidal diurnal inequality provides ample work windows for deployment, recovery, and maintenance activity.

The FVCOM model output reported in Calandra et al. [2023] has remarkable accuracy relative to the stationary measurements, with *AEP* values and maximum speeds in strong agreement. This makes it tempting to target the ‘hot spot’ shown in the model (Figure 1), which is just northwest of the stationary measurement sites. However, the mobile survey indicates that this is also where the flow begins to separate and shed eddies at the corner of the island. Further, the acceleration of flow is sufficiently localized that the momentum extraction from the turbines might alter the flow sufficiently to displace the hot spot. For these reasons, it seems more prudent to target the quasi-homogeneous region surveyed by the stationary measurements, where the flow is rectilinear and the bathymetry is smooth.

5 Conclusion

The OPALCO site at the western edge of Rosario Strait (WA, USA) has been characterized for potential tidal current power generation. Stationary and mobile measurements using ADCPs have determined the flow conditions and Annual Energy Production (*AEP*). The Sea Spider results satisfied the IEC 62600-201 standard. Additional measurements from Stablemoor and surface buoy moorings expanded the spatial context and improved the turbulence characterization. A prior numerical modeling study has strong agreement with the measurements.

Overall, the site is well-suited to tidal current power generation. A minimum *AEP* of 4.0 GWh can be expected from two turbines, and up to 5.0 GWh is feasible.

6 Data and software archive

All data, processing code, and results have been submitted to MHKDR (Marine Hydrokinetic Data Repository) as submission #609.

<https://mhkdr.openei.org/submissions/609>.

Some analysis codes from public GitHub libraries also were used, including

<https://github.com/SASlabgroup/SWIFT-codes/Waves/UVZwaves.m> and

https://github.com/SASlabgroup/NortekCodes/blob/main/Signature/sigProcess_all.m.

7 Acknowledgments

Joe Talbert, Alex de Klerk, and Amy Larson completed the design, rigging, and fabrication of the deployment platforms. Andy Ellers and Anna McBee operated the R/V Jack Robertson. Malcolm LeClair, Christie Hegermiller, Ari Athair, Sarah Palmer, Jayden Wood, Fiona Drum, and Aidan Hunt assisted with the deployments and recoveries. 48 North Solutions provided permitting support.

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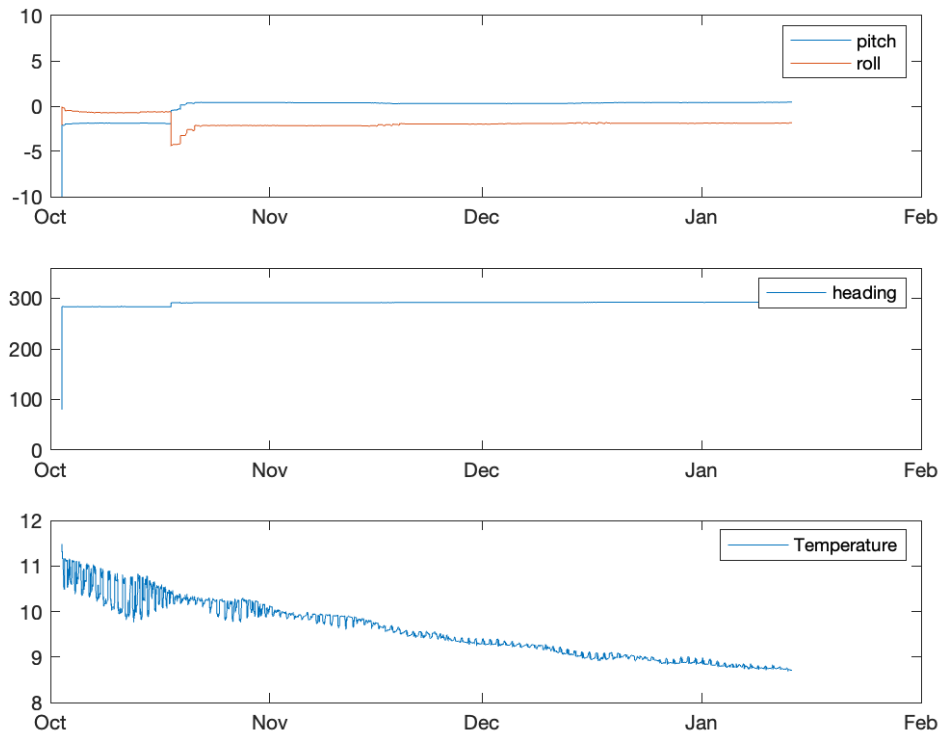


Figure A1: Sea Spider tripod Sig250 ancillary data.

A Quality control / assurance of Sea Spider tripod data

The ancillary data from the Sig250 in Figure A1 suggest no significant motion or turning of the Sea Spider tripod, other than a few degrees of settling during the first spring tide of the deployment. The water temperatures show expected tidal advection in the fall and then fully mixed conditions in the winter.

The backscatter amplitude data from the Sig250 in Figure A2 show an expected decrease with range and strong surface reflections around the black line showing the depth indicated by the pressure gauge. The red line shows the cutoff range $z = d \cos(\theta)$ used to avoid surface reflections. There are no anomalies in the backscatter and no indications of occlusion.

The broadband correlation data from the Sig250 in Figure A3 show nearly 100% correlation for all beams at all depths and at all times. Again, the surface screening shown by the red line appears to catch all surface contaminated bins.

The velocity components shown in Figure A4 show clear tidal signals without discontinuities. The surface bins have been removed above the red line in the previous figures. There is a [probably] spurious signal in the vertical velocity component around $z = 30$ m in the last month of deployment. The consistent depth of the spurious signal suggests that it is self-generated, such as a secondary reflection from the surface or other interference. This spurious signal is small (0.2 m/s) and does not appear to affect horizontal current measurement. Further, it is below the rotor sweep of the intended turbine.

The vertical velocity discrepancy from the Sig250 is shown in Figure A5. This is the difference between the two distinct estimates of vertical velocity that arise from the coordinate transform of the four slanted beams. The values are expected to be small, unless there are significant velocity gradients (i.e., inhomogeneity)

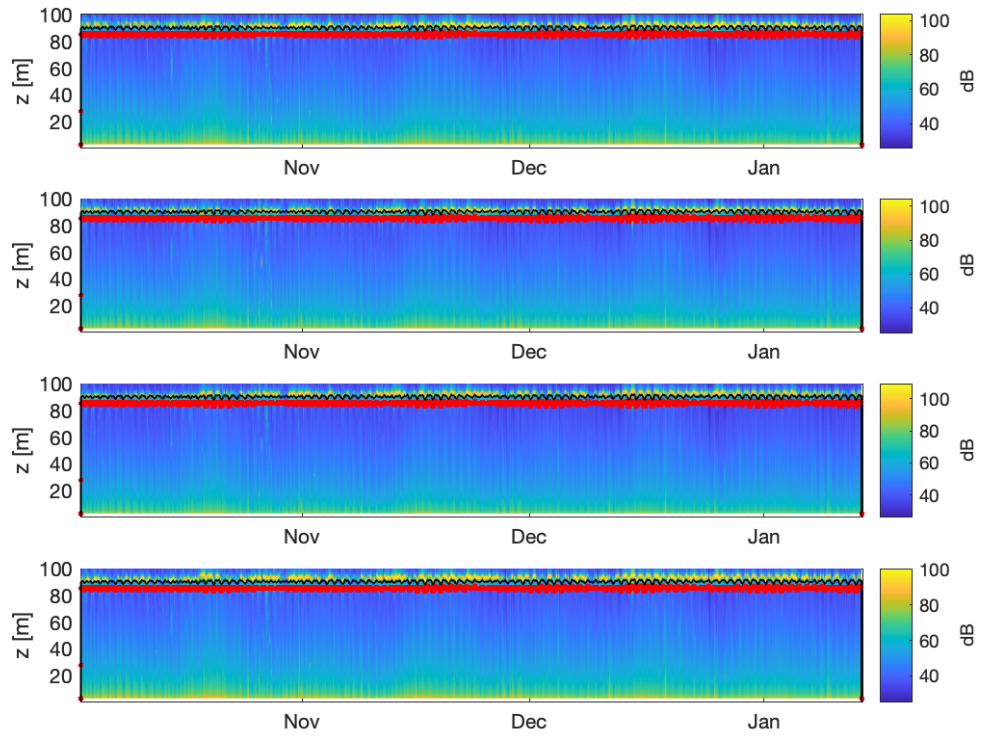


Figure A2: Sea Spider tripod Sig250 backscatter amplitude.

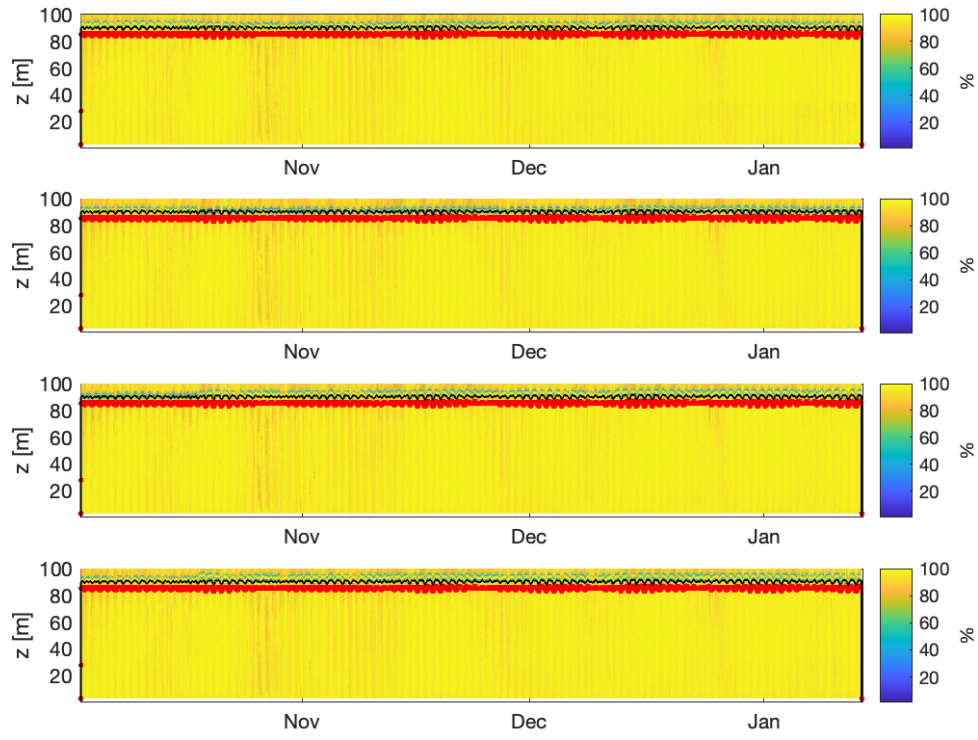


Figure A3: Sea Spider tripod Sig250 Doppler correlations.

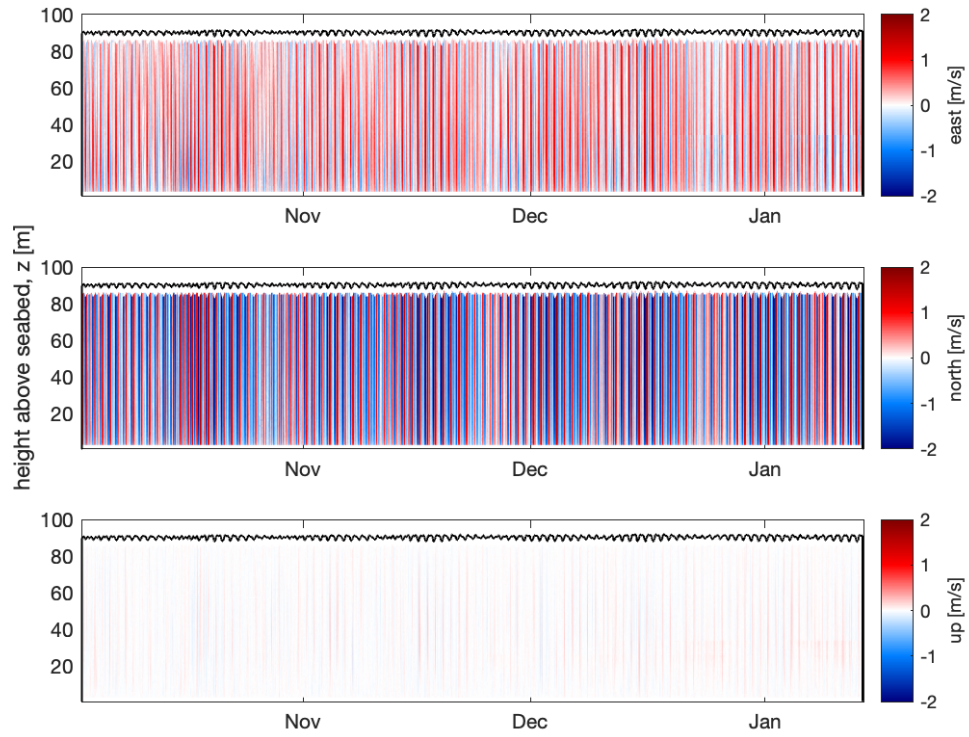


Figure A4: Sea Spider tripod Sig250 profiles of velocity components.

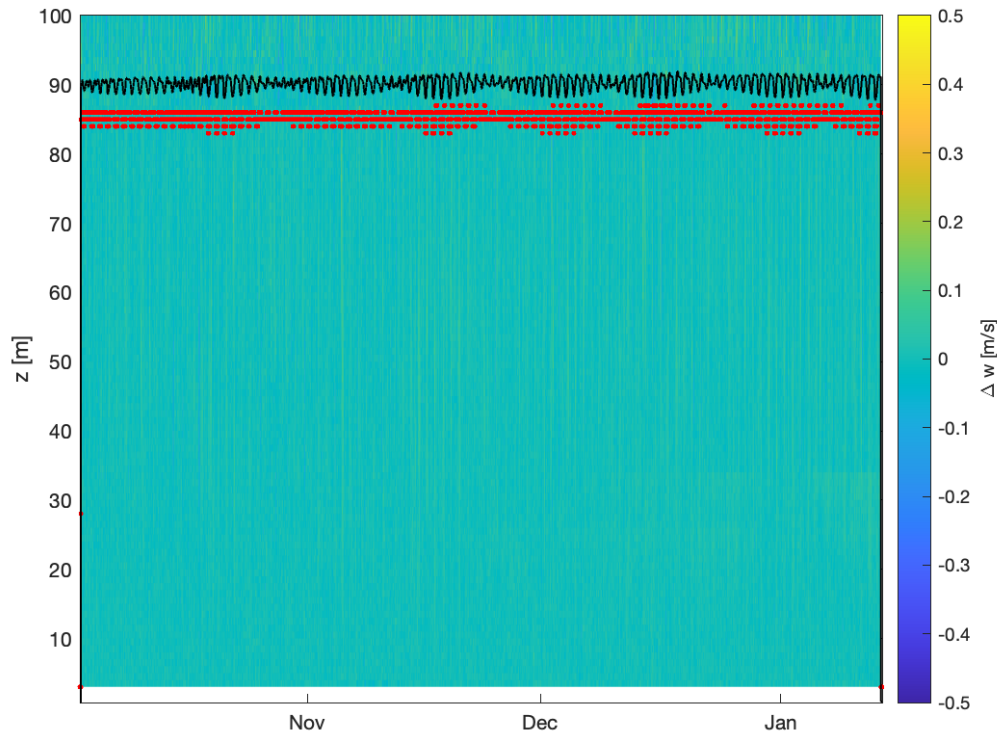


Figure A5: Sea Spider tripod Sig250 vertical velocity error estimates.

within the cone of the ADCP beams or there is bad data from a particular beam. The values here are mostly within the intended precision ± 0.05 m / s for all velocity components. The spurious signal at $z \approx 30$ m in Jan 2025 is subtle, but present.

B Quality control / assurance of Stablemoor data

Here follow figures for the Stablemoor that are similar to the preceding Sea Spider quality control figures, with the notable difference that all Stablemoor data are presented as a merged product of the two Sig500s (up- and down-looking). A black line indicates the Stablemoor height above the seafloor through these figures. There is, of course, more motion in Figure B1 because the Stablemoor adjusts to the currents. The backscatter amplitudes decay symmetrically away from the Stablemoor in Figure B2 and the Doppler correlations are universally high in Figure B3. The velocity components in Figure B4 show the enhanced vertical velocities, relative to the Sea Spider measurements, which are related to platform motion. However, testing a three-dimensional scalar speed ($\sqrt{u^2 + v^2 + w^2}$) has negligible effect on the *AEP* and *CF* calculations, relative to a two-dimensional scalar speed, so the differences between these values for the Stablemoor and Sea Spider are likely spatial variability, not a measurement or processing artifact. The vertical velocity discrepancies in Figure B5 are universally small.

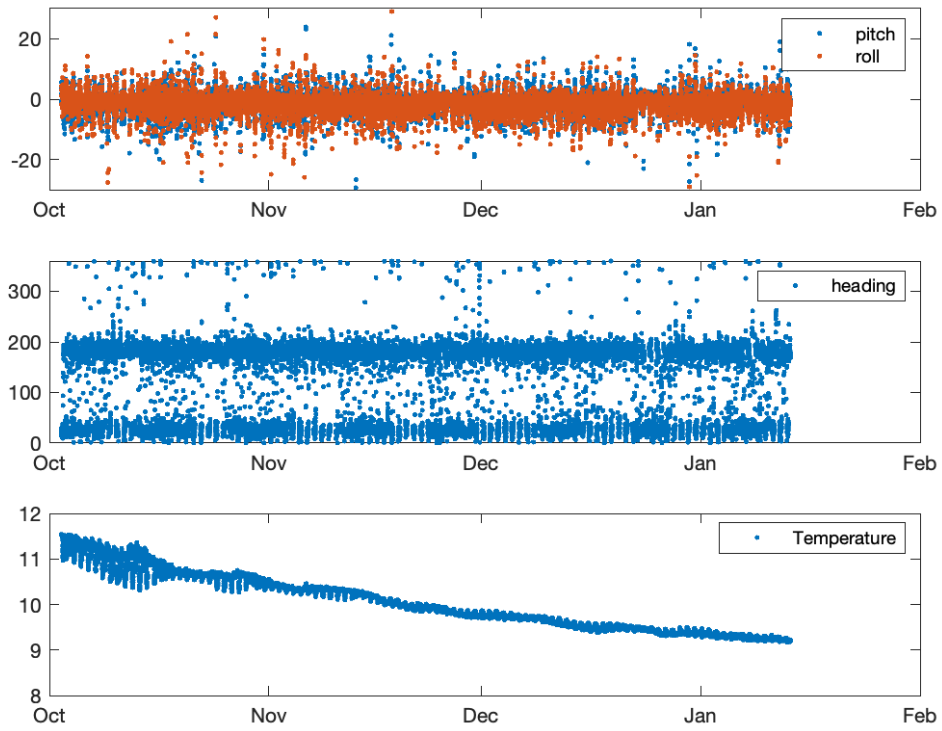


Figure B1: Stablemoor pitch and roll, heading, and water temperature.

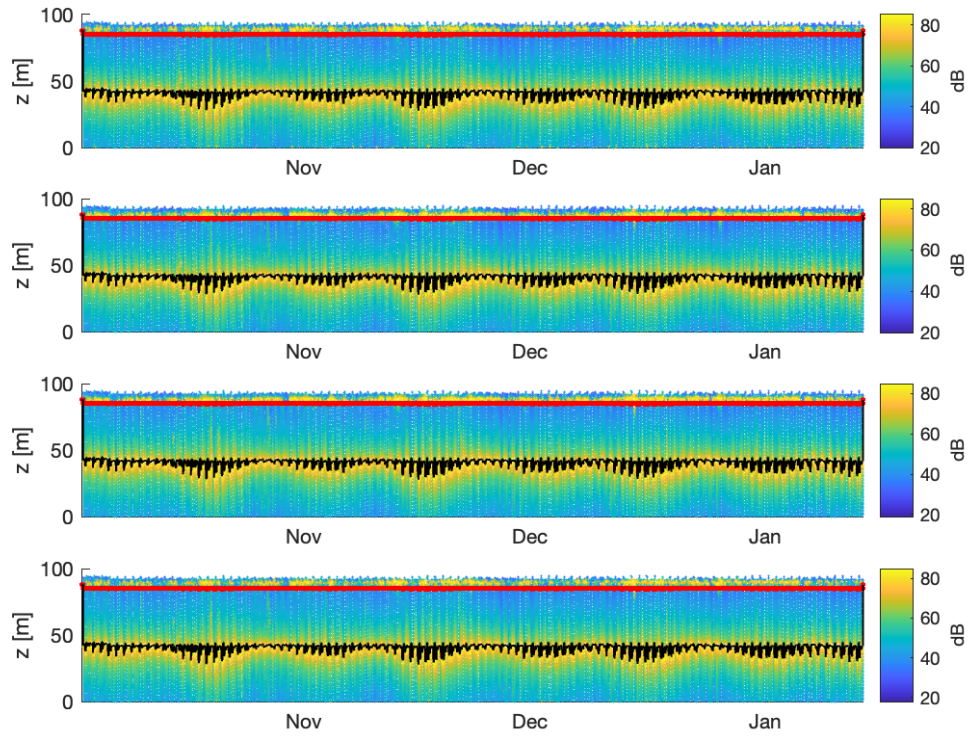


Figure B2: Stablemoor merged Sig500s backscatter amplitude.

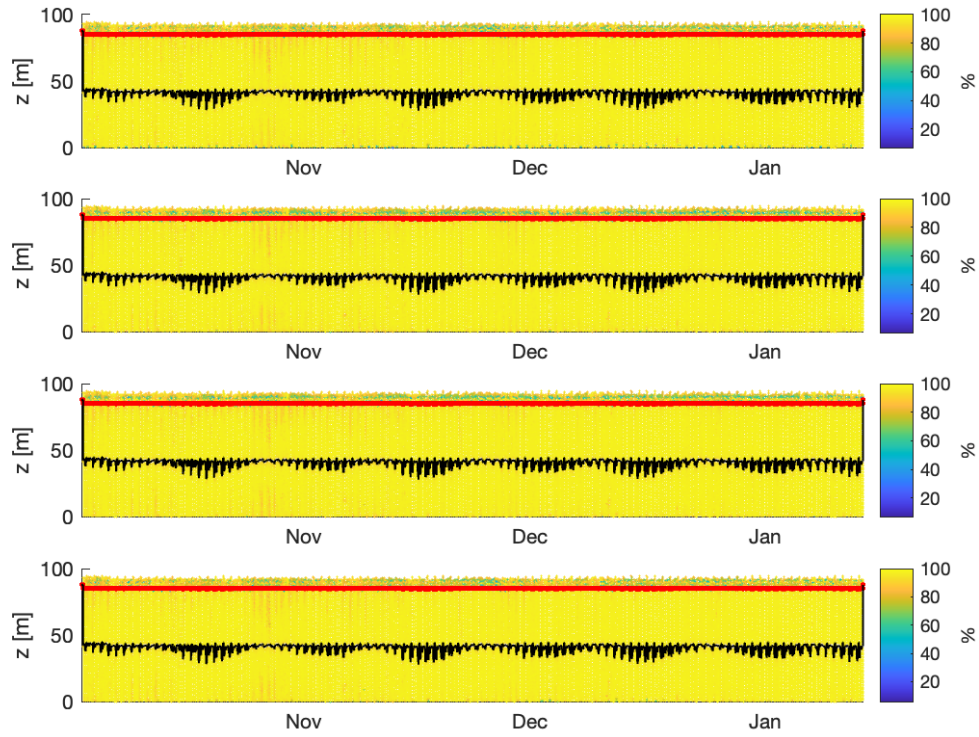


Figure B3: Stablemoor merged Sig500s Doppler correlation.

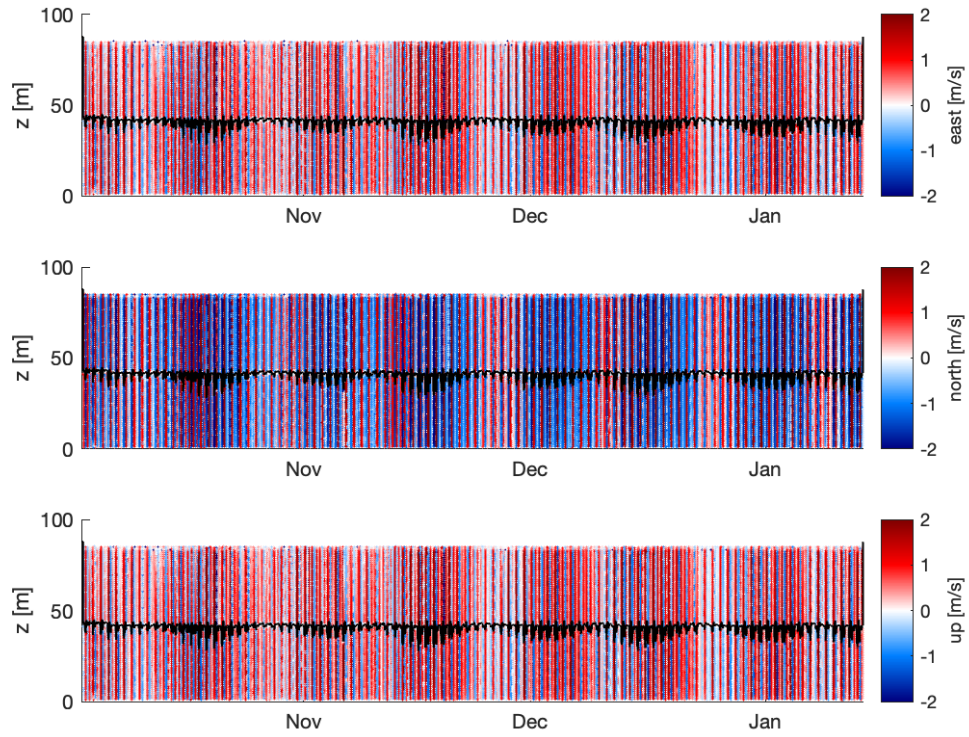


Figure B4: Stablemoor merged Sig500s velocity components.

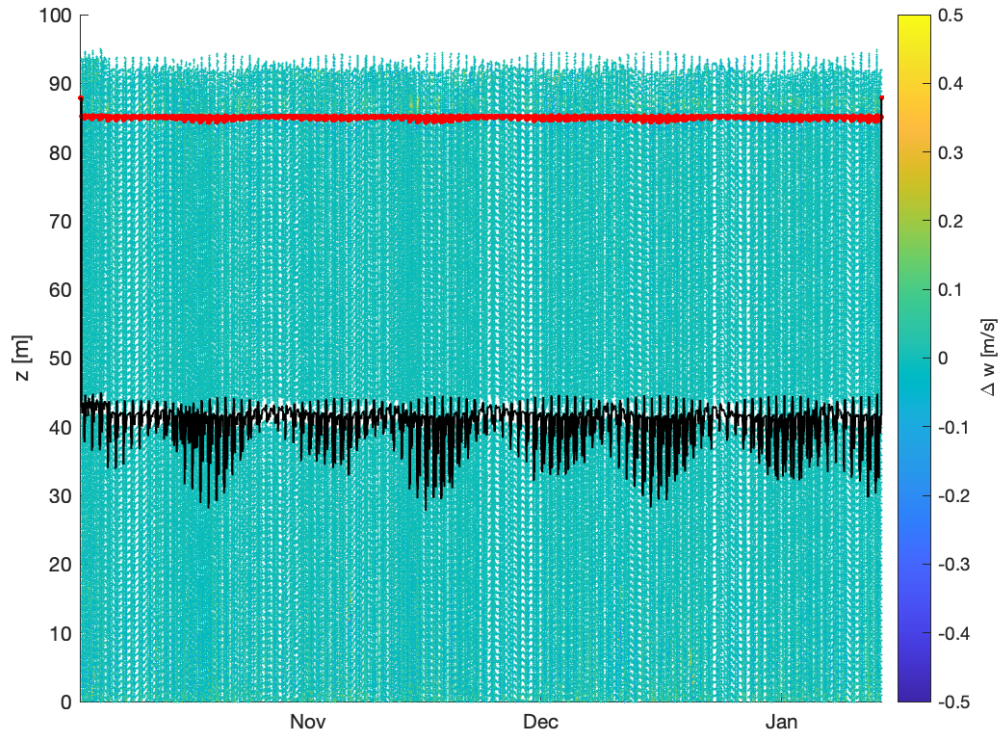


Figure B5: Stablemoor merged Sig500s vertical velocity error estimates.

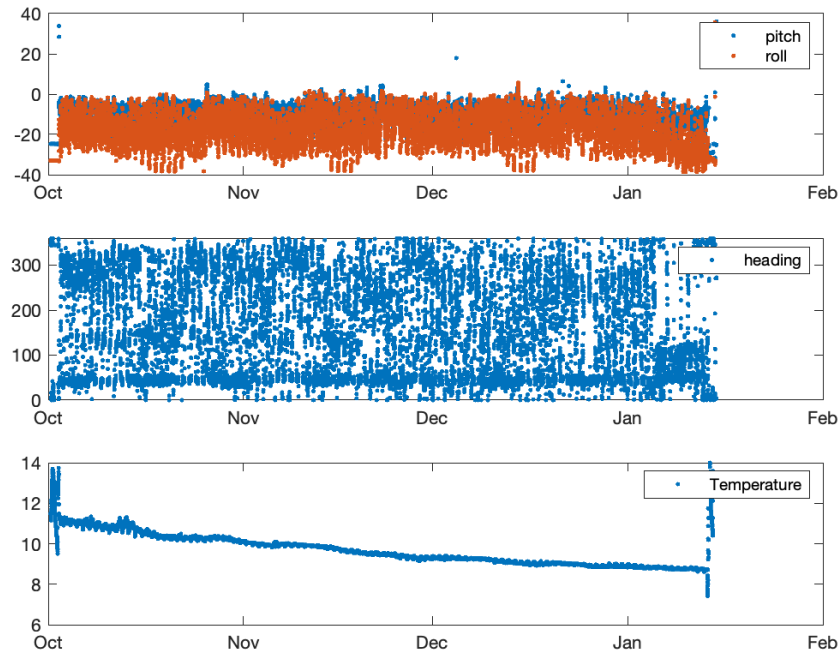


Figure C1: Surface buoy Aquadopp pitch and roll, heading, and temperature.

C Quality control / assurance of Surface Buoy data

The Surface Buoy Aquadopp motion in Figure C1 has larger variations than the Stablemoor because the spherical buoy is not streamlined and sheds vortices. The Aquadopp backscatter amplitude in Figure C2 has a notable reduction in beam 3, which is the downstream beam (and thus most likely to be obscured). Converting to beam coordinates for Figure C3 shows spurious velocities in beam 3, which prompted the two-beam solution described in the Results.

There is no correlation plot for the Aquadopp, because it is narrow-band Doppler system. There is not vertical error Δw plot because Aquadopp is only a 3-beam system (and multiple w estimates requires 4 or 5 beams).

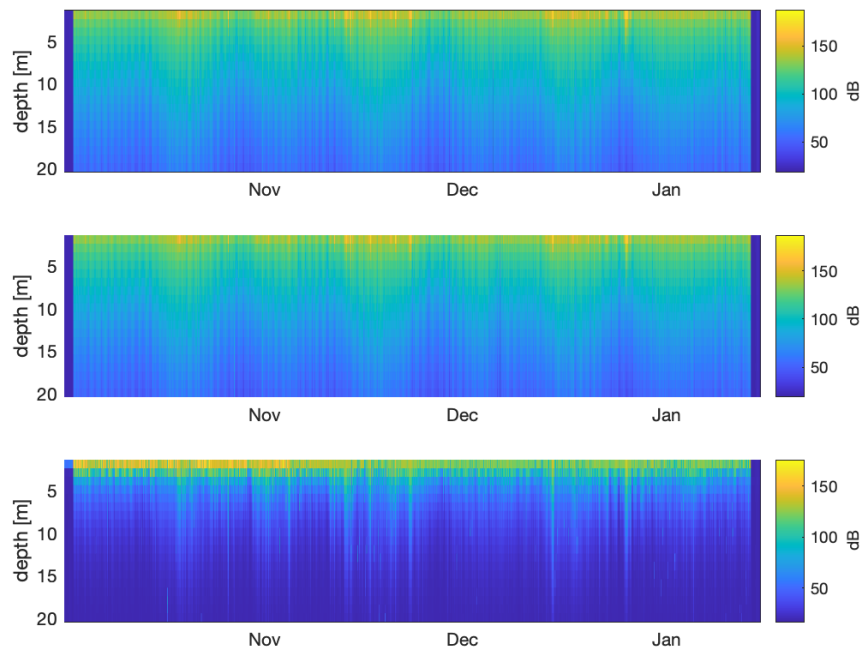


Figure C2: Surface buoy Aquadopp amplitude.

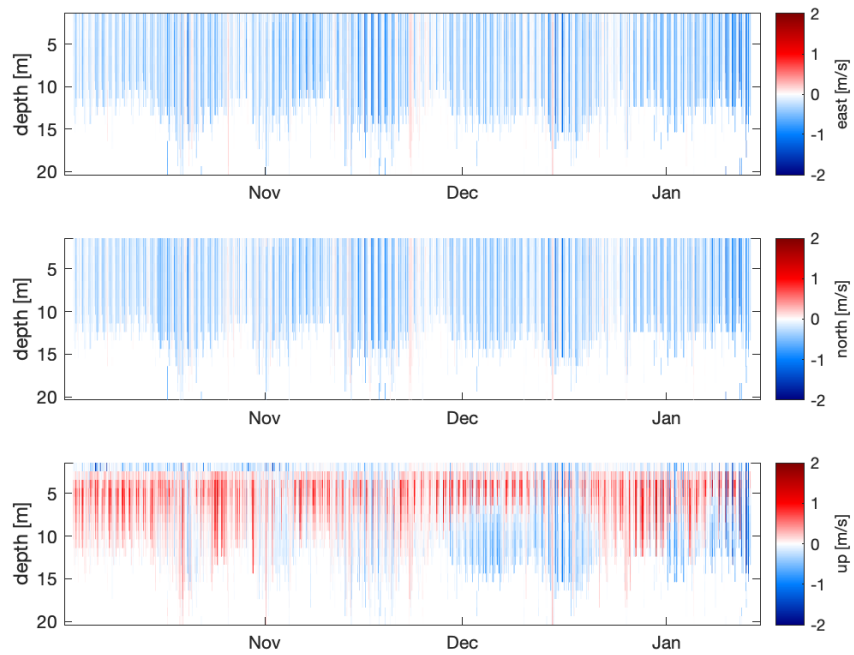


Figure C3: Surface buoy Aquadopp velocity components, in beam coordinates.

D Tidal Harmonic Analysis

Tidal harmonic analysis using T-Tide v1.5b [Pawlowicz et al., 2002] resolved 35 constituents, including the M10 optional constituent for nonlinear flow in shallow channels. The inputs were the u, v components at hub depth as measured by the Sig250 on the Sea Spider. (In T-tide, these are input as a complex-valued vector $u + vi$.) The reconstructed velocities capture 96% variance of the original data, when compared over the same 103 day record.

Figure D1 shows the joint probabilities of velocity components from the reconstruction and from the data. The principal axes and distributions are similar, though there is more off-axis variation in the observations. This is likely related to larger scale turbulent eddies, which can cause biases in the two-minute ensembles of the observations relative to the hourly values from the harmonic reconstruction.

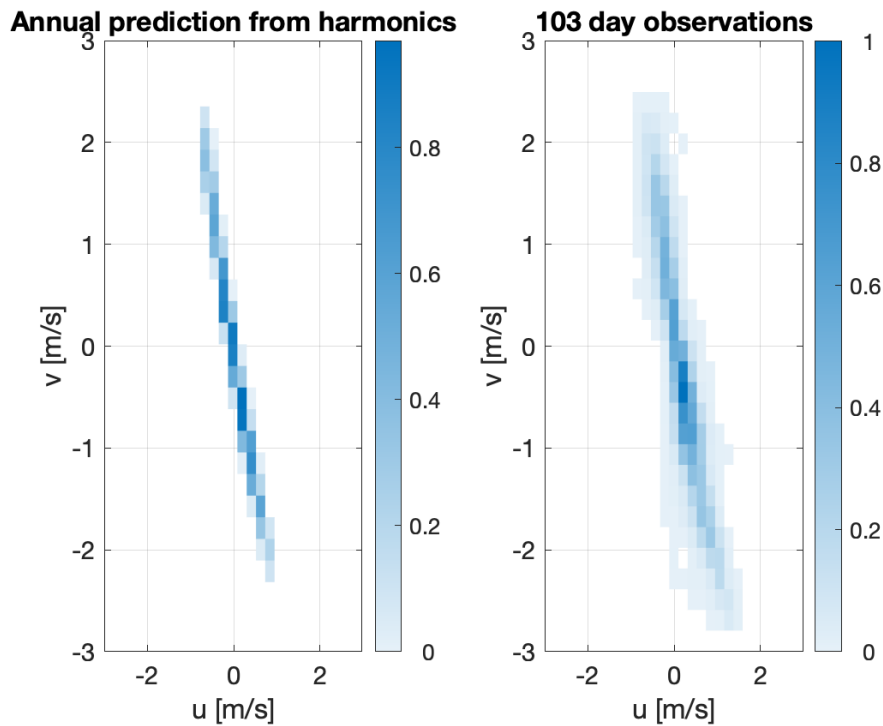


Figure D1: Joint probability of velocity components from harmonic reconstruction (left, 1 year duration) and from observations (right, 103 days duration).

Figure D2 shows the exceedance probability of scalar current speed at hub depth from the harmonic reconstruction and observations. In the region of power production ($U > 1$ m/s), the curves agree well, though the observations have slightly more probability for the highest speeds. The annual prediction has a slight bias towards lower speeds.

When using harmonic reconstruction to produce a full year time series of velocity, the resulting $AEP = 4.1$ GWh is slightly less than the statistical estimate using the direct observations. Based on the work of Polagye and Thomson [2013], we expect the statistical estimate to be a more accurate representation of the site.

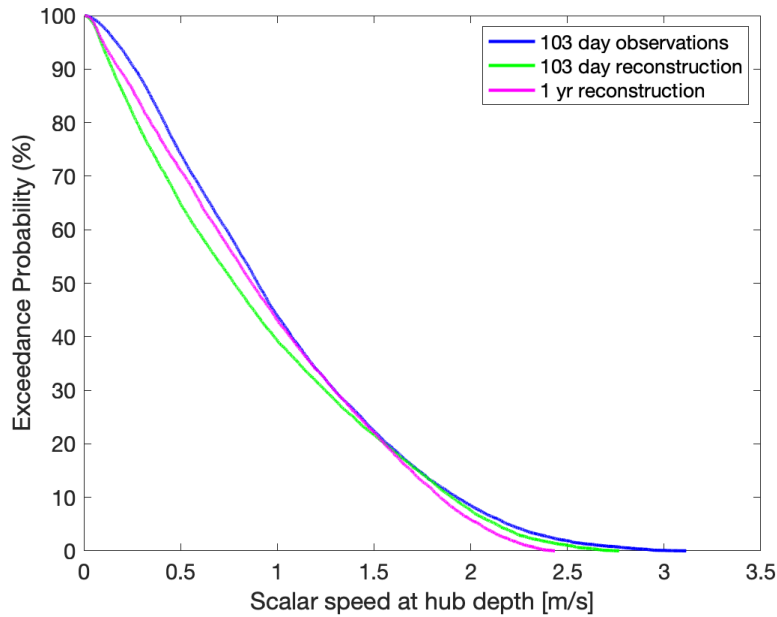


Figure D2: Exceedance probabilities for scalar current speed at hub depth. Results for 103 day observations (blue), 103 day reconstruction (green), and 1 yr reconstruction (magenta).

The full harmonic analysis is given in Table 3, and these values are included in the data submitted to MHKDR. The columns are

- Name of constituent
- Frequency of tidal constituent [cycles/hr]
- Major and Minor axes of constituent [m/s]
- E_{maj} , E_{min} 95% confidence intervals major and minor values
- Inc, ellipse orientations [degrees]
- E_{inc} , 95% confidence intervals for Inc
- Phase of constituent (degrees relative to Greenwich)
- E_{phase} , 95% confidence interval for phase
- SNR, signal to noise ratio

Table 3: Tidal Harmonic Analysis results for Sea Spider Sig 250 velocities at hub depth.

Name	Freq	Major	E_{maj}	Minor	E_{min}	Inc	E_{inc}	Phase	E_{phase}	SNR
*MM	0.0015122	0.048	0.018	0.009	0.02	128.12	19.05	193.61	22.72	7
*MSF	0.0028219	0.079	0.020	-0.013	0.01	117.75	9.53	251.24	14.96	16
ALP1	0.0343966	0.018	0.026	0.002	0.01	110.53	42.62	254.73	71.98	0.46
2Q1	0.0357064	0.013	0.026	-0.009	0.02	112.47	143.59	344.51	173.84	0.26
*Q1	0.0372185	0.054	0.026	0.008	0.01	110.66	13.94	176.19	23.46	4.4
*O1	0.0387307	0.349	0.026	0.033	0.01	105.88	2.00	176.83	3.72	1.8e+02
NO1	0.0402686	0.025	0.026	-0.007	0.01	110.40	26.15	195.97	41.72	0.95
*K1	0.0417807	0.808	0.026	0.014	0.01	108.20	0.92	193.82	1.66	9.6e+02
*J1	0.0432929	0.047	0.026	0.005	0.01	108.48	15.53	238.71	27.56	3.2
*OO1	0.0448308	0.027	0.026	0.007	0.01	109.69	19.05	237.28	31.04	1.1
UPS1	0.0463430	0.008	0.022	0.005	0.02	49.63	128.81	137.32	136.25	0.14
EPS2	0.0761773	0.010	0.018	0.001	0.01	99.58	67.68	133.08	104.66	0.31
*MU2	0.0776895	0.033	0.017	0.024	0.01	114.97	65.72	197.32	71.91	3.8
*N2	0.0789992	0.263	0.017	-0.008	0.01	111.53	2.78	276.19	3.88	2.4e+02
*M2	0.0805114	1.193	0.017	-0.030	0.01	109.90	0.60	311.08	0.86	4.8e+03
*L2	0.0820236	0.071	0.018	-0.002	0.01	93.63	13.26	34.12	21.20	16
*S2	0.0833333	0.332	0.017	-0.009	0.01	111.63	2.11	325.22	2.94	3.8e+02
ETA2	0.0850736	0.017	0.018	0.007	0.01	99.49	32.99	322.46	45.55	0.96
*MO3	0.1192421	0.038	0.008	-0.001	0.01	129.65	11.07	21.41	11.29	20
M3	0.1207671	0.005	0.008	-0.001	0.01	130.51	105.76	134.28	107.49	0.33
*MK3	0.1222921	0.060	0.008	0.001	0.01	125.02	7.26	40.71	7.52	50
*SK3	0.1251141	0.021	0.008	0.000	0.01	139.64	20.52	2.56	20.18	6.5
*MN4	0.1595106	0.014	0.007	-0.009	0.01	128.67	64.99	105.81	62.78	4.4
*M4	0.1610228	0.026	0.008	-0.019	0.01	146.33	43.23	110.48	45.24	12
SN4	0.1623326	0.006	0.008	-0.003	0.01	153.75	78.65	112.90	93.07	0.67
*MS4	0.1638447	0.037	0.007	-0.010	0.01	130.49	12.93	150.15	12.26	29
S4	0.1666667	0.005	0.008	0.000	0.01	167.92	69.74	45.05	100.37	0.33
*2MK5	0.2028035	0.038	0.007	0.006	0.01	120.93	11.18	277.60	10.82	28
2SK5	0.2084474	0.005	0.007	0.002	0.01	136.69	112.64	264.63	112.94	0.43
*2MN6	0.2400221	0.014	0.006	0.005	0.00	173.45	27.60	91.45	32.68	5.8
*M6	0.2415342	0.021	0.006	0.010	0.00	169.11	22.61	95.37	25.77	12
*2MS6	0.2443561	0.023	0.006	0.009	0.00	12.52	16.37	356.89	19.17	15
*2SM6	0.009	0.006	0.000	0.00	20.43	32.41	356.11	38.64	2.4	15
*3MK7	0.2833149	0.011	0.005	-0.004	0.01	66.80	34.44	111.57	32.59	4.8
*M8	0.3220456	0.015	0.004	0.001	0.00	103.77	19.62	221.56	17.71	14
*M10	0.4025570	0.009	0.004	-0.002	0.00	126.24	36.07	48.18	34.98	4.7

E Additional calculations for FERC application

This appendix presents additional calculations required for FERC license application. The FERC Whitepaper for hydrokinetic projects includes several required metrics that are ill-defined for tidal sites, but are still required because the hydrokinetic license application was adapted from conventional hydropower in rivers. The FERC requirements are quoted in italics and answers follow.

The estimated average head on the plant.

The average tidal elevation change of 2.1 m could be used to indicate the average head, though this is physically not the same metric. Operation of the turbines would, for example, not cause this head drop in Rosario Strait across the array.

The estimated minimum and maximum hydraulic capacity of the plant (flow through the plant) in cubic feet per second.

The volumetric flow rate through the swept area of a single turbine would vary from a minimum of 0 cfs to a maximum of 65,584 cfs. The ‘plant’ has two turbines, so maximum of 131,168 cfs.

The estimated average flow of the stream or water body at the plant or point of diversion.

The average volumetric flow rate through a single turbine would be 20,728 cfs, and thus 41,456 cfs for the two-turbine plant. The average volumetric flow through all of Rosario Strait (i.e., the water body) can be approximated with a tidal prism analysis, which considers the volume of water exchanged with each tide. For Rosario Strait, this has an average value of 289,000 cfs.

Monthly min/max/mean for: Temporal current speed and wave activity

As shown in Figure E1, tidal flows are highly periodic and do not have the strong seasonal variations of a river basin hydrograph. The monthly minimum will always be zero, given the slack tides that occur each day, and the monthly maxima will only vary slightly based on lunar and solar perigee-apogee cycles. The strongest tides (here, 3.2 m/s = 10.6 ft/s) will occur during full and new moons, and during the solistic and equinox. The tidal harmonic analysis in the preceding appendix gives the full annual cycle.

The wave activity is far less regular (see Figure 16), since the waves are generated by local wind and weather patterns. The max observed $H_s = 1.8$ m in December can be considered a global maximum for all months, though the summer months are expected to have far less wave activity. The wave minimum in any month is nominally zero.

Section 5.6(d)(3)(iii)(C) – A monthly water velocity duration curve based on available flow data and the correlation of flow (cubic feet per second) to velocity (feet per second) at the project site.

Tidal channels are not monitored for volumetric flow rates the way rivers are. The flow in Rosario Strait (in cfs or m^3/s) can only be crudely estimated using a tidal prism analysis. Of course, there is a relationship between the volume flow rate of Rosario Strait and the current speed at the site, but it is not an operationally useful metric (nor can it be robustly determined from observations). Such information could be obtained from a numerical model, such as the FVCOM model referenced elsewhere in this report.

An alternative is to present the relation between tidal stage (elevation) and current speed at turbine hub depth. As shown in the right panel of Figure E1, the current speeds are fastest (~ 3 m/s) at the lowest tidal stage. The apparent ‘scatter’ in this plot is actually the phasing of tidal stage and tidal flow, which is not 1:1 depending upon spring-neap cycles, diurnal inequalities, and basin geometry. These patterns and distributions are expected to be similar for any other three-month window throughout the year.

Project’s dependable capacity.

Tidal flows are highly dependable, since they are based lunar and solar motion, not weather. The predicted capacity factor is $CF \approx 0.20$, based on a rated power of $P = 1.3\text{MW}$.

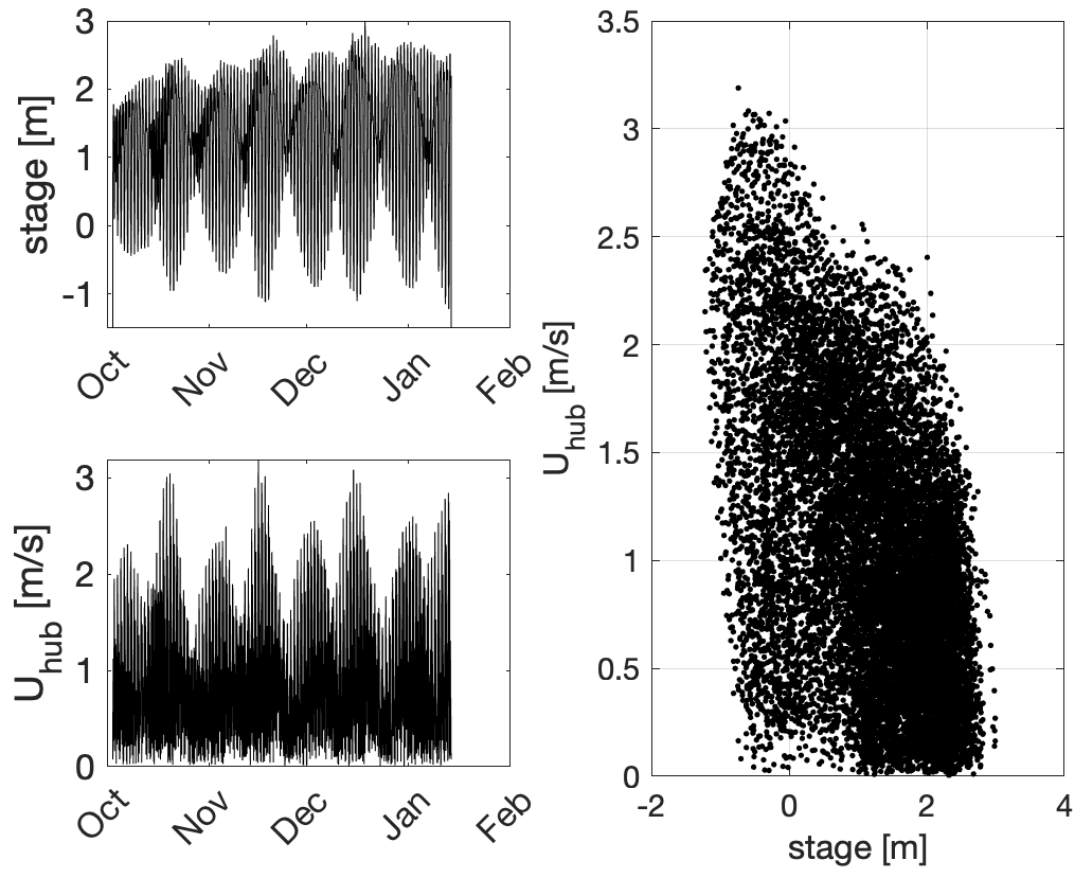


Figure E1: Time series of water depth (upper left) and current speed (lower left). Current speeds versus tidal stage (right).

Volume 2

Exhibit E Environmental Report

Rosario Strait Tidal Energy Project

San Juan Islands, Washington

FERC Project No. 15368



Federal Energy Regulatory Commission



Orcas Power & Light Cooperative (OPALCO)

183 Mount Baker Road

Eastsound, Washington 98245

26 March 2025

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
ADCP	Acoustic Doppler Current Profiler
AIS	Automatic Identification System
APE	Area of Potential Effect
APL-UW	Applied Physics Laboratory, University of Washington
AQI	Air Quality Index
ATB	articulated tug barges
BC	British Columbia
B-field	magnetic field
BMP	best management practice
BOEM	Bureau of Ocean Energy Management
C&P	Cargo and Passenger ferries
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cm	centimeter
cm/s	centimeters per second
CPS	Coastal Pelagic Species
CSZ	Cascadia Subduction Zone
CTD	conductivity, temperature, and depth
CWA	Clean Water Act
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
DAHP	Washington Department of Archaeology and Historic Preservation
dB	decibel
dB re 1V/μPa	decibel relative to 1 volt per 1 micropascal
DC	direct current
DMMP	Dredged Material Management Program
DNR	Washington Department of Natural Resources
DOE	U.S. Department of Energy
DPM	detection positive minutes
DPS	distinct population segment
ECDF	empirical cumulative distribution functions
Ecology	Washington Department of Ecology
EEZ	exclusive economic zone
EFH	Essential Fish Habitat
E-field	electric field
EIS	Environmental Impact Statement
ELI	Environmental Law Institute
EMEC	European Marine Energy Centre
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act



ESU	evolutionarily significant unit
FERC	Federal Energy Regulatory Commission
FFWCC	Florida Fish and Wildlife Conservation Commission
FMC	Fishery Management Council
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FPA	Federal Power Act
FR	Federal Register
ft	foot/feet
ft/s	feet per second
ft ²	square feet
GHG	greenhouse gas(es)
GLO	General Land Office
HAPC	Habitat Areas of Particular Concern
HF	high-frequency
HPA	Hydraulic Project Approval
HTI	High Tech, Inc.
Hz	hertz
IAP2	International Association of Public Participation
iE	induced electric
IMO	International Maritime Organization
in.	inch(es)
in./s	inches per second
IPaC	Information for Planning and Consultation
IUCN	International Union for Conservation of Nature
kHz	kilohertz
km	kilometer
km ²	square kilometers
kV	kilovolt
kW	kilowatt
kWh	kilowatt hour
lbs.	pounds
LED	light-emitting diode
LF	low frequency
m	meter
m/s	meters per second
m ²	square meter
M2USN	Marine intertidal unconsolidated shore, regularly flooded
m ³	cubic meter
m ³ /s	cubic meters per second
MBE	multibeam echosounder
MBTA	Migratory Bird Treaty Act
MF	mid frequency
MHHW	mean higher high water



MHW	mean high water
MLLW	mean lower low water
MLW	mean low water
MMPA	Marine Mammal Protection Act of 1972
MMS	Minerals Management Service
MPA	Marine Protected Area
MRE	marine renewable energy
MSA	Magnuson-Stevens Fishery Conservation and Management Act
multi-cat	multi-category
MW	megawatt
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NM	nautical mile(s)
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
NWIFC	Northwest Indian Fisheries Commission
NWR	National Wildlife Refuge
NWSI	Northwest Straits Marine Conservation Initiative
OA	otariid pinnipeds (in-air)
ODFW	Oregon Department of Fish and Wildlife
OESE	Ocean Energy Systems- Environmental
OPALCO	Orcas Power & Light Cooperative
Orbital	Orbital Marine Power
Orbital O2-X	Orbital Marine O2-X Floating Tidal device
ORJIP	Offshore Renewables Joint Industry Programme
OSHA	Occupational Safety and Health Administration
OW	otariid pinnipeds (under water)
PA	phocid pinnipeds (in-air)
PAHs	polycyclic aromatic hydrocarbons
PBF	physical or biological feature
PFMC	Pacific Fishery Management Council
PHS	Priority Habitats and Species
PME	protection, mitigation, and enhancement
PNNL	Pacific Northwest National Laboratory
PRMMI	Point Roberts Middle Mile Infrastructure Project
PPT	parts per thousand
Project	Rosario Strait Tidal Energy Project
PSD	pressure spectral densities
PTS	permanent threshold shift
PW	phocid pinnipeds (under water)



RCW	Revised Code of Washington
RHA	Rockfish Hot Spot Areas
RHIB	rigid-hulled inflatable boat
ROI	Region of Influence
rpm	revolutions per minute
R/V	Research Vessel
SB	surface buoy
SBP	sub-bottom profiler
SCBP	San Juan County/Cypress Island Marine Biological Preserve
SEPA	State Environmental Policy Act
Services	National Marine Fisheries Service and U.S. Fish and Wildlife Service
SHPO	State Historic Preservation Officer
SMA	Shoreline Management Act
SMP	Shoreline Master Program
SOP	standard operating procedure
SPL	sound pressure level
SRKW	Southern Resident Killer Whale
SS	Sea Spider
SSC	suspended sediment concentrations
SSWS	sea star wasting syndrome
STBM	StableMoor mooring
TCP	Traditional Cultural Place
TEAMER™	Testing and Access to Marine Energy Research
Treaty	Treaty of Point Elliott
TTS	temporary threshold shift
U&A	Usual and Accustomed
U.S.	United States
U.S. DOT	U.S. Department of Transportation
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S. Coast Guard
USFWS	U.S. Fish & Wildlife Service
USGS	U.S. Geological Survey
UW	University of Washington
VHF	very high frequency
W/m ²	watts per square meter
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WEMD	Washington Emergency Management Division
WISAARD	Washington Information System for Architectural and Archaeological Records Database
WSDOT	Washington State Department of Transportation
WSF	Washington State Ferries
μT	micro-Tesla



1. Introduction

1.1 Application

Pursuant to 18 Code of Federal Regulations (CFR) Part 5, Orcas Power & Light Cooperative (OPALCO) is applying to the Federal Energy Regulatory Commission (FERC) for an original hydrokinetic pilot project license for the proposed Rosario Strait Tidal Energy Project (Project). In connection with this, OPALCO submits this Draft License Application, Exhibit E, for consideration. FERC issued a preliminary permit on January 13, 2025, Project No. 15368-000, which grants OPALCO the priority to apply for a license for the proposed Project.

The Project would be located off the eastern shore of Blakely Island in Rosario Strait, Washington State (approximately 48.5611°N, 122.7679°W; see **Figure 1**). Electricity generated by the Project would be delivered via a new subsea cable to an existing substation on Blakely Island, where it would be power-conditioned and connected to the existing power grid operated by OPALCO.

The proposed Project is to investigate the feasibility of installing one Orbital Marine O2-X Floating Tidal device (Orbital O2-X) to serve as a pilot project to test the capacity of Rosario Strait for tidal turbine electricity generation that supports OPALCO's microgrid. The Orbital O2-X was designed by Orbital Marine Power (Orbital). Orbital O2 technology, an earlier model than the proposed O2-X, has been deployed for over 32 months in the Orkney Islands of Scotland. In Scotland, the Orbital O2 is connected to the European Marine Energy Centre (EMEC) grid via a subsea cable, generating enough electricity for approximately 1,700 homes.

As the first project of this type in the United States (U.S.), the goal is to emulate the current deployment off the Orkney Islands. The marine conditions in Rosario Strait are similar, and an existing subsea cable conduit is available on the south shore of Blakely Island to connect to the OPALCO grid. The electrical output would benefit a growing island community that seeks to strengthen its energy independence and improve livelihoods by divesting from the power supplied from mainland Washington State.

1.1.1 Purpose of Action

President Trump issued an Executive Order on January 20, 2025, Unleashing American Energy, acknowledging hydropower as a critical domestic energy resource (The White House 2025). Furthermore, Secretary of Energy Wright issued a Secretarial Order on February 25, 2025, establishing directives to strengthen grid reliability and support energy innovation for hydropower and other domestic resources (The White House 2025). As an island community, San Juan County is at risk of unreliable electricity. The vast majority of OPALCO's power is transmitted using subsea cables connected to the power grid on mainland Washington. When service is disrupted, San Juan County can be subjected to long wait times as repairs are beyond its control. OPALCO is committed to implementing local energy generation resources and microgrids that strengthen the resilience of infrastructure and increase safety and reliability for its service area while keeping rates affordable.

The OPALCO grid is evolving to meet the pressing needs to decarbonize and increase local energy resilience. To prepare for expected near-term electrical capacity shortfalls and long-term load doubling, OPALCO has been exploring local generation options to ensure resilience, reliability, and ability to support beneficial electrification and regulatory clean energy goals.

While solar is minimal during the Pacific Northwest winter, tidal power is strong and predictable year-round. Notably, it can also be farmed within a fraction of the surface area that solar requires. OPALCO has investigated the feasibility of installing one Orbital O2-X in the waters of the San Juan Island archipelago, Washington. This Project would serve as a pilot project to test the capacity of the Rosario Strait site and tidal turbine technology to generate electricity that supports OPALCO's microgrid for its island service area.



1.2 Geographic Region

The proposed Project would be located within Rosario Strait, a strait within the Salish Sea (**Figure 1**). This location was chosen for its favorable tidal flows, minimizing impacts on threatened and endangered species, and existing OPALCO infrastructure in the area. The Salish Sea is a marginal sea located between British Columbia (BC), Canada and Washington State. This water body includes the Strait of Georgia, Strait of Juan de Fuca, Puget Sound, and the archipelago of the San Juan Islands. It encompasses waters from Olympia (WA) to Campbell River (BC) and west to Neah Bay (WA). Puget Sound is an interconnected estuarine system of islands, waterways, and basins east of Admiralty Inlet. Ports within this sea include the ports of Tacoma, Seattle, Everett, Bellingham, Vancouver, and Victoria.

The proposed Project area and boundaries are described in **Section 2.2.2**.



Figure 1. Vicinity Map

1.3 Statutory and Regulatory Requirements

Projects in the marine environment require review under several regulations. Engagement and coordination with Tribal Nations, federal, state, and local agencies; and stakeholders is a critical component of the regulatory process in Washington State. Consultation generally involves analysis of a proposed Project to determine any potential effects and develop effective monitoring, mitigation, and adaptive management measures necessary to prevent, minimize, and/or mitigate Project



impacts on the environment. Statutory requirements applicable to the proposed Project are summarized in **Table 1** and discussed in further detail below.

In the State of Washington, Tribal Nations have legal co-management of natural resources that support their livelihoods and cultural heritage, pursuant to the landmark Boldt Decision in 1974 (see **Section 1.3.4**) and numerous subsequent decisions (United States v. Washington, 384 F. Supp. 312 [W.D. Wash. 1974]). It is necessary to engage with Tribal Nations to understand these important resources, how they are used, and how the construction and operations of a project may affect the rights that are guaranteed under these treaties and federal laws, as well as the requirements set forth by other federal laws and guidelines for identifying and assessing effects on Tribal resources and cultural resources.

Table 1. Major Statutory and Regulatory Requirements of the Project

Entity	Policy	Approval
Federal		
FERC	National Environmental Policy Act Review	Environmental Analysis (Record of Decision)
	Section 106 of the National Historic Preservation Act	Finding of Effect
	Section 10(j) Recommendations of the Federal Power Act	FERC Approval in License
USACE	Section 10 of the Rivers and Harbors Act	Individual Permit
	Section 404 of the Clean Water Act	Individual Permit
NMFS	Section 7 of the Endangered Species Act	Concurrence/Incidental Take Authorization
	Magnuson-Stevens Fishery Conservation and Management Act (Section 305(b) (2))	Concurrence
	Marine Mammal Protection Act	Incidental Harassment Authorization/Incidental Take Authorization
USFWS	Section 7 of the Endangered Species Act	Concurrence/Incidental Take Authorization
	Migratory Bird Treaty Act	Concurrence
	Bald and Golden Eagle Protection Act	Concurrence
USCG	Ports and Waterways Safety Act (33 USC 1221 et seq.)	Consultation
State		



Entity	Policy	Approval
Ecology	Coastal Zone Management Act and related requirements (Shoreline Management Act, Clean Water Act, Clean Air Act, Ocean Resources Management Act)	Consistency Determination
	Section 401 of the Clean Water Act	Water Quality Certification
	Section 402 of the Clean Water Act	National Pollutant Discharge Elimination System Permit
DNR	RCW 79.105	Aquatic Use Authorization
DAHP	Section 106 of the National Historic Preservation Act of 1966	Concurrence
WDFW	RCW 77.55	Hydraulic Project Approval
Local		
San Juan County	Chapter 197-11 WAC	State Environmental Policy Act Review
	971 Shoreline Management Act, Chapter 90.58 of the RCW	Shoreline Master Program Review
Notes: DAHP = Washington Department of Archaeology and Historic Preservation; DNR = Washington State Department of Natural Resources; Ecology = Washington Department of Ecology; FERC = Federal Energy Regulatory Commission; NMFS = National Marine Fisheries Service; RCW = Revised Code of Washington; USACE = U.S. Army Corps of Engineers; USC = United States Code; USCG = U.S. Coast Guard; USFWS = U.S. Fish and Wildlife Service; WAC = Washington Administrative Code; WDFW = Washington Department of Fish and Wildlife		

1.3.1 Federal Energy Regulatory Commission (FERC)

1.3.1.1 National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires federal agencies to prepare an analysis for federal actions that have the potential to significantly affect the quality of the human environment, including both natural and cultural resources. Environmental Assessments are developed to determine whether an action may cause significant environmental effect. If the action is determined not to have significant impacts, then the federal agency issues a Finding of No Significant Impact (FONSI). If the action is determined to have significant impacts, then the federal agency would prepare an Environmental Impact Statement (EIS).

1.3.1.2 Federal Power Act: Section 10(j)

Under Section 10(j) of the Federal Power Act, each license issued by FERC must include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, and enhancement of fish and wildlife resources affected by the Project. FERC is required to include these conditions unless it determines that they are inconsistent with the purposes and requirements of the Federal Power Act or other applicable laws. Before rejecting or modifying an agency recommendation, FERC is required to attempt to resolve any such inconsistency



with the appropriate agency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency.

1.3.1.3 *The Services*

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) and U.S. Fish & Wildlife Service (USFWS) are collectively referred to herein as the Services. As the lead regulatory agency overseeing this proposed Project, FERC would consult with the Services under the following legislation:

Endangered Species Act: Section 7

The Services share responsibility for administering Section 7 of the Endangered Species Act (ESA). The USFWS manages land and freshwater species, including sea- and shorebirds, while the NMFS manages Section 7 for marine species, such as marine mammals, sea turtles, marine and anadromous fish, and marine invertebrates and plants.

Section 7 of the ESA requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species. Once designated by FERC as its non-federal representative for purposes of ESA consultation, OPALCO would begin informal ESA consultation efforts with NMFS and USFWS for the Project.

ESA-listed species and designated critical habitat in the proposed Project area are identified in **Section 3.4.6**. The effects of the proposed Project on ESA-listed species and designated critical habitat are discussed in **Section 4.3**.

Marine Mammal Protection Act

All marine mammals are protected under the Marine Mammal Protection Act of 1972 (MMPA). The MMPA generally prohibits the “take” of marine mammals—including harassment, hunting, capturing, collecting, or killing—in U.S. waters. NMFS, USFWS, and the Marine Mammal Commission are the federal entities that share responsibility for enforcing the MMPA.

In 1986, Congress amended the MMPA and ESA to authorize incidental takings (lethal, injurious, or harassment) of depleted, endangered, or threatened marine mammals, provided the takings were small in number and had a negligible impact on marine mammals. Analysis of potential effects of the proposed Project on marine mammals is presented in **Section 4.1** and **Section 4.3.3**.

Magnuson-Stevens Act

The Magnuson–Stevens Fishery Conservation and Management Act (MSA) and amendments require federal agencies to consult with NMFS on all proposed and/or authorized activities that may have an adverse effect on Essential Fish Habitat (EFH). EFH in the proposed Project area is described in **Section 3.4.2** and potential effects on EFH are described in **Section 4.3.4**.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA), administered by the USFWS, prohibits the take of protected migratory bird species. Any activities that may impact these birds or their habitats may be required to follow appropriate conservation measures. Avian species in the proposed Project area are described in **Section 3.5.2** and potential impacts are discussed in **Section 4.3.5**.

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act provides protection of bald and golden eagles by prohibiting take, including their parts (e.g., feathers), nests, or eggs. Avian species (including eagles) in the proposed Project area are described in **Section 3.5.2** and potential impacts are discussed in **Section 4.3.5**.



1.3.1.4 Washington Department of Archaeology and Historic Preservation

As the lead regulatory agency overseeing this proposed Project, FERC would consult with the Washington Department of Archaeology and Historic Preservation (DAHP) under the following legislation:

National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to consider the effects of their undertakings on historic properties (i.e., any district, site, building, structure, or object that is listed in, or eligible for listing in, the National Register of Historic Places [NRHP]). Undertakings include any project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including those carried out by, or on behalf of, a federal agency; those carried out with federal financial assistance; and those requiring a federal permit, license, or approval. Under 36 CFR part 800.2(c) of the NHPA's implementing regulations, compliance also requires federal agencies to consult with various parties that may have consulting roles in the Section 106 process. These include the State Historic Preservation Officer (SHPO), Tribal Nations, and stakeholders and interested parties. Depending on the circumstances, this may also include the Advisory Council on Historic Preservation, which oversees the Section 106 process. Compliance with 36 CFR 800 includes these five steps:

1. Initiate process by coordinating with other environmental reviews, consulting with SHPO, identifying and consulting with interested parties, and identifying points in the process to seek input from the public and to notify the public of proposed actions.
2. Identify cultural resources and evaluate them for NRHP eligibility, resulting in the identification of historic properties.
3. Assess effects of the project on historic properties.
4. Consult with the SHPO, affected Tribes, and interested parties regarding adverse effects on historic properties, resulting in a memorandum of agreement.
5. Proceed in accordance with the memorandum of agreement, if necessary.

Historic properties are defined as archaeological sites, buildings, structures, traditional cultural places, and objects, that are eligible for listing in the NRHP. The identification of historic properties in Washington State involves the DAHP.

Tribal and cultural resources in the proposed Project area are described in **Section 3.10**. Potential effects of the proposed Project on those resources are described in **Section 5.3**.

1.3.2 U.S. Army Corps of Engineers (USACE)

1.3.2.1 Rivers and Harbors Act: Section 10

Section 10 of the Rivers and Harbors Act of 1899 provides the USACE with permitting authority over projects that include construction, excavation, or deposition of materials in, over, or under navigable waters, or any work that would affect the course, location, condition, or capacity of navigable waters, to the limit of the continental shelf. Section 10 of the Rivers and Harbors Act requires that *“regulated activities conducted below the Ordinary High Water elevation of navigable waters of the United States be approved/permitted by the USACE. Regulated activities include the placement/removal of structures, work involving dredging, disposal of dredged material, filling, excavation, or any other disturbance of soils/sediments or modification of a navigable waterway. Navigable waters of the United States are those waters of the U.S. that are subject to the ebb and flow of the tide shoreward to the mean high water mark and/or are presently used or have been used in the past or may be susceptible to use to transport interstate or foreign commerce.”*

To prohibit the obstruction or alteration of navigable waters, any structures or activities (e.g., anchoring cables, aids to navigation) occurring in or affecting the navigable waters of the U.S. are subject to authorization by the USACE.



1.3.2.2 Clean Water Act: Section 404

Section 404 of the Clean Water Act (CWA) requires that any person, company, Tribe, or government agency planning to work in waters of the U.S. must obtain a permit from the USACE before initiating any regulated activity. The USACE, the lead agency, in partnership with the U.S. Environmental Protection Agency (EPA), is responsible for implementation of the Section 404 Program in Washington State. The Section 404 of the CWA is triggered when a proposed Project would either remove material from or place fill into navigable waters of the U.S. Proposed Project activities are not expected to trigger Section 404.

Section 401 of the CWA (the Water Quality Certification process) would be regulated by the Washington Department of Ecology (Ecology; see **Section 1.3.5.2**).

1.3.3 U.S. Coast Guard (USCG)

1.3.3.1 Ports and Waterways Safety Act

The USCG is responsible for providing FERC with an evaluation of the potential impacts of the Project on the safety of navigation and the traditional uses of Rosario Strait. The USCG must also offer recommendations to provide for navigational safety and to minimize potential adverse impacts. USCG's authority comes from the Ports and Waterways Safety Act (33 U.S. Code [USC] 1221 et seq.), which requires the USCG to consider all possible uses of a waterway to reconcile the need for safe access routes with the needs of all other waterway uses. The USCG is also authorized to approve private aids to navigation. The analysis of this Project's effect on navigation is further discussed in **Section 5.1.2**. A Navigation Safety Plan (Appendix B6) would be submitted to USCG for approval.

1.3.4 Tribal Nations

Indigenous Tribal Nations and populations have been in the Pacific Northwest since time immemorial. Under treaties negotiated by Territorial Governor Isaac Stevens on behalf of the United States, Tribal Nations ceded 64 million acres of land to the United States for non-Indian settlement and the subsequent establishment of Washington State. Tribal Nations retained approximately 6 million acres of reservation lands and specifically reserved the right to gather and access foods and access religious sites in their treaties with the federal government. Tribal Nations also retain rights via executive orders and legislative actions.

As a result of the Boldt Decision, the Northwest Indian Fisheries Commission was formed to support Tribal governments in managing fishing in Washington State (NWIFC 2016b). Now, co-management occurs through a government-to-government process where Tribal Nations work with Washington State to set annual fishing quotas in federal waters, sit on technical committees to pursue conservation goals, and work to restore fish habitat and stocks (NWIFC 2016c). Although coordination takes place throughout the year, it culminates with the annual North of Falcon Meeting where state, federal, and Tribal fishery managers get together to plan the Northwest's recreational and commercial salmon fisheries (WDFW 2025). The North of Falcon Meeting coincides with Pacific Fishery Management Council (PFMC) meetings, which are responsible for setting ocean salmon seasons from 3 to 200 nautical miles (NM) off the U.S. Pacific coast (WDFW 2025).

The proposed Project area is the traditional territory of several Tribal Nations who signed the Treaty of Point Elliott in 1855. Tribes and bands who were signatory to the Treaty of Point Elliott included the "Dwamish, Suquamish, Sk-kahl-mish, Sam-ahmish, Smalh-kamish, Skope-ahmish, St-kah-mish, Snoqualmoo, Skai-wha-mish, N'Quentl-ma-mish, Sk-tah-le-jum, Stoluck-wha-mish, Sno-ho-mish, Skagit, Kik-i-allus, Swin-a-mish, Squin-ah-mish, Sah-ku-mehu, Noo-wha-ha, Nook-wa-chah-mish, Mee-see-qua-guilch, Cho-bah-ah-bish, and other allied and subordinate Tribes and bands of Indians occupying certain lands situated in said Territory of Washington, on behalf of said Tribes, and duly authorized by them" (Washington Governor's Office of Indian Affairs, n.d.). Today, many of the Tribes and bands who signed the Treaty of Point Elliott (Treaty) are represented by modern-day federally recognized Tribal Nations, including Lummi Nation, Muckleshoot Indian Tribe, Nooksack Indian Tribe,



Samish Indian Nation, Sauk-Suiattle Indian Tribe, Skokomish Tribe, Snoqualmie Indian Tribe, Stillaguamish Tribe of Indians, Suquamish Tribe, Swinomish Indian Tribal Community, Tulalip Tribes, and Upper Skagit Tribe. Certain Tribes and bands that signed the Treaty have reserved the right to fish, hunt, and gather including Lummi Nation, Muckleshoot Indian Tribe, Nooksack Indian Tribe, Sauk-Suiattle Indian Tribe, Skokomish Tribe, Stillaguamish Tribe of Indians, Suquamish Tribe, Swinomish Indian Tribal Community, Tulalip Tribes, and the Upper Skagit Tribe. Treaty fishing may occur in small and large rivers as well as marine areas. Other Tribal Nations that may have an interest in the Project include the Confederated Tribes of the Umatilla, Jamestown S’Klallam Tribe, and the Port Gamble S’Klallam Tribe.

1.3.4.1 Tribal Engagement

Engagement and coordination with Tribal Nations is a key aspect of this Project. In early 2022, OPALCO began outreach with Tribal Nations in the region including the Lummi Nation, Samish Indian Nation, Suquamish Tribe, Swinomish Indian Tribal Community, and Tulalip Tribes. OPALCO has been actively engaging with these Tribal Nations to share information about the Project, including location and technology, to seek meaningful engagement on the Project early in the process, seek feedback on the Project description, and start to identify concerns, risks, and possible effects. Representatives from these Tribal Nations have participated in meetings and correspondence. OPALCO’s understanding is that these representatives have shared the Project details with the Tribal Nations’ fishing community and elected officials. In August 2024, the Confederated Tribes of the Umatilla, Jamestown S’Klallam Tribe, and Port Gamble S’Klallam Tribe were contacted at the recommendation of FERC and would be engaged moving forward. In December 2024, the Northwest Indian Fisheries Commission (NWIFC) recommended expanding Tribal engagement efforts to all Tribal Nations who were signatory to the Treaty. This includes the Muckleshoot Indian Tribe, Nooksack Indian Tribe, Sauk-Suiattle Indian Tribe, Skokomish Tribe, Snoqualmie Indian Tribe, Stillaguamish Tribe of Indians, and Upper Skagit Tribe. The Consultation Record (Appendix A) includes the timeline and engagement activities that have occurred with Tribal Nations.

OPALCO is continuing engagement through meetings and correspondence at key milestones throughout the duration of the development of the DLA. Ultimately, government-to-government consultation with the Tribal Nations would occur between FERC and the Tribal Nations once a DLA is submitted. The Consultation Record (Appendix A) also includes a summary of the feedback and inquiries received from the Tribal Nations to date. Determinations of significant impacts and effects on Tribal treaty rights, interests, and resources would be conducted with engagement with the Tribal Nations and through government-to-government consultation with FERC.

1.3.5 Washington State Department of Ecology

1.3.5.1 Coastal Zone Management Act (CZMA)

Section 307 of the federal CZMA mandates that any federal action occurring in or outside of a state’s coastal zone must be consistent with the approved Coastal Zone Management (CZM) Program for that state. In Washington, Ecology is responsible for ensuring that federal actions comply with these standards, as well as the enforceable policies or programs that have been incorporated into the program (e.g., land use planning statutes including the Shoreline Management Act [SMA], State Environmental Policy Act [SEPA], and water quality standards). Certification under Section 307 applies to all federal permitted/licensed or federally funded projects, or any activity within the coastal zone of a state to ensure that a proposed action is consistent with the state’s CZM Program.

1.3.5.2 Clean Water Act: Section 401

Section 401 of the CWA authorizes Ecology to ensure that activities meet water quality standards established by the State of Washington under the CWA. The Section 401 Water Quality Certification process is triggered when the USACE decides that an application requires a Section 404 permit (i.e.,



that a proposed Project would either remove material from or place fill into navigable waters of the U.S.).

1.3.6 Washington Department of Natural Resources

1.3.6.1 Revised Code of Washington (79.105)

Under Washington State law (Revised Code of Washington [RCW] 79.105), projects on or over state-owned aquatic lands, including “bedlands,” “1st class tidelands and shorelands,” and “2nd class tidelands and shorelands,” must obtain an authorization (e.g., a lease or easement) from the Washington Department of Natural Resources (DNR). The duration of use authorization would depend on the proposed uses and the class of land leased. Once a project has received all necessary permits, DNR would then finalize an agreement.

1.3.7 Washington Department of Fish and Wildlife

1.3.7.1 Revised Code of Washington (77.55)

Washington State law (RCW 77.55) requires those planning hydraulic projects in or near state waters to get a Hydraulic Project Approval (HPA) from the Washington Department of Fish and Wildlife (WDFW). A “hydraulic project” is defined as the construction or performance of work that will use, divert, obstruct, or change the natural flow or bed of any of the salt or freshwaters of the state. A new subsea cable in state waters would be subject to an HPA to safeguard fish and their aquatic habitats from potential effects of the installation activities.

1.3.8 San Juan County

1.3.8.1 Chapter 197-11 Washington Administrative Code

San Juan County would be the likely SEPA lead for the Project. The intent of SEPA is to ensure that all environmental values are considered by the local governing agency when making decisions about a proposed project. Washington’s SEPA requires all state and local governments to ensure that “...environmental amenities and values would be given appropriate consideration in decision making along with economic and technical considerations...” (RCW 43.21C.030(2)(a) and (2)(b)). State or local agencies review proposals to identify potential environmental impacts associated with a Project. Chapter 197-11 of the Washington Administrative Code (WAC) contains the policies and procedures for SEPA.

1.3.8.2 Shoreline Management Act

The Shoreline Master Program (SMP) is the local instrument by which San Juan County and Ecology jointly administer the Shoreline Management Act (SMA), Chapter 90.58 of the RCW. SMPs carry out the policies of the SMA at the local level, regulating the use and development of shorelines. The overarching goal of the SMA is “to prevent the inherent harm in an uncoordinated and piecemeal development of the state’s shorelines.”

Under the SMA, each local jurisdiction that contains “shorelines of the state” must develop and adopt its own SMP. “Shorelines of the state” generally refers to rivers, lakes, and marine waterfronts along with their associated shorelands, wetlands, and floodplains (per RCW 90.58.030[2]).

Any permanent or temporary project that interferes with the public use of shorelands requires review of the SMA by the local jurisdiction. This includes projects in or within 200 feet (ft) (61 meters [m]) of marine waters, streams, lakes, and floodplains. The San Juan County SMP was last updated in 2021 (Ordinance No. 08-2020).



1.4 Stakeholder Engagement

1.4.1 Community Engagement

OPALCO is an electric co-op serving more than 20 islands, with a primary audience of more than 11,000 co-op members. For the proposed Project, OPALCO organized specific outreach groups to engage with as outlined below. These groups are OPALCO’s key stakeholders and indicate different audiences that require different outreach efforts. OPALCO would document outreach efforts to include materials, comments collected, and OPALCO’s response to comments.

1.4.2 Community and Stakeholder Groups

For the Project, OPALCO has engaged with numerous regional groups, including:

- OPALCO Co-op Members
- San Juan Islands Community Organizations/Businesses/Elected Officials
- San Juan Islands Environmental Organizations/Businesses
- Regional Environmental Organizations & Related Businesses
- Regional Elected Officials

For a complete list of stakeholder organizations, names, and contacts, see the Consultation Record (Appendix A).

1.4.3 Engagement Goals

At this stage of the Project, engagement was focused primarily on informing and educating stakeholders. The intent was to increase public awareness of the Project, the importance of local renewable electricity generation, and gauge public support. Engagement goals included:

- Providing clear communications to inform co-op members and stakeholders about the benefits of this clean, renewable energy Project that would bring greater community resilience.
- Providing opportunities to gather feedback about the Project.
- Solicit, gather, and evaluate input about the benefits of this Project.
- Determine interest and necessity of advisory group.

1.4.4 Levels of Engagement

To inform engagement techniques, it is important to set clear expectations for the level of influence target audiences would have on Project decisions. A proposed level of engagement with target audiences is presented in **Table 2**.

Table 2. Proposed Levels of Engagement with Target Audience

Target Audience	Engagement with the Audience
OPALCO Co-op Members	We will actively keep you informed of the project processes and timeline. We will look to you for feedback on the importance to co-op members on the Project and to actively educate yourself and decide the level of buy in.
San Juan Islands Community Organizations	We will keep you informed on the Project process, timeline, and potential benefits with direct outreach. We look to you to opt in to learn and offer advice on ways to incorporate community.



San Juan Islands Environmental Organizations	We will provide a detailed outline of the permit process, timeline, and environmental requirements. We will listen and consider your concerns and aspirations directly related to local environmental issues.
Regional Environmental Organizations / Businesses	We will provide information documents to introduce you to the Project.
Regional Elected Officials	We will provide information documents to introduce you to the Project.

1.4.5 Engagement Activities

Table 3 includes engagement activities for the Rosario Strait Tidal Energy Project that occurred within the time period of June 1, 2024 – March 31, 2025.

Table 3. Proposed Project Phase 1 Engagement Activities

Target Audience	Activities	Details
OPALCO Co-op Members	Two virtual information workshops Three in person workshops, print and digital materials	<ul style="list-style-type: none"> Present information on process and timeline Gather feedback Gauge interest Track attendance and feedback themes
San Juan Island Community Organizations	In-person meeting	<ul style="list-style-type: none"> Invite to informational sessions Host meeting to review the potential benefits and gauge future participation as stakeholders
San Juan Island Environmental Organizations	Email Project facts One-on-one briefings	<ul style="list-style-type: none"> Direct outreach with fact sheets and invite to one-on-one briefing of Project
Regional Environmental Organizations / Businesses	Email Correspondence	<ul style="list-style-type: none"> Email correspondence introducing the Project and include flyer and facts about Project
Regional Elected Officials	Email Correspondence One-on-one briefings	<ul style="list-style-type: none"> Email correspondence introducing the Project and include flyer and facts about Project
Source: IAP2 n.d.		

The following is the engagement schedule:

- March 2023: Virtual workshop (Audience: OPALCO Co-op Members)
- March 2024: Announce funding opportunity and media release (Audience: All)
- August 2024: Virtual workshop (Audience: OPALCO Co-op Members)
- October 2024: Print and digital article (Audience: Mailed to OPALCO Co-op Members)
- December 2024: In-person informative meeting (Audience: San Juan Island Community Organizations)
- January 2025: Email correspondence / one-on-one briefings as needed (Audience: San Juan Island Community Organizations, San Juan Island Environmental Organizations, Regional environmental Organizations / Businesses)
- January 2025: In-person workshop (Audience: OPALCO Co-op Members)



- May 2025: Announce grant completion and DLA submittal via media release (Audience: All)

1.4.6 Regulatory Engagement

OPALCO has engaged the following state and federal agencies to discuss regulations and authorizations that would be applicable to a tidal energy deployment in Rosario Strait:

- FERC
- NMFS
- Washington State Office for Regulatory Innovation and Assistance
- USFWS
- USACE
- USCG
- DAHP
- U.S. Department of Energy (DOE)
- DNR
- Ecology
- WDFW
- San Juan County



2. Proposed Action and Alternatives

2.1 Description of Action

In 2024, OPALCO was awarded a grant from the DOE to investigate the feasibility of deploying a pilot project demonstration of a single Orbital O2-X with two turbine rotors rated at 1.2 megawatts (MW) each in Rosario Strait. To demonstrate the commercial viability of this Marine Renewable Energy (MRE) device and allow it to connect to OPALCO's existing electrical grid, the proposed Project must be authorized by FERC. As such, OPALCO is seeking a license from FERC for this pilot hydrokinetic project.

Tidal energy is harnessed from the motion of tides turning turbines installed in the water column to convert into electricity. Unlike the variability in solar and wind conditions, tidal currents are a reliable and predictable form of energy potential. Areas with high tidal ranges and strong currents present the best potential for capturing tidal energy. As the industry is in its early stages, research is ongoing to develop technologies and optimize power output to make tidal a viable energy alternative.

The proposed Project would harness energy from the motion of the tides turning two rotors—one on each of the two legs of the Orbital O2-X—installed in the water column and converting this energy into electricity. The electricity would be transmitted via a new subsea power cable installed on the seabed and connected to the Orbital O2-X, which would feed into OPALCO's existing microgrid for its San Juan Island service area.

This Project would serve as a pilot to test the capacity of the Rosario Strait site and tidal turbine technology to generate electricity that supports OPALCO's microgrid for its island service area.

2.2 Project Location

2.2.1 Rosario Strait

Through a DOE-funded Testing and Access to Marine Energy Research (TEAMER™) project, Pacific Northwest National Laboratory (PNNL) assessed five potential locations for a tidal energy project within the waters of Washington State's San Juan Islands archipelago (Copping et al. 2021). Based on multiple factors including seasonal weather patterns (**Section 3.3**), wave height (**Section 3.2.1**), tides and current speed (**Section 3.2.2**), prevailing wave and current direction (**Section 3.2.1** and **Section 3.2.2**), proximity to shipping lanes (**Section 3.8.3**), and visibility of the Project from the shoreline (**Section 3.8.1**), and impacts to species and habitat (**Section 3.4**, **Section 3.5**, and **Section 3.7**), Rosario Strait was identified as a tidal resource hotspot and considered an optimal location for deploying floating tidal turbine technology (Yang et al. 2021; Calandra et al. 2023).

2.2.2 Proposed Project Area

The proposed Project area within Rosario Strait is located east of Blakely Island (at approximately 48.5611°N, 122.7679°W). Blakely Island is a small, sparsely populated island, approximately 2.4 kilometers (km) (1.5 miles) south of Orcas Island where OPALCO offices are located. According to the nearest tidal station at Rosario, Orcas Island, with mean lower-low water (MLLW) near the proposed Project area at 0.0 m (0.0 ft), the mean higher-high water (MHHW) is 2.4 m (7.89 ft), mean high water (MHW) is 2.2 m (7.24 ft), and mean low water (MLW) is 0.7 m (2.31 ft) (NOAA 2024a). The change in water level between low tide and high tide, as measured with the National Geodetic Vertical Datum, at the proposed Project site is 4 m (13.2 ft) (Appendix C2).

The proposed Project area is shown in **Figure 2** and includes the locations for all proposed technology components: the Orbital O2-X device, mooring lines, anchors, and transmission lines (i.e., new subsea cable); as well as an existing marine shoreline cable conduit and existing land-based shoreline conduit facility at the southern end of Blakely Island (**Figure 3**). The approximate boundaries of the proposed Project area are described in **Table 4**. The approximate locations of proposed Project components within the boundaries are listed in **Table 5**.



For the purposes of this DLA, the proposed Project boundary defines an area of approximately 500 m x 760 m (1,640 ft x 2,494 ft), or 380,000 square meters (m²) (~94 acres), to encompass the footprint of the Orbital O2-X, its anchoring components, and a buffer area (**Figure 4**). The footprint of the proposed Project components within the boundary could range from a minimum of 280 m x 480 m (919 ft x 1,575 ft) to a maximum of 322 m x 552 m (1,056 ft x 1,811 ft), depending on the final deployment configuration.

Additionally, the proposed boundary includes an adjacent corridor area of 25,300 m² (~6.25 acres) for the proposed new subsea cable that would be approximately 5.3 km (3.3 mile) in length (**Figure 4**). In total, the proposed Project area would be 325,300 m² (~80.38 acres) before adding a buffer area. However, final determination of the area is subject to consultation with Tribal Nations and regulatory agencies. Under Preliminary Permit Project No. 15368, issued by FERC on January 13, 2025, OPALCO maintains priority in applying for a license for a hydrokinetic pilot project at this location.

Table 4. Approximate Boundaries of the Proposed Project Area

Corner (Cardinal Direction)	Latitude (°N)	Longitude (°W)
Northwest	48.566277	-122.769801
Northeast	48.566209	-122.762983
Southwest	48.559339	-122.769742
Southeast	48.559429	-122.762922

Note: Coordinates determined using Projected Coordinate System NAD 1983 State Plane Washington South FIPS 4602 [U.S. Feet]. The 2.3-m (7.5-ft) buffer around the new subsea cable is excluded from the proposed Project area coordinates in this table.

Table 5. Approximate Location of the Proposed Project Components

Project Component	Latitude (°N)	Longitude (°W)
Orbital O2-X	48.559278	-122.766336
North Point – New Subsea Cable Corridor	48.561142	-122.767909
South Point – New Subsea Cable Corridor	48.531458	-122.809621
Existing Marine Shoreline Conduit	48.531466	-122.809625
Existing Land-Based Conduit Facility	48.531896	-122.809359

Note: Coordinates determined using Projected Coordinate System NAD 1983 State Plane Washington South FIPS 4602 [U.S. Feet]

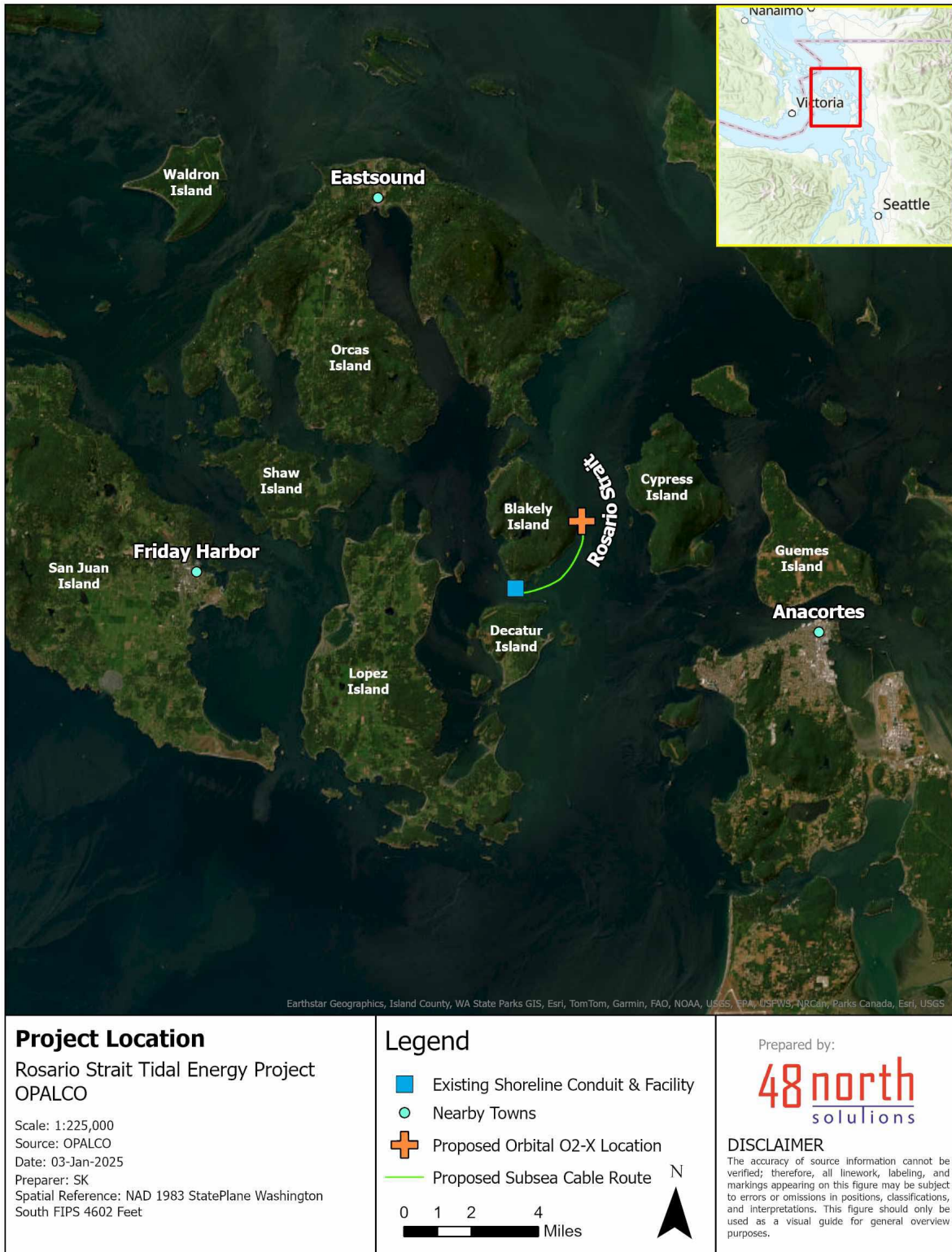


Figure 2. Proposed Project Location

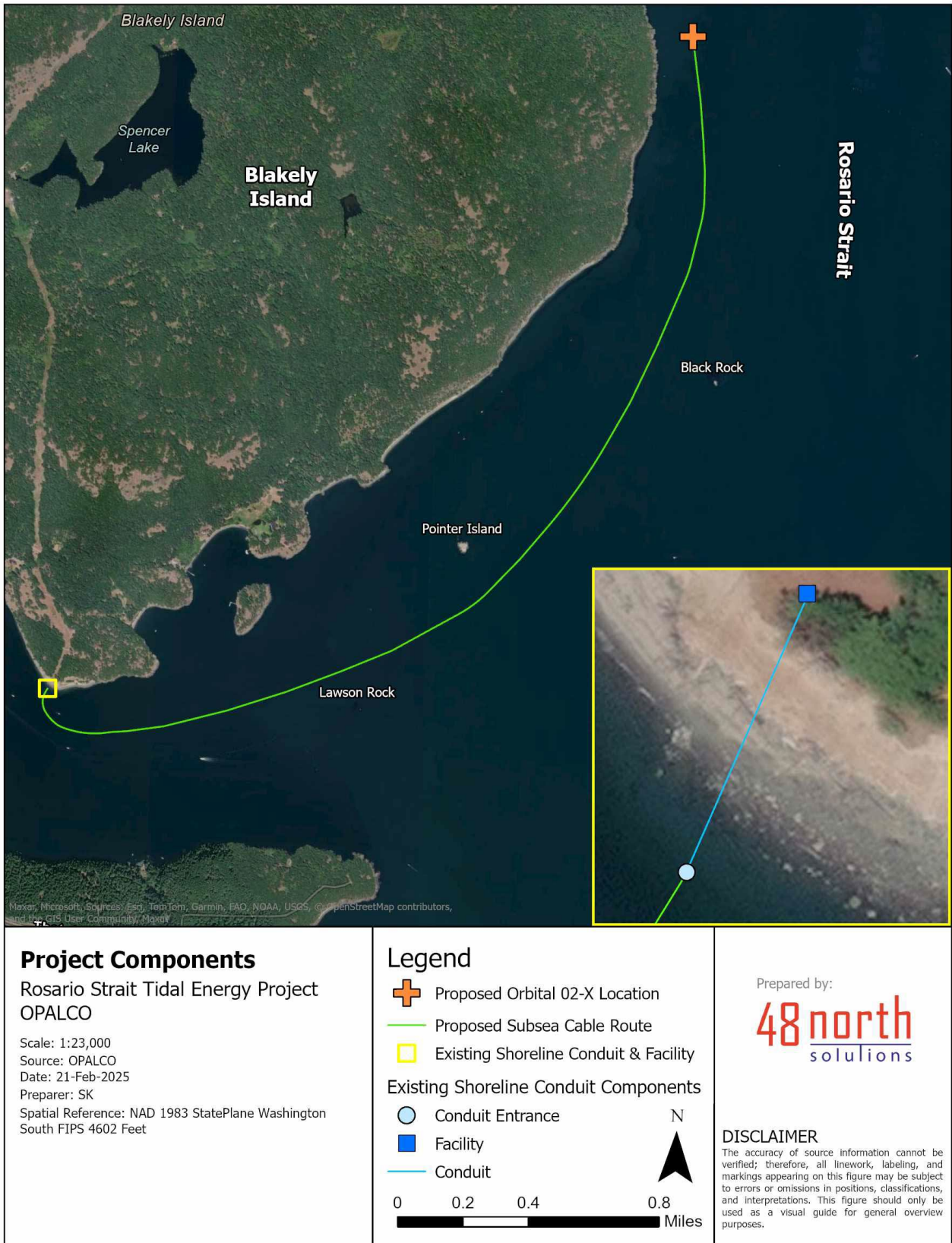


Figure 3. Proposed Project Components

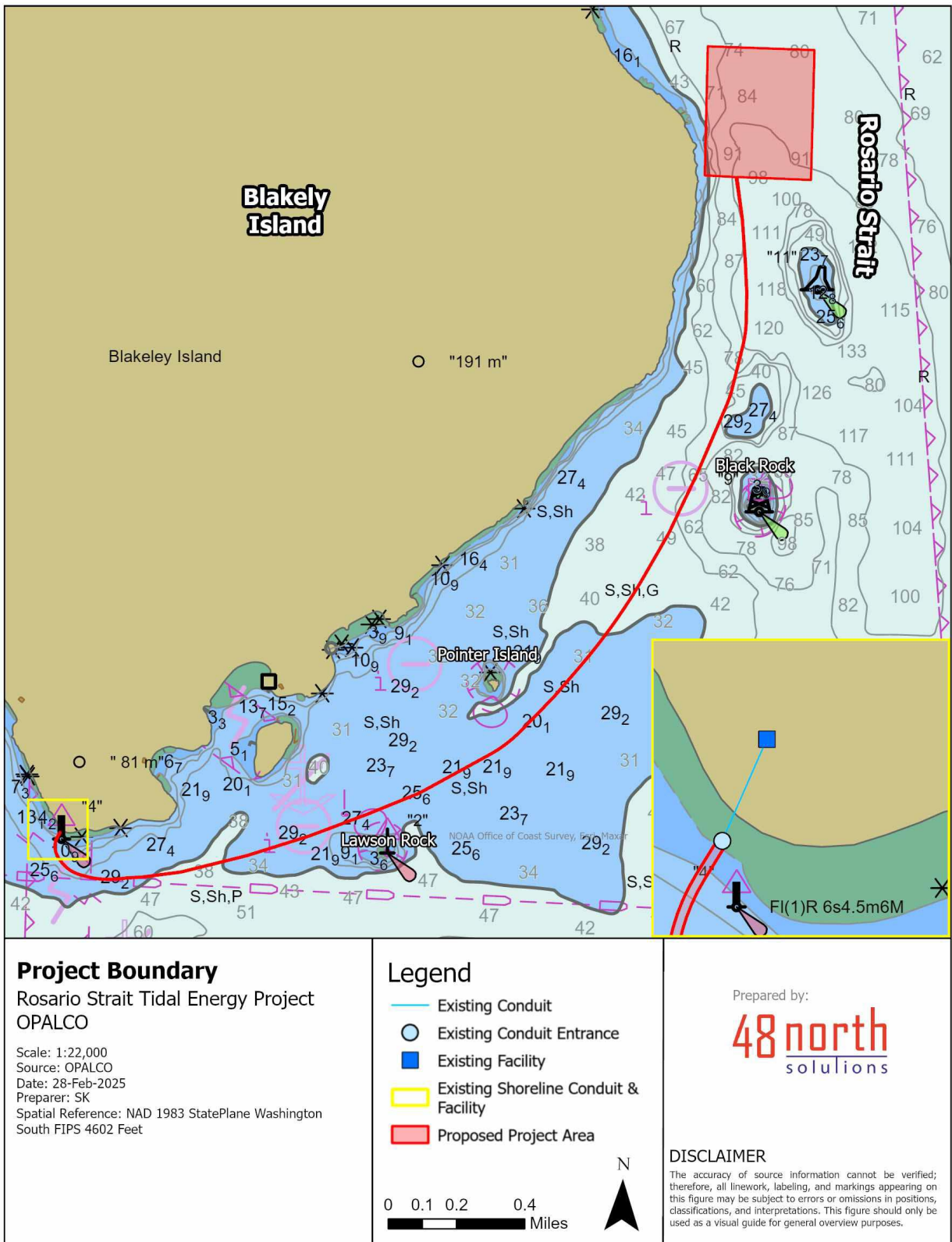


Figure 4. Proposed Project Boundary in Rosario Strait

2.3 Infrastructure

2.3.1 Proposed Infrastructure

The proposed Project infrastructure includes: one Orbital O2-X device (**Section 2.3.1.1**), four mooring lines (**Section 2.3.1.2**), four anchors (**Section 2.3.1.3**), and one new subsea power cable (**Section 2.3.1.4**). A summary of these components is found in the section below.

2.3.1.1 Orbital O2-X Floating Tidal Device (Orbital O2-X)

The Orbital O2-X is a floating tidal energy generator consisting of two 1.2 MW turbines (2.4 MW rated power combined). The main body of the Orbital O2-X consists of a cylindrical steel superstructure that houses power conversion and auxiliary systems and serves as a stable floating platform for the attachment of two leg structures with nacelles and rotors mounted at their ends. A nacelle is a container that houses the generating components of a turbine. The leg structures are attached to the main body with hinge attachments and can be used to lower nacelles and rotors in the optimal placement of the tidal stream to generate electricity. The leg structures can also be raised to bring the nacelles and rotors to the surface for servicing and towing the Orbital O2-X.

The Orbital O2-X features two twin-bladed rotors with blades that are manufactured from glass-fiber reinforced epoxy. During operation, the rotors rotate in opposing directions to support platform stability, and the blades' angles can be adjusted as needed. Exterior and interior surfaces exposed to seawater are coated with appropriate antifouling coatings to avoid permanent build-up of marine growth.

The main design parameters are listed in **Table 6**, though dimensions may change based on the site-specific characteristics of the proposed Project location. Cross sections and dimensions (in meters) of the Orbital O2-X are shown in **Figure 5** and **Figure 6**. A labeled diagram of the main internal systems is included in **Figure 7**, and an image of an Orbital O2 device in the water with legs raised is depicted in **Figure 8**.

For more design drawings please see Exhibit F. OPALCO acknowledges that FERC's regulations require Exhibit F drawings to be depicted in feet. However, the preliminary Exhibit F drawings currently available from Orbital Marine and included in this DLA are depicted in meters. OPALCO's final Exhibit F drawings to be submitted during or after the licensing process will include measurements in feet, as required by the Commission.

Table 6. Design Parameters of the Orbital O2-X

Summary of Device Characteristics	
The number of generating units including auxiliary units	One Orbital O2-X device that houses two rotor-powered generators (i.e., two turbines)
Type of each hydraulic turbine	Horizontal axis tidal turbines
Estimated minimum and maximum hydraulic capacity of the plant (flow through the plant) in cubic feet per second	127 cubic feet per second (cfs) to 65,584 cfs
Installed (Rated) Capacity	c. 2.4 MW (1.2 MW per turbine)
Average Annual Energy Production	2,100,000 kWh per turbine (4,200,000 kWh total)
Dependable Capacity	0
Displacement	1,000 tonnes (2,204,623 pounds [lbs.])



Summary of Device Characteristics	
Rated Current Speed	2.5 meters per second (m/s; 8.2 feet per second [ft/s])
Cut-In Current Speed	1 m/s (3.3 ft/s)
Shut Down Current Speed	5 m/s (16.4 ft/s)
Maximum Hull Length	85 m (279 ft)
Approximate Diameter of Hull Tube	4 m (13.1 ft)
Approx Depth to Uppermost Rotor Tip During Operation (Rotors Extended)	3 m (9.8 ft)
Approx Depth to Bottom of Rotor Tip (Deepest Point) During Operation (Rotors Extended)	33 m (108 ft)
Maximum Depth of Platform Below Waterline	2.4 m (7.9 ft)
Height of Hull Tube Exposed Above Water Surface	1.6 m (5.2 ft)
Rated Rotor Speed	9.2 revolutions per minute (rpm)
Maximum Rotor Speed	11.2 rpm
Maximum Rotor Diameter	30 m (98 ft) (each blade is 15 m [49 ft])
Maximum Rotor Swept Area	706 m ² (7,600 ft ²) (x 2)
<p>Notes: cfs = cubic feet per second; ft = feet; ft² = square feet; ft/s = feet per second; kWh = kilowatt hours; lbs. = pounds; m = meters; m² = square meters; m/s = meters per second; MW = megawatt; rpm = revolutions per minute</p> <p>¹ A definitive average of annual energy production for this project has not yet been calculated, as the optimal rotor size and associated energy yield has not yet been determined.</p>	

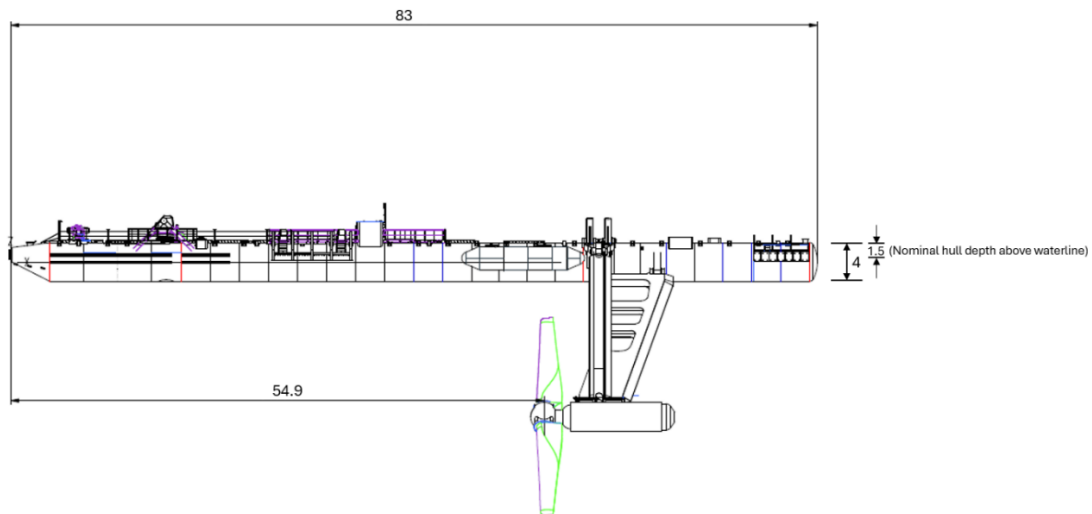


Figure 5. Orbital O2-X in Operation Mode (in meters)

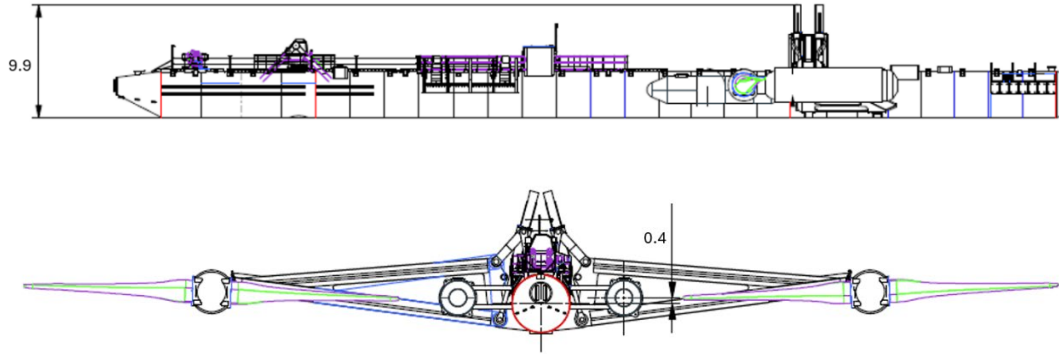


Figure 6. Orbital O2-X in Transport Mode (in meters)

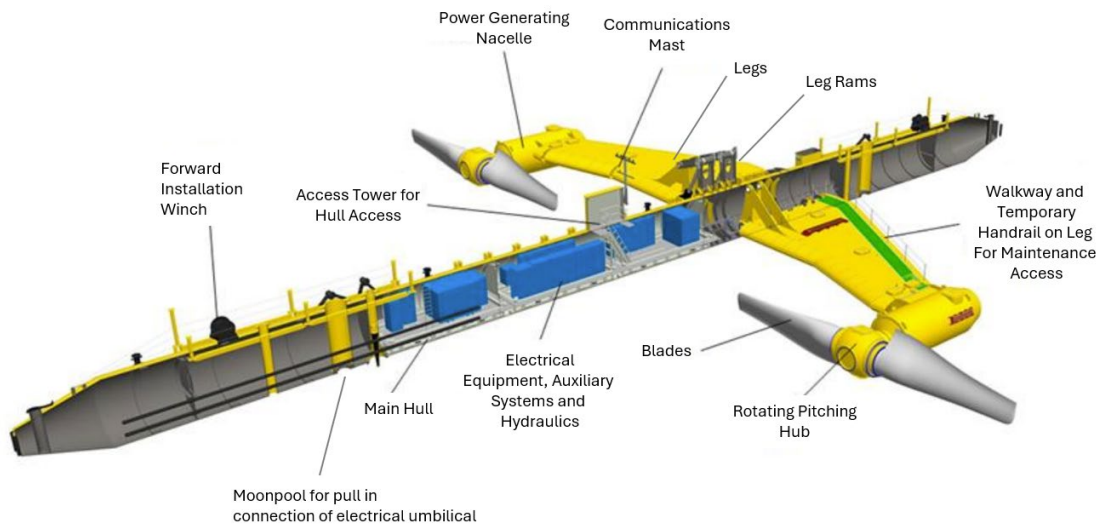


Figure 7. Main Internal Systems of Orbital O2-X



Figure 8. Orbital O2 Deployment in Orkney Islands, Scotland

2.3.1.2 Mooring lines

The mooring system for the Orbital O2-X would be comprised of four catenary mooring lines, which would be moored to the seabed via four separate anchors, designed in accordance with Offshore Standard DNV-OS-E301 (DNV 2013).

There would be a single-point mooring connection at the forward end of the hull that spreads out to four anchoring points (**Figure 9**). During each tidal cycle, the system would slowly pivot its position in a 360-degree manner, like a moored boat during a tide change (**Figure 10**). During the tidal changes, the turbines would not operate due to insufficient tidal current to turn the turbines.



Figure 9. Single-Point Mooring Location on Orbital O2-X Hull

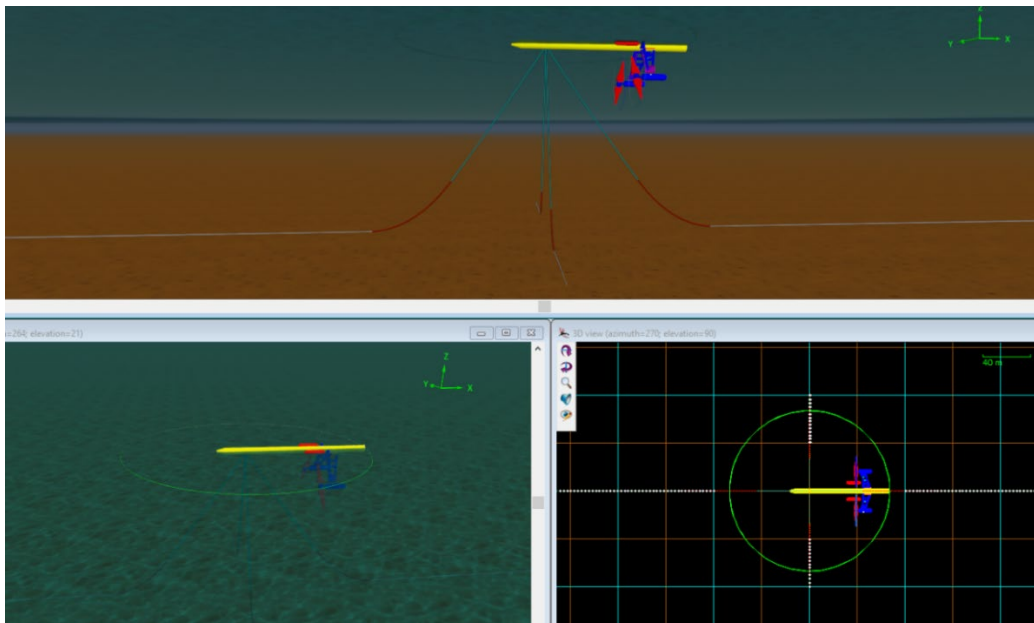


Figure 10. Mooring System and Pivot Radius

The mooring lines would be approximately 334 m (1,096 ft) in length. The maximum difference between high and low tide, or the tidal range, recorded at the Project area by the Applied Physics Laboratory, University of Washington (APL-UW), is 4 m (13.1 ft) (Appendix C2). During slack tide (the transition time between tides), a total length of approximately 246 m (807 ft) of each mooring line would be in contact with the seabed, which is represented by white dotted lines in **Figure 11** and **Figure 12**. The mooring lines remain slack when the Orbital O2-X rotates 180 degrees as the tide changes direction, and the entire mooring line spread covers a minimum area of approximately 280 m x 480 m (918 ft x 1,575 ft).

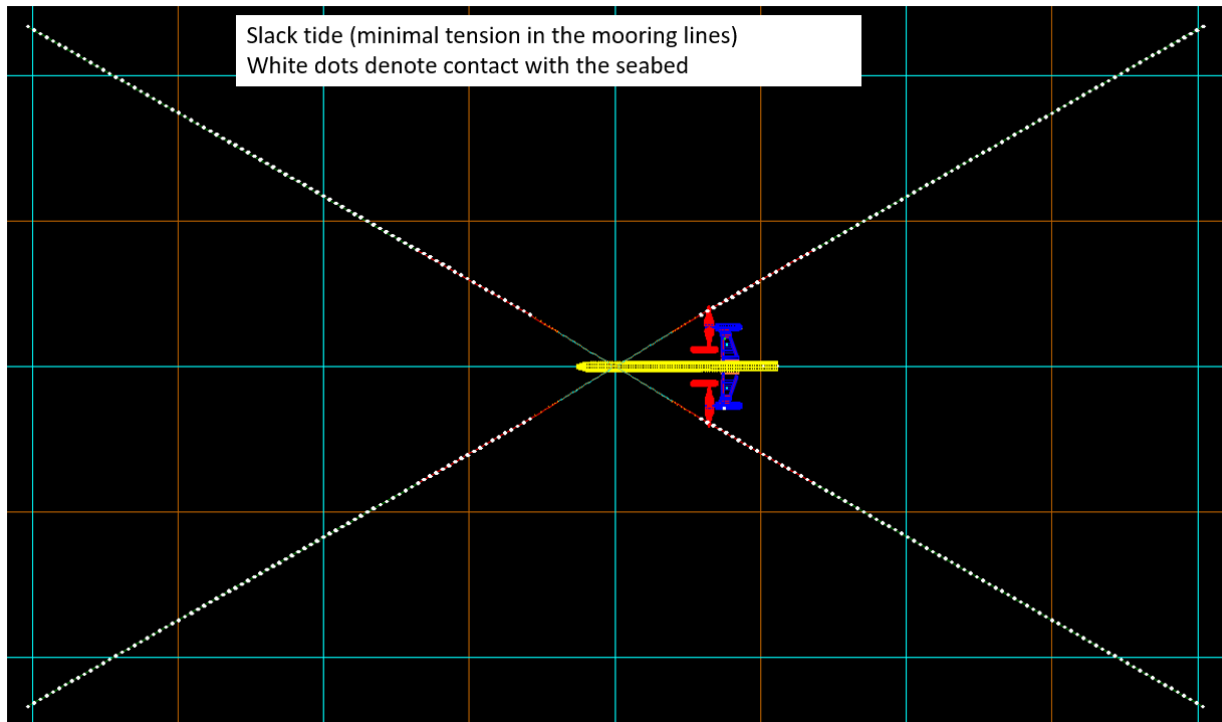


Figure 11. Mooring Lines at Slack Tide (above view)

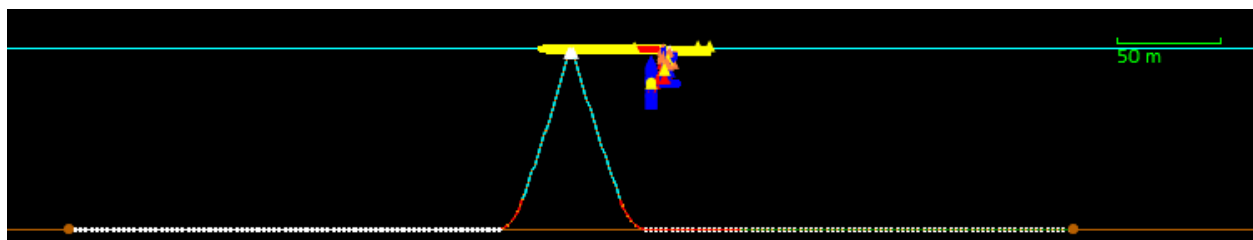


Figure 12. Mooring Lines at Slack Tide (side view)

When the mooring lines reach the position of rated power (when tidal currents are strong enough to turn the rotors), the mooring lines downstream of the Orbital O2-X would remain on the seabed while the mooring lines upstream of the Orbital O2-X would lift off the seabed (**Figure 13**). Even when the mooring lines are slack, less than 10 tonnes (22,046 pounds [lbs.]) of tension remains per line.

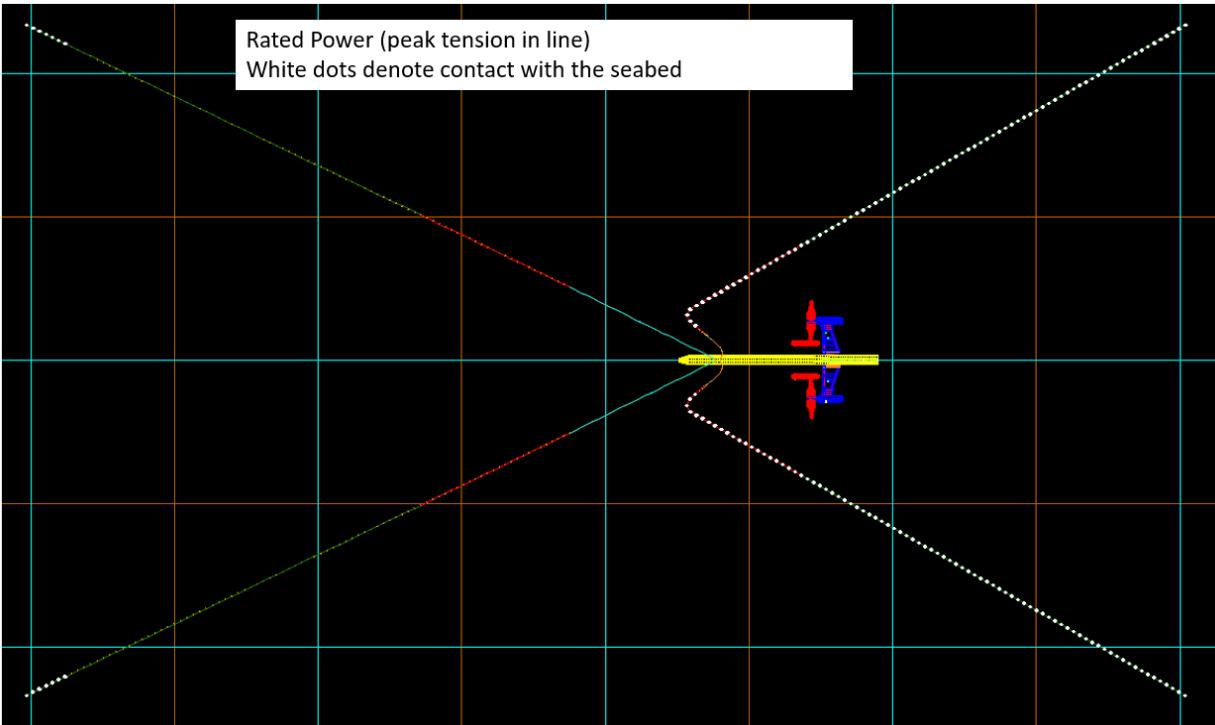


Figure 13. Mooring Lines at Rated Power

Previous deployments of the Orbital O2 exemplified that the mooring lines lift and are placed back down in approximately the same location amidst tidal cycles, showing a very narrow area of disturbance to the seabed. The width of the area where they are placed back down is less than 1 m (3 ft), so the total area of disturbance is approximately 246 m² (2,648 ft²) per line, or 984 m² (10,592 ft²) total for all four lines. There is one area along each mooring line where it is dragged over the seabed rather than lifted. This area is approximately 10 m² (108 ft²) in size, totaling 40 m² (432 ft²) across the four lines, that would be disturbed by mooring lines dragging on the seabed.

In the highly unlikely event that a mooring line failed, any single remaining mooring line can hold the entire system. The mooring spread would cover a minimum area of approximately 280 m x 480 m (918 ft x 1,575 ft). The mooring line system would consist of approximately 95 millimeter (mm) (3.7 inches [in.]) and 115 mm (4.5 in.) diameter studlink mooring chain. Synthetic or steel rope may be used in the lines as well but would be limited to the upper section of the mooring lines and would be jacketed polyester rope approximately 170 mm (6.7 in.) in diameter.

2.3.1.3 Anchors

Four gravity anchors or four drilled rock bolt anchors would likely be used to anchor the Orbital O2-X, subject to seabed conditions. Gravity anchors would be composed of a “steel basket” filled with ballast (**Figure 14**). The anchor baskets would be approximately 11 m x 11 m x 2.5 m (36 ft x 36 ft x 8.2 ft) and weigh approximately 35 tonnes (77,200 lbs.). The ballast would consist of scrap steel chain (7.6 cm [3 in.] in diameter), steel modules approximately 5.5 m x 5.2 m x 2 m (18 ft x 17 ft x 6.6 ft), or cast concrete blocks.

Rock bolt anchors are steel vertical piles that are drilled into the seabed to keep the Orbital O2-X in its designated location in the water. Rock bolt anchors can either be grouted in place in the seabed or mechanically locked in place to prevent pull out (**Figure 15**). In a mechanically locked system, the “cutting fingers” of the drilling bit are expanded within the bolt hole to secure the anchor in place.

Four rock bolt anchors are proposed, each likely 6.1 m (20 ft) in vertical length and up to 58.4 centimeter (cm) (23 in.) in diameter. Each would be drilled into the seabed with its head protruding from the seabed with a specialized mooring connector.

Each mooring point would have a single rock bolt. The exact sizing would be subject to seabed conditions analysis and detailed design.

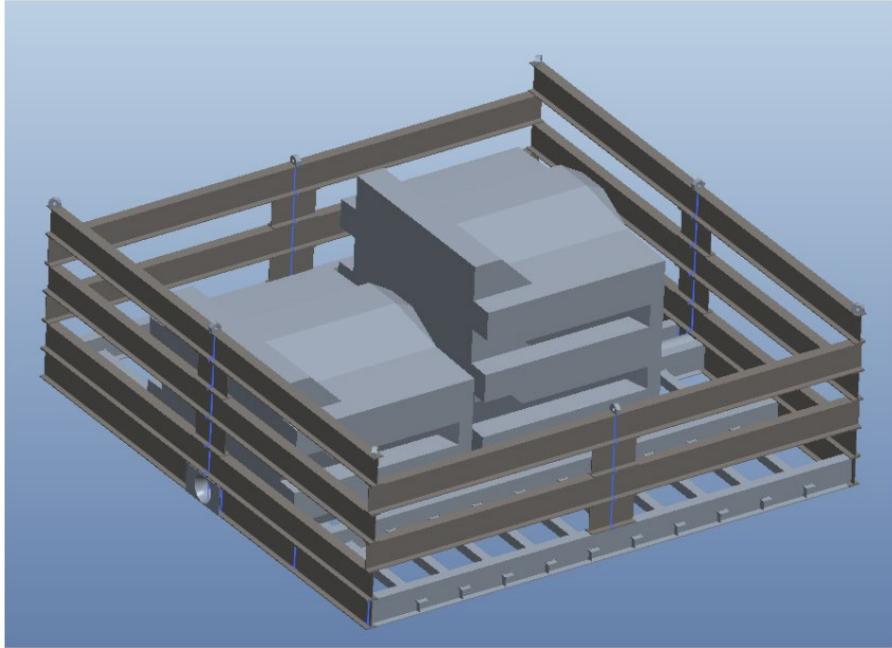


Figure 14. Anchor Basket with Ballast

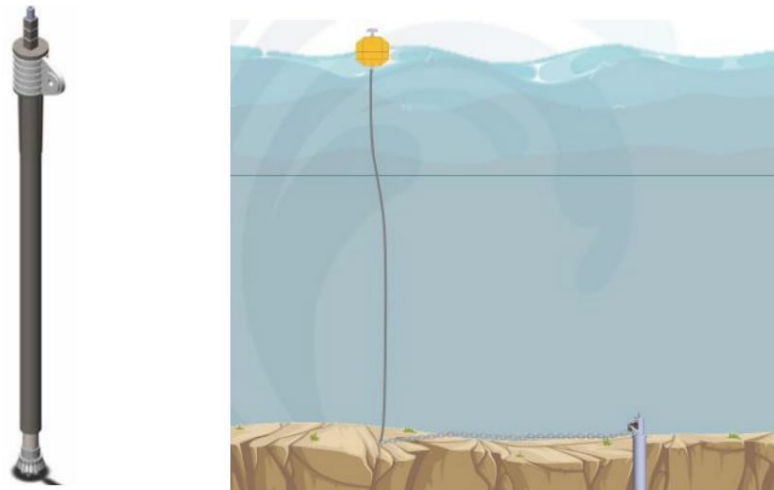


Figure 15. Example of a Rock Bolt Anchor

Mooring Connector

The mooring lines, attached to the anchors at the seabed, would terminate at a connector on the base of the Orbital O2-X (**Figure 9**). The connector has four places for mooring lines to attach, designed to allow the device to rotate 180 degrees with the changes of the tide, and has a full rotational range of 360 degrees.

During the Orbital O2-X installation and mooring line connection procedure, the connector would be situated on the seabed directly below the final proposed location for the Orbital O2-X device. There on the seabed, the four mooring lines would be attached to the connector. Once the anchors are installed and the mooring lines attached, the connector would be lifted via chain to its final position in a receptacle in the hull of the Orbital O2-X via a winch system on the Orbital O2-X platform. A hydraulic system would lock the connector in position within the hull.

If the Orbital O2-X needs to be removed, first the electrical connections would be disconnected, then the connector would be released from the hydraulic system on the Orbital O2-X hull, and finally the on-platform winch system would lower the connector to the seabed. This connector, its chain, and the mooring lines would have sufficient mass to remain in place on the seabed until they are either reconnected to the Orbital O2-X or recovered when the project components are removed.

When the Orbital O2-X reaches its destination orientation during peak tidal currents, it would excuse (i.e., leave or deviate from) its usual radius of its watch circle. As the tidal current speed increases from slack tide and the Orbital O2-X starts to generate power, it would slowly drift backwards from its watch circle radius by approximately 30 m (98 ft) over a period of 45 minutes to 1 hour. When the tidal current changes direction at slack tide, the Orbital O2-X would slowly turn with the tide, like a moored boat would, over a period of about 30 minutes. The Orbital O2-X would not generate power during this period, as the tidal speeds are too low to turn the rotors.

2.3.1.4 Subsea power cable

Power is exported from the Orbital O2-X via a dynamic cable from the Orbital O2-X device to the seabed where a new subsea cable would traverse approximately 5.3 km (3.3 miles) to export power ashore to the existing shoreline conduit, connecting the tidal system to OPALCO's microgrid.

The proposed Project would incorporate a new one-cross-linked polyethylene subsea power cable with a voltage of 12.5 kilovolts (kV). The cable would extend from the electrical port on the Orbital O2-X where it would travel down the umbilical portion of the cable (i.e., the portion that is vertical in the water column) to the seabed where it would traverse 5.3 km (3.3 miles) along the seabed and connect to OPALCO's electrical grid via an existing shoreline conduit at the south end of Blakely Island (**Figure 3**). The power cable would consist of multiple layers including conductor, insulation, and armoring. Depending on seabed survey results, the cable would be up to 17.8 cm (7 in.) in diameter and weigh up to 25 kilograms (kg) per m (kg/m) (16.8 lbs./ft) in water. A 2.3-m (7.5-ft) buffer area on either side of the cable would be reserved for placing the cable around sensitive habitat during deployment, if necessary.

The umbilical portion of the cable is 105 m (344 ft) long and reaches a depth of 87 m (285 ft) (**Figure 16**). Once installed, the umbilical would have a sweep area of approximately 314 m² (3,380 ft²) (**Figure 17**), though the cable would only be in contact or drag along the seabed at this location during slack tide. During peak tide when the Orbital O2-X is at rated power, the umbilical is taught and lifts entirely off of the seabed (**Figure 18**). The remainder of the new subsea cable is expected to remain in the location it was laid on the seabed for the duration of the Project.

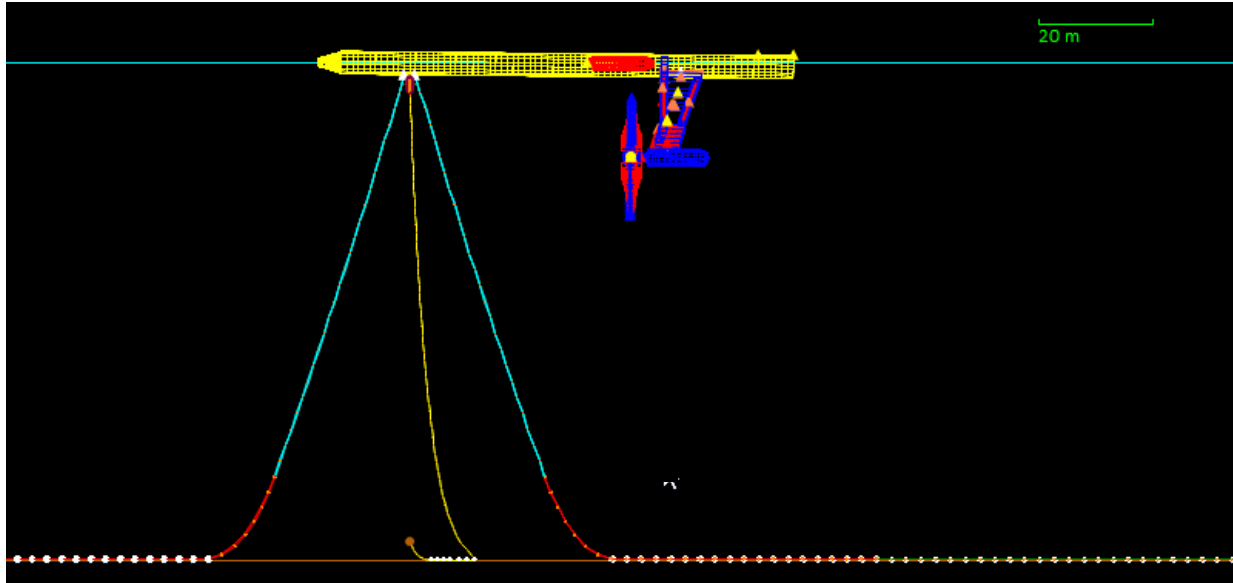


Figure 16. Umbilical Sweep Area During Slack Tide (side view)

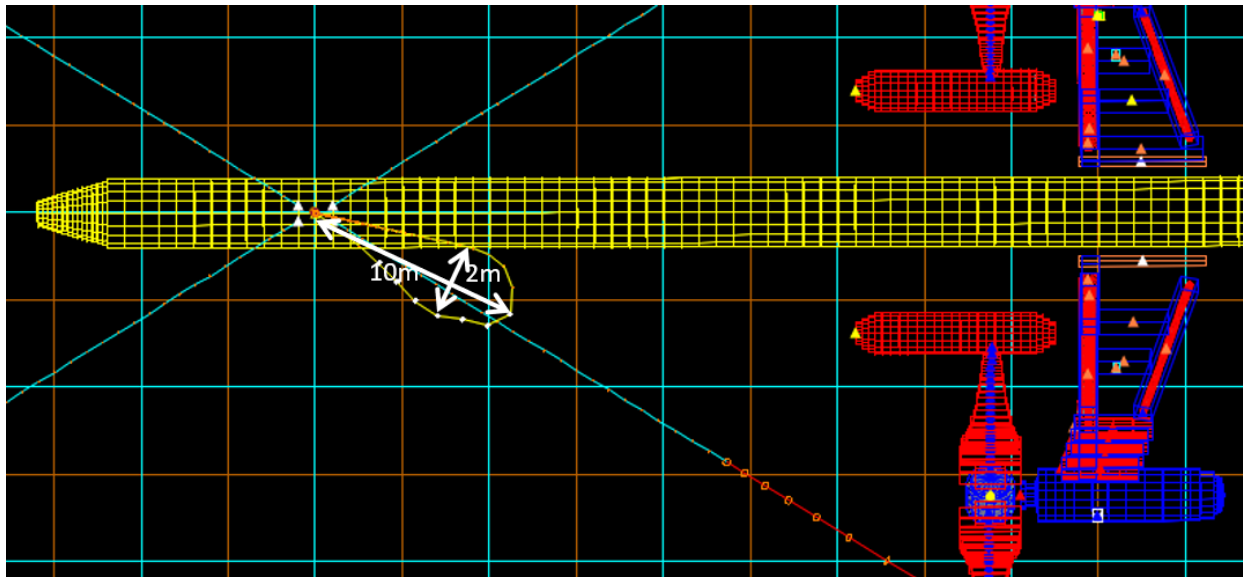


Figure 17. Umbilical Sweep Area During Slack Tide (above view)

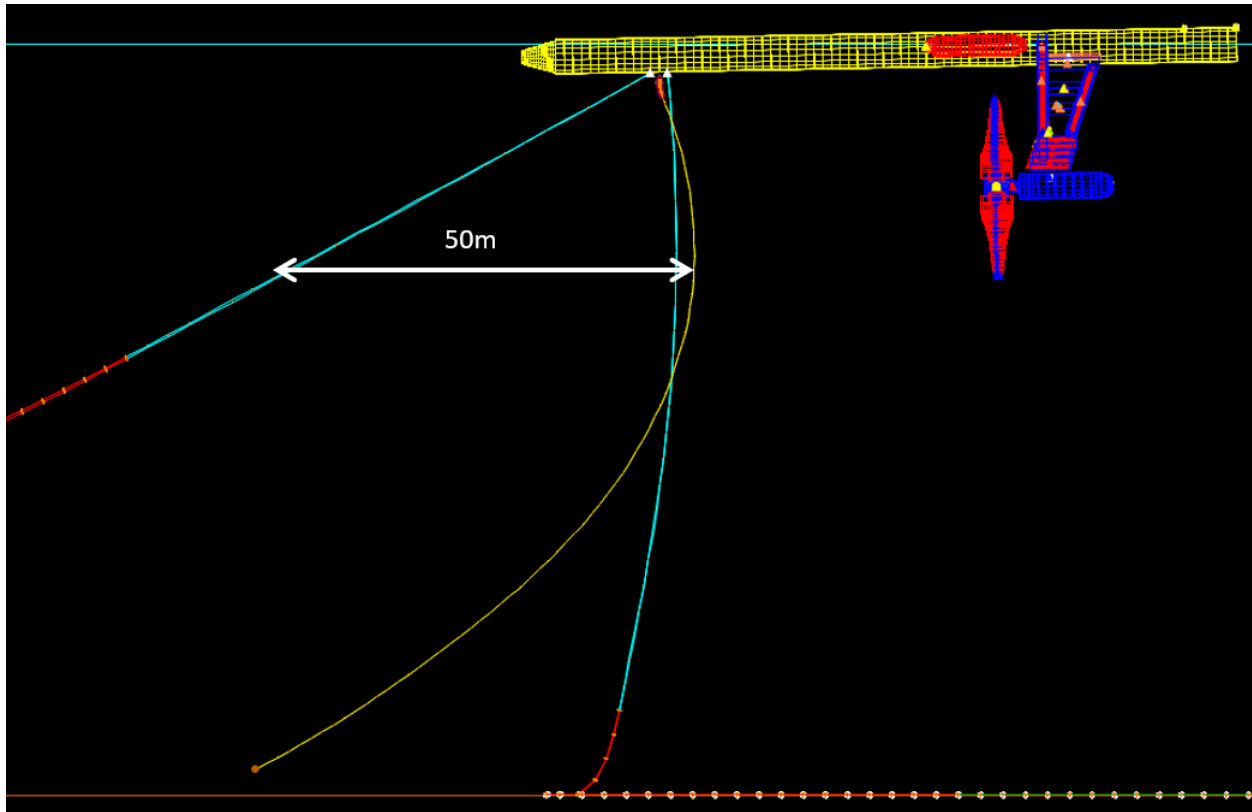


Figure 18. Umbilical During Peak Tide (side view)

2.3.2 Existing Infrastructure

The proposed Project would utilize the following existing infrastructure at Blakely Island:

- 45.7-centimeter (cm) (18 in.) diameter shoreline conduit off the south shore of Blakely Island.
- A land-based shoreline conduit facility on the southern end of Blakely Island.

The interconnection between the Orbital O2-X and OPALCO's microgrid would be via the existing 45.7 cm (18 in.) shoreline conduit off the south shore of Blakely Island, which was installed by OPALCO in 2004. The conduit is buried in the slope of Blakely Island with an opening on land near OPALCO's substation, and the other end emerging underwater offshore Blakely Island. The subsea cable would be threaded through the existing shoreline conduit so that energy generated by the Orbital O2-X would be transmitted from the Orbital O2-X to OPALCO's transmission system and the surrounding islands along existing power cables.

2.4 Project Installation

Project components and installation methods are described below. For all Project activities using vessels, trained onboard crew will visually monitor the area for protected species (see **Section 3.6**). An estimated schedule for the proposed Project is presented in **Table 7**. If a situation arises where emergency removal of all Project components is necessary, the removal process will take approximately 2-3 weeks (Appendix B4 and Appendix B7).

**Table 7. Estimated Project Schedule**

Activity	Location	Approximate Duration
Anchor Installation	Blakely Island	8 days (2 days per anchor)
Mooring Installation	Blakely Island	4 days (1 day per mooring line)
New Subsea Power Cable Installation	Blakely Island	1 week
Turbine Delivery from Anacortes to Blakely Island	Anacortes	1 day
Orbital O2-X Install on Moorings	Blakely Island	2 days (during slack periods)
First Grid Connection	Blakely Island	2 days
Commissioning	Blakely Island	12 weeks
Operation	Blakely Island	Up to 10 years
Decommissioning	Blakely Island	6 months
Removal	Blakely Island	2-3 weeks

2.4.1 Anchor Installation

Anchors to moor the Orbital O2-X would be composed of modular heavy ballast sections installed into single holding structures located on the seabed. The anchor and mooring installation would be conducted using a single standard multi-category (multi-cat) vessel or similar.

If rock bolt anchors are required, a submersible and remotely operated drill rig would be deployed from a multi-cat vessel or similar inshore construction vessel. The drill rig would embed the rock anchor in the seabed. The anchors would be positioned using a Global Navigation Satellite System, a heading sensor, and cameras installed on the drilling rig. After installation of each anchor, the drill rig would be recovered before the support vessel's position is changed, using a pre-laid arrangement of moorings.

2.4.2 Mooring Line Installation

There are four mooring lines. Each would take 1 day to install using a multi-cat vessel.

2.4.3 New Subsea Cable Installation

The new subsea cable would first be fed into the existing conduit off the south end of Blakely Island. Divers would uncover the conduit end offshore and attach the cable to a pulley fed through the top end on shore. Then, the cable would be pulled through the existing conduit where it can be hooked up to the existing shoreline facility.

The cable would be spliced to the static cable on the seabed. A vessel platform, such as a multi-cat vessel, would be configured for cable laying and splicing operations. The new subsea cable would be



laid on the surface of the seabed and create only minimal temporary disturbance via potential short-term turbidity in the water column upon impact with the seabed. After installation, the cable is expected to remain in place until it is removed during future Project decommissioning.

2.4.4 Orbital O2-X Installation

The Orbital O2-X would be installed in the proposed Project area during a neap tidal cycle (i.e., two slack periods). The Orbital O2-X would be put in the water in Anacortes and towed by vessel to the proposed Project area. Once locked into position by the mooring lines and anchors, the Orbital O2-X would pick up the power cable from the seabed using a winching system and install it in the hull where it would remain in place until the Orbital O2-X is removed from the proposed Project area. After commissioning, Project operation would begin, and the turbines would generate energy to transmit to the electrical grid.

2.4.5 Project Operation

During operation, the power conversion system applies loading torque to the generators based on the tidal flow and pitch angle. The blade pitch is adjusted to maximize power generation during low tidal flows and limit power during high tidal flows.

To support platform stability, the rotors rotate in opposing directions. The revolutions per minute (rpm) and tip speed of the rotors increase and decrease with the speed of the tidal currents, meaning the Orbital O2-X turbine generates power any time the tidal current speed is higher than the cut-in speed (0.5 meter per second [m/s] [1.6 feet per second (ft/s)]), or the minimum tidal current speed required to generate electricity. Under expected conditions in the deployment area in Rosario Strait, the turbine would operate most of the time, as the average cross-sectional tidal current speed in Rosario Strait is 0.88 m/s (Yang et al. 2021), with a maximum tidal current speed during spring tides of 3.14 m/s (10.30 ft/s).

Importantly, the mechanics of crossflow turbine design mean that essentially no suction or entrainment force is created during operations. Water is decelerated as it approaches the rotors. The turbine is designed to operate at a rated rotation speed of 9.2 rpm, with a maximum rotation speed of 11.2 rpm, which is relatively slow in comparison to ship and boat propellers that operate at higher velocities of 1,000 rpm. In lab-scale experiments, this effect is apparent at 1 to 2 diameters upstream, such that deceleration would begin 30 m to 60 m (98 ft to 197 ft) upstream of the rotors. During operation, the rotors would be halted or paused if a collision were to occur (with debris for example). A collision would be an extremely rare event. At the site of the Orbital O2 deployment in the Orkney Islands in Scotland, which has been in operation for more than 32 months, no collision with debris has been recorded.

For more information on Project operations, see the Project and Facilities Operations Monitoring Plan (Appendix B1).

2.4.6 Project Maintenance

The Orbital O2-X components, including the platform, rotors, and mooring systems, are designed for low-cost maintenance with easy access for annual servicing requirements. The leg structures can be raised to bring the legs, nacelles, and rotors to the surface for servicing. Typical operation and maintenance for the Orbital O2-X is outlined in **Table 8**.

As a floating device, scheduled and unscheduled maintenance operations on electrical, control, and hydraulic systems can be carried out onboard the device by transferring personnel from a small vessel onto the hull of the Orbital O2-X. Throughout deployment, regular maintenance would be performed to maintain structural integrity and high uptime for maximum power generation.

Regular maintenance would be conducted using a variety of survey systems such as side scan and multibeam sonar, drop-down camera, and inspections of biofouling coatings to ensure they remain



intact. Sensors would also be integrated with the main control system to provide feedback from several parts of the system.

For more significant maintenance operations or when weather conditions preclude a personnel transfer, the Orbital O2-X can be disconnected from its mooring and towed to a maintenance location. Once disconnected from its mooring and the rotor legs are retracted, the low transport draught of the turbine allows the use of local shallow bays/pontoon facilities for maintenance.

As part of the control system, certain parameters would be monitored solely for the safe and reliable operation of the Orbital O2-X, including:

- Hydraulic pressure, temperature, and reservoir levels.
- Cooling water temperature.
- Equipment space temperature/humidity.
- Generator temperature.
- Generator voltage and current.
- Bilge level alarms.

Additional details about project maintenance activities can be found in the Project and Public Safety Plan (Appendix 5).

Table 8. Frequency of Operational Maintenance Service Tasks

Maintenance Type	Frequency	Effort
Mooring Survey	Periodically	<ul style="list-style-type: none"> • Checking the integrity and conditions of the moorings and anchors.
Orbital O2-X Inspection at Site	12 months	<ul style="list-style-type: none"> • Cleaning with high-pressure water/steam cleaner. • Inspect corrosion protection. • Visual inspection of all rotors, blades, etc. • Check lube oil level, magnetic plugs, take samples. • New lube oil filling.
Orbital O2-X Overhaul	5–8 years	<ul style="list-style-type: none"> • Inspection and exchange of worn parts. • Test runs after assembly. • Refurbishment of corrosion protection system.
Platform Inspection	12 months	<ul style="list-style-type: none"> • Checking and cleaning the platform hull and structures. • Repairs and replacement carried out as required.
Electrical Inspection at Site	6 months	<ul style="list-style-type: none"> • Check the ventilation system/changing ventilator mats. • Inspect critical electronics installations. • Inspection for corrosion. • Optical inspection.
Major Inspection	5 years	<ul style="list-style-type: none"> • Inverter inspection and maintenance.
Automatic Condition Monitoring System	Continuous	<ul style="list-style-type: none"> • Automatic data recording. • Frequent reports.



Maintenance Type	Frequency	Effort
(i.e., Mechanical monitoring and early fault detection)		<ul style="list-style-type: none"> Alarm if defined threshold values are exceeded.

2.4.7 Project Removal

Protocols for Project removal due to the end of the license term or an emergency would be developed prior to commencement of the Project and included in the Project Removal, Site Restoration, and Financial Assurance Plan (Appendix B4) and the Emergency Shutdown Plan (Appendix B7), and the entire decommissioning process is expected to take up to six months. At the end of the Project, all components, including but not limited to the mooring lines, anchors, and subsea cables, would be removed in accordance with the requirements of the applicable federal and state agencies, and the specific requirements determined through the relevant permitting processes. A summary of the Project removal process is shown in **Table 9**.

Post-decommissioning seabed surveys would be undertaken to ensure that all equipment has been removed from the site. The post-decommissioning survey would also record any potential impacts on the seabed at the anchoring points and along the mooring lines where there has been contact with the seabed. Currently, all evidence indicates that given the nature of the seabed and proposed non-invasive works, no restoration work would be required.

Table 9. Summary of Project Removal Process

Activity Type	Effort
Pre-removal	<ul style="list-style-type: none"> Complete environmental effects analysis of occupational health and safety.
Removal of Project Components	<ul style="list-style-type: none"> Remove the electrical connection of the platform. Tow Orbital O2-X off-site and store at an appropriate harbor or sheltered bay location.
Removal of Platform	<ul style="list-style-type: none"> Remove the mooring shackles to the seabed and the navigation/pick-up buoys attached to enable recovery. Recover gravity anchor cages and ballasts, including mooring lines. If rock bolt anchors are used instead, the mooring lines would be removed and the anchors left on the seabed (unless removal is required by FERC). Recycle, reuse, or dispose of old parts.
Post-removal	<ul style="list-style-type: none"> Complete post-decommissioning seabed surveys. Complete restoration work to the seabed, if necessary.

2.5 Alternatives to the Action

2.5.1 No-action Alternative

Under the no-action alternative, all proposed Project activities would not be constructed. San Juan County is at risk of unreliable electricity, as the vast majority of OPALCO’s power is transmitted using subsea cables connected to the grid on mainland Washington State. When service is disrupted on the mainland, San Juan County can be subjected to long wait times as repairs are beyond their control. Therefore, if the proposed Project were not to occur, OPALCO would not be able to test the feasibility of tidal power as a local energy generation resource that could strengthen the resilience of infrastructure and increase safety and reliability for its service area. The no-action alternative would mean that the installation of the Orbital O2-X in Rosario Strait would not occur and OPALCO would continue to rely on mainland Washington State for electricity.



Additionally, data from this proposed Project would be used to inform future tidal power projects in the U.S. If this proposed Project were not to occur, the U.S. may not have the same opportunity to position itself as a renewable energy leader. This no-action alternative is not evaluated further in the DLA.

2.5.2 Alternatives Considered but Eliminated

2.5.2.1 Alternative Location

In 2021, PNNL created a report with support from the DOE Waterpower Technologies Office through the TEAMER program that analyzed two potential locations in the U.S. for Orbital O2-X deployment: San Juan Islands, Washington and Western Passage, Maine (Copping et al. 2021). After an in-depth analysis of bathymetry, tidal resources, protected and sensitive marine animals and habitats, seabird habitat, environmental data, and environmental effects, it was determined that Rosario Strait in Washington State is a better potential site. The Western Passage, Maine location was eliminated from consideration.

3. Affected Environment

3.1 Geology and Soils

The Salish Sea is a section of a larger geological province of the Puget Lowland Formation, located between the Cascade and Olympic Mountain ranges. The region is in the fore-arc basin between the Juan de Fuca tectonic plate subduction zone and the Cascade mountain range volcanoes (**Figure 19**).

The area was carved out by massive glaciers that extended south past Olympia, Washington, covering the landscape in ice thousands of feet thick (Shipman 2008). Poorly sorted glacial sediments were deposited over the past 2 million years by several glacial events, forming the main landscape. This was subsequently eroded by the Vashon Glaciation circa 15,000–12,000 years ago, which shaped the deep troughs throughout the Salish Sea and Puget Sound as they exist today (Shipman 2008). Glacial scouring of the area resulted in the development of deep basins separated by sills of variable depth, which confine water to the individual basins (Banas et al. 1999). The most abundant and widespread geologic units found today in the Puget Lowland are the unconsolidated deposits of sediments that were left by the glaciers as they receded (**Figure 20**).

Since the Vashon Glaciation, the major rivers in the area have further altered the landscape by carrying sediments from the mountains into Puget Sound, and through deposition, forming alluvial valleys and deltas. The sediments in this basin are poorly sorted, mainly mud and clay, with some sand and shell debris.

The San Juan Islands consist of an archipelago in the northern Puget Lowland and are composed of metamorphic rocks that were accreted onto North America 160 million years ago. The islands represent the highest points of a submerged mountainous area that extends across the Puget Lowland from the mainland to Vancouver Island, BC. Channels between the islands attain depths of 200 m (656 ft) and in some places exceed 300 m (984 ft) (Easterbrook 2015).

Blakely Island is 17.9 km² (6.9 square miles [miles²]) in area and is highest in elevation at Blakely Dome at 323 m (1,060 ft), the northeast region of the island (NPS 2006). There is an additional mountain, Bald Bluff, on the west side of the island that has an elevation of 268 m (880 ft) (NPS 2006). Glacial sediment remains at the southern end of the island, but the land is generally rocky with steep shorelines (NPS 2006). Some of the steepest shorelines are situated on the east side of the island near the proposed Project area where the shore rises 238 m (780 ft), and the southern end of the island consists of a smaller hill with an elevation of 79 m (260 ft) (NPS 2006).

The shorelines adjacent to the proposed Project area are composed of bedrock (**Figure 21**) and therefore has limited to no littoral drift or accretion potential (i.e., little potential for changes to the local beach sedimentation) (**Figure 22**). According to Ecology, slope failure along the east shore of Blakely Island is an intermediate risk (Ecology 2023a; **Figure 23**). See **Section 3.2.3** for more information about the slope and sediment of the seafloor.

Methane gas plumes occur along three major faults in the seafloor of the Puget Sound estuary. The methane from these bubble plumes is mixed throughout the estuary by tides and local currents (Johnson et al. 2021). Single-beam sonar was used to collect data in 2011, 2018, 2019, 2020, and 2021, and the acoustic signature of 349 individual bubble plumes was mapped (Johnson et al. 2021). There are no major faults located in or near to the Project area that would impact, or be impacted by, the proposed Project. and there is no oil and gas production in Washington State (Johnson et al. 2021).

Studies indicate that the chemical characteristics of marine sediments around the San Juan Islands are generally of high quality (Long et al. 2008; Partridge et al. 2014). The majority of samples studied contained background levels of trace metals, including copper, lead, zinc, cadmium, and mercury (Long et al. 2008; Partridge et al. 2014). Results from the study conducted by Partridge et al. (2014) indicate that the concentrations of chromium and certain polycyclic aromatic

hydrocarbons (PAHs) did not increase significantly over the study period from 2003 to 2012, and overall sediment quality remained high in 2012. No chemical concentrations in the samples exceeded Washington State thresholds. Concentrations of these chemicals in the substrate of the proposed Project area are currently unknown; however, they are expected to be similar in quality to the sediments around the San Juan Islands archipelago.

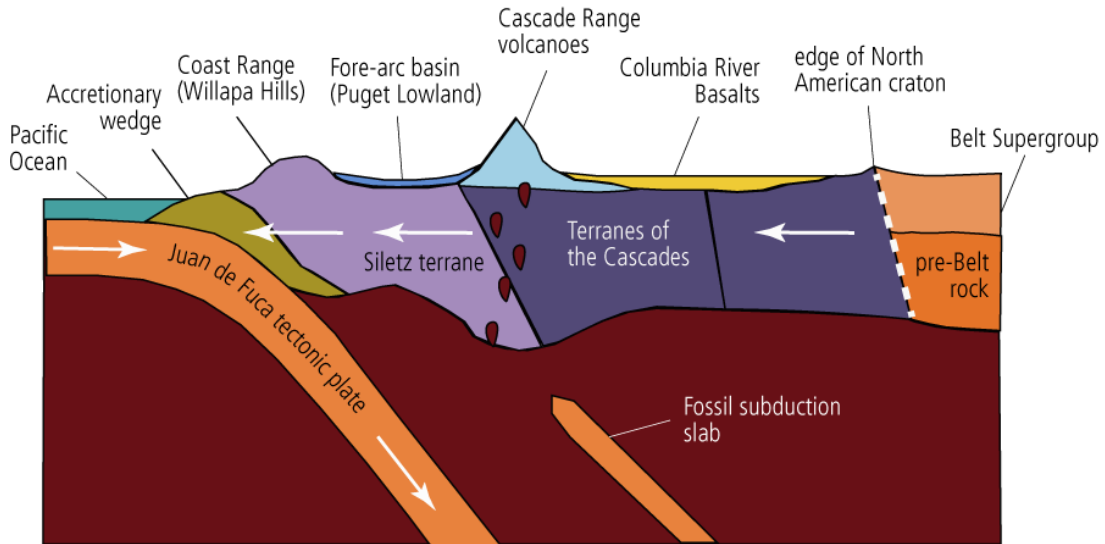


Figure 19. Puget Lowland Location in the Fore-arc Basin, Cascadia Subduction Zone
 Source: DNR 2024a

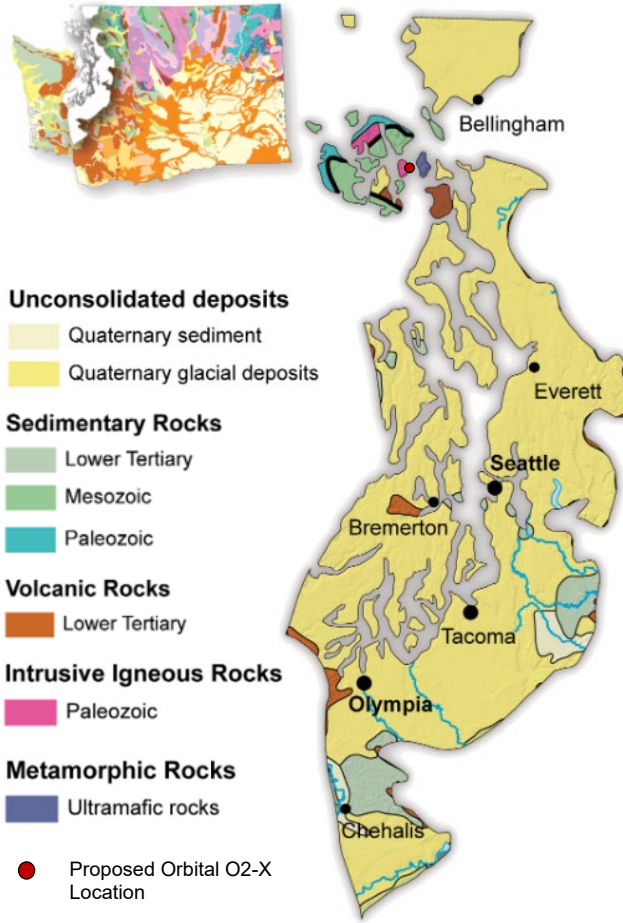


Figure 20. Rock Types in the Puget Lowland
Source: DNR 2024b

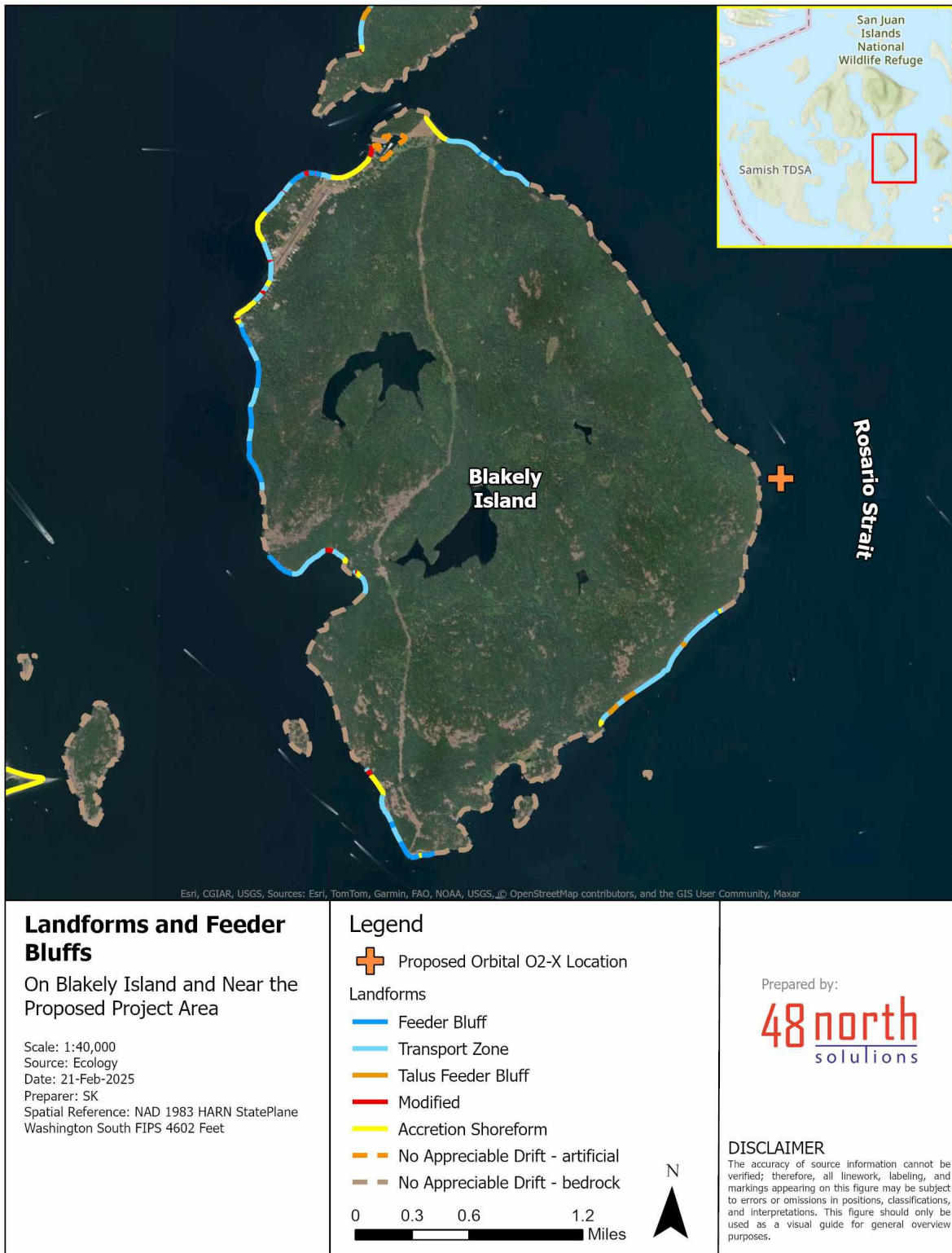


Figure 21. Landforms and Feeder Bluffs on Blakely Island

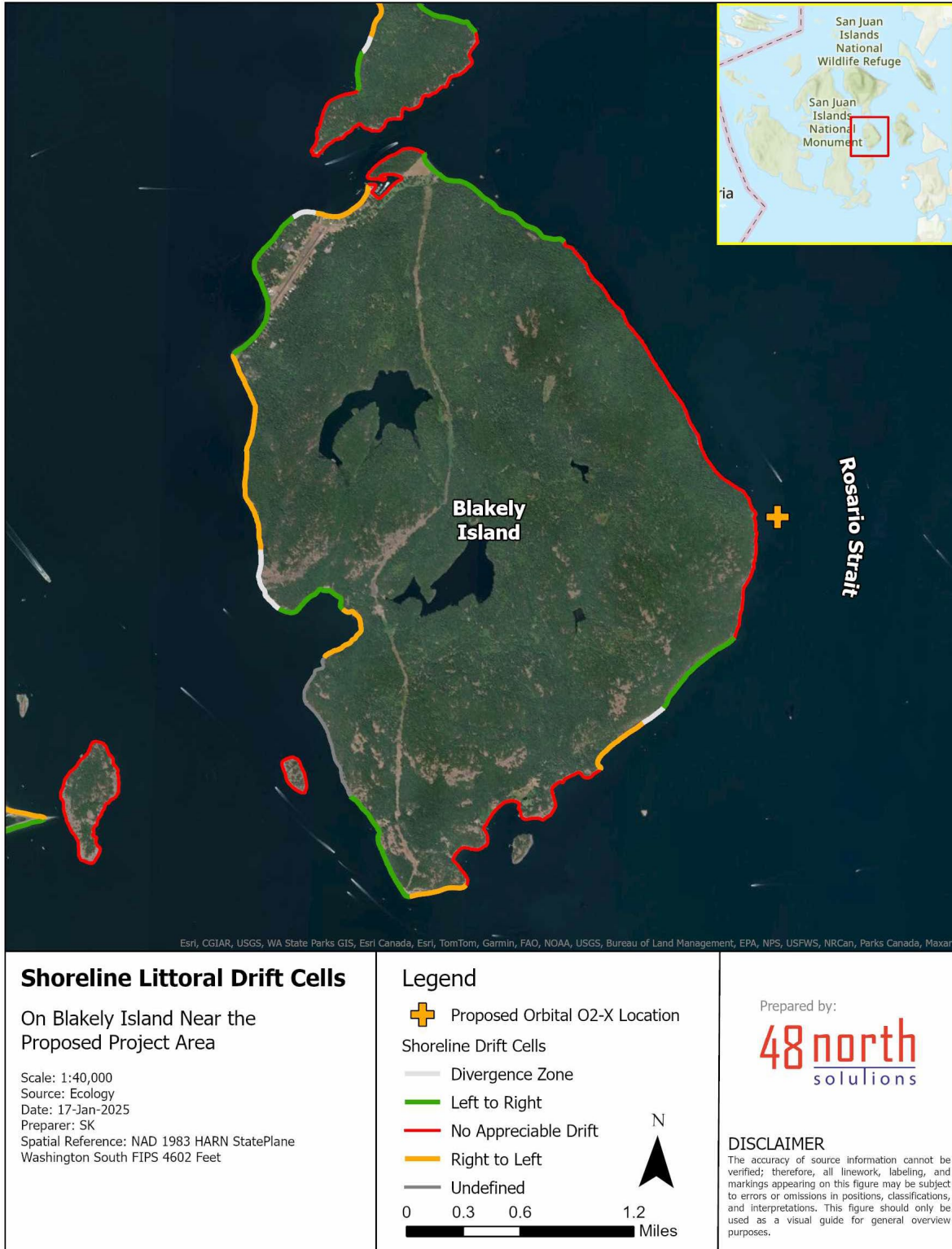


Figure 22. Shoreline Drift Cells on Blakely Island



Figure 23. Slope Stability and Topography on Blakely Island

3.1.1 Geologic Hazards

Due to its location on the Ring of Fire, a major area of the Pacific Ocean basin characterized by numerous volcanoes, Washington State can experience varying intensities of geologic hazards such as landslides, earthquakes, tsunamis, and volcanic activity that could have varying impacts on the proposed Project area.

3.1.1.1 Landslides

Washington State is one of the most landslide-prone states due to the mountainous regions of the Cascades, Olympics, and surrounding foothills, but the San Juan Islands themselves are at low risk for landslides (WEMD and Washington Military Department 2023). No evidence of submarine landslides was observed in the bathymetric data collected by Tetra Tech, Inc. in October 2024 in support of this Project (Appendix C1), but landslides are possible along the steep, sedimented edges of Blakely Island.

3.1.1.2 Faults and Earthquakes

There are hundreds of active faults in and within the vicinity of Washington State, the largest being the Cascadia Subduction Zone (CSZ) in the Pacific Ocean. Small earthquakes occur in Washington State daily, but large ones from the CSZ occur about once every 247 years (Figure 24; WEMD and Washington Military Department 2023). Since the 1870s, 27 moderate earthquakes of magnitude 5 or higher on the Richter scale have occurred (WEMD and Washington Military Department 2023). Active faults are more likely to cause earthquakes; while there are no active faults within the San Juan Islands, there are many surrounding them (WEMD and Washington Military Department 2023). The DNR rates the San Juan Islands with a medium level Shaking Hazard risk (DNR 2024c).

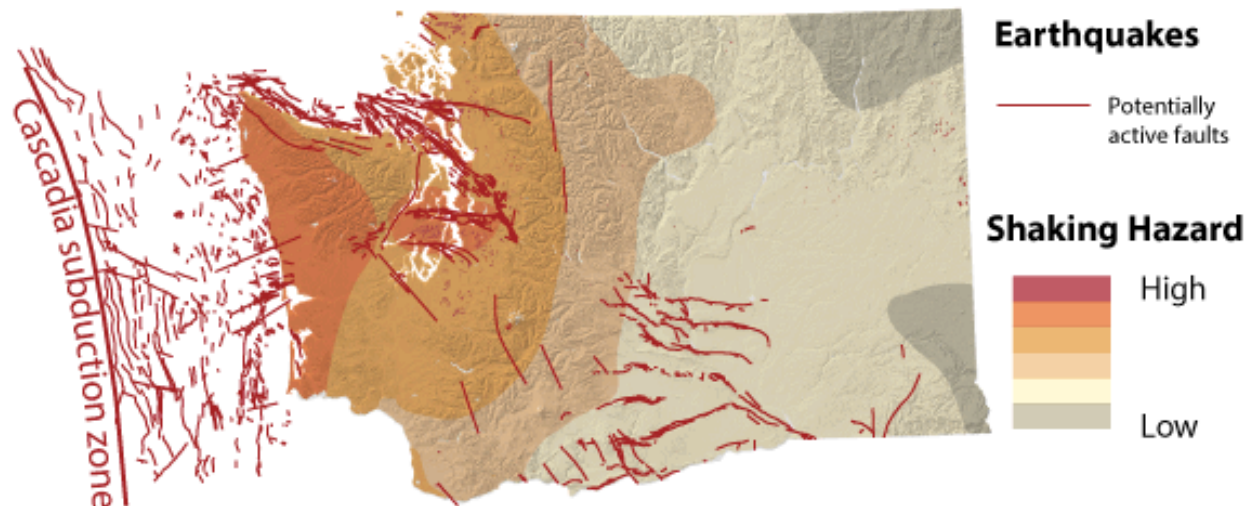


Figure 24. Earthquake Hazard Potential in Washington State

Source: DNR 2024c

In 2012 and 2013, DNR analyzed 20 earthquake scenarios in Washington State with a variety of intensities and epicenter locations (Washington Geological Survey 2017). Of those 20 scenarios, eight were projected to impact the San Juan Islands, including: (1) the Boulder Creek fault zone, (2) CSZ, (3) north CSZ, (4) Darrington-Devils Mountain fault zone, (5) Darrington-Devils Mountain fault zone west, (6) Lake Creek-Boundary Creek fault zone, (7) the Seattle fault, and (8) the south Whidbey Island fault scenarios (Washington Geological Survey 2017). The expected impacts of seismic activity include liquefaction, landslides, tsunamis, aftershocks, property damage, and the loss of lives (DNR 2013).

Figure 25 displays all known faults near the San Juan Islands, with black lines representing faults that have no evidence of being active within the Quaternary (Czajkowski and Bowman 2014). There are no active faults within the center of the San Juan Islands; however, there are active faults on the periphery of the Islands, including many faults that last ruptured during the Holocene (red), the latest Pleistocene (orange), during the mid to late Pleistocene (blue), during the Pleistocene (purple), and class B faults (green) (Czajkowski and Bowman 2014).

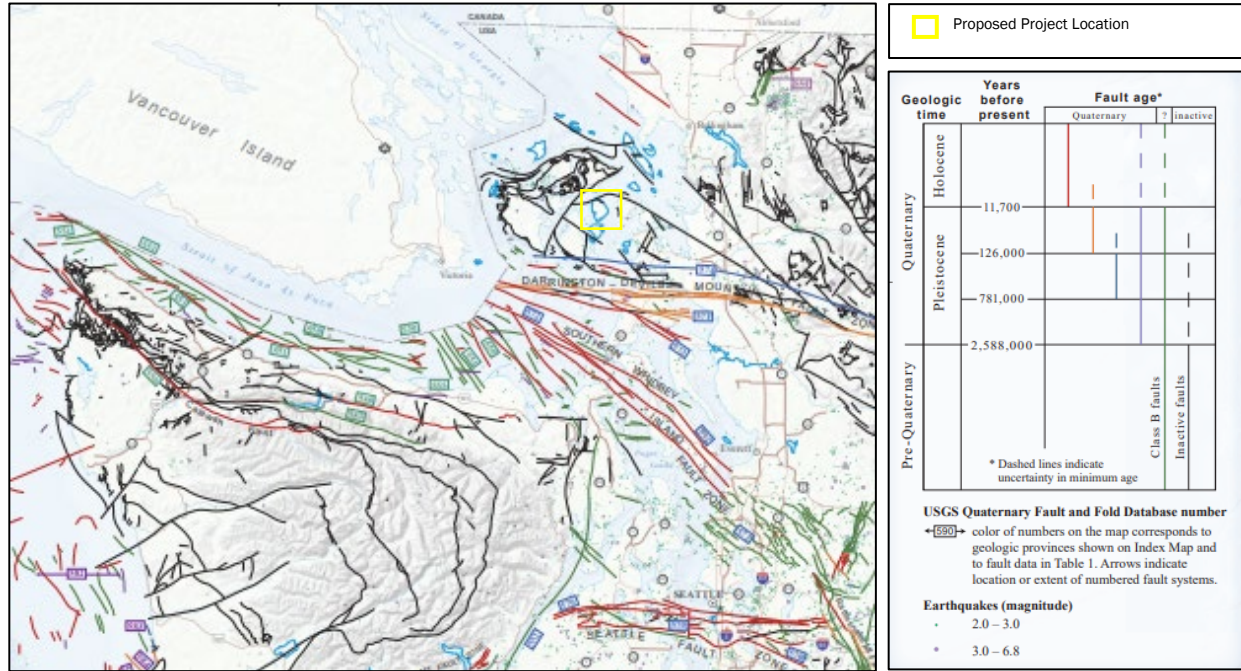


Figure 25. Faults and Earthquakes in Washington State
 Source: Czajkowski and Bowman 2014

3.1.1.3 Tsunamis

Due to the large amount of earthquake activity in Washington State and its proximity to the Pacific Ocean, tsunamis could occur in the proposed Project area. The CSZ earthquake and resulting tsunami is predicted to have a 10 to 14 percent chance of occurrence by 2050 (Peterson et al. 2002).

According to 2020 research by the NOAA Pacific Marine Environmental Laboratory, a modeled 9.0 magnitude earthquake on the CSZ would create a tsunami that would take more than 1.25 hours to reach the San Juan Islands (Arcas et al. 2020). The maximum amplitude of the modeled tsunami occurred at Eastsound on Orcas Island at 4.91 m (16.1 ft), and the maximum current speed does not occur until the third wave at 40 centimeters per second (cm/s) (1.3 ft/s) (Figure 26; Figure 27; Arcas et al. 2020). According to Figure 26 and Figure 27, the modeled amplitude near the proposed Project area is estimated to be between 3.2 and 4.2 m (10.5 to 13.8 ft), and the maximum wave current is estimated to be between 2.0 and 4.0 m/s (6.6 to 13.1 ft/s). Although this model gives estimates of what could be expected during a 9.0 magnitude earthquake on the CSZ, it did not include the impact of tides, sea level rise, or the possible locations of eddies that may form in the channels during a tsunami of this scale (Arcas et al. 2020).

Models of coastal inundation during the CSZ tsunami show that the most inundation to occur on Blakely Island would be on the northwest tip of the island (Arcas et al. 2020).

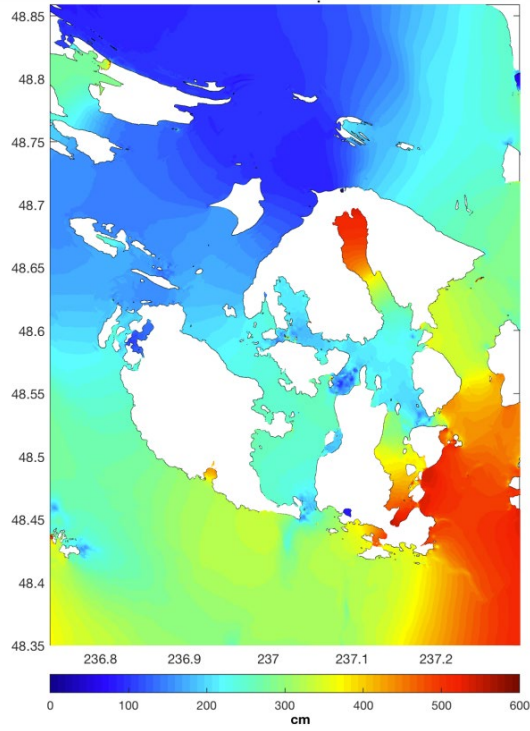


Figure 26. Maximum Modeled Tsunami Wave Amplitude Distribution for the San Juan Islands
Source: Arcas et al. 2020

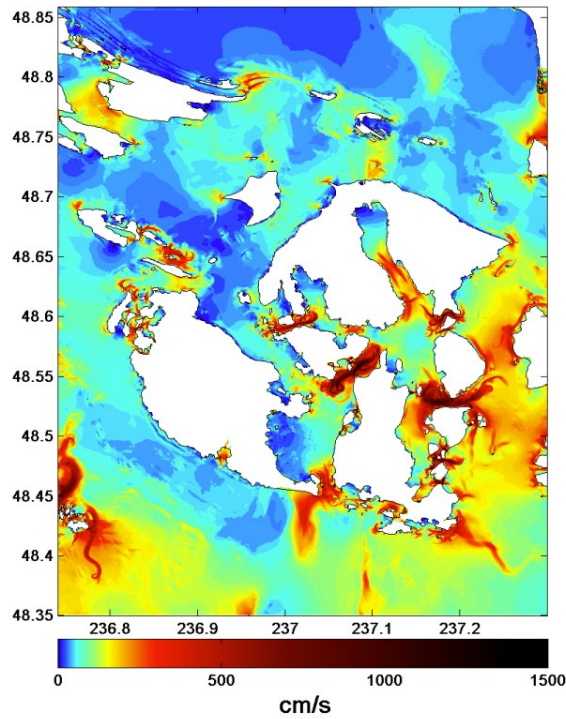


Figure 27. Maximum Modeled Tsunami Wave Current Distribution
Source: Arcas et al. 2020

3.1.1.4 Volcanic Activity

In Western Washington, there are five active volcanoes: Mount Adams, Mount Baker, Glacier Peak, Mount Rainier, and Mount St. Helens. They are associated with seismic activity that occurs in the region. Mount St. Helens was the most recent to erupt in 1980, destroying more than 200 homes and killing 57 people (WEMD and Washington Military Department 2023).

With the San Juan Islands being located offshore, the lahar flows (mudflows) from the nearest possible eruptions of Mount Baker or Glacier Peak would not reach them, and the main immediate impact of an eruption would likely be from suspended ash and earthquakes (**Figure 28**). However, the San Juan Islands receive most of their electricity from mainland Washington State via subsea cables, so if power sources or lines are damaged during an eruption event, the Islands could temporarily lose power access.

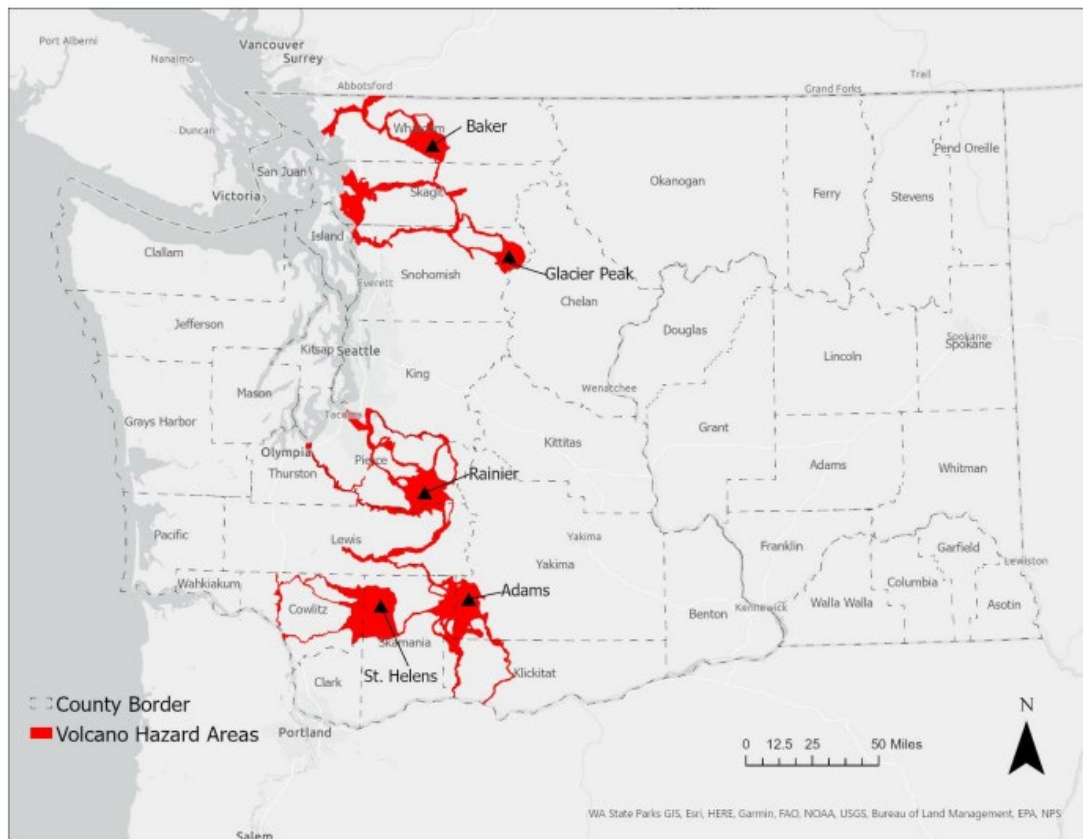


Figure 28. Volcanic Hazard Areas for Washington State including Lava, Rock Falls, and Lahar Zones
Source: WEMD and Washington Military Department 2023

3.2 Water Resources

Information in this section was obtained through a combination of desktop research and additional Project location-specific water resource data collected during a site survey and characterization study conducted by the APL-UW between October 2024 and January 2025 (103 days) (Appendix C2). To make a full-depth profile of water resources in the area, APL-UW deployed the following (water depth of 80 to 95 m [262 to 311 ft]): (1) a Nortek Signature 250 kilohertz (kHz) Acoustic Doppler Current Profiler (ADCP) attached to a fiberglass tripod (i.e., Sea Spider; SS) on the seafloor; (2) a Stablemoor mooring (STBM) with a pair of down-looking and up-looking Nortek Signature 500 kHz ADCPs; and (3) a surface buoy (SB) to support an additional down-looking ADCP



(Nortek Aquadopp 1 megahertz [MHz]) (Figure 29). All work was completed by APL-UW from the Research Vessel (R/V) Jack Robertson, which is owned and operated by APL-UW.

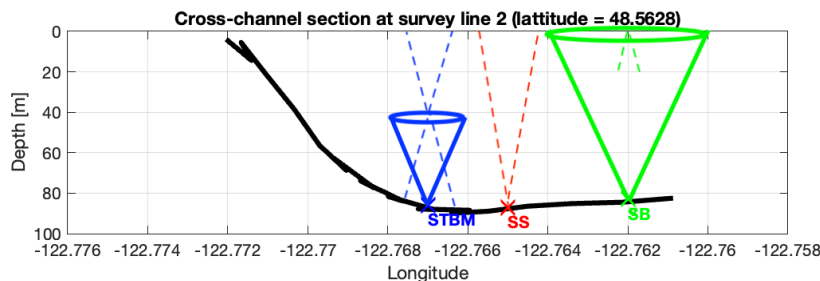


Figure 29. Side View of the Stationary Platforms Including Watch Circles and ADCP Beam Cones

3.2.1 Waves

Swells from the Pacific Coast must travel far to reach the shores throughout the Salish Sea. While sizable waves can enter the Salish Sea from the Strait of Juan de Fuca, wave energy is significantly diminished before reaching the San Juan Islands and surrounding channels.

Within the eastern portion of the Strait the Juan de Fuca, wave heights can be 1.5 m (4.9 ft), and up to 2.7 m (8.9 ft) (Thomson 1981). Rips occur off prominent points and are especially heavy at the approaches to Haro Strait and Rosario Strait (Thomson 1981). Research has also indicated that significant wave height (i.e., the mean wave height of the highest third of waves) in the region would not exceed approximately 2 m (6.6 ft) due to fetch limitations (i.e., length of water a given wind can blow without obstruction) (Gemrich and Pawlowicz 2020).

STBM surface wave data was collected by APL-UW (Appendix C2). Due to the limited fetch distances for wave generation and the minimal propagation of swell to the protected site, the waves at the Project area are small in height and short in period, compared to open ocean conditions. Figure 30 shows the time series of surface wave heights (H_s , in m) and peak wave periods (T_p , in seconds [s]). The wave activity in the Project area is irregular, since the waves are generated by local wind and weather patterns. From October 2024 to January 2025, the largest waves observed were $H_s = 1.8$ m (5.9 ft) on December 14, 2024, during a historic storm with significant regional impact (i.e., an extreme event). This maximum observed wave height (1.8 m [5.9 ft]) can be considered a global maximum for all months of the year, though the summer months are expected to have far less wave activity. The wave minimum in any month is nominally zero. Note that there is a known data gap due to file corruption from November 21-29, November 2024.

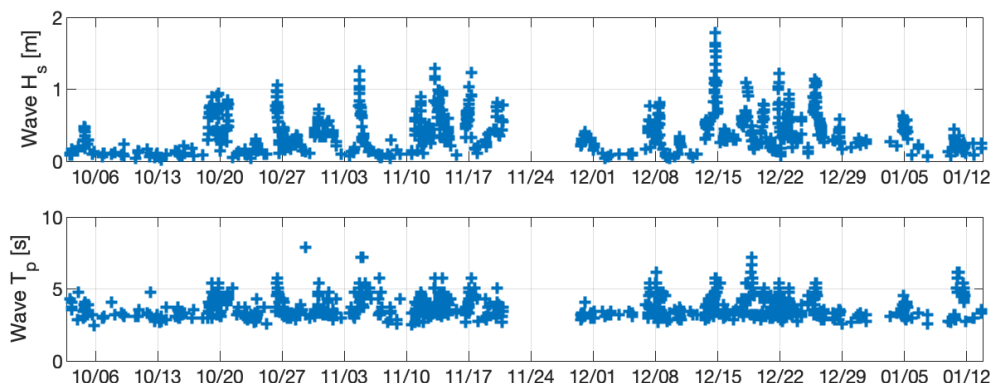


Figure 30. Time Series of Surface Wave Height (H_s , [m]) and Peak Period (T_p , [s]) Measured from STBM

Figure 31 shows a joint histogram of surface wave heights (H_s) and peak periods (T_p). The correlation of H_s , T_p is expected based on both fetch-limited wave evolution (Dobson et al. 1989; Thomson and Rogers 2014) and the steepness limitation of deep-water waves (Schwendeman et al. 2014; Schwendeman and Thomson 2015). The scarce observations of small H_s and longer T_p may be small amounts of swell energy refracting to the Project area, but the effect is minimal.

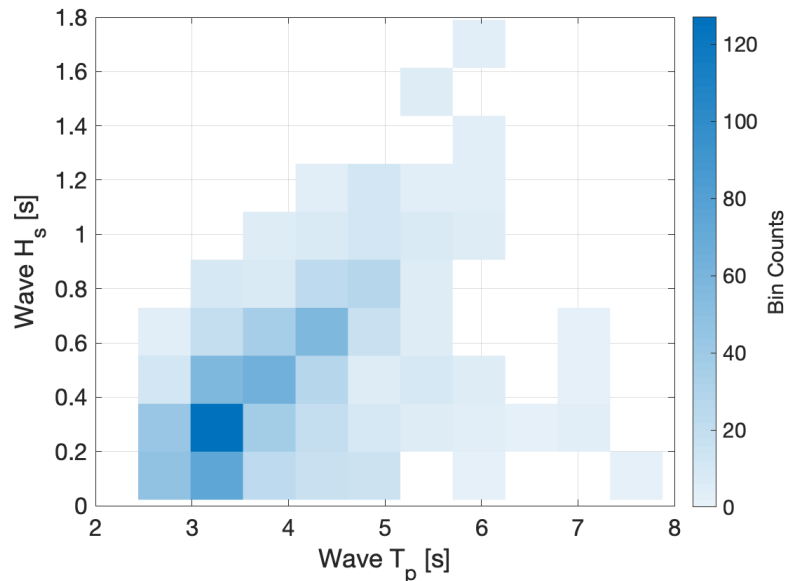


Figure 31. Joint Histogram of Surface Wave Heights (H_s) and Peak Periods (T_p) Measured from the STBM

APL-UW's STBM wave observations confirm previous wave climatology studies conducted in the region (Yang et al. 2019; Gemmrich and Pawlowicz 2020). These studies indicate that this resource characterization spans the portion of the annual cycle with the most storm activity (i.e., fall and winter), while the other seasons (i.e., spring and summer) are expected to have less wave activity. Given the short periods and rapid depth attenuation of such waves, the wave climate is unlikely to be a significant concern for the operation of a tidal turbine at this site. For the extreme condition of $H_s = 1.8$ m (5.9 ft), $T_p = 5.8$ s on December 14, 2024, the orbital velocities are approximately 1 m/s (3.3 ft/s) at the surface and approximately 0.12 m/s (0.39 ft/s) at hub depth (wavelength is 51 m [167 ft] for $T_p = 5.8$ s).

3.2.2 Tides and Currents

Tides in the Salish Sea are (predominantly) semi-diurnal and mixed diurnal patterns, that enter from the Pacific Ocean as progressive long waves and propagate through the San Juan Islands archipelago. This produces a complex current pattern in this region, with strong tidal currents in both Haro and Rosario Strait (Yang and Wang 2013; Cannon et al. 1978). Consequently, tides in the Salish Sea exhibit a strong spring-neap tidal cycle and diurnal inequality (Yang et al. 2021).

The tidal conditions of the proposed Project location in Rosario Strait were assessed to determine the optimal location for tidal energy within the Salish Sea. The following factors were considered:

- The magnitude of tidal current speed and any temporal and spatial variabilities (e.g., tidal asymmetries in flow direction and magnitude).
- Spring-neap tidal cycle.
- Eddy currents.
- Diurnal inequality.

Site characteristics were measured and modeled for Rosario Strait and used to determine tidal power density, kinetic energy flux, and generation potential for tidal channel cross section.

The maximum tidal current speed in Rosario Strait exceeds 2 m/s (6.6 ft/s); however, tidal current speed exceeds 1 m/s (3.3 ft/s) approximately 20 percent of the time (i.e., greater than 80 percent of the time, current speed is less than 1 m/s [3.3 ft/s]) (Yang et al. 2021). The average cross-sectional current speed in Rosario Strait is 0.9 m/s (2.9 ft/s; Yang et al. 2021), although it varies considerably both temporally and spatially through the channel. Tidal current magnitude in Rosario Strait exceeds 2.5 m/s (8.2 ft/s) during both peak flood and ebb, displaying stronger currents toward the western (deeper) side of the channel (Yang et al. 2021). During peak ebb, positive velocities occur on the eastern (shallower) side of the channel, indicating eddy currents are produced by the presence of Cypress Island across the channel (**Figure 32**; Yang et al. 2021). During spring and neap ebb, Rosario Strait has a maximum tidal energy at spring tide of 3.17 m/s (10.4 ft/s), and minimum tidal energy at neap tide of 1.80 m/s (5.9 ft/s) (**Figure 32**; Yang et al. 2021).

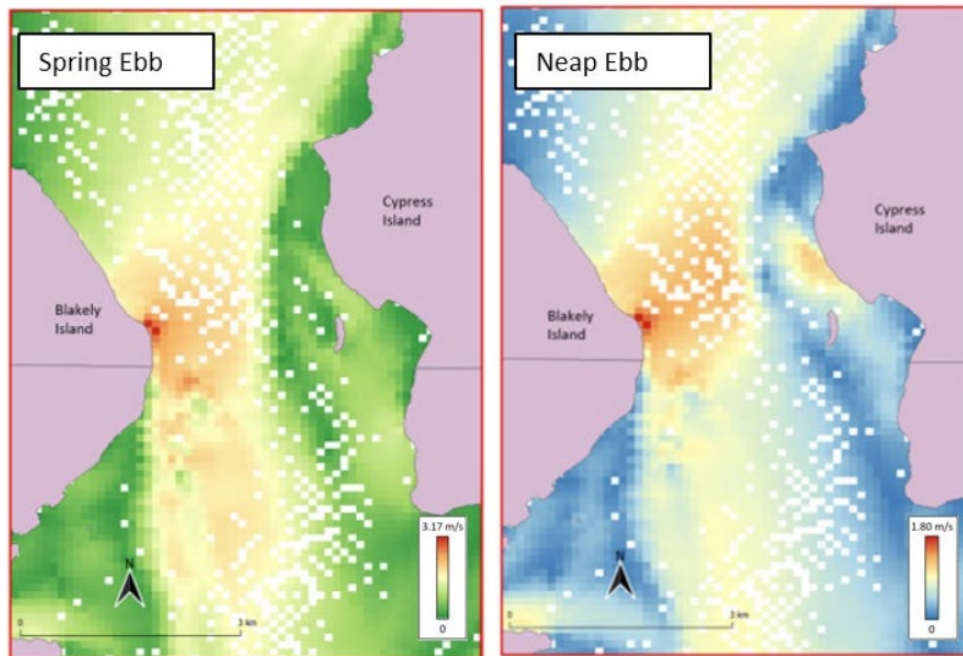


Figure 32. Tidal Current Velocity (m/s) Maps for Rosario Strait

Source: Yang et al. 2021

Yang et al. (2021) characterize a tidal energy hotspot as a tidal channel, or section of a channel, that has strong tidal currents exceeding a mean current speed criterion of 0.5 m/s (1.64 ft/s). Tidal power density (measured in watts per square meter [W/m^2]) is a function of both seawater density and current speed. Mean kinetic energy flux (measured in kilowatts [kW]) through a channel cross section is a function of the time-averaged tidal power density (W/m^2) and area (m^2) of the cross section (Yang et al. 2021).

Rosario Strait is an identified tidal energy hotspot with a mean kinetic energy flux of 72,833 kW (Yang et al. 2021). Rosario Strait has a maximum tidal power density slightly greater than 3 kW/m^2 near the western side of the channel, which was selected as the proposed Project location (**Figure 33**; Yang et al. 2021, Calandra et al. 2023). The mean tidal range in Rosario Strait south of Orcas Island is 1.5 m (4.94 ft) (NOAA 2024a).

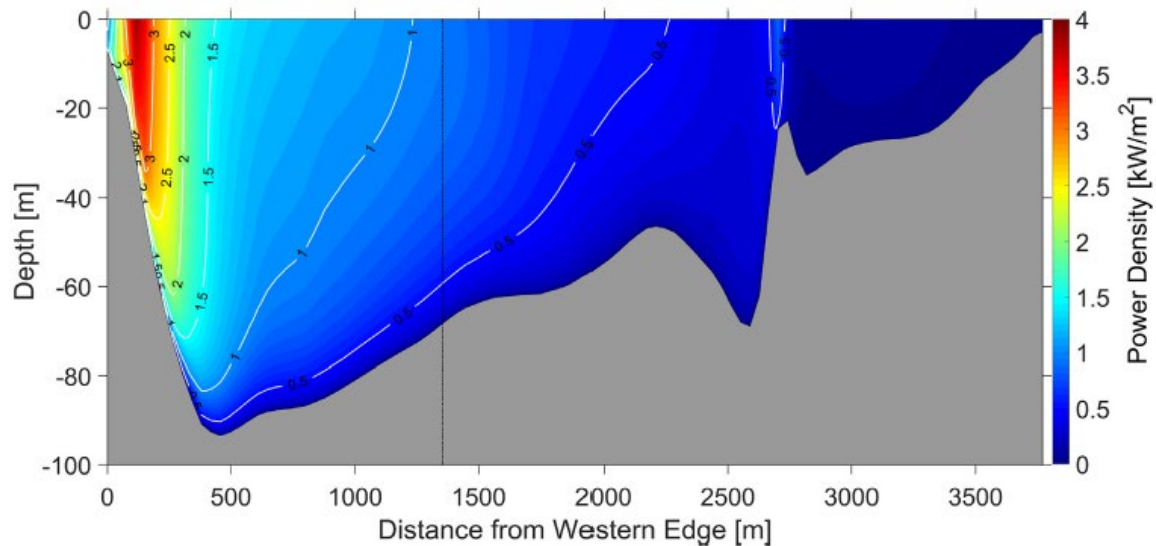


Figure 33. Power Density Profile for Rosario Strait

Source: Calandra et al. 2023

Project area-specific stationary measurements of tidal currents were collected by APL-UW from October 2, 2024 through January 13, 2025 (103 days). This duration was sufficient to determine at least 20 tidal constituents using classic tidal harmonic analysis and purely statistical description of tidal currents.

Regarding a monthly water velocity duration curve based on available flow data and the correlation of flow (in cfs) to velocity (ft/s) at in the Project area, tidal channels are not monitored for volumetric flow rates in the same manner that rivers are monitored. The flow in Rosario Strait (in m^3/s or cfs) can only be crudely estimated using a tidal prism analysis. There is a relationship between the volume flow rate of Rosario Strait and the current speed in the Project area, but it cannot be robustly determined from observations.

An alternative is presented that shows the relation between tidal stage (elevation) and current speed at turbine hub depth (U_{hub} ; ft/s) (**Figure 34**). As shown in the right panel of **Figure 34**, the current speeds are fastest (approximately 3 m/s [9.8 ft/s]) at the lowest tidal stage. The apparent “scatter” in the right panel of **Figure 34** is the phasing of tidal stage and tidal flow, which is not 1:1 depending on spring-neap cycles, diurnal inequalities, and basin geometry. While these patterns are shown for October 2024 through January 2025, these patterns and distributions are expected to be similar for any other 3-month window throughout the year.

Results show that the maximum tidal elevation range is 4 m (13 ft) in the Project area, and an average tidal elevation change of 2.1 m (6.9 ft) (Appendix C2). Regarding the monthly minimum, maximum, and mean for temporal current speed (in ft/s), as shown in the left panels of **Figure 34**, tidal flows in the Project area were determined to be highly periodic and without the strong seasonal variations of a river basin hydrograph. The monthly minimum temporal current speed is zero (m/s), given the lack of slack tides that occur each day, and the monthly maxima will only vary slightly based on lunar and solar perigee-apogee cycles. The strongest tides (3.2 m/s [10.6 ft/s]), will occur during full and new moons, and during the solstice and equinox.

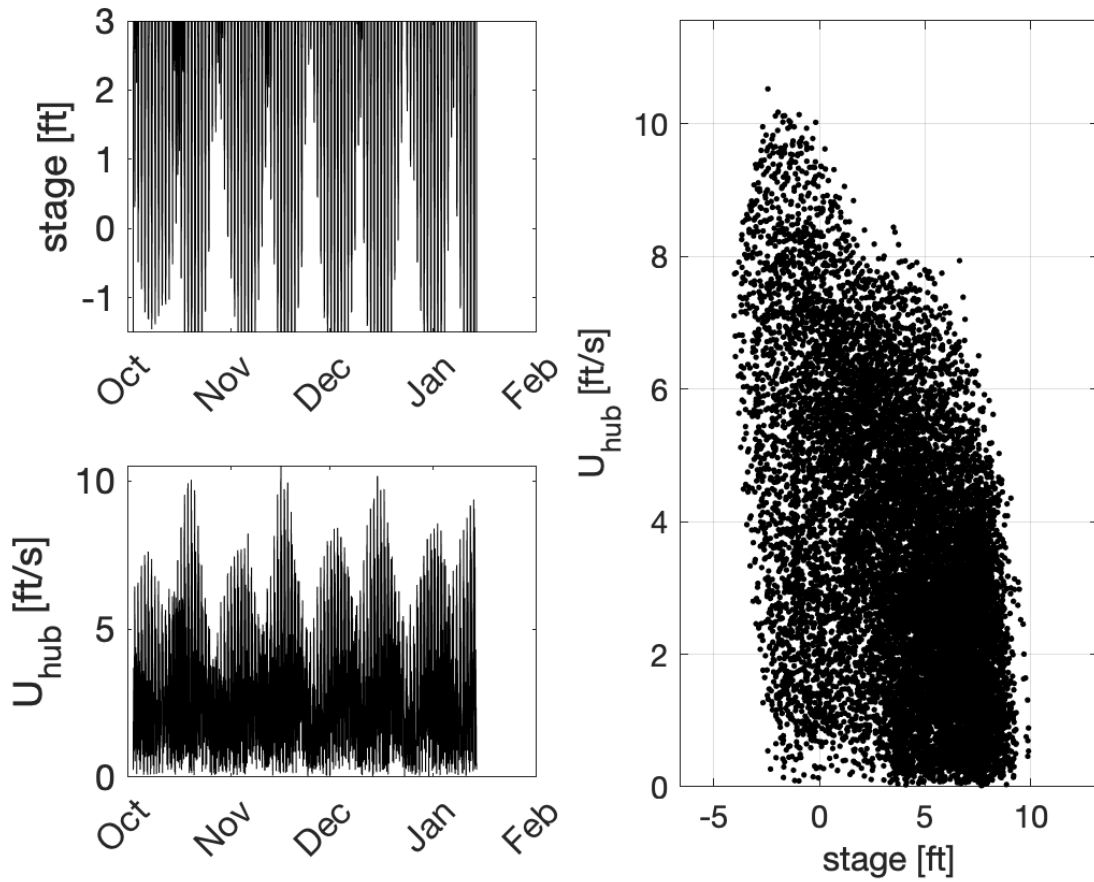


Figure 34. Time Series of Water Depth (Upper Left, [ft]) and Current Speed (Lower Left, U_{hub} [ft/s]), and Current Speeds Versus Tidal Stage (ft; Right)

Data from NOAA station 9449771 in Rosario Strait were also obtained to show changes in water surface levels between low and high tides for MHW, MHHW, MLW, and MLLW – shown in **Figure 35**, **Figure 36**, **Figure 37**, and **Figure 38**, respectively (NOAA 2024a).

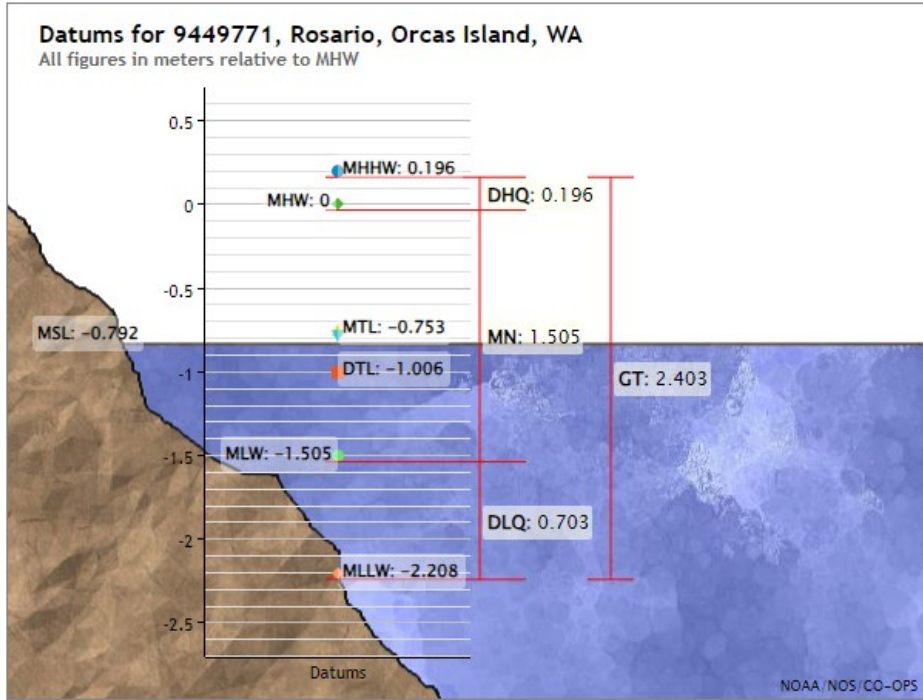


Figure 35. Water Surface Elevation Data in Rosario Strait Relative to MHW
Source: NOAA 2024a

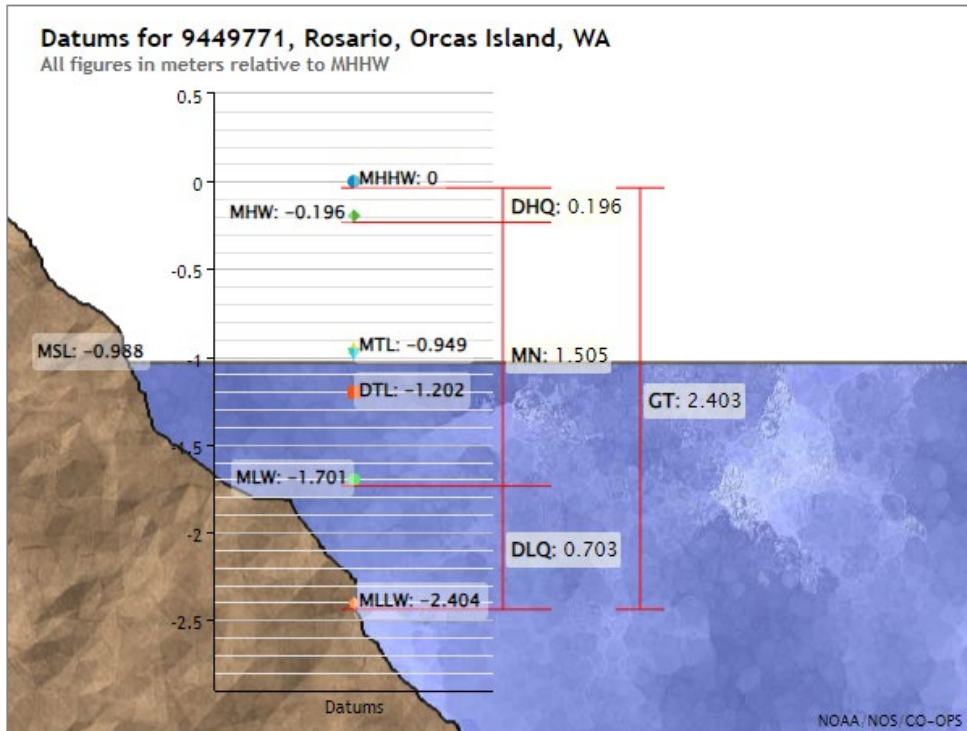


Figure 36. Water Surface Elevation Data in Rosario Strait Relative to MHHW
Source: NOAA 2024a

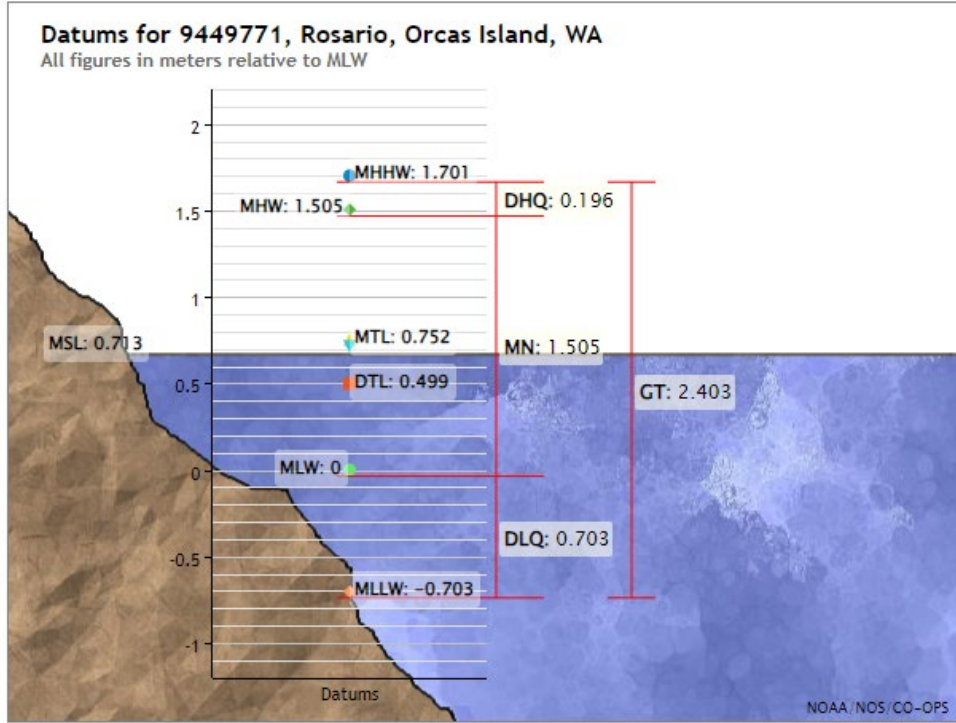


Figure 37. Water Surface Elevation Data in Rosario Strait Relative to MLW
Source: NOAA 2024a

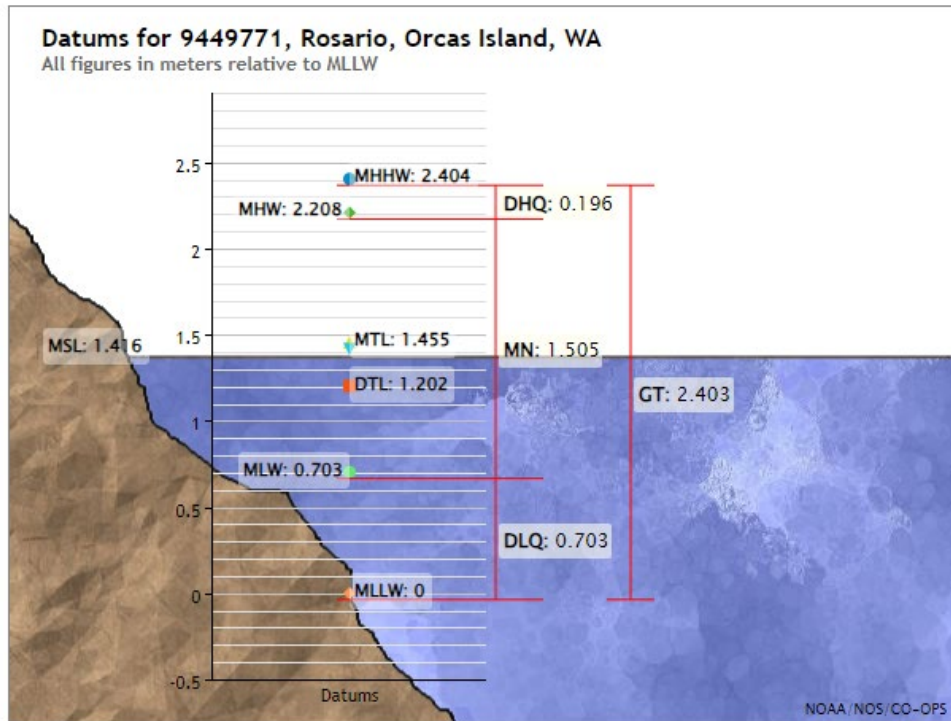


Figure 38. Water Surface Elevation Data in Rosario Strait Relative to MLLW
Source: NOAA 2024a



While tidal currents dominate the flow patterns in most coastal areas, the primary controls of physical oceanography between the Strait of Juan de Fuca, Strait of Georgia, and the San Juan Islands are estuarine circulation and wind-driven currents superimposed on tidal currents (Cannon et al. 1978). The San Juan Islands contain a complex series of channels and passageways, which result in complex circulation dominated by tidal forcing. The three most significant flow channels are Haro Strait, Rosario Strait, and Middle Passage.

Two-layer estuarine flow dominates the San Juan Island basin within the Salish Sea, driven by the outflow of freshwater at the surface from the Fraser River into the Strait of Georgia and an inflow of saline water at depth from the Pacific Ocean, forcing a reverse current in deep water (Kammerer et al. 2021; Masson 2006; Davenne and Masson 2001; Thomson 1994; LeBlond et al. 1983). Estuarine circulation in the San Juan Islands is seasonal, and river inflow can fluctuate from 1,000 cubic meters per second (m^3/s) (35,315 cubic feet per second [cfs]) in the winter to more than 10,000 m^3/s (353,147 cfs) in late spring (Thomson 1994). Additionally, wind forcing and coastal ocean effects from the Strait of Juan de Fuca vary seasonally and can alter circulation as well as intermediate and deep-water replacement. Dilution of the Strait of Georgia waters by Fraser River runoff, together with intense tidal mixing in Haro and Rosario Straits and inward movement of oceanic water along the Strait of Juan de Fuca, lead to water renewal within the deeper portions of the basin.

In Rosario Strait, the diurnal constituent is nearly as great as the mixed constituent, and the tidal current ellipses for each constituent can vary dramatically over short distances, resulting in opposite flow and strong tidal rips or convergence zones (Parker 1977; Kammerer et al. 2021). According to PNNL, the surface currents in Rosario Strait alternately flow north to south and south to north depending on the timing of the tidal cycle (PNNL 2020). In the Strait of Juan de Fuca, currents are essentially parallel to the axis of the channel. Near the surface, the residual current has a speed of 10 to 20 cm/s (3.9 to 7.9 inches per second [in./s]) toward the west, concentrated in the middle of the channel. In deep water, the residual current is stronger on the sides of the channel, flows toward the east, and has a typical speed of 10 cm/s (3.9 in./s) (Davenne and Masson 2001). Within the Strait of Georgia, residual circulation follows a similar path, but complex bathymetry and strong tidal currents influence residual currents.

Project area-specific SS data collected by APL-UW (Appendix C2) for horizontal water speed (m/s) and velocities (m/s) are shown as a time series between October 2, 2024 and January 13, 2025; 103 days) in **Figure 39** and **Figure 40**. Collected data recorded horizontal current speeds reaching up to 3.5 m/s (11.5 ft/s) in the project area (**Figure 39**). The data show a strong spring-neap cycle and diurnal inequality of the tides, with the strongest tides observed near the winter solstice, as expected. Additionally, the ebbs (toward the southeast) are slightly stronger than the floods (toward the northwest).

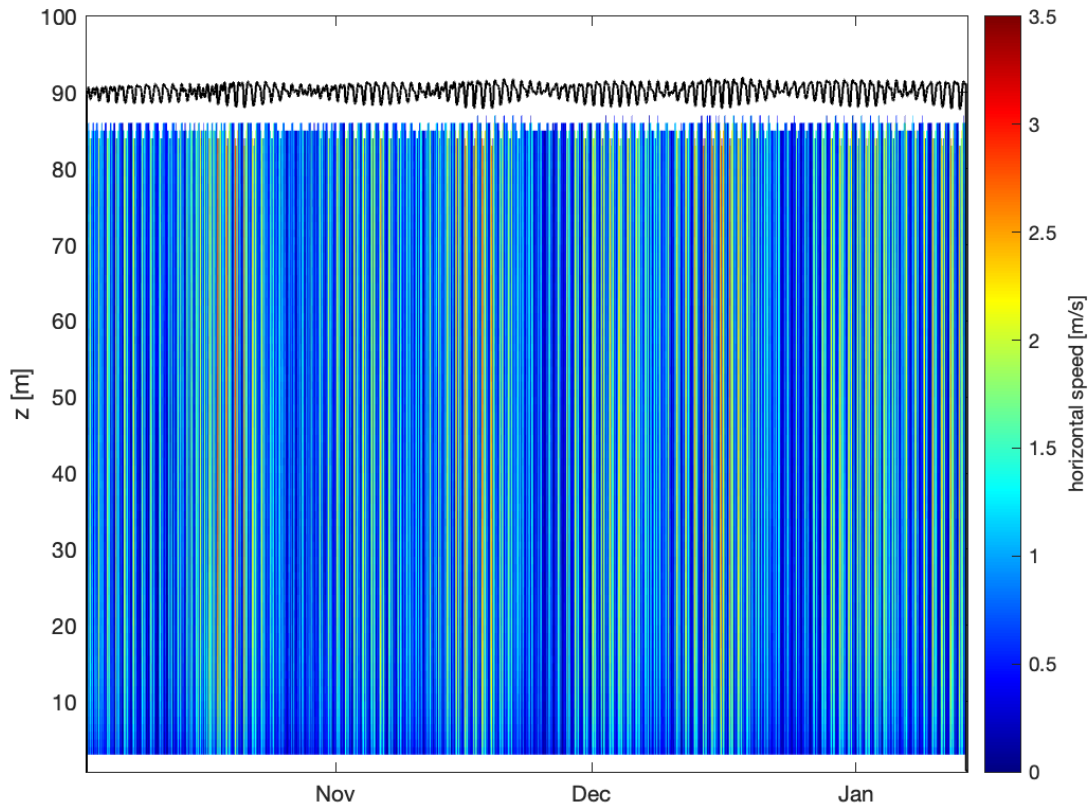


Figure 39. SS Profile of Horizontal Current Speed

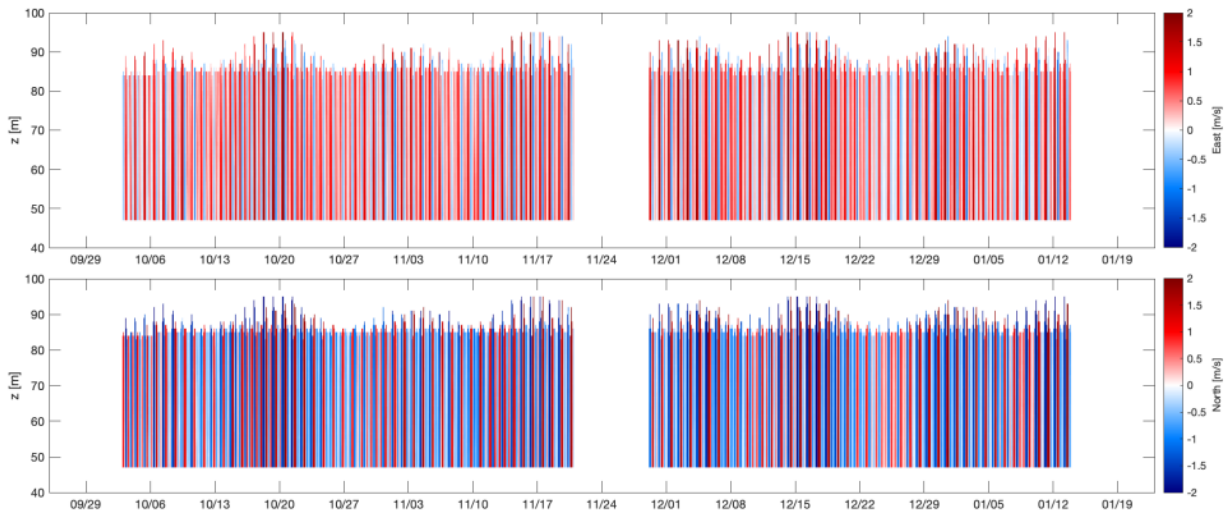


Figure 40. Components of currents measured by the Signature 500s on the Stablemoor

Winds can also have a direct influence on surface flow in the Strait of Juan de Fuca but are less predictable than tidal currents. Surface winds typically blow from high to low pressure in a direction dictated by topography and transfer momentum downward by vertical mixing (Thomson 1981). In Rosario Strait, winds move from south or southeast to north through the strait (Figure 41). In the winter, winds are greater than 15 m/s (29 knots) approximately 10 to 15 days per month, compared

to only 1 to 2 days per month in the summer (Thomson 1981). A maximum westerly sea breeze (exceeding 15 to 20 m/s [49 to 66 ft/s]) can result in surface flow on the order of 0.5 m/s (1.6 ft/s) (Cannon et al. 1978; Thomson et al. 2007; NOAA 2021).

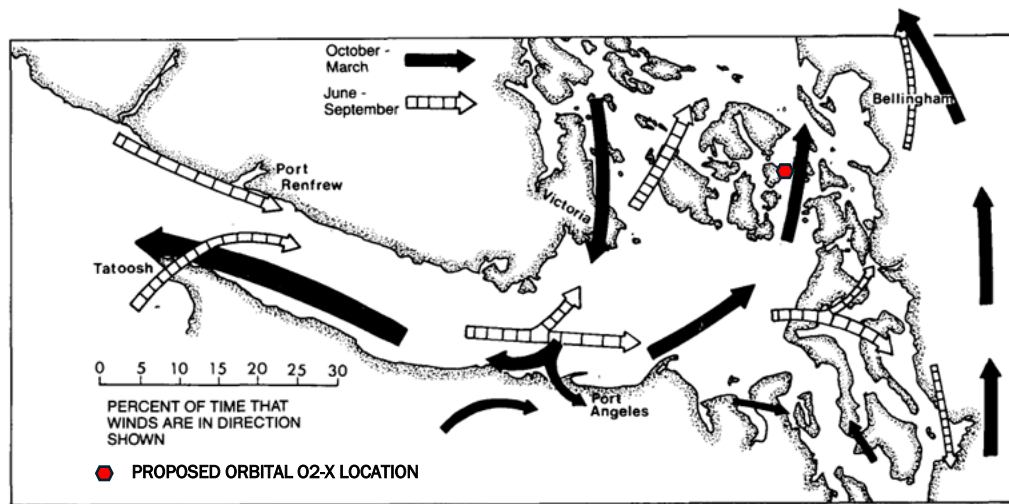


Figure 41. Surface Winds over the Strait of Juan de Fuca in Winter and Summer

Thick arrows correspond to wind speeds over 9 m/s, medium arrows for speeds between 4.5 and 9.0 m/s, and thin arrows for speeds less than 4.5 m/s. The red dot represents the location for the proposed Project.

Source: Thomson 1981

3.2.3 Bathymetry

The bathymetry of the Salish Sea is characterized by steep-sided slopes that transition to a gently sloping flat seafloor, with Rosario Strait having a mean water depth of 60 m (197 ft) (Donnelly et al. 1988; Yang et al. 2021).

In October 2024, Tetra Tech, Inc. performed bathymetric multibeam echosounder (MBE; using R2Sonic 2026 system) and sub-bottom profiler (SBP; using Innomar medium-100 system) geophysical surveys of the proposed Project area and a 200-m (656-ft) wide corridor centered on the new subsea cable route for the proposed Project (**Figure 42** and **Figure 44**; Appendix C1). Innomar SBP was used to investigate the shallow subsurface and assess sediment stratigraphy and depth to bedrock (when possible). Following the survey, the data were processed and additional quality control measures (e.g., using SonarWiz software) were performed to confirm accuracy and precision (Appendix C1).

Survey results indicate sediment movement (i.e., carried by waves) in the area and numerous boulders assumed to be carried by historical glaciers. These boulders range in size from approximately 1 m (3.3 ft) to nearly 15 m (49 ft), with the greatest concentration in Thatcher Pass at the south end of Blakely Island, which would be avoided by the new subsea cable route. Survey results also indicate that at the proposed Project Orbital O2-X location, there exists a uniform hard bottom such as glacial till, and strong currents are likely to prevent the accumulation of fine-grained sediments over the hard base layer of gravels and glacial deposits.

MBE survey data show that a distinct change in seabed texture occurs where the area wraps around the easternmost point on Blakely Island (**Figure 44**). To the north, the seabed is relatively smooth with some undulations that suggest underlying bathymetric features close to the surface. To the south, the overlying sediment layer has been scoured away, revealing a textured hard bottom that extends between and around the outcrops of Black Rock. Inshore of the Black Rock, the seabed again is smooth and sedimented. Collected SBP data indicate that while the northern part of the studied area appears sedimented, this sediment layer is likely very thin.

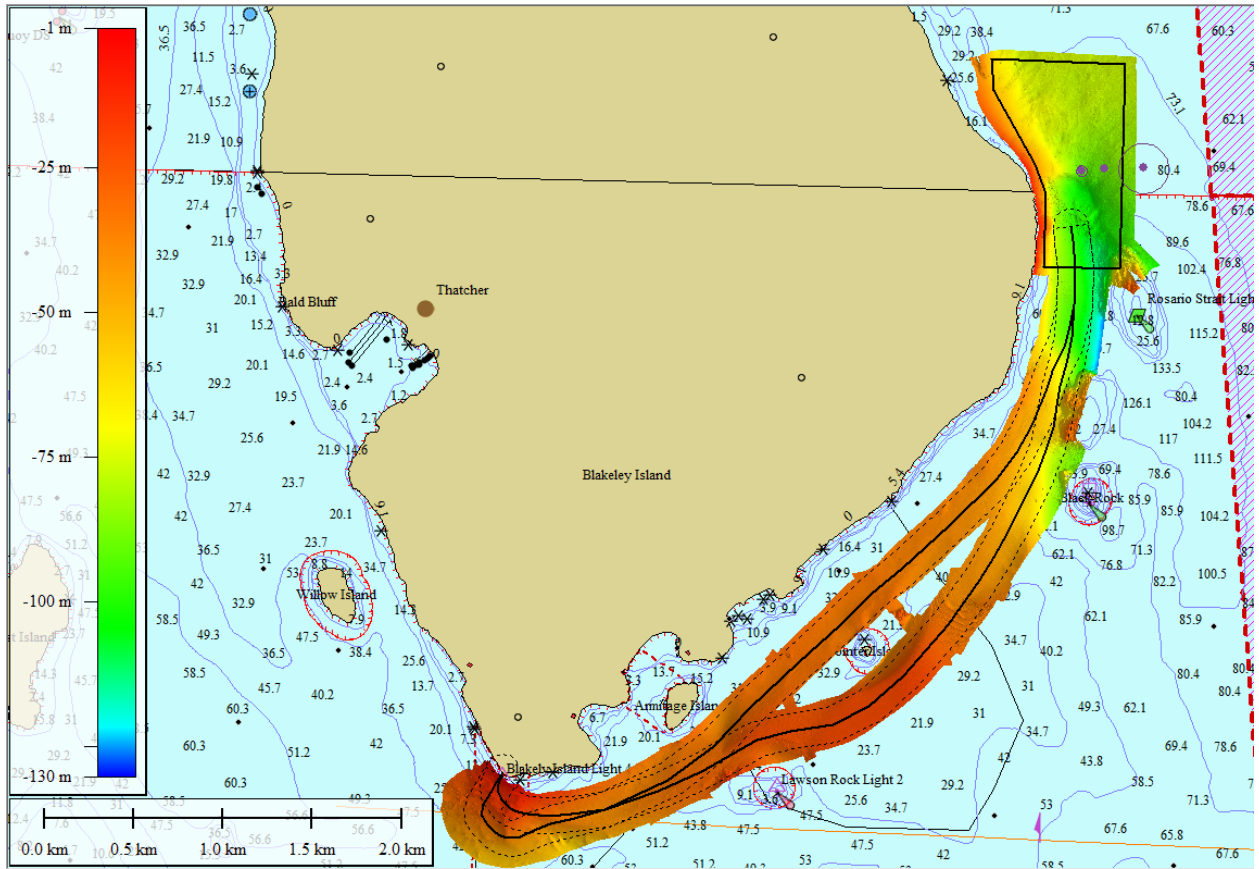


Figure 42. Bathymetric Rendering of the Survey Area off Blakley Island
Source: Appendix C1

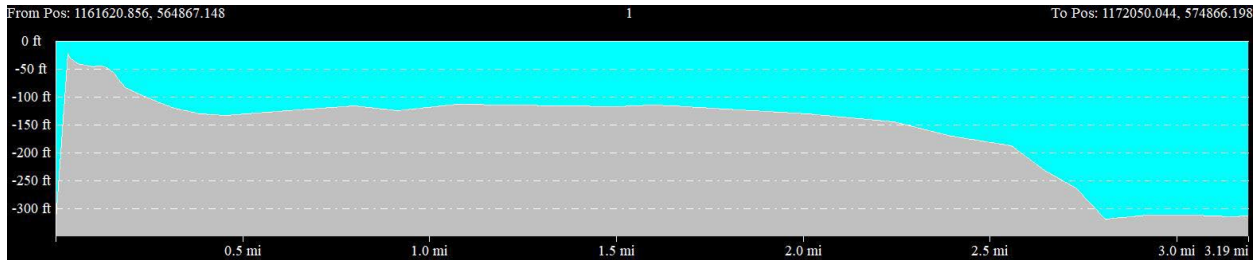


Figure 43. Bathymetric Profile Along Preferred Route (New Subsea Cable Landing to Turbine Area)
Source: Appendix C1

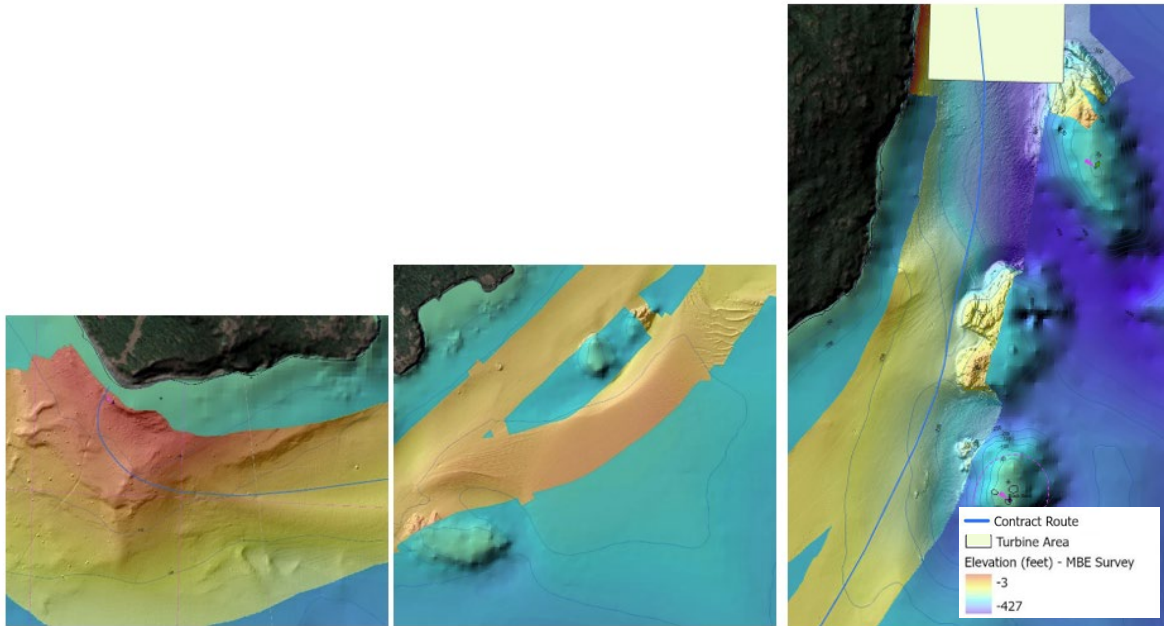


Figure 44. MBE Data Collected in and Along the Proposed Subsea Cable Route
Source: Tetra Tech, Inc. 2024

3.2.4 Water Quality

3.2.4.1 Water Temperature

Water temperature in the eastern portion of the Strait of Juan de Fuca and Rosario Strait is strongly influenced by oceanic conditions, river runoff, and tidal processes. It ranges between 7 degrees Celsius ($^{\circ}\text{C}$) and 11 $^{\circ}\text{C}$ (45 degrees Fahrenheit [$^{\circ}\text{F}$] and 52 $^{\circ}\text{F}$), although surface temperatures occasionally reach as high as 14 $^{\circ}\text{C}$ (57 $^{\circ}\text{F}$) (Ecology 1999; Thomson 1981).

For regional context, in early spring, colder water (6–7 $^{\circ}\text{C}$ [43–45 $^{\circ}\text{F}$]) from the Pacific Ocean penetrates up-channel along the bottom of the Strait of Juan de Fuca, even though surface temperatures remain slightly below 10 $^{\circ}\text{C}$ (50 $^{\circ}\text{F}$). There is no significant change in surface temperatures until the beginning of the spring in the Strait of Georgia, when large volumes of freshwater begin discharging from the Fraser River. Most of this water, which may warm to over 20 $^{\circ}\text{C}$ (68 $^{\circ}\text{F}$) in the near-surface layer of the Strait of Georgia, works its way southward through the three main channels (i.e., Haro Strait, Rosario Strait, and Middle Passage) into the eastern basin of the Strait of Juan de Fuca and is tidally mixed along the way. Even with tidal mixing, the total heat content of the water increases in the Strait of Juan de Fuca and raises average temperatures throughout its entire depth (Thomson 1981). By mid-August, patches of surface water in the Strait of Juan de Fuca can attain temperatures of 12–14 $^{\circ}\text{C}$ (54–57 $^{\circ}\text{F}$) from local solar heating, but bottom values continue to be cold. In the fall, surface water temperatures return to between 8 and 10 $^{\circ}\text{C}$ (46 and 50 $^{\circ}\text{F}$) in combination with enhanced wind activity and colder ocean water. In contrast, bottom water temperatures increase as warmer water slowly moves inland from the Pacific Ocean, causing temperatures to return to nearly uniform throughout the region (Thomson 1981).

In Rosario Strait, seasonal variability in temperature is generally insignificant because the waters are vertically well-mixed from intense tidal processes, so temperatures remain relatively uniform (Thomson 1981, 1994). APL-UW measured water temperature in the Project area, showing tidal variations in the early autumn, then well-mixed conditions (i.e., no variations) in the late fall and early winter (**Figure 45**). This is expected as autumn storms drive mixing of the full water column, coincident with a lack of solar radiation to provide surface warming.

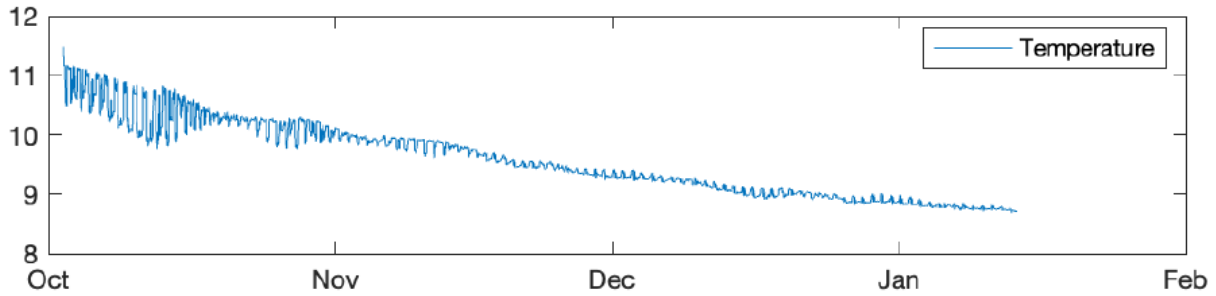


Figure 45. Temperature at the Project Area (October 2024 through January 2025)

3.2.4.2 Stratification

The San Juan Islands are known to have stratification and estuarine circulations in addition to strong tidal flows (MacCready and Geyer 2010), with stratification monitored at repeat stations throughout the region by Ecology. Typical values are a few parts per thousand (PPT) salinity change and a few degrees °C change over 50 to 200 m (164 to 656 ft) depth. The associated estuarine conditions are weak, relative to the tidal currents, and are most prominent during neap tidal cycles (Deppe et al. 2017). Thus, seasonal variations in stratification in the Project area are not expected to have a significant effect on the currents or annual energy production estimates. **Figure 46** shows APL-UW collected data from a conductivity, temperature, depth (CTD) sensor mounted on the STBM, which are typical variations for a tidal channel in this region. The clusters, or stripes, in **Figure 46** are mixing lines along which water masses are evolving while advecting through the region.

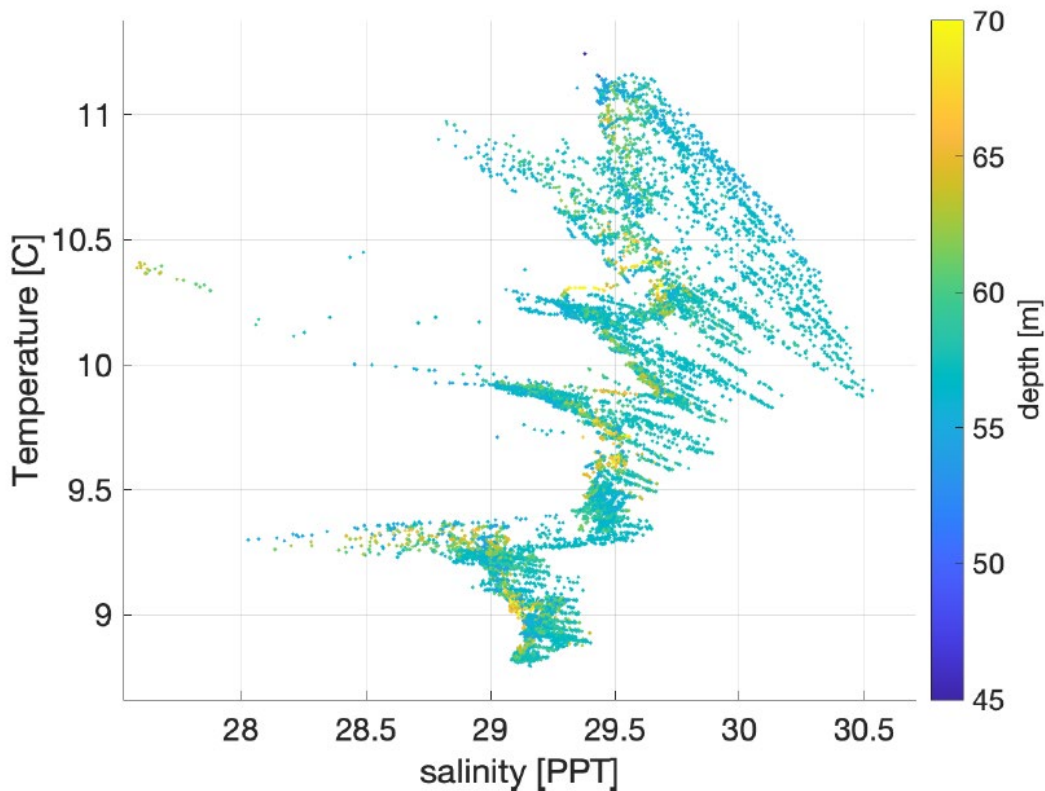


Figure 46. Temperature Versus Salinity Measured on APL-UW’s STBM



3.2.4.3 Dissolved Oxygen

Ecology's Water Quality Assessment of Washington was approved by the EPA in 2016, with standards that are intended to protect all indigenous fish and non-fish aquatic species in waters of the state (Ecology 2022). According to that assessment, the dissolved oxygen (DO) numeric criteria applied to the waters of the Project area indicate an 'extraordinary' DO standard (7 milligrams/liter [mg/L] (Ahmed et al. 2019). A DO criteria (one-day minimum) of 7.0 mg/L indicates "extraordinary quality salmonid and other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing and spawning" (WAC 173-201A-210(1)(d)).

3.3 Climate and Weather

3.3.1 Geography and Climate

The State of Washington is known for its wide range of terrain and climates, varying regional weather patterns, and rich ecosystem biodiversity. Key regional features contribute to its diverse climate and moderate weather patterns, including the Pacific Ocean, Olympic Mountains, Cascade Mountain Range, and the large estuary of the Salish Sea. The Cascade Mountain Range divides the state vertically down the middle, creating a coastal climate in Western Washington influenced by the Pacific Ocean and Salish Sea, while Eastern Washington experiences a rain shadow effect causing a continental climate. Elevations in Washington State range from sea level to 4,392 m (14,410 ft) at the top of Mount Rainier where glaciers are situated and five major rivers spawn (NPS 2024). The proximity of Washington State to large bodies of water provides a moderating effect on the climate and on regular weather patterns (Overland and Walter 1983).

Topographical features both deter and channel pressure systems and airflow in a manner that contributes to the moderate climate and weather patterns of the region. The mountain ranges in Washington State impact airflow and the migration of pressure systems in the state. The Cascades, Olympics, and the Canadian Rocky Mountains protect the Salish Sea from cold air masses traveling south across Canada toward Washington State (Overland and Walter 1983). Additionally, Willapa Hills, the Olympic Mountains, and the Vancouver Island Mountain Ranges shelter Washington State from intense winter storms (Overland and Walter 1983). The Strait of Juan de Fuca, Strait of Georgia, and Chehalis River Valley provide low-elevation passages for maritime air to funnel into inland areas and deter surface winds (Overland and Walter 1983). The proposed Project area is within Rosario Strait in the Salish Sea where weather systems are channeled over and between the steep cliffs of the San Juan Islands.

3.3.2 Weather

Surrounded by nearby mountain ranges and the channels of the Salish Sea, the San Juan Islands are located inside of a rain shadow, which means they receive significantly less rainfall than the rest of Western Washington (**Figure 47**; NPS 2022). When warm winds off the Pacific Ocean hit the Olympic Mountains and Vancouver Island, the air cools as it rises up the slopes and releases its moisture as precipitation. By the time the air masses pass over the mountain ranges, they are much drier. This results in the San Juan Islands having an annual rainfall per year that tends to be less than 76.2 cm (30 in.), while the Olympic Mountains receive approximately five times as much precipitation at 381 cm (150 in.) per year (NPS 2022).

From October to April, about 70 percent of annual precipitation falls on the San Juan Islands (NPS 2022). In the summertime, winds shift to westerly-northwesterly airflows and influence a dry period from June to August. The San Juan Islands also have a greater number of sunny days than other portions of Western Washington, with an annual average of about 247 sunny days (NPS 2022; San Juan Island Visitors Bureau 2024).

Daily temperatures in the San Juan Islands tend to be moderate in the summers and winters. The mean annual temperature range from 1991 to 2020 was 6.7°C to 14.1°C (44°F to 57°F). Winter

temperatures tend to stay above freezing, although occasionally they may drop below freezing and bring about a hard frost (NPS 2022).

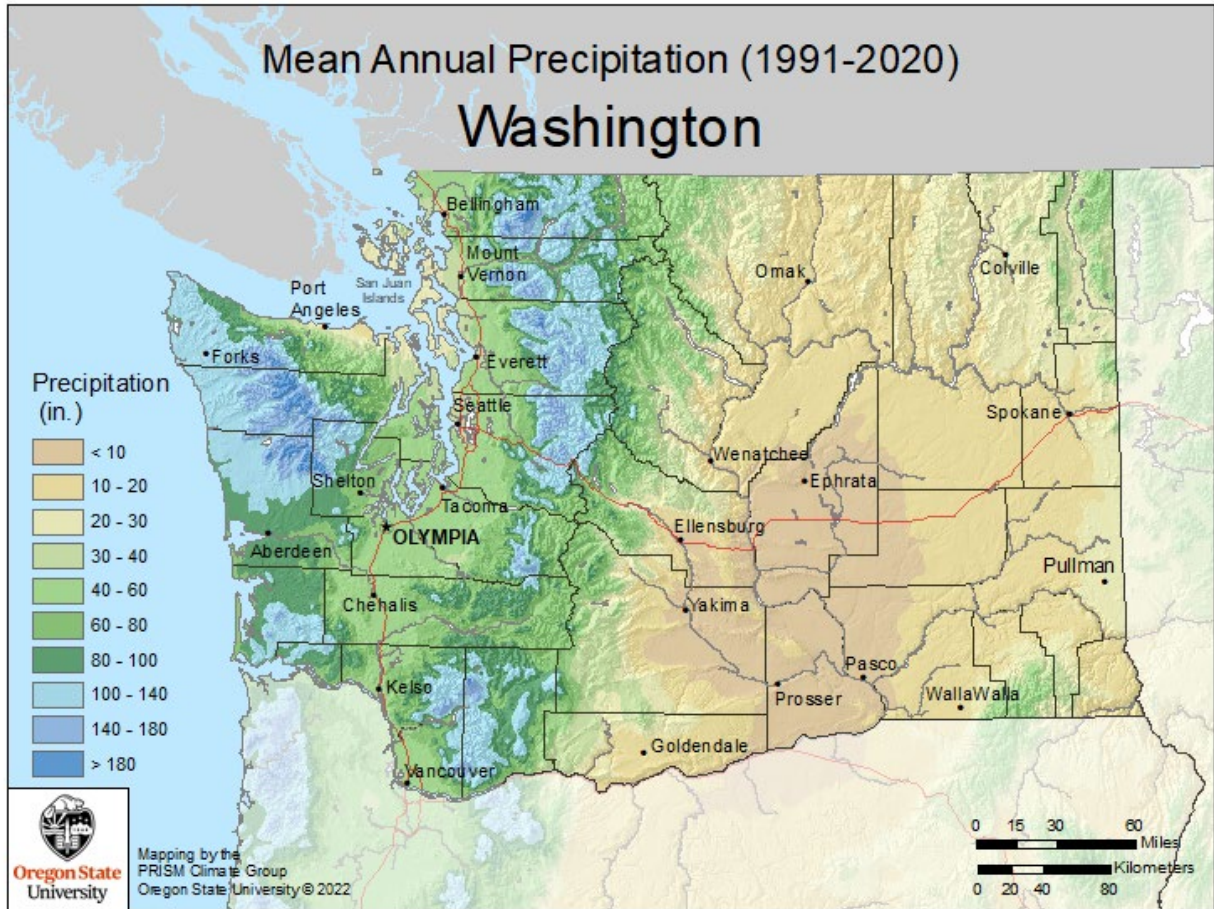


Figure 47. Mean Annual Precipitation in Washington from 1991 – 2020
 Source: PRISM Climate Group 2022

3.4 Fish and Aquatic Resources

The fish and aquatic resources described include the federally listed fish and (proposed) echinoderm species that may occur within the project area, as well as important habitats such as designated critical habitat, EFH, and Habitats of Particular Concern (HAPC) for spawning, rearing, feeding, and refugia. The existing underwater acoustic environments, including estimated decibel levels, are also described. APL-UW also took opportunistic measurements for tagged fish using a Vemco receiver on the SS tripod, and did not detect any tagged fish from October 2024 through January 2025.

3.4.1 Federally Listed Aquatic Species

Federally ESA-listed fish species that may occur within the project area include Puget Sound-Georgia Basin distinct population segment (DPS) bocaccio (*Sebastes paucispinis*) and yelloweye rockfish (*Sebastes ruberrimus*), Puget Sound evolutionarily significant unit (ESU) Chinook salmon (*Oncorhynchus tshawytscha*), Puget Sound DPS steelhead (*O. mykiss*), Southern DPS eulachon (*Thaleichthys pacificus*), Southern DPS green sturgeon (*Acipenser medirostris*), and Coterminous U.S. Population (Coastal Recovery Unit) bull trout (*Salvelinus confluentus*). Additionally, the proposed threatened sunflower sea star (*Pycnopodia helianthoides*) may also occur within the project area.



3.4.1.1 Fish Species

Bocaccio, Puget Sound-Georgia Basin DPS

NMFS listed the Puget Sound-Georgia Basin DPS of bocaccio (*Sebastes paucispinis*) as endangered on April 28, 2010, effective July 27, 2010 (75 Federal Register [FR] 22276), re-affirmed and effective March 24, 2017 (82 FR 7711). The Puget Sound-Georgia Basin DPS of bocaccio includes fish residing within the Puget Sound-Georgia Basin to the western boundary of the Strait of Juan de Fuca; northern boundary of the Strait of Georgia; along the southern contours of Quadra Island, Maurelle Island, and Sonora Island; and all of Bute Inlet.

Bocaccio are large rockfish that live along the Pacific coast. They have long, flattened bodies and very large mouths. They can reach up to 1 m (3 ft) in length and have a distinctive long jaw extending to at least their eye socket. Their appearance varies among individuals, ranging in color from olive to burnt orange or brown. They are suspected to live up to 54 years (Drake et al. 2010). Breeding occurs in the fall, generally between August and November, with embryonic development taking 1 month. In Washington State, female bocaccio release larvae in January through April, peaking in February (Drake et al. 2010). Bocaccio larvae are planktivores that feed on larval krill, diatoms, and dinoflagellates (Drake et al. 2010). Pelagic juveniles are opportunistic feeders, consuming fish larvae, copepods, krill, and other prey, while larger juveniles and adults are primarily piscivores, eating other rockfishes, hake, sablefish, anchovies, lanternfishes, and squid (Love et al. 2002; Drake et al. 2010).

Larvae are found throughout the water column, and the highest densities of pelagic juveniles tend to be found close to the surface in areas with floating kelp mats and submerged kelp habitat (Love et al. 2002; 74 FR 18516). Most bocaccio remain pelagic for 3.5–5.5 months prior to settling in shallow, intertidal, nearshore waters in rocky, cobble, and sand substrates with or without kelp (Love et al. 2002; 74 FR 18516). Several weeks after settlement, bocaccio move to deeper waters in the range of 18–30 m (60–100 ft) and are found on rocky reefs (Carr 1983; Feder et al. 1974; Johnson 2006; Love and Yoklavich 2008), sandy substrates, kelp forest habitat, and artificial structures (Love et al. 2002; 74 FR 18516). Adults inhabit deeper waters as they increase in size, ranging from 12–478 m (40–1,570 ft) in depth, but are most common at depths of 50–250 m (164–820 ft) (Feder et al. 1974; Love et al. 2002). Adults usually exhibit strong site fidelity to rocky bottoms and outcrops but will occasionally wander from hard substrata into mudflats (74 FR 18516).

Bocaccio range from Punta Blanca, Baja California, to the Gulf of Alaska, but are most common from Oregon to northern Baja California (Love et al. 2002). Their occurrence within the Georgia Basin is limited to certain areas. Their relationship between habitat preference and distribution within the Georgia Basin is not fully understood, with available information indicating bocaccio are frequently found in areas lacking hard substrate, potentially due to their pelagic behavior or prey availability (74 FR 18516). Based on surveys of the recreational fishery, bocaccio in Washington State's inland waters are rare north of Puget Sound and are mostly found south of the Tacoma Narrows (Drake et al. 2010). Analysis of Rockfish Hot Spot Areas (RHAs) has shown that bocaccio hot spots occur in Puget Sound south of Whidbey and Camano Islands, and just east of Kingston, Washington on the Kitsap Peninsula (NRC 2016). There are no bocaccio RHAs in or around the San Juan Islands (NRC 2016); however, since the project area overlaps with their designated critical habitat (79 FR 68041), there is the potential for bocaccio to occur within the project area.

The primary factors responsible for the decline of the Puget Sound-Georgia Basin DPS of bocaccio are degradation of rocky habitat, loss of eelgrass (*Zostera marina*) and kelp, introduction of non-native species that modify habitat, and degradation of water quality.

Critical Habitat

On November 13, 2014, NMFS designated critical habitat for bocaccio, effective February 11, 2015 (79 FR 68041). The proposed Project area overlaps with marine nearshore and deepwater



designated critical habitat for Puget Sound-Georgia Basin DPS bocaccio. NMFS does not currently have sufficient information regarding the habitat requirements of larval bocaccio to determine which features are essential for conservation; thus, they do not identify critical habitat specifically for this life stage.

The essential physical or biological features (PBFs) of deepwater sites or benthic habitats (i.e., sites deeper than 30 m [98 ft]) are areas of complex bathymetry consisting of rocky and/or highly rough habitat. These features support growth, survival, reproduction, and feeding opportunities by providing the structure for rockfish to avoid predation, seek food, and persist for decades. PBFs specific to the conservation of the Puget Sound-Georgia Basin DPS include sites and habitat components that support the adult life stage, including:

- Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities.
- Water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities.
- The type and amount of structure and rugosity that support feeding opportunities and predator avoidance.

Settlement habitats for juveniles are located in the nearshore (i.e., the area of extreme high tide to a depth of 30 m [98 ft]) with substrates such as sand, rock, and/or cobble compositions that also support kelp (families Chordaceae, Alariaceae, Lessoniaceae, Costariaceae, and Laminariceae). These areas are essential for conservation because these features enable forage opportunities and refuge from predators and enable behavioral and physiological changes needed for juveniles to occupy deeper adult habitats. PBFs specific to the conservation of this DPS include sites and habitat components that support the juvenile life stage, including:

- Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities.
- Water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities.

Yelloweye Rockfish, Puget Sound-Georgia Basin DPS

The Puget Sound-Georgia Basin DPS of yelloweye rockfish (*Sebastes ruberrimus*) was listed as threatened by NMFS on April 28, 2010, effective July 27, 2010 (75 FR 22276). On January 23, 2017, NMFS updated and amended the Puget Sound-Georgia Basin DPS of yelloweye rockfish, reaffirming its status as threatened, effective March 24, 2017 (82 FR 7711). The listing description for yelloweye rockfish Puget Sound-Georgia Basin DPS includes fish residing within the Puget Sound-Georgia Basin, inclusive of the Queen Charlotte Channel to Malcom Island, in a straight line between the western shores of Numas and Malcom Islands.

Yelloweye rockfish can weigh up to 18 kg (40 lbs.), are orange red to orange yellow in color, with bright yellow eyes, and can reach up to 1 m (3 ft) in length (NMFS 2024e). They are among the longest-lived rockfish, living up to at least 118 years (potentially 150 years), are slow growing, and late to mature, beginning to reproduce at 5 to 20 years of age (Love 1996; Love et al. 2002; NMFS 2024e). Their fertilization and embryo development are internal, and females give birth to live larval young (Love et al. 2002). After birth, larvae are pelagic for several months prior to settling into a demersal habitat (Drake et al. 2010).

Yelloweye rockfish are opportunistic feeders. Larval rockfish feed on diatoms, dinoflagellates, tintinnids, and cladocerans, and juveniles consume copepods and euphausiids of all life stages (Sumida and Moser 1984; 74 FR 18516). Larger adult yelloweye rockfish consume bottom and mid-water dwelling invertebrates and small fishes including sand lance, gadids, flatfishes, shrimps, crabs, gastropods, and other rockfish species associated with kelp beds, rocky reefs, pinnacles, and sharp drop-offs (Sumida and Moser 1984; Love 1996; Love et al. 2002; Yamanaka et al. 2006).

Larvae are widely dispersed on the surface and can occupy the full water column but are generally found in the upper 80 m (262 ft). They have been observed under free-floating algae, seagrass, and detached kelp (Love et al. 2002; Weis 2004). Juveniles and subadults are generally found in shallower waters, around rocky reefs, kelp canopies, and artificial structures (Love et al. 2002; 74 FR 18516). Adults generally move into deeper waters, 24 to 475 m (80 to 1,560 ft) depth, but are most common in depths ranging from 91 to 180 m (300 to 590 ft) (Love 1996; 74 FR 18516). In Washington State's inland waters, adults have been documented in non-rocky areas such as sand, mud, and other unconsolidated sediments (Washington 1977; Miller and Borton 1980; Reum 2006). Many adults exhibit strong site fidelity to rocky bottoms and outcrops, and some may live their entire life on a single rock pile (Yoklavich et al. 2000; 74 FR 18516).

Yelloweye rockfish range from northern Baja California to the Aleutian Islands, Alaska, but are most common from central California northward to the Gulf of Alaska (Love 1996; 74 FR 18516). They are distributed throughout the Salish Sea, including around the San Juan Islands, in areas most frequently coinciding with high relief, complex rocky habitats, and are observed more frequently in north Puget Sound and the Strait of Georgia (Miller and Borton 1980; Yamanaka et al. 2006; 74 FR 18516). Yelloweye rockfish are potentially present in Rosario Strait based on an RHA analysis, with RHAs east and southeast off the coast of Blakely Island (**Figure 48**) (NRC 2016). Additionally, the project area overlaps with designated critical habitat for yelloweye rockfish juveniles and adults (79 FR 68041). Therefore, it is anticipated that yelloweye rockfish could occur within the project area.

The primary factors responsible for the decline of the yelloweye rockfish Puget Sound-Georgia Basin DPS are depletion from commercial and recreational fishing, rocky habitat degradation that includes loss of eelgrass and kelp, water quality problems and elevated contaminant levels, and inadequate existing regulatory mechanisms (75 FR 22276).

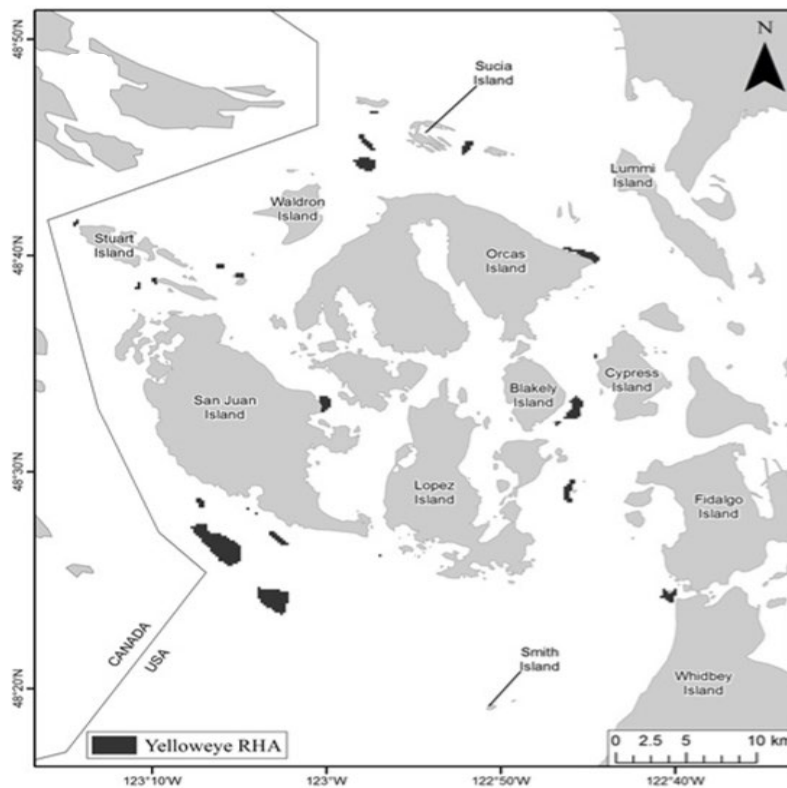


Figure 48. Spatial Distribution of Yelloweye Rockfish Hotspot Areas (RHA) Around the San Juan Islands

Source: NRC 2016



Critical Habitat

On November 13, 2014, NMFS issued its final rule designating critical habitat for the Puget Sound-Georgia Basin DPS of yelloweye rockfish, effective February 11, 2015 (79 FR 68041). The proposed Project area is within the deepwater critical habitat for the Puget Sound-Georgia Basin DPS of yelloweye rockfish. NMFS does not currently have sufficient information regarding the habitat requirements of larval yelloweye rockfish to determine which features are essential for conservation; thus, they do not identify critical habitat specifically for this life stage. However, NMFS notes that larvae of yelloweye rockfish are very likely use the areas designated as critical habitat.

Benthic habitats or sites deeper than 30 m (98 ft) that possess or are adjacent to areas of complex bathymetry consisting of rock and or highly rough habitat are essential to conservation because these features support growth, survival, reproduction, and feeding opportunities by providing the structure for rockfishes to avoid predation, seek food, and persist for decades. Specific PBFs essential to the conservation of the Puget Sound-Georgia Basin DPS of yelloweye rockfish include sites and habitat components that support adult and juvenile life stages, including:

- Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities.
- Water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities.
- The type and amount of structure and rugosity (roughness) that supports feeding opportunities and predator avoidance.

Chinook Salmon, Puget Sound ESU

On March 24, 1999, NMFS listed the Puget Sound ESU of Chinook salmon (*Oncorhynchus tshawytscha*) as threatened (effective May 24, 1999 [64 FR 14308]), reaffirmed on June 28, 2005, and effective August 29, 2005 (70 FR 37159). The listing was again reaffirmed, effective April 14, 2014 (79 FR 20802). The Puget Sound ESU of Chinook salmon includes naturally spawned Chinook salmon originating from rivers flowing into Puget Sound from the Elwha River (inclusive) eastward, including rivers in Hood Canal, South Sound, North Sound, and the Strait of Georgia, as well as Chinook salmon from 26 artificial propagation programs (NMFS 2016a; 79 FR 20802).

Chinook are the largest of the Pacific salmon (i.e., king salmon) (Netboy 1958), reaching approximately 0.9–1.5 m (3–5 ft) in length. They regularly weigh more than 18 kg (40 lbs.) and can potentially reach up to 58.5 kg (129 lbs.) (Shared Strategy for Puget Sound 2007; NMFS 2024a). They reach maturity at 3-4 years when they return to freshwater to spawn (Myers et al. 1998). Chinook salmon dig out redds (i.e., gravel nests) on streambeds where they lay their eggs (63 FR 11482). All Chinook die after spawning, with their carcasses providing a valuable source of energy and nutrients (e.g., nitrogen, phosphorous) to river ecosystems, leading to improved newly hatched salmon growth and survival (NMFS 2024a).

Chinook salmon are anadromous, meaning they incubate, hatch, and emerge in freshwater streams and rivers before migrating out to the oceanic saltwater environment to feed and grow, before returning to their natal freshwater streams to spawn (Myers et al. 1998). In the ocean, Chinook appear blue-green on the back and top of their head, with silvery flanks and white bellies and have small black spots on both lobes of their tail, as well as black pigment along the base of their teeth (Shared Strategy for Puget Sound 2007; NMFS 2024a). Spawning adult males can be distinguished by a hooked upper jaw, and females by their torpedo-shaped body, robust mid-section, and blunt nose. Freshwater juveniles (i.e., fry) have well-developed parr marks on their sides that they lose when migrating out to sea, then gain the dark back and light belly characteristic of fish living in open water (Healey 1991; NMFS 2024a).

Chinook fry feed on forage fish eggs in large aggregations along sheltered shorelines. Young Chinook salmon feed on terrestrial and aquatic insects, amphipods, crustaceans, annelids, arachnids,



playhelminthes, gastropoda, rotifera, and osteichytes (Levy et al. 1979; Levings et al. 1991). Older Chinook primarily feed on other fish, such as bocaccio, herring, anchovy, and sardines (Love et al. 2002). Chinook are the primary year-round prey of Southern Resident Killer Whales (SRKWs), comprising approximately 50 percent of their diet in the fall, 70 to 80 percent in mid-winter/early spring, and nearly 100 percent in the spring (Hanson et al. 2021). They are also eaten by other marine mammals such as sea lions, sharks and other fish (e.g., whiting, mackerel), and birds (NMFS 2024a).

In North America, Chinook salmon range from Monterey Bay, California to the Chukchi Sea region of Alaska (Myers et al. 1998) but have diverse migration patterns due to a complex blend of environmental and genetic factors (Healey 1991; Quinn et al. 2005). Chinook salmon also exhibit two distinct juvenile life history patterns—ocean-type and freshwater stream-type—with ocean-type being the most common in the southern portion of their range (Washington State, Oregon, and California) (Gilbert 1912; Healey 1983; Taylor 1990). The ocean-type Chinook salmon tend to stay in protected inland and coastal areas, including nearshore estuaries found in Washington State (Healey 1983; Sharma 2009; 63 FR 11482).

The Salish Sea is a migratory corridor for adult Chinook and provides habitat for out-migrating juveniles from rivers to their oceanic phase as adults. Adults typically spawn in the mainstems and larger tributaries of Puget Sound and greater Salish Sea, preferring clean gravel riffles with moderate water velocity (WDF et al. 1992). Early-timed Chinook salmon tend to enter freshwater as immature fish in the spring, migrate far upriver, and spawn in the late summer and early fall. Late-timed Chinook enter freshwater in the fall at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within days to weeks of freshwater entry (Myers et al. 1998).

The return of adult Chinook salmon to freshwater within Washington State occurs from late March to early December and varies considerably across and within major river basins. Fall run Chinook salmon are the most common group of Chinook on the U.S. west coast, spending 3 to 4 years in the ocean prior to migrating to their spawning grounds. They journey to their spawning grounds beginning in late July, peaking in September, and ending in December (NMFS 2022c). According to WDFW and NMFS, there are no freshwater spring, summer, or fall Chinook streams, nor is there designated freshwater critical habitat for Chinook salmon on Blakely Island (NMFS 2024g; WDFW 2024q, 2024r). However, Chinook salmon do have designated critical habitat (70 FR 52629) along the nearshore waters of Blakely Island, which overlaps with the Project area in part; therefore, they may occur within the Project area.

Critical Habitat

On September 2, 2005, NMFS issued a final rule designating critical habitat for 12 ESUs of west coast salmon, including the Chinook salmon Puget Sound ESU, effective January 2, 2006 (70 FR 52629). Designated critical habitat for the Chinook salmon Puget Sound ESU includes approximately 3,824 km (2,376 miles) of nearshore marine areas. In nearshore marine areas, critical habitat includes areas contiguous with the shoreline from the line of extreme high tide out to a depth no greater than 30 m (98 ft) relative to the MLLW (70 FR 52629).

Specific critical habitat PBFs essential for conservation of the Chinook salmon Puget Sound ESU are those sites and habitat components that support one or more life stages, including:

- Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development.
- Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.



- Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.
- Estuarine areas free of obstruction and excessive predation with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.
- Nearshore marine areas free of obstruction and excessive predation with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.
- Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Steelhead, Puget Sound DPS

On May 11, 2007, NMFS listed the Puget Sound DPS of steelhead (*O. mykiss*) as threatened, effective June 11, 2007 (72 FR 26722), updated and effective on April 14, 2014 (79 FR 20802). The Puget Sound steelhead DPS includes more than 50 stocks of summer- and winter-run fish, the latter being the most widespread and numerous of the two run types (72 FR 26722).

Steelhead are in the salmon family (i.e., salmonid). They have dark spots scattered over their entire body, including the tail, with slight to pronounced rainbow coloring. They have a life span of approximately 4 to 6 years in the wild and can weigh up to approximately 14 kg (30 lbs.) or more but are between 3.6 and 5 kg (8 and 11 lbs.) on average. Steelhead have a varied diet, eating zooplankton when young, then fish eggs, small fish, crustaceans, mollusks, and insects as they mature.

Steelhead distribution extends from Kamchatka Peninsula of Russia east to Alaska, and south along the Pacific coast to the U.S.-Mexico border (Busby et al. 1996; 67 FR 21586). *O. mykiss* exhibit the most complex life history of any Pacific salmonid and can be either anadromous (steelhead) or freshwater residents (rainbow or redband trout [*O. mykiss gairdnerii*]) and can yield offspring of the alternate life history form (72 FR 26722). Anadromous *O. mykiss* may spend up to 7 years in freshwater prior to smoltification and spend up to 3 years in saltwater prior to migrating back to their natal streams to spawn and may spawn more than once in their lifetime (72 FR 26722).

Within the range of west coast steelhead, spawning migrations occur throughout the year, with seasonal peaks of activity (72 FR 26722). In Washington State, steelhead are divided into two basic reproductive ecotypes – summer or winter run – based on the state of sexual maturity at the time of river entry and duration of spawning migration (Burgner et al. 1992). The summer run or “stream-maturing” type enters freshwater in a sexually immature condition between May and October and requires several months to mature and spawn (72 FR 26722). The winter run or “ocean-maturing” type enters freshwater between November and April with well-developed gonads and spawns shortly thereafter (72 FR 26722).

Winter runs spawn close to the ocean—requiring less travel time—and prefer fast-flowing water in small-to-large mainstem rivers and medium-to-large tributaries (Myers et al. 2015). Summer steelhead usually spawn farther upstream than winter steelhead (Withler 1966; Roelofs 1983). When spawning, females dig out a redd in the gravelly bottom of a stream riffle and the male fertilizes them. The redd is covered by gravel until the eggs hatch.

The boundaries of a steelhead population are influenced in part by the spatial confines of its spawning habitat (Myers et al. 2015). Each river basin may have one or more peaks in migration



activity, and the runs are usually named for the season in which the peak occurs (e.g., winter, spring, summer, or fall steelhead) (72 FR 26722). In areas with both summer and winter steelhead runs, the summer run usually happens where the winter run does not fully use the habitat, or where a temporary barrier, such as a seasonal waterfall, separates them. In Washington State, most steelhead summer runs occur east of the Cascade Mountains, entering streams in the summer to reach spawning grounds by the following spring (Myers et al. 2015). According to WDFW, there are no winter or summer steelhead streams on Blakely Island, making it unlikely that steelhead would migrate to and from Blakely Island for spawning or rearing reasons (WDFW 2024q). However, given the prominence of steelhead migrating and foraging throughout the Salish Sea, particularly to freshwater streams to the east of the San Juan Islands (e.g., Nooksack and North Fork Skagit Rivers), there is the potential for Puget Sound DPS steelhead to occur within or near the project area.

Factors leading to the decline of Puget Sound DPS steelhead and limiting their recovery include the following:

- Habitat destruction and modification.
- Reduced habitat quality through changes in river hydrology, temperature profile, downstream gravel availability, and reduced movement of large woody debris.
- Continued urban development in the lower reaches of many Puget Sound rivers and tributaries, causing increased flood frequency and peak flows during storms, and reduced groundwater-driven summer flows.
- Altered stream hydrology from dikes and hardening riverbanks with riprap, resulting in gravel scour, bank erosion, disrupted sediment deposition, channelization, reduced river braiding and sinuosity, and increased likelihood of displacing rearing juveniles (NMFS 2016a).

Critical Habitat

On February 24, 2016, NMFS issued a final rule designating critical habitat for Puget Sound DPS steelhead, effective March 25, 2016 (81 FR 9251). The specific areas designated include approximately 3,269 km (2,031 miles) of freshwater and estuarine habitat in Puget Sound (81 FR 9251). The designated critical habitat for the Puget Sound DPS of steelhead does not overlap with the proposed Project area.

Eulachon, Southern DPS

On March 18, 2010, NMFS listed the Southern DPS of eulachon (*Thaleichthys pacificus*) as threatened, effective May 17, 2010 (75 FR 13012). The Southern DPS of eulachon consists of populations spawning in rivers south of the Nass River in British Columbia, Canada, to the Mad River in California (74 FR 10857). Within the range of the Southern DPS, core populations for this species include the Columbia and Fraser rivers and may have historically included the Klamath River (74 FR 10857).

Eulachon are anadromous smelt in the family Osmeridae. They are distinguished from other smelts by having four to six gill rakers on the upper half of the gill arch (others have eight to 14 gill rakers), and distinctive circular lines on the gill plate and the area below it (NMFS 2024s). Eulachon have a prominent adipose fin and exhibit strong blue and silver countershading (darker coloration on the top of the body and lighter on the bottom). Juvenile eulachon from 30–100 mm (1.2 to 4 in.) in length disperse within the first year of life to open marine waters on the continental shelf and reside near the bottom at depths of 50 to 200 m (164 to 656 ft), then mature when they are about 160 to 250 mm (6 to 10 in.) in length. Adults typically spawn at 2 to 5 years of age in the lower portions of rivers (NMFS 2024s). Many rivers within the range of eulachon have consistent yearly spawning runs; however, eulachon may appear in other rivers only on an irregular or occasional basis. The spawning migration usually occurs between December and June.

Eulachon are basically a cold-water species and are adapted to feed on a northern assemblage of copepods in the ocean during the critical transition period from larvae to juvenile (and much of their



recent recruitment failure may be traced to mortality during this critical period) (75 FR 13012). Post-larval and juvenile (20–157 mm [0.8–6 in.]) eulachon consume various planktonic crustaceans, particularly adult copepods, and adult eulachon primarily consume euphausiids (krill) as well as cumaceans (small shrimp-like crustaceans) and copepods (NMFS 2022a).

Southern DPS eulachon can be found in the northeastern Pacific Ocean, from the Mad River in northern California to the Nass River in British Columbia, Canada (NMFS 2024s). Most of the eulachon production in Washington State originates in the Columbia River Basin, including the Columbia River, the Cowlitz River and Grays River, the Kalama River, Lewis River, and Sandy River (Gustafson et al. 2010; NMFS 2017). While eulachon spend 95 to 98 percent of their lives at sea (Hay and McCarter 2000; NMFS 2017), little is known concerning their saltwater life stage. However, eulachon have occurred as bycatch in some U.S.-based groundfish fisheries (NMFS 2017). The species may potentially be found through the Salish Sea, as the entirety of Washington's inland waters are within the Southern DPS eulachon's range (NMFS 2024s). However, there is scant evidence suggesting that Southern DPS eulachon would occur within the Project area, as their presence has been primarily observed within and near the Elwha River, which flows into the Strait of Juan de Fuca approximately 75 km (47 miles) away from the project area (Shaffer et al. 2007). Therefore, it is anticipated that Southern DPS eulachon would not occur within the Project area, or that it would be an extremely rare event.

The most significant threat to the Southern DPS of eulachon is the changing of ocean conditions due to climate change (e.g., a warming ocean leading to reduced foraging success) (74 FR 10857; NMFS 2024s). Distribution shifts result in increased predation of eulachon by Pacific hake, as well as increased competition for food resources with other species. The other two primary factors responsible for the decline of the Southern DPS of eulachon are the destruction, modification (e.g., river dams), or curtailment of habitat (in part due to climate change) and inadequacy of existing regulatory mechanisms (75 FR 13012). Climate-driven changes in streamflow timing and intensity impact eulachon spawning times, creating a mismatch in timing between their life history and prey species (Gustafson et al. 2010).

Critical Habitat

On October 20, 2011, NMFS issued a final rule designating critical habitat for the Southern DPS of eulachon, effective December 19, 2011 (76 FR 65324). NMFS designated 16 specific areas as critical habitat within the states of California, Oregon, and Washington, consisting of a combination of freshwater creeks and rivers and their associated estuaries, encompassing approximately 539 km (335 miles) of habitat (76 FR 65324). The designated critical habitat for the Southern DPS of eulachon does not overlap with the proposed Project area.

Green Sturgeon, Southern DPS

There are two DPSs of North American green sturgeon (*Acipenser medirostris*): Northern DPS and Southern DPS. The Southern DPS has been listed as a threatened species under the ESA, whereas the Northern DPS of green sturgeon remains a federal Species of Concern. NMFS published a final rule on April 7, 2006, listing the Southern DPS as threatened, effective June 6, 2006 (71 FR 17757).

Southern DPS green sturgeon reach sexual maturity at about 15 years of age or a length of 150–155 cm (59–61 in.) (Van Eenennaam et al. 2006). They typically spawn every 3–5 years, primarily in the Sacramento River and its tributaries in California (Brown 2007; Mora et al. 2018; NMFS 2024b). Green sturgeon prey includes benthic invertebrates and fish, such as shrimp, mollusks, amphipods, crabs, anchovies, and sand lances (Moser and Lindley 2007; Dumbauld et al. 2008).

Green sturgeon typically occupy depths of 20–70 m (66–230 ft) in marine habitats (Erickson and Hightower 2007; Huff et al. 2011), quickly swimming up toward the surface at night (Erickson and Hightower 2007). They are found in high concentrations in coastal bays and estuaries along the North American west coast during the summer and fall, particularly in Washington State's Willapa Bay and Grays Harbor, and the Columbia River estuary (Lindley et al. 2008; Moser et al. 2016;



Schreier et al. 2016). Tagged individual green sturgeon released in the Sacramento River have been captured as far north as Willapa Bay, and those from the Columbia River have been captured from Vancouver Island to the Sacramento River (ODFW 2005; Moser and Lindley 2007).

Green sturgeon range from Mexico to Alaska in marine waters, foraging in estuaries and bays from San Francisco Bay, California to British Columbia, Canada (Houston 1988; Moyle and Leidy 1992; NMFS 2024b), travelling vast distances in the open ocean between freshwater rivers. Southern DPS green sturgeon spawn in the Sacramento River, then enter San Francisco Bay in late winter through early spring, migrate upstream, and spawn from April through early July (Heublein et al. 2009; Poytress et al. 2015; Miller et al. 2020). They spawn in deep pools within large, turbulent, freshwater river mainstems, and their eggs mainly stick to gravel or rocks, or settle in small cracks (Van Eenennaam et al. 2001). Upon hatching, they move downstream as they transition from larvae into juveniles.

Green sturgeon frequent Washington State's coastal waters and enter estuaries during summer when water temperatures are more than 2°C (3.6°F) warmer than adjacent coastal waters (Moser and Lindley 2007). Green sturgeon are present within the Strait of Juan de Fuca in greater numbers than Admiralty Inlet and Puget Sound (Moser et al. 2021), and they have designated critical habitat within the southern end of Rosario Strait, east of Lopez Island (74 FR 52299), that does not overlap with the project area. Given their presence within Washington State's coastal waters and estuarine systems and close proximity of designated critical habitat, with no barriers impeding their movement between their critical habitat and the project area, there is the potential for Southern DPS green sturgeon to occur within the project area.

The main threats to the Southern DPS of green sturgeon are dams and other impassible barriers, altered flows, and entrapment in water diversions that impede or inhibit their migration (NMFS 2024b), insufficient freshwater flow rates in spawning areas, contaminants, fisheries bycatch, poaching, invasive species, and unfavorable water conditions (NMFS 2021c, 2024g).

Critical Habitat

Critical habitat for the Southern DPS of green sturgeon was designated by NMFS on October 9, 2009, effective November 9, 2009 (74 FR 52299). The designated critical habitat for the Southern DPS of green sturgeon does not overlap with the proposed Project area.

Bull Trout, Coterminous U.S. Population (Coastal Recovery Unit)

On November 1, 1999, the USFWS listed all populations of bull trout (*Salvelinus confluentus*) within the coterminous U.S., including the Coastal-Puget Sound DPS, as threatened, effective December 1, 1999 (64 FR 58910). This final listing added bull trout in the Coastal-Puget Sound populations (Olympic Peninsula and Puget Sound regions) to the previous listing of three DPSs of bull trout in the Columbia River, Klamath River, and Jarbidge River basins (80 FR 58767). The Coastal Recovery Unit of bull trout is located within western Oregon and Washington State, with the greater Puget Sound region being a major geographic region of the unit (USFWS 2015).

Bull trout size and age at maturity depend on habitat capacity and subsequent life history strategy, but resident fish tend to be smaller than migratory fish at maturity and produce fewer eggs (Fraleley and Shepard 1989; Al-Chokhachy and Budy 2008; USFWS 2015). Bull trout frequently live for 10 years, but occasionally for 20 years or more (McPhail and Baxter 1996; Al-Chokhachy and Budy 2008). Bull trout are opportunistic feeders in freshwater systems, preying on terrestrial and aquatic insects, macro-zooplankton, and small fish (Goetz 1994; Donald and Alger 1993). Adult fluvial migratory bull trout in Western Washington's coastal areas feed on Pacific herring, Pacific sand lance, and surf smelt (Goetz et al. 2004; USFWS 2015).

Bull trout exhibit resident and migratory life history strategies throughout much of their range, using small streams, large rivers, lakes, and marine waters to rear, mature, and spawn (Rieman and McIntyre 1993; USFWS 2015). Migratory bull trout spawn in tributary streams where juveniles stay



from 1–4 years before migrating to either a lake (adfluvial) (Downs et al. 2006), river (fluvial form) (Fraleigh and Shepard 1989), or in certain coastal areas, to saltwater where maturity is reached (Goetz et al. 2004; Brenkman et al. 2007; USFWS 2015). Resident and migratory forms of bull trout may be found together, with either form producing offspring that exhibit either resident or migratory behavior (Brenkman et al. 2007; Homel et al. 2008; USFWS 2015). The amphidromous (fish that migrate between freshwater and saltwater, but not for reproduction) life form of bull trout is specific to the Coastal-Puget Sound DPS (64 FR 58921), often migrating seasonally to freshwater as sub-adults before returning to spawn (Willson 1997; Brenkman and Corbett 2005).

In freshwater systems, their specific habitat requirements have been described as the “Four C’s:” cold, clean, complex, and connected habitat (USFWS 2015). They are seldom found in waters exceeding 15 to 18°C (59 to 64°F) and are often found in waters less than 12°C (54°F; USFWS 2015). Anadromous bull trout enter marine waters in early spring, with residence time in saltwater averaging 2 to 4 months (Goetz 2016). Bull trout’s use of marine habitats in the Salish Sea is likely limited to nearshore areas with lower salinity levels. However, because bull trout are primarily a freshwater species, the extent to which they utilize nearshore marine habitats is not well understood.

Bull trout are a char native to western North America. Their range includes the Columbia River and Snake River basins, extends east to headwater streams in Idaho and Montana, into Canada and southeast Alaska, and to the Puget Sound and Olympic Peninsula watersheds of western Washington and Klamath River basin of south-central Oregon (USFWS 2015). Bull trout have been documented as being most abundant in Washington State’s inland waters during spring and late summer, with relatively few captured during winter months (Goetz et al. 2004). They require stable stream channels, clean spawning and rearing gravel, complex and diverse cover, and unblocked migratory corridors (USFWS 2008). Bull trout are present throughout freshwater streams and rivers in western Washington, including those east of the San Juan Islands (e.g., Samish and North Fork Skagit Rivers) that flow into Bellingham, Samish, and Skagit Bays (WDFW 2024q). Because there are no streams in the San Juan Islands known to be occupied by or serve as migration routes for bull trout, it is unlikely that they would be found in the Project area, though it is still possible.

The most significant threats that bull trout face are historical habitat loss and fragmentation, interaction with non-native species, and fish passage issues (USFWS 2008, 2015).

Critical Habitat

On September 26, 2005, critical habitat was designated for the Coterminous U.S. DPS (Coastal Recovery Unit) of bull trout, effective October 26, 2005 (70 FR 56211). On October 18, 2010, the USFWS revised the critical habitat designation, effective November 17, 2010 (75 FR 63897). The designated critical habitat for the Coterminous U.S. DPS (Coastal Recovery Unit) of bull trout does not overlap with the proposed Project area.

3.4.1.2 Echinoderms

Sunflower Sea Star (Proposed)

A petition to list the sunflower sea star (*Pycnopodia helianthoides*) under the ESA was submitted on August 18, 2021. On March 16, 2023, NMFS proposed to list the sunflower sea star as a threatened species under the ESA throughout its range (88 FR 16212). Sunflower sea stars are native to marine waters along the Pacific Coast, from northern Baja California to the central Aleutian Islands, including the Salish Sea. The species is most abundant in the waters off eastern Alaska and British Columbia (Lowry et al. 2022).

Adult sunflower sea stars have up to 24 arms and range in color from purple to brown, orange, or yellow. Using their 15,000 individual tube feet, they can move up to 1 m (3.3 ft) per minute, helping their ability to capture prey (Monterey Bay Aquarium 2024). The sunflower sea star is an opportunistic predator and generalist feeder that exploits diverse intertidal and subtidal habitats (Galloway et al. 2023). They use chemosensing (ability to sense chemicals) to locate prey, and their



diet includes benthic and mobile epibenthic invertebrates (e.g., sea urchins, snails, crab, sea cucumbers, sea stars), sessile invertebrates (e.g., barnacles, bivalves), and dead or dying fish, seabirds, and octopus (Shivji et al. 1983; Mauzey et al. 1968; Brewer and Konar 2005; Lowry et al. 2022).

Sunflower sea stars are broadcast spawners, releasing large amounts of eggs and sperm into the water column to reproduce, which requires proximity to other individuals for successful fertilization (86 FR 73230). Although reproductive seasonality is largely undocumented, localized studies have documented breeding from December through June (Feder and Christensen 1966; Morris et al. 1980; Gravem et al. 2021). Egg fertilization is followed by a free-floating larval period that can last 50-146 days (Strathmann 1978; Gravem et al. 2021). Individuals then settle and transform into juveniles, which continue to feed and grow (86 FR 73230).

Sunflower sea stars are a broadly distributed, occurring on mud, sand, shell, gravel, rocky bottoms, kelp forests, and the lower rocky intertidal area (Mauzey et al. 1968; Lambert 2000; Galloway et al. 2023). Sunflower sea stars can live in waters ranging from a few feet deep to greater than 427 m (1,400 ft) deep but are most abundant in depths shallower than 25 m (82 ft) and rarely in depths greater than 120 m (394 ft) (Lambert 2000; Hemery et al. 2016; Gravem et al. 2021).

The sunflower sea star may occur within the project area, however, their abundance in the Salish Sea is generally considered to be very low since the outbreak of sea star wasting syndrome (SSWS), the primary threat to their existence. Since the outbreak of SSWS in 2013, through 2020 there was an estimated decline in density of approximately 92 percent in the Salish Sea, even with recent settlements having been recorded (Hamilton et al. 2021; Gravem et al. 2021; Lowry et al. 2022). While anecdotal evidence indicates sunflower sea star recruitment continues in the Salish Sea, few juveniles appear to survive until adulthood (Lowry et al. 2022). Despite substantial population declines from 2013 to 2017, sunflower sea stars still occupy the entirety of their range from Alaska to northern Mexico, including the Salish Sea (88 FR 16212). While it is anticipated that sunflower sea stars are unlikely to be present within the project area due to the decimated population numbers, given that they are habitat generalists with a preference for depths at which the project would occur, there is the potential for them to occur within the project area.

Critical Habitat

NMFS has not proposed designating critical habitat because it is not currently determinable (88 FR 16212).

3.4.2 Essential Fish Habitat

Section 3 of the MSA defines EFH as “*those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity*” (50 CFR § 600.10). For the purposes of this definition: “*Waters*” include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; “*substrate*” includes sediment, hard bottom, structure underlying the waters, and associated biological communities; “*necessary*” means the habitat required to support a sustainable fishery and the managed species contribution to a healthy ecosystem; “*spawning, feeding, and breeding*” is meant to encompass the complete life cycle of a species (50 CFR § 600.10).

EFH is determined by identifying spatial habitat and habitat characteristics that are required for each federally managed species through a cooperative effort by NMFS, Fishery Management Councils (FMCs), and federal and state agencies. These descriptions provide the basis for assessing development and other activities in specified marine areas. Further, EFH is designated based on best available scientific information and the levels defined by the MSA:

- Level 1 information corresponds to distribution.
- Level 2 information corresponds to density or relative abundance.
- Level 3 information corresponds to growth, reproduction, or survival rates.



- Level 4 information corresponds to production rates.

The PFMC has jurisdiction over federal waters off the coasts of Washington State, Oregon, and California. Specifically, the PFMC has jurisdiction over the management of fisheries for species such as groundfish, salmon, coastal pelagic species, and highly migratory species like tunas and sharks. Section 305(b)(2) of the amended MSA directs each federal agency to consult with NMFS with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by such agency that may adversely affect any EFH. Implementing regulations for this requirement are at 50 CFR 600 of the MSA.

EFH is found within the proposed Project area for Pacific Coast Groundfish (all life stages), Pacific Coast Salmon, and Pacific Coastal Pelagic Species (CPS) for finfish and market squid (all life stages), the *Thysanoessa Spinifera* and *Euphausia Pacifica* species of krill (all life stages), and other krill species (all life stages) (Table 10). All the species are managed by PFMC.

Table 10. EFH Within the Proposed Project area

Common Name (<i>Scientific Name</i>)	Fishery Management Plan
Species	
Pacific Coast Groundfish (all life stages)	Pacific Coast Groundfish FMP
Pacific CPS (all life stages)	CPS FMP
Finfish and Market Squid	CPS FMP
Krill (<i>Thysanoessa Spinifera</i>)	CPS FMP
Krill (<i>Euphausia Pacifica</i>)	CPS FMP
Other Krill Species	CPS FMP
Pacific Coast Salmon	Pacific Coast Salmon FMP
Chinook Salmon (<i>Oncorhynchus tshawytscha</i>)	Pacific Coast Salmon FMP
Coho Salmon (<i>O. kisutch</i>)	Pacific Coast Salmon FMP
Pink Salmon (<i>O. gorbuscha</i>)	Pacific Coast Salmon FMP
Notes: CPS = Coastal Pelagic Species; EFH = essential fish habitat; FMP= Fishery Management Plan	

3.4.2.1 Habitat Areas of Particular Concern (HAPC)

In addition to EFH designations, regional FMCs designate HAPC. Designated HAPC are discrete subsets of EFH that provide highly important ecological functions or are especially vulnerable to degradation (50 CFR § 600.805–600.815). Categorization of an area as HAPC does not confer additional protection or restriction to the designated area. HAPC include estuaries, canopy kelp, seagrass, rocky reefs, and “areas of interest” for groundfish. In Washington State, “areas of interest” refer to all waters and sea bottom in state waters shoreward to the MHHW. FMCs may designate a specific habitat area as a HAPC based on one or more of the following reasons:

- 1) Importance of the ecological function(s) provided by the habitat.
- 2) The extent to which the habitat is sensitive to human-induced environmental degradation.



- 3) Whether, and to what extent, development activities are, or will, stress the habitat type.
- 4) Rarity of the habitat type.

No HAPCs were identified within the proposed Project area. Eelgrass presence at the new subsea cable landing site has been designated as “patchy” by DNR (2025); however, surveys conducted by Tetra Tech, Inc. in October 2024 detected no eelgrass in the MBE data, nor were any observed (**Figure 49**; Appendix C1). Patchy and continuous kelp beds are also present along the Blakely Island coastline (DNR 2025), but survey results indicate that they are not near the existing conduit (**Figure 50** and **Figure 51**).



Figure 49. Eelgrass on the Blakely Island Shoreline



Figure 50. Kelp Beds on the Blakely Island Shoreline

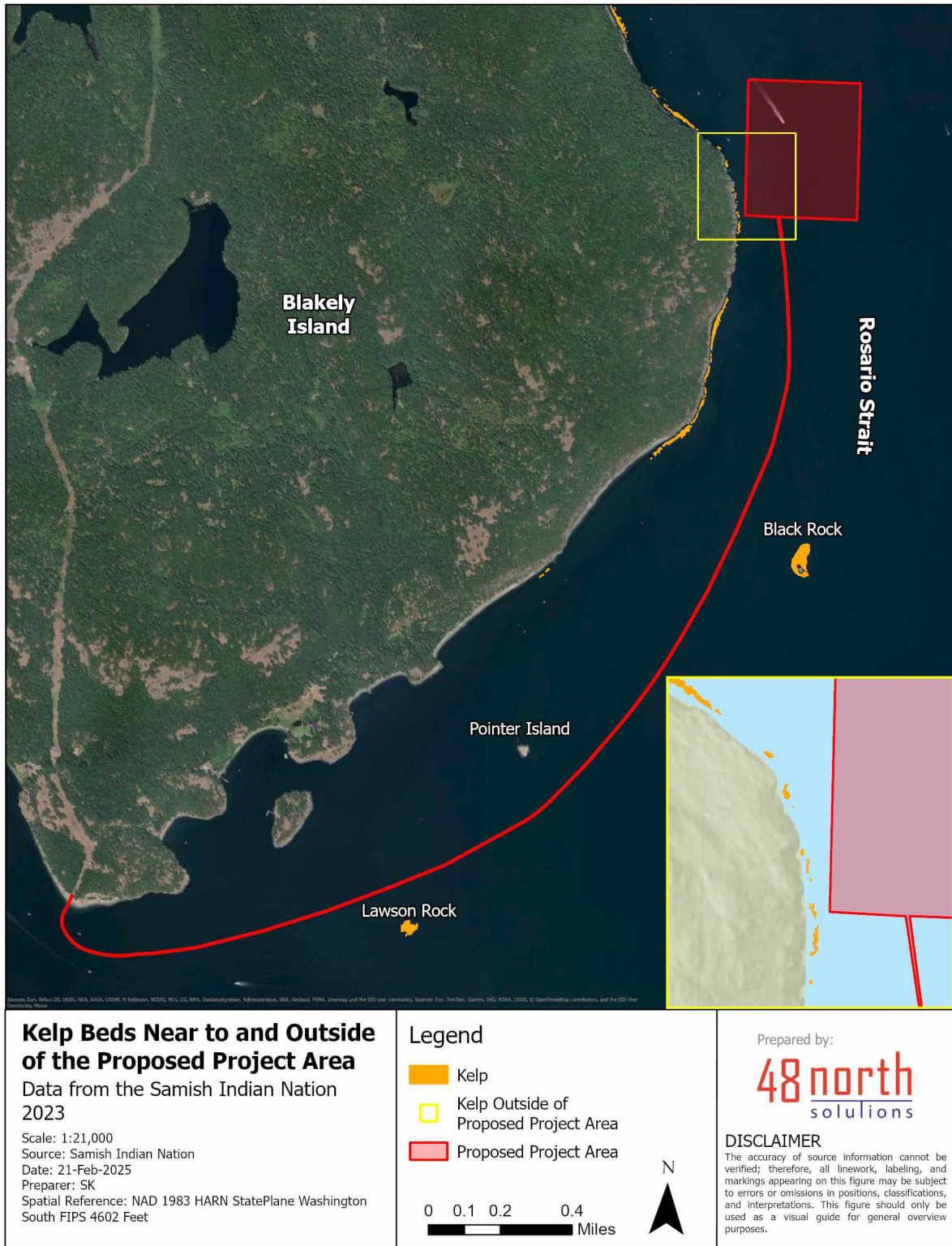


Figure 51. Kelp Beds Surveyed by the Samish Indian Nation in 2023



3.4.2.2 Pacific Coast Groundfish

The management unit in the Pacific Coast Groundfish Fishery Management Plan (FMP) includes more than 90 groundfish species over the entire U.S. west coast Exclusive Economic Zone (EEZ; an area of coastal water and seabed that the U.S. claims exclusive rights for fishing and other economic activities). Groundfish include many species of rockfish, sablefish, flatfish, and Pacific whiting that are often, but not exclusively, found on or near the ocean floor or other structures. Groundfish that may be present within the proposed Project area include:

- Dover sole (*Microstomus pacificus*)
- Starry flounder (*Platichthys stellatus*)
- Sand sole (*Psettichthys melanostictus*)
- English sole (*Parophrys vetulus*)
- Lingcod (*Ophiodon elongatus*)
- Pacific cod (*Gadus macrocephalus*)

Information on the life histories and habitats of these species varies in completeness, so while some species are well-studied, there is relatively little information on other species. Therefore, the FMP does not include descriptions identifying EFH for each life stage of the managed species but rather includes a description of the overall area identified as groundfish EFH.

The Pacific Coast Groundfish EFH consists of the aquatic habitat necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a healthy ecosystem. The PFMC identifies the overall area designated as groundfish EFH for all species covered in the FMP as all waters and substrates within the following areas: depths less than or equal to 3,500 m (11,500 ft) to MHHW level, or the upriver extent of saltwater intrusion, defined as upstream and landward to where ocean-derived salts measure less than 0.5 parts per trillion during the period of average annual low flow; seamounts in depths greater than 3,500 m (11,500 ft); and areas designated as HAPC not identified by the above criteria (PFMC 2024c).

This PFMC groundfish EFH identification follows a precautionary approach because uncertainty still exists about the relative value of different habitats to individual groundfish species and life stages, and thus the actual extent of groundfish EFH (PFMC 2024c). The primary habitats designated as EFH for groundfish include: the epipelagic zone (sunlight zone) of the water column, including macrophyte canopies (seaweed) and drift algae; unconsolidated sediments consisting of mud, sand, or mixed mud/sand; hard bottom habitats composed of boulder, bedrock, cobble, gravel, or mixed cobble/gravel; mixed sediments composed of sand and rocks; vegetated bottoms consisting of algal beds, macrophytes (aquatic plants), or rooted vascular plants. The entirety of the Project area lies within Pacific Coast Groundfish EFH, including the epipelagic zone of the water column, hard bottom habitats, and mixed sediment areas.

3.4.2.3 Pacific Coastal Pelagic Species (CPS)

CPS have value to commercial fisheries and are important prey species for other fish, marine mammals, and birds. The CPS FMP specifies a management framework for four finfish, invertebrate market squid, and all euphausiid krill species in the U.S. west coast EEZ (PFMC 2024a), listed below:

- Northern anchovy (*Engraulis mordax*, central and northern populations).
- Pacific sardine (*Sardinops sagax*).
- Pacific (chub) mackerel (*Scomber japonicus*).
- Jack mackerel (*Trachurus symmetricus*).
- Market squid (*Doryteuthis opalescens*).
- Krill: *Euphasia pacifica*, *Thysanoessa spinifera*, *Nyctiphanes simplex*, *Nematocelis difficilis*, *T. greagaria*, *E. recurve*, *E. gibboides*, and *E. eximia*.



CPS finfish are pelagic (i.e., in the water column near the surface and not associated with substrate). CPS are grouped together as a single species complex due to similarities in life history, habitat requirements, and/or overfishing pressures.

The PFMC defines the EFH for CPS finfish based on thermal range bordered by the geographic area where finfish occur at any life stage, where CPS have historically occurred during periods of similar environmental conditions, or where environmental conditions do not preclude colonization by CPS (PFMC 2024a). The identification of EFH for CPS accommodates the fact that the geographic range of CPS varies widely over time in response to the temperature of the upper mixed layer of the ocean (PFMC 2024a).

According to the PFMC (2024a), the east-west geographic boundary of EFH for CPS is defined to be all marine and estuarine waters from the shoreline along the coasts of Washington State, Oregon, and California offshore to the boundaries of the EEZ and above the thermocline (where sea surface temperatures range between 10°C and 26°C [50°F and 79°F]). The southern boundary is the U.S.-Mexico maritime boundary. The northern boundary is more dynamic and is defined as the position of the 10°C (50°F) isotherm (a line on a map that connects points that have the same mean temperature), which varies seasonally and annually (PFMC 2024a).

The EFH designation for krill extends the length of the U.S. west coast from the shoreline to the 1,000-fathom isobath (approximately 1,830 m or 6,000 ft) and to a water depth of 400 m (1,312 ft) and is based on information for the two principal species, *Euphausia pacifica* and *Thysanoessa spinifera* (PFMC 2024a). CPS are considered sensitive to overfishing, loss of habitat, reduction in water and sediment quality, and changes in marine hydrology (PFMC 2024a). The Project area lies entirely within Pacific CPS EFH, particularly the components that would reside within the water column.

3.4.2.4 Pacific Coast Salmon

The FMP for Pacific Coast Salmon covers all natural and hatchery salmon species caught by fisheries in the waters off the coasts of Washington State, Oregon, and California (PFMC 2024b). Chinook salmon, coho salmon (*Oncorhynchus kisutch*), and pink salmon (*O. gorbuscha*) are the main species covered by the plan.

Chinook and coho salmon EFH includes all water bodies currently or historically occupied by PFMC-managed Chinook and coho salmon and includes the estuarine and marine areas extending from the extreme high tide line in nearshore and tidal submerged environments within state territorial waters out to the full extent of the EEZ (200 NM) offshore of Washington State, Oregon, and north of Point Conception in California (50 CFR §660.412). Puget Sound pink salmon EFH includes all water bodies currently or historically occupied by PFMC-managed Puget Sound pink salmon in Washington State, and includes the estuarine and marine areas extending from the extreme high tide line in nearshore and tidal submerged environments within state territorial waters north and east of Cape Flattery, Washington, including Puget Sound, the Strait of Juan de Fuca, and Strait of Georgia; and the waters of the U.S. EEZ north of the 48°N latitude to the U.S.-Canada border (50 CFR §660.412). According to the definition (50 CFR §660.412), the Project area would lie within Pacific Coast Salmon EFH.

For Pacific salmon, the PFMC has designated five HAPC prioritized for conservation and management efforts (PFMC 2014):

- 1) Complex channels and floodplain habitats.
- 2) Thermal refugia.
- 3) Spawning habitat (low gradient stream reaches [less than 3 percent], containing clean gravel with low levels of fine sediment and high inter gravel flow).
- 4) Estuaries (nearshore areas such as bays, sounds, inlets, river mouths and deltas, pocket estuaries, and lagoons influenced by ocean and freshwater).
- 5) Marine and estuarine submerged aquatic vegetation (e.g., canopy kelps and eelgrass).

Except for estuaries, none of these HAPCs have been comprehensively mapped, and some may vary in location and extent over time. The Project area is not anticipated to overlap with HAPCs for Pacific Coast Salmon.

3.4.3 Acoustic Environment

To measure ambient noise levels within the Project area, APL-UW deployed two Loggerhead Snap recording hydrophones 3 m (9.8 ft) above the seabed (Appendix C2). The units were equipped with High Tech, Inc. 96-min hydrophones (serial numbers 4371090 and 4371088) with nominal sensitivities of approximately -170 decibels relative to 1 volt per 1 micropascal (dB re 1V/ μ Pa), including internal preamplifiers. The units were programmed with an additional 11.1 dB gain applied by the analog to digital converter prior to data storage. Sampling with hydrophones was carried out for 30 s every 10 minutes throughout the deployment at a sampling rate of 44.1 kHz. Recordings produced data for pressure spectral densities (PSDs; in dB re 1 μ Pa²/Hz) and sound pressure level (SPL; in dB re 1 μ Pa) calculations, all derived from frequency-domain analysis of each recording. PSD curves were integrated to calculate SPLs.

SPL is a means of characterizing the amplitude of sound. Noise levels exhibited some dependence on velocity that was not clearly attributed to flow noise, as demonstrated by the distributions in **Figure 52** and **Figure 53**. The distributions in **Figure 52** indicate that the overall impact of flow noise at frequencies greater than 500 hertz (Hz) is relatively small. All plots in **Figure 52** show that for currents below 0.4 m/s (1.3 ft/s) the upper and lower limits of measured noise do not change, suggesting flow noise is minimal. This may be attributed to sediment generated noise (Basset et al. 2013), bubbles entrained due to turbulence, and other identified noise sources.

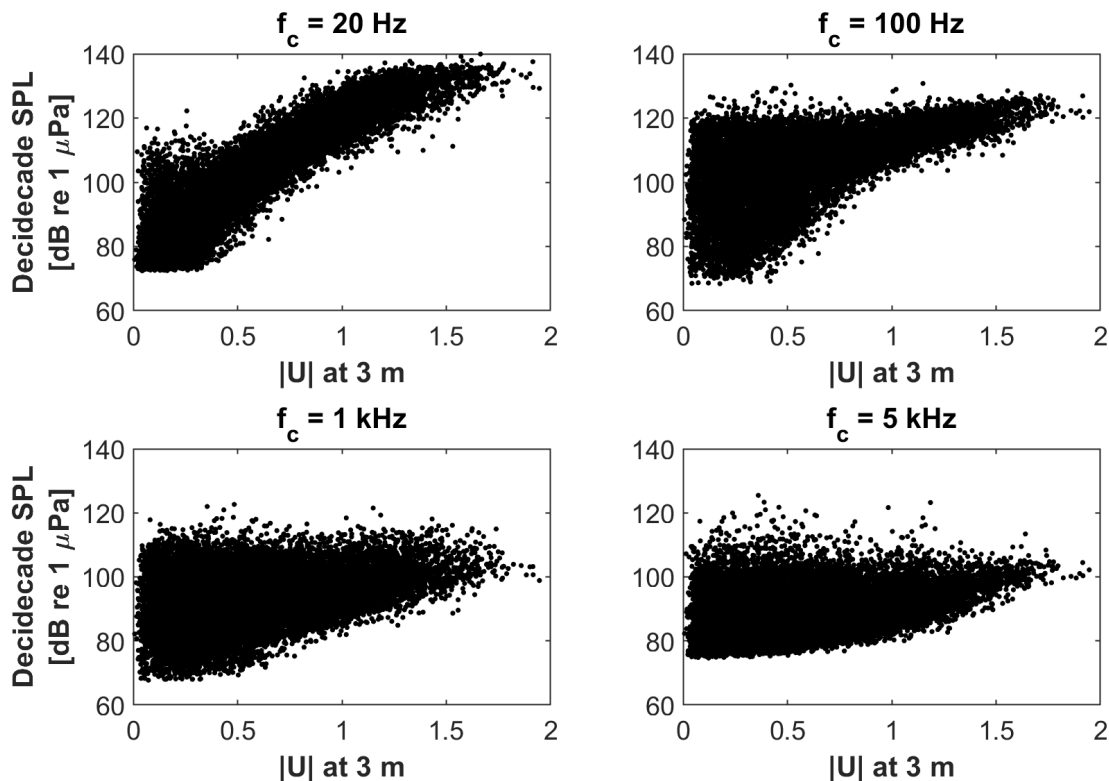


Figure 52. Distribution of Decidecade SPLs as a Function of Frequency, at Four Frequencies (20 Hz, 100 Hz, 1 kHz, and 5 kHz)

A time series of broadband SPLs (500 Hz to 20 kHz) is shown in **Figure 53**. Throughout the hydrophone deployment (October 2024 to January 2025), SPLs on the order of 85 dB re 1 μ Pa were recorded regularly, while the maximum broadband SPL recorded was approximately 134 dB re 1 μ Pa.

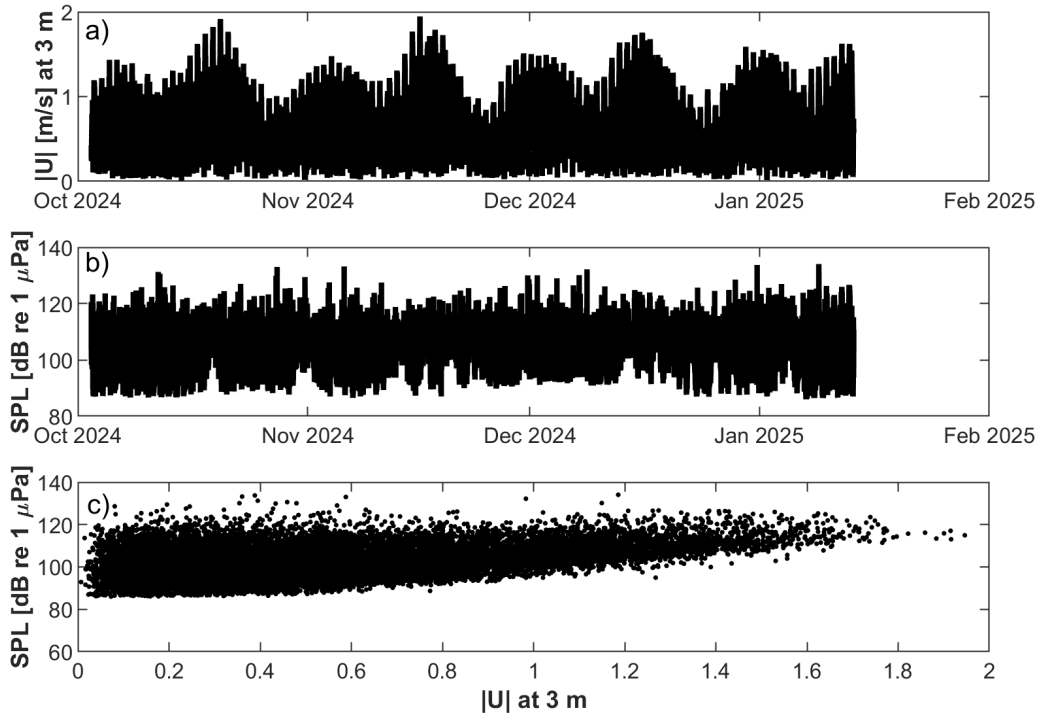


Figure 53. (a) Current Speed at 3 m (9.8 ft) Above Seabed; (b) Broadband SPLs (500 Hz to 20 kHz); (c) Broadband SPLs as a Function of Current Speed

A shorter time series (one day, November 2, 2024) of current speed and broadband SPLs is shown in **Figure 54**. The data show that while increases in inflow speed do result in higher noise floor, the highest levels of ambient noise that are observed are not correlated with the inflow conditions. Noise measurements were taken every 10 minutes and **Figure 54** shows broadband SPLs regularly changed substantially during these periods. While this reveals that the variability in the soundscape was under-resolved at short time scales, it is hypothesized that over the multi-month APL-UW data sampling period, the broader statistics likely capture the full distribution of noise at the Project area.

Broadband (10 Hz to 22 kHz) SPL distributions for the velocity threshold data APL-UW collected are shown in **Figure 55**. The mean broadband SPL calculated for low speeds throughout the hydrophone deployment was 120.3 dB re 1 μ Pa, while the median value was 110.2 dB re 1 μ Pa. The impact of the high intensity levels on the mean is shown in the empirical cumulative distribution functions (ECDF; **Figure 55** [right]), which show that although the mean broadband SPL is approximately 120 dB re 1 μ Pa, SPLs are lower than the mean approximately 78 percent of the time (during low flow period). These are relatively noise conditions that are consistent with prior observations in the Salish Sea, which are attributed primarily to vessel traffic (Bassett et al. 2012).

Empirical probability density functions (EPDFs) for spectral levels at frequencies between 10 Hz and 20 kHz are shown in **Figure 56** (white and red lines show the median and mean values, respectively), calculated for data with current speeds below 0.4 m/s (1.3 ft/s). The highest PSDs that are regularly observed occur below 100 Hz are likely attributed to vessel traffic in Rosario Strait. The distribution of observed noise levels generally decreases with frequency with the highest probability spectral densities occurring between approximately 70 and 0 dB re 1 μ Pa²/Hz around 100 Hz, 60 and 80 dB



re $1 \mu\text{Pa}^2/\text{Hz}$ around 1,000 Hz, and between 45 and 55 dB re $1 \mu\text{Pa}^2/\text{Hz}$ around 10 kHz. At frequencies near 10 kHz, high structure noise exists that creates frequency-dependent patterns in the data, likely attributable to self-noise from an instrument or other equipment that was part of the hydrophone deployment. Decade SPL Statistics and a Contour Plot of EPDFs of Decade SPLs are shown in **Figure 57** and reflect the broader trends identified in the statistics for PSDs.

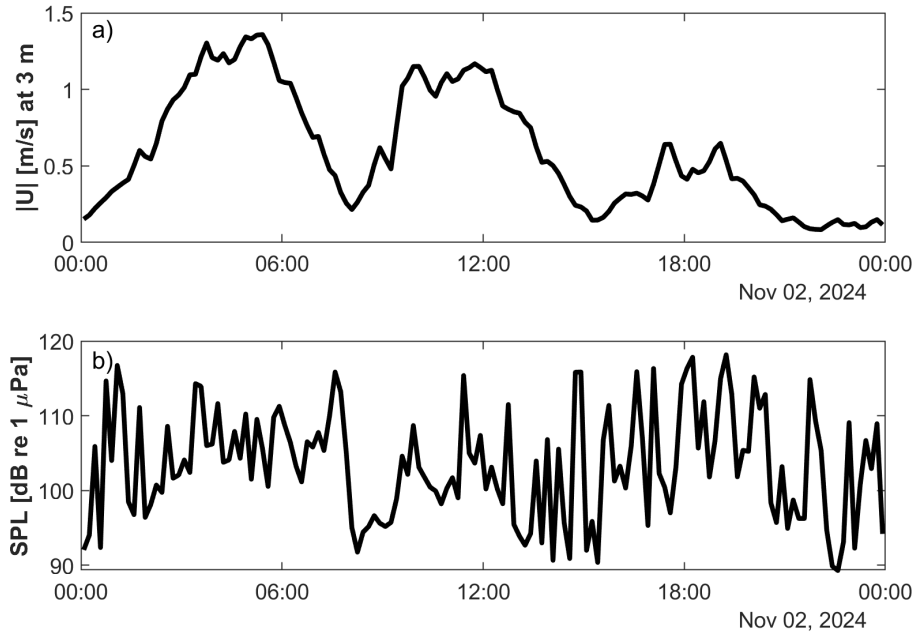


Figure 54. Time Series Data for a Single Day (November 2, 2024)

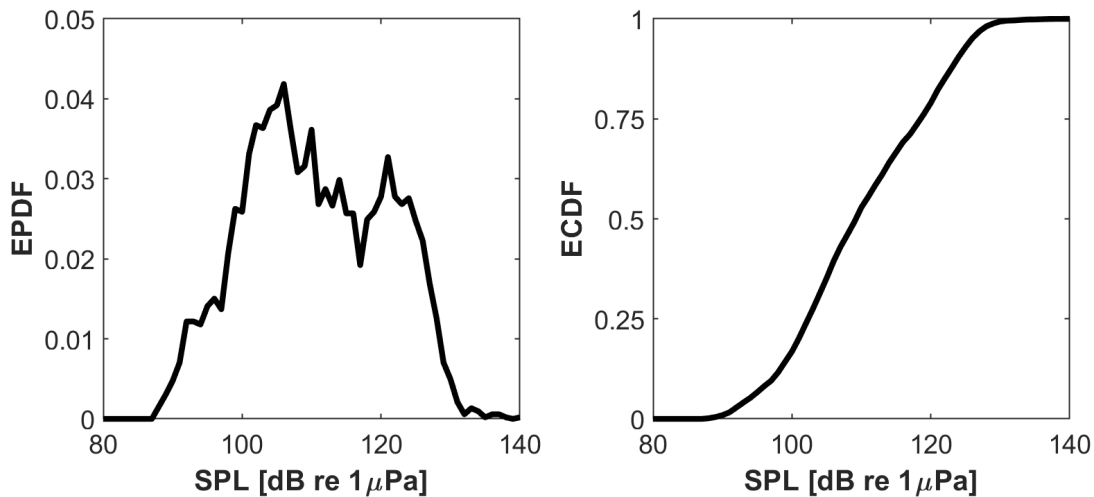


Figure 55. (Left) EPDFs and (Right) ECDFs for Broadband Noise at Low Current Speeds in Project Area

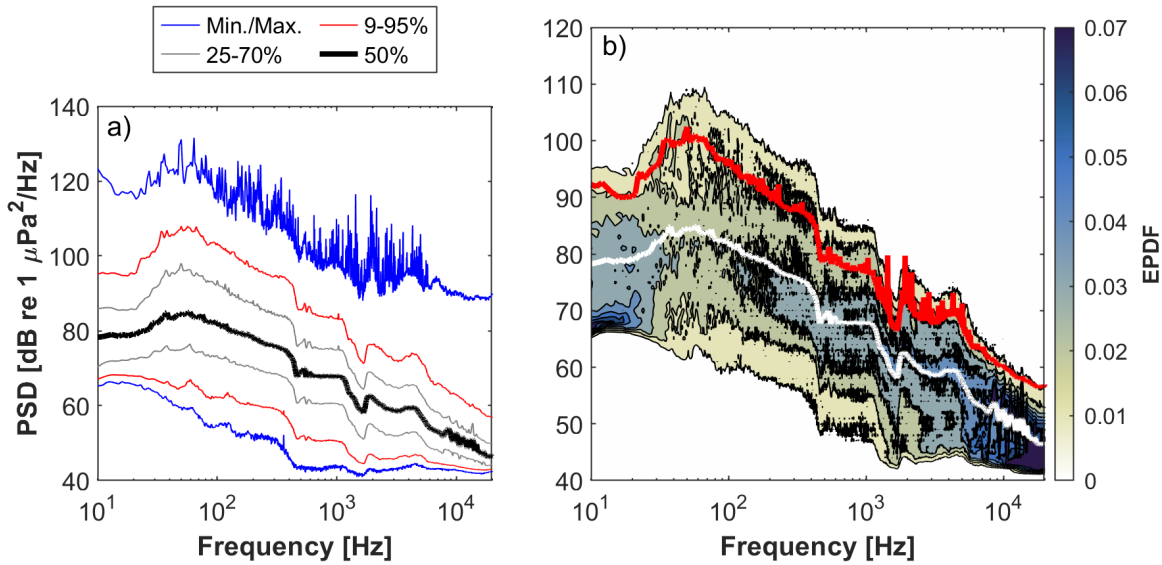


Figure 56. (a) PSD Statistics and (b) Contour Plot of EPDFs of Pressure Spectral Densities

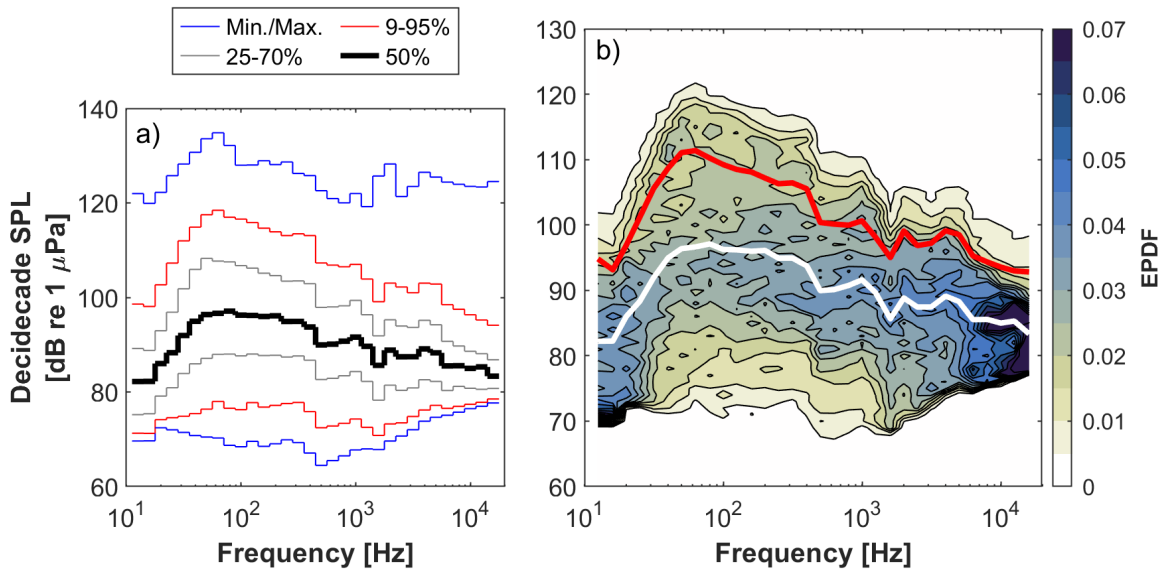


Figure 57. (a) Decidecade SPL Statistics and (b) a Contour Plot of EPDFs of Decidecade SPLs

3.5 Wildlife and Botanical Resources

The wildlife resources described include marine mammal species, avian (including seabird) species, Washington state’s Priority Habitats and Species (PHS), aquatic invasive species of greatest concern, and insects (monarch butterfly) that may occur within the project area. This Project would include no new terrestrial components or routes, nor would any staging or work occur on Blakely Island itself; therefore, terrestrial resources are only briefly addressed. The existing below- and above-water acoustic environments, including estimated decibel levels, are also described.



3.5.1 Marine Mammals

The Marine Mammal Protection Act (MMPA) (**Section 1.3.1.3**) prohibits the take of marine mammals. Thirteen marine mammal species occur within the Salish Sea (**Table 11**) with the possibility that they could occur within the vicinity of the Project area, with varying degrees of likelihood. The federally threatened southern sea otter (*Enhydra lutris nereis*)—also protected under the MMPA—is not included because its range is predominantly on Washington’s outer coast and lies outside of the Salish Sea (Hale et al. 2022). The North American river otter (*Lontra canadensis*), while abundant throughout the Salish Sea and San Juan Islands, is not included because it is primarily a terrestrial animal not protected under the MMPA.

Table 11. Marine Mammals in the Salish Sea

Common Name (<i>Scientific Name</i>)	Protection	Presence in Proposed Project Area
Whales		
Humpback Whale, Mexico and Central America DPSs (<i>M. novaeangliae</i>)	ESA, MMPA	Uncommon
Gray Whale (<i>Eschrichtius robustus</i>)	MMPA	Uncommon
Minke Whale (<i>Balaenoptera acutorostrata</i>)	MMPA	Uncommon
Dolphins and Porpoises		
Killer Whale, Southern Resident DPS (<i>Orcinus orca</i>)	ESA, MMPA	Uncommon
Bigg’s (Transient) Killer Whale (<i>Orcinus rectipinnus</i>)	MMPA	Uncommon
Short-finned Pilot Whale (<i>Globicephala macrorhynchus</i>)	MMPA	Uncommon
Dall’s Porpoise (<i>Phocoenoides dalli</i>)	MMPA	Uncommon
Harbor Porpoise (<i>Phocoena phocoena</i>)	MMPA	Common
Pacific White-sided Dolphin (<i>Lagenorhynchus obliquidens</i>)	MMPA	Uncommon
Pinnipeds		
California Sea Lion (<i>Zalophus californianus</i>)	MMPA	Common
Harbor Seal (Washington Inland Waters Stock) (<i>Phoca vitulina</i>)	MMPA	Common
Northern Elephant Seal (<i>Mirounga angustirostris</i>)	MMPA	Uncommon
Steller Sea Lion (<i>Eumetopias jubatus</i>)	ESA ¹ , MMPA	Uncommon



Common Name (<i>Scientific Name</i>)	Protection	Presence in Proposed Project Area
<p>Notes: ESA = Endangered Species Act; MMPA = Marine Mammal Protection Act</p> <ol style="list-style-type: none"> The Steller Sea Lion is split into two populations: Eastern (not ESA-listed) and Western DPSs (endangered). The Eastern DPS is the population east of 144°W; however, Western DPS Steller Sea Lions do also occur east of 144°W. NMFS (Alaska Region) offers guidance on the occurrence of Western and Eastern DPSs east of 144°W (2020), but these occurrences primarily occur within Alaska and are not within the proposed Project area, San Juan Islands, or Salish Sea (NMFS 2020). Therefore, the Western DPS (endangered) of the Steller Sea Lion is not considered to be present within or anywhere near the proposed Project area. 		

3.5.1.1 Federally Listed Marine Mammals

Federally ESA-listed marine mammals that may occur within the Project area include the Southern Resident DPS of killer whales (SRKW; *Orcinus orca*) and Central America and Mexico DPSs of humpback whales (*Megaptera novaeangliae*).

Killer Whale, Southern Resident DPS

The SRKW was listed by NMFS as endangered on November 15, 2005, effective February 16, 2006 (70 FR 69903), and updated on April 4, 2014 (79 FR 20802). The SRKW is one of four distinct and recognized communities of resident killer whales in the northeastern Pacific: Southern, Northern, Southern Alaska, and Western Alaska (NMFS 2021b, 2024f). The Southern Resident DPS consists of three pods—J, K, and L—which are frequently sighted near the San Juan Islands (Olson et al. 2018).

SRKWs have a lifespan of approximately 30–90 years. Mating and calving seasons often span several months, with a 17- to 18-month gestational period (Krahn et al. 2002). In Washington State waters, most SRKW births occur between October and March, indicating a mating season from May to September (Olesiuk et al. 1990). SRKWs usually give birth to a single calf every 3 to 10 years. SRKWs prey on salmonids, in particular Chinook salmon (Ford and Ellis 2006; Hanson et al. 2010; Ford et al. 2016) and to a lesser extent steelhead (*Oncorhynchus mykiss*) (Hanson et al. 2021). They are highly mobile, travelling up to 160 km (99 miles) in a 24-hour period (Baird and Whitehead 2000).

The SRKW range extends from southeastern Alaska to central California. Historically, SRKWs have spent a significant portion of the year in Washington State’s inland waterways, having been consistently present during the spring, summer (especially August), and fall, when all three pods regularly occur around San Juan Islands (Felleman et al. 1991; Heimlich-Boran 1988; Osborne 1999; Olson et al. 2018). During the warmer months, all three pods would concentrate their activities in Haro Strait, Boundary Passage, the southern Gulf Islands, the eastern end of the Strait of Juan de Fuca, and several localities in the southern portion of the Strait of Georgia (Felleman et al. 1991; Heimlich-Boran 1988; Ford et al. 2011). Rosario Strait would be used by SRKWs with less frequency than other areas of the Salish Sea (Figure 58; Olson et al. 2018).

However, recent shifts in the availability and presence of SRKWs’ preferred prey, particularly Fraser River Chinook Salmon, within the central Salish Sea, is believed to have resulted in shifting SRKW presence throughout Washington’s inland waters (Ettinger et al. 2022; Shields 2023). The K and L pods would typically arrive in May or June and remain until October or November, making frequent trips lasting a few days to Washington State’s outer coast (Ford et al. 2011). The J pod has typically occurred intermittently in the Georgia Basin during late fall, winter, and early spring. Recent studies have suggested that this seasonal trend has essentially reversed over the course of the past 20 years, with summer presence declining and May to August being the time in which SRKWs are least present in central Salish Sea, while their late fall and winter (October through February) presence has been increasing (Ettinger et al. 2022; Shields 2023).

One of the most important habitat features for SRKWs is the availability of salmon prey, with the occurrence of SRKWs in the Salish Sea being strongly correlated with salmon migration (Heimlich-Boran 1988; Felleman et al. 1991; Bubac et al. 2021). Major corridors for migrating salmon and SRKW presence are primarily in Haro Strait and west of San Juan Island (J, K, and L pods), but much less in Rosario Strait (J and L pods) (Ford et al. 2011; Hauser et al. 2007; Bubac et al. 2021). Therefore, while there is the potential for SRKWs to occur within or near the project area, given their more heavily used migration and foraging routes, they are not anticipated to be common within the project area.

The three main causes of SRKW decline are:

- Reduced prey quantity and quality leading to poor body conditions (Durban et al. 2009; Fearnbach et al. 2011, 2018; Wasser et al. 2017; Matkin et al. 2017).
- Persistent organic pollutants causing immune or reproductive system dysfunction (NMFS 2021b).
- Vessel noise and disturbance (NMFS 2014b, 2024f).

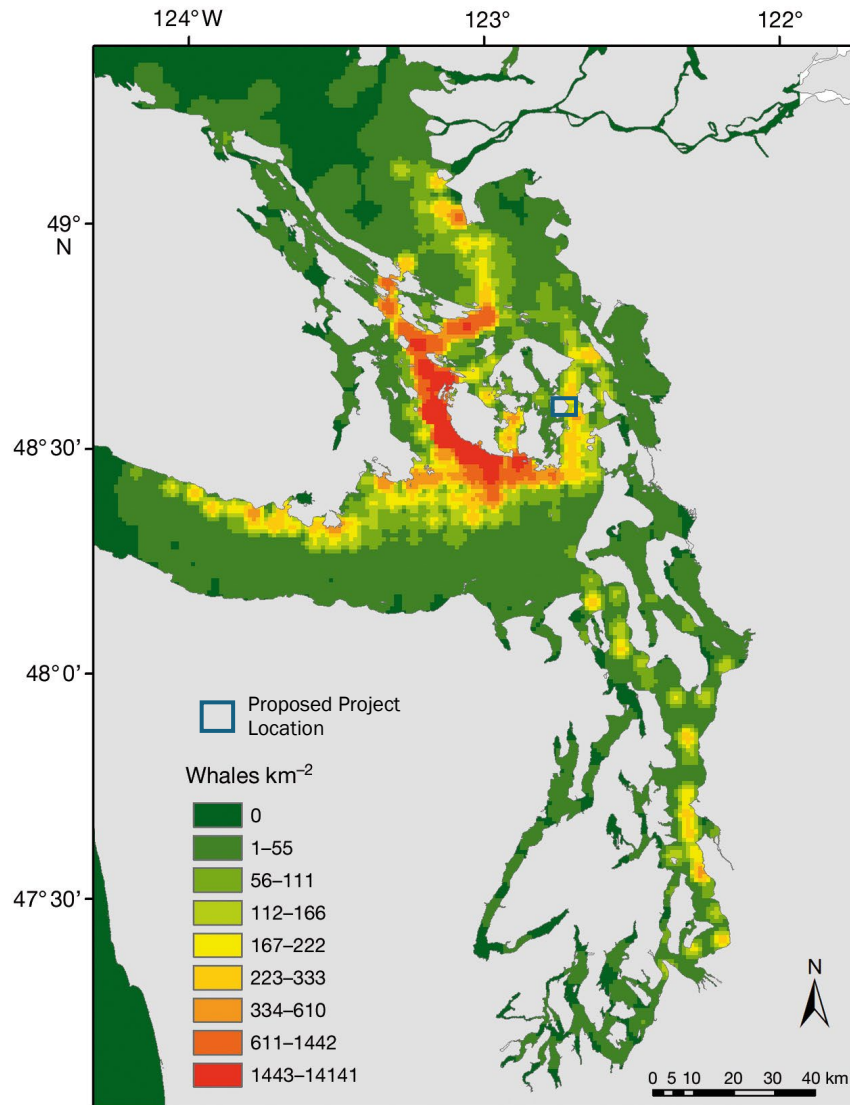


Figure 58. SRKW Density Based on Effort-Corrected Data in the Salish Sea from 1976–2014
 Source: Olson et al. 2018



Critical Habitat

Critical habitat for SRKWs was designated on November 29, 2006, effective December 29, 2006 (71 FR 69054). It was expanded on August 2, 2021, effective September 1, 2021 (86 FR 41668). Designated SRKW critical habitat includes the marine waters of Washington State, including “waters relative to a contiguous shoreline delineated by the line at a depth of 6.5 m [21.3 ft] relative to extreme high water.” The proposed Project area lies within SRKW designated critical habitat, as part of the *Summer Core Area*. The *Summer Core Area* consists of all U.S. marine waters in Whatcom and San Juan counties; and all marine waters in Skagit County west and north of the Deception Pass Bridge (Highway 20) (48° 24' 25" N/122° 38' 35" W) (86 FR 41668).

The PBFs essential for conservation of the SRKW are (86 FR 41668):

- Water quality to support growth and development.
- Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth.
- Passage conditions to allow for migration, resting, and foraging.

Humpback Whale, Central America and Mexico DPSs

On September 8, 2016, NMFS designated four DPSs of the humpback whale (*Megaptera novaeangliae*) as either threatened or endangered, effective October 11, 2016 (81 FR 62259). The Mexico DPS of humpback whales was designated as threatened and the Central America DPS as endangered. NMFS, Alaska Region, have published Section 7 guidance for humpback whale consultations, updated on August 6, 2021 (NMFS 2021a). Within it, NMFS lists the probability of encountering different humpback whale DPSs in inland Washington State waters (including the San Juan Islands) summer feeding area as follows: Hawaii DPS (not ESA-listed) at 69 percent; Mexico DPS (listed threatened) at 25 percent; and Central America DPS (listed endangered) at 6 percent (Wade 2021; NMFS 2021a).

Humpback whales can live up to 90 years, grow to a length of 18 m (60 ft), and weigh up to approximately 40 tons (NMFS 2024c). Their bodies are primarily black, but individuals have different amounts of white on their pectoral fins, bellies, and the undersides of their flukes (tails). Their flukes can be up to 5.5 m (18 ft) wide and are serrated along the trailing edge and pointed at the tips (NMFS 2024c). Female humpbacks mature and reproduce between approximately 5 and 11 years of age (Chittleborough 1955; Gabriele et al. 2017), producing a single calf every 2–3 years (Clapham et al. 2003). Humpback whales forage either at or below the water surface, feeding on benthic and pelagic organisms including euphausiids, copepods, and other crustacean zooplankton; small schooling fish (e.g., sand lance and herring); and salmonids, pollock, capelin, and some cephalopod mollusks (Perry et al. 1999).

Humpback whales primarily congregate along the continental shelf in coastal habitats that are highly productive and provide available prey. The west coast of Washington State is a corridor for humpback whale annual migration from their northern feeding grounds to their southern breeding grounds. The Mexico DPS population breeds along the Pacific Coast of Mexico and the Revillagigedo Islands, transits the Baja California Peninsula, and feeds across a broad range from California to the Aleutian Islands in Alaska (81 FR 62259; NMFS 2024c). The Central America DPS breeds along the Pacific coast of Central America and primarily feeds off the coast of California and Oregon, with a few entering northern Washington State and southern British Columbia waters (81 FR 62259; NMFS 2024c).

Sightings of humpbacks in the Salish Sea have been historically rare; however, they have been increasing since the late 1990s. A total of 13 unique individual humpback whales were sighted in 2003 and 2004, 11 of which could be identified in inside waters of British Columbia or Washington State (primarily in the Strait of Juan de Fuca and Strait of Georgia), including one juvenile in the San



Juan Islands (Falcone et al. 2005). In both 2014 and 2015, there were more than 500 sighting reports of humpback whales in the Salish Sea (Calambokidis et al. 2017). Most of the humpback sightings have occurred within the Strait of Juan de Fuca, Haro Strait, Moresby Passage, and Southern Puget Sound (Calambokidis et al. 2017). It is anticipated that a Mexico and/or Central America DPS humpback whale occurrence within the project area would be a rare event; however, there is the possibility that it could occur given their increasing presence within the Salish Sea and passages around the San Juan Islands.

Increased vessel strikes and fishing gear entanglement are the primary threats to the Mexico and Central America DPSs, especially in areas with large vessel traffic (Carretta et al. 2010, 2019; Neilson et al. 2012; Douglas et al. 2008; Bettridge et al. 2015; 81 FR 62259). Vessel noise from whale watching activities has been shown to be a driver of behavioral changes in humpback whales, resulting in decreased resting time, increased respiration rate, increased swim speed, and altered group cohesiveness (Senigaglia et al. 2016; Machernis et al. 2018; Sprogis et al. 2020).

Critical Habitat

On October 9, 2019, NMFS proposed designated critical habitat for the endangered Central America DPS and threatened Mexico DPS of humpback whales (84 FR 54354), publishing their final rule on April 21, 2021, effective May 21, 2021 (86 FR 21082). The designated critical habitat for the Central America DPS and Mexico DPS does not overlap with the proposed Project area.

3.5.1.2 MMPA Species

Whales

Whale species present within the Salish Sea include the gray whale (*Eschrichtius robustus*), minke whale (*Balaenoptera acutorostrata*), and humpback whale (*Megaptera novaeangliae*). The fin whale (*Balaenoptera physalus*) is extremely rare within the Salish Sea, with an anomalous sighting in 2016 in the Strait of Juan de Fuca and none confirmed between then and 1930 (Towers et al. 2018). Therefore, the fin whale is not further discussed in this document.

Gray Whales

Gray whales are between 13 and 15 m (43 and 49 ft), weighing up to 40,823 kg (90,000 lbs.), with a mottled gray body and small eyes above just above the corners of their mouth, broad pectoral flippers, and dorsal humps (NMFS 2024h). They are frequently observed traveling alone, or in small and mostly unstable groups. They inhabit shallow coastal waters in the North Pacific Ocean. Most of the eastern North Pacific stock, found along the west coast of North America, migrate north to the Bering and Chukchi Seas during the summer to feed. In the fall, gray whales migrate south to Baja California to breed, with calves born during migration or in Mexico's shallow lagoons and bays in January to mid-February (NMFS 2024h). They are primarily bottom feeders, consuming benthic and epibenthic invertebrates such as amphipods. Gray whales are observed in the spring and summer in Washington State's inland waters, and the areas around the San Juan Islands are important for their migration and feeding (Copping et al. 2021). Therefore, while it is anticipated that they are not common, there is the potential for gray whales to be present within or near the project area.

Minke Whales

Minke whales are the smallest species of rorqual baleen whales in North American waters (i.e., whales that have pleats or grooves on their throats and bellies, known for their ability to take in large amounts of water and food when feeding). They have dark, sleek bodies that can reach up to 11 m (36 ft) in length and weigh up to 9,072 kg (20,000 lbs.), with black to dark gray-brown in color with a white underbelly and a pale chevron on their back behind their head (NMFS 2024i). Minkes vocalize and create sounds that include clicks, grunts, pulse trains, ratchets, thumps, and "boings." They are usually sighted individually or in small groups of two or three but have been observed in groups as large as 400 in feeding areas near the Earth's poles. They most likely mate and calve in the winter



and opportunistically feed on crustaceans, plankton, and small schooling fish (e.g., anchovies, dogfish, coal fish, cod, eels, mackerel, and more) (NMFS 2024j).

Minke whales are found in coastal and oceanic areas globally but prefer temperate to boreal waters. They feed in cooler waters at higher latitudes and can be found in both inshore coastal and offshore oceanic areas. Minke whales are present within the inland waters of Oregon, California, and Washington State—including around the San Juan Islands—and are considered “residents” because they have an established home range (i.e., not all migrate) (Towers et al. 2013). Minke whales can be seen during the summer months (April through October) in the waters of the San Juan Islands (Towers et al. 2013). Therefore, it is anticipated that Minke whales could potentially be present within or near the project area.

Dolphins and Porpoises

Dolphins and porpoise species present within the Salish Sea include the Bigg’s (Transient) killer whale, short-finned pilot whale (*Globicephala macrorhynchus*), Dall’s porpoise (*Phocoenoides dalli*), harbor porpoise (*Phocoena phocoena*), and Pacific white-sided dolphin (*Lagenorhynchus obliquidens*).

Killer Whale, Bigg’s (Transient)

Bigg’s (also known as “Transient”) killer whales (*Orcinus rectipinnus*) are considered a separate killer whale ecotype than SRKWs (Morin et al. 2024). Bigg’s killer whales differ slightly in size and appearance from SRKWs within the Salish Sea. Male transients can grow to lengths exceeding 8 m (27 ft) and have a tall dorsal fin (at least 1.5 m [5 ft]), while female transients can grow to lengths greater than 7 m (23 ft) and have a slightly triangular dorsal fin with a pointed tip and wider base. Bigg’s killer whales are highly social, have a smaller group size than SRKWs, and offspring of either sex may disperse from their mother’s group (Morin et al. 2024). Bigg’s are typically silent while foraging and roam widely in search of prey, with some seasonal patterns.

Bigg’s killer whales have a range in the North Pacific Ocean basin that spans the coasts off Northern Mexico, north along the U.S. West Coast to the Aleutian Islands, Alaska, to waters off the eastern coast of Russia and northern Japan (Morin et al. 2024). They have had an increasing presence within the Salish Sea over the past four decades, with record sightings beginning in the late 2010s (Shields et al. 2018). Historically, Bigg’s killer whale presence in the Salish Sea has peaked during the months of August to September but starting in the 2000s they began to peak a second time of the year during April to May (Houghton et al. 2015; Shields et al. 2018). Unlike SRKWs, which primarily feed on Chinook salmon, Bigg’s have a diet that consists mostly of other marine mammals. Bigg’s feed on harbor seals, a species which comprises just over 50 percent of their diet, but they also occasionally feed on squid (Ford et al. 2013; Shields et al. 2018). Bigg’s killer whales have been observed within the Salish Sea feeding on harbor seal at haul out sites (e.g., around Protection Island) (McInnes et al. 2020). Considering that harbor seals are considered common in and around the Salish Sea and project area, and the occurrence of Bigg’s killer whales throughout the Salish Sea, there is the potential that they may be present in or near the project area.

Short-finned Pilot Whale

The short-finned pilot whale is one of two species of pilot whales, the other being the long-finned pilot whale. Short-finned pilot whales are long-lived, slow to reproduce, and are highly social. They have a bulbous head without an obvious rostrum and have a black or dark brown body with a large gray saddle behind their dorsal fin. They are between 3.5 and 7.5 m (11.5 and 24.6 ft) in length and weigh between 1,000 and 3,000 kg (2,200 and 6,600 lbs.), living for 35 -60 years (NMFS 2024j). Females have calves every 5 to 8 years, with a 15-month gestational period. Short-finned pilot whales live in stable groups of about 15–30 individuals comprised of close family relatives, and typically live in localized, resident populations. Their diet consists mainly of squid, also feeding on octopuses and small fish, in water depths below approximately 305 m (1,000 ft; NMFS 2024j).

Short-finned pilot whales are found around the globe but tend to prefer warmer tropical and temperate waters. Three stocks are found in U.S. waters: east coast, west coast, and Hawaii. Once abundant, the west coast stock has plummeted, currently estimated at approximately 800 individuals (Barlow 2016). While the range of the short-finned pilot whale does include the Salish Sea, it is highly unlikely that any would be present within or near the Project area since they virtually disappeared from the U.S. west coast after a strong El Niño event in 1982-1983, after which, sightings and takes have been rare (Barlow 2016; NMFS 2016c).

Dall's Porpoise

Dall's porpoises are common throughout the northern Pacific Ocean along the U.S. west coast, between California and the Bering Sea in Alaska. They reach 2.1–2.4 m (7–8 ft) in length, weighing up to 181 kg (400 lbs.), and live for 15–20 years. They are relatively fast swimmers that can achieve 55 km per hour (34 miles per hour) in short bursts (NMFS 2024k). They have a small and triangular head with little-to-no beak, and a thick robust body, sometimes mistaken for baby killer whales. Dall's porpoises are typically found in groups averaging between 2 and 12 individuals but can be found in groups of hundreds or even thousands. Dall's porpoises can dive to depths of 500 m (1,640 ft) to prey on small schooling fish (e.g., anchovies, herring, and hake), mid- and deep-water fish (e.g., lantern fish and smelts), cephalopods (e.g., squids and octopuses), and crustaceans (e.g., crabs and shrimp) (NMFS 2024k).

Dall's porpoises live in temperate to boreal waters greater than 183 m (600 ft) deep, with temperatures ranging from 2–17 °C (36–63 °F). They are found in offshore, inshore, and nearshore waters between 30° N and 62° N latitudes (NMFS 2024k). They occur throughout the coastal and pelagic waters of the northern Pacific Ocean, commonly found in the Gulf of Alaska, Bering Sea, Okhotsk Sea, and Sea of Japan. They are also commonly seen in the inshore waters of Washington State, British Columbia, and Alaska, with migration patterns based on morphology, geography, and seasonality (NMFS 2024k). Dall's porpoise is considered a prominent species in the San Juan Islands archipelago and are present year-round (Teller 2012). Dall's porpoises tend to be found in deeper waters around the San Juan Islands (e.g., those in the Haro Strait), but can be present within shallower waters (Calambokidis et al. 2004; Teller 2012). Given their presence around the San Juan Islands, there is the potential for Dall's porpoise to be present within or near the Project area; however, given their preference for deeper waters (e.g., approximately 183 m [600 ft]) than exist at the Project area, it is anticipated that they would be uncommon, if present.

Harbor Porpoise

Harbor porpoises are not ESA-listed but are protected by the MMPA. They have a small, robust body with a short blunt beak and medium-sized triangular dorsal fin. They reach 1.5–1.7 m (5–5.5 ft) in length, weighing between 61 and 77 kg (135 and 170 lbs.), and have a lifespan of approximately 24 years (NMFS 2024l). Their back is dark gray, which fades to lighter gray along their sides, and their belly and throat are white with a dark gray chin patch. They are shy animals, most often seen in groups of two or three, but have been reported in groups of 10 or up to 200. Harbor porpoises primarily consume schooling fish (e.g., herring and mackerel) and occasionally eat squid and octopus.

Harbor porpoises live in northern temperate and subarctic waters, including arctic coastal and offshore waters. Off the west coast of North America, they are found from Point Conception (off of Central California) to the Beaufort Sea in Alaska. They inhabit waters east of Cape Flattery, Washington, year-round and are often found in harbors, bays, and estuaries in waters shallower than 200 m (656 ft; NMFS 2024l). Historically, harbor porpoises have been in higher densities than other marine mammal species (e.g., Dall's porpoise) around the San Juan Islands, and are considered a prominent species throughout the archipelago (Teller 2012). Harbor porpoises are more common in shallow waters, such as the San Juan Channel, (Calambokidis et al. 2004; Hayes 2014) and have a high probability of presence within the coastal waters of each major island of the San Juan Islands,



including Blakely Island (Cox 2021). Therefore, it is considered likely that harbor porpoises would be present within and near the Project area.

Pacific White-sided Dolphin

Pacific white-sided dolphins have a robust body, short rostrum (nose), and large dorsal fin relative to their body size. Their bellies are white; their back, fluke, and lips are black; and their sides, dorsal fin, and flippers are gray. They also have a white or light gray stripe that extends from their eye to their tail. The typical adult is 1.7–2.4 m (5.5–8 ft) in length, weighs 136–181 kg (300–400 lbs.), and has a lifespan of 36–40 years (NMFS 2024m). Females have a 9-month gestation period, giving birth in late spring to fall (except in the central Pacific, where calves are born in late winter to spring). Their diet consists of squid and small schooling fish (e.g., capelin, sardines, and herring). They eat up to 9 kg (20 lbs.) of food daily and are considered a playful and social animal.

Pacific white-sided dolphins live in the open ocean and the nearshore waters of the temperate north Pacific Ocean but are unlikely to be very close to shore. In the U.S., the Pacific white-sided dolphin lives off the coasts of California, Oregon, Washington State, and Alaska, and can usually be seen in group sizes of 10–100 (NMFS 2024m). Their range includes Washington State's inland waters, including the Salish Sea. Pacific white-sided dolphins occupy a similar ecological niche as harbor porpoises and occur in greater densities throughout the Salish Sea during the fall and winter (Cox 2021). While they may be present throughout the Salish Sea, it is unclear how probable their presence would be within the San Juan Islands, given the lack of observations and recent scientific evidence. It is considered unlikely that Pacific white-sided dolphins would occur within the Project area.

Pinnipeds

Seals and sea lions (i.e., pinnipeds) are present within the Salish Sea, including the California sea lion (*Zalophus californianus*), harbor seal (Washington State Inland Waters Stock; *Phoca vitulina*), northern elephant seal (*Mirounga angustirostris*), and Steller sea lion (*Eumetopias jubatus*).

California Sea Lion

California sea lions are “eared seals” native to the west coast of North America, living in coastal waters and hauling out to move around on beaches, docks, buoys, and jetties. Females are 1.8 m (6 ft) in length and can weigh up to 109 kg (240 lbs.), while males are 2.3 m (7.5 ft) in length and can weigh up to 318 kg (700 lbs.; NMFS 2024n). They have a lifespan of approximately 20–30 years. Adult females and juveniles are slender-bodied and blonde to tan in color, while adult males are mostly dark brown and black. They have broad front flippers and long, narrow snouts, visible ear flaps, and three to five claws on their hind flippers. They are social on land and in water, and bark like dogs to communicate with one another. California sea lions are deep-diving animals that prey on squid, anchovies, mackerel, rockfish, and sardines in offshore coastal upwelling areas (NMFS 2024n).

California sea lions range from southeast Alaska to the Pacific coast of central Mexico. Their breeding range is from the Channel Islands in southern California to central Mexico. There are no major breeding colonies located near Washington State's coast or in the Salish Sea. Males migrate during the winter to feeding areas off California, Oregon, Washington, British Columbia, and southeast Alaska, but females and pups stay near the breeding colonies until pups are weaned (NMFS 2024n). In warm water years (such as an El Niño event), they can be found as far north as Oregon and Washington, including throughout the Salish Sea and San Juan Islands where they have been observed during spring months (Jefferson et al. 2023). California sea lions are considered common throughout the Salish Sea and are anticipated to potentially occur within and around the Project area.



Harbor Seal (Washington State Inland Waters Stock)

Harbor seals are one of the most common marine mammals along the U.S. west and east coasts, commonly seen resting on rocks and beaches. NMFS has identified 16 stocks of harbor seals, with the Washington State Inland Waters Stock present within the Salish Sea (NMFS 2024o).

Harbor seals are part of the “true seal” family. They have short forelimbs (i.e., flippers) and lack external ear flaps, instead having a small hole on either side of their head. They have two basic fur color patterns: light tan to silver, or blue-gray with dark speckling or spots and a dark background with light rings. Adult harbor seals weigh approximately 82–130 kg (180–285 lbs.), reaching 1.5–1.8 m (5–6 ft) in length, and have a lifespan of approximately 25–30 years (NMFS 2024o).

Harbor seals haul out on rocks, reefs, beaches, and drifting glacial ice to regulate their body temperature, molt (shed old fur and grow new fur), socialize, give birth, and nurse their pups. They make shallow dives to hunt for fish, shellfish, and crustaceans.

Harbor seals live in temperate coastal habitats along the northern coasts of North America, Europe, and Asia. Along the U.S. west coast, harbor seals are found from Baja California to the Bering Sea. They are considered non-migratory, generally remaining within 24–50 km (15–31 miles) of their natal area; however, tracking data have shown that they sometimes travel 100–784 km (62–487 miles) to exploit seasonally available food or birth their pups (NMFS 2024o). Females typically give birth during the spring and summer months, but seals of the Washington State Inland Waters Stock are born approximately 2 months later than seals along Washington State’s outer coast. Harbor seals are abundant throughout the Salish Sea, and surveys have confirmed their presence throughout the San Juan Islands (numbering in the thousands) (Jefferson et al. 2021). Therefore, it is considered likely that harbor seals could occur within and near the Project area.

Northern Elephant Seal

The northern elephant seal is the largest of the “true seals” of the northern hemisphere. Fully grown adult males weigh up to 2,000 kg (4,400 lbs.) and can reach lengths surpassing 4 m (13 ft). Females are significantly smaller, weighing up to 590 kg (1,300 lbs.) and reaching approximately 3 m (10 ft) in length (NMFS 2024p).

They have a lifespan of approximately 13 years (males) to 19 years (females). Adult northern elephant seals are dark brown or gray. When males reach puberty at approximately 7 years of age, they develop a proboscis (large inflatable nose) and a thick neck with calloused skin to protect them when fighting other males. Pups are born in early winter, from December to January, after an 11-month gestation period. Females have smaller noses and smoother necks. Northern elephant seals primarily consume squid and fishes, as well as rays and sharks. Males typically feed near the eastern Aleutian Islands and in the Gulf of Alaska, while females feed farther south in the offshore waters of Washington State and Oregon. In March to August, adults return to land to molt (males later than females) and return to their feeding areas between their spring-summer molt and winter breeding season (NMFS 2024p).

Northern elephant seals are found in the eastern and central North Pacific Ocean, ranging from Baja California to Alaska, and typically breed in the southern portion of their range from December to March (NMFS 2024p). Their range includes the Salish Sea (NMFS 2024p); however, they appear to occur mostly off the outer coast of California, Oregon, and Washington, and at the southern end of their range off the coast of Baja California, Mexico and southern California, particularly on the Channel Islands (Lowry et al. 2014; NMFS 2024p). Therefore, it is anticipated that it would be unlikely that northern elephant seals occur within or near the Project area.

Steller Sea Lion (Eastern DPS)



The Steller sea lion is the largest member of the “eared seals,” which include all sea lions and fur seals. They are split into two populations—Eastern DPS (not ESA-listed) and Western DPS (listed endangered)—which differ genetically and morphologically.

Steller sea lions are sexually dimorphic. Males can weigh up to 1,134 kg (2,500 lbs.) and reach approximately 3.4 m (11 ft) in length, while females can weigh up to 363 kg (800 lbs.) and reach 3 m (9.8 ft) in length (NMFS 2024q). They have a lifespan of 20 (males) to 30 (females) years and molt every year. Adult males have long, coarse hair on their chest, shoulders, and back, and have a chest and neck more massive and muscular than a female’s. Both males and females have light blonde to reddish brown coats that are slightly darker on the chest and abdomen. Steller sea lions have a wide diet that varies in different parts of their geographic range. They forage and feed both nearshore and offshore, in benthic and pelagic zones, on more than 100 species of fish (e.g., Atka mackerel, walleye pollock, salmon, Pacific cod, Pacific herring, rockfish) and cephalopods (e.g., squid and octopus) (NMFS 2024q).

Steller sea lions are colonial breeders, mating and giving birth on land at traditional sites known as rookeries, typically coming back to mate on their natal rookery site (e.g., beaches, ledges, and rocky reefs) each year. Pupping occurs from mid-May to mid-July, peaking in June (NMFS 2024q).

Steller sea lions are distributed along the coast and also inhabit deeper continental slope and pelagic waters during the non-breeding season. Previous survey efforts showed Steller sea lions to be uncommon, but they have been observed in the San Juan Islands, mostly during the autumn months but also spring and winter (Gaydos and Pearson 2011; Jefferson et al. 2023). They also have a population within the nearby San Juan Channel (Wilkins 2011) and can be found throughout the Salish Sea (Gaydos and Pearson 2011; Cox 2021). Therefore, it is anticipated that there is the potential for Steller sea lions to be present within and near the Project area.

3.5.1.3 *Porpoise clicks*

Additional opportunistic measurements conducted by APL-UW used ‘C-POD’ (Chelonia) click detectors with automated onboard processing to listen for marine mammal echolocation and record the details of the click trains associated with each echolocation event. **Figure 59** shows detections by species class reported by the manufacturer software. Each click event is assigned a certainty value based on its acoustic characteristics, with subsequent analysis restricted to events with “Hi(gh)” and “Mod(erate)” certainties. Click events are statistically represented through “detection positive minutes” (DPM), i.e., a minute with at least one click event at a given certainty level. As shown in **Figure 59**, the only species with routinely high certainty classifications are harbor porpoises. The “low” certainty click events mirror those with “Mod” certainty. “Dolphin” click events, which would be indicative of SRKW echolocation, are generally absent in the data (only possible classifications are low certainty). Sonars are intermittently detected with moderate to high certainty, potentially associated with subsistence fishing or deployment/retrieval operations by the R/V Jack Robertson. The “No Species” click events are all low certainty and, given the roughly 14-day oscillations, may be “clicks” associated with sediment transport during period with stronger currents (Bassett et al. 2013).

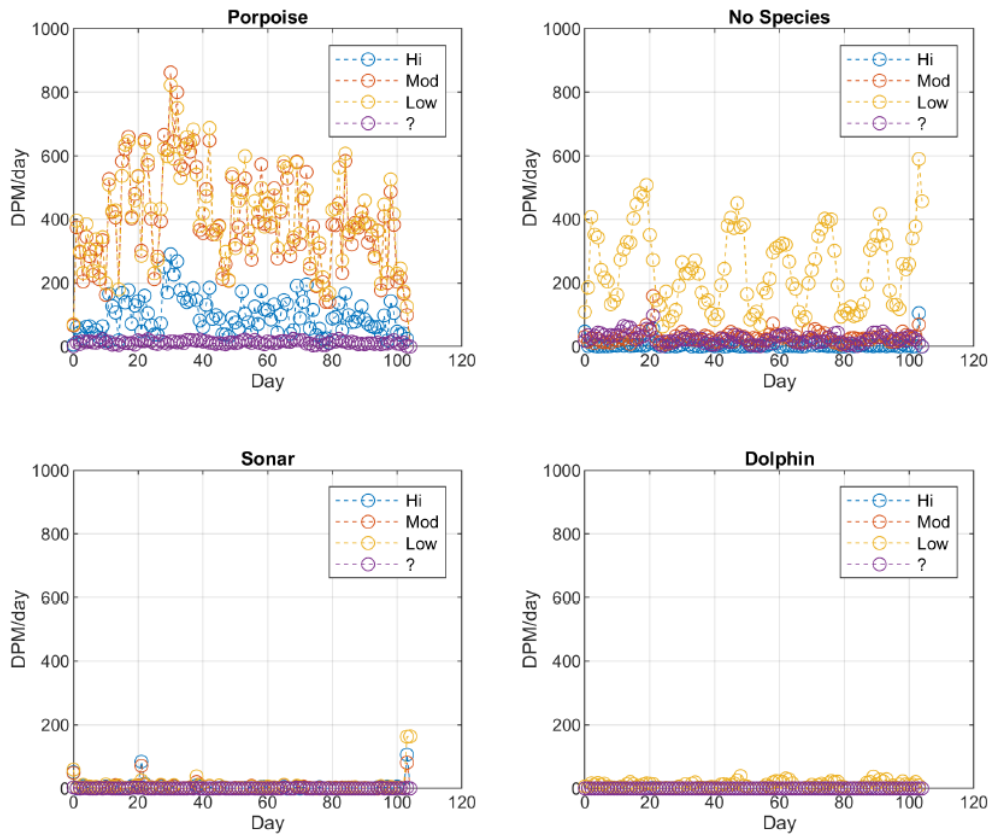


Figure 59. C-POD Detections by Certainty Level and Click Event Type

3.5.2 Avian Species

Numerous avian species are present on and/or around Blakely Island and the proposed Project area within Rosario Strait. However, the suitability of larger islands for nesting, including Blakely Island, within the San Juan Islands archipelago has been reduced due to habitat loss and threats associated with development and disturbance (Copping et al. 2021). The avian species listed in **Table 12** are birds that: (1) are of particular concern, warranting special attention within the proposed Project area; (2) may be present on and/or around Blakely Island; or (3) may have nearby nesting sites within the San Juan Islands National Wildlife Refuge (NWR). Blakely Island is not part of the San Juan Islands NWR. While there are no terrestrial portions of the Project, migratory avian species found on Blakely Island are included due to their proximity to the proposed Project area and potential for flying in relatively proximity to Project components, including offshore areas.

An increased probability of presence for each species, as identified by the USFWS, is included where possible in **Table 12**. The increased probability of presence approximately corresponds to migration timing through the proposed Project area, as determined by USFWS survey efforts (USFWS 2024b, 2024c). Note, however, that data gaps exist for certain time periods for each species; therefore, these time windows are approximations, and it is possible that there are times outside of them in which these avian species may be present within the proposed project area.



Table 12. Avian Species that May Be Present within the Proposed Project Area

Common Name (<i>Scientific Name</i>)	San Juan Islands NWR Common Nesting Species ¹	Occurrence on Blakely Island and/or Offshore Proposed Project area ²	Increased Probability of Presence (USFWS)	Breeding Season Across Entire Range
Eagles				
Bald Eagle (<i>Haliaeetus leucocephalus</i>)	No	Blakely Island	Resident (year-round)	Mar. 1 to Aug. 31
Golden Eagle (<i>Aquila chrysaetos</i>)	No	Blakely Island	Early- to Mid-Apr.	Mar. 1 to Aug. 31
Migratory and Seabirds				
Ancient Murrelet (<i>Synthliboramphus antiquus</i>)	No	Blakely Island	Mid-Nov. to Early-Jan; Early-May	Mar. 10 to Sept. 10
Black Oystercatcher (<i>Haematopus bachmani</i>)	No	Blakely Island	Resident (year-round)	Apr. 15 to Oct. 31
Black Swift (<i>Cypseloides niger</i>)	No	Blakely Island	Mid-Sept.	June 15 to Sept. 10
Black Turnstone (<i>Arenaria melanocephala</i>)	No	Blakely Island	Early- to Mid-March; End-July to Mid-Apr.	Breeds elsewhere
Brandt's Cormorant (<i>Phalacrocorax penicillatus</i>)	No	Blakely Island	Mid-Oct. to Early-Jan; Early-Mar. through Apr.; Early-July; Mid-Aug. to Mid-Sept.	Apr. 15 to Sept. 15
California Gull (<i>Larus californicus</i>)	No	Blakely Island	Mid-July to Mid-Nov.; Early-Mar., Apr, and May	Mar. 1 to July 31
Chestnut-backed Chickadee (<i>Poecile rufescens rufescens</i>)	No	Blakely Island	Resident (year-round)	Mar. 1 to July 31
Common Loon ³ (<i>Gavia immer</i>)	No	Blakely Island, Offshore Proposed Project area	Early Mar. to End-May; Early Oct.	Apr. 15 to Oct. 31
Common Murre (<i>Uria aalge</i>)	No	Blakely Island, Offshore Proposed Project area	End-Oct. to End-Jan.; Early Mar. to End-April; End-July through Sept.	Apr. 15 to Aug 15. ¹



Common Name (<i>Scientific Name</i>)	San Juan Islands NWR Common Nesting Species ¹	Occurrence on Blakely Island and/or Offshore Proposed Project area ²	Increased Probability of Presence (USFWS)	Breeding Season Across Entire Range
Double-crested Cormorant (<i>Phalacrocorax auritus</i>)	Yes	Blakely Island, Offshore Proposed Project area	Early Mar. to End-Apr; Early-July; Mid-Aug. to Early Jan.	Apr. 20 to Aug. 31
Evening Grosbeak (<i>Coccothraustes vespertinus</i>)	No	Blakely Island	Early-May; June	May 15 to Aug. 10
Lesser Yellowlegs (<i>Tringa flavipes</i>)	No	Blakely Island	Early-May and Early-Aug.	Breeds elsewhere
Long-tailed Duck (<i>Clangula hyermalis</i>)	No	Blakely Island, Offshore Proposed Project area	Early Mar. to End-April; Dec.	Breeds elsewhere
Marbled Godwit (<i>Limosa fedoa</i>)	No	Blakely Island	Early-Sept.	Breeds elsewhere
Marbled Murrelet ^{3,4} (<i>Brachyramphus marmoratus</i>)	No ⁵	Blakely Island, Offshore Proposed Project area	Apr to mid-May; End-June to End-Oct.	Breeds elsewhere
Olive-sided Flycatcher (<i>Contopus cooperi</i>)	No	Blakely Island	Mid-May to Mid-Aug.	May 20 to Aug. 31
Red-breasted Merganser (<i>Mergus serrator</i>)	No	Blakely Island, Offshore Proposed Project area	Early Dec. to End-April; Early Oct.	Breeds elsewhere
Red-necked Phalarope (<i>Phalaropus lobatus</i>)	No	Blakely Island, Offshore Proposed Project area	End-July to Early-Sept.	Breeds elsewhere
Red-throated Loon (<i>Gavia stellata</i>)	No	Blakely Island, Offshore Proposed Project area	Early-Mar. to Mid-April; Early-Dec.	Breeds elsewhere
Ring-billed Gull (<i>Larus delawarensis</i>)	No	Blakely Island, Offshore Proposed Project area	Early-Jan.; Early-Aug. to Early-Oct; End-Nov.	Breeds elsewhere
Rufous Hummingbird (<i>Selasphorus rufus</i>)	No	Blakely Island	End-March to Early-Aug.	Apr. 15 to July 15
Short-billed Dowitcher (<i>Limnodromus griseus</i>)	No	Blakely Island	Mid-July to Mid-Aug.	June 1 to Aug. 10



Common Name (<i>Scientific Name</i>)	San Juan Islands NWR Common Nesting Species ¹	Occurrence on Blakely Island and/or Offshore Proposed Project area ²	Increased Probability of Presence (USFWS)	Breeding Season Across Entire Range
Surf Scoter (<i>Melanitta perspicillata</i>)	No	Blakely Island, Offshore Proposed Project area	End-Nov. to End-Apr.; Early-July; Mid-Sept. to Mid-Oct	Breeds elsewhere
Tufted Puffin ³ (<i>Fratercula cirrhata</i>)	Yes	Blakely Island, Offshore Proposed Project area	End-June	Breeds elsewhere
Western Grebe ³ (<i>Aechmophorus occidentalis</i>)	No	Blakely Island	End-Sept., Oct., Nov., Dec., and Jan.	June 1 to Aug. 31
Western Gull (<i>Larus occidentalis</i>)	No	Blakely Island	End-Jan.; Mid-Apr.; Early-Mid Aug.	Apr. 21 to Aug. 25
Western Screech-owl (<i>Megascops kennicottii cardonensis</i>)	No	Blakely Island	End-May and Early-Aug.	Mar. 1 to June 30
White-winged Scoter (<i>Melanitta fusca</i>)	No	Blakely Island, Offshore Proposed Project area	Early- to Mid-Dec.	Breeds elsewhere

Notes: ESA = Endangered Species Act; NWR = National Wildlife Refuge; IPaC = Information for Planning and Consultation; PHS = Priority Habitats and Species; USFWS = U.S. Fish and Wildlife Service; WDFW = Washington Department of Fish and Wildlife

1. There are additional San Juan Islands NWR common nesting species that do not appear in this table, but may be present within the project area, including the following: rhinoceros auklet (*Cerorhinca monocerata*), pigeon guillemot (*Cephus columba*), pelagic cormorant (*Phalacrocorax pelagicus*), and glaucous-winged gull (*Larus glaucescens*). These species are present and known to nest in the San Juan Islands, or within the Salish Sea more generally, but they do not appear when using agency tools (e.g., USFWS’s IPaC and WDFW PHS range mapper) on Blakely Island or the offshore project area.
2. Some species were identified as being located on Blakely Island, but not offshore (and vice versa), using USFWS’s IPaC planning tool (USFWS 2024b, 2024c). Species located on Blakely Island may also potentially appear within the offshore project area (e.g., ancient murrelets) while foraging or migrating to and from Blakely Island and other areas.
3. Species is also listed as a PHS (Larsen et al. 2004; WDFW 2008).
4. Species is also protected under ESA.
5. Marbled murrelets are not observed on San Juan Island NWR islands, but forage in waters around refuges (USFWS 2010).

Sources: Larsen et al. 2004; WDFW 2008; USFWS 2010, 2024b, 2024c

There are additional avian species that may be present within the San Juan Islands archipelago, or are San Juan Islands NWR common nesting species, that do not appear in **Table 12**, but have the potential to occur within the project area due to their general presence in the Salish Sea, including the following: rhinoceros auklet (*Cerorhinca monocerata*), pigeon guillemot (*Cephus columba*), pelagic cormorant (*Phalacrocorax pelagicus*), and glaucous-winged gull (*Larus glaucescens*). These species are present and known to nest in the San Juan Islands, or within the Salish Sea more generally (e.g., on Protection Island near Admiralty Inlet), but they do not appear when using agency tools (e.g., USFWS’s IPaC and WDFW’s PHS range mapper) on Blakely Island or the offshore project area.



3.5.2.1 Federally Listed Avian Species

The federally listed marbled murrelet (*Brachyramphus marmoratus*) may occur within the project area, as they are known to forage in nearshore waters throughout the San Juan Islands. According to the USFWS (2024b), species lists, and information gathered from existing wildlife resource agency databases, the yellow-billed cuckoo (*Coccyzus americanus*) and northern spotted owl (*Strix occidentalis caurina*) may also occur within portions of the proposed Project area. However, existing evidence indicates that these species are extremely unlikely to be present within the proposed Project area or affected by project activities (Forsman et al. 2002; Carroll and Johnson 2008; USFWS 2011; Wiles and Kalasz 2017; 79 FR 59992).

Marbled Murrelet

The USFWS listed the marbled murrelet (*Brachyramphus marmoratus*) as threatened in Washington State, Oregon, and California on October 1, 1992, effective November 2, 1992 (57 FR 45328). In 2015, the estimated Washington State population was about 7,500 birds, concentrated near the Strait of Juan de Fuca and northern Puget Sound (Desimone 2016; WDFW 2024I). As of 2021, WDFW surveys have estimated approximately 3,100 murrelets in the Strait of Juan de Fuca, San Juan Islands, and Puget Sound (McIver et al. 2021).

Marbled murrelets are small diving seabirds, living up to 15 years and reaching maturity at the age of 2–3 years. Their breeding season occurs from early April through late September. Most of the marbled murrelet's biological and physical interactions occur at sea, usually within 2 km (1.2 miles) of the shoreline where they spend time foraging, loafing, molting, preening, and exhibiting courtship behavior (USFWS 1997; McShane et al. 2004). They prefer sheltered foraging grounds within 1.6–4.8 km (1–3 miles) from shore, diving to feed on small fish (e.g., surf smelt, sand lance, herring) and invertebrates (e.g., mysids, euphausiids, amphipods) (Burkett 1995; Desimone 2016; Pearson et al. 2022). They forage at all times of the day and in some cases during night hours (Ralph et al. 1995). Diving depth varies and may depend on location of prey species but typically occurs in waters less than 30 m (98 ft) deep (McShane et al. 2004; Desimone 2016; WDFW 2024I).

Marbled murrelets come inland to nest in forest stands with late-successional and dense old-growth forest, characterized by large trees with large branches or deformities for use as nesting platforms (Ralph et al. 1995; McShane et al. 2004; Piatt et al. 2007; USFWS 2024a). Large and unfragmented stands of old-growth, dominated by Douglas-fir, appear to be the highest quality habitat for marbled murrelet nesting. Marbled murrelets nest in old-growth forests on the Olympic Peninsula, Washington State and Vancouver Island, British Columbia (USFWS 2010). The highest nesting presence is on the Olympic Peninsula, the northern Cascades, and in limited remaining habitat in southwest Washington State (WDFW 2024I). Marbled murrelets are not known to nest within the San Juan Islands archipelago, and it seems unlikely that they do as their preferred nesting and critical habitat primarily is located on the Olympic Peninsula and Cascade Mountain Range; however, they do forage in the waters near the San Juan Islands NWR (61 FR 26256; USFWS 2010).

The largest portion of the marbled murrelet population occurs in Alaska and British Columbia, Canada. In Washington State, the current and historical marine distribution of marbled murrelets includes northern Puget Sound, the Strait of Juan de Fuca, and along the northwestern coast (Desimone 2016; DNR 2018). While at-sea distribution varies over time and location, there is a general shift in winter abundance eastward from the Strait of Juan de Fuca to Puget Sound and the San Juan Islands. In fall and winter, British Columbia's populations move southward toward Puget Sound (DNR 2018). The range for marbled murrelets includes the Rosario Strait and San Juan Islands (USFWS 2024a), including marine waters off the southeast shore of Blakely Island (Lorenz et al. 2016; Lorenz and Raphael 2018). The San Juan Islands provide breeding and marine foraging habitat for marbled murrelets, and they have been observed and recorded as extensively using the marine waters throughout the archipelago (Lorenz et al. 2016; Lorenz and Raphael 2018) making it likely that they would be present around the project area.



Continued threats to marbled murrelet recovery include forest fragmentation and loss (particularly due to commercial timber harvest and wildfires) and nesting habitat degradation, climate change impacts on marine and forest habitats, pollutants, and mortality from commercial fishing nets (Desimone 2016; USFWS 2024a).

Critical Habitat

The USFWS designated critical habitat for the marbled murrelet on May 24, 1996, effective June 24, 1996 (61 FR 26256), revised it on October 5, 2011 (effective November 4, 2011) (76 FR 61599), and then on August 4, 2016, confirmed the effective date of November 4, 2011 (81 FR 51348). There is no designated critical habitat for the marbled murrelet within the proposed Project area.

Yellow-Billed Cuckoo

Only 20 sightings of yellow-billed cuckoos have been documented in Washington State since the 1950s, 16 of which occurred in Eastern Washington, with nineteen occurring from 1974 to 2016 at an average rate of one sighting every 2.3 years (Wiles and Kalasz 2017). The last confirmed breeding occurred in Washington State in the 1930s, thereby making it likely that they are extirpated as a breeder in Washington (79 FR 59992; Wiles and Kalasz 2017). Records of yellow-billed cuckoos in nearby Whatcom and Skagit counties pre-date 1950, and no historical detections have occurred on the San Juan Islands (Wiles and Kalasz 2017). In western Washington, yellow-billed cuckoos are strongly associated with large patches of low to mid-elevation riparian habitat characterized by high humidity (79 FR 59992). Yellow-billed cuckoos are not expected to occur within the Project area due to their extremely low numbers in Washington State, lack of historical record of appearing on the San Juan Islands, and lack of any suitable habitat, such as riparian corridors, since the Project occurs offshore.

Northern Spotted Owl

Northern spotted owls generally rely on old-growth forest habitats (Carroll and Johnson 2008) because such forests contain the structures and characteristics required for their nesting, roosting, and foraging (USFWS 2011). They also disperse through highly fragmented landscapes typical of mountain ranges found in Washington State and Oregon (e.g., Cascade Range) (USFWS 2011). However, large bodies of water, such as those found in Washington State's inland waters (e.g., Hood Canal, Puget Sound, etc.), as well as large tracts of unforested land, act as barriers to movement and dispersal of northern spotted owls (USFWS 2011). Radio telemetry suggests that northern spotted owls move around large bodies of water, rather than through them, and do not typically cross them (Forsman et al. 2002). Therefore, it is very unlikely that the northern spotted owl would be present within or near the proposed Project area.

3.5.2.2 *Bald and Golden Eagles*

The MBTA and Bald and Golden Eagle Protection Act of 1940 (**Section 1.3.1.3**) were established to protect avian species by minimizing harmful disturbances due to anthropogenic activities. It is expected that both Bald and Golden eagles may occur within and/or near the Project area.

Bald Eagle

Bald eagles (*Haliaeetus leucocephalus*) are widely distributed across North America and area associated with aquatic habitats, including marine coasts (e.g., oceans, bays, and estuaries), rivers, and lakes (Kalasz and Buchanan 2016). Their breeding range extends from Alaska south through northern Canada and the lower 48 states, with the largest populations along coasts and large inland waterways (Kalasz and Buchanan 2016). Their average home range within Washington State during breeding season is 4.9 square kilometers (km²) (1.9 miles²) (Watson 2002). Post-breeding dispersal is complex in Washington State, but after nestlings have fledged, breeding bald eagles migrate north to British Columbia and Alaska to forage on late summer and fall run salmonids, returning in the early winter to their nesting territories (Watson and Pierce 2001; Stinson et al. 2001, 2007).



Washington State also supports a substantial population of wintering bald eagles, as well as others that remain year-round near where they nested (Stinson et al. 2007).

Bald eagles are well-distributed throughout Washington State and have year-round presence within the San Juan Islands. They primarily occur west of the Cascade Mountain Range, with most nesting sites near the marine environment, including the Salish Sea and San Juan Islands (Kalasz and Buchanan 2016). They typically nest in large trees but are known to nest in suburban landscapes near human activity (Parson 1994; Millsap et al. 2004). Greater than 50 percent of their diet consists of fish, with one study in Washington State showing their diet to contain 78 percent fish, 19 percent birds, and 3 percent mammals (Watson 2002). Overwintering bald eagles in Washington State depend on chum salmon (*Oncorhynchus keta*) and other salmonids in the fall and early winter (Stinson et al. 2007) and rely more heavily on waterfowl in mid- to late-winter, as well as carrion (Watson 2002). Bald eagles occur on or near Blakely Island year-round, and there is the potential for them to migrate through, or forage, in the coastal waters within or near the project area (USFWS 2024c).

Golden Eagle

Golden eagles (*Aquila chrysaetos*) have been identified as a Species of Greatest Conservation Need under Washington State's Wildlife Action Plan and are a Priority Species under WDFW's PHS program. In Washington State, breeding golden eagles are non-migratory (Watson et al. 2014). They are associated with steep terrain and found mostly in dry open forests of Eastern Washington, shrubsteppe (grassland), canyonlands, in high-alpine zones, and sparsely in clearcut areas in Western Washington, with nests situated on cliffsides, rocky outcrops, large trees, and human-made structures (e.g., power poles and transmission towers) (WDFW 2024k). There are over 300 documented breeding territories in Washington State, 80 percent of them in Eastern Washington. They are known to breed and nest irregularly in the rain shadows of the Olympic and Cascade Mountains, and San Juan Islands, although it is unknown if any sites are located on Blakely Island itself (WDFW 2024k). There is the potential for golden eagles to be present on Blakely Island, or nearby, particularly during early to mid-April (USFWS 2024c).

3.5.2.3 San Juan Islands NWR Seabirds

Seabirds spend most of their time on the ocean and return to land only to reproduce and raise their young (USFWS 2010). They have very specific nesting requirements, primarily a habitat free of predators and human disturbance (especially for ground or crevice nesting species), and with suitable soils for burrow nesting species (USFWS 2005, 2010). They also tend to be site-faithful, returning each year if they were successful in fledging young the previous year (USFWS 2010).

The San Juan Islands NWR provides important habitat for migratory birds, including black oystercatchers (*Haematopus bachmani*), double-crested and pelagic cormorants (*Phalacrocorax auritus* and *P. pelagicus*), rhinoceros auklets (*Cerorhinca monocerata*), and pigeon guillemots (*Cepphus columba*), and other marine mammal wildlife (e.g., harbor and elephant seals). While Blakely Island itself is not part of the San Juan Islands NWR, three nearby islands/rocks in Rosario Strait are part of the NWR: (1) Lawson Rock, (2) Pointer Island, and (3) Black Rock (USFWS 2010). These three NWR locations, along with the Project area's shoreline area on Blakely Island, may provide habitat for several seabird species of the Salish Sea. Six seabird species that commonly nest on San Juan Islands NWR areas that may be present within the project area include the following (USFWS 2010):

- rhinoceros auklet,
- tufted puffin,
- pigeon guillemot,
- pelagic cormorant,
- double-crested cormorant, and



- glaucous-winged gull (*Larus glaucescens*)

Note that of the six species listed above, only the double-crested cormorant and tufted puffin appear as being potentially present within the offshore project area and/or on Blakely Island, according to USFWS (USFWS 2024b, 2024c). The rhinoceros auklet, pigeon guillemot, pelagic cormorant, and glaucous-winged gull may potentially be present within the project area, e.g., during foraging activities, but it is unclear what their presence may be on Blakely Island and its offshore waters. Additionally, Brandt's cormorant (*Phalacrocorax penicillatus*) is typically observed within the Salish Sea during the breeding season, but they very rarely breed in the project area, primarily doing so along Washington State's west coast (USFWS 2010).

3.5.3 Washington State Priority Habitats and Species

Within Washington State, PHS (which may or may not be also federally listed under the ESA), require protective measures for their survival due to their population status, sensitivity to habitat alterations, and/or recreational, commercial, or Tribal importance. The PHS program is WDFW's primary means of sharing fish and wildlife information to protect Priority Habitats for land use planning.

Three PHS species have ranges that overlap with and may be present within the proposed Project area: pandalid shrimp (family *Pandalidae*), pinto abalone (*Haliotis kamtschatkana*), and Townsend's big-eared bat (*Corynorhinus townsendii*) (WDFW 2024p; **Table 13**). Of these three species, the Townsend's big-eared bat is a Washington State candidate for being listed, and the pinto abalone is designated as endangered in Washington State. In addition to the PHS listed in **Table 13** and avian species in **Table 13**, there are priority avian species that may potentially occur within or near the project area due to their known presence in or near San Juan County, but do not have information specific to Blakely Island or the project area: Cassin's Auklet (*Ptychoramphus aleuticus*), Short-tailed Albatross (*Phoebastria albatrus*), Great Blue Heron (*Ardea herodias*), Harlequin Duck (*Histrionicus histrionicus*), cavity-nesting ducks (e.g., Wood Duck [*Aix sponsa*], Barrow's Goldeneye [*Bucephala islandica*], Common Goldeneye [*B. clangula*], Bufflehead [*B. albeola*], and Hooded Merganser [*Lophodytes cucullatus*]), Snow Goose (*Chen caerulescens*), Trumpeter Swan (*Cygnus buccinator*), Tundra Swan (*C. columbianus*), Western High Arctic Brant (*Branta bernicla*), Band-tailed Pigeon (*Columba fasciata*), Vaux's Swift (*Chaetura vauxi*), and Oregon Vesper Sparrow (*Poocetes gramineus affinis*) (Larsen et al. 2004; WDFW 2008).

The proposed Project area is located within Rosario Strait, an aquatic habitat (M2USN: Marine intertidal unconsolidated shore, regularly flooded). However, no new terrestrial infrastructure is planned for this Project; therefore, no terrestrial wetlands are present in the proposed Project area.



Table 13. Washington State PHS that may be in the Proposed Project Area

Occurrence Name (<i>Scientific Name</i>)	Federal Status	State Status	Site Name	Sensitive Location
Species				
Pandalid Shrimp (family <i>Pandalidae</i>)	N/A	N/A	Not Given	No
Pinto Abalone (<i>Haliotis kamtschatkana</i>)	N/A	Endangered	Orcas and Blakely Islands, Lawson Rock (Thatcher Pass)	No
Townsend’s Big-eared Bat (<i>Corynorhinus townsendii</i>)	N/A	Candidate	Not Given	Yes
Habitat				
Estuarine and Marine Wetland - NWI Wetlands	N/A	N/A	N/A	No
Notes: N/A = Not applicable; NWI = National Wetlands Inventory, PHS = Priority Habitats and Species. Source: WDFW 2024p				

The pinto abalone ranges from Baja California to Alaska and is the only abalone species found in Washington State (WDFW 2024n). NOAA has listed the pinto abalone as a Species of Concern since 2004, and while NOAA did receive petitions to list the species under the ESA, it was determined that the pinto abalone did not meet the criteria of being endangered throughout the entirety of its range (WDFW 2024n). In Washington State, pinto abalone are generally found between water depths of 2.7 and 18.3 m (9 and 60 ft), aggregating in areas of complex rocky reef habitat (WDFW 2024n). these depths are shallower than the depth of the where the Orbital O2-X would be located within Rosario Strait (approximately 61 m [200 ft]), but within the depth that the subsea power cable would be located.

3.5.4 Invasive Species

While 251 aquatic species are considered invasive in Washington State, there are four aquatic invasive species of greatest concern: European green crab (*Carcinus maenas*), zebra mussel (*Dreissena polymorpha*), quagga mussel (*Dreissena bugensis*), and northern pike (*Esox lucius*) (WDFW 2024b). The WDFW Western Washington State Regional Invasive Species list also contains several insects (e.g., emerald ash borer, Japanese beetle, spotted lanternfly), plants (e.g., butterfly bush, purple loosestrife, Scotch broom), disease (e.g., white nose syndrome), and other species (e.g., feral swine, nutria).

3.5.5 Insects

According to the USFWS (2024b), the monarch butterfly (*Danaus plexippus*) may occur within portions of the proposed Project area.

3.5.5.1 Monarch Butterfly

On December 12, 2024, USFWS proposed to list the monarch butterfly as a threatened species and designate critical habitat under the ESA, as amended (89 FR 100662). Monarch butterflies are found throughout North America to southern Canada (up to about 50° N latitude), but are uncommon in western Washington (i.e., west of the Cascade Mountain Range), northwest Oregon, and western British Columbia, where native milkweeds are currently and generally absent (Pyle et al. 2015) and there are no breeding areas (Western Association of Fish and Wildlife Agencies 2019). Although monarchs have occasionally been observed in western Washington in the spring months,

their host plants (milkweed [*Asclepias syriaca*]) and breeding habitat occur naturally in only the eastern half of the state (i.e., east of the Cascade Mountain Range) (Western Association of Fish and Wildlife Agencies 2019). Given their lack of suitable habitat and host plants in western Washington, and that there would be no new terrestrial components associated with the proposed project, it is considered extremely unlikely that the monarch butterfly would occur within the project area. Therefore, the monarch butterfly will not be discussed any further.

3.5.6 Terrestrial Resources

This Project would include no new terrestrial components or routes, nor would any staging or work occur on Blakely Island itself. Therefore, the proposed Project would not have any effect on any terrestrial cover type, wildlife habitat, botanicals, wetlands, or terrestrial mammals. The only terrestrial portion of the Project would be an existing 46 cm (18 in.) diameter conduit on southwest Blakely Island, which would be used as an interconnection between the new Orbital O2-X and OPALCO's grid. This interconnection would connect to an existing substation on Blakely Island where the electricity would then be transmitted via OPALCO's 69 kV transmission system to the surrounding islands along existing subsea power cables. Terrestrial resources on Blakely Island will not be discussed further.

3.5.7 Acoustic Environment

For a description of below-water acoustic environment in the proposed Project area, see **Section 3.4.3** (Acoustic Environment; Fish and Aquatic Resources). For a description of the above-water acoustic environment in the proposed Project area, see **Section 3.8.2** (Acoustic Aesthetics; Aesthetic Resources).

3.6 Aesthetic Resources

The San Juan Islands are known for their aesthetic value (i.e., their intrinsic beauty), and conscious efforts are taken by Washington State residents to preserve it. The following section describes the current visual, acoustic, and light aesthetics in the proposed Project area and the vicinity.

3.6.1 Visual Aesthetics

The visual components of the proposed Project area (**Figure 60**) include the adjacent waters of Rosario Strait (**Figure 61**) and the scenic coastline on the east side of Blakely Island (**Figure 62**). The east side of Blakely Island has no residential homes or built areas, thus no residence or community centers with regular views of the proposed Project area. Further south from, and outside of, the proposed Project area is Black Rock (**Figure 63**). Past the south end of Blakely Island, WSDOT automobile ferries pass regularly throughout the day and the preexisting conduit is buried in the cliffs (WSDOT 2024; **Figure 64**). Other private ferries occasionally run past the proposed Project area and around the north side of the island. There are temporary increases in human activity when recreational boats (including kayaks), fishermen, shipping vessels, or ferries transit the region. Recreational vessel use is most popular from July to September, while oceangoing vessels pass through Rosario Strait year-round (NOAA 2024e). The passengers on these vessels are the most likely to view and interpret the visual aesthetic of the proposed Project area regularly.

The presence of species that may be seen in the Project area fluctuates as they migrate throughout the year. Potential species include avian species, cetaceans, pinnipeds, and fishes (see **Section 3.4**, **Section 3.5**, and **Section 3.6** for more details about local species).

Blakely Island is heavily forested, with few maintained roads or paths. There is one main road, Spencer Road, which travels north and south through the center of the island, with few side streets. The highest point of elevation is Blakely Peak at 318 m (1,042 ft) on the northeast corner of the island, and the total area of the island is 16.9 km² (6.5 miles²). The island also includes two freshwater lakes, Horseshoe Lake and Spencer Lake, as well as Spencer Creek that flows from Spencer Lake to Thatcher Bay (Blakely Island Field Station 2018).



Figure 60. Visual Aesthetics in the Project Area



Figure 61. Rosario Strait Looking South (with Blakely Island to the Right)



Figure 62. Proposed Orbital O2-X Location East of Blakely Island



Figure 63. Black Rock Southeast of Blakely Island



Figure 64. Ferry Passing South of Blakely Island (View from Southwest Side of Island)

3.6.2 Acoustic Aesthetics

Anthropogenic noise in the vicinity of the proposed Project area is primarily generated by small-engine boats (typically 125 - 165 dB) and large passenger or oceangoing vessels in the distance, with noise levels of up to 192 dB (Barlett and Wilson 2002). The above-water ambient noise levels in the Project area largely consist of wave noise, which is typically 60 dB at 0.4 m (1.3 ft) waves to 78 dB at 2.0 m (6.6 ft) waves (Bolin and Abom 2010). **Table 14** outlines the dB level of typical anthropogenic noise sources in the proposed Project area.

Table 14. Common Noise Sources and Typical Levels

Source	Noise Level (dB)
Conversational Speech	60
Small Piston-Powered Airplane	65
Business Jet Plane	75
Street Traffic	85
Single Engine Boat	125 - 165
Large Cargo Vessel	192
Notes: dB = decibel	
Sources: Aircraft Owners and Pilots Association N.D.; Barlett and Wilson 2002; Hildebrand 2009	

From October 2024 to January 2025, APL-UW conducted the Rosario Strait Characterization Study in collaboration with OPALCO to collect baseline data for the proposed Orbital O2-X site. Data collected in the proposed Project area includes underwater ambient noise, providing baseline data of current underwater ambient sound at the site (see **Section 3.4.3**).

3.6.3 Light Aesthetics

On the east side of Blakely Island, the proposed Project area consists of a natural coastline along the Salish Sea. Most of the light in the area is ambient – bright during the day from sunlight and dark at night from lack thereof. No residential or commercial buildings along the coast contribute lux to the proposed Project area.

The current lighting buoys and beacons near the proposed Project area include lighted buoys at Lawson Rock, Black Rock, and the outcrop north of Black Rock. The Blakely Island light beacon is located at the subsea cable landing on the south end of the island.

There are currently two marine lights near the proposed Project area. One is a warning float that is located 280 m (919 ft) southeast of the proposed Orbital O2-X location that flashes a green light every 2.5 seconds (s) and is bright enough to be seen 4 NM away (NOAA 2024c). The other light is farther south at about 2,500 m (8,202 ft) away and flashes a green light every 4 s, also visible 4 NM away (NOAA 2024c). These lights mark both a shallow water area and a group of small islands to warn vessels to stay away.

Figure 65 displays the existing night lights impact in the San Juan Islands per the National Aeronautics and Space Administration (NASA) Visible Infrared Imaging Radiometer Suite data. Most of the artificial light comes from various vessels that pass through the area – the brightest coming from automobile ferries and cargo ships, and the dimmest from fishing or recreational boats.

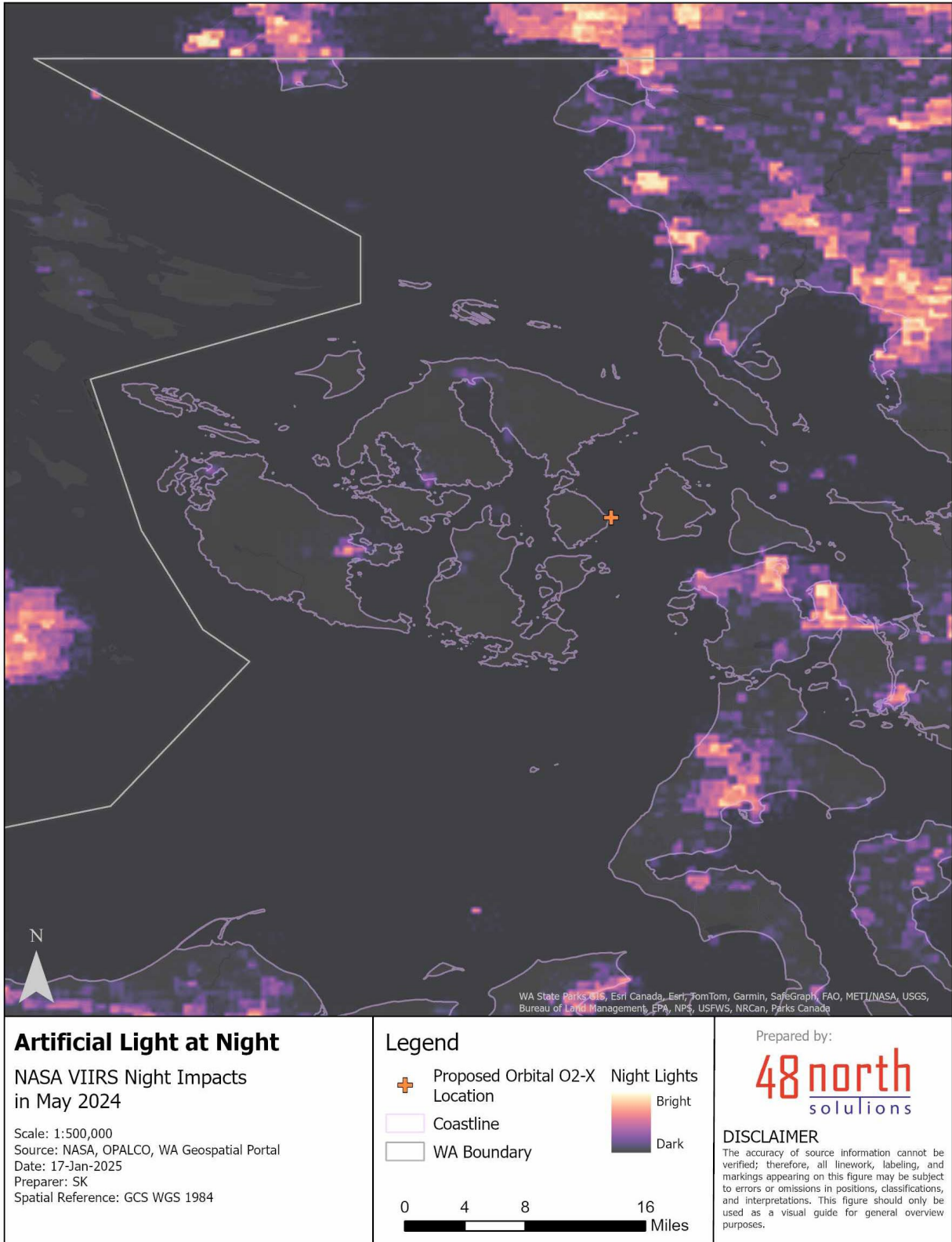


Figure 65. Existing Artificial Light Impact in the Vicinity of the Proposed Project Area



3.7 Federally Listed Species and Habitats

This section highlights the species and designated critical habitats listed under the ESA that may be present within the Project area, as described throughout the previous sections (**Section 3.4.1**, **Section 3.5.1.1**, **Section 3.5.2.1**, and **Section 3.5.5.1**). All ESA-listed species included were identified using scientific literature, and tools and records published by the Services (NMFS 2024d, 2024g; USFWS 2024b). Each of the twelve species shown in **Table 15** either has critical habitat within the proposed Project area or may be present within the proposed Project area (e.g., migrating or foraging). As previously mentioned, it is considered extremely unlikely that the yellow-billed cuckoo, northern spotted owl, and monarch butterfly would be present within and/or near the Project area.

The Project area overlaps with designated critical habitat for four species: SRKWs, Puget Sound-Georgia Basin DPS of bocaccio and yelloweye rockfish, and Puget Sound ESU of Chinook salmon (**Figure 66**). There are no terrestrial or freshwater components of the proposed Project; therefore, no threatened or endangered terrestrial species (e.g., animal, plant, or insect) are included in this section.

Table 15. Federally Threatened and Endangered Species that May Occur in the Project Area

Common Name (<i>Scientific Name</i>)	ESA Status	Jurisdiction	Critical Habitat in Proposed Project Area
Marine Mammals			
Killer Whale, Southern Resident DPS (<i>Orcinus orca</i>)	Endangered	NMFS	Yes
Humpback Whale, Mexico DPS (<i>Megaptera novaeangliae</i>)	Threatened	NMFS	No
Humpback Whale, Central America DPS (<i>M. novaeangliae</i>)	Endangered	NMFS	No
Fishes			
Bocaccio, Puget Sound-Georgia Basin DPS (<i>Sebastes paucispinis</i>)	Endangered	NMFS	Yes
Yelloweye Rockfish, Puget Sound-Georgia Basin DPS (<i>S. ruberrimus</i>)	Threatened	NMFS	Yes
Chinook Salmon, Puget Sound ESU (<i>Oncorhynchus tshawytscha</i>)	Threatened	NMFS	Yes
Steelhead, Puget Sound DPS (<i>O. mykiss</i>)	Threatened	NMFS	No
Eulachon, Southern DPS (<i>Thaleichthys pacificus</i>)	Threatened	NMFS	No
Green Sturgeon, Southern DPS (<i>Acipenser medirostris</i>)	Threatened	NMFS	No
Bull Trout, Coterminous U.S. Population (coastal Recovery Unit) (<i>Salvelinus confluentus</i>)	Threatened	USFWS	No
Birds			



Common Name (<i>Scientific Name</i>)	ESA Status	Jurisdiction	Critical Habitat in Proposed Project Area
Marbled Murrelet (<i>Brachyramphus marmoratus</i>)	Threatened	USFWS	No
Yellow-billed Cuckoo ¹ (<i>Coccyzus americanus</i>)	Threatened	USFWS	No
Northern Spotted Owl ¹ (<i>Strix occidentalis caurina</i>)	Threatened	USFWS	No
Echinoderms			
Sunflower Sea Star (<i>Pycnopodia helianthoides</i>)	Proposed Threatened	NMFS	None Designated
Insects			
Monarch Butterfly ¹ (<i>Danaus plexippus</i>)	Proposed Threatened	USFWS	None Designated
<p>Notes: ESA = Endangered Species Act; ESU = Evolutionarily Significant Unit; DPS = Distinct Population Segment; IPaC = Information for Planning and Consultation; NMFS = National Marine Fisheries Service; USFWS = U.S. Fish and Wildlife Service</p> <p>1. The species is considered <u>extremely</u> unlikely to occur within the project area, but does appear when using agency tools (e.g., USFWS's IPaC) to determine species' presence.</p> <p>Source: NMFS 2024d, 2024b; USFWS 2024b</p>			

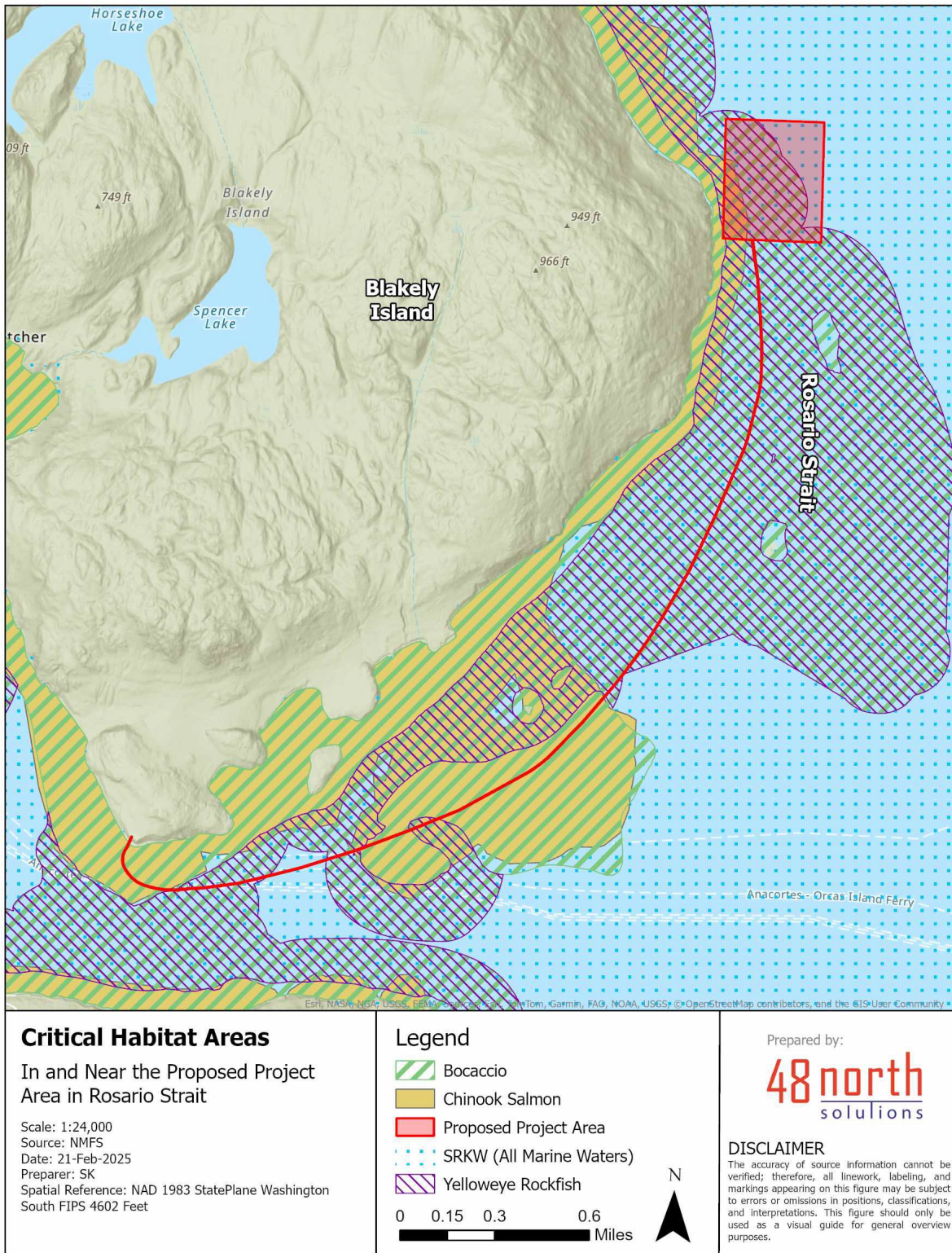


Figure 66. Designated Critical Habitat Areas



3.8 Recreation, Land Use, and Ocean Use

The proposed Project area is in Rosario Strait, within WDFW designated Marine Area 7, which includes all marine waters north of Trial Islands to the U.S.-Canada border, including the San Juan Islands, Haro Strait, Rosario Strait, Bellingham Bay, the southern Strait of Georgia, and the northeastern portion of the Strait of Juan de Fuca (WDFW 2024m, 2024u). Due to the mixed use of the area, activities in Marine Area 7 are co-managed by multiple agencies, included in this section.

3.8.1 Recreation

In WDFW Marine Area 7, recreators take part in activities such as SCUBA, freediving, kayaking, boating, and fishing. Whale watching tour companies commonly operate throughout the county. Recreators enjoy the scenic views of the San Juan Islands and high levels of biodiversity in the area.

SCUBA and freediving occur throughout the region, but Rosario Strait and the proposed Project area are unpopular due to the danger of diving in the strong dynamic currents. Strawberry Island on the eastern side of Rosario Strait is a popular diving spot.

Kayaking is popular throughout the San Juan Islands, and there are few limits as to where kayakers can travel. Knowledge of tides and currents is necessary to navigate the waters, and private kayak tours and parties travel past all sides of Blakely Island at various times of the day depending on their route and the time of day and year. The proposed Project area is not a particularly popular kayak destination due to Blakely Island consisting of private residences and no public parks, but kayakers may occasionally pass through on their way to visit other areas of the San Juan Islands.

Marinas, docks, and beaches in the San Juan Islands are operated by San Juan County, Washington State Parks, the San Juan Islands National Monument, and the San Juan Island National Historical Park (WDFW 2024m). In the San Juan Islands, there are 16 Washington State Parks, and boat launches are scattered throughout the region at public locations in nearby Anacortes, Deception Pass State Park, Burrows Bay, La Conner, Bellingham, and Blaine (Washington State Parks 2024b; WDFW 2024m). San Juan County owns and maintains eight docks with floats and eight boat ramps, and leases two outer island moorage docks (WDFW 2023). Private docks and marinas also exist throughout the region.

The marina on northern Blakely Island is the only public access point to the upper terrestrial portion of the island. Though there are beaches around the remaining perimeter of the island, they too are private, bordered by steep cliffs and most are only accessible during low tide. Visitors can stop at the Blakely Island General Store and Marina to re-fuel, shop at the store, eat at the restaurant, or reserve an overnight boat slip moorage (Blakely Island General Store and Marina 2024). Since the island is entirely private property, travel beyond the marina is prohibited without a property owner's permission. There is no public lodging on the island. The asphalt airstrip on the island is for private use only.

Blakely Island is in Game Management Unit 415 and the greater WDFW management District 13, which includes all of Snohomish, Island, and San Juan counties, along with the islands of Skagit County (WDFW 2023). As per the *2023 District 13 Hunting Prospects Report and San Juan County Ordinance*, all hunting within San Juan County requires written permission from the landowner (WDFW 2023). Deer hunting is permitted on Blakely Island in some years. The deer are smaller than their relatives on the mainland, but access to hunting them can vary year-to-year depending on deer populations and the permission of landowners (WDFW 2023).

See **Section 3.8.2.1** for information about recreational fishing and shellfish gathering.

In conclusion, the most likely marine recreation in and around the proposed Project area includes fishing, boating, and kayaking which could temporarily traverse the proposed Project area (**Figure 67**).

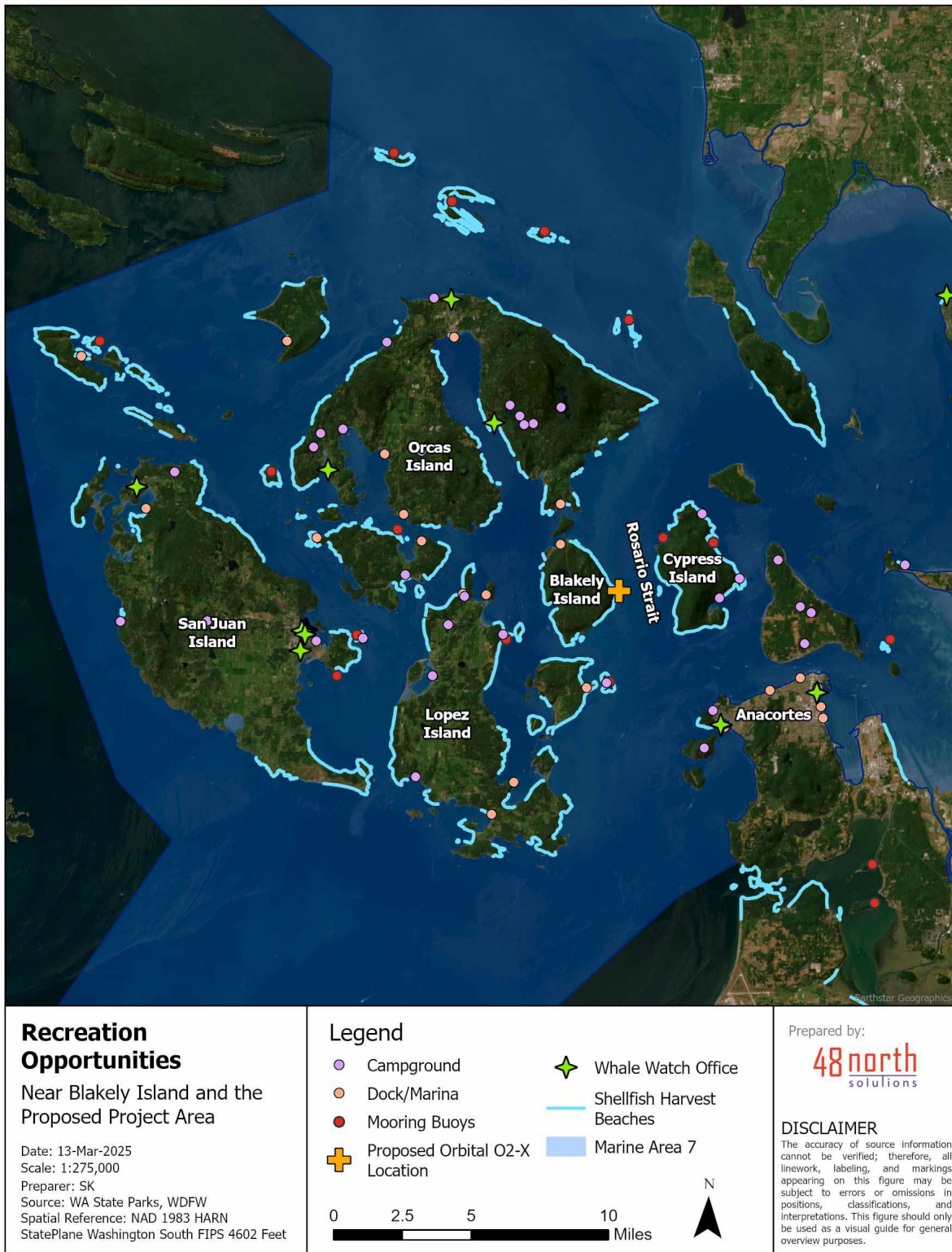


Figure 67. Marine Recreation Opportunities in the Proposed Project Area



3.8.2 Fisheries

3.8.2.1 Recreational Fishing

Many recreators visit the San Juan Islands to fish. Boats and recreators with fishing permits can set up to fish most anywhere in the waters that weave between the San Juan Islands, except for in Lummi Bay, the Lummi Nation reservation, and the San Juan Islands Marine Preserve (WDFW 2024u). The most popular fishing spots in the San Juan Islands are Hein Bank and Bellingham Bay (WDFW 2024m). Fishing is permitted around Blakely Island, and boats can be launched at marinas in the region to take trips to destinations throughout the San Juan Islands (**Figure 67**). Blakely Island is privately owned, so only residents and their guests can take part in fishing on the island. With permits, shellfish harvesting can occur on four WDFW beaches on Blakely Island that are only accessible via boat for clam, mussel, crab, and oyster harvest (see the defined “Shellfish Harvest Beaches” in **Figure 67**). A recreational license is required to fish in Washington State.

The best time for salmon fishing begins in July, but the timing of their presence varies each year (WDFW 2024m). Due to the convergence of multiple large bodies of water in the San Juan Islands, there are many places to fish for Chinook salmon and baitfish (WDFW 2024m). In late-summer and early fall, coho salmon arrive in the exterior of the San Juan Islands and in Rosario Strait, and pink salmon run from mid-July into early-September in odd-numbered years (WDFW 2024m). Trout, steelhead, sturgeon, mackerel, herring, anchovy, sardine, sand lance, smelt, Pacific halibut, and bottom fish species are also popular recreational fish in the region (Washington Fishing 2023).

Many of these species have fishing seasons that are year-round, except for Pacific halibut, salmon species, and bottomfish (Washington Fishing 2023). While salmon fishing is popular, fisheries have been more limited in recent years due to concerns about species conservation (WDFW 2024m). See **Table 16** for a summary of legal fishing seasons and additional rules for fish species in Marine Area 7, although it is important to note that emergency rule changes can occur throughout the year and are updated regularly on the WDFW website (WDFW 2024u).

Table 16. Marine Area 7: Fishing Rules in the San Juan Islands

Species	Season	Additional Rules
Trout	Year-round	Catch-and-release
Steelhead	Year-round	Daily limit two hatchery steelhead
Sturgeon	Year-round	Catch-and-release
Mackerel	Year-round	No minimum size and no daily limit
Herring, Anchovy, Sardine, Sand Lance, and Smelt	Year-round	No minimum size, with daily limit of 10 lbs., all species combined. All smelt caught must be kept and count toward the daily limit except fishing for eulachon is closed (Columbia River smelt). Herring - Closed year-round north of a line from Sandy Point to Patos Island to the Canadian boundary. For smelt: Jig gear may be used 7 days a week. Dipnets may be used from 6:00 a.m. until 10:00 p.m. Fridays through Tuesdays.
Pacific Halibut	Check the WDFW website at https://wdfw.wa.gov/fishing/regulations/halibut or call (360) 902-2700 in April for information on Pacific halibut seasons and	



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Species	Season	Additional Rules
		regulations. No min. size. Daily limit 1. Annual limit 6. Descending device required onboard vessels.
Other Food Fish	Year-round	No minimum size. Daily limit 2 of each species.
All Other Fish	CLOSED	CLOSED to fishing for, retaining, or possessing.
Salmon		
Entire Area	July 18 – July 20	Chinook - minimum size 22". Other salmon species - no minimum size. Daily limit two including no more than one Chinook. Release chum, sockeye, wild coho, and wild Chinook. Additional Chinook openings may occur based on available quota. Check the WDFW website at wdfw.wa.gov.
	July 21 – July 31	CLOSED
	Aug. 1 – Aug. 31	No minimum size. Daily limit two. Release Chinook, chum, sockeye, and wild coho.
	Sept. 1 – Sept. 29	No minimum size. Daily limit two. Release Chinook, sockeye, and chum.
Bottomfish		
Lingcod	May 1 – June 15	Hook and line season. Minimum size 26". Maximum size 36". Daily limit one.
	May 21 – June 15	Spearfishing season. Maximum size 36". Daily limit one.
Surfperch	Year-round	No minimum size. Daily limit 10. Except shiner perch daily limit 15: not included in bottomfish limit.
Rockfish	CLOSED	This fishery is CLOSED to fishing for, retaining, or possessing this species.
Pacific Cod, Pollock, Hake	Year-round	No minimum size. Daily limit two of each species.
Cabezon	May 1 – Nov. 30	Minimum size 18" and daily limit one.
Wolf-Eel	Year-round	CLOSED to retention.
Sixgill, Sevengill, and Thresher Sharks	Closed	This fishery is CLOSED to fishing for, retaining, or possessing these species. Sixgill shark may not be removed from the water.
Source: WDFW 2024u		



Shellfish harvesting occurs throughout the year in Washington State. In the San Juan Islands, shrimping is productive during spring and early-summer, and crabbing is popular from mid- to late-summer through early fall (WDFW 2024u). Recreators who harvest shellfish or crabs must obtain a recreational license (WDFW 2024i).

The only crabs permitted for harvesting are Dungeness crab, red rock crab, and tanner crab, and they may only be harvested with a pot, by hand, or with a dipnet; gear is not allowed to pierce the shell to harvest (WDFW 2024i). When it comes to gear, one unit of gear is one trap, one ring net, and one pot (WDFW 2024r). In Marine Area 7 (San Juan Islands), the maximum units of gear per person for shrimp are two pots per person, with no more than four shrimp pots per boat (WDFW 2024r). The maximum units of gear per person for crabbing have no limit, but traps must be ring nets or star traps that lie flat on the seafloor (WDFW 2024r). Additionally, every shellfish pot, ring net, or star trap left unattended must have its own buoy line and a separate buoy that is permanently marked with the owner and operator's first name, last name, and permanent address (WDFW 2024r).

The waters of the proposed Project area are not used in any greater intensity than recreational fishing, shellfish, and crab harvesting in and around the greater San Juan Island region.

3.8.2.2 Tribal Fishing

Indigenous Tribal Nations and populations have been in the Pacific Northwest since time immemorial. Under treaties negotiated by Territorial Governor Isaac Stevens on behalf of the United States, such as the Treaty of Point Elliott in 1855, Tribal Nations ceded 64 million acres of land to the United States for non-Indian settlement and the subsequent establishment of Washington State. Tribal Nations retained approximately 6 million acres of reservation land and specifically reserved the right to gather and access foods and religious sites in their treaties with the federal government. Tribal Nations retain treaty-reserved fishing rights and rights via executive orders and legislative actions that are distinct from recreational fishing regulations. Tribal Nations still use traditional fishing practices to harvest half of annual salmon each year in Washington State, as affirmed by the Boldt Decision.

In the State of Washington, Tribal Nations have legal co-management of all natural resources that support their livelihoods and cultural heritage, confirmed by the Boldt Decision and several subsequent decisions (United States versus Washington 1974; United States versus Washington 1995). In 1974, Judge George Boldt issued what is now known as the Boldt Decision in the federal court case *US. v. Washington*, in which Tribal treaty fishing rights were reaffirmed. The decision included (1) an interpretation of the original Treaty of Point Elliott language to mean that the Tribes are entitled to half the harvestable number of salmon returning to or passing through the Tribes' usual and accustomed fishing areas (U&A), which are harvest areas that reflect the historical region in which natural resources were collected by Tribes, (2) established the Tribes as co-managers of the salmon resource with the state, and (3) established conservation standards that restricted the ability of the state to regulate Treaty Tribal fishing (NWIFC 2016a).

Tribes have deep spiritual and cultural connections to salmon and other aquatic species that have been used for religious ceremonies, cultural practices, subsistence, and trade dating back thousands of years (PFMC n.d.). Fishing continues to play a meaningful role in Tribal culture for commercial purposes, ceremony, and subsistence. Tribal Nations in the Pacific Northwest historically and presently fish for salmon, Pacific halibut, blackcod, Pacific whiting, species of rockfish and flatfish, as well as shellfish such as clams, crab, oysters, and shrimp, in addition to other species (NWIFC 2016d; NWIFC 2016e). Tribal fishing techniques include hook, line, and sinker, traps, weirs, nets (reef, dip, seines, and gill), spears, rakes, wheels, crab pots, and more, depending on whether species are in open water or bottomfish (Bohan 2009; NWIFC 2016d; Wild Salmon Center 2020). Several of the Tribal Nations engaged on the proposed Project have shared that Tribal fishing activities in the vicinity of the Project include, but are not limited to, crab pot deployment and gillnet fishing, specifically.



Each Treaty Tribe has staff who sample salmon, and fish tickets are collected with data that is shared daily with state co-managers, while sport fishermen report their catches months after their outing. Respect for Tribal fishing regulations are upheld by Tribal enforcement officers, and citations are issued if someone is not following Tribal regulations (NWIFC 2016f).

Tribal Nations in Washington State are also guaranteed the right to harvest shellfish. In May of 1994, the Rafeedie Decision affirmed the right to harvest half of shellfish on both public and private beaches down to the low tide watermark. To this day, Tribes coordinate with property owners and WDFW to perform a shellfish population survey and schedule a time to harvest (NWIFC 2016g). A total of 15 Tribes are included in the ruling, including Jamestown S’Klallam, Lummi, Muckleshoot, Nooksack, Port Gamble S’Klallam, Skokomish, Suquamish, Swinomish, Tulalip, and Upper Skagit, and as a result they can continue to harvest shellfish in their U&A territory (NWIFC 2016g; NWIFC 2016h).

3.8.2.3 Commercial Fishing

The state’s commercial fishing industry is structured around a multi-species fishery. Commercial fishing in Washington State includes the following fisheries: Dungeness crab, Puget Sound salmon, Willapa Bay and Grays Harbor gillnet salmon, wild stock geoduck clam, Puget Sound herring, Puget Sound smelt, razor clam, sea urchin, sea cucumber, coastal hagfish, shrimp, albacore tuna, Pacific sardine, coastal salmon, and scallops (WDFW 2024c). Only some of the fisheries are active within and around the proposed Project area in Rosario Strait, and they are summarized in **Table 17**. Each of the fisheries listed above has its own seasons and regulations.

Table 17. Commercial Fisheries in the Proposed Project Area

Fishery	Season	Gear	Additional Rules
Dungeness crab	Jan. – Sept.	Crab pots	In 2024, the season opened October 1 and was later closed due to an Emergency Ruling.
Puget Sound salmon	Varies	Purse seine, gillnet, reef net, beach seine	Rules are updated as the season progresses.
Puget Sound smelt	Year Round	Drag (beach) seine gear	Closes via Emergency Regulation when 60,000-pound annual quota is reached.
Sea urchin	Oct. – Feb.	Gloves, knife, garden tiller, diving gear	The season depends on the current health of the sea urchin population.
Sea cucumber	Aug. – Nov (15 weeks)	Hand-held prying tool, diving gear	The season depends on current conditions and biotoxin levels.
Scallop	Closed	Scallop net, diving gear	This fishery is currently closed and has been for years, but the main harvest area is in the San Juan Islands.

Source: WDFW 2024a, 2024c, 2024d, 2024f, 2024g, 2024t

In 2022, non-Tribal commercial fish landings from Washington State fisheries totaled 72,521 tonnes (approximately 159,887,000 lbs.) for a total value of \$325,410,000 (NMFS 2022b). In terms of regional catch, the coastal area is by far the largest contributor to commercial fish harvesting, accounting for 85 percent of total pounds landed. Vessels in the Puget Sound make up approximately two-thirds of the vessels under 12.2 m (40 ft) in Washington State (WDFW 2012).



While some commercial fishing occurs within the Salish Sea, no data are publicly available on commercial fishing intensity in Rosario Strait.

3.8.3 Vessel Traffic

The San Juan Islands region is valuable for the commercial and economic port infrastructure in Washington State; thus, a variety of vessel types pass by the proposed Project area regularly. International container ships, the municipal ferry service, cruise liners, Navy surface/subsurface vessels, fishing vessels, and recreational boaters regularly transit the region.

The U.S. Coast Guard (USCG) cooperatively manages the vessel traffic in this area through the establishment and operation of the Vessel Traffic Service Puget Sound or “Seattle Traffic” under the Ports and Waterways Safety Act to continue safe use of waters in the U.S. (USCG 2021). This is part of the greater Traffic Separation Scheme that is recognized by the International Maritime Organization (IMO) (Ecology 2009). The waters of Puget Sound are a regulated navigation area per 33 CFR § 165.1303, which limits tank vessel size.

Ecology publishes Vessel Entry and Transits data annually to share a summary of vessel traffic statistics with the public (Ecology 2023b). According to Ecology, the types of vessels that pass through the region include articulated tug barges (ATB), cargo and passenger vessels (C&P), ferries, fishing vessels, tank barges, and tanker ships (Ecology 2023b). The types of tanker ships include chemical tankers, liquid natural gas, liquified petroleum gas, liquified gas, oil, and tankers bound for layup or shipyards (Ecology 2023b). The closest principal port to the proposed Project area is in Anacortes (NOAA and BOEM 2024). See **Table 18** for more information about statistics on vessel types present in 2023.

Table 18. Vessel Entries and Transits in Washington State Salish Sea Waters in 2023

Vessel Type	Entering Transits	Individual Vessels
C&P bound for Washington ports	1,918	854
Tank ships bound for Washington ports	413	150
Tank barges/ATB	2,805	1,256
Tank barges/ATB companies	8	5
Ferries	144,284	22
Commercial fishing vessels	39	28
Factory fishing vessels/fish processors	91	36
Notes: ATB = articulated tug barges; C&P = cargo and passenger vessels Entering Transit = A vessel traveling from sea or Canada waters into Washington waters, regardless of destination. The trip back out to sea is not counted. Individual Vessel = A unique vessel, counted only once even if it enters Washington waters more than once in the calendar year. Source: Ecology 2023b		

The U.S. Marine Highway system includes 31 “U.S. Marine Highway Routes” that serve as extensions of the surface transportation system, with each all-water route (designated by the Secretary of Transportation) offering relief to landside corridors suffering from traffic congestion, excessive air emissions, or other environmental challenges (U.S. DOT 2025). The U.S. Marine Highway Program was created by the U.S. Department of Transportation (U.S. DOT) and is used to transport goods



around the U.S. via waterways instead of highways to reduce motor vehicle traffic (U.S. DOT 2025). The nearest Marine Highway route does not pass through the San Juan Islands and Rosario Strait and instead routes southbound through the Strait of Juan De Fuca to Seattle (NOAA and BOEM 2024). There is, however, a designated traffic lane and two-way route that runs between Puget Sound and Rosario Strait (NOAA and BOEM 2024). The closest approach of the main north-south shipping lane through Rosario Strait is located approximately 0.4 km (0.25 mile) from the east boundary of the proposed Project area.

Washington State Ferries (WSF), a government agency as part of the Washington State Department of Transportation (WSDOT), runs ten routes serving 20 terminals around Puget Sound and the San Juan Islands. **Figure 68** displays the WSDOT-managed automobile and passenger ferry system from Anacortes on Fidalgo Island to Lopez Island, Shaw Island to Orcas Island, and to Friday Harbor on San Juan Island (WSDOT 2024). These routes travel through Rosario Strait and south of Blakely Island, but do not cross through the proposed Project area. Blakely Island itself does not have a ferry terminal or public ferry service (WSDOT 2024). According to WSDOT, other ferry routes traverse the region, but they do not stop at Blakely Island and instead pass from Bellingham north of Blakely Island to Friday Harbor and beyond.

Access to Blakely Island is only accessible by private plane at Blakely Island's airstrip, or private boat arriving at the marina at the northern end of the island. Mariners should be aware the Washington State Ferries may deviate from published standard routes due to inclement weather, traffic conditions, navigational hazards, or other emergency conditions.

The Marine Cadastre inventory AccessAIS mapper demonstrates a visual representation of transit paths through the San Juan region using annual vessel transit track data (BOEM et al. 2024). As shown in **Figure 69**, which includes a visual distribution of all marine traffic transits from 2023, most marine traffic passes to the south of Blakely Island, with the second most popular route being along the north end of the island near the Blakely Island General Store and Marina.

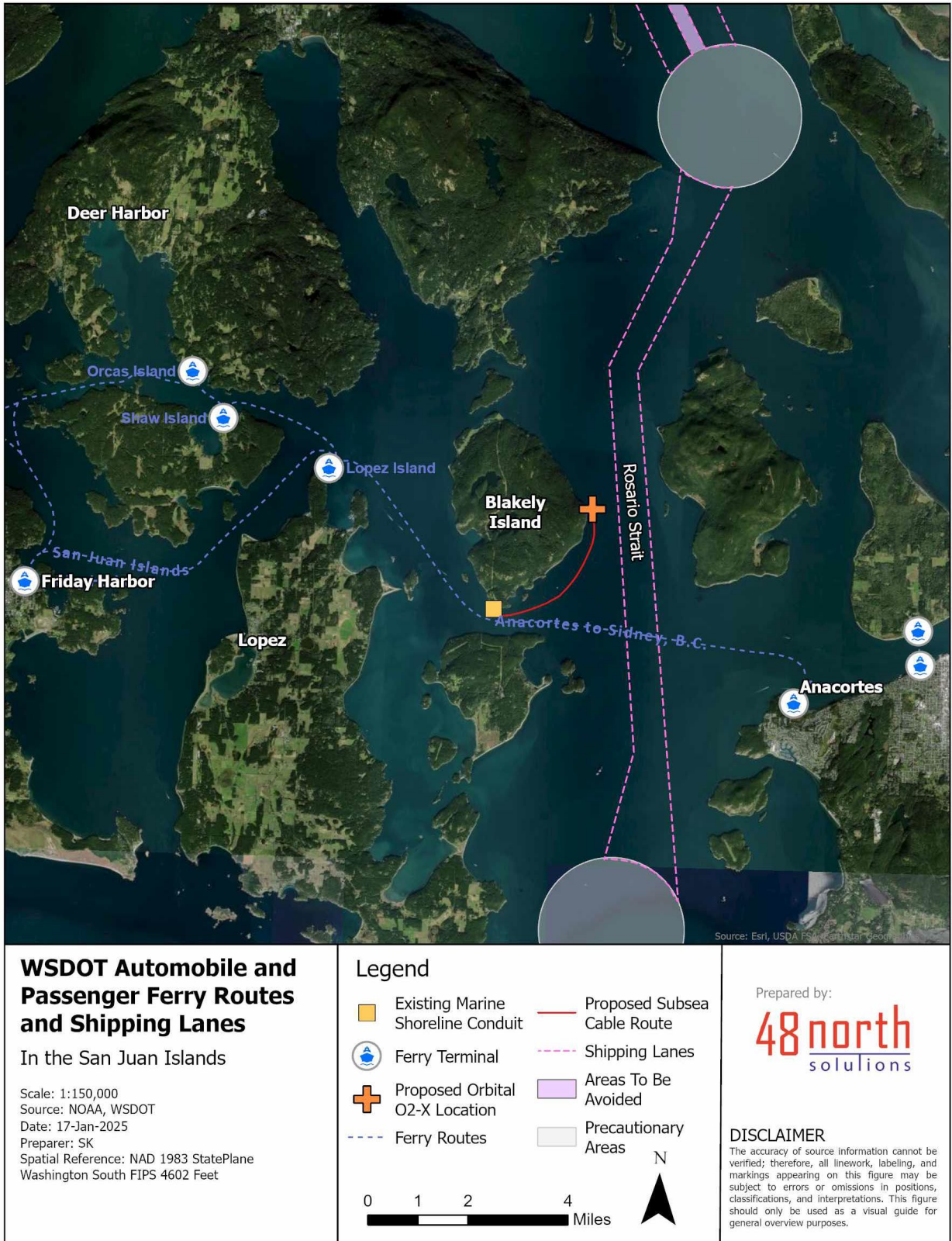


Figure 68. Vessel Traffic Near the Proposed Project Area

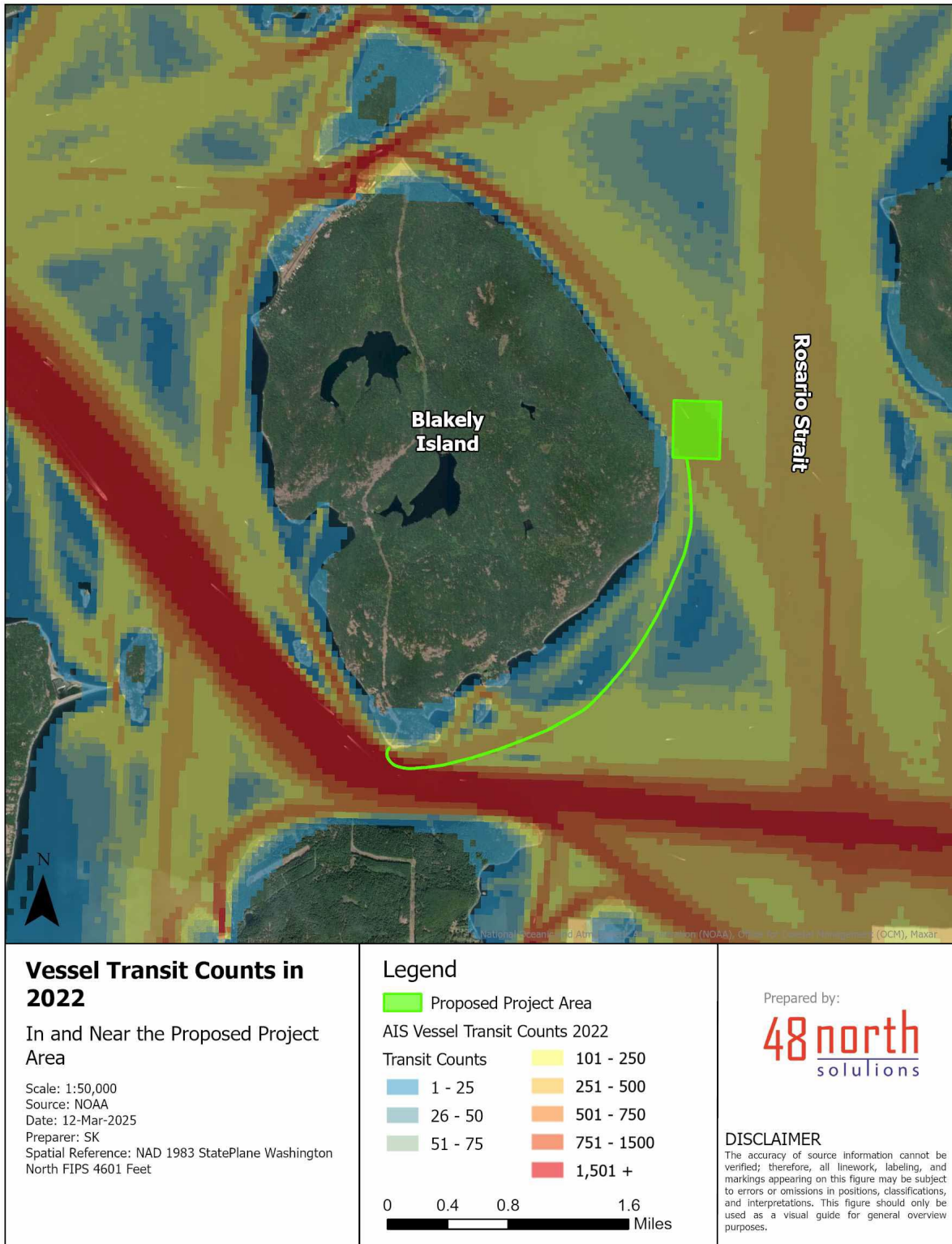


Figure 69. Marine Cadastre AccessAIS Vessel Transit Counts 2023
 Source: BOEM et al. 2024



Spring and summer are the busiest time of year for vessel traffic in the San Juan Island region. In 2018, peak fishing and passenger vessel transit through the region was during April–June and July–September. This increase reflects the timing of fisheries openings and favorable boating conditions during the spring and summer. Seasonal marine events, including sailing regattas and fishing derbies, take place mostly during the spring and summer months. The increase in passenger vessels also indicates peak tourism season, with cruise ship passengers arriving to participate in water-based activities like whale watching season. Recreational vessel traffic also significantly increases between July and September, likely due to favorable boating weather in the late summer months (Ecology 2021).

The current lighting buoys and beacons near the proposed Project area include lighted buoys present at Lawson Rock, Black Rock, and the outcrop north of Black Rock. The Blakely Island light beacon is located at the subsea cable landing on the south end of the island.

3.8.4 Marine Protected Areas

Marine Protected Areas (MPAs) are defined by the Washington State Legislature as “a geographic marine or estuarine area designated by a state, federal, Tribal, or local government in order to provide long term protection for part or all of the resources within that area.” (Substitute Senate Bill 6231, 2008). In Washington State, a total of 127 MPAs are managed by 11 federal, state, and local agencies, 83 percent of which are managed by the state.

The terminology defining Washington State’s MPAs is not standardized because each MPA was created on an individual (ad-hoc) basis. Therefore, not all of Washington State’s MPAs meet the international protected area definition that was established by the International Union for Conservation of Nature (IUCN), which is that protected areas are “a clearly defined geographical space, recognized, dedicated, and managed through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.” NOAA’s MPA Inventory in western Washington State is depicted in **Figure 70**. **Figure 71** shows the MPAs near the proposed Project area (NOAA 2023).

Table 19 provides an overview of the categories of MPAs in Washington State. These sites span an area of approximately 260,618 hectares (644,000 acres), including more than 1,828 km (1,136 miles) of shoreline.

There is one MPA in the proposed Project area: the San Juan County/Cypress Island Marine Biological Preserve (NOAA 2023). There are also two MPAs near Blakely Island and the proposed Project area: Cypress Island Aquatic Reserve, and San Juan Islands NWR (NOAA 2023). Each is managed by a different agency and follows its own distinct management plan. MPAs near the proposed Project area can be seen in **Figure 71**, and additional details about each are presented in **Section 3.8.4.1** and **Section 3.8.4.2** below.

3.8.4.1 MPAs in the Proposed Project Area

San Juan County/Cypress Island Marine Biological Preserve

The San Juan County/Cypress Island Marine Biological Preserve (SCBP) shares a border with San Juan Island County. The Washington State legislature created it in 1923 as a “preserve of marine biological materials useful for scientific purposes, except when gathered for human food” including the marine waters, beds, and shores of the San Juan Islands and Cypress Island (Environmental Law Institute [ELI] 2014). The SCBP is managed by the University of Washington Friday Harbor Laboratories, is categorized as an IUCN MPA, and its primary conservation focus is natural heritage (NOAA 2023). The provision that developed the SCBP made it a criminal misdemeanor to take non-food materials, although the collection of non-food materials for scientific purposes is arranged through the Laboratories “on a case-by-case basis” (ELI 2014). The SCBP is to be managed for “research and education, conservation of bottomfish, invertebrates, and marine plants, and habitat protection” (ELI 2014).



Since the SCBP shares a border with San Juan County, the entire proposed Project area on the east side of Blakely Island is within the SCBP.

3.8.4.2 MPAs near the Proposed Project area

Cypress Island Aquatic Reserve

The Cypress Island Aquatic Reserve was created in 2007 when 2,454 hectares (6,065 acres) of state-owned lands were designated as the reserve (DNR 2024d). It surrounds the nearly 32 km (20 miles) of Cyprus Island’s shoreline and is the largest, relatively undeveloped island in the San Juan Islands (DNR 2024d). The reserve qualifies as an IUCN MPA with a focus on natural heritage and is managed by DNR (NOAA 2023).

The boundary of the reserve is approximately 2.5 km (1.6 miles) east of Blakely Island, which does not overlap with the proposed Project area.

San Juan Islands National Wildlife Refuge

The San Juan Wilderness, a portion of the San Juan Islands NWR, was established in 1976 in support of the Wilderness Act, which “secure[d] for the American people of present and future generations the benefits of an enduring resource of wilderness” (USFWS 2024d). Today there are 83 units of the San Juan Islands NWR, which is composed of many islands that, combined, total 143 hectares (353 acres) of land (USFWS 2024d). As a NWR, the mission in managing this land is to contribute an effort “to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the US for the benefit of present and future generations of Americans” (USFWS 2024f). The San Juan Islands NWR is managed by the USFWS and categorized as an IUCN MPA, with a primary conservation focus of natural heritage (NOAA 2023).

Blakely Island and the proposed Project area are not within the San Juan Islands NWR, but some small island areas offshore Blakely are included. The proposed new subsea cable may pass between some of them on the southeastern side of Blakely Island but would not cross the boundaries or fall within these MPAs.



Table 19. Types of Marine Protection in Washington State

	Aquatic Reserves Program	MPAs: Conservation Areas/Marine Preserves	San Juan County/Cypress Island Marine Biological Preserve	Underwater Parks and Marine Parks	Natural Area Preserves/ Natural Resources Conservation Areas
Authority	DNR	WDFW	State Legislature	Washington State Parks	DNR
Jurisdiction and Boundaries	State land from high tide waterward, including estuarine	Intertidal and subtidal areas in Puget Sound	Salt waters, beds, and shores of San Juan County and Cypress Island	State waters, with priority on “unique or diverse marine life” or underwater features	Representative areas of land or water which retain natural character or important for conservation
Prohibited Uses	Activity conflicting with educational, scientific, or environmental purpose	Conservation Areas: no take of fish, shellfish, or wildlife; Marine Parks: species- or gear-based restrictions	No take of “marine biological materials useful for scientific purposes” without permit	Protection of “natural, cultural, and recreational resources”; invertebrate harvest prohibited	Limited public access other than for education or low impact use
Notes: DNR = Washington State Department of Natural Resources; MPA = marine protected area; RCW = Revised Code of Washington; WAC = Washington Administrative Code; WDFW = Washington Department of Natural Resources					

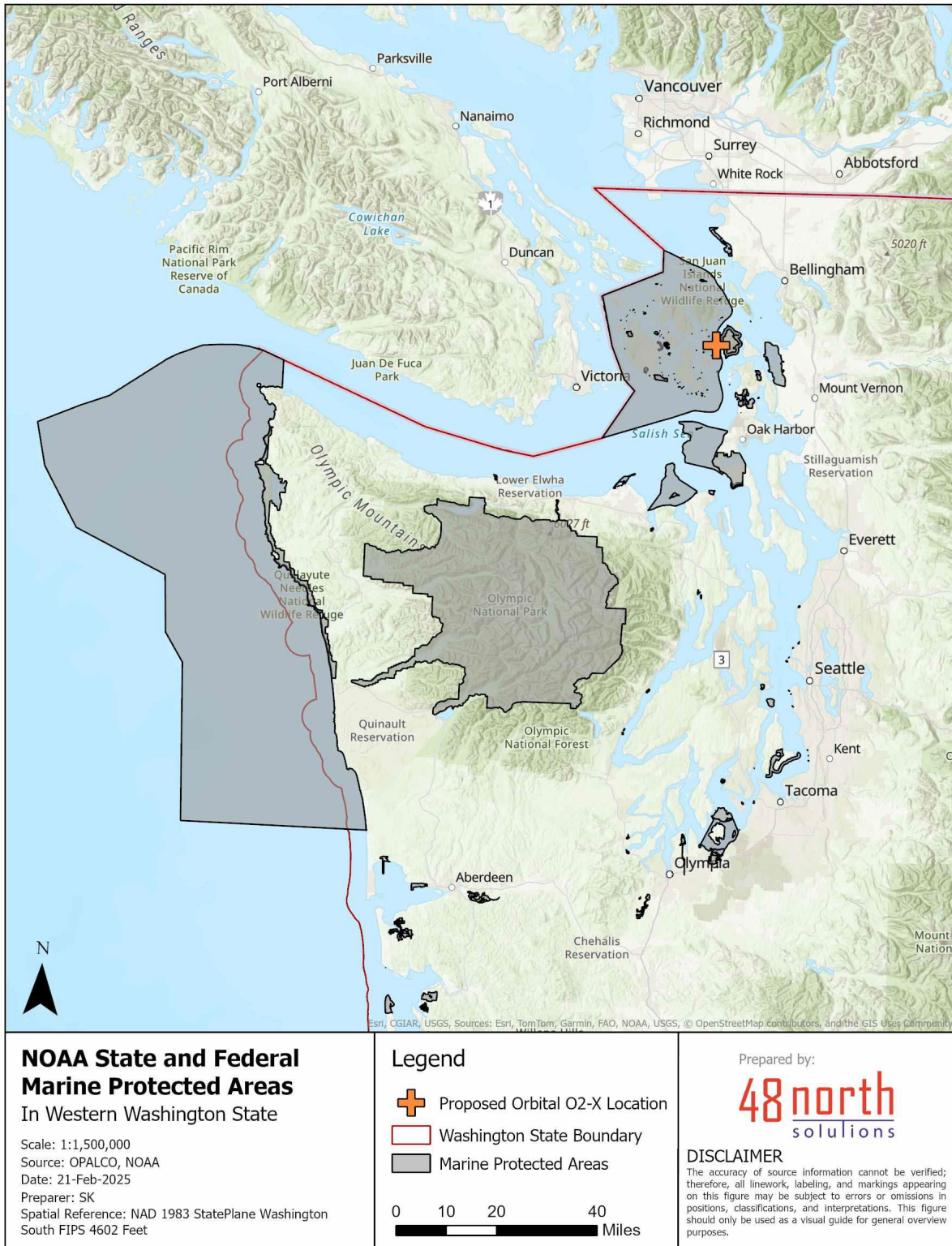


Figure 70. All Marine Protected Areas in Western Washington

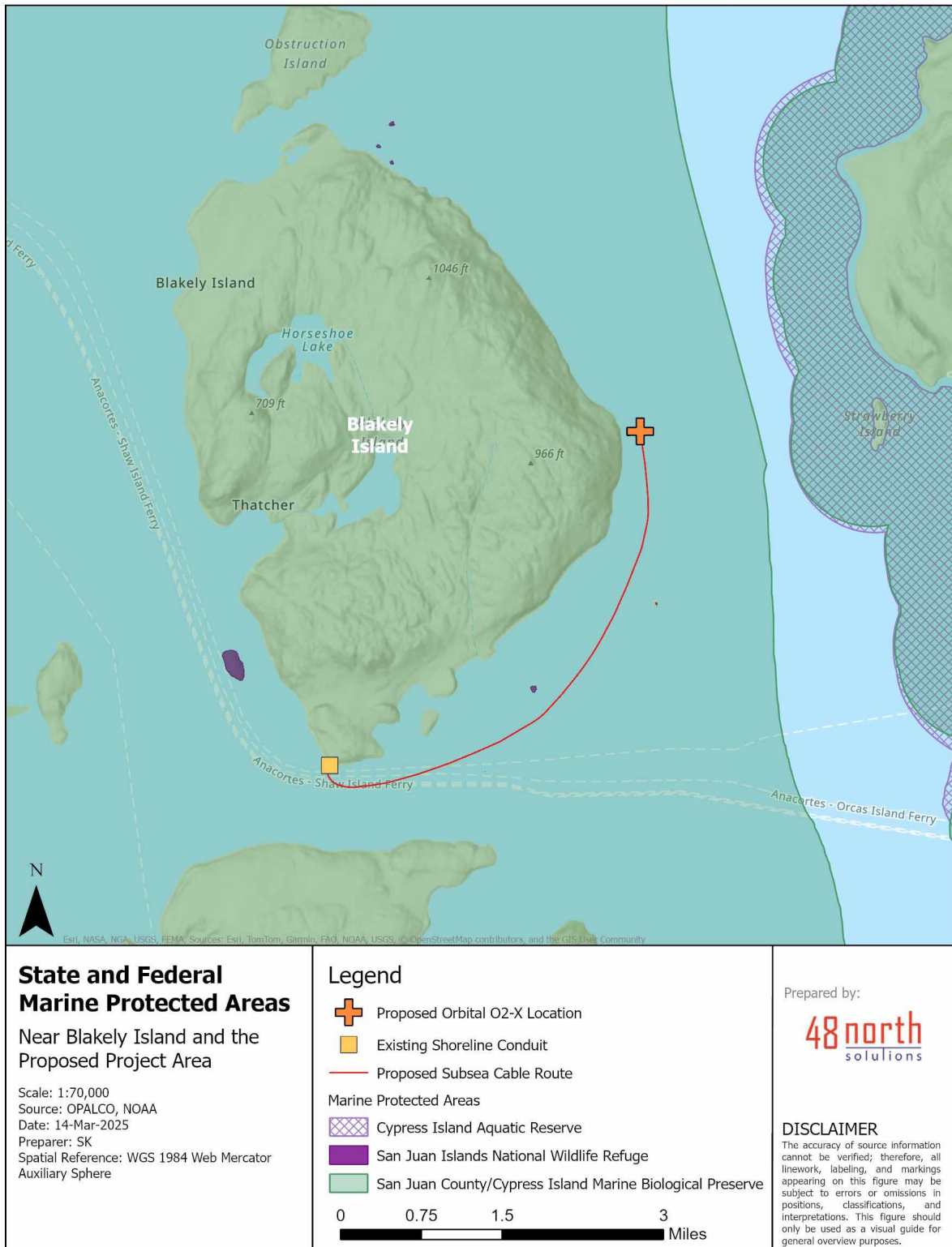


Figure 71. MPAs Near Blakely Island and the Proposed Project Area



3.8.1 Restricted Areas

The proposed Project area is not in or near any restricted areas. No military zones are near or within the proposed Project area, and there are no shipwrecks or obstructions in the water (NOAA and BOEM 2024). There is one dispersive dredged material disposal site in Rosario Strait, southeast of Blakely Island, approximately 5 km (3 miles) away from the proposed Project area (USACE 2024). Restricted areas will not be discussed further in this document.

3.9 Air Quality

The baseline air quality in the area east of Blakely Island is considered good. As a privately owned island, there are no residential subdivisions or commercial built areas. There are temporary increases in human activity when recreational boats, shipping vessels, or ferries transit the surrounding area. The WSDOT passenger ferry system has routes along the south of Blakely Island through Rosario Strait (see **Figure 68**). Blakely Island does not have a WSDOT ferry terminal or public ferry service. There is some residential car traffic on Blakely Island, with a small number of maintained roads or paths. Blakely Island Marina is the only public access to the island with occasional recreational pleasure boat presence.

The Air Quality Index (AQI) ranges from 0 to 500 and is regulated by the EPA under the Clean Air Act. The AQI tracks pollutants (carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, and particulate matter of 10 micrometers or less) that are considered harmful to public health and the environment. There is no AQI station on Blakely Island, but readings from Decatur Island (just south of Blakely Island) have historically remained below an AQI rating of 50 (indicating “good” air quality) according to PurpleAir, a community-based system of low-cost sensors that measure harmful pollutants in the air (Johnson et al. 2019).

3.10 Tribal and Cultural Resources

This section describes the Tribal resources and cultural resources within the proposed Project area. The information presented in this section is based on the existing information available and includes input received from several of the Tribal Nations. OPALCO has led Tribal engagement to identify potential effects early in the process. FERC would conduct formal consultation on potential effects on Tribal resources and cultural resources. Consultation with the Tribal Nations would continue as the Project moves through NEPA review, compliance with Section 106 of the NHPA, as well as permitting and construction.

3.10.1 Tribal Resources

The term “Tribal resources” refers to the collective rights and access to traditional areas and times for gathering resources associated with a Tribe’s sovereignty since time immemorial. It also includes inherent rights or formal treaty rights associated with U&A territories and lands formally ceded by the Tribes and bands under the Treaty of Point Elliott in 1855. Tribal resources may also include archaeological or historic sites, elements of the built environment, and Traditional Cultural Places (TCPs) associated with Tribal use, and sites considered sacred by Tribes.

It is important to engage with Tribal Nations to identify and understand these important resources and areas, how they are used, and how the construction and operations of a project may affect the rights that are guaranteed under these treaties and federal laws.

The identification and analysis of Tribal resources is based on published materials as well as information shared by Tribal Nations. To incorporate the perspective of Tribal Nations, the analysis considered natural resources and cultural resources associated with Tribal interests and treaty rights. This section includes consideration of the unique perspectives and potential effects on the Tribal Nations when evaluating Project effects. This analysis has identified Tribal resources as plants, wildlife, and areas important to traditional cultural practices and those associated with treaty rights



related to U&A places. Technical reports, correspondence from the Tribal Nations, publicly available sources, and unpublished ethnographic data were used to develop the list of resources. The following sources were reviewed:

- Letter from Swinomish Tribe dated October 29, 2024.
- “White Paper” provided by the Samish Indian Nation dated April 5, 2024.
- Published ethnographic studies and historic contexts.

Natural resources are inextricably linked with the lives of Indigenous peoples. All animal species have some connection to Indigenous people through traditional stories or practice. Plant gathering is an essential subsistence and cultural activity that is documented in ethnographic literature, Tribal legend and stories, and archaeological sites. Plants were historically and are currently gathered for food, medicine, and ritual uses, as well as raw material for tools, clothing, basketry and mats, and other uses. Participation by Tribal members in those gathering activities is a part of cultural identity. Aquatic habitats in the proposed Project area support a variety of wildlife species. **Section 3.4**, **Section 3.5**, and **Section 3.6** provide lists of protected wildlife species likely to occur in the proposed Project area.

During early coordination with DAHP, State Archaeologist Dr. Rob Whitlam recommended the formation of a working group including the Tribal Historic Preservation Officers, DAHP, FERC, and OPALCO once Section 106 consultation is initiated. OPALCO would work with the Tribal Nations and DAHP to bring together this working group in coordination with FERC early in the process.

3.10.1.1 Usual & Accustomed Treaty Fishing Rights

Indigenous Tribal Nations and populations have been in the Northwest since time immemorial. Under treaties negotiated by Territorial Governor Isaac Stevens on behalf of the U.S., Tribal Nations ceded 64 million acres of land to the U.S. for non-Indian settlement and the subsequent establishment of Washington State. Tribal Nations retained approximately 6 million acres of reservation land and specifically reserved the right to gather and access foods and access religious sites in their treaties with the federal government. Tribal Nations also retain rights via executive orders and legislative actions.

In Washington State, Tribal Nations have legal co-management of all natural resources that support their livelihoods and cultural heritage, affirmed by the Boldt Decision and subsequent decisions that determined the Tribes are entitled to half the harvestable number of salmon returning to or passing through the Tribes’ U&A. The proposed Project area is the traditional territory of several Tribal Nations who signed the Treaty of Point Elliott in 1855.

Fishing strategies used by many Tribal fisherpeople can include the use of weirs, fish traps, reef nets, dip nets, and fish wheels (Wild Salmon Center 2020). **Section 3.8.2.2** provides a detailed discussion on the types of Tribal fishing that may be occurring in the proposed Project area.

Based on the information received from the Tribal Nations, the proposed Project could affect Tribal interests, treaty rights, and resources in and around the areas where facilities are located. See Appendix A – Consultation Record for a detailed summary of the comments and/or concerns received.

3.10.1.2 Tribal Canoe Journey

Canoe travel has been a cultural practice of Indigenous people on the West Coast since time immemorial. Canoes play a meaningful role in Indigenous culture beyond a means of transportation. The U.S. and Canadian governments restricted canoe travel in the twentieth century. In 1989, Indigenous people revitalized the Canoe Journey, or Tribal Journey, in coastal communities of the Pacific Northwest to heal and preserve this cultural practice (Masterman 2024).



Each year, various Indigenous groups from the Pacific Northwest's Coast Salish Tribes travel by traditional canoes along ancestral waterways, stopping along the way until they converge at a host nation's destination. Protocol plays an important role in the Canoe Journey and serves as a system of rules that help participants honor Indigenous teachings. Once participants arrive, they ask for permission to land on another's Tribal territory and follow protocol to share their identity and culture through songs, dances, traditional greetings, and other cultural practices (The Intertribal Canoe Society and American Friends Service Committee 2011).

In 2023 the Canoe Journey took place again after a 4-year break due to the COVID-19 pandemic. The event was called "Paddle to Muckleshoot" and hosted by the Muckleshoot Indian Tribe. In 2024, the event was known as "Power to Paddle to Puyallup" and hosted by the Puyallup Indian Tribe. As many as 25 canoes, each carrying up to 43 people, participated in the Canoe Journey (Washington State Parks 2024a).

In 2025, the Canoe Journey will be hosted on the Olympic Peninsula in Washington State by the Lower Elwha Klallam Tribe. The event is tentatively scheduled for August 1, 2025 (Montesano 2024). OPALCO will continue engagement with the Tribal Nations to learn about future dates and routes to work to avoid, minimize, or mitigate effects on the Canoe Journey. It's possible the route has gone through Rosario Strait (and will do so again) and Tribal Nations from the north travel to host areas in Puget Sound and south.

3.10.2 Cultural Resources

For this document, the term "cultural resources" is used to describe resources that are evidence of past human activity including archaeological sites, districts, buildings, structures, and objects that have not been evaluated for eligibility for listing in the NRHP. Cultural resources also include non-Native American built environment and archaeological resources that would not likely be considered Tribal resources by the Tribal Nations.

The San Juan Islands are the traditional territory of the Central Coast Salish peoples who spoke Straits Salish (or Northern Straits), one of the five different languages that divided the territory (Samish Indian Nation 2017; Suttles and Lane 1990). Blakely Island was the traditional territory of the Samish Indian Nation; historically, their territory also included the eastern half of Lopez Island, "Guemes, Cypress and other islands between Lopez and the mainland and portions of Samish Bay, Padilla Bay and Fidalgo Island" (Lane 1975). Several other Tribes also lived throughout the San Juan Islands, including the Lummi, Klalakamish, Saanich, Semiahmoo, Songhees, and Swallah (Suttles 1990). Like other Coast Salish groups, the specific territory of each Tribe was ambiguous, and resources were often shared; no borders were formerly drawn until the 1854–1855 treaties (Suttles and Lane 1990). There are no identified village locations on Blakely Island, but there is ethnographic information of villages on Orcas, Waldron, Guemes, Lopez, and San Juan islands (Lane 1975; Sam 1933; Suttles 1974; 1990).

Like other Coast Salish groups, people living in the San Juan Islands traveled mainly by canoe, with several different styles for traveling on saltwater and on rivers. Canoes and other cultural materials such as cordage, baskets, clothing, mats, towels, mattresses, and even seasonal huts were made with western redcedar. Continued creations include intricate blankets woven from the hair of a now-extinct wooly dog, mountain goat wool, waterfowl down, and fireweed cotton (Samish Indian Nation 2017; Suttles and Lane 1990). Villages occupied by the Coast Salish people were often along the water at an access point where their canoes could easily be beached (Suttles and Lane 1990). The Samish, as well as the Lummi and Semiahmoo, engaged in reef-netting (Lane 1975).

The San Juan Islands became the subject of a boundary dispute between Great Britain and the United States in the mid-1800s. Until the boundary dispute was mediated in 1871, Great Britain and the United States held their established positions at opposite ends of San Juan Island. In 1874, Euro-Americans, comprised of a high number of former soldiers, began to lay claim on land left



vacant by British troops (Thompson 1972). Once the boundary conflict concluded, Euro-Americans began to formally settle the San Juan Island archipelago.

On Blakely Island, the first recorded white settler was Paul K. Hubbs, Jr., who moved to the island in 1850. A mill was established on Thatcher Bay, on the west side of the island, and operated from 1879 – 1942 (Regional Fisheries Coalition 2024). While there was some settlement on the island, it was relatively minimal; the school that opened in 1889 closed in 1949. An airport was built that same year (1949). Harold Bartram and Floyd Johnson made plans to develop the island in the mid-1950s, but shortly thereafter sold their land to the Puget Sound Pulp & Timber Company of Bellingham (Bishop 2024). In 1993, half of the island was placed in trust, and trust lands were expanded in 2010.

The identification and analysis for cultural resources is based on technical reports, correspondence from the Tribal Nations, publicly available sources, and unpublished ethnographic and scientific data. This existing information was used to identify cultural resources and the potential for cultural resources eligible for listing in the NRHP to conduct a cultural resources assessment of the proposed Project area. OPALCO would comply with Section 106 of the NHPA, which would be initiated following submittal of the DLA and complete a full and comprehensive cultural resources assessment to identify historic properties in the Area of Potential Effects (APE) in consultation with Tribal Nations and the DAHP. Since the Project is a federal undertaking, FERC is the lead federal agency responsible for complying with Section 106 of the NHPA and its implementing regulations (36CFR800).

The following sections describe the cultural resources assessment for the Project.

3.10.2.1 Records and Literature Review

A records search of the proposed Project area was conducted using the Washington Information System for Architectural and Archaeological Records Database (WISAARD). WISAARD contains all cultural resources documents submitted to DAHP since 1995. Additional sources of background research and information included: historical maps and General Land Office (GLO) records, NRHP-listed properties, historic U.S. Geological Survey (USGS) topographic maps, and modern aerial photographs and topographic maps.

The records search completed on October 29, 2024, did not identify any previously recorded cultural resources or historic properties within the proposed Project area. The nearest archaeological site is approximately 0.6 km (0.4 mile) from the proposed Project area. No prior cultural resources assessments have been undertaken within 1.6 km (1 mile) of the proposed Project area (DAHP 2024). There are no recorded ethnographic place names within 8 km (5 miles) of the proposed Project area, although there are several throughout the San Juan Islands (Suttles and Lane 1990). WISAARD does not contain all ethnographic information and is limited to what has been researched, identified, and shared by researchers and Tribal Nations. Unrecorded resources could be present and may not be widely shared because of the confidentiality of that information.

The shoreline in the vicinity of the proposed Project area is classified as “Very High Risk” in DAHP’s Statewide Predictive Model for containing precontact-era archaeological sites (DAHP 2010). The Statewide Predictive Model is a tool used by archaeologists and planners to evaluate potential archaeological risks on a broad scale and to inform methods for determining if historic properties are present. The model was developed to statistically evaluate multiple environmental factors (e.g., elevation, slope percent, aspect, distance to water, soils, and landforms) to predict where archaeological resources might be found (Kauhi 2013).

The proposed Project area has not been previously surveyed. Two archaeological sites have been recorded in the vicinity (less than 1.6 km [1 mile] away); both of these are associated with shoreline locations.



Archaeological sites along the coast and nearshore environment in the San Juan Islands typically include shell midden deposits. These include shellfish processing locations that are associated with littoral environments where shellfish can be harvested nearby. Accumulations of shell and shell middens provide an ideal environment for the preservation of bone, and often contain the bones of vertebrate faunal prey, lithics, and even human remains from burials. Middens are often directly associated with long-term habitation sites, but this is not always the case. Features associated with shellfish processing, other than shell middens, include, but are not limited to, hearths and pole- or post-holes for drying racks.

Shell middens can be associated with occupation sites including villages and seasonal camp sites. Occupation sites are located on stable landforms that are not periodically inundated. These sites represent collection points for resources on the landscape. When resources are extracted and processed elsewhere, they are generally moved to an occupation site where they are stored, consumed, and used. These sites may either be short-term (e.g., base camp) or long-term occupation (e.g., winter village) sites. Artifacts at these sites are indicative of the activities that occurred during resource extraction and processing of the surrounding landscape. Features at these sites include, but are not limited to, temporary shelters, permanent shelters, storage pits, hearths, ritual features, burials, and tool production areas.

3.10.2.2 Previously Recorded Archaeological Sites within 1.6 km (1 Mile)

There are no previously recorded archaeological sites in the proposed Project area; however, there are two previously recorded archaeological site within 1.6 km (1 mile) including Site 45SJ00154 and Site 45SJ00160.

Site 45SJ00154 is in the southwestern portion of Blakely Island, approximately 0.6 km (0.4 mile) north of the proposed Project area. Site 45SJ00154 was first recorded in 1954 and was described as a midden deposit measuring 59 m (195 ft) in length, 31.8 m (125 ft) in width, and with depths of deposits ranging from 0.2 to 0.6 m (0.5 to 2 ft). In 1985, the archaeological site was revisited by archaeologist Gary Wessen who described the site as a “continuous mass of shell midden deposits” (Wessen 1986a). No other features were noted.

Site 45SJ00160 is located on the northern portion of Decatur Island approximately 1.3 km (0.8 mile) south of the proposed Project area. Site 45SJ00160 was first recorded in 1947 by R. Lane with the University of Washington (UW 2024). The site was described as a rock cairn and no artifacts or other cultural deposits were noted. In 1985, the archaeological site was revisited by archaeologist Gary Wessen; however, the rock cairn could not be relocated (Wessen 1986b).

3.10.2.3 Historic Buildings or Structures

No historic buildings or structures (i.e., historic built environment resources) have been recorded and mapped in WISAARD within the proposed Project area (DAHP 2024).

3.10.2.4 Traditional Cultural Places

There are no previously recorded TCPs identified within the proposed Project area or a 1.6-km (1-mile) radius. The Tribal Nations are being engaged to determine if TCPs are present.

3.10.2.5 Cemeteries

No cemeteries have been recorded and mapped in WISAARD within the proposed Project area or a 1-mile radius (DAHP 2024).

3.10.2.6 Potential for Cultural Resources

The entire proposed Project area is located underwater and has been submerged for an extended period. Archaeological sites in the vicinity of the proposed Project area are primarily located along the shoreline on beaches and terraces in the nearshore environment outside the proposed



boundaries of the Project. An assessment of the potential for submerged archaeological sites was conducted using a desktop review of published data as well as a review of the side-scan sonar results conducted as part of the site characterization studies to inform the mapping of the seafloor in the vicinity of the proposed Project area.

3.10.2.7 Potential for Submerged Archaeological Sites

The post-glacial creation of the Salish Sea Islands, including Blakely Island and the other San Juan Islands, occurred approximately 15,500 years ago with the recession of the Cordilleran ice sheet and flooding of what is now the Juan De Fuca Strait, Straits of Georgia, and Puget Sound. Relative sea level has fluctuated throughout that time, both above and below current shorelines. Relative sea level changes occurred most widely in the period from 15,000 to 5,000 years ago because of post-glacial isostatic rebound and continued Holocene era glacial melting, large-scale tectonic plate movement, several large magnitude earthquakes in the region occurring between 3,100 and 300 years ago, and both local and global eustatic sea level changes. In summary, relative sea levels were up to approximately 50 m (150 ft) below modern levels in the period from 13,000 to 10,000 years ago and generally rose in the period from 10,000 to 5,000 years ago, with contemporary shorelines established about 5,000 years ago. Relative sea level has continued to rise much more slowly since that time (Beale 1990; Fedje et al. 2018; Hutchings and Williams 2020; Shugar et al. 2014; James et al. 2005). At current sea levels, the subsurface elements of the Project (i.e., anchors and cable) would lie at depths of approximately 101 m (330 ft) to 14 fathoms (84 ft), except for a small shelf at the south end of Blakely Island that lies at 11 m (36 ft) (Office of Coast Survey 2024).

The U.S. Bureau of Ocean Energy Management developed a predictive model for potential locations of underwater archaeological sites by identifying potential relict submerged landforms that would have survived marine transgressive processes associated with sea level rise across the Pacific Coast of the North America (ICF International et al. 2013). According to the map dataset, the seafloor on the east and south side of Blakely Island has a low to low-moderate potential for relict landforms, with only a very small area of potentially higher probability near the proposed location of the Orbital O2-X (Data Basin 2024).

If present, submerged archaeological resources would likely be of three primary types within the Salish Sea: historical shipwrecks and other historical objects, subtidal middens and occupation sites, and subtidal resource harvesting sites or features. Shipwrecks would typically be expected to have left large and distinct materials on the seafloor, such as hull, cargo, and ballast. The type and extent of materials would vary based upon the ship type and size, material construction, and amount of ballast and cargo. In addition, shipping could leave isolated materials from lost or jettisoned cargo and deck-gear (Arcas Consulting Archaeologists Ltd. 2000). There are no known shipwrecks within the proposed Project area, and a recent sonar side scan conducted for this Project by Tetra Tech, Inc. in October of 2024 indicates that the seafloor is uniform and bare other than a pocket of large boulders; it is otherwise free of evident features or objects (Appendix C1).

Precontact archaeological sites such as subtidal middens, occupations sites including villages and temporary camps could occur with the proposed Project area in areas less than 46 m (150 ft). Seasonal temporary camps and occupation sites could consist of small features, stone and bone artifacts, and fire-modified rock. Larger more intensively used locations may contain archaeological middens housing similar materials, as well as large shellfish deposits and anthropogenic soils. These site types are unlikely to have remained intact (if once present) from inundation, wave action, and tidal and current impacts in the steeply sloping terrain of the proposed Project area, particularly along the east side of Blakely Island. The small shelf at the southern end of Blakely Island would hold the greatest potential for subtidal middens and terrestrial occupation sites such as seasonal camps and villages. The ADCP results indicate increased wave action in the fall and winter months with a significant storm in December 2025 with wave heights of 1.8 m (5.9 ft) creating significant erosional forces on the shoreline (Appendix C2).



Subtidal resource harvesting sites, such as those related to reef net fishing could be present at the southern end of Blakely Island since the landform in that location is a headland. Reef net sites are recognized by distinct piles of stones once used to anchor the nets, refreshed annually. Reef net sites typically occur in shallow waters usually at depths less than 25 feet (8 meters). Landform components of an intertidal beach include the beach face and low-tide terrace and can be found on beaches primarily shaped by wave action. Such landform components are extremely unstable and are constantly reworked by wave action, creating seaward-dipping or cross-bedded sedimentary laminations (Waters 1992). Intertidal beach landform components are composed of sediments eroded and deposited by wave action (Waters 1992).

Based on this cultural resources assessment, there is limited potential for the Project to encounter cultural resources. There are no previously recorded resources and site types associated with submerged resources in this environment would no longer remain intact (if previously present). With the depth of the existing conduit and the wave/tidal forces at this location, it is unlikely that subtidal harvesting or resource gathering sites would still be present. Based on this analysis, there is limited potential for intact cultural resources or historic properties to be present within the proposed Project area.



4. Natural Resources Environmental Analysis

4.1 Potential Project Effects on Natural Resources

The potential effects (stressors) to natural resources due to Project activities are described in the following subsections. Project activities include the installation, operation and maintenance, and decommissioning and removal of the Orbital O2-X device and supporting infrastructure. The analysis of effects is organized and presented for the following categories of stressors:

- Entanglement
- Collision
- Entrainment
- Noise disturbance
- Displacement
- Habitat alteration
- Electromagnetic field (EMF) exposure
- Artificial light
- Changes in oceanographic systems.

These identified stressors are parts of the Orbital O2-X, maintenance operations, or a result of Orbital O2-X's functioning, that may have potential to harm or stress a receptor (i.e., a marine animal, habitat, or ecosystem).

Where possible, each stressor has been considered during different Project phases (i.e., installation, operation and maintenance, and removal) for different receptors (e.g., marine mammals, fish, avian species, and invertebrates) in the proposed Project area. Key terms used in the analysis of effects are defined below.

“Likelihood” is the probability of an interaction occurring, described qualitatively as “Low,” “Medium,” or “High.”

“Impact” (as defined in Minerals Management Service [MMS] 2007) is the estimated degree of effect from the stressor, and is described as negligible, minor, moderate, or major. “Negligible” means the stressor will have no measurable impact on the receptor. “Minor” impact means that most impacts on the affected receptor could be avoided with proper mitigation; if impacts occur, the affected receptor will likely recover without any mitigation once the impacting agent is eliminated. “Moderate” impact means the viability of the affected receptor is not likely to be threatened, although some impacts may be irreversible, or the affected receptor is likely to recover completely if proper mitigation is applied during the life of the Project or proper remedial action is taken once the impacting agent is eliminated. “Major” impacts on the affected receptor are unavoidable, the viability of the affected receptor may be threatened, and the affected receptor is not likely to fully recover even if proper mitigation is applied during the life of the Project or remedial action is taken once the impacting agent is eliminated.

“Risk” considers both the likelihood of occurrence and level of impact from the stressor described above, qualitatively rated as “Low,” “Medium,” or “High.”

For the purposes of this effects analysis, these stressors and impacts have been evaluated without applying any mitigation measures, to better understand their greatest potential effect. The anticipated effects of the proposed Project, based on scientific literature and modeling, are also discussed in this section. In consultation with Tribal Nations, regulatory agencies, and stakeholders, appropriate best management practices (BMPs) and mitigation measures would be administered to reduce the risk and potential impacts of the proposed Project.

4.1.1 Entanglement

Entanglement, which occurs when an animal becomes intertwined with mooring lines or cables, is a concern for marine mammals, large pelagic elasmobranchs (e.g., sharks, rays, skates), and other marine animals such as seabirds, sea turtles, and large fish. Concern over entanglement has been voiced about possibly occurring during the following Project operations:

- Primary entanglement during the installation, operation, decommissioning, and removal of Project components.
- Primary entanglement with Project vessel moorings.
- Secondary entanglement with derelict gear caught in mooring lines or the umbilical portion of the new subsea cable (i.e., the portion that is vertical in the water column).

4.1.1.1 Primary Entanglement

The risk of primary entanglement, or direct entanglement with Project components, is considered low for this Project. To date, no entanglements of marine animals with marine renewable energy (MRE) systems have been observed, and no evidence demonstrates that such an event has occurred (ORJIP Ocean Energy 2022a). The Project's new subsea cable and mooring lines are heavy, under tension, and do not have loose ends nor sufficient slack to create an entangling loop (Benjamins et al. 2014) (**Figure 72**). Overall, the probability of interaction between a marine mammal or other species of concern and the mooring lines of a single Orbital O2-X device is low, as the mooring lines occupy only a small portion of the water column, allowing mobile species to easily navigate around them (Copping and Hemery 2020).

Due to the lack of studies concerning species interactions with mooring lines for MRE devices, additional studies and modeling efforts would help to better understand any risks. As such, drop camera footage of the Project's mooring lines would be reviewed for evidence of entanglement events, and a reporting protocol would be established for the operator to follow in the event of an entanglement.



Figure 72. Typical Orbital O2-X Subsea Cable Slack

Temporary vessel mooring lines would be used to keep vessels in place during installation and removal of the Orbital O2-X, as well as during any manual device maintenance. In general, vessel



presence on-site would be minimal. There has been limited study on the entanglement risk posed by vessel moorings during MRE deployment and other offshore construction projects, primarily due to their temporary nature and widespread use across various marine sectors. Given their temporary nature, the vessel moorings for this Project are unlikely to cause primary entanglement.

4.1.1.2 *Secondary Entanglement*

Secondary entanglement, or the entanglement of marine species in human-made waste materials, is a concern. Derelict (i.e., lost or discarded) fishing gear and other marine debris are known to pose an entanglement risk for a range of species (Garavelli et al. 2024). Once entangled, small marine animals are typically unable to free themselves, and most die without human intervention (Duncan et al. 2017; Schrey and Vauk 1987). Although no part of the Project would be abandoned or discarded, secondary entanglement is possible for MRE devices, if waste attaches to the mooring lines or umbilical of the new subsea cable (Taormina et al. 2018). Since no instances of secondary entanglement have been reported on MRE devices, the likelihood of fishing gear becoming snagged on components of the Project mooring is considered very low. However, this risk ultimately depends on the types and density of gear in the surrounding waters (Macfadyen et al. 2009; Richardson et al. 2019).

In the U.S. portion of the Salish Sea, the predominant derelict gear types are drift and set gillnets from salmon fisheries and shellfish pots from the Dungeness crab and shrimp fisheries (Drinkwin et al. 2023). Gillnets are considered high-risk for secondary entanglement due to their mobility, multispecies impacts, durability, and ability to entangle with other debris and create larger masses (Gilman et al. 2021). While crab pots are typically designed to stay anchored to the seafloor, storm surges or strong tides can dislodge and transport them, potentially creating secondary entanglement scenarios. The frequency of derelict gillnets and shellfish pots in the Salish Sea has been relatively well-documented since 2002, when the Northwest Straits Foundation launched the Northwest Straits Marine Conservation Initiative (NWSI) Derelict Fishing Gear Program. This program has removed thousands of derelict nets and pots from the Salish Sea via diver-led retrieval methods, as well as recorded data (e.g., location, depth, area, habitat type) on each recovered gear item (Drinkwin et al. 2023). Also in 2002, the Washington State legislature passed legislation to develop safe, effective methods to remove derelict fishing gear and discourage future gear losses.

While the Washington State Derelict Gear Database is not publicly available, published maps indicate that at least 10 nets were recovered from Rosario Strait between 2002 and 2012, although not necessarily from within the proposed Project area (Drinkwin et al. 2023). While location and habitat information about recovered pots is less available than for gillnets, potential hotspots are outside of the proposed Project area (e.g., Port Townsend Bay, Dungeness Bay, and Port Gardner) (NSF 2016).

Secondary entanglement is known to impact elasmobranchs and smaller marine animals such as sea turtles, fur seals, and sea lions (Garavelli 2020). NWSI has documented more than 270 unique species trapped in derelict fishing gear in the Salish Sea, including porpoise, sea lions, scoters, grebes, cormorants, canary rockfish, Chinook salmon, and Dungeness crab (NSF 2016). Because of the types and density of derelict fishing gear in the Salish Sea and the documented impacts on marine mammals, fish, diving seabirds, and other species found in or near the proposed Project area, Orbital O2-X deployment poses a medium risk for secondary entanglement, even with a low likelihood of occurrence, primarily due to the impact on a marine animal if it were to occur. There would be cameras and hydrophones mounted on the Orbital O2-X to enable monitoring of the mooring lines and umbilical cable for evidence of entanglement events. A reporting protocol would be established for the operator to follow in the event of an entanglement.

4.1.2 Collision

Collision is the direct contact between an animal and a vessel, the Orbital O2-X device, and/or one of its components (e.g., a turbine blade), but does not always imply injury (Amaral et al. 2015; Garavelli et al. 2024). Marine mammals may also interact with the mooring lines and subsea cable umbilical in the water column, although little is known about resulting consequences of this type of encounter (Copping and Hemery 2020). The potential for collision exists during the following Project operations:

- Vessel operations required for installation, maintenance, and removal of the Orbital O2-X.
- Operation of Orbital O2-X's two turbine blades during energy generation in the tidal currents.
- Orbital O2-X movement within its watch circle between peak tide periods.

For the proposed Project, there are varying degrees of collision risk based on the vessel, Orbital O2-X device or component (e.g., turbine blade), species type (e.g., marine mammals, fish, and birds), and likelihood of impact occurrence. Given the technical and logistical complications involved in observing and/or recording marine species in proximity to tidal energy systems, current knowledge about collision risk comes from both empirical and modeling studies examining animal behavior in proximity to a turbine (Garavelli et al. 2024), as well as studies using passive acoustic monitoring and/or multibeam sonar (Viehman and Zydlewski 2015; Copping et al. 2017; Palmer et al. 2021; Gillespie et al. 2023).

4.1.2.1 Vessel

Vessel collision has the potential to occur during all Project actions using vessel support: installation, maintenance, and removal of the Orbital O2-X device and supporting infrastructure. A large barge with a maximum size of 83 m x 23 m (275 ft x 75 ft) would be used to install the Orbital O2-X near Blakely Island; for routine maintenance visits, the largest vessel to visit the Project area would be approximately 25 m (82 ft) in length. Examples of the types of boats and vessels used for installation and maintenance of another Orbital tidal device (which is very similar in type and size to the O2-X) are shown in **Figure 73**, **Figure 74**, and **Figure 75**.



Figure 73. Example of Vessel and Boat Installing Orbital Tidal Device



Figure 74. Example of Maintenance Personnel and Boat for Orbital Tidal Device

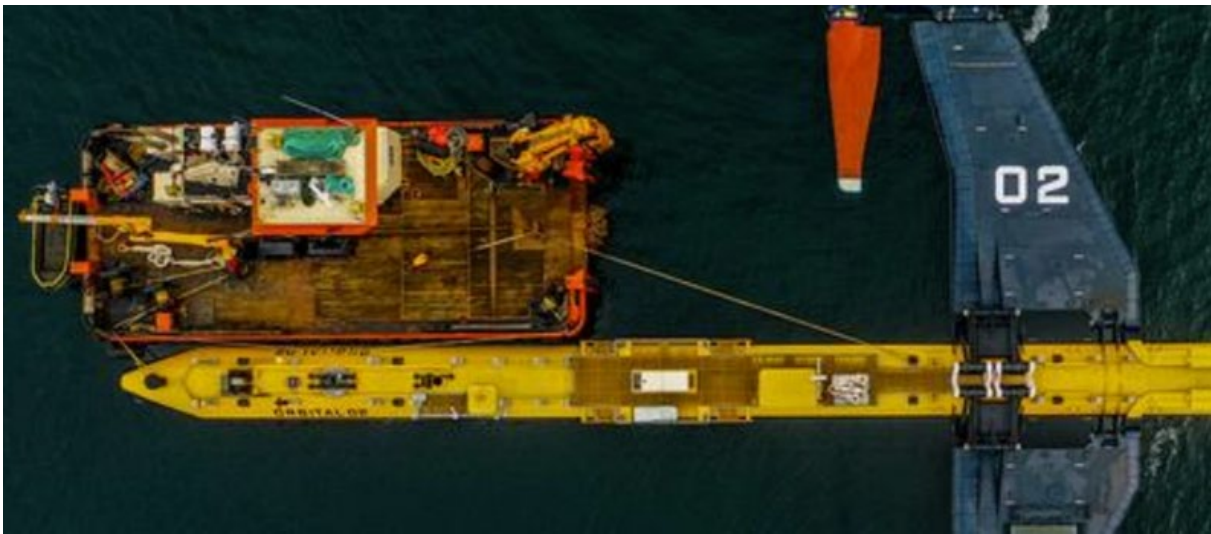


Figure 75. Example of Maintenance Boat for Orbital Tidal Device

While some risk of collision between Project vessel(s) and marine animals exists, these mobile marine animals would likely avoid the vessel or otherwise alter their behavior to avoid a collision. Individuals may deflect around vessels and continue along their path, but these behaviors would not likely result in significant disruption of normal behavioral patterns. Cetaceans (whales and dolphins) are known to tolerate slow-moving vessels within several hundred meters, especially when the vessel is not directed toward the animal and when there are no sudden changes in direction or engine speed (Wartzok et al. 1989, Richardson et al. 1995, Heide-Jørgensen et al. 2003).

Evidence indicates that the probability of lethal injury to cetaceans and other marine animals increases with vessel speed, while there is a substantial decrease in lethality as a vessel's speed falls below 15 knots (Vanderlaan and Taggart 2007; Hazel et al. 2007; Rudebusch et al. 2020). Vessels would follow BMPs to mitigate vessel collision risk to marine mammals when traveling to and from the Project area, which includes traveling at a speed limited to 9 knots or less during transit,



and 3 knots or less while installing the new subsea power cable on the seafloor. The vessel(s) would follow standardized procedures, which are outlined below, for navigating the presence of ESA-listed species (e.g., SRKWs). Vessel personnel would also be instructed to monitor for ESA-listed species to reduce the likelihood of impact and severity of a collision with a marine animal.

After installation of the Orbital O2-X and supporting components, vessel presence for on-site maintenance would be limited to one or two times per year for inspections and periodic mooring surveys, unless unexpected challenges arise (see **Table 8**). Additionally, vessels would be present for an Orbital O2-X overhaul at approximately 5 years into operations, and major inspection between 5 to 8 years (see **Table 8**). Based on existing evidence, vessel collision is not expected to occur due to the proposed Project, including subsea power cable installation (Taormina et al. 2018). In order to reduce collision risk during maintenance and surveys, vessel(s) and staff would be compliant with any required standard operating procedures (SOPs) and BMPs. With mitigation measures in place to minimize the potential collision risk, including using industry-wide SOPs, BMPs, and vessel regulations related to marine mammals, vessel traffic associated with the proposed Project is not expected to increase the likelihood of a vessel collision with marine mammals or other marine species. Without the implementation of protection measures (e.g., SOPs and BMPs), there would be a moderate likelihood of a vessel collision, which, if it occurred, could have a moderate impact and pose a potentially high risk to marine mammals.

During project activities requiring vessels, trained personnel would visually monitor for wildlife. If marine mammals are sighted:

- Vessels should maintain a minimum distance of 91 m (300 ft; 100 yards) from the marine mammal sighting, when feasible. BMPs by sighting type are provided below:
 - SRKWs: Vessels would stay 914 m (3,000 ft; 1,000 yards) (approximately 0.5 NM) away from SRKWs in all directions whenever possible. If a SRKW approaches within 366 m (1,200 ft; 400 yards) of the vessel, it would disengage the transmission until the SRKW moves away. If a vessel operator believes it may be closer than 914 m (3000 ft; 1,000 yards) to SRKW(s), but not within 366 m (1,200 ft; 400 yards), the vessel operator could attempt to navigate out of the path of the SRKW(s) at a speed of 7 knots or less (RCW 77.15.740).
 - Project vessels should not leapfrog SRKW but would stay out of the forward path of whales, at any point within 366 m (1,200 ft; 400 yards).
 - Other ESA-listed marine mammals: If an ESA-listed marine mammal comes within approximately 91 m (300 ft; 100 yards) of the vessel, onboard personnel may modify vessel operations until the animal moves safely out of the area and remains unobserved for 30 minutes.
 - Bigg's/Transient killer whales: Vessels would stay 183 m (600 ft; 200 yards) away from Bigg's/Transient killer whales and would not park in their path within 366 m (1,200 ft; 400 yards).
 - All other marine mammals: Vessels would stay 91 m (300 ft; 100 yards) from all other marine mammals (e.g., humpback whales, gray whales, sea lions, seals) and 183 m (600 ft; 200 yards) from baleen whales resting or with a calf.
- Vessels would not be permitted to cross directly in front of or intersect the path of any sighted marine mammals.
- If a large marine mammal (e.g., whale) passes along the ship, the vessel operator would maintain a steady heading and constant speed that is not faster than the sighted individual's speed.
- Vessels should not position themselves in the path of a whale or cut in front of a whale in a way or at a distance that causes the whale to change direction of travel or behavior (including breathing/surfacing pattern), whenever possible.



- If sighted marine mammals demonstrate defensive or disturbed actions, the vessel would slow or be taken out of gear until the animal calms and/or moves a safe distance away from the vessel.
- Vessels would take reasonable steps to alert other vessels in the vicinity of whale(s).

In the highly unlikely event of a vessel collision with a marine mammal during installation activities or vessel transit, the vessel operator must document the conditions at the time of the incident, including the following:

- Latitude and longitude of the vessel at the incident location.
- Date and time of the incident.
- Speed and bearing of the vessel at the time of the incident.
- Approximate size of the animal (length) and take a photo if possible.
- Condition of the animal (e.g., alive, dead, wounded, bleeding).
- Environmental conditions at the time of the incident, including wind speed and direction, swell height, visibility in miles, percent cloud cover, and presence or absence of precipitation or fog.
- The names of the vessel, vessel operator, vessel owner, and captain or officer in charge of the vessel at the time of the incident.

If a collision occurs, the vessel must stop if it is safe to do so and attempt to evaluate the condition of the animal for reporting purposes. Any vessel strike would be reported immediately by telephone communications to NOAA's West Coast Region Marine Mammal Stranding Network:

- West Coast Region Marine Mammal Stranding Hotline: **1 (866) 767-6114**.

Vessel operators are not permitted to aid injured marine mammals or recover a carcass unless specifically instructed to do so by the Stranding Coordinator from the hotline.

4.1.2.2 Turbine Blade and Device Collision

During Orbital O2-X operation, there is the risk of potential collision with the device's turbine blades. These events are difficult to predict or measure (Sparling et al. 2020). However, ongoing monitoring, mitigation strategies, and adaptive management throughout the Project's lifespan would help minimize the likelihood of these events occurring.

The Orbital O2-X's turbine rotors operate at a relatively slow speed, with a rated rotation of 9.2 rotations per minute (rpm) and a maximum of 11.2 rpm. This slow rotation significantly reduces the risk of serious injury or death to marine animals in the extremely unlikely event of an interaction with a turbine blade. There is also a risk of marine mammals colliding with the Orbital O2-X device itself during operation while it pivots with the changes of the tide. An individual may experience a sublethal collision, which has the potential to disrupt life history in the future (Onoufriou et al. 2019). However, because the device moves slowly due to its tidal-driven operation, this risk is considered low, with a low likelihood and minor impact if it were to occur.

Marine Mammals

For the proposed Project, the likelihood of a collision with a turbine blade is low. To date, there have been no detected or recorded instances of direct collision of marine mammals with the Orbital O2 device deployed in Scotland (Onoufriou et al. 2021; Garavelli et al. 2024). If one were to occur, it would have a moderate impact, resulting in a medium risk level for marine mammals. Although the likelihood of a collision between SRKWs and a turbine blade is low, the small population size makes each individual more valuable, increasing the potential for a major impact. The sensory capabilities of marine mammals (e.g., sight, hearing, and echolocation) suggest that a collision with a turbine blade would be a rare event, as they can detect objects in the water and avoid them.

A case study was recently conducted at MeyGen (Pentland Firth, Scotland), a site with an array of four horizontal axis 1.5 MW tidal turbines (Gillespie et al. 2021). Using video cameras, active and passive acoustic monitoring, and tagging, results showed that no collision or other detectable impacts were caused by the presence of tidal turbines, and that harbor seals avoided the area when turbines were operational (Sparling et al. 2020; Gillespie et al. 2021; Coles et al. 2021). Additional MeyGen studies showed that harbor seals foraged in the area of tidal turbines but spent very little time within 100 m (328 ft) of them (Coles et al. 2021). Porpoises frequently swam within 150 m (492 ft) of operational turbines, but their presence dropped between 33 and 78 percent during turbine operation (Coles et al. 2021). After 451 days of monitoring, there was no evidence of detectable species tracks going through the rotor swept area while the turbine was operating (Gillespie et al. 2021).

Fish

For the proposed Project, the likelihood of a collision would be low, but the impact would be moderate, resulting in a medium risk level for fish species. Several recent risk monitoring studies for fish collision have focused on detecting direct contact with turbine blades using various technologies (Garavelli et al. 2024). In Alaska, interaction between sockeye salmon smolts and the ORPC RivGen® river turbine in the Kvichak River was assessed using video cameras (Courtney et al. 2022). Of the 2,374 fish identified in the images, 382 fish (16 percent) were observed to swim in a disoriented manner (related to turbulence and flow) and 36 fish (1.5 percent) in direct contact with the turbine at production speed (Garavelli et al. 2024). Collision outcomes were unobservable and unknown.

Tidal turbines may also act as a fish aggregating device, increasing their numbers and potential for collision (Fraser et al. 2018; Williamson et al. 2019). Studies have shown that fish begin to occupy deeper areas at night in areas of tidal turbines, which may increase the risk of collision due to poor visual detection at low light conditions (Williamson et al. 2019; da Silva et al. 2022). MeyGen site studies also showed that fish schools were at a much higher abundance during neap tides compared to spring tides (Couto et al. 2022). Laboratory studies using fish released upstream and downstream of an axial flow turbine have shown significant avoidance behavior by the fish, which increased as blade tip speed increased (Zhang et al. 2017). Yoshida et al. (2020) observed that most fish pass outside an operating turbine blade, with a one percent chance of blade collision; two collisions were observed and neither resulted in fish injury.

Avian Species

For the proposed Project, the likelihood of a collision is low, but the impact would be moderate, resulting in a medium risk level for avian species. Collision risk is a concern for seabirds in locations where tidal turbines overlap with diving and foraging areas; however, much less is known about the risk concerning diving seabirds compared to other types of marine species (Couto et al. 2022).

There is a lack of information regarding the threat of collisions between avian species and tidal turbines, with no studies available for the species that may be present within or near the proposed Project area. In other studies, the black guillemot (*Cepphus grille*) and European shag (*Phalacrocorax aristotelis*) (neither of which occur in the San Juan Islands) were investigated due to diving behavior (Sparling et al. 2020), and their risk could be extrapolated and applied to other diving seabird species. A 5-year study focused on the Nova Innovation turbine array (Bluemull Sound, Shetland, Scotland) indicated that black guillemot and European shag actively pursued fish prey in the vicinity of tidal turbines but did not interact with them (Coles et al. 2021). Of the 12 individual European shags and five individual black guillemots observed at the same site, no physical contact with the turbine blade was observed (Garavelli et al. 2024). Other land- and boat-based studies observing seabirds in tidal areas suggest that highly energetic tidal channels may provide predictable foraging sites for a range of seabirds, but that collision risk is site-specific and can even vary within a single site (Waggitt and Scott 2014; Wade 2015).



Invertebrates

Since marine invertebrates are primarily sessile or mobile benthic species, and if present would be out of range from any vessels or the Orbital O2-X device, it is expected that there is no collision risk posed to these types of species.

Summary

The 2024 State of the Science report (Garavelli et al. 2024), as well as the most recent literature (Matzner et al. 2017; Sparling et al. 2020; Copping and Hemery 2020; Copping et al. 2023; da Silva et al. 2022), indicate that there have been no recorded instances of marine mammals, diving seabirds, or other marine animals colliding with an operational tidal or river turbine. Potential exceptions involve fish species, as river turbine technology has been shown to result in a low direct collision rate (approximately 1.5 percent) at production speed (Courtney et al. 2022; Garavelli et al. 2024). Worst-case scenario collision modeling also suggests small collision risk rates for fish (Shen et al. 2016; Grippo et al. 2017; da Silva et al. 2022). Since sessile and mobile marine invertebrates are primarily benthic organisms, no collision risk is expected for these species.

The available observations cannot definitively confirm that fish and other marine animals would always avoid a rotating turbine. However, the majority of evidence suggests that the sensory capabilities of marine animals would alert them to the presence of a hazard, allowing for high survivability rates (Jacobson et al. 2012; Schweizer et al. 2011; Bevelhimer et al. 2016; Copping et al. 2023). It is highly likely that marine animals would avoid the Orbital O2-X device, turbine blades, or other moving components of the proposed Project (Fraser et al. 2018; Gillespie et al. 2021; Onoufriou et al. 2021). Therefore, a collision between marine animals and vessels or the Orbital O2-X is expected to be a rare event (Copping and Hemery 2020; Copping 2023).

Based on existing evidence, there is a low likelihood of collision events occurring, but the potential impact on marine animals (e.g., injury or death) remains uncertain, and could range from moderate to major (Garavelli et al. 2024). A low likelihood of collision is predicted with the Orbital O2-X device and/or turbine blades; however, the collision impact varies depending on the nature of the collision and type of species (**Table 20**). Without any mitigation measures in place, the overall risk of vessel collision with a marine mammal would be considered high; the risk of turbine blade collision for marine mammals, fish, and avian species would be medium; and the risk of marine mammal collision with the device itself would be low. In consultation with Tribal Nations, regulatory agencies, and stakeholders, appropriate BMPs and mitigation measures will be implemented to reduce the risks and potential impacts of the proposed Project.

Ultimately, collision risk with Project components is influenced by factors such as the device's location, water depth at the deployment site (approximately 60 m [197 ft] depth; 27 m [89 ft] from the bottom of the rotor blade tip), tidal velocity, and blade tip speed, as well as the behavioral patterns of nearby marine species, including their vertical distribution within the water column and swimming behavior in tidal currents and nearby foraging areas (da Silva et al. 2022). Mitigation measures, such as SOPs, BMPs, and reduced vessel operating speeds, along with post-installation monitoring, will be implemented to minimize collision risk and impact from project activities.

4.1.2.3 Mooring Line Collision

Very little is known about marine mammal interactions with MRE device mooring lines, making it an emerging area of research (Copping and Hemery 2020). The primary concern with marine mammals encountering mooring lines is not collision injury, but entanglement risk (discussed in **Section 4.1.1**). The likely consequences of marine mammal encounters with MRE mooring lines (e.g., injury or death) remain largely unknown, although impacts are expected to be negligible.



4.1.3 Entrainment

In the context of this proposed Project, “entrainment” refers to the transport of marine animals through the water due to flow, which can be affected by turbine sweep, i.e., being drawn toward/into the tidal turbine(s). Entrainment is a concern during the following Project activities:

- Project operation during peak tidal current flow when turbines are in motion.

Entrainment into a tidal turbine is a primary concern for marine mammals, fish, and seabirds (USFWS 2024e), as it could potentially lead to collision with turbine blades resulting in injury and/or mortality. In conventional hydrokinetic turbines, fish may suffer injuries or mortality due to rapid pressure changes, cavitations (bubbles forming and popping), and shear stress (layers of water moving at different speeds) (Dadswell and Rulifson 1994; Čada et al. 2006). For a single Orbital O2-X tidal turbine device, there is no “engine” involved or fast rotating propellers. Therefore, these types of effects are not expected.

Very few studies have focused on the susceptibility of species to entrainment by tidal turbine devices. Most available entrainment studies have focused on fish species and analogous MRE systems (e.g., vertically oriented turbines, devices deployed in river systems, or conventional hydropower). A discussion is provided below:

Marine Mammals

Very few studies have investigated the entrainment risk posed by tidal turbines to different types of marine mammals (e.g., pinnipeds and cetaceans). No studies exist on the entrainment of cetaceans by any type of turbine, so little is known about their entrainment risk with a single tidal turbine device. The few existing studies primarily focus on altered behavior and collision risk with turbine blades (**Section 4.1.2**), particularly in harbor porpoises and smaller mammals. None have reported marine mammals becoming entrained or suffering injury or death (Gillespie et al. 2021)

At the 1.5 MW horizontal-axis turbine array at the MeyGen site (Pentland Firth, Scotland), harbor porpoises have been observed swimming in close proximity to a rotating tidal turbine (9 m [29.5 ft] rotor sweep area), but they generally avoid the area close to the rotors whether or not the turbine was operating (Gillespie et al. 2021). Of the 344 occasions when harbor porpoises swam close to the operating turbine (“events”) (10 m [33 ft] up/downstream), 111 (32 percent) occurred when the turbine was rotating (greater than 1 rpm) and 233 (68 percent) when it was stationary (less than/equal to one rpm) (Gillespie et al. 2021). None of the harbor porpoises clearly passed through the rotor sweep area, but of the 111 events when the turbine was rotating, 11 passed the turbine with a clear swim direction (one above and slightly to the side, 10 below or to the side), while a further 19 were either passing or milling; the behavior of the remaining 90 unknown (Gillespie et al. 2021). Approximately 75 percent of the observed porpoises passed the turbine at distances greater than 35 m (115 ft) (Gillespie et al. 2021). This study suggests that porpoises (and possibly other similar-sized marine mammals) that do swim close to tidal turbines would likely evade or avoid them, swimming below or around the rotor swept area, and would not get entrained into the operating turbine.

Fish

Studies have investigated the entrainment risk to fish, but many knowledge gaps remain concerning single tidal turbine devices. At the Fall of Warness tidal test site (Orkney, Scotland), consistent aggregations of fish schools have been observed around the tidal turbine during reduced flood velocities in its wake, while fish have displayed avoidance behavior during peak flow velocities (Fraser et al. 2018). It is inconclusive whether increased fish presence around the tidal turbine increased entrainment risk and/or occurrence.

Other studies indicate that fish species have low susceptibility to entrainment and high survival rates if they do pass through an operating turbine: Amaral et al. (2014) tested fish species passing



through turbines operating at 1.5 m/s and 2.0 m/s (4.9 ft/s and 6.6 ft/s), observing survival rates of 94 to 100 percent for turbine-passed fish, while avoidance rates were between 86 and 100 percent (32 to 65 percent for white sturgeon [*Acipenser transmontanus*]) (Amaral et al. 2014).

Acoustic cameras have observed the effects of fish size, tidal turbine motion, and diel cycle (i.e., daytime or nighttime) on fish behavior at a commercial-scale tidal turbine energy site in Cobscook Bay, Maine (Viehman and Zydlewski 2015). While the turbine was rotating, the probability of fish entering the turbine decreased by over 35 percent and avoidance behavior increased by 120 percent, but the probability of passing increased by 97 percent compared to a non-operating turbine (Viehman and Zydlewski 2015). Schools had a 56 percent lower probability of entering the turbine than individual fish and reacted at greater distances from the turbine: median 2.5 m (8.2 ft) for schools and 1.7 m (5.6 ft) for individuals (Viehman and Zydlewski 2015). Fish behavior in response to tidal turbines would likely be similar to their response to other obstacles (e.g., trawls), and does not indicate an increased risk of entrainment. This suggests that fish are more likely to avoid a tidal turbine than to get entrained.

Avian Species

No studies have been conducted on the entrainment risk from tidal turbines to seabirds. Given the relatively low blade speed of the Orbital O2-X's turbines and the low likelihood that birds (including diving seabirds) would be present near the device, no entrainment risk to avian species is expected.

Invertebrate

Since the marine invertebrates are sessile or mobile benthic species and would not be in close proximity to the Orbital O2-X, no entrainment risk is posed to these species.

Summary

The mechanics of crossflow turbine design create essentially no suction or entrainment force during operations. Although few studies have evaluated entrainment risk to marine mammals, it is not expected to result from the proposed Project, as evidenced by entrainment not occurring at other deployed tidal turbine sites (Gillespie et al. 2021; Garavelli et al. 2024). The turbine is designed to operate at a rated rotation speed of 9.2 rpm (11.2 rpm maximum). Water is decelerated as it approaches the rotors, and in lab-scale experiments, this effect is apparent at 1 to 2 diameters upstream, such that deceleration would begin 30 to 60 m (98 to 197 ft) upstream of the rotors. Therefore, it is very unlikely that a suction force strong enough to entrain marine mammals would occur due to the Orbital O2-X's operating turbines.

If entrainment were to occur, it would likely be on a small scale and unlikely to pose an overall serious danger to nearby mammals, fish, and seabirds. Of all the species in the area, schooling fish may have some entrainment risk. The most relevant studies that have been conducted concerning marine species (e.g., porpoises) colliding with tidal turbines (see **Section 4.1.2.2**) indicate that species actively avoid nearby areas while turbines are in operation compared to non-operation (Coles et al. 2021; Onoufriou et al. 2021). There is a very low risk of entrainment due to the proposed Project.

4.1.4 Noise Disturbance

Ocean noise can interfere with or obscure the ability of marine animals to hear the natural sounds of the ocean. Noise intensity is measured by its sound pressure (amplitude, in dB), while hearing ranges are measured by the speed of sound waves (frequency, in Hz or kHz). Additionally, because water is denser than air, sound travels faster and farther in the ocean (approximately 1,500 m/s [4,921 ft/s]) compared to the atmosphere (340 m/s [1,115 ft/s]) (Solé et al. 2023). Both underwater and aerial noise disturbance is expected during the following Project actions:

- Vessel presence during Project installation, operation, maintenance, and removal.
- Rock-drilled anchor installation and removal (if they are used, as opposed to gravity anchors).



- Powertrain energy conversion during operation and maintenance.

The risk of noise disturbance to marine animals is expected but would vary during different actions of the proposed Project. Vessel operations for Project activities would also be an occasional noise source throughout all stages (Table 20).

Table 20. Noise Disturbance Risk Due to Project Activities

Device	Receptor	Likelihood	Impact	Risk
All Stages				
Vessel	Marine Mammals	Medium	Minor	Medium
	Fish	Medium	Minor	Medium
Installation				
Rock-drilled Anchor Drill (if used)	Marine Mammals	Medium	Minor	Medium
	Fish	Medium	Minor	Medium
Operation and Maintenance				
Orbital O2-X Powertrain	Marine Mammals	Low	Minor	Low
	Fish	Low	Minor	Low

Noise levels would be elevated during installation and removal activities. To install rock-drilled anchors, if used, a submersible and remotely operated drill rig would be deployed from a multi-cat vessel, or equivalent, operated by a hydraulic power unit on deck. The drilling operation to install the anchors would be completed in a short timescale (e.g., 12 hours of drilling per anchor; 48 hours total for four). Mooring lines would take 4 days to install (one per day), and the new subsea cable would take up to 1 week to install. Once installed and operating, broadband noise (e.g., the hum of machinery) from the Orbital O2-X would be created by the rotation of the turbines and their powertrains. Noise generated by the flow of water around the Orbital O2-X device or in the turbine wake is not expected to significantly contribute to ambient noise levels because the source is an inefficient radiator of sound.

While operating, the Orbital O2-X turbines would generate relatively low-frequency noise, evidenced by other tidal turbine devices. Two 1.5 MW tidal turbines at the MeyGen site (Pentland Firth, Scotland) (Atlantis AR1500 and Andritz AHH1500) were shown to produce noise levels between 50 Hz and 1 kHz (Risch et al. 2023). The operating Atlantis AR1500 turbine, a three-bladed horizontal axis tidal-stream turbine, was shown to emit elevated noise levels by approximately 30–40 dB at 100 m (328 ft), equivalent to a 30–40 percent increase based on ambient noise measurements of 100 dB (Risch et al. 2020). At a distance of 2.3 km (1.4 miles) from the turbine, elevated noise was reduced to 5 dB (Risch et al. 2020).

4.1.4.1 Scope of Impact

Increased noise levels due to Project activities would be temporary, from sources including vessel(s) for Project activities, installation of rock-drilled anchors (if used), and the Orbital O2-X device powertrain (operation and maintenance). The likelihood of noise disturbance occurring varies depending on the source, ranging from low (Orbital O2-X powertrain only) to medium, with expected



minor impacts. The risk to marine animals is also low (Orbital O2-X powertrain only) to medium (**Table 20**). Unlike commercial vessels, the Orbital O2-X has no engine or fast-rotating propellers that generate the noise commonly associated with shipping, nor does it produce propeller cavitation that could potentially injure or disturb marine animals.

Post-installation acoustic monitoring of other tidal turbines gives insight into the scope of impact expected from the Orbital O2-X. The Orbital O2 device installed at the EMEC Fall of Warness tidal test site in the Orkney Islands, Scotland was studied in July–August 2021. Under low wind conditions and a drifting speed of 2.6–3.5 m/s (8.5–11.5 ft/s), the Orbital O2 operating at 25 percent capacity was clearly detectable at frequencies between 1 Hz and 1 kHz, with a difference in median SPL of 40 dB above ambient noise and 10–15 dB compared to when the device was not generating power (PNNL 2024). Similar noise ranges can be expected from the operating Orbital O2-X in Rosario Strait.

4.1.4.2 Species Impacts

Noise disturbance can have various effects on marine animals, including attraction, avoidance, harm, or injury. However, the impact on different species would depend on the noise source. Increased noise levels from vessel operations, rock-drilling anchor installation (if needed), and the Orbital O2-X powertrain are expected to affect marine animals to varying degrees. The risks to marine animals depend on several factors: the amplitude (dB), frequency (Hz-kHz), and directionality of the noise source, as well as prevailing ambient noise, the attenuation of noise with distance, and a species' hearing thresholds and potential behavioral responses (Rose et al. 2024). Impacts are primarily a concern for marine mammals and fish species due to their sensitivity to underwater noise and existing scientific evidence. While noise impacts on avian and invertebrate species are briefly discussed, there is insufficient evidence to assess the likelihood, impact, and risk to these groups with the same certainty as for marine mammals and fish.

Noise from the Orbital O2-X turbine operation would be a continuous, non-impulsive source. Non-impulsive sounds can vary in frequency (broadband, narrowband, or tonal), duration (brief or prolonged), and pattern (continuous or intermittent). Unlike impulsive sounds, they do not have high peak sound pressures with quick rises or falls in volume (NMFS 2018, 2024r) (**Table 21**).

Auditory injury occurs when the inner ear is damaged, particularly the nerves that transmit sound signals to the brain. This damage can impair hearing and may disrupt the connections between nerves, potentially leading to permanent threshold shift (PTS), also known as permanent hearing loss (NMFS 2018, 2024r) (**Table 22**). Temporary threshold shift (TTS) is temporary, reversible hearing damage at a specified frequency or portion of an individual's hearing range above a previously established reference level (NMFS 2018, 2024r; Engel et al. 2024) (**Table 23**). Project activities, including installation, Orbital O2-X operation and maintenance, and removal, are expected to produce noise levels within the hearing ranges of the marine mammal groups shown in **Table 21**, but outside the ranges indicated in **Table 22** and **Table 23**. As a result, no auditory injuries or temporary threshold shifts (TTS) to marine mammals are anticipated.

Table 21. Marine Mammal Hearing Group Ranges

Hearing Group	Species	Generalized Hearing Range ¹ (2024 ²)
Underwater		
Low-frequency (LF) cetaceans	Baleen whales, including gray whales	7 Hz – 36 kHz



Hearing Group	Species	Generalized Hearing Range ¹ (2024 ²)
High-frequency (HF) cetaceans ³	Killer whales, pilot whales, and some dolphin species	150 Hz – 160 kHz
Very High-frequency (VHF) cetaceans ⁴	Dolphins and porpoises	200 Hz – 165 kHz
Phocid pinnipeds (PW)	True seals	40 Hz – 90 kHz
Otariid pinnipeds (OW)	Sea lions and fur seals	60 Hz – 68 kHz
In-Air		
Phocid pinnipeds (PA)	True seals	42 Hz – 52 kHz
Otariid pinnipeds (OA)	Sea lions and fur seals	90 Hz – 40 kHz
<p>Notes: dB = decibel; HF = high-frequency; Hz = hertz; LF = low frequency; kHz = kilohertz; MF = mid-frequency; NMFS = National Marine Fisheries Service; OA = otariid pinnipeds (in-air); OW = otariid pinnipeds (underwater); PA = phocid pinnipeds (in-air); PW = phocid pinnipeds (underwater); VHF = very high-frequency</p> <ol style="list-style-type: none"> Generalized hearing range represents 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 ranges are based on ~65 dB threshold from normalized composite audiogram (NMFS 2018, 2024r). Generalized Hearing Ranges (2024) are the updated ranges from the NMFS Draft 2024 Update to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 3.0) (NMFS 2024r). HF cetaceans are listed as "MF cetaceans" in NMFS' 2018 Technical Guidance (Version 2.0), for the Generalized Hearing Range listed in this table (NMFS 2018, 2024r). VHF cetaceans are listed as "HF cetaceans" in NMFS' 2018 Technical Guidance (Version 2.0), for the Generalized Hearing Range listed in this table (NMFS 2018, 2024r). <p>Source: NMFS 2018, NMFS 2024r</p>		

Table 22. Summary of Auditory Injury Onset Criteria for Impulsive and Non-Impulsive Noise Sources (sound intensity; dB)

Hearing Group	Auditory Injury Onset Criteria ¹	
	Impulsive	Non-impulsive
Underwater		
LF Cetaceans	Peak Sound Pressure ² , flat: 222 dB Weighted cumulative sound pressure ³ , 24 hours: 183 dB	Weighted cumulative sound pressure, 24 hours: 197 dB
HF Cetaceans	Peak Sound Pressure, flat: 230 dB Weighted cumulative sound pressure, 24 hours: 193 dB	Weighted cumulative sound pressure, 24 hours: 201 dB
VHF Cetaceans	Peak Sound Pressure, flat: 202 dB Weighted cumulative sound pressure, 24 hours: 159 dB	Weighted cumulative sound pressure, 24 hours: 181 dB



Auditory Injury Onset Criteria ¹		
Hearing Group	Impulsive	Non-impulsive
Phocid pinnipeds (PW)	Peak Sound Pressure, flat: 223 dB Weighted cumulative sound pressure, 24 hours: 183 dB	Weighted cumulative sound pressure, 24 hours: 195 dB
Otariid pinnipeds (OW)	Peak Sound Pressure, flat: 230 dB Weighted cumulative sound pressure, 24 hours: 185 dB	Weighted cumulative sound pressure, 24 hours: 199 dB
In-Air		
Phocid pinnipeds (PA)	Peak Sound Pressure, flat: 162 dB Weighted cumulative sound pressure, 24 hours: 140 dB	Weighted cumulative sound pressure, 24 hours: 154 dB
Otariid pinnipeds (OA)	Peak Sound Pressure, flat: 177 dB Weighted cumulative sound pressure, 24 hours: 163 dB	Weighted cumulative sound pressure, 24 hours: 177 dB
<p>Notes: dB = decibels; HF = high-frequency; Hz = hertz; LF = low frequency; NMFS = National Marine Fisheries Service; OA = otariid pinnipeds (in-air); OW = otariid pinnipeds (underwater); PA = phocid pinnipeds (in-air); PW = phocid pinnipeds (underwater); VHF = very high-frequency</p> <ol style="list-style-type: none"> 1. The Auditory Injury Onset Criteria are those that appear in the NMFS Draft 2024 Update to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 3.0) (NMFS 2024r). 2. Peak Sound Pressure ($L_{p,0-pk}$) has a reference value of 1 μPa, and weighted cumulative sound exposure level ($L_{E1p, PW}$) has a reference value of 1 $\mu\text{Pa}^2\text{s}$. 3. "Flat" indicates peak sound pressure are flat weighted or unweighted within the generalized hearing range of marine mammals (i.e., 7 Hz to 160 Hz), and "24 hours" refers to the recommended accumulation period of 24 hours. 		

Table 23. TTS Onset Criteria for Non-Impulsive Sounds

Hearing Group	Weighted TTS Onset Acoustic Criteria ¹
Underwater	
LF Cetaceans	177 dB
HF Cetaceans	181 dB
VHF Cetaceans	161 dB
Phocid pinnipeds (PW)	175 dB
Otariid pinnipeds (OW)	179 dB
In-Air	
Phocid pinnipeds (PA)	134 dB
Otariid pinnipeds (OA)	157 dB



Hearing Group	Weighted TTS Onset Acoustic Criteria ¹
<p>Notes: HF = high-frequency; Hz = hertz; LF = low frequency; kHz = kilohertz; NMFS = National Marine Fisheries service; OA = otariid pinnipeds (in-air); OW = otariid pinnipeds (underwater); PA = phocid pinnipeds (in-air); PW = phocid pinnipeds (underwater); TTS = temporary threshold shift; VHF = very high-frequency</p> <p>1. Determined from minimum value of auditory exposure function and weighting function at its peak.</p>	

Marine Mammals

Marine mammals, especially cetaceans, are highly vocal and depend on sound for many aspects of their life history including reproduction, feeding, predator and hazard avoidance, communication, and navigation, thus making them particularly vulnerable to increased underwater noise (Weilgart 2007; Rose et al. 2024). This has been a focus of research in recent years (Polagye et al. 2011; Thomsen et al. 2015; Harding et al. 2019, 2023; Risch et al. 2023).

Noise effects on marine mammals can range from no obvious response, behavioral responses, to masking other important sounds used for social interaction, mating, navigation, foraging, and predation avoidance (Popper and Hawkins 2018; Popper et al. 2023; Rose et al. 2024). On a small scale, harbor seals avoid simulated tidal turbine sounds (Hastie et al. 2018) and harbor porpoise click activity decreases within a few hundred meters of an active device compared to baseline levels (Tollit et al. 2019; Coles et al. 2021). Severe potential effects of increased underwater noise (e.g., threshold shift, physiological changes, physical injury, and death) have not been observed for MREs (Popper and Hawkins 2018; Popper et al. 2023).

Increased noise disturbance due to vessel activity, installation, and removal of the Orbital O2-X and supporting infrastructure is expected to have a medium likelihood of occurrence, with minor impacts on marine mammals, resulting in an overall medium risk. Increased noise disturbance due to the Orbital O2-X powertrain is expected to have a low likelihood of occurrence, with minor impacts, resulting in an overall low risk.

Fish

Vessel activity, installation, and removal of Orbital O2-X and supporting infrastructure are expected to have a medium likelihood of causing minor impact on fish species, resulting in an overall medium risk. Increased noise disturbance due to the Orbital O2-X powertrain is expected to have a low likelihood of occurrence, with minor impacts, leading to an overall low risk.

Fishes’ ability to detect sounds differs between species and depends on their physiology and morphology (Zang et al. 2023). All fish hear through their inner ears by sensing particle motion, while species with specialized structures can also hear sound through pressure (Popper and Hawkins 2018; Popper et al. 2019). Demersal fish (i.e., groundfish) may be sensitive to particle motion during the Project’s construction and installation activities, while diadromous and pelagic fish may be sensitive to the sound frequencies of the Orbital O2-X’s continuous operational noise (ORJIP Ocean Energy 2022b).

Studies have shown that fish do not experience adverse effects from elevated noise levels up to approximately 160 dB re 1 μPa. However, at higher noise levels, fish may exhibit avoidance behavior, stress, temporary or permanent hearing loss, auditory and non-auditory tissue damage, egg damage, reduced growth rates, or mortality (Hastings and Popper 2005; Popper et al. 2014). While mortality and physical injuries are rare, they can occur when fish are exposed to high-magnitude impulsive sounds, such as pile driving or explosions at close range. In comparison, physiological and behavioral changes, along with impaired hearing, are more likely. This hearing impairment can reduce fishes’ ability to detect biological sounds from predators, prey, and acoustic cues for navigation. (Zang et al. 2023). However, the noise levels produced by these activities are beyond the range anticipated for the proposed Project and will not occur.



Avian Species

There is uncertainty regarding the potential impacts of underwater noise on seabirds, and the significance of underwater hearing and hearing thresholds for these species remains largely unknown (ORJIP Ocean Energy 2022b). However, it is important to note that for a single tidal turbine device, the potential noise impacts on seabirds are considered low, and the available evidence is limited (ORJIP Ocean Energy 2022b). A summary of the relevant information on avian hearing is provided below.

For example, Atlantic puffins (*Fratercula arctica*) had the lowest measured hearing thresholds between 1 and 2 kHz, but measurable responses to noise began between 0.5 and 6 kHz (Mooney et al. 2019). Common murrelets (*Uria aalge*) exposed to underwater noise react to sound intensities between 110 and 137 dB re 1 μ Pa, with a clearly graded response to higher received levels (Hansen et al. 2020). Other aquatic bird species, such as the lesser scaup (*Aythya affinis*) and the great cormorant (*Phalacrocorax carbo*), exhibit hearing thresholds very similar to odontocetes (toothed whale species) and pinnipeds at low frequencies (Crowell et al. 2016; Hansen et al. 2017).

Evidence suggests that effects on some avian species' breeding behavior begin at noise levels of 38 dB (Reijnen et al. 1995; Engel et al. 2024). TTS has been observed in avian species exposed to noises between 93 and 110 dB for budgerigars (budgies, *Melopsittacus undulatus*) and small mammals (Dooling and Popper 2007), and vocalization masking has been reported from noise sources producing amplitudes between 85 and 125 dB (Engel et al. 2024). Physiological responses have been observed between 85 and 140 dB, and behavioral responses between 38 and 140 dB (Engel et al. 2024). Noise has also resulted in American oystercatchers (*Haematopus palliatus*) and Brandt's cormorants spending less time on their nests (Borneman et al. 2016; Buxton et al. 2017).

Invertebrates

Particle motion, a component of underwater sound, is detectable by invertebrates; however, scientific understanding of the significance of sound perception in marine invertebrates is limited (Popper and Hawkins 2018; Solé et al. 2023). Due to the lack of focused studies on this subject, it is difficult to assess how noise from the Orbital O2-X and Project activities might affect marine invertebrate species. While there is potential for acoustic cues to attract both sessile (e.g., larvae) and mobile invertebrates (Garavelli et al. 2024), the likelihood of this occurring is considered very low, and any resulting impacts are expected to be negligible.

4.1.4.3 Summary

Overall, the scientific community generally agrees that underwater noise from operating devices in small-scale MRE projects, such as the proposed Project, does not significantly impact marine animals (Copping et al. 2019; Copping and Hemery 2020; ORJIP Ocean Energy 2022b; Polagye and Bassett 2020).

Due to the temporary nature of increased vessel presence during the installation and removal of the Orbital O2-X and supporting infrastructure, only minor impacts would be expected on marine mammals, fish, avian species, and invertebrates. Once installed, operational noise from the Orbital O2-X is unlikely to cause acoustic injury to marine mammals, fish, seabirds, or other species (e.g., sunflower sea star). The likelihood of noise disturbance is low, with minor impacts and an overall low risk to marine animals. However, marine mammals and fish may exhibit behavioral responses, such as avoidance or reduced activity near the tidal turbine (Hastie et al. 2018; Tollit et al. 2019; Polagye and Bassett 2020). These behavioral changes could potentially provide benefits, such as a reduced risk of collision with the Orbital O2-X or its components. Any impacts are expected to be small and limited to areas in close proximity to the device.

Impacts from vessel noise can be mitigated by following SOPs and BMPs, complying with marine mammal regulations, and implementing specific mitigation measures as determined in consultations



with experts. Post-installation monitoring of the Orbital O2-X device would include monitoring for any noise events from the system that could exceed known biological thresholds.

4.1.5 Displacement

Project activities could potentially displace life history activities of marine mammals, fish, and seabirds. Displacement may occur due to:

- Vessel presence, including the noise generated during the installation, operation, maintenance, and removal of the Orbital O2-X.
- Noise from the installation and removal of anchors and mooring lines.
- The marine areas that Project components would spatially occupy and transverse.

Displacement of marine animals due to the presence and/or operation of vessels and devices can include attraction, avoidance, and exclusion behaviors that cause animals to interact unusually with their preferred or critical habitats, or to move into areas that are unfamiliar to them (Hasselmann et al. 2023; Hemery et al. 2024; Garavelli et al. 2024). Displacement varies; it can be over a range of spatial scales, short- or long-term, temporary (e.g., effects change over time as species adjust), or permanent (e.g., a species never returns to habitat area).

“Attraction” is the intentional movement of animals toward an area within or immediately adjacent to an MRE. “Avoidance” is the intentional bypassing of an area with an MRE to travel in the same general direction. Regarding displacement, “exclusion” refers to an animal leaving the area and moving away from the device, creating a “barrier effect” (Hemery et al. 2024; Garavelli et al. 2024). Reasons for displacement can include underwater noise, exposure to electromagnetic fields (EMF), habitat changes, physical presence and movement of the Orbital O2-X device, and hydrodynamic changes (Hemery et al. 2024).

4.1.5.1 Species Impacts

Vessels will be needed for several activities in the proposed Project, which is expected to have a medium likelihood of causing displacement, with minor impacts. This results in an overall medium risk level for marine mammals, fish, and avian species. Vessel operations are not expected to affect or pose any risk to invertebrate species.

Orbital O2-X operations and maintenance, including the device’s spatial sweep while rotating between tides, would have a low likelihood of causing displacement or avoidance, with negligible impacts, resulting in a low overall risk for marine mammals, fish, avian, and invertebrate species. Additionally, there would be a medium likelihood of attraction to the Orbital O2-X device by marine mammals, fish, and avian species, with negligible impacts and low risk. Fish and avian species may be drawn to the water column components of the device; for example, birds attracted to prey aggregation around them. Invertebrate attraction to the device components on the seafloor is anticipated to have a low likelihood, with negligible impacts and low overall risk.

Various marine animals are vulnerable to displacement due to their life history and biological traits (e.g., mobility around the device), including large whales, small cetaceans, pinnipeds, seabirds, and both pelagic and demersal fish. Potential effects of displacement could involve changes in energy use, disruptions in predation, competition, and connectivity, alterations to essential functions such as breeding, rearing, and migration, and in severe cases, population decline (Hemery et al. 2024). The extent of displacement would depend on the significance of the habitat for a species' life history and the availability of alternative suitable habitats. However, for a small-scale or single MRE device, these effects are expected to be minimal.

Marine Mammals

Limited research exists on the impacts of a single MRE device on whale species. Large cetaceans, such as humpback whales, may be displaced during the installation and operation of a tidal turbine



due to underwater noise (e.g., vessel traffic) and the physical presence of the Orbital O2-X (Kraus et al. 2019; Hemery et al. 2024). Previous studies suggest that cetaceans may experience local-scale spatial changes of tens to a few hundred meters around an MRE device (Tollit et al. 2019; Coles et al. 2021).

Small cetaceans are less at risk of displacement due to their maneuverability compared to larger cetaceans (Hemery et al. 2024). However, small cetaceans may be displaced due to increased underwater noise (e.g., from vessels and installation activities) as has been shown in harbor porpoises and bottlenose dolphins (*Tursiops truncatus*) (Graham et al. 2017; Brandt et al. 2018). Studies have shown that species such as harbor porpoises appear to adjust over time to disturbance and are only temporarily displaced (Thompson et al. 2013; Robertson et al. 2018). In some cases, local cetacean activity has been shown to resume shortly after a disturbance, once the activity stops (Tollit et al. 2019).

Evidence also suggests that habitat displacement caused by single MRE devices occurs at a relatively small scale for pinnipeds. Harbor seals may exhibit altered behavior up to 100 m (328 ft) away from a tidal turbine due to underwater noise (Robertson et al. 2018) and have previously demonstrated displacement between 200 m and 2 km (656 ft and 1.2 miles) (Joy et al. 2018; Hastie et al. 2018; Onoufriou 2020; Coles et al. 2021).

Fish

Critical habitat exists within the proposed Project area for bocaccio and yelloweye rockfish (Puget Sound Georgia Basin DPS), and Chinook salmon (Puget Sound ESU). Potential effects of displacement within critical habitat for these species are described further in **Section 4.3.2.2**. Additionally, EFH exists for Pacific Coast Groundfish, Coastal Pelagic Species, and salmon within the proposed Project area where the Orbital O2-X would be deployed. Displacement effects on EFH for these fishes are described further in **Section 4.3.4**.

Displacement of large pelagic fish is possible due to underwater noise and EMF emitted from cables, which may attract or repel species depending on their sensitivities (Garavelli et al. 2024). Forage fish schools may avoid the Orbital O2-X area during installation activities or operation due to underwater noise, visual changes, and changes in flow patterns, while other fish species may be attracted to new habitats and foraging areas (Williamson et al. 2019; Garavelli et al. 2024). However, little is known about these effects.

For demersal fish, as with other fish species, the effects of displacement may be species-specific, with some being attracted to the area as it provides new habitat. Larvae may be more attracted to the device than adults, as they may respond differently to visual and acoustic cues; however, hydrodynamic changes may displace some larvae from suitable habitats (Anderson et al. 2021).

Avian Species

Very little information is available to describe the extent of potential displacement of avian species due to a single tidal turbine device. Most existing knowledge comes from studies focused on seabird interactions with offshore wind energy infrastructure (Dierschke et al. 2016; Kelsey et al. 2018). Site-specific displacement could potentially occur if there is a decrease in habitat quality or food availability, or even attraction to any lighting on the above-water portions of the tidal turbine (Dierschke et al. 2016). These factors have only been explored for offshore wind farms and not tidal turbines and therefore may not be directly applicable to a single MRE device such as the Orbital O2-X (Garavelli et al. 2024). Displacement of diving seabirds is most likely to be species-specific (e.g., marbled murrelet compared to a tufted puffin) and site-specific (Washington State's inland waters compared to its Pacific coast), depending on the time of year, activity of the seabird, and a species' vulnerability to collision risk, as well as food availability or attraction to new roosting habitats (Dierschke et al. 2016; Kelsey et al. 2018; Garavelli et al. 2024).

Invertebrates



Both sessile (e.g., larvae) and mobile invertebrates may be displaced due to habitat alteration (**Section 4.1.6**), such as seafloor footprint impacts and the creation of artificial habitat, or may be attracted to the Orbital O2-X device through acoustic cues or EMF (Langhamer 2016; Anderson et al. 2021; Garavelli et al. 2024). Orbital O2-X operations and maintenance are expected to present a low likelihood of displacement, attraction, and/or avoidance with a negligible impact, resulting in a low overall risk for invertebrate species. Vessel operations are not expected to affect or pose any risk to invertebrate species.

If they are present in the area, sessile benthic invertebrates would likely be displaced only in areas from anchoring devices and the new subsea cable infrastructure. Mobile invertebrates, such as the sunflower sea star, are expected to move around these devices, similar to how they would move around a rock. Given the small seafloor footprint of the proposed Project relative to Rosario Strait—anchoring devices and cable diameter (17.8 cm [7 in.]) and length (5.3 km [3.3 miles])—it is unlikely that benthic invertebrates would be displaced from any significant portion of their habitat in the area. Artificial habitat around and near the anchoring points and cable for the Orbital O2-X may attract mobile and sessile invertebrates to the area. Larvae (e.g., oysters, mollusks, and mussels) may settle on the artificial habitat before reaching nearby natural habitats, particularly if they are attracted by the soundscape or other cues from the tidal turbine (Lillis et al. 2015; Morello and Yund 2016; Williams et al. 2022).

Summary

Vessel activity presents a medium likelihood of displacement, with minor impact, resulting in an overall medium risk level for marine mammals, fish, and avian species. Based on existing studies, the risk of permanent habitat displacement from the proposed Project is low; however, temporary displacement may occur for nearby marine mammals, fish, avian species, and invertebrates due to the presence and operation of vessels, the Orbital O2-X device, and associated infrastructure.

Mitigation strategies would be implemented to reduce the effects of displacement, avoidance, and/or attraction to vessels, the Orbital O2-X device, and its supporting infrastructure. Mitigation of displacement effects due to vessels would be achieved by using SOPs and BMPs, and implementing specific strategies as determined in consultations with experts. Monitoring data could also be collected using multibeam sonars focused on the nearfield behavior of fish, marine mammals, and diving birds in the vicinity of the device to understand potential displacement effects.

4.1.6 Habitat Alteration

Habitat alteration refers to the temporary or permanent change of benthic or pelagic habitats. Habitat alteration may occur during the following Project operations:

- Installation, operation, and removal of Project components including the Orbital O2-X tidal energy device, anchors, mooring lines and umbilical cable, and new subsea power cable

4.1.6.1 Benthic Habitat Alteration

Project activities may alter benthic habitats by increasing turbidity during installation and removal, seafloor scour, and the sweeping of sediment by mooring chains.

Installation and Removal of Device Infrastructure

Changes in turbidity (the amount of sediment suspended in the water column) may occur during the installation and removal of anchors for the Orbital O2-X. Installing and removing anchors from the seafloor would create local turbulence that resuspends nearby sediments. It is expected that the turbulence would create a plume of suspended sediments with a radius of a few meters.

Increases in turbidity would depend on location, active currents, sediment type, and other variables. Given the strength of currents and tides in Rosario Strait, suspended sediment is expected to disperse, be diluted, and resettle relatively quickly. Coarse sediments (sand or larger) would likely



resettle to the seafloor within seconds within the immediate area, whereas fine sediments (silt to clay) tend to drift and remain in suspension for minutes to hours (Hitchcock et al. 1999). Once installed, the moorings would not result in alterations in suspended sediments or turbidity levels until their removal, which would likely create a similar degree of temporary sediment suspension.

The installation and removal of the new subsea cable on the seafloor could also create localized, short-term, small-scale increases in turbidity, to the extent sediment may be disturbed when the cable touches down onto the seabed. Although no study has focused on the impact of sediment resuspension induced by cable installation on marine communities, it is expected to have negligible impacts on marine ecosystems, particularly for a cable that is surface laid and not buried (Taormina et al. 2018). Increases in turbidity due to cable installation would depend on location, active currents, sediment type, elapsed time, and other variables. However, due to the small size of the new subsea cable (maximum diameter of 17.8 cm [7 in.]), the minimally disruptive installation technique of laying the cable on the seafloor, and the short-term timeframe of one-time installation operations, there would be no permanent or long-term impacts on marine water quality due to suspended sediments.

The seafloor below the Orbital O2-X device—where the anchors, mooring lines, and subsea power cable would be installed—largely consists of hard substrate with a thin sediment layer (see **Section 3.2.3**). Direct effects from sediment suspension and increased turbidity on fish populations may include reduced visibility, changes in feeding rates, reduction in predator-avoidance ability, or smothering of feeding and respiratory organs (Wilber and Clarke 2001; Utne-Palm 2002; Au et al. 2004). To avoid these effects, fishes respond by relocating nearby until water clarity returns to levels similar to pre-disturbance conditions. The activities of the proposed Project would generate only minimal and short-term impacts on benthic habitat and cause a negligible increase in suspended materials over a very short timeframe, which is expected to be largely undetectable by fishes.

Seabed Sweeping

Mooring chains sweeping over the seabed throughout the 10-year Project duration also have the potential to disturb sediment on the seafloor. These chains include necessary slack to accommodate tidal fluctuations and naturally curve under their own weight (forming a catenary), which helps absorb lift and shock from wave action (Morrisey et al. 2018). As a result, mooring chains may be dragged across the seabed, which can disturb or destroy benthic habitat or organisms in that zone, as well as prevent recolonization until the mooring lines are removed. Each mooring line would have two areas in contact with the seabed: (1) where the mooring chain is lifted up and placed back down (i.e., no “sweep”); and (2) where the chain is dragged over the seabed (i.e., “sweep”).

The mooring chain would be lifted up off the seabed over a length of 246 m (807 ft) and placed back down in the same location. Remotely operated vehicle footage from other MRE sites has shown a very narrow area of disturbance to the seabed; the width is less than 1 m (3.3 ft), giving an affected area of less than 246 m² (2,648 ft²) per mooring line and 984 m² (10,592 ft²) in total area. The black circles in **Figure 76** denote an area where the chain is dragged over the seabed, rather than lifted up and placed back down (an area of approximately 10 m² [108 ft²] per mooring line, or 40 m² [431 ft²] in total area). Slack tide (minimal tension on the chains) and at rated power (peak tension) would affect contact with the seabed differently, as denoted by the white dots in **Figure 77** and **Figure 78**, respectively.

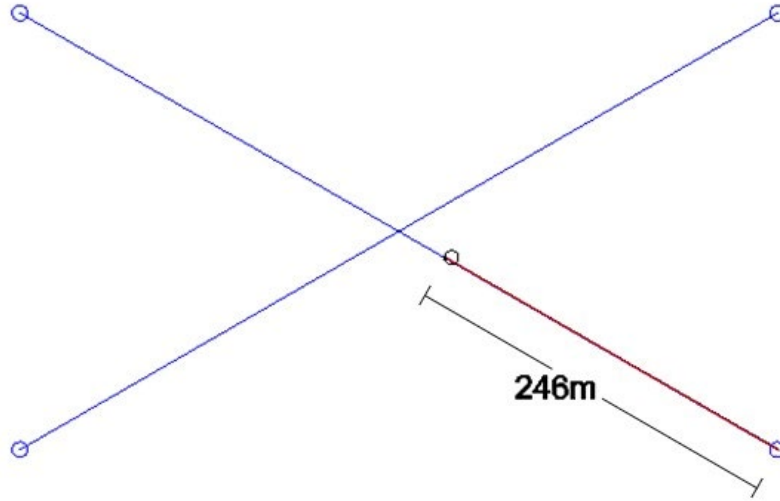


Figure 76. Extent of Mooring Line Contact with Seabed

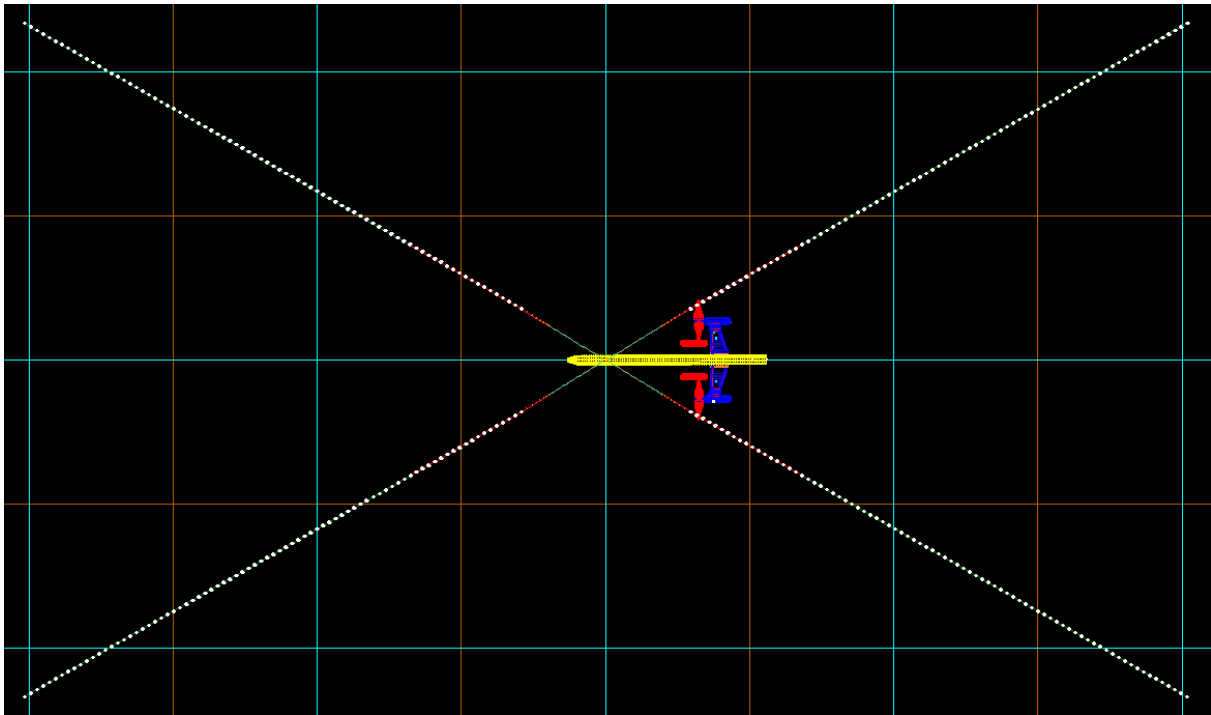


Figure 77. Slack Tide (Minimal Tension in Mooring Lines)

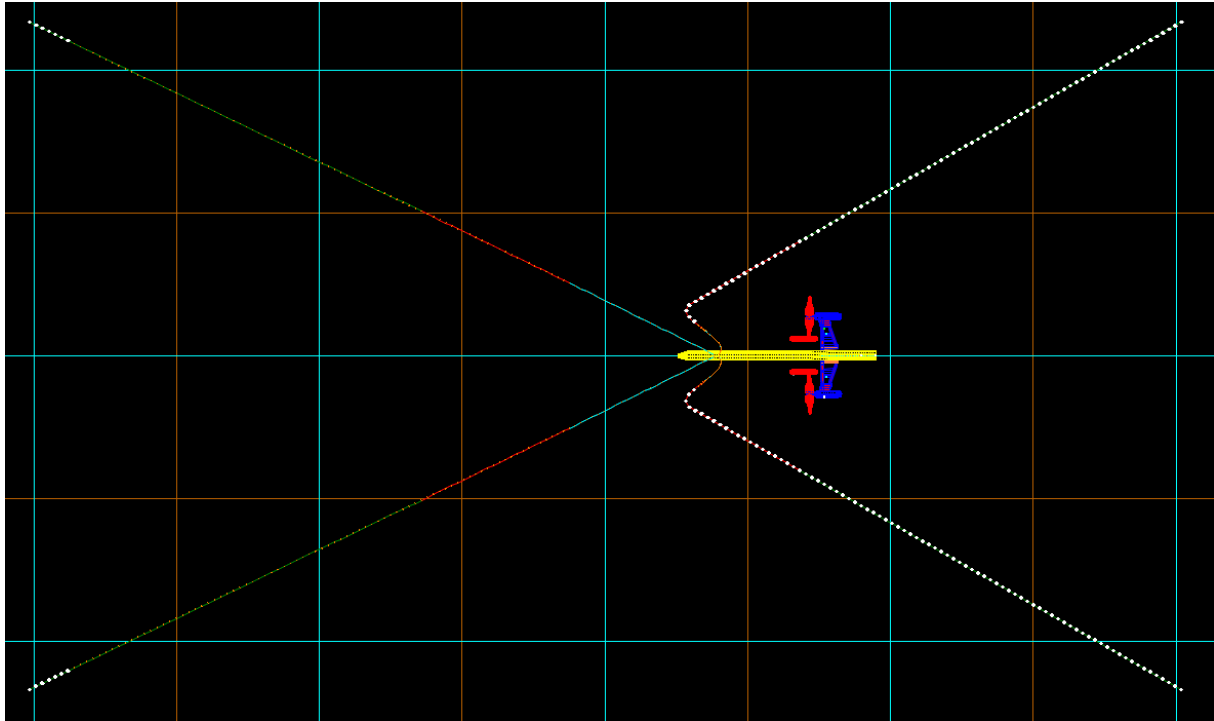


Figure 78. Rated Power (Peak Tension in Line)

The seabed substrate exposed to mooring chain contact and sweep is primarily smooth with some ridges, with a likely very thin sediment layer (according to the Tetra Tech, Inc. survey from October, 2024) and is not considered to be sensitive habitat (Appendix C1). Due to the strength of the currents and tides of Rosario Strait, thin sediment layers may continue to cover the mooring line sweep area and produce small, localized turbidity plumes. These sediment disturbances are expected to be short-lived and of very low intensity. Turbidity would be dispersed, with sediments carried away by the currents and tides of Rosario Strait and settled back to the seafloor and diluted to background levels, likely within minutes after disturbance. As such, turbidity increases due to mooring chain contact with the seafloor is not expected to meaningfully affect the water quality of the surrounding aquatic environment.

Scouring

Increased turbulence and flow velocity changes could lead to scour of fine sediment (i.e., footprint effect) around the Orbital O2-X's bottom structures (e.g., anchors and subsea cable) (Copping and Hemery 2020; Lancaster et al. 2022; Garavelli et al. 2024). If scour were to occur, the resulting footprint would be extremely small relative to Rosario Strait, due to the size of the four rock bolt anchors (58.4 cm [23 in.] diameter, each) and the surface-laid subsea cable (up to 20 cm [8 in.] in diameter).

In previous studies, abundances of invertebrates such as polychaetes and oligochaetes (e.g., worms), bivalves (e.g., clams), and small crustaceans (e.g., crabs) were shown to be higher closer to artificially installed benthic structures compared to areas without structures (Mendoza and Henkel 2017). However, no meaningful effects on species' diversity or richness were measured in relation to distance from the structures, nor were meaningful population changes, compared to areas without artificial structures (Mendoza and Henkel 2017). Another study assessing potential changes to sediment characteristics and macrofaunal communities (i.e., species large enough to see with the naked eye) around anchors deployed at Oregon State University's PacWave-North test site off Newport, Oregon, showed that median sediment grain size and the macrofaunal organism



communities were not meaningfully different compared to reference locations of similar depths (Henkel 2016). Any seafloor changes that did occur were localized and did not appear to result in ecological changes (i.e., there were few changes to species abundance and no change to species compositions [Henkel 2016]).

While scour could potentially affect benthic habitat and less resilient benthic organisms, which may include prey species for ESA-listed and EFH species in the proposed Project area, any effects would likely be limited to the seafloor area directly adjacent to the Orbital O2-X device and infrastructure, such as has been shown in other tidal turbine locations (e.g., SeaGen in Strangford Lough, Northern Ireland) (Kregting et al. 2016; O’Carroll et al. 2017; Copping and Hemery 2020). It is not expected that any scour effects to sediment and benthic organisms would scale up to a point that would adversely affect the quality and quantity of the surrounding aquatic habitat in any meaningful way; therefore, scour is expected to have minimal impacts.

4.1.6.2 Benthic and Pelagic Habitat Alteration

Impacts on benthic and pelagic habitat include habitat alteration, biofouling (e.g., algae growth, barnacles) on Project components, and artificial reef effects.

Habitat Alteration

Areas of benthic and pelagic habitat would be temporarily occupied by Project components. The benthic footprint of the Orbital O2-X includes the four mooring anchors and new subsea cable. Rock bolt anchors are 60 cm (23.6 in.) in diameter, resulting in a relatively small footprint. Notably, the subsea cable route would be surface laid, and unburied cables are much less likely to result in habitat alteration than buried cables because no trenching is required. Disturbance of surface-laid cable is limited to the cable width itself, or to the dimensions of the materials used to stabilize and protect (Wilhelmsson et al. 2010). This Project would utilize cable that is up to 17.8 cm (7 in.) in diameter along the 5.3 km (3.3 miles) route, resulting in a very small footprint. Furthermore, the subsea cable route design is based on marine survey results and avoids macroalgae, eelgrass, and critical habitats wherever possible. Based on Tetra Tech’s marine survey from October 2024 (Appendix C1), the seabed in the turbine area (i.e., below the device and the mooring anchor sites) is composed of textured hard bottom where sediment has been scoured away or with a thin layer of sediment. The new subsea cable would lay atop exposed hard bottom area until inshore of Black Rock, where the seabed then transitions to a smooth, sedimented bottom.

Tidal energy projects require high tidal velocities that usually result in a seafloor dominated by coarse sediments, boulders, or rocky outcrops. Benthic communities associated with these habitats are typically stress-tolerant, highly resilient, and mainly composed of mosaics of opportunistic species adapted to great physical disturbance (Copping and Hemery 2020). While the cable route does not necessarily experience the same tidal velocities as the turbine area, and thus may host a different benthic community, impacts from cable installation are still expected to be minimal. One study found that the biological impacts of an unburied subsea cable on organisms living on and within the seafloor were “minor at most” (Kogan et al. 2006). The placement of the cable on the seafloor may result in the cover, disturbance, injury, or death of sessile or slow-moving benthic organisms. However, any affected benthic organisms are expected to quickly recolonize the affected area. Notably, mobile organisms such as fish could easily relocate to avoid Project installation activities. Bottom-dwelling fish and other mobile organisms would likely avoid the area during installation activities. Seabed contact and sweeping by mooring lines may also limit access to habitat during the Project duration. In areas of rocky seafloor or cobble, sessile organisms present in this sweep zone are unlikely to recolonize the immediate area until the mooring is removed, while throughout the Project duration mobile species could occupy areas of the sweep zone that are temporarily unobstructed by the mooring chain (Morrisey et al. 2018).



The Orbital O2-X would be installed in pelagic habitat (i.e., the water column). Its presence and operation may cause localized effects such as shading, changes in water flow and turbulence, and fish aggregation. However, because the device rotates with the tides, any one area would only be affected for a short duration before the device repositions. With the implementation of BMPs and other mitigation measures, along with the temporary nature of the proposed Project, there would be no permanent reduction in the quantity or quality of pelagic habitat, and any effects would remain minimal.

During installation of the Orbital O2-X device, mooring lines, and umbilical, pelagic-dwelling fish and other highly mobile organisms would likely avoid the area and return upon completion of activities. Once installed, the Orbital O2-X device, operating turbines, mooring lines, and umbilical would occupy the immediate area of pelagic habitat in the water column. While the mooring spread of the four line consists of a much larger area than the mooring chains themselves, mobile organisms would easily maneuver around the lines and/or relocate to avoid them (Hasselmann et al. 2023; Hemery et al. 2024; Garavelli et al. 2024).

Any spatial effects that may result from the Orbital O2-X device and Project infrastructure would be temporary (up to 10 years maximum, the allowable lifespan of a pilot project), and habitat within the water column would return to pre-installation conditions after Orbital O2-X decommissioning and removal. No permanent displacement would occur. The presence of the Orbital O2-X, including its two turbines, four mooring lines, and subsea umbilical in the proposed Project area, is not expected to result in significant effects to pelagic habitat or the pelagic community, nor is it expected to meaningfully reduce available habitat.

Biofouling and Artificial Reef Effects

Over time, the seafloor infrastructure and Orbital O2-X hull bottom below the water surface may be colonized by marine life, including biofouling organisms and non-native organisms, which may impact local biodiversity and attract foraging fish species (Garavelli et al. 2024). Biofouling starts with a biofilm of marine bacteria and fungi followed over time by successions of initial colonizers (e.g., barnacles, hydroids, and tubeworms), then secondary colonizers (e.g., anemones and mussels) (Causon and Gill 2018; Dannheim et al. 2019), which can occur relatively rapidly (e.g., within 2 months in some cases) (Viola et al. 2018). Other device sites have shown an increase in green algae, snails, barnacles, and sponges on the devices themselves, but had sediment free from megafauna and macroalgae (Marine Solutions 2023). At tidal device sites in the Orkney Islands, Scotland, biofouling has been reported, but no non-native species were detected in previous studies (Nall et al. 2022; Want et al. 2023).

While biofouling would likely occur to some extent on Project infrastructure, it is not expected that it would affect the water quality. Additionally, to reduce the accumulation and potential impacts due to biofouling, antifouling paints that comply with the IMO International Convention on the Control of Harmful Anti-fouling Systems on Ships would be used, as well as inspections of coatings during regular maintenance intervals to ensure that they remain intact.

MRE device installations may also become artificial reefs, providing ecological benefits such as providing foraging opportunity to marine animals and attracting demersal and pelagic fish species (Langhamer et al. 2009; Broadhurst and Orme 2014; Langhamer 2016; Causon and Gill 2018; Dannheim et al. 2019). By increasing the complexity of the seafloor and surrounding water, the Orbital O2-X device and supporting infrastructure could provide shelter or flow refuge for aggregating species, leading to changes in the local organismal community diversity, abundance, and size (Copping and Hemery 2020). Negative reef effects could also occur, such as non-native species or causing shifts in local community composition (Dannheim et al. 2019; Loxton et al. 2017; Copping and Hemery 2020). However, studies have indicated that artificial structures on the seafloor and in surrounding areas do not significantly differ in non-native species attraction and composition (Nall et al. 2022; Want et al. 2023).



Related to artificial reef effects, nutrient enrichment around the Orbital O2-X device and seafloor infrastructure may also occur due to the accumulation of organic matter and decaying shells from increased litterfalls from biofouling and marine organisms attracted to the device (Wilding 2014; Garavelli et al. 2024). An increase in benthic biomass could in turn benefit higher trophic levels, up to apex predators, thereby potentially intensifying the artificial reef effect (Raoux et al. 2017). However, this effect is less likely to occur near tidal turbines due to the hydrodynamic forces preventing the local accumulation of organic matter (Garavelli et al. 2024).

The magnitude and extent to which the Orbital O2-X could create an artificial reef effect would ultimately depend on the existing local ecosystem, natural habitats, and nearby species composition (Loxton et al. 2017). Over time, artificial reefs may be created near the anchors, mooring lines, subsea cable, and potentially on the underside of the Orbital O2-X hull; however, the effects would be limited to small area of the single Orbital O2-X device. It is not expected that artificial reef effects would lead to significant regional changes (e.g., a shift from soft-sediment to hard-substrate communities) (Causon and Gill 2018).

Benthic and pelagic habitat would not be significantly impacted by artificial reef effects. Based on past studies, artificial reefs may attract mobile marine species while foraging for food and/or shelter, as well as increase local species diversity, richness, and abundance, and colonization by sessile and mobile invertebrates and fish (Langhamer 2012; Taormina et al. 2018; Bender et al. 2020; Garavelli et al. 2024). Therefore, species may be attracted to the proposed Project area for foraging and sheltering opportunities created by the presence of the Orbital O2-X and supporting infrastructure. Since some of these artificial reef effects have only been hypothesized and modeled and could take up to decades to develop (i.e., much longer than the proposed Project timeline), it is unlikely that significant habitat-altering artificial reef effects would occur (Raoux et al. 2017; Copping and Hemery 2020).

4.1.7 Electromagnetic Field (EMF) Exposure

Electromagnetic fields (EMF) are naturally present throughout the world's oceans from the background magnetic field of the Earth and from atmospheric and solar influences. All marine animals are exposed to these natural fields, and some have evolved the ability to sense and respond to them. Subsea power cables emit anthropogenic EMF that can interact with natural geomagnetic EMF, potentially affecting the behavior of electromagnetic sensitive species by disrupting cues. EMF are generated by current flow passing through power cables during operation and can be divided into electric fields (E-fields, measured in volts per meter) and magnetic fields (B-fields, measured in micro-Tesla [μT]) (Taormina et al. 2018). B-fields have a second induced component, a weak electric field, or an induced electric (iE) field. Both E- and B-fields rapidly diminish in strength with increasing horizontal and vertical distance from the source.

The proposed Project would install a new 5.3-km (3.3-mile) double-armor subsea cable with an operating voltage of approximately 12.47 kV to export power from the Orbital O2-X. The cable's operational frequency would be approximately 60 Hz to match the local grid with current levels of 111 Amps per phase of the electrical system at normal operating power. As an example of a much higher capacity cable, the magnetic fields generated from a high voltage direct current (150 kV) subsea power transmission cable at the sediment surface ranged from 50 μT at the cable surface, dropping off rapidly to approximately 35 μT at 1 m (~3 ft) from the cable (Copping et al. 2016). The Earth's background magnetic field ranges from 30 to 60 μT (Copping et al. 2016).

A common concern regarding MRE projects is the potential sensitivity of elasmobranchs and other fishes, marine mammals, sea turtles, and invertebrates to anthropogenic EMF (Normandeau et al. 2011; Snyder et al. 2019). Anthropogenic EMF from subsea power cables can affect exploratory/foraging behavior in some benthic and demersal marine species (Hutchison et al. 2020) or affect animal physiology, development, and growth (Woodruff et al. 2012) and biochemical



processes (Kuz'mina et al. 2015). Although elevated EMF may be detectable by benthic species at the power cable location, impacts fall off within a short distance from the cable, as magnetic field levels decrease with the inverse of distance from the cable and are proportional to the current carried by the cable.

Field measurements of subsea power cable EMF are scarce. Some show a close match between measurements and models (e.g., Kavet et al. 2016), others have shown the EMF recorded are not always consistent with the models, especially for the alternating current case (Hutchison et al. 2020). In-situ measurements suggest that EMF from cables can be present over tens of meters, but the overall EMF environment is complex and influenced by the power system, ambient magnetic fields (e.g., geomagnetic field) and water movements (Hutchison et al. 2020, 2021). Modeling suggests that EMF from cables decreases with distance from the cable core (Chainho and Bald 2021; Hutchison et al. 2021) but does not provide insight about potential effects on marine animals. Nonetheless, there is consensus amongst researchers, developers, and regulators that EMF traveling through cables from single or small numbers of devices would be of relatively low intensity and of very localized extent, thereby posing minimal risk to sensitive marine species (Gill et al. 2014; Copping and Hemery 2020).

EMF are thought to cause changes in the behavior and movement of susceptible animals, and potentially long-term changes in growth or reproductive success. The evidence to date suggests that the ecological impacts of EMF emitted from power cables from single devices or small arrays are likely to be limited, and marine animals living in the vicinity of devices and export cables are not likely to be harmed (Copping and Hemery 2020). Data are limited, but only minor responses (such as lingering near or being attracted to cables) have been noted in electrosensitive species (e.g., elasmobranchs, benthic species). No interactions with anthropogenic EMF from subsea cables have been recorded for marine mammals or sea turtles.

Not all marine animals are able to detect EMF; only a few species have the sensory capabilities to sense and react to them. The animals most likely to encounter and be affected by EMF from MRE systems are those that spend time close to a power cable over extended periods, most commonly sedentary benthic organisms. Among fishes, demersal species, including sensitive life history stages (embryos, larvae) with lengthy incubation periods, are thought to have the greatest likelihood for exposure to EMF from cables (Nyqvist et al. 2020). It is uncertain whether EMF-sensitive fishes are routinely found in the proposed Project area, in the immediate vicinity of cables where exposure may occur, or along the subsea cable corridor that leads to shore-based infrastructure.

Given the limited scale of the proposed Project (i.e., a single 2.4 MW device), EMF are anticipated to be minimal and localized to the immediate vicinity of the cable and to have negligible effects on any sensitive species that may be present. At this scale of development, EMF are not expected to result in the death of marine species or the harmful alteration, disruption, or destruction of habitat. This is consistent with the current global state of knowledge about the effects of EMF from MRE devices on marine animals, including fish (Copping and Hemery 2020; Copping et al. 2021; Gill and Desender 2020). Overall, EMF produced from the Project are likely to be low intensity and approach background levels within a few meters from the source (Baring-Gould et al. 2016; Copping and Hemery 2020).

4.1.8 Artificial Light

Artificial light could impact natural resources during the following Project activities:

- Project operation when artificial light would be used for both internal and external lighting on the Orbital O2-X.
- All Project activities with vessel navigation lights during Project area visits.



The Orbital O2-X would have lighting systems that are situated in each compartment within the device. These internal lights are fed from battery-backed power supplies and include fixtures such as fire exit and escape route bulkhead lighting, navigational lighting, and surface deck walkway lighting for use during maintenance. Additionally, the Orbital O2-X device would have a marking and lighting schedule to make its location highly visible to vessels that may transit the region 24 hours a day. The device would be yellow in color above the water line and lit by two amber lights that display synchronized flashing once every 3 s. These flashing lights have a nominal visible range of 3 NM and would be mounted a minimum of 3 m (10 ft) above the waterline. The device would also be fitted with a radar reflector at a similar elevation and a navigation aid AIS (Automated Identification System) transmitter.

Underwater lighting may sometimes be used to conduct monitoring studies and to track the frequency of interactions that marine mammals, fish, diving birds, and invertebrates have with Project components. A final decision on monitoring equipment would be determined after consultation with relevant agencies.

In Washington State, vessels are required to have the appropriate navigation lights (Island County 2015). For all vessels that measure 5 to 12 m (16 to 40 ft) in length, navigation lights with a visibility range of 1 NM are required while the vessel is in motion. For all vessels 14 to 20 m (45 ft to 65 ft) in length, navigation lights must be visible at 3 NM for masthead lights and at 2 NM for all other navigation lights (Island County 2015). See **Table 24** for more information about lighting requirements per vessel size and operation.

Table 24. Washington State Vessel Navigation Light Requirements

Equipment & Action	Requirement
Power Driven Vessel (underway)	<ul style="list-style-type: none"> • Sidelights, masthead, stern light. • Vessels less than 12 m (39 ft) may exhibit an all-round white light in lieu of separate masthead and stern lights.
Sailing Vessel (underway)	<ul style="list-style-type: none"> • Sidelights, stern light. • If less than 20 m (66 ft) these lights can be combined into one lantern to be carried at or near the top of the mast. • A sailing vessel under 7 m (23 ft) may substitute a white lantern or flashlight, which shall be exhibited in sufficient time to prevent a collision – this does not include sailing vessels under mechanical power.
Rowing Vessel (underway)	<ul style="list-style-type: none"> • Sidelights, stern light, or have at ready a white lantern or flashlight that shall be exhibited in sufficient time to prevent a collision.
Any Vessel (at anchor)	<ul style="list-style-type: none"> • All around white light visible for 2 NM at night unless in a chart-designated anchorage.
<p>Notes: ft = feet; m = meters; NM = nautical miles Source: Island County 2015; WAC 352-60-060</p>	

4.1.8.1 Potential Impacts on Species

Around the world, artificial light is being used more frequently, and its spatial extent is expanding (Cinzano et al. 2001; Hölker et al. 2010). While increasingly more research is taking place about the impact of artificial light on terrestrial species, there is less research about impacts on marine life (Depledge et al. 2010). Most species have evolved under the natural cycles of exposure to



moonlight, sunlight, and starlight, and these cycles cue species activity times, offer navigation aid, help regulate and coordinate maturation and reproductive events, provide constant regulation of physiology, and inform visually guided behavior such as predation and communication (Gaston et al. 2013; Davies et al. 2014).

Research results about the impact of artificial light on terrestrial species include findings that artificial light triggers the advancement of sexual maturation of birds (Dominoni et al. 2013), the intensifying of foraging efforts of birds (Titulaer et al. 2012), and the extension of dawn song time by birds into the night (Nordt and Klenke 2013). Some species become attracted to or avoid areas where artificial light is present and thus are either displaced from or occupy new habitat (Rydell 1992; Stone et al. 2012; Davies et al. 2014). The same types of cues are changed in marine species as well, and those potential behavior changes can be sorted into four categories: orientation, reproduction and recruitment, predation, and communication (Davies et al. 2014).

Orientation

Birds and sea turtles, among other species, use natural light to navigate, and it is common for vessel strikes with birds to occur at night when they become disoriented by artificial lights on vessels (Tuxbury and Salmon 2005; Merkel 2010). One of the marine species that is most studied when it comes to light exposure impacts are sea turtles who prioritize laying eggs in dark locations and whose hatchlings can be led astray toward inland lights instead of toward the water (FFWCC 2022). New artificial lights like light-emitting diodes (LEDs) have shorter wavelengths that penetrate deeper into the water thus impacting more ecosystems, but solutions such as using red light that does not penetrate water as deeply or using shields to block coastal areas from artificial light exposure are being studied (Miller and Rice 2023).

Orientation to moonlight is also researched in sandhopper invertebrates, dung beetles, and fish, and the introduction of new artificial lights can introduce confusion in behaviors that need intentional orientation (Ugolini et al. 2005; Dacke et al. 2003; Marchesan et al. 2005). Coastal lighting around estuaries is found to aggregate fish in artificially lit habitats, and the behavior of some species gravitating toward artificial lights is used to catch squid (Becker et al. 2012). The impacts of artificial lights on marine ecosystems can be so profound that artificial lights captured by satellites can be used to quantify fishing pressure, spawning grounds, and migration routes (Kiyofuji and Saitoh 2004).

Reproduction and Recruitment

In marine environments, many species use light regimes to regulate times of reproduction, maturation, and synchronized spawning events (Davies et al. 2014). Patterns of reproduction can be changed by the introduction of artificial lights, and due to this, techniques of artificial light use are common in aquaculture to control the sexual maturation of fish (Oppedal et al. 2011). One example of this is the spawning of the palolo worm (*Eunice viridis*), which releases gametes only during a few days of the third quarter moon in October (Naylor 1999). Other species that use the moon for spawning cues include polychaetes, coral, and echinoderms (Bentley et al. 1999; Harrison 2011; Lessios 1991). While the extent to which additional factors such as day length, temperature, and tidal conditions could play a role in these spawning events is unknown, it seems that lunar light intensity provides the final trigger for spawning (Harrison 2011). Some scientists are researching whether moonlight could be masked in the sky by artificial lights (Davies et al. 2013), and as a result interfere with the synchronization of spawning events and could result in decrease in cross fertilization and thus decline among a species (Davies et al. 2014).

Predation

Artificial light can impact predation by changing the lighting in a habitat and thus changing the ability of predators and prey to camouflage or use nocturnal adaptations to hunt or hide (Davies et al. 2014). The ability to locate prey or avoid predation relies on a predator's ability to see its prey among



habitats with various shapes, colors, and patterns, and the ability of the prey to disguise itself to avoid detection (Troschianko et al. 2009). The introduction of more light means that there is a greater likelihood that predators will see their prey; in the marine environment, artificial light often attracts both predators and prey to the lit area, thus increasing predation opportunities (Becker et al. 2012). Fish larvae or fry exposed to artificial light pollution exhibit habitat avoidance, a disruption in the endocrine and metabolic systems during metamorphosis, and an increase in susceptibility to predation (O'Connor et al. 2019; Tabor et al. 2021). Additionally, some species use bioluminescence to either deter or attract prey by confusing predators, sacrificing light-emitting parts of their body, attracting the predators or predators, or mimicking ambient light (Haddock et al. 2010). The introduction of artificial light can change possibilities for these adaptive behaviors to occur.

In one project, the lights on bridges that passed over the Puntledge River in British Columbia, Canada were turned off, and it was found that there was reduced predation by harbor seals (on migrating juvenile Pacific salmon (Yurk and Trites 2000)). Artificial lights have potentially drastic impacts on species' populations and food chains.

Communication

Several marine species have developed complex eyes including fish, cephalopods, and arthropods, and this adaptation assists with inter- and intra-species communication (Davies et al. 2014). Cephalopods for example use adaptive displays of color-changing cells to communicate (Mathger et al. 2009). Visually guided behaviors of species such as mate selection could be influenced by artificial light introduction since physical features that are used to communicate fitness will be more recognizable under whiter light (Davies et al. 2013). Additionally, if brighter artificial lights enter an ecosystem, then sexual communication via bioluminescence could also be disrupted (Haddock et al. 2010).

Summary

The proposed Project area currently has little exposure to artificial light since there are no residential or commercial buildings along the shoreline, and the current presence of artificial light is primarily due to vessel traffic from ferry routes, recreational or commercial vessel use, or buoys.

Due to proposed Project activities, an increase in artificial light use would occur to mark the Orbital O2-X device with two amber lights that display synchronized flashing once every 3 s. Since these lights would be situated at least 3 m (10 ft) above the waterline, be amber in color, and have inconsistent intensity due to the flashing, impacts are expected to be minimal.

Finally, additional vessel presence during all Project phases could increase artificial light presence in the proposed Project area, but due to the preference for the majority of Project work to occur during daytime hours, increased use of artificial light via vessel presence in the proposed Project area would be minimal and temporary.

4.1.9 Changes in Oceanographic Systems

The proposed Project could impact oceanographic systems during the following Project activities:

- Operation when the Orbital O2-X is deployed in Rosario Strait.

When deploying a device like the Orbital O2-X, there are concerns about the ways in which the device would alter oceanographic systems and processes, such as the transportation of sediments and planktonic organisms, the distribution of the concentrations of dissolved gases and nutrients, tidal circulation and basin flushing, wave action, ocean currents, temperature and salinity gradients, the exchange of heat, and maintenance of habitats and water quality (OESE 2022). Drastic changes to these systems could have negative implications for healthy ecosystems.



The tidal and wave regimes are governed by much larger, regional-scale oceanographic processes, which would not be disrupted by the presence of the Project infrastructure. Wang and Yang (2017) explored tidal power extraction scenarios from tidal inlets in Puget Sound and indicated that system-wide environmental effects were unlikely to be a concern for small-scale projects.

Alterations to water circulation patterns due to the presence of an MRE can affect sedimentation rates, reducing rates both upstream and downstream, which could lead to modification of sediment depositional patterns (Roberts et al. 2016; Kadiri et al. 2012). Small-scale deployments (less than four MRE's), like that of the Orbital O2-X, do not result in changes that are measurable within the natural variability of the ecosystem, so the proposed Project would not impact sedimentation rates (Copping and Hemery 2020).

The spinning of turbines makes the water move faster downstream and creates swirling currents, which can increase shear stress (Sun et al. 2018; Chen et al. 2017; Hill et al. 2014). Sediment bed-shear stress is linked to changes in the strength of tidal currents, meaning that extracting tidal energy could significantly impact sediment movement. This could lead to a temporary decline in water quality due to increased turbidity from disturbed sediment (Neill et al. 2017; Kadiri et al. 2012). Given the existing effect of strong tides on the currents, sediment deposition, and suspended sediments in Rosario Strait, this Project is not expected to cause substantive change over the natural variation in Rosario Strait. Also, computer models consistently show that groups of fewer than 10 tidal energy devices would have very little effect on wave heights, water flow, and the movement of sediment (Baring-Gould et al. 2016).

Hydrokinetic tidal energy conversion takes energy from the water, which changes the local water conditions. Even though energy removal may not cause noticeable changes at a small pilot project scale, factors like temperature, salinity, oxygen levels, and the concentrations of metals and nutrients in the water could be affected, since they depend on the water's movement.

Kadiri et al. (2012) investigated the hydro-environmental impacts associated with tidal renewable energy systems, with a focus on water quality impacts. They found that local tidal power extraction may reduce tidal flushing, leading to a decrease in salinity levels within the water column. The extent of this salinity change depends on the water volume within the area where energy is extracted. A reduction in salinity could increase the residence time of nutrients in the sediment because there would be less competition between nutrients and seawater ions for binding sites on sediment particle surfaces. Additionally, reducing the magnitude of tidal currents could lead to a decrease in suspended sediment concentrations and turbidity levels (Kadiri et al. 2012).

Because the Orbital O2-X is a floating tidal stream generator rather than a tidal barrage, it would not significantly obstruct tidal flushing, and no noticeable changes in salinity or dissolved oxygen levels in the water column are expected. The reduction in suspended sediment levels following the introduction of a single Orbital O2-X could lead to lower metal concentrations in the downstream water column. However, accelerated flow around the turbine could cause localized sediment resuspension, potentially increasing metal concentrations near the device (Kadiri et al. 2012). Operation of a floating tidal turbine may increase nutrient availability due to reduced tidal flushing and longer residence time, but nutrient concentrations are not expected to increase substantially, and eutrophication (i.e., excess nutrients) is unlikely to occur (Kadiri et al. 2012).

Despite these concerns, evidence suggests that small arrays of MRE generation devices (one to four devices with less than 10 MW generation potential total), such as that of a single Orbital O2-X device, would not result in changes that are measurable relative to the natural variability of the oceanographic system (Copping and Hemery 2020; OESE 2022). Overall, the scientific community has reached consensus that potential changes to oceanographic systems from small-scale deployments of marine energy devices are below the natural variability of oceanographic systems and the risk can be considered discountable (Copping and Hemery 2020; OESE 2022; De Dominicis et al. 2017; Robins et al. 2014).



The operation of the Orbital O2-X would have a low likelihood of impacting oceanographic systems such as ocean dynamic processes and sediment transport, and any impacts would be negligible and would not rise above the natural variation of those systems.

4.2 Geology and Soils

Localized impacts on the seabed geology and geomorphology could occur during the following proposed Project activities:

- Project anchoring in benthic habitat.
- Project operation activities due to mooring line and umbilical sweep areas.

Project activities could result in changes in: (1) seabed level/morphology due to placement of infrastructure (e.g., anchors, cable protection, scour protection); (2) changes in seabed level/morphology due to changes in sediment deposition; and (3) changes in suspended sediment concentrations due to installation activities and movement of mooring lines and the subsea cable umbilical during operation.

The placement of infrastructure on the seabed could alter seabed levels locally, depending on the anchor foundation used. This may have a localized effect on seabed morphology, with the potential for effects during the operation stage of the Project. The accelerated flows in the immediate region around the tidal turbine could scour the seabed around the device (Kadiri et al. 2012). The rotor's effect, the increased wake effect under the turbine, and the tip clearance (i.e., the distance between the tip of a rotating blade to a stationary part, point, or object) are the main considerations for scour induced by tidal turbines (Chambel et al. 2024; Chen and Lam 2014). The hard substrate of the seabed would limit the potential to generate scour from the anchoring operations.

Prior to installation, a scour assessment would be completed to determine the need for protection, and if required, the protection would be installed to eliminate the potential scouring. These mitigation measures would prevent scour developing around the four anchors and mooring lines.

Installation of anchors, particularly through drilling, may result in a small and localized increase in suspended sediment concentrations (SSC). Additionally, the mooring sweep areas (40 m² [430 ft²] total for four mooring lines), the mooring line lift and lower areas (246 m² [2,648 ft²] per mooring line or 984 m² [10,592 ft²] total), and the subsea cable umbilical sweep area (314 m² [3,380 ft²]) may cause small, local, temporary sediment plumes when the Orbital O2-X changes orientation in the water due to the changes of the tide. For more information about local turbidity and suspension of sediments, see **Section 4.1.6**.

The Orbital O2-X would be in an area with fast flows, where outcropping bedrock is more likely. The rise and fall of the mooring lines with the tides would be slow and progressive, and the associated sedimentation would be highly localized and rapidly dispersed in a tidally active area. In the context of the potential for mooring lines and subsea cable umbilical to be moved on the seabed within the sweep area, seabed sediment disturbance is expected to be minimal. Therefore, increases in SSC associated with the movement of mooring lines would be minimal and would be in line with general SSC within the western portion of Rosario Strait.

4.3 Species and Habitats Effects Analysis

The potential effects due to the Project on fish and wildlife species and habitats are analyzed within this section, including federally listed species and critical habitats, marine mammals, EFH, avian species, Washington's PHS, and aquatic invasive species. The Fish and Wilding Monitoring Plan (Appendix B1) and Adaptive Management Plan (Appendix B3) outline the monitoring efforts and their response to data that is collected during the proposed Project.



4.3.1 Federally Listed Species Effects Analysis

The potential effects on ESA-listed species that may be present in the proposed project area are analyzed separately in this sub-section, due to their federal protection. The following is not intended as an ESA-listed species effects determination, as consultation with NMFS and USFWS has not yet occurred. The Project is anticipated to potentially affect the ESA-listed species in ways described below; however, it is not expected that any potential effects would rise to the level of being significant.

4.3.1.1 Marine Mammals

Killer Whale (Southern Resident DPS) and Humpback Whale (Central America and Mexico DPSs)

Southern Resident Killer Whales (SRKWs) are well-documented in Rosario Strait but occur in lower abundance there compared to other areas of the Salish Sea, such as Haro Strait, Boundary Passage, the southern Gulf Islands, and the eastern end of the Strait of Juan de Fuca (Olson et al. 2018). Humpback whale presence is still considered rare within the Salish Sea in general, and when sightings do happen, they tend to be within the Strait of Juan de Fuca, Haro Strait, Moresby Passage, and Southern Puget Sound (Calambokidis et al. 2017); i.e., outside of the proposed Project area. The Project is anticipated to potentially have the effects described below on SRKWs and Central America and Mexico DPSs of humpback whales.

Entanglement: The existing scientific literature supports the conclusion that whales would not get entangled in either catenary or tensioned mooring lines. The Project's new subsea power cable and four mooring lines would not have loose ends or sufficient slack to create an entangling loop. Therefore, the risk of entanglement in mooring lines for this Project is considered to be discountable for SRKWs and humpback whales.

Derelict gear could present a secondary entanglement concern, if it were to become snagged in Orbital O2-X infrastructure and whales were foraging within the proposed Project area. However, there have been no reported instances of secondary entanglement on MRE devices (Macfadyen et al. 2009; Richardson et al. 2019). Therefore, there is a low likelihood of SRKWs and humpback whales in the proposed Project area getting entangled in derelict fishing gear snagged on the Orbital O2-X or its mooring lines, but it is considered a medium risk given the impacts on either species if entanglement were to occur.

Collision and Entrainment: A collision with O2-X turbine blades would be a rare event (Onoufriou et al. 2021; Garavelli et al. 2024). There have been no instances of marine mammals, including whales, colliding with an operational tidal or river turbine (Sparling et al. 2020; Copping and Hemery 2020; Garavelli et al. 2024). Entrainment due to underwater tidal turbines remains a primary environmental concern. The potential for injury or mortality of a whale due to blade strike, from either collision and/or entrainment, is uncertain but expected to be low according due to industry SOPs, BMPs, and mitigation measures that would be employed at the proposed Project (Copping and Hemery 2020; Copping et al. 2023; Garavelli et al. 2024).

Noise Disturbance: Exposure to increased noise levels is expected due to vessel presence for the installation, operation, maintenance, and removal of the Orbital O2-X and supporting infrastructure. Noise emitted from Project activities is not expected to rise to the level of being injurious or harassing; however, it is possible that SRKWs and humpback whales, if present within close proximity of Project construction activities (e.g., anchor and mooring line installation and removal), may exhibit altered behavior such as avoidance of the proposed Project area. Evidence suggests that underwater noise emitted from operational MRE devices is unlikely to significantly alter behavior or cause physical harm to marine animals (Copping and Hemery 2020).

Displacement: Whales have been known to tolerate slow-moving vessels within several hundred meters, especially when the vessel is not directed toward the animal and when there are no sudden



changes in direction or engine speed (Wartzok et al. 1989; Richardson et al. 1995; Heide-Jørgensen et al. 2003). In the presence of a slow-moving vessel, neither humpback whales nor SRKWs are anticipated to be meaningfully displaced. Feeding and traveling humpback whales are likely to maintain their behavioral state regardless, and surface active whales may have short-term and minor changes in movement and behavior (Schuler 2019). Similar responses are expected from SRKWs, and it is anticipated that their behavior would not change, or that they would temporarily relocate to a suitable location and resume previous activities.

Overall, the proposed Project area is on the periphery of SRKW passageways through Rosario Strait (Olson et al. 2018) and is not expected to result in significant displacement of SRKWs. Humpback whales are also not expected to be meaningfully displaced from their habitat, since they are already considered rare in the Salish Sea. When humpbacks are spotted within the Salish Sea, it is primarily in the Strait of Juan de Fuca and Strait of Georgia (Falcone et al. 2005) and outside of the proposed Project area.

Habitat Alteration (including turbidity): Benthic and pelagic habitat effects, such as a temporary increase in suspended sediment (i.e., turbidity), biofouling, and artificial reef effects, are expected to have minimal impacts on SRKWs and humpbacks. While SRKWs and humpbacks may avoid the immediate location where the Orbital O2-X would be deployed, they are highly mobile and would not be temporarily or permanently displaced by Project activities. There is a potential for benthic artificial reef effects to lead to localized increased prey abundance. However, given the relatively small size of the Project (i.e., one device, not an array), the artificial reef effect is unlikely to meaningfully impact SRKW or humpback habitat or prey availability and is considered discountable.

EMF Exposure: EMF produced from the Project are likely to be low intensity and approach background levels within a few meters from the subsea power cable, which would be located on the seafloor. Therefore, EMF effects on SRKWs and humpback whales would be discountable because neither species is expected to be within a few meters of the subsea cable for any appreciable amount of time.

Artificial Light: The Orbital O2-X would be lit by two amber lights synchronized flashing once every 3 s with a nominal range of 3 NM and mounted a minimum of 3 m (9.8 ft) above the waterline. Marine mammals with sensitive eyes, including cetaceans, may be temporarily and minimally affected by artificial light due to the proposed Project (Miller and Rice 2023). Marine mammal presence may increase to predate on aggregated fish species (McConnell et al. 2010; Nguyen and Winger 2019); however, the light intensity from the Orbital O2-X device is not anticipated to result in significant behavioral changes from, or adverse effects to, either SRKWs or humpback whales.

Changes in Oceanographic Systems: As a single device, the Orbital O2-X operation would have a low likelihood of impacting oceanographic systems (e.g., dynamic processes and sediment transport), and any impacts that could occur on SRKWs and humpback whales (Central America and Mexico DPSs) would be negligible.

4.3.1.2 Fish Species

Bocaccio (Puget Sound-Georgia Basin DPS), Yelloweye Rockfish (Puget Sound-Georgia Basin DPS), Chinook Salmon (Puget Sound ESU), Steelhead (Puget Sound DPS), Eulachon, Green Sturgeon (Southern DPS), and Bull Trout (Coterminous U.S. Population [Coastal Recovery Unit])

Bocaccio and yelloweye rockfish (Puget Sound-Georgia Basin DPS) and Chinook salmon (Puget Sound ESU) each has designated critical habitat that overlaps with the proposed Project area and therefore have the potential to be present. Steelhead (Puget Sound DPS), eulachon, green sturgeon (Southern DPS), and bull trout (Coterminous U.S. Population [Coastal Recovery Unit]) do not have critical habitat that overlaps with the proposed Project area but may be present during Project activities. The Project is anticipated to potentially have the effects described below on the aforementioned ESA-listed fish species:



Entanglement: Given the cross section of the mooring lines and subsea cable umbilical, it is not considered possible for listed fish species to become entangled in one of them. There have been no reported instances of secondary entanglement on MRE devices (Macfadyen et al. 2009; Richardson et al. 2019) due to derelict fishing gear, which has been increasingly removed from the Salish Sea due to concerted efforts (Drinkwin et al. 2023). While the likelihood of ESA-listed fish species getting entangled in derelict fishing gear caught on the Orbital O2-X or its mooring lines is low, the risk is considered medium because of the potential harm entanglement could cause to these species.

Collision and Entrainment: As of 2024, no collisions between marine fish and tidal turbines have been observed (Garavelli et al. 2024). Unlike fish passing through a conventional hydroelectric dam, those in the vicinity of the Orbital O2-X can swim around and avoid the turbine. While ESA-listed fish near the turbine may face a potential risk of collision (e.g., blade strike), the likelihood is low. If a collision were to occur, it could result in injury, leading to a moderate classification of risk.

Due to limited studies, the effects of entrainment on fish cannot be definitively determined. However, given the Orbital O2-X turbine's design and slow-moving rotors, entrainment is expected to be highly unlikely. In the rare event that it does occur, it is unlikely to be lethal to fish.

Noise Disturbance: Knowledge on the effects of noise exposure on fishes is sparse, particularly regarding behavioral disturbances (Popper et al. 2014). Noise associated with the Orbital O2-X during installation, operation, maintenance, and removal is expected; however, the elevated noise would not reach levels that cause adverse or injurious effects to nearby ESA-listed fish species. Avoidance of the proposed Project area due to increased noise may occur during installation and removal of the Orbital O2-X and infrastructure; however, these activities would be temporary (e.g., 12 hours for anchoring devices). Noise levels during tidal turbine operations are expected to be low enough that there would not be adverse effects on listed fish species. If any listed fish are near noise-emitting activities and/or vessels during installation, operation, maintenance, and removal of the Orbital O2-X, they would likely relocate to another suitable location and resume their previous activities.

Displacement: When reacting to a vessel, fish usually exhibit an avoidance response such as diving, horizontal movements, or altered tilt angle distributions (Mitson 1995; De Robertis and Handegard 2013). Fish well ahead of an approaching vessel have been documented to move toward the vessel path, although this tends to be attributed to vessel noise more than physical presence (Misund et al. 1996; Handegard and Tjøstheim 2005). The effects on ESA-listed fish species from a temporary increase in Project-related vessel presence (and noise) would be minimal, and it is not anticipated to result in any meaningful displacement. Any listed fish species in the area would most likely temporarily relocate to another suitable location and resume their previous activities.

Fish may be displaced from the Orbital O2-X area due to underwater noise emitted from construction activities, visual stimuli, and minor changes in flow patterns, while other fish may be attracted to new artificial habitats and foraging areas (Williamson et al. 2019; Hemery et al. 2024; Garavelli et al. 2024). Displacement effects are expected to be species-specific, and it is currently unknown how each of the listed fish species would behave. Fish would likely relocate to another suitable location and resume their previous activities during any construction activities emitting noise. Displacement effects would be temporary, with affected fish returning to the area once the Orbital O2-X is operational. Long-term consequences of such displacement, if any, are still unknown (Hemery et al. 2024).

Habitat Alteration: Benthic and pelagic habitat effects such as a temporary increase in suspended sediment (i.e., turbidity), components occupying a footprint area, scouring, and seabed sweep from moorings, as well as habitat creation (e.g., biofouling and/or artificial reef effects) may affect listed fish species within the proposed Project area.



Given the strength of the currents and tides of Rosario Strait and temporary nature of the turbidity-increasing activities, suspended sediment is expected to dissipate and quickly resettle (in minutes to hours), which would not degrade long-term water quality or significantly alter fish habitat conditions of the surrounding marine environment. Fish may find new habitats on and around the anchoring and mooring components, while smaller life stages (e.g., larvae and small juveniles) may benefit from food and protection provided by components on the seafloor and in the water column (Garavelli et al. 2024). Given the relatively small area of the one Orbital O2-X device (single, as opposed to an array) and its moorings and anchorings, biofouling and artificial effects are expected to be small and localized. There may be an increase in the presence of prey species for listed fish, thereby attracting them to the proposed Project area. It is not expected that any significant adverse effects to listed fish species would occur from habitat alteration.

EMF Exposure: The amount of cable lying on the seabed, relative to the vast scale of Rosario Strait, represents an exceedingly small area over which listed fish species could pass and be influenced by the EMF from the new subsea cable. Salmon occasionally come into close proximity with subsea cable(s) at marine energy sites, causing some displacement concerns due to EMF (Wyman et al. 2018); however, these effects would be minimal, causing little-to-no response (Snyder et al. 2019). The likelihood of listed fish species being negatively affected by magnetic fields associated with the Project is discountable.

Artificial Light: The Orbital O2-X would be lit by two amber lights synchronized flashing once every 3 s with a nominal range of 3 NM and mounted a minimum of 3 m (9.8 ft) above the waterline. Artificial light pollution has the potential to attract and aggregate listed fish species (and potentially their predators) to the proposed Project area (McConnell et al. 2010; Nguyen and Winger 2019), but the light intensity from the Orbital O2-X device is not expected to result in significant behavioral changes from, or adverse effects to, any of the listed fish species. Light intensity from operating vessels present during installation, maintenance, and removal of the Orbital O2-X and supporting infrastructure may have the potential to alter listed fish species' behavior (e.g., migration and foraging). However, these effects would be temporary and primarily occur during daytime hours, thereby reducing their potential impact.

Changes in Oceanographic Systems: As a single device, the Orbital O2-X operation would have a low likelihood of impacting oceanographic systems (e.g., dynamic processes and sediment transport), and any impacts on ESA-listed fish species would be negligible.

4.3.1.3 Avian Species

Marbled Murrelet

Although they appear in relatively small numbers, marbled murrelets are documented throughout Washington State's inland waters, particularly in shallow nearshore areas while foraging and diving for small fish (Sealy 1974; McIver et al. 2021; Pearson et al. 2022). There are no known murrelet nesting sites on Blakely Island; the nearest is on the Olympic Peninsula of Washington State. They do forage within nearshore areas of the San Juan Islands; therefore, they may be present in low numbers within the proposed Project area. The Project is anticipated to potentially have the following effects on the marbled murrelet:

Entanglement: Given the cross section of the mooring lines and subsea cable umbilical and their place within the water column, it would not be possible for a marbled murrelet to become entangled in one. Derelict gear could present a secondary entanglement concern, if it were to become snagged in Orbital O2-X infrastructure and marbled murrelets were foraging and diving within the proposed Project area. However, there are no reported instances of secondary entanglement on MRE devices (Macfadyen et al. 2009; Richardson et al. 2019) due to derelict fishing gear, which has been increasingly removed from the Salish Sea due to concerted efforts (Drinkwin et al. 2023). The likelihood of marbled murrelets becoming entangled in derelict fishing gear caught on the Orbital O2-



X or its mooring lines is low. However, the risk is considered medium due to the potential impact on murrelets if entanglement were to occur.

Collision and Entrainment: Very few studies focusing on seabird collision with turbine blades exist in the scientific literature, and practically none exist concerning entrained seabirds. While collision risk between the marbled murrelet and turbine blades is a concern, the current scientific literature is insufficient to accurately determine the level of risk. Based on the information available about other species, it is unlikely for collision or entrainment to occur nor result in injury or mortality.

Noise Disturbance: Any above-water acoustic noise due to Project activities, including increased vessel noise, is not expected to reach or exceed the thresholds for harassment or harm of any marbled murrelet that may fly over the proposed Project area or occupy the nearby waters. Installation and removal activities would be temporary, and the continuous operation of the Orbital O2-X would generate low-level non-impulsive noise that does not significantly contribute to ambient noise levels. If marbled murrelets are present during Project activities, they would likely relocate to a more suitable location and resume previous activities.

Displacement: If any marbled murrelet is flying overhead, foraging, or otherwise occupying nearby waters while vessels are installing or removing Project infrastructure (e.g., anchors, mooring lines, cable, Orbital O2-X), the effect would not be demonstrably different than the presence of any other small watercraft or vessels that would also be in Rosario Strait or surrounding area. Murrelets would likely relocate to a more suitable location and resume previous activities. Therefore, temporary vessel presence is not expected to result in displacement of marbled murrelets.

Site-specific displacement could occur if there is a decrease in habitat quality or food availability, or even attraction to any lighting on the above-water portions of the Orbital O2-X (Dierschke et al. 2016). No studies are currently available that have investigated the displacement of diving seabirds or avian species due to tidal turbine devices. Because marbled murrelets forage in the nearshore marine environment, they could potentially be displaced from the immediate proposed Project area if they were present. If displaced, murrelets would likely relocate to a more suitable location and resume previous activities.

Habitat Alteration: Benthic and pelagic habitat effects such as a temporary increase in suspended sediment (i.e., turbidity), footprint effect, scouring, and seabed sweeping, as well as habitat creation (e.g., biofouling, or marine reserve and artificial reef effects) are not expected to have a significant impact on marbled murrelets. Any increase in suspended sediment, or turbidity, would be temporary and local to the benthic zone where the four anchors, four mooring lines, and the new subsea cable would be located. There may be the potential for increased marbled murrelet diving and foraging activity if the Orbital O2-X and supporting infrastructure act as a fish-aggregating device (e.g., through artificial reef effects) for prey species; however, any habitat alteration effects would not meaningfully affect marbled murrelets within the proposed Project area.

EMF Exposure: No EMF effects on marbled murrelets are expected, given that they would not be present near any benthic EMF emitted by the subsea power cable.

Artificial Light: The Orbital O2-X would be lit by two amber lights synchronized flashing once every 3 s with a nominal range of 3 NM and mounted a minimum of 3 m (9.8 ft) above the waterline. Amber and red light have been shown to have a diminished effect on nearby seabirds, as opposed to green or blue (Syposz et al. 2021). Altered behavior of marbled murrelets is possible due to artificial light during the installation, maintenance, and removal activities; however, these activities would primarily occur during daylight hours when light disturbance would not occur. There is the potential for marbled murrelets to be attracted to, or repelled by, the amber lights based on the documented behavior of other bird species (Syposz et al. 2021). This would be expected to primarily occur during night hours due to a lack of other artificial light in the area. Any change in murrelet behavior due to artificial light would not likely adversely affect the individual or population.



Changes in Oceanographic Systems: The Orbital O2-X single device operation is expected to have a low likelihood of impacting oceanographic systems (e.g., dynamic processes and sediment transport), and any impacts that could occur on marbled murrelets would be negligible.

4.3.1.4 Echinoderms

Sunflower Sea Star

While historically abundant, the number of sunflower sea stars in the Salish Sea has drastically declined and is now considered rare in nearshore Washington State marine areas (88 FR 16212). Even with their population decline in the Salish Sea due to sea star wasting syndrome (SSWS), they are still more abundant than in the southern end of their range (e.g., in California). Therefore, there is the potential for sunflower sea star presence within the proposed Project area, even if it is unlikely due to the estimated low population numbers.

The Project is not expected to imperil the continued existence of the proposed sunflower sea star because impacts would not rise to a level that would prevent either their survival or population recovery. Baseline conditions of the sunflower sea star habitat and connectivity would be maintained, as no significant or permanent alterations from Project activities are anticipated to occur. The Project is anticipated to potentially have the following effects on the sunflower sea star:

Entanglement: It is expected that there would be no entanglement risk with mooring lines or subsea cable for sunflower sea stars given their cross section area and presence within the water column. There is the potential for secondary entanglement due to derelict gear if it were to get snagged on the Orbital O2-X and/or mooring lines and impact the seafloor habitat of sunflower sea stars; however, there have been no reported instances of secondary entanglement on MRE devices (Macfadyen et al. 2009; Richardson et al. 2019). It is very unlikely that derelict gear would get snagged on the Orbital O2-X or its infrastructure to present an entanglement concern for the benthic sunflower sea star. Therefore, entanglement impacts on the species are considered discountable.

Collision and Entrainment: Given that the Orbital O2-X would rest on the water's surface and the sunflower sea star inhabits the seafloor (the benthic zone), it is not anticipated that a collision or entrainment could occur. There would be no collision or entrainment risk for sunflower sea stars that may be present within the proposed Project area.

Noise Disturbance: Studies have examined the potential impacts of anthropogenic noise on marine invertebrates (Solé et al. 2023); however, few are insightful (Morley et al. 2014). It is expected that increased noise due to Project-related activities (e.g., Orbital O2-X installation and anchoring and vessel presence) would have a discountable impact on sunflower sea stars that may be present within the proposed Project area.

Displacement: A temporary increase in vessel traffic on the water surface, as necessary for Project-related activities, is not anticipated to have any displacement effect on sunflower sea stars if they are present within the proposed Project area. The sunflower sea star, if present, may be displaced due to the seafloor footprint from anchoring and new subsea cable installation. However, the footprint is expected to be relatively small within Rosario Strait. Since the sunflower sea star is mobile, if any are present within the proposed Project area, they would likely move around these components, as they would a rock. Any displacement effects that occur to the sunflower sea star are not likely to be significant.

Habitat Alteration: Benthic and pelagic habitat effects such as a temporary increase in suspended sediment (i.e., turbidity), seafloor footprint, scouring, and seabed sweeping from moorings, as well as habitat creation (e.g., biofouling and/or artificial reef effects) would locally alter the benthic habitat of sunflower sea stars that may occur within the proposed Project area. Benthic effects would be limited to four anchors and the diameter of the power cable between the Orbital O2-X and existing cable landing station on the southern end of Blakely Island.



If any sunflower sea stars in the proposed Project area were to be disturbed by suspended sediment due to Project-related activities, they may not be able to relocate to a more suitable location and resume previous activities with enough time. However, sunflower sea stars are adaptable, can tolerate a range of environmental conditions, and would not be significantly impacted by the minor increase in turbidity that is expected to dissipate quickly due to the strength of the currents and tides of Rosario Strait. Because sunflower sea stars are mobile, they would likely maneuver around the devices installed on the seafloor. Sunflower sea stars may become attracted to the devices due to any artificial reef effects that may occur, particularly if local diversity, prey availability, and biomass and nutrients increase (Garavelli et al. 2024). Habitat disturbance would also occur when all anchoring devices and the subsea cable are removed, particularly if any artificial reefs are established. However, effects are expected to be temporary, and the habitat would recover quickly after the disturbance.

EMF Exposure: EMF emitted from the Project would be low intensity and approach background levels within a few meters from the subsea power cable. While no study has investigated EMF effects on the sunflower sea star, others studying 24-hour exposure of the common starfish (*Asterias rubens*) and other invertebrates to high levels of EMF found no significant differences in physiological stress or behavioral responses (Chapman et al. 2023). It is expected that similar (lack of) responses would occur if any sunflower sea stars were exposed to EMF emitted from the subsea power cable; therefore, EMF effects on sunflower sea stars are discountable.

Artificial Light: The Orbital O2-X would be lit by two amber lights synchronized flashing once every 3 s with a nominal range of 3 NM and mounted a minimum of 3 m (9.8 ft) above the waterline. While artificial light pollution has the potential to alter the behavior of aquatic invertebrate species (e.g., movement, habitat choice, and foraging), the light intensity from the Orbital O2-X device would not significantly alter sunflower sea star behavior in their seafloor habitat. Light intensity from operating vessels present during installation, maintenance, and removal of Orbital O2-X and supporting infrastructure may have the potential to alter sunflower sea star behavior; however, these effects would only be temporary during these types of Project activities and primarily occur during daylight hours. Therefore, it is expected that artificial light would not meaningfully affect the sunflower sea star.

Changes in Oceanographic Systems: As a single device, the Orbital O2-X operation would have a low likelihood of impacting oceanographic systems (e.g., dynamic processes and sediment transport), and any impacts that could occur on the sunflower sea star would be negligible.

4.3.2 Critical Habitat Effects Analysis

The potential effects on designated critical habitat for ESA-listed species by project activities are described within this sub-section. The following is not intended as an ESA-listed designated critical habitat effects determination, as consultation with NMFS and USFWS has not yet occurred. The Project is anticipated to potentially affect ESA-listed critical habitats that overlap with the project area in ways described below; however, it is not expected that any potential effects would rise to the level of being significant.

4.3.2.1 Marine Mammals

Killer Whale, Southern Resident DPS

The Project is anticipated to potentially have effects on SRKW designated critical habitat, although not significantly, due to the following:

- Project activities would occur within designated critical habitat for SRKWs.
- Any impacts on water quality (e.g., increased turbidity) would be temporary in nature and localized, and are expected to have insignificant effects on the overall water quality of SRKW critical habitat.



- SRKW presence is very closely correlated to salmon migration patterns throughout the Salish Sea, and these migration patterns are not expected to be significantly altered by Project activities and the Orbital O2-X presence in its proposed location, which is outside of dense SRKW migration areas through the San Juan Islands (Olson et al. 2018).
- The Project is located in an area of less SRKW abundance compared to other areas of the San Juan Islands and is not expected to significantly alter their passage conditions through Rosario Strait.

The following discussion addresses the essential PBFs for SRKW critical habitat and the associated assessment for each element.

1. *“Water quality to support growth and development”*

Proposed Project area: The proposed Project would create very temporary and localized turbidity plumes that extend into the water column, mainly due to installation of an anchoring system into the seafloor. In the proposed Project area, the seafloor is mainly hard substrate covered by a thin layer of sediment. Given the strength of the currents and tides of Rosario Strait, that resulting turbidity would be temporary, localized, dispersed quickly, and have insignificant impacts on the surrounding aquatic environment. Project activities are not expected to affect the water quality within the proposed Project area with any measurable impact that would adversely affect the growth and development of SRKWs.

2. *“Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth”*

Proposed Project area: Short-lived increases in turbidity have the potential to affect SRKW’s prey species, which is primarily Chinook salmon, during the short time in which there is an increase in suspended sediment. However, if prey species are in the vicinity of the proposed Project area during installation and removal activities that increase turbidity (e.g., anchoring system), they would most likely relocate to a suitable location and resume their previous activities. SRKW’s presence in Washington State’s inland waters is strongly correlated with Chinook salmon migration, and the proposed Project activities are not expected to alter or affect salmon populations’ migration capabilities, which is already less common in Rosario Strait than other areas of the Salish Sea (Ford et al. 2011; Hauser et al. 2007; Bubac et al. 2021). Vessel and Orbital O2-X device noise, presence on the water surface, or other potential effects are not expected to affect the sufficient quantity, quality, and availability of prey species (such as Chinook salmon) for SRKWs. Therefore, it is anticipated that this PBF may be affected but would not be adversely affected.

3. *“Passage conditions to allow for migration, resting, and foraging”*

Proposed Project area: The Project would contribute vessel traffic in the proposed Project area offshore Blakely Island on the edge of Rosario Strait during installation, maintenance, and removal activities. Once the Orbital O2-X device is installed, the space taken up by the device and its sweep area have the potential to displace SRKWs; however, this is unlikely to occur and would have negligible impact on SRKWs. Additionally, SRKWs can likely hear noise associated with the installation, maintenance, or removal of the device, and/or device operations, although effects are expected to be minor and not significantly contribute to altering conditions required for their migration, resting, or foraging. Given the low likelihood of displacement and relatively lower abundance of SRKWs in the proposed Project area compared to the rest of the Salish Sea and Rosario Strait (Olson et al. 2018), it is not expected that the passage conditions to allow for SRKW migration, resting, and foraging would be adversely affected. Therefore, it is anticipated that this PBF may be temporarily affected but would not be adversely affected.



4.3.2.2 Fishes

Bocaccio, Puget Sound-Georgia Basin DPS

The Project is anticipated to potentially have effects on critical habitat for the Puget Sound-Georgia Basin DPS of bocaccio, although not significantly, due to the following:

- Project activities would occur within designated critical habitat for bocaccio.
- Pelagic juvenile bocaccio are opportunistic feeders, and their prey species are not expected to be impacted in such a way that their quantity, quality, or availability would meaningfully be affected, or reduce the feeding opportunities for bocaccio.
- Project activities would result in an increase in turbidity; however, any increases are expected to be temporary, localized, disperse and resettle quickly (hours), and have insignificant effects on the water quality of the surrounding marine environment. Dissolved oxygen levels would not be altered.
- A majority of the seafloor under the Orbital O2-X device (where anchoring would be installed) and the cable laying route is comprised of hard substrate with areas covered by a thin layer of sediment, but the location and route have been selected and designed in such a way as to avoid the textured hard substrate where bocaccio may be more likely to be present.

The following discussion addresses the essential PBFs for bocaccio critical habitat and the associated assessment for each element.

1. *“Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities (adults and juveniles)”*

Proposed Project area: Potential impacts on the benthic marine environment associated with this Project are a temporary increase in localized turbidity due to anchor installation and removal, and laying the 17.8 cm (7 in.) diameter subsea power cable on the seafloor between the Orbital O2-X device and existing landing station (5.3 km [3.3 miles]) on the southern tip of Blakely Island. The temporary turbidity increase is not expected to impact fish species, including bocaccio prey (e.g., fish larvae, copepods, krill, other rockfish, and hake). Therefore, the proposed Project is not expected to meaningfully impact the quantity, quality, and availability of prey species to support the individual growth, survival, reproduction, and feeding opportunities of juvenile and adult bocaccio (Puget Sound-Georgia Basin DPS).

2. *“Water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities (adults and juveniles)”*

Proposed Project area: Potential increases in turbidity associated with the proposed Project would be temporary, localized, and have an insignificant impact on the overall water quality of the proposed Project area, given the strength of tides and currents of Rosario Strait. Project activities are not expected to have any impact on the levels of dissolved oxygen in the area. Therefore, the proposed Project is not expected to produce any meaningful adverse effects to the surrounding water quality that would adversely affect the growth, survival, reproduction, and feeding opportunities of juvenile and adult bocaccio.

3. *“The type and amount of structure and rugosity that supports feeding opportunities and predator avoidance (adult life stage only)”*

Proposed Project area: The proposed Project activities would not adversely impact the types and amount of structure and rugosity, such as rocky bottoms and outcrops, that support feeding opportunities and predator avoidance for adult bocaccio. While the majority of the seafloor where the Orbital O2-X anchoring and subsea power cable would be installed is hard substrate (with



some areas having a thin layer of sediment above it), the seafloor has been mapped and shown to be relatively smooth (north end of the Project area). There are areas of textured hard substrate in the south end of the proposed Project area, around outcrops of Black Rock, but the inshore area of Black Rock is smooth and sedimented. The subsea cable laying route would avoid those outcrop and textured hard substrate areas to the maximum extent possible, primarily being laid on relatively smooth substrate. Therefore, it is expected that there would be no effect on this PBF.

Yelloweye Rockfish, Puget Sound-Georgia Basin DPS

The Project is anticipated to potentially have effects on critical habitat for the Puget Sound-Georgia Basin DPS of yelloweye rockfish, although not significantly, due to the following:

- Project activities would occur within designated critical habitat for yelloweye rockfish.
- Larger juvenile and adult yelloweye rockfish are opportunistic feeders and their prey species are not expected to be impacted in such a way that their quantity, quality, or availability would meaningfully reduce the feeding opportunities for yelloweye rockfish.
- Project activities would result in an increase in turbidity; however, any increases are expected to be temporary, localized, disperse and resettle quickly (in minutes to hours), and have an insignificant impact on the water quality of the surrounding marine environment. Dissolved oxygen levels would not be altered.
- A majority of the seafloor under the Orbital O2-X device (where anchoring would be installed) and the cable laying route is comprised of hard substrate with areas covered by a thin layer of sediment, but the location and route have been chosen and designed in such a way as to avoid rugose or textured hard substrate where yelloweye rockfish may be more likely to be present.

The following discussion addresses the essential PBFs for yelloweye rockfish critical habitat and the associated assessment for each element.

1. *“Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities (adults and juveniles)”*

Proposed Project area: Potential impacts on the benthic marine environment associated with the Project are limited to a temporary increase in localized turbidity due to rock bolt anchor installation and removal at the end of Project life, and laying the 17.8 cm (7 in.) diameter subsea power cable on the seafloor between the Orbital O2-X device and existing landing station (5.3 km [3.3 miles]) on the southern tip of Blakely Island. The temporary turbidity increase is not likely to impact invertebrate and fish species, including yelloweye rockfish prey (e.g., sand lance, gadids, flatfishes, shrimps, crabs, gastropods, and other similar species). Therefore, the proposed Project is not expected to meaningfully impact the quantity, quality, and availability of prey species to support the individual growth, survival, reproduction, and feeding opportunities of juvenile and adult yelloweye rockfish (Puget Sound-Georgia Basin DPS).

2. *“Water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities (adults and juveniles)”*

Proposed Project area: Potential increases in turbidity associated with the proposed Project would be temporary, localized, and have an insignificant impact on the overall water quality of the proposed Project area, given the strength of tides and currents of Rosario Strait. Project activities are not expected to have any impact on the levels of dissolved oxygen in the area. Therefore, the proposed Project is not expected to produce any meaningful effects to the surrounding water quality that would adversely affect supporting the growth, survival,



reproduction, and feeding opportunities of juvenile and adult yelloweye rockfish (Puget Sound-Georgia Basin DPS).

3. *“The type and amount of structure and rugosity that supports feeding opportunities and predator avoidance (adults and juveniles)”*

Proposed Project area: The proposed Project activities would not adversely impact the types and amount of structure and rugosity that support feeding opportunities and predator avoidance, such as high relief and complex rocky habitats, for juvenile and adult yelloweye rockfish. The majority of the seafloor where the Orbital O2-X anchoring and subsea power cable would be installed is hard substrate (with some areas having a thin layer of sediment above it) and has been mapped and shown to be relatively smooth (north end of the proposed Project area). There are areas of textured hard substrate in the south end of the proposed Project area, around outcrops of Black Rock, but the inshore area of Black Rock is smooth and sedimented. The cable laying route would avoid outcrops and textured hard substrate areas to the maximum extent possible, primarily being laid on relatively smooth substrate. Therefore, it is expected that there would be no effect on the type and amount of structure and rugosity that supports feeding opportunities and predator avoidance for adult bocaccio (Puget Sound-Georgia Basin DPS).

Chinook Salmon, Puget Sound ESU

The Project is anticipated to potentially have effects on critical habitat for the Puget Sound ESU of Chinook salmon, although not significantly, due to the following:

- Project activities would occur within designated critical habitat for Puget Sound ESU Chinook salmon.
- Project activities would not occur within any freshwater spawning or rearing sites, migration corridors, or any offshore marine areas for Chinook salmon.
- Project activities would occur within an estuarine (Salish Sea) and nearshore marine area. Turbidity increases would be temporary, localized, and have an insignificant impact on the overall water quality of the surrounding aquatic environment, i.e., salinity conditions, natural cover, and foraging opportunities would not be affected.
- The Orbital O2-X would create a spatial obstruction in areas below the water surface (e.g., the operating turbines, moorings); however, Chinook salmon would be able to avoid these obstructions, and their presence would not impact nearby submerged wood, large rocks and boulders, or foraging opportunities.
- Project activities would not result in any increase in predation of Chinook salmon.

The following discussion addresses specific critical habitat PBFs, cited in the 2005 FR as primary constituent elements (PCEs; *replaced* by the term PBF) essential for conservation of the Chinook salmon Puget Sound ESU, and the associated assessment for each element.

1. *“Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development”*

Proposed Project area: The proposed Project would not go through any freshwater spawning sites for Chinook salmon; therefore, this PBF would not be affected by the proposed Project activities.

2. *“Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks”*



Proposed Project area: The proposed Project would not go through any freshwater rearing sites for Chinook salmon; therefore, this PBF would not be affected by proposed Project activities.

3. *“Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival”*

Proposed Project area: The proposed Project would not go through any freshwater migration corridors for Chinook salmon; therefore, this PBF would not be affected by proposed Project activities.

4. *“Estuarine areas free of obstruction and excessive predation with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation”*

Proposed Project area: The Project is within the Salish Sea, a large estuarine system. Potential increases in turbidity associated with Project activities would be temporary, localized, and have an insignificant impact on the overall water quality of the proposed Project area, given the strength of tides and currents of Rosario Strait. Therefore, temporary turbidity increases are not expected to meaningfully affect water quality, quantity, or salinity conditions in such a way as to adversely impact juvenile and adult physiological transitions of Chinook in the area. Project activities would not affect natural cover, such as submerged and overhanging large wood, large rocks and boulders, or side channels. Survey mapping of the area has confirmed that no aquatic vegetation (e.g., eelgrass or kelp) is present within the proposed Project area. Installation of the Orbital O2-X device, anchoring system, moorings, and subsea power cable on the seafloor is not expected to meaningfully affect the foraging capabilities of juvenile and adult Chinook salmon in support of their growth and maturation.

5. *“Nearshore marine areas free of obstruction and excessive predation with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels”*

Proposed Project area: Increases in localized turbidity due to anchor installation and subsea power cable laying in the nearshore marine areas would be temporary, disperse, and resettle quickly (minutes to hours) due to the strength of Rosario Strait’s current and tides, resulting in insignificant impacts on the surrounding marine environment. Therefore, water quality and quantity conditions are not expected to be impacted to such a degree that conditions would be impaired for Chinook salmon to forage in support of their growth and maturation. Project activities would not create conditions of excessive predation of Chinook salmon. Natural cover, such as submerged and overhanging large wood, large rocks and boulders, or side channels, would not be affected by Project activities or the presence of the Orbital O2-X device and supporting infrastructure. Survey mapping of the area has confirmed that no aquatic vegetation (e.g., eelgrass or kelp) is present within the Orbital O2-X area.

6. *“Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation”*

Proposed Project area: No Project activities or components would occur in offshore marine areas; therefore, this PBF would not be affected by proposed Project activities.



4.3.3 Marine Mammal Species Effects Analysis

A summary of the potential Project effects on marine mammal species protected under the MMPA, and their expected responses to each effect, are listed below in **Table 25**. Potential Project effects on marine mammal species protected under the ESA (SRKWs and humpback whales [Central America and Mexico DPSs]) are described in **Section 4.3.1.1**.

Table 25. Summary of Potential Project Effects on MMPA Species

Potential Effect to Marine Mammal Species	Response
<p>Entanglement</p> <p>When a marine animal becomes intertwined with mooring lines or cables (primary), or derelict fishing gear snagged in Project infrastructure (secondary)</p>	<ul style="list-style-type: none"> • The Project’s new subsea cable and mooring lines do not have loose ends or sufficient slack to create an entangling loop that could pose an entanglement risk to mammals. • To date, no entanglements of marine mammals with MRE systems have been observed, and no evidence indicates that such event has occurred (ORJIP Ocean Energy 2022a). • Derelict gear may snag on the Orbital O2-X or its supporting infrastructure and pose an entanglement risk; however, due to the unlikelihood of this occurring within the proposed Project area, effects are considered negligible. • The risk of entanglement due to mooring lines, the new subsea cable, and (potential) derelict gear is considered to be very low to negligible for all marine species, including mammals (Copping and Hemery 2020).
<p>Collision</p> <p>Direct contact between an animal and vessel, the Orbital O2-X device, and/or one of its components (e.g., a turbine blade)</p>	<ul style="list-style-type: none"> • While there exists a risk of collision between Project vessel(s) and nearby marine mammals, species are expected to avoid or otherwise alter their behavior to avoid collision. • Studies show that the probability of a lethal injury to whales increases with vessel speed, while there is a substantial decrease in lethality as a vessel speed falls below 15 knots (Vanderlaan and Taggart 2007); however, vessel SOPs and BMPs would reduce this risk by operating at much slower speeds (e.g., 1–3 knots). • Maintenance requiring vessel would primarily occur one to two times per year, with the exception of periodic mooring surveys and infrequent (e.g., every five or eight years) major maintenance. During maintenance, vessel(s) would follow BMPs when in proximity of marine mammals. • Substantive evidence suggests that when marine animals can detect operational tidal turbines, they exhibit evasion or avoidance behaviors (Wilson et al. 2007; Pearson et al. 2010; Garavelli et al. 2024) and take measures to prevent being struck by turbine blades (Fraser et al. 2018; Gillespie et al. 2021; Onoufriou et al. 2021). • Past evidence and the sensory capabilities of marine mammals suggest that a collision with a turbine blade would be an extremely rare event, as to date, there have been no detected or recorded instances of direct collision (Copping and Hemery 2020; Copping et al. 2023; Onoufriou et al. 2021; Garavelli et al. 2024). • There would be a low likelihood but moderate impact of collision (if one were to occur), leading to a medium risk level for marine mammals.
<p>Entrainment</p> <p>The unwanted forced passage of marine animals through a water intake or</p>	<ul style="list-style-type: none"> • No studies that focused on smaller mammals (e.g., harbor porpoises) have shown or indicated marine mammals becoming entrained and suffering injury or death.



Potential Effect to Marine Mammal Species	Response
<p>turbine sweep; i.e., getting sucked into the tidal turbine(s)</p>	<ul style="list-style-type: none"> The mechanics of crossflow turbine design means that essentially no suction or entrainment force is created during operations; therefore, although very few studies exist on entrainment risk to marine mammals, it is not expected to occur.
<p>Noise Disturbance Sounds made by human activities that can interfere with or obscure the ability of marine animals to hear the natural sounds of the ocean due to vessel operations, installation, operation and maintenance of Orbital O2-X device, and removal</p>	<ul style="list-style-type: none"> Vessel activity, installation, and removal of the Orbital O2-X and supporting infrastructure (e.g., rock-drilled anchoring), is anticipated have a medium likelihood of generating noise levels causing disturbance with a minor impact on marine mammals; therefore, it is considered to be an overall medium risk. Increased noise due to the Orbital O2-X powertrain is expected to have a low likelihood of resulting in disturbance effects to nearby marine mammals, with expected minor impacts; therefore, it is considered an overall low risk. Harbor seals avoid simulated tidal turbine sounds (Hastie et al. 2018), and harbor porpoise click activity has been shown to be reduced compared with baseline levels within a few hundred meters of an active device (Tollit et al. 2019; Coles et al. 2021). Overall, increased noise levels due to installation, maintenance, and removal of the Orbital O2-X would be temporary and not likely to cause harassment and/or injury of nearby marine mammals. There is the potential for altered behavior (e.g., avoidance); however, this is not expected to cause significant adverse effects to marine mammal species. Severe potential effects of increased underwater noise (e.g., threshold shift, physiological changes, physical injury, and death) have <u>not</u> been observed for MRE devices (Popper and Hawkins 2018; Popper et al. 2023). Overall, there is consensus that underwater noise from operational devices within the small-scale MRE developments (one to six devices) does not pose a significant risk to marine mammals (Copping et al. 2019, 2020; ORJIP Ocean Energy 2022b; Polagye and Bassett 2020).
<p>Displacement Mechanisms (including attraction, avoidance, and exclusion) that cause animals to depart from, or not enter into, their preferred or critical habitats, or to move into areas that are new to them</p>	<ul style="list-style-type: none"> Large cetaceans may be temporarily displaced during installation, maintenance, and removal activities due to underwater noise (e.g., increased vessel traffic) and physical presence of the Orbital O2-X (including sweep area), as well as have limited maneuverability around the device (Kraus et al. 2019; Hemery et al. 2024). Small cetaceans are at less risk of displacement due to their maneuverability and improved swimming capabilities (Hemery et al. 2024). In some cases, local cetacean activity has been shown to resume shortly after disturbance due to the cessation of construction or maintenance (Tollit et al. 2019). Evidence also suggests that habitat displacement caused by single MRE devices occurs at a relatively small scale for pinnipeds (e.g., harbor seals). The risk of permanent habitat displacement from the Orbital O2-X device is low overall; however, temporary displacement (including avoidance and attraction) is anticipated for nearby marine mammals with a minor (vessel) to negligible (Orbital O2-X device) impact.



Potential Effect to Marine Mammal Species	Response
<p>Habitat Alteration</p> <p>Temporary or permanent physical transformation of benthic or pelagic habitats (e.g., footprint effect, scour, sweep, biofouling, and artificial reef effect)</p>	<ul style="list-style-type: none"> • An increase in temporary suspended sediment in the water column may cause whales and other mammals to alter their normal movements, but these minor movements would be too small to be meaningfully measured or detected. Mammals would be able to easily swim away from the minor turbidity plume and would not be adversely affected by passing through it. • Alteration of the benthic habitat (e.g., footprint effect, scour, and sweep) is not expected to significantly affect marine mammals within the proposed Project area. There is the potential for an artificial reef effect to cause fish prey to aggregate and attract predator mammals, but the small-scale extent to which this may occur due to the four moorings and anchors for a single MRE device is not expected to meaningfully affect nearby marine mammals. • Effects of habitat alteration of the pelagic environment (e.g., presence of mooring lines) are expected to be the same as those due to displacement: temporary displacement with a negligible impact. Marine mammals are highly mobile and could maneuver around mooring lines in the water column.
<p>EMF</p> <p>Force generated by current flow passing through power cables during operation and can be divided into electric fields and magnetic fields</p>	<ul style="list-style-type: none"> • EMF produced from the Project are likely to be low intensity and approach background levels within a few meters from the source (Baring-Gould et al. 2016; Copping and Hemery 2020). • No interactions with anthropogenic EMF from subsea cables have been recorded for marine mammals, and it is anticipated EMF from the subsea power cable would have no effect on nearby marine mammals.
<p>Artificial Light</p> <p>Anthropogenic sources of light needed for the Project’s installation, operation and maintenance, and removal</p>	<p>There is a lack of scientific evidence to determine the level of impact that artificial light may have on nearby marine mammals; therefore, a fully informed impact assessment or risk determination cannot be accurately made.</p>
<p>Changes in Oceanographic Systems</p> <p>Changes in water circulation, wave heights, and current speeds, which in turn can affect sediment transport and water quality, within both nearfield and farfield environments around MRE devices</p>	<p>The scientific literature indicates that changes in oceanographic systems from properly sited small tidal and wave deployments (one to six devices) would be lower than those within the natural variability of the system (Garavelli et al. 2024). Therefore, any changes in oceanographic systems would be not significant enough to cause adverse, or beneficial, effects on nearby marine mammal species.</p>
<p>Notes: BMP = best management practice(s); EMF = electromagnetic field; MMPA = Marine Mammal Protection Act; MRE = marine renewable energy; ORJIP = Offshore Renewables Joint Industry Programme</p>	



4.3.4 Essential Fish Habitat Effects Analysis

“Adverse effect” refers to any impact that reduces the quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR § 600.810).

The effects of the proposed Project are described below. BMPs and mitigation measures would be implemented to reduce or otherwise mitigate potential impacts. The potential Project-related impact stressors on EFH include:

- Habitat Alteration: Benthic and Pelagic
- EMF Exposure

In Washington State, “areas of interest” are HAPC, which encompass all waters and sea bottom in state waters from the 3 NM boundary of the territorial sea shoreward to the MHHW. Therefore, it would be impossible to avoid this type of HAPC. BMPs and mitigation measures would be employed throughout the Project’s lifespan to minimize adverse effects to this HAPC.

Other types of HAPC are not present within the proposed Project area. Patchy eelgrass presence has been documented at the new subsea cable landing site (DNR 2025); however, surveys conducted by Tetra Tech, Inc. in October 2024 detected no eelgrass in their MBE data, nor was any observed (**Figure 50**; Appendix C1). Patchy and continuous kelp beds are also present along the Blakely Island coastline (DNR 2025), but survey results indicate that they are not near the new subsea cable landing station or other proposed Project areas (**Figure 50** and **Figure 51**). Because HAPC are not present nor affected by Project activities, they are not further addressed in this DLA.

4.3.4.1 Habitat Alteration

Both benthic and pelagic EFH alteration is expected to occur due to the installation, operation, and removal of the Orbital O2-X device and supporting infrastructure. As described in **Section 4.1.6**, the two main changes for benthic and pelagic EFH would include adverse effects (e.g., increased turbidity, habitat alteration) due to seafloor infrastructure installation and removal, and habitat creation over time (e.g., biofouling and artificial reefs), which could have both positive and negative consequences (Copping and Hemery 2020; Garavelli et al. 2024). As such, the installation, presence, operation, and removal of the Orbital O2-X device and supporting infrastructure would result in some changes to EFH that may differ from natural variability (Garavelli et al. 2024). Relative to the size of the surrounding waters of Rosario Strait and the greater Salish Sea, effects on EFH attributable to the proposed Project activities would occur on a small spatial scale and be minimized by implementing BMPs, mitigation measures, and avoidance of HAPC. These actions would help ensure that effects on EFH for Pacific Coast groundfish, CPS, and Pacific salmon are temporary and minimized.

Benthic EFH Effects

Impacts on benthic EFH include an increase in turbidity due to the installation and removal of Project infrastructure, mooring line and subsea cable sweep, and scour.

Turbidity: Sediment disturbance is expected due to the following: (1) the installation and removal of anchors and subsea power cable on the seafloor; (2) areas of mooring chain and subsea cable contact and sweep along the seafloor; and (3) scouring of sediment around benthic structures. Although a variety of EFH species are found in the marine waters of Rosario Strait where the proposed Project would occur, the likelihood of any species being present during the installation, operation, movement of the Orbital O2-X, mooring chains, subsea cable, and removal phases depends largely on the habitat needs of those species.



1. Installation and Removal of Device Infrastructure

Increases in sediment disturbance within EFH would primarily occur during the installation and removal of anchors and subsea power cable along its proposed length of 5.3 km (3.3 miles) and would be limited to the size of the anchors (58.4 cm [23 in.] diameter) and width of the cable (up to 20 cm [8 in.]). During installation and removal, the elevated turbidity levels are expected to be temporary and localized to the seafloor and nearby water column, and due to the strength of currents and tides within Rosario Strait, suspended sediment is expected to disperse and resettle quickly (minutes to hours) (Hitchcock et al. 1999) and have an insignificant impact on the surrounding EFH and aquatic environment (Taormina et al. 2018). Once installed, and until removal, the rock bolt anchors and subsea power cable would not cause any additional localized turbidity.

The seafloor below the proposed Orbital O2-X device—where the anchors, mooring lines, and subsea power cable would be installed and removed—largely consists of hard substrate with a thin sediment layer (see **Section 3.2.3, Bathymetry**). The seabed on the northern end of the proposed Project area is relatively smooth with some undulation and a very thin sediment layer. To the south, the overlying sediment layer has been scoured away, and inshore of Black Rock (along the proposed subsea cable route), the seabed is smooth and sedimented. The proposed Project area, including the subsea power cable route, was chosen in part to avoid areas of complex seafloor structure that would otherwise provide essential habitat for EFH species in the area (Pacific Coast groundfish, CPS, and Pacific salmon), which likely reduces the concentration and frequency of species present.

2. Mooring Line Sweep

Throughout the duration of the proposed Project, there is the possibility of mooring chain contact with, and sweep along, the seabed, which is likely to disturb sediment along the seafloor. The mooring chains would have necessary slack to allow for tidal rise and fall, and to form a catenary against lift and shock from wave action (Morrisey et al. 2018). As such, mooring chains for the Orbital O2-X may be dragged repeatedly across the seabed, which can disturb benthic habitat around the mooring anchor, as well as prevent recolonization until the mooring lines are removed. Each mooring line would have two areas in contact with the seabed: (1) where the mooring chain is lifted up and placed back down (i.e., no “sweep”); and (2) where the chain is dragged over the seabed (i.e., “sweep”).

The mooring chain would be lifted up off the seabed over a length of 246 m (807 ft) and placed back down in the same location. Remotely operated vehicle footage from other MRE sites has shown a very narrow area of disturbance to the seabed; the width is less than 1 m (3.3 ft), giving an area of less than 246 m² (2,648 ft²). Areas where the mooring chain is dragged over the seabed, rather than lifted up and placed back down would impact an area of approximately 10 m² [108 ft²], and contact with the seabed would change from slack tide (minimal tension) to rated power (peak tension) (see **Section 4.1.6.1, Seabed Sweeping**).

The seabed substrate exposed to mooring chain contact and sweep is primarily smooth with some undulation, with a likely very thin sediment layer (according to Tetra Tech, Inc. survey) and is not considered to be sensitive habitat even though it is located within EFH for Pacific Coast groundfish, CPS, and Pacific salmon (Appendix C1). Due to the strength of the currents and tides of Rosario Strait, thin sediment layers may continue to cover the sweep area and produce small, localized turbidity plumes. These sediment disturbances would be short-lived and of very low intensity. Turbidity would likely be dispersed, carried away by the currents and tides of Rosario Strait, and settle back to the seafloor and dilute to background levels within minutes to hours of mooring chain movement. As such, turbidity increases due to mooring chain contact with the seafloor is not expected to meaningfully affect the water quality of the surrounding aquatic environment but instead have minimal impacts on EFH and Pacific Coast groundfish, CPS, and Pacific salmon (Taormina et al. 2018).



3. Scour

There is the possibility of increased turbulence and flow velocity changes leading to scour around the Orbital O2-X's bottom structures (e.g., anchors and subsea cable) (Copping and Hemery 2020; Lancaster et al. 2022; Garavelli et al. 2024). If scour were to occur, the resulting footprint would be extremely small relative to Rosario Strait, due to the size of the four rock bolt anchors (58.4 cm [23 in.] diameter, each) and the surface-laid subsea cable (up to 20 cm [8 in.] in diameter).

In previous studies, abundances of invertebrates such as polychaetes, oligochaetes, bivalves, small crustaceans (which can serve as prey for Pacific Coast groundfish, CPS, and Pacific salmon) were shown to be higher closer to artificially installed benthic structures compared to areas without structures (Mendoza and Henkel 2017). However, no meaningful effects on diversity or richness were measured in relation to distance from the structures, nor were meaningful changes in infaunal communities measured, compared to areas without artificial structures (Mendoza and Henkel 2017). Another study around anchors deployed at Oregon State University's PacWave-North test site off Newport, Oregon, showed that median sediment grain size and the macrofaunal organism communities were not meaningfully different than areas outside the test site (Henkel 2016). Any seafloor changes that occurred were very localized and did not appear to result in ecological changes, i.e., there were few changes in species abundance and no change in species composition (Henkel 2016).

While scour could potentially affect benthic EFH, including prey species for EFH species in the proposed Project area, any effects would likely be minor and limited to the seafloor area directly adjacent to the Orbital O2-X device and infrastructure, such as has been shown in other tidal turbine locations (e.g., SeaGen in Strangford Lough, Northern Ireland) (Kregting et al. 2016; O'Carroll et al. 2017; Copping and Hemery 2020). It is anticipated that any scour effects to sediment and benthic organisms would not scale up to a point that would meaningfully affect the quality and quantity of EFH or the nearby surrounding benthic environment; therefore, scour is not expected to meaningfully negatively affect EFH for Pacific Coast groundfish, CPS, or Pacific salmon.

Benthic and Pelagic EFH Effects

Impacts on benthic and pelagic EFH include habitat alteration, biofouling, and artificial reef effects.

Habitat Alteration

A temporary reduction in available EFH would occur due to the inaccessibility of portions of seafloor habitat directly underneath the Orbital O2-X device and infrastructure while installed on/in the substrate (Hemery 2020). Resulting impacts would be limited to the footprint of the four anchors, area of mooring chain contact and sweep on the seafloor, the subsea power cable on the seafloor, and any benthic areas subject to turbulence from the proposed Project. Once installed, benthic organisms and Pacific Coast groundfish, and likely other EFH species, would be unable to use these immediate areas of their benthic habitat until the end of the Project's life (up to 10 years). Upon device removal, any artificial reef habitat created by colonization on the structures would be lost (Miller et al. 2013).

The temporary exclusion from some benthic habitat due to anchors and subsea power cables in the MRE industry is widely acknowledged by decision-makers (Hemery 2020) and has been factored into the proposed Project's design and siting to avoid or minimize any adverse effects to seafloor habitat. Mooring chain contact with the seafloor has the potential to affect a much larger benthic area than the four anchors and subsea power cable (see '2. Mooring Line Sweep' within the *Turbidity* subsection above). While the surface area of contact between the mooring line chains and seafloor would cover a relatively large area (246 m² [2,648 ft²] per mooring line or 984 m² [10,592 ft²] total), similar to the subsea power cable, much of the affected area would be narrow (a width of approximately 1 m [3.3 ft] or less). The total area susceptible to mooring chain drag, which would



also result in a loss of benthic habitat, is estimated to be approximately 10 m² (108 ft²) per mooring chain, or 40 m² (430 ft²) total.

Surveys conducted by Tetra Tech, Inc. in October 2024 confirmed that no sensitive habitats or HAPC (e.g., eelgrass, canopy kelp, or rocky reefs) are present in areas where the Orbital O2-X, anchoring, mooring line, and subsea cable installation would occur (Appendix C1). Additionally, the anchoring and cable route avoids areas of complex hard rocky substrate, which could otherwise provide sensitive habitat for sheltering and foraging opportunities for different EFH species. While installation of the proposed Project infrastructure would affect the benthic habitat for EFH species, these effects would be temporary and minimized as a result of the design choices made to avoid sensitive habitats and HAPC, as well as BMPs and mitigation measures that would be implemented.

The maximum depth of the Orbital O2-X platform below the water would be 2.4 m (7.9 ft) for the length of its hull (85 m [279 ft]), spatially displacing an area of approximately 204 m² (2,196 ft²). Each rotor would have two turbine blades for a total diameter of 30 m (98 ft); i.e., 60 m (196.7 ft) total for two rotors. From the water surface, the uppermost part of the rotor tip would be 3 m (9.8 ft) deep and the bottom tip (deepest part while rotors extended) 33 m (108 ft) deep. The maximum rotor sweep area for each rotor would be 706 m² (7,600 ft²) (i.e., 1,412 m² [15,199 ft²] total). The mooring line system would consist of four approximately 95 mm (3.7 in.) and 115 mm (4.5 in.) diameter studlink mooring chains, with synthetic or steel rope potentially limited to the upper section (approximately 170 mm [6.7 in.] in diameter). The four mooring lines and anchoring components would cover a minimum area of approximately 280 m x 480 m (918 ft x 1,575 ft) or 134,400 m² (~1,446,700 ft²).

Pelagic-dwelling fish (e.g., CPS) and other highly mobile organisms would likely avoid the proposed Project area if disturbed, and return upon completion of installation, removal, and maintenance activities. While the mooring spread of the four lines consists of a much larger area than the mooring chains themselves, mobile organisms, such as most Pacific Coast groundfish, CPS, and Pacific salmon species, are anticipated to easily maneuver around the lines and/or relocate to avoid their presence in the water column (Hasselman et al. 2023; Hemery et al. 2024; Garavelli et al. 2024). However, tidal turbines may also act as a fish aggregating device (Fraser et al. 2018), with studies showing that fish begin to occupy deeper areas at night in areas of tidal turbines (Williamson et al. 2019; da Silva et al. 2022).

Any spatial effects that do result from the Orbital O2-X device and Project infrastructure would be temporary (up to 10 years maximum, the allowable pilot project lifespan), and the water column would be fully unobstructed again after Orbital O2-X decommissioning and removal, i.e., no Pacific Coast groundfish, CPS, or Pacific salmon species would be permanently displaced from their EFH. The presence of the Orbital O2-X, including its two turbines and raising/lowering legs for maintenance, and four narrow mooring lines and subsea cable in the proposed Project area is not expected to result in significant direct effects to pelagic EFH or the pelagic community, nor is it expected to meaningfully remove available habitat from Pacific Coast groundfish, CPS, or Pacific salmon. With the implementation of BMPs and other mitigation measures, and the temporary nature of the proposed Project, there would be no permanent reduction in the quality and/or quantity of pelagic EFH for Pacific Coast groundfish, CPS, or Pacific salmon.

Biofouling and Artificial Reef Effects

Over time, the seafloor infrastructure and Orbital O2-X hull may be colonized by benthic marine life including biofouling organisms and non-native organisms, which may impact local biodiversity and attract foraging Pacific Coast groundfish, CPS, and Pacific salmon (Garavelli et al. 2024). Biofouling has been reported at tidal device sites in the Orkney Islands, Scotland; however, no non-native species were detected (Nall et al. 2022; Want et al. 2023). Biofouling would likely occur to some extent on Project infrastructure within EFH, although it is not likely to significantly affect the water quality of EFH as the Project anchoring, mooring connections, and cable have a relatively small



footprint. To minimize potential biofouling impacts, antifouling paints would be used, as well as regular inspections of coatings during regular maintenance intervals to ensure that they remain intact.

Artificial reefs have also been created around MRE devices, providing beneficial effects for the surrounding marine environment and species (Langhamer et al. 2009; Broadhurst and Orme 2014; Langhamer 2016). By increasing the complexity of the seafloor and surrounding water, the Orbital O2-X device and supporting infrastructure could provide shelter or flow refuge for fish species, increase the local organismal community diversity, abundance, and size (Copping and Hemery 2020), and aggregate EFH fish species that may not occur without device introduction (Causon and Gill 2018; Dannheim et al. 2019). Negative artificial reef effects on EFH are also possible, such as facilitating the introduction of non-native species or causing significant shifts in local communities (Dannheim et al. 2019; Loxton et al. 2017; Copping and Hemery 2020); however, studies have indicated that near artificial structures there has not been a significant increase in non-native species attraction and composition (Nall et al. 2022; Want et al. 2023).

Artificial reefs may also result in nutrient enrichment around the Orbital O2-X device and seafloor infrastructure, due to the accumulation of organic matter and decaying shells from increased litterfalls from biofouling and marine organisms attracted to the device (Wilding 2014; Garavelli et al. 2024). Increased benthic biomass could benefit higher trophic levels, up to apex predators, thereby potentially intensifying the artificial reef effect (Raoux et al. 2017); however, this is less likely to occur near tidal turbines due to the strength of hydrodynamic forces preventing the local accumulation of organic matter (Garavelli et al. 2024).

EFH for Pacific Coast groundfish, CPS, and Pacific salmon is not expected to be impacted by artificial reef effects. There may, however, be positive outcomes, e.g., EFH species may be attracted to the proposed Project area if increased foraging opportunities are created. Based on past studies, artificial reefs can attract mobile marine species while foraging for food and/or shelter, as well as increase local species diversity, richness, and abundance, and colonization by sessile and mobile invertebrates and fish (Langhamer 2012; Taormina et al. 2018; Bender et al. 2020; Garavelli et al. 2024). Species including Pacific Coast groundfish, CPS, and Pacific salmon may be attracted to the proposed Project area for foraging and sheltering opportunities created by the presence of the Orbital O2-X and supporting infrastructure. Some of these artificial reef effects have only been hypothesized and modeled and could take up to decades to develop (the proposed Project would be temporary, up to 10 years). It is unlikely that any significant EFH-altering artificial reef effects would occur (Raoux et al. 2017; Copping and Hemery 2020).

4.3.4.2 EMF Exposure

EMF from the proposed new subsea power cable is a general concern for potentially sensitive species such as elasmobranchs, fishes, marine mammals, sea turtles, and invertebrates (Normandeau et al. 2011; Snyder et al. 2019). Although elevated EMF may be detectable by benthic species, such as Pacific Coast groundfish near the power cable location, the impacts decrease quickly with distance from the cable. Magnetic field levels diminish with the inverse of the distance from the cable and are proportional to the current carried by the cable. For example, the magnetic fields generated from a high voltage (150 kV direct current [DC]) submarine power transmission cable at the sediment surface ranged from 50 μT at the cable surface, dropping off rapidly to approximately 35 μT at 1 m (3.3 ft) from the cable (Copping et al. 2016). For context, the Earth's background magnetic field ranges from 30 to 60 μT (Copping et al. 2016). The proposed new subsea power cable would have an operating voltage of 12.47 kV (dependent on local infrastructure, but considerably lower than 150 kV DC), 60 Hz to match the local grid.

Pacific CPS finfish—generally occurring and harvested from above the thermocline in the upper mixed layer of the ocean—are not associated with the seafloor where the power cable would be located. While other studies have considered potential impacts on pelagic species, such as



impairment of navigation or homing, changes in feeding success, mate finding, and predator evasion, these effects are generally considered negligible (Snyder et al. 2019). CPS are not expected to be exposed to EMF emitted from the Project's subsea power cable and, if so, would only be for fleeting periods of time as they swim by. EFH for krill species (*Euphausia pacifica* and *Thysanoessa spinifera*) extends from the shoreline to the 1,830 m (6,000 ft) isobath to a depth of 400 m (1,312 ft); however, there is currently no evidence to suggest that EMF would affect krill species. Given that EMF is expected to drop off dramatically within a short distance from the subsea power cable (less than 1 m [3.3 ft]), it is not likely that CPS EFH would be meaningfully altered due to EMF.

Pacific Coast groundfish species, which include over 90 commercially important species such as rockfish, flatfish, roundfish, sharks, and skates inhabiting coastal seafloor habitats, are most likely to encounter EMF produced by subsea power cables (Snyder et al. 2019). Although groundfish species would be closer to undersea power cables and potentially be exposed for longer periods of time, the rapid environmental decay of EMF minimizes potential impacts (Synder et al. 2019). Other species, such as Atlantic cod (*Gadus morhua*) larvae, have been shown to have reduced swimming activity, but no change in spatial distribution, when exposed short-term to artificially intense DC B-fields (22–156 μ T) (Cresci et al. 2023). MRE arrays may attract benthic sharks, skates, and rays because of EMF generated by multiple subsea power cables (Maxwell et al. 2022; Synder et al. 2019), but a single device with a subsea power cable, such as the Orbital O2-X, is not expected to emit EMF strong enough to attract these types of groundfish. EMF emitted from the subsea power cable would have negligible consequences for Pacific Coast groundfish and EFH, even if they are more likely to be exposed than pelagic species.

Modeling results suggest that magnetic fields emitted by alternating current cables might be detectable by spawning and migrating salmon, but the fish would need to be within several meters of the cable. Additionally, their pelagic behavior keeps them away from the strongest fields (Normandeau et al. 2011). There is evidence that salmon species rely on multiple senses, including sight and smell, during migration; therefore, they may be able to compensate for a localized disturbance in the geomagnetic signal (Normandeau et al. 2011). Other studies have shown that the migration success of Chinook salmon was largely unchanged after installing a 200 kV high-voltage DC subsea cable (much stronger than the 12.47 kV cable for the proposed Project), although transit times through the cable area were slightly reduced (Wyman et al. 2018). As such, it is very unlikely that any potential EMF effects would meaningfully affect the quality or quantity of Pacific salmon EFH, including their prey and other required ecosystem components.

The current evidence suggests that the ecological impacts of EMF emitted from power cables of single MRE devices are likely limited, and marine animals living in the vicinity of devices and export cables are not likely to be harmed (Copping and Hemery 2020). Given the relatively small scale of the proposed Project, EMF would be minimal and localized to the immediate vicinity of the 5.3 km (3.3 miles) long cable, with negligible effects on any Pacific Coast groundfish, CPS, or Pacific salmon that may be present within the proposed Project area. These EMF are not likely to result in the harmful alteration, disruption, or destruction of EFH. While there may be measurable effects from EMF on a small number of individuals (e.g., behavior, physiology, and development), these effects are not evident at EMF intensities associated with current small-scale MREs, such as the Orbital O2-X (e.g., most bony fishes have not evolved to detect EMF at 60 Hz) (Snyder et al. 2019; Copping and Hemery 2020; Copping et al. 2021; Gill and Desender 2020; Garavelli et al. 2024). EMF emitted by the proposed Project subsea power cable would likely be low intensity and approach background levels within a few meters from the source (Baring-Gould et al. 2016; Copping and Hemery 2020). Therefore, they are not expected to have significant adverse effects on EFH for Pacific Coast groundfish, CPS, or Pacific salmon, or their prey species.

4.3.4.3 Effects Not Considered



Hazardous material contamination was assessed but is not considered a Project-related stressor because it is not reasonably likely to occur and/or adversely affect EFH, EFH species, or prey. As with any motorized vessel at sea, there is a potential for accidental oil or fuel releases to occur during operations, which could introduce pollutants into marine water that may affect fish species. Sources of hazardous materials include petroleum-based fuel and oil used in vessel operations for installation, maintenance, and removal of the Orbital O2-X device and supporting infrastructure, and anti-fouling coating, oils, chemicals, and lubricants from the Orbital O2-X device during operations.

To mitigate for potential contamination effects due to hazardous materials, vessels would abide by SOPs and have proper spill response materials and follow protocols for fuel spills or leaks, e.g., should a fuel or oil spill occur from a vessel, it would be cleaned immediately using onboard spill kits. To mitigate potential effects from hazardous materials associated with the Orbital O2-X device, only industry-accepted anti-fouling coatings and biodegradable materials, or other acceptable options, would be used. An Emergency Response and Recovery Plan would be developed with spill prevention, response actions, and control protocols, as well as provisions for recording types and amounts of hazardous fluids contained in Project components.

4.3.5 Avian Species Effects Analysis

A summary of the potential Project effects to avian species, and their expected responses to each effect, are summarized in **Table 26**.

Table 26. Summary of Potential Project Effects to Avian Species

Potential Effect to Avian Species	Response
<p>Entanglement</p> <p>When a marine animal becomes intertwined with mooring lines or cables (primary), or derelict fishing gear snagged in Project infrastructure (secondary)</p>	<ul style="list-style-type: none"> No entanglement is expected to occur between avian species (including diving seabirds) and mooring lines and subsea power cable. Derelict fishing gear has the potential to snag on turbine structures and pose a secondary entanglement risk for foraging diving seabirds; however, the effects are expected to be negligible. If derelict fishing gear is found to be snagged on the Orbital O2-X device and/or supporting infrastructure (e.g., mooring lines), it would be promptly removed.
<p>Collision</p> <p>Direct contact between an animal and vessel, the Orbital O2-X device, and/or one of its components (e.g., a turbine blade)</p>	<ul style="list-style-type: none"> No physical contact between a tidal turbine blade and seabird has been observed in previous studies (Garavelli et al. 2024). It is expected that there would be a low likelihood but would be a moderate impact of collision with Orbital O2-X turbine blade(s), leading to a medium risk level for avian species. Collision risk is a concern for seabirds in locations where tidal turbines overlap with diving and foraging areas; however, much less is known about the risk concerning diving seabirds compared to other types of marine species (Couto et al. 2022). No other studies have indicated that collisions between avian species and single tidal turbine devices and/or parts have occurred, and it is not expected that the Orbital O2-X would present a significant risk to seabirds
<p>Entrainment</p> <p>The unwanted forced passage of marine animals through a water intake or turbine sweep,</p>	<ul style="list-style-type: none"> Given the relatively low blade speed and expected high unlikelihood that birds (including diving seabirds) could get sucked into the Orbital O2-X turbine blades, no entrainment risk to avian species is expected.



Potential Effect to Avian Species	Response
i.e., getting sucked into the tidal turbine(s)	
<p>Noise Disturbance</p> <p>Sounds made by human activities that can interfere with or obscure the ability of marine animals to hear the natural sounds of the ocean due to vessel operations, installation, operation and maintenance of Orbital O2-X device, and removal</p>	<ul style="list-style-type: none"> • For a single MRE device such as the Orbital O2-X, the importance of noise on seabirds is considered low, and the available evidence base remains poor (ORJIP Ocean Energy 2022b). • Noise from installation and removal activities (e.g., rock bolt anchors) would be temporary and primarily occur underwater. • There is the potential for an increase in aerial noise due to Project construction activities (e.g., vessel presence); however, these noise levels are not expected to have a significant effect on avian species. While operating, the device is not expected to produce aerial noise levels that would affect avian species. • It is expected that noise created by the Orbital O2-X device turbine operations would be above ambient noise levels, but not at a level that would negatively affect avian species, including diving seabirds, present in the proposed Project area. Any avian species present during installation and removal activities would likely forage elsewhere nearby and return to resume their regular behavior once construction activities cease.
<p>Displacement</p> <p>Mechanisms (including attraction, avoidance, and exclusion) that cause animals to depart from, or not enter into, their preferred or critical habitats, or to move into areas that are new to them</p>	<ul style="list-style-type: none"> • Displacement of avian species due to vessel activity required during all Project phases (due to presence and noise) is expected to have minor, or insignificant, temporary effects on avian species near Project activities. • Any avian species present during installation, maintenance, and removal activities would likely forage elsewhere nearby, and return to resume their regular behavior once construction activities cease. • Once installed and operating, the Orbital O2-X has the potential to displace, attract, and result in avoidance of the proposed Project area; however, the likelihood is considered low and the potential effects negligible.
<p>Habitat Alteration</p> <p>Temporary or permanent physical transformation of benthic or pelagic habitats (e.g., footprint effect, scour, sweep, biofouling, and artificial reef effect)</p>	<ul style="list-style-type: none"> • Habitat alteration effects are expected to largely be confined to the benthic habitat, and to a lesser degree in the water column, neither of which are expected to significantly affect avian species. • MRE devices may potentially attract mobile organisms and act as artificial reefs or fish aggregating devices (Dannheim et al. 2019; Langhamer 2016), which would have the potential to increase seabird foraging in the area. The extent of this effect is unknown but is expected to not significantly negatively impact avian species near or in the proposed Project area.
<p>EMF</p> <p>Force generated by current flow passing through power cables during operation and can be divided into electric fields and magnetic fields</p>	<ul style="list-style-type: none"> • Given the location of the subsea power cable on the seafloor, no impacts on avian species due to EMF are expected.



Potential Effect to Avian Species	Response
<p>Artificial Light</p> <p>Anthropogenic sources of light needed for the Project’s installation, operation and maintenance, and removal</p>	<ul style="list-style-type: none"> • Artificial light is expected to increase due to vessel lighting and lighting on the Orbital O2-X device. The majority of Project work would occur during daytime hours, thereby minimizing and making temporary the increased use of artificial light via vessel presence. • The Orbital O2-X device would have two amber lights that display synchronized flashing once every 3 s, situated at least 3 m (10 ft) above the waterline. • There is the potential for avian species to be attracted to, or become disoriented, due to the introduction of artificial light in the proposed Project area; however, the effects due to vessel lighting are expected to be discountable due to their temporary nature and minimization measures (e.g., work during daylight hours). Avian species may become attracted to the Orbital O2-X lighting, but this is not expected to result in significant adverse effects to avian species.
<p>Changes in Oceanographic Systems</p> <p>Changes in water circulation, wave heights, and current speeds, which in turn can affect sediment transport and water quality, within both nearfield and farfield environments around MRE devices</p>	<ul style="list-style-type: none"> • The scientific literature suggests that changes in oceanographic systems from properly sited tidal and wave developments will be lower than those within the natural variability within the system, allowing the risk posed to the marine environment to be retired for a small number of devices (e.g., one to six) (Garavelli et al. 2024). • No significant adverse effects are expected on avian species due to any changes in oceanographic systems that may occur due to the installation and operation of the Orbital O2-X device.
<p>Notes: EMF = electromagnetic field; f = feet; m = meters; MRE = marine renewable energy</p>	

4.3.6 Washington PHS Effects Analysis

Due to their habitat location on the seafloor, pandalid shrimp (family *Pandalidae*) and the Washington State (not federally ESA-listed) endangered pinto abalone (*Haliotis kamtschatkana*) could potentially be impacted by the new subsea cable, Orbital O2-X anchors, and mooring lines. Potential effects include the following:

- Secondary entanglement in derelict gear that may get caught in mooring lines (**Section 4.1.1.2**).
- Noise disturbance during all Project phases (**Section 4.1.4**).
- Displacement of habitat due to new subsea cable installation (**Section 4.1.5**).
- Temporary increase in turbidity due to the new subsea cable and anchors installation (**Section 4.1.6**).
- Habitat alteration due to mooring anchors, mooring lines footprints, and sweep (**Section 4.1.6**).
- EMF exposure due to new subsea cable installation (**Section 4.1.7**).

During Project activities, Townsend’s big-eared bats (*Corynorhinus townsendii*) (Washington State candidate listing species) could potentially fly over the proposed Project area to forage for prey through their use of echolocation (WDFW 2024s). The following are potential effects to this species:

- Collision with the Orbital O2-X above-water components (**Section 4.1.2.2**).



- Noise disturbance during all Project phases (**Section 4.1.4**).
- Displacement due to the Orbital O2-X footprint (**Section 4.1.5**).
- Artificial light exposure during all Project phases (**Section 4.1.8**).

No potential effects to PHS estuarine and marine wetlands along the shore of Blakely Island are expected. The new subsea cable would be threaded through the existing conduit to connect to OPALCO's power grid.

4.3.7 Invasive Species Effects Analysis

The proposed Project would not have the potential to impact the transfer of invasive species in Washington State. All vessels proposed for use in Project activities would be property of OPALCO or local subcontracting companies, so no aquatic invasive species prevention permit from WDFW would be needed since vessels would be registered in Washington State (WDFW 2024o).

All vessels used for Project activities would also follow WDFW-recommended BMPs to "Clean/Drain/Dry" all vessels and gear (e.g., paddles, waders, shoes, life vests, nets, buckets, and trailers) (WDFW 2024o). If vessel and gear operators become aware of potential exposure, they would deploy decontamination methods to remove all aquatic invasive species from their vessel(s) and gear.

The Orbital O2-X device and all Project components would be delivered in new condition and not having been used in outdoor projects prior. Therefore, they pose no risk of delivering new invasive species into Washington State.

The Project team would adhere to law (RCW 77.135.040) and would not possess, transport, or traffic prohibited invasive species or release non-native species into state waters through intentional or unintentional means (WDFW 2024o).

4.4 Air Quality

The proposed Project could impact air quality during the following activities:

- Increased vessel traffic to and from the Project area.

A single multi-cat vessel would tow the Orbital O2-X to the proposed Project area, for anchor and mooring installations, and for any surveys or geotechnical investigations, as needed. Multi-cat vessels are relatively small but powerful workboat tugs that have a large deck area, high-capacity hydraulic cranes, and large winches. These vessels typically use diesel fuel, with the exhaust consisting of a mixture of gases and particulates (i.e., carbon, ash, metallic abrasion particles, sulfates, and silicates) produced from fuel oil combustion (OSHA 2013).

It is anticipated that all marine operations would be undertaken during periods of weakest tidal stream within neap tidal cycles, targeting daylight hours and favorable weather. It is expected to amount to a period of a maximum of 10 working days per month during construction and installation, notwithstanding weather limitation.

During certain operations, particularly during moored maintenance operations where vessels may not be able to respond to an incident in a timely manner, an additional vessel such as a rigid-hulled inflatable boat (RHIB) or similar class of vessel would be employed as a safety vessel and to transfer crew. These vessels are commonly 4 to 9 m (13 to 29 ft) long and typically use diesel fuel. Infrequent maintenance of the Orbital O2-X is expected on a once per month basis during the first year and likely less frequent over time.

As a renewable energy device powered by tidal energy, the Orbital O2-X would not produce any greenhouse gas (GHG) emissions or other air pollution (Shetty and Priyam 2022).



Overall, the impacts on air quality from increased vessel presence associated with the proposed Project would be low. Vessels used for installation and operational maintenance would emit typical particulate matter and gases such as carbon dioxide, sulfur oxides, and nitrogen oxides. These emissions would have a localized effect on the atmosphere but are not considered significant in comparison to usual vessel traffic in the region. In addition, there would be no long-term impact on air quality due to the limited number of working days per month that the multi-cat vessel would operate and the infrequent expected use of a RHIB.

4.5 Terrestrial Resources

The Project would include no new terrestrial components or routes, nor would any staging or work occur on Blakely Island. The only terrestrial portion of the Project would be an existing 46 cm (18 in.) conduit on southwest Blakely Island, which would be used as an interconnection between the new turbine and OPALCO's grid. This interconnection would connect to an existing substation on Blakely Island where the energy would then be transmitted, via OPALCO's 69 kV transmission system, to the surrounding islands along existing subsea power cables. No terrestrial resources (e.g., wetlands or species) would be directly impacted by Project activities.



5. Human Environmental Analysis

5.1 Recreation, Land Use, and Ocean Use

5.1.1 Recreation

Common recreational activities in the region, like SCUBA, freediving, kayaking, boating, and camping, would not be greatly impacted by the proposed Project due to its location on the Rosario Strait where currents are strong and less desirable for recreating. While hunting is permitted on Blakely Island at times, it would not be impacted by the proposed Project. No public camping is permitted on Blakely Island, and the more popular SCUBA spots are east across Rosario Strait near Strawberry Island. While kayakers and boaters may transit the region occasionally, their routes can be easily navigated around the proposed Project area as they travel to their desired destinations.

The Project is not expected to have any significant negative effects on recreation or land use.

5.1.2 Fisheries

Recreational, Tribal, and commercial fisheries would be impacted by the temporary presence of Project installation and removal equipment, as well as the presence of Project components. The location of the Orbital O2-X device would impede fishing in Marine Area 7 of the San Juan Islands due to its location in the water. Once the Project activities are finalized in coordination with relevant agencies, the complete impact on fishing can be determined.

One or two times per year, the OPALCO team would visit the proposed Project area and drop cameras to investigate mooring lines and remove derelict gear from the mooring system, if necessary.

Recreational shellfish harvest would also be limited in the proposed Project area. While the beaches on the east side of Blakely Island where shellfish harvest is permitted would be unaffected, off-beach areas where crabbing and shrimping areas could be impacted. Once the Project location is finalized in coordination with relevant agencies, the impacts on recreational shellfish harvest can be determined.

Six types of commercial fisheries in the San Juan Islands could be affected by the proposed Project: Dungeness crab, Puget Sound salmon, Puget Sound smelt, sea urchin, sea cucumber, scallop, and squid fisheries. Due to the small size of the area relative to Marine Area 7 and its strong currents, it is not expected that the ability of commercial fishing vessels to pass through the area would be significantly impacted, nor would it greatly impact their harvest quantities.

5.1.3 Vessel Traffic

The proposed Project area is outside of vessel traffic and shipping lanes. Shipping lanes are to the east of the proposed Project area, and scheduled WSDOT WSF pass to the south. In rough weather, WSDOT WSF may use an alternate route that passes through Rosario Strait; however, the ferries remain in the vessel traffic lanes east of the proposed Project area.

Due to its proximity to the shoreline, the proposed Project would not change or impact vessel transit lanes. The only impact of vessels on the proposed Project would be their wake.

5.1.4 Marine Protected Areas

Since the San Juan County/Cypress Island Marine Biological Preserve (SCBP) shares a border with San Juan County, the entire proposed Project area on the east side of Blakely Island is within the SCBP Marine Protected Area (MPA).

The SCBP protects ecological and cultural resources, and could be affected by the following Project activities: an increase in turbidity during installation of the four anchors, the new subsea cable, and mooring line and umbilical sweep (**Section 4.1.6**); an increase in artificial light due to navigation lights on the Orbital O2-X or associated vessels (**Section 4.1.8**); and acoustic disturbance due to

increased vessel traffic to the area and the turbine operations (**Section 4.1.4**). Additionally, local species may be displaced from habitat due to the presence of the turbine (**Section 4.1.5**). No change is expected in oceanography, such as currents and sediment distribution, due to the small scale of the proposed Project (**Section 4.1.9**).

Due to the effects of these Project activities, the proposed Project could impact the species, habitats, and natural resources in the SCBP. Collaboration with local agencies and the University of Washington Friday Harbor Laboratories would occur to ensure that BMPs to reduce negative effects would be adhered to for the duration of the proposed Project.

See **Section 5.2** for more information on potential Project effects on the cultural resources of the SCBP.

5.2 Aesthetic Resources

5.2.1 Visual Aesthetic

The proposed Project would impact the aesthetic environment due to the:

- Footprint of the Orbital O2-X.
- Increase in vessel traffic to and from the Project area.

The Orbital O2-X would sit at the surface of the water, so there are potential impacts on the aesthetic viewshed. The body portion of the Orbital O2-X would remain 1.5 m (5 ft) above the waterline during operations and 2.3 m (7.5 ft) below the waterline, leaving the main component visible to those passing by (**Figure 79**). The legs of the Orbital O2-X would sit below the water surface up to 27.4 m (90 ft) maximum depth when the Project is operational and would only be visible from the surface when the legs are raised for maintenance. The subsea components, including the four mooring lines, four anchors, and the new subsea cable, would be out of sight.



Figure 79. Orbital O2 with Wings Up during Orkney Islands, Scotland Deployment

The closest road to the Project area on Blakely Island is an unnamed road that runs east from Spencer Road, although it does not reach the edge of the island, so it is unlikely that the Orbital O2-X would be frequently viewed by island residents. No roads on Blakely Island are expected to offer views of the deployed Project. Surrounding vegetation would not be affected during site preparation and installation activities.



Depending on the weather, WSF passengers may be able to see the body of the Orbital O2-X from the ferry vessel, and its amber flashing safety lights, as it passes to the south of Blakely Island throughout the day. Other visible components of the Project (e.g., OPALCO conduit) have previously been installed and would not be modified as part of the proposed Project.

The proposed installation of the Orbital O2-X to this area would slightly increase the presence of vessel traffic during the installation, monitoring, maintenance, and removal of the turbine, although it would not be frequent. After the installation and commissioning period, a singular vessel would visit the Project area one or two times per year for maintenance, inspections, and monitoring (**Table 8**). One multi-cat vessel and one barge would be present during the installation and removal periods. The Orbital O2-X would be installed using a barge, and subsequent routine visits would occur via a 25 m (82 ft) vessel.

5.2.2 Acoustic Aesthetic

The addition of the Orbital O2-X to the proposed Project area could add new noise to the acoustic environment such as humming from generators and from the spinning turbines. The dB and frequency of the noise coming from the turbine has yet to be quantified, but research from prior turbine deployments estimates the noise levels to be between 50 Hz and 100 Hz, or 30–40 dB at 100 m (328 ft) away (Risch et al. 2020, 2023). Since humans would remain generally far from the proposed Project area, they would less likely be impacted by the change in acoustic aesthetic.

For information about acoustic impacts on the natural environment, see **Section 4.1.4**.

5.2.3 Light Aesthetic

The installation of the Orbital O2-X would increase the amount of artificial light in the area due to the 24-hour safety lighting that would make the proposed Project area visible to oncoming marine vessels or for repairs. The Orbital O2-X would have two amber lights with synchronized flashing once every 3 s, mounted a minimum of 3 m (9.8 ft) above the waterline. The amber lights would have a nominal visible range of 3 NM. These lights, although visible at a distance, would have a minimal impact on the overall light emitted from the area since the Orbital O2-X turbine and proposed Project area are relatively small compared to the size of Rosario Strait and the greater San Juan Islands.

Additionally, vessel traffic during the installation, monitoring, maintenance, and removal of the Orbital O2-X may have lights. This addition of extra light would be temporary, especially as most installation procedures would take place during daylight hours. It is expected that there would be 1-2 vessel visits per year to the proposed Project area for routine maintenance (**Table 8**).

There are currently two additional marine lights near the proposed Project area. One is a warning float located 280 m (918.6 ft) southeast of the proposed Orbital O2-X location and flashes a green light every 2.5 s and is bright enough to be seen from 4 NM (NOAA 2024c). The other light is farther south, about 2,500 m (8,200 ft) away, and flashes a green light every 4 s, and can also be seen 4 NM away (NOAA 2024c). These lights mark a shallow water area and a group of small islands to warn vessel operators.



5.3 Tribal and Cultural Resources

5.3.1 Tribal Resources

The analysis of effects on Tribal resources, including Tribal treaty fishing rights, differs compared to the impact analysis for other natural and cultural resources. Natural resources are analyzed elsewhere in Volume 2 and associated reports to determine if the project would have significant adverse effects from a non-Tribal perspective, and whether or not those could be mitigated. Initial feedback received from many of the Tribal Nations demonstrate that natural and cultural resources are highly interconnected. The Tribal Nations would have an opportunity to comment and provide feedback on the monitoring plans proposed elsewhere in this application as part of avoidance, minimization, and mitigation for potential impacts to natural resources.

OPALCO would continue to collaborate with the Tribal Nations to better understand the potential effects, and seek avoidance, minimization, or mitigation (where/if possible). It is important to engage with Tribal Nations to understand these important areas, how they are used, and how the installation, operations, maintenance, and decommissioning activities of a project could affect the rights that are guaranteed under treaties and federal laws, as well as the requirements set forth by other federal laws and guidelines for identifying and assessing effects on Tribal resources and cultural resources.

Effects are possible if Tribal resources are permanently removed or altered, or if access to resources is temporarily or permanently limited during construction, operation, or maintenance. Potential sources of effects include installation, contamination, ground-disturbing effects; changes in setting; temporary and/or permanent exposure to noise or vibration, and general lack of access to U&A treaty areas for hunting, fishing, and/or gathering.

The analysis of effects on Tribal resources considered the following:

- Construction and operation impacts on plant and animal species used by Tribal members.
- Loss of, or modifications to, habitats of species used by Tribal members.
- Indirect effects on species and habitats used by Tribal members, including fragmentation of habitats and impediments to migration.
- Loss of access to a traditional hunting, fishing, or gathering area, or to an area where other traditional practices occur.
- Loss of revenue to Tribal members as a result of the project.
- Interruption of spiritual practices.
- Loss of medicinal and traditional plants and foods.

The presence of the O2-X device and moorings would reduce some of the area available for Tribal fishing. Entanglement of fishing gear could occur, especially trolling (i.e., salmon) and trapping (i.e., crab) fisheries. As previously discussed, Project anchors would likely act as artificial reefs and could attract rockfish and other groundfish (e.g., lingcod) to bottom structures, and potentially increase Tribal fishing opportunities for these species.

The potential effects of proposed Project installation, operations, and de-commissioning activities on Tribal resources are uncertain. Impacts from vessel activity, installation, and removal of the Orbital O2-X and supporting infrastructure (e.g., rock-drilled anchoring), could have an effect on Tribal fishing rights. Prior to Project deployment, government consultations between Tribal Nations and government agencies would occur regarding the size and extent of the boundaries of the Project area and any limitations (e.g., seasonal) to access or activities within it.



Project construction could result in short-term, temporary displacement of Tribal fishing vessels, for example, while the vessel or barge is laying the subsea transmission cable, when the anchors are being installed, and when the Orbital O2-X device is being deployed. Once the subsea cable is laid and the device installed, most of the proposed Project area would be accessible.

The Project could affect Tribal treaty rights. As previously discussed, Tribal treaty fishing rights include access to traditional areas and times for gathering resources associated with a Tribe's sovereignty since time immemorial. OPALCO is continuing Tribal engagement throughout the duration of the development of the DLA and Final License Application. Ultimately, government-to-government consultation with the Tribal Nations would occur between FERC and the Tribal Nations. Determinations of significant effects, and effects on Tribal treaty rights and Tribal Resources would be coordinated through government-to-government consultation between FERC and the Tribal Nations.

It is possible that effects from vessel presence and installation and removal of the Orbital O2-X and supporting devices (e.g., rock-drilled anchoring) could be mitigated using standard operating procedures (SOPs) and in consultation with the Tribal Nations. Access to most of the area would be maintained during installation, with limitations only in place adjacent to the active construction area. OPALCO would minimize potential effects by coordinating directly with Tribal Nations and Tribal co-managers to limit installation, maintenance, and de-commissioning activities during periods of active Tribal treaty fishing.

5.3.2 Cultural Resources

The effects on cultural resources was defined based on the criteria used to assess adverse effects for cultural resources listed or eligible for listing in the NRHP. Based on the existing information available, the Project would not affect any cultural resources because none have been identified. The Project is not expected to cause temporary (construction) or long-term (operational) effects on cultural resources or indirect effects on cultural resources because no cultural resources have been identified. If historic properties (i.e., cultural resources determined eligible for listing in the NRHP) are identified during future phases of the Project, OPALCO would avoid and minimize effects by avoiding all uplands work and focusing nearshore activities within existing facilities and previously disturbed areas to the extent possible.

While no effects on cultural resources requiring mitigation have been identified, there is the potential that yet-unknown resources may be encountered during Project construction. To account for this possibility, the Project would have a cultural resources Inadvertent Discovery Plan in place during installation. The plan would be developed between the consulting parties as part of compliance with Section 106 of the NHPA and would have procedures to follow in the event that potential cultural resources are identified during construction activities. Tribal Nations would continue to be consulted during the Section 106 compliance process, for which FERC is functioning as Lead Agency.



6. Developmental Economic Analysis

The proposed Project will install an Orbital O2-X device with two turbines, an anchoring system, and a new subsea cable to the east of Blakely Island in Washington State. Calculations of costs related to Project installation, operations, maintenance, and removal are preliminary and subject to change. Current estimated costs and energy generation are outlined in **Table 27**.

Table 27. Economic Analysis per 18 CFR 5.18(b)(5)(E)

Summary of Economic Analysis Statistics	
Construction Costs	\$38 million
Annual Operation Costs (O&M plus Insurance)	\$611,000
Average Annual Energy Generation	4,265,991 kWh
Anticipated Price per kWh	\$0.093 per kWh
Annual Revenue	\$396,737
PME Measures (Appendices B1 & B3)	\$650,000 to \$950,000
Notes: kWh = kilowatt hour; PME = protection, mitigation, and enhancement	



7. Cumulative Impacts

This section: (1) defines cumulative impacts; (2) describes past, present, and reasonably foreseeable future actions relevant to cumulative impacts; (3) analyzes the incremental interaction the proposed Project may have with other projects; and (4) evaluates cumulative impacts potentially resulting from these interactions.

7.1 Definition

The Council on Environmental Quality (CEQ) regulations implementing the procedural provisions of NEPA define cumulative impacts as: “...the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time” (40 CFR 1508.7). At the time of writing this document, CEQ has proposed to withdraw this regulatory definition of “cumulative impact” as part of a rescission of certain NEPA regulations (see 90 Fed. Reg. 10610 [Feb. 25, 2025]).

Each resource, ecosystem, and human community may be analyzed in terms of its ability to accommodate additional effects, based on its own time and space parameters. Therefore, cumulative effects analysis normally would encompass a Region of Influence (ROI) or geographic boundaries beyond the immediate area of the proposed Project, and a time frame including past projects and foreseeable future projects, to capture these additional effects.

For the proposed Project activities to have a cumulatively significant impact on an environmental resource, two conditions may be considered. First, the combined effects of all identified past, present, and reasonably foreseeable projects, activities, and processes on a resource—including the effects of the proposed Project—must be significant. Second, the proposed Project must make a substantial contribution to that significant cumulative impact. To analyze cumulative effects, a cumulative effects region must be identified where the effects of the proposed Project and other past, present, and reasonably foreseeable actions would occur.

The cumulative impacts analysis for the proposed Project activities considers known past, present, and reasonably foreseeable future actions located within an 8 km (5 mile) ROI, that is, sufficiently close to have interacting impacts. Direct and indirect impacts, as well as unavoidable and irreversible impacts, are considered in this analysis. The level of detail required for the cumulative effects analysis presented in this DLA Volume 2 is appropriate and consistent with the scope and magnitude of the proposed Project due to its limited extent.

This analysis also lists the past, present, and reasonably foreseeable future projects within the ROI that have had, continue to have, or are expected to have some impact on the natural and human environment. Past projects in this analysis are limited to those implemented in the last 5 years or those with ongoing contributions to environmental effects, and future projects considered include those occurring up to 30 years into the future.

All past, present, and reasonably foreseeable future Projects within 8 km (5 miles) of the proposed Project area are included in **Table 28**.



Table 28. Past, Present, and Reasonably Foreseeable Future Projects within 8 km (5 miles) of the Proposed Project

Organization	Project	Project Description	Project Timeframe		
			Past	Present	Future
DNR	Dredged Material Management Program (DMMP)	Rosario Strait is an “aquatic lands disposal site on state-owned aquatic lands [that is used to deposit] materials dredged from rivers, harbors, and shipping lanes.” This site received regularly scheduled environmental monitoring events to verify that the program is protecting the environment against unacceptable adverse impacts (DNR 2009).	X	X	X
OPALCO	Submarine Power & Fiber-Optic Cable	OPALCO has existing fiber-optic and power cables deployed to bring power and internet capabilities to the San Juan Islands (see Figure 80).	X	X	X
OPALCO	Submarine Power & Fiber Optic Cable	Within OPALCO’s 20-year workplan they will be seeking to install a redundant 69 kV submarine transmission cable in an existing route connecting the San Juan Islands to the mainland for power and fiber to meet current and future system capacity needs. The scope of the project would be to install a new dielectric armored cable from Anacortes to Decatur to Lopez.			X
Samish Indian Nation	Bull Kelp Restoration Project	The Samish Indian Nation has been collecting bull kelp data in the San Juan Islands and is using the information to determine where to begin restoration efforts (Mesa 2024).			X
Whidbey Telecom	Point Roberts Middle Mile Infrastructure Project (PRMMI)	Whidbey Telecom’s project goal is to improve internet infrastructure between South Whidbey Island and Point Roberts, Washington, as well as underserved areas in between. This includes an estimated 77 km (48 miles) of terrestrial cable installation and 101 km (63 miles) of subsea cable installation (Whidbey Telecom 2024).			X
WSDOT	New Hybrid-Electric Ferries	State Ferries has started to outsource the building of its first five hybrid-electric vessels. The first two ferries are expected to launch by 2028, with the additional three by 2030 (WSDOT 2025a).			X



Organization	Project	Project Description	Project Timeframe		
			Past	Present	Future
<p>Notes: DMMP = Dredged Material Management Program; DNR = Washington State Department of Natural Resources; km = kilometers; kV = kilovolt; OPALCO = Orcas Power and Light Cooperative; WSDOT = Washington State Department of Transportation</p>					

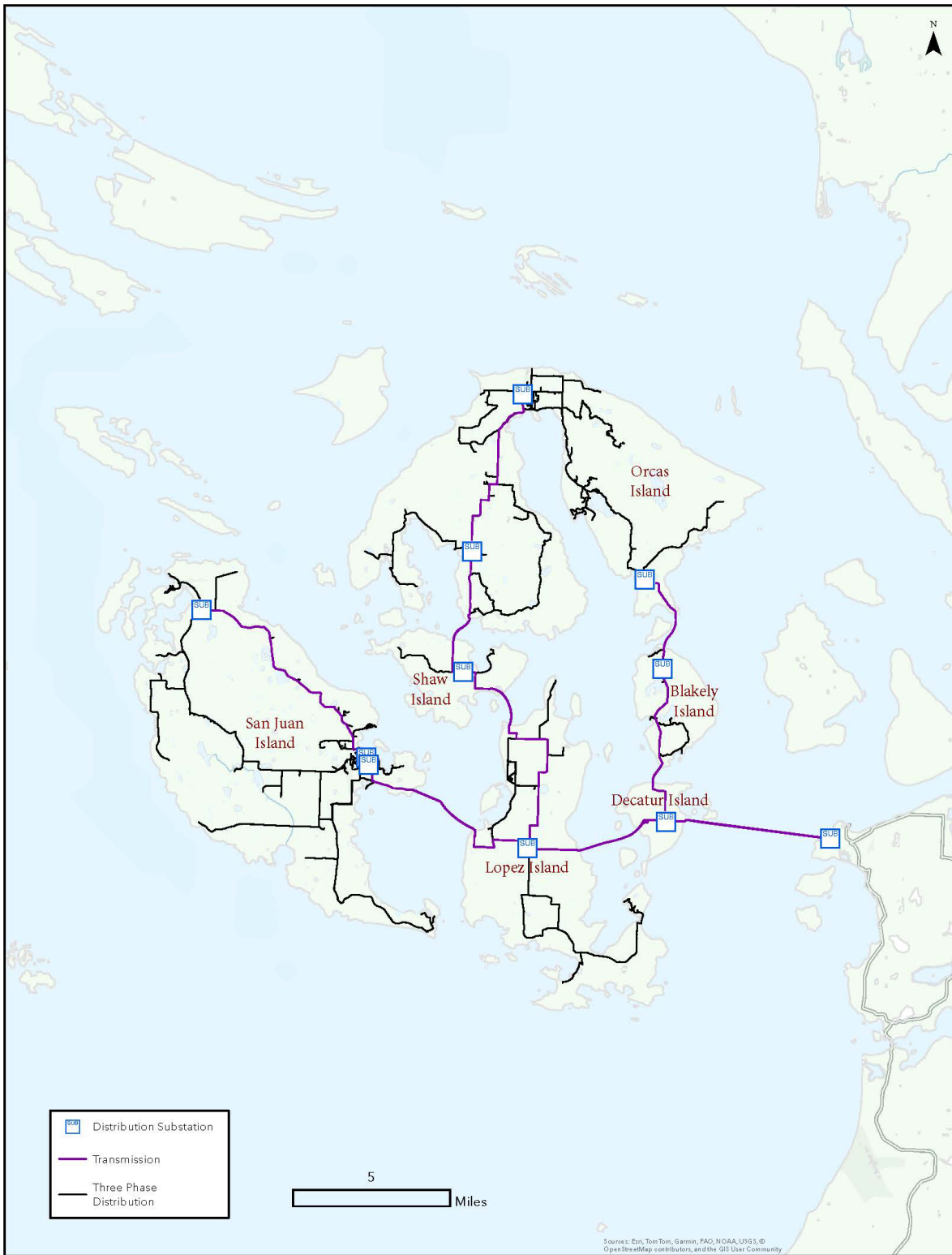


Figure 80. OPALCO Service Area



7.2 Assessment of Cumulative Impacts by Resource

OPALCO evaluated whether the following aspects could experience cumulative impacts because of the proposed Project and other projects in the ROI:

- Geology and Soils
- Water Resources
- Species and Habitats
- Air Quality
- Marine Protected Areas
- Terrestrial Resources
- Marine Activities
- Tribal and Cultural Resources
- Aesthetic Environment
- Economic Impact

7.2.1 Geology and Soils

7.2.1.1 Past and Present Project Impacts

Past and present projects have had temporary but minor impacts on geology and soils. The past OPALCO Submarine Power and Fiber Optic Cable project involved cable laying operations on the seafloor, with cable burial where feasible, which likely caused temporary sediment plumes. The suspension of sediment from this project was minor, temporary, and localized due to the small width of the subsea fiber cables and the relatively fast installation speed.

An increased sediment load was created when each Dredged Material Management Program (DMMP) approved Site Use Application for dredged material deposition in Rosario Strait was deployed (DNR 2009). The currents in Rosario Strait are strong; therefore, the dredged sediment disposed of in this area was likely redistributed by currents more quickly than at locations with weaker tidal currents and more environmentally stable habitats (Yang et al. 2021; Bolam and Rees 2003). This site receives regularly scheduled environmental monitoring to verify that the DMMP is protecting the environment from unacceptable adverse impacts (DNR 2009).

7.2.1.2 Proposed Project Impacts

The proposed Project has the potential to impact geology and soils during all activities. The installation of the new subsea cable and anchors, whether gravity anchors or rock bolt anchors are used, would create temporary sediment plumes. If rock bolt anchors are used, the drilling process would involve altering a portion of the seafloor to install the anchors, each of which is 60 cm (23.6 in.) in diameter. This installation would remove 11,309 cm² (1,753 in.²) of surface area from the seafloor and replace it with the anchors. The anchors may remain in place at the end of the Project to reduce the likelihood of additional seafloor or habitat disturbance, to be determined in consultation with Tribes and regulatory agencies.

During Project operations, each of the four mooring lines would create sweep areas, covering an area of 10 m² (108 ft²) per mooring line, or 40 m² (430 ft²) in total. The subsea umbilical would also create a sweep area of 314 m² (3,380 ft²). Additionally, an area of less than 246 m² (2,648 ft²) per mooring line, or 984 m² (10,592 ft²) total for all four, would be disturbed as mooring lines are raised and lowered onto the seafloor with the changing tide. These sweep and disturbance areas would impact sediment by creating small, localized sediment plumes that are expected to be short term and settle back to the seafloor within minutes. Localized scouring could occur, and mitigation would be installed around anchors as a preventative measure. Scouring that does occur is expected to be small and negligible and, therefore, would have a minimal negative impact on geology and soils.



7.2.1.3 *Future Project Impacts*

The OPALCO Submarine Power and Fiber Optic Cable project and the Whidbey Telecom Point Roberts Middle Mile Infrastructure project (PRMMI) would cause temporary, small-scale sediment plumes during cable laying operations that would quickly dissipate. The Samish Indian Nation Bull Kelp Restoration may also create small-scale sediment plumes, depending on kelp restoration methods, survey equipment, or planting methods deployed on the seafloor. As stated previously, the use of the DMMP disposal site in Rosario Strait would continue to cause changes in sediment composition at the disposal site, but sediment would be redistributed quickly due to strong local currents. The WSDOT New Hybrid-Electric Ferries Project would not impact geology and soils in the ROI.

7.2.1.4 *Summary*

In combination with other projects, the proposed Project would contribute to a cumulative impact of sediment plume creation within the ROI, although due to strong currents in Rosario Strait and the thin preexisting layer of sediment on the seafloor, these increases are expected to quickly become redeposited and indiscernible from adjacent seafloor sediment levels.

7.2.2 **Water Resources**

7.2.2.1 *Past and Present Project Impacts*

Past and present projects in the ROI, including the DNR DMMP and the OPALCO Submarine Power and Fiber Optic Cable project, have had no impact on water resources.

7.2.2.2 *Proposed Project Impacts*

The scientific community has reached consensus that the risk of potential oceanographic system changes due to small-scale marine energy projects (i.e., four or less devices with less than 10 MW total energy generation capacity) can be discounted (Hemery 2020; OESE 2022). The proposed Project would have no impact on water resources.

7.2.2.3 *Future Project Impacts*

The DMMP, OPALCO Submarine Power and Fiber Optic Cable project, the Whidbey Telecom PRMMI project, and the WSDOT New Hybrid-Electric Ferries project are expected to have no impacts on water resources.

Future proposed projects in the ROI are expected to have no negative or positive impacts on water resources.

The Samish Indian Nation Bull Kelp project could have positive effects on water resources. Oceanographic systems and processes are affected inside of kelp forests; current speeds are slower and can provide better refuge for fish, invertebrates, and marine mammals, and bull kelp can provide sun protection and lower temperatures for species in rocky areas where other aquatic plants struggle to survive (NOAA 2024b). Bull kelp forests are considered a foundational species and a HAPC on the west coast due to their positive role in marine ecosystems (NOAA 2024b).

7.2.2.4 *Summary*

Projects in the ROI are expected to have a neutral or positive cumulative impact on water resources. The majority of the projects in the ROI, including the proposed Project, have no impact on water resources, but the successful restoration of kelp beds would contribute to a positive cumulative effect on water resources in the ROI.

7.2.3 **Species and Habitats**

7.2.3.1 *Past and Present Project Impacts*



All past and present projects have had impacts on protected species and habitat. The OPALCO Submarine Power and Fiber Optic Cable project impacted species and habitats due to vessel noise during project activities, displacement of benthic communities due to the cable footprint on the seafloor, and habitat alteration due to temporary turbidity during installation and the cable footprint. Long-term impacts of cable projects are considered modest to species and habitats since the most significant impacts occur during installation due to increased vessel traffic and seafloor disturbance when the cable is laid (NOAA 2024d).

The DMMP disposal site impacted species and habitats due to turbidity generated during dredged material deposition, and the disruption of the natural quantity of sediment distribution. However, researchers have concluded that in areas such as Rosario Strait where there are strong currents, recovery rates of benthic communities are relatively rapid (several months) after dredged material disposal (Bolam and Rees 2003). DNR continues to ensure that this site receives regularly scheduled environmental monitoring events to verify that the program is protecting the environment against unacceptable adverse impacts (DNR 2009).

7.2.3.2 *Proposed Project Impacts*

The potential effects to protected species and habitats due to the proposed Project include the following (for more details, see **Section 4.1**): entanglement, collision, entrainment, noise disturbance, displacement, habitat alteration, EMF exposure, artificial light, and changes in oceanographic systems. Of these potential effects, the following are expected to occur to varying degrees, while the remainder, if they were to occur, would be isolated incidents: noise disturbance (due to vessel presence and the Orbital O2-X powertrain system), displacement (due to Project construction activities, vessel noise, and the area that the Project components occupy), habitat alteration (due to the installation, operations, and decommissioning of Orbital O2-X components), EMF exposure (due to the new subsea cable presence), and an increase in artificial light (due to the installation of amber lights on the device).

Before Project deployment, the proposed Project team would meet with Tribal, local, state, and federal agencies and regulators to ensure that Project components and activity methodologies are approved and in line with species and habitat protection regulations and initiatives in the proposed Project area, and that all relevant BMPs are implemented throughout the Project to minimize impacts on protected species and habitats. The proposed Project would also require review under NEPA to ensure that all potential impacts on species and habitats are considered before deployment.

7.2.3.3 *Future Project Impacts*

The impacts on protected species and habitats in the future due to the DNR DMMP and the OPALCO Submarine Power and Fiber Optic Cable project are the same as those listed in **Section 7.2.3.1** (*Past and Present Project Impacts*).

The Samish Indian Nation Bull Kelp project could include positive effects to protected species and habitats due to the increase in biodiversity and habitat that is associated with the restoration of bull kelp forests.

The potential impacts on protected species and habitats due to the Whidbey Telecom PRMMI Project are similar to those of the OPALCO Submarine Power and Fiber Optic Cable project and would likely include noise disturbance from vessel presence during project activities, displacement of benthic communities or habitats due to the cable in or on the seafloor, and habitat alteration due to temporary turbidity during installation and due to the addition of a cable on the seafloor.

The WSDOT New Hybrid-Electric Ferries project would likely only add new positive impacts on protected species and habitats since, when the new ferries are launched, they will continue to operate as usual along pre-established ferry routes but with a reduction in noise.



7.2.3.4 Summary

Most projects within the ROI have short-term impacts on protected species and habitats due to project activities. These impacts, such as displacement, habitat alteration, or noise disturbance, mostly cease at the conclusion of the installation of cable projects, or in the case of dredged material deposition, a few months after project activities occur.

The long-term cumulative impacts of projects, including those of the proposed Project, include habitat displacement due to the presence of project components. Positive effects to protected species and habitats could occur due to the Samish Indian Nation Bull Kelp project and WSDOT New Hybrid-Electric Ferries project.

7.2.4 Air Quality

7.2.4.1 Past and Present Project Impacts

The DNR DMMP and the OPALCO Submarine Power and Fiber Optic Cable project created small impacts on air quality due to the increased vessel presence in the ROI. Overall, due to the low Air Quality Index (AQI) rating of less than 50 within the ROI, these impacts were low.

7.2.4.2 Proposed Project Impacts

The proposed Project would likely create a small impact on air quality in the ROI due to increased vessel traffic during the installation, maintenance, and removal activities. The frequency of visits to the proposed Project area is expected to be as often as once a month during the first year and likely less frequent during subsequent years of operation.

7.2.4.3 Future Project Impacts

The impact on air quality due to future projects would result from increased vessel traffic from the DNR DMMP, the OPALCO Submarine Power and Fiber Optic Cable project, the Samish Indian Nation Kelp Restoration project, and the Whidbey Telecom PRMMI project. These impacts are expected to be low since they are all temporary and infrequent. Positive effects are expected from the WSDOT Hybrid-Electric Ferries project, which has a goal of acquiring a completely emission-free ferry fleet by 2050 (WSDOT 2025a), although it is currently unknown precisely what stage of progress these goals would be at by the end of the next 10 years. Ferries are currently one of the most frequent and largest vessels that consistently pass through the ROI, with ferries departing from Anacortes to the San Juan Islands at least 16 times daily (WSDOT 2025b).

7.2.4.4 Summary

Most projects in the ROI are expected to have a small cumulative impact on air quality due to temporary increases in vessel traffic during project activities. In the long term, the cumulative impact of projects on air quality in the ROI could become neutral or positive due to the emissions that are expected to be removed due to the WSDOT Hybrid-Electric Ferries project.

7.2.5 Marine Protected Areas

All projects in the ROI have the potential to impact three Marine Protected Areas: (1) the San Juan County/Cypress Marine Biological Preserve (SCBP), which shares a border with San Juan County; (2) the Cypress Island Aquatic Reserve around Cypress Island; and (3) the San Juan Islands NWR.

7.2.5.1 Past and Present Project Impacts

Due to all projects taking place inside at least the SCBP, they have impacted the SCBP. The OPALCO Submarine Power and Fiber Optic Cable project impacted marine protected areas due to temporary increases in noise due to vessel operations, the displacement of habitat due to the small area which the fiber optic cable occupied on the seafloor, and small temporary turbidity plumes due to the cable being installed on the seafloor.



When the DNR DMMP approves a Site Use Application, the sediment deposited in Rosario Strait likely caused distress to benthic communities. However, due to the strong currents of Rosario Strait, recovery rates of benthic communities are likely relatively rapid (several months) after dredged material disposal (Bolam and Rees 2003).

7.2.5.2 Proposed Project Impacts

The proposed Project would impact the SCBP due to small temporary turbidity plumes during the installation of the new subsea cable and during operations due to mooring line and umbilical sweep. There would also be turbidity during the installation of anchors, an increase in artificial light during Project operation to mark the Orbital O2-X Project area, increased acoustic disturbance due to noise from vessels in the proposed Project area and the Orbital O2-X's powertrain system, the displacement of species and habitats due to the presence Project components, and potential EMF exposure within a close range of the new subsea power cable.

7.2.5.3 Future Project Impacts

The Whidbey Telecom PRMMI project and the OPALCO Submarine Power and Fiber Optic Cable project would have the same potential impacts as the OPALCO Submarine Power and Fiber Optic Cable project did in **Section 7.2.5.1 (Past and Present)**. The Samish Indian Nation Bull Kelp Project would continue to have potentially positive effects on bull kelp forests and species biodiversity, and the temporary impacts of the DNR DMMP would remain the same. The addition of the WSDOT New Hybrid-Electric Ferries project, depending on the timing of deploying new ferries to the San Juan Islands, could decrease the noise from ferry vessels that transverse the ROI.

7.2.5.4 Summary

While the impacts from the DNR DMMP would remain the same, and the Samish Indian Nation Bull Kelp project would continue to potentially improve biodiversity, the cumulative impacts of additional cable projects and the proposed Project would increase habitat displacement within the marine protected areas in the ROI, with the greatest impact coming from the proposed Project's anchor footprints, mooring line sweep, and umbilical sweep.

The total area of displaced habitat includes 10 m² (108 ft²) per mooring line or 40 m² (430 ft²) in total, 314 m² (3,380 ft²) for the umbilical, and less than 246 m² (2,648 ft²) per mooring line (or 984 m² [10,592 ft²] total) by mooring lines being raised and lowered onto the seafloor during tidal current changes.

7.2.6 Terrestrial Resources

7.2.6.1 Past and Present Project Impacts

The only past and present project in the ROI that has impacted terrestrial resources is the OPALCO Submarine Power and Fiber Optic Cable project. Infrastructure such as beach manholes, powerlines, cables, and cable conduits were installed in the terrestrial environment. These additions could have had short-term negative impacts on natural resources due to noise disturbance, displacement, and habitat alternation during construction activities, but these impacts usually cease once the cable is installed and land is restored. Long-term impacts could include maintenance activities or continual habitat displacement due to clearings for transmission line corridors that are installed in remote or forested areas.

7.2.6.2 Proposed Project Impacts

The proposed Project would not impact terrestrial resources. The Project would use an existing cable conduit on the south shore of Blakely Island to connect to OPALCO's grid, so no construction within the terrestrial environment would occur.



7.2.6.3 *Future Projects Impacts*

The OPALCO Submarine Power and Fiber Optic Cable project and Whidbey Telecom PRMMI project could include terrestrial infrastructure such as beach manholes, powerlines, cables, and cable conduits. These activities would temporarily increase noise and cause displacement and habitat alteration, but impacts are expected to be low due to the relatively small area that cables and associated infrastructure occupy.

The WSDOT New Hybrid-Electric Ferries project would not impact terrestrial resources within the ROI.

7.2.6.4 *Summary*

While cumulative impacts of habitat alteration and displacement would continue in the ROI due to cable installation projects by OPALCO and Whidbey Telecom, the cumulative impacts of projects in the ROI on terrestrial resources are expected to be small due to the small size and relatively fast installation of project components.

7.2.7 **Recreation, Land Use, and Ocean Use**

7.2.7.1 *Past and Present Project Impacts*

The project activities associated with the DNR DMMP and the OPALCO Submarine Power and Fiber Optic Cable project have had a minimal impact on marine activities in the ROI. Dredged material deposition operations and cable laying operations created a temporary increase in turbidity that displaced marine species from the deposition site, but once project activities ended, marine species returned to the area.

All past and present projects have temporarily increased vessel traffic in their project areas, and therefore limited recreation and vessel access to project locations temporarily during project activities. The impacts of increased vessel traffic were short term.

7.2.7.2 *Impacts of the Proposed Project*

Recreation and fishing activities may be temporarily affected by the presence of Project installation and removal equipment, vessels, and Project components. The placement of the Orbital O2-X device would displace fishing in a small section of Marine Area 7 in the San Juan Islands due to its location in the water. A more precise assessment of the Project's impact on fishing will be determined through consultation with Tribal Nations and relevant agencies. The proposed Project area is located outside vessel traffic lanes, shipping areas, and WSDOT ferry routes, and vessels will be able to pass over the new subsea cable without disruption.

7.2.7.3 *Future Project Impacts*

Future activities in the ROI such as the DNR DMMP, the OPALCO Submarine Power and Fiber Optic Cable project, and the Whidbey Telecom PRMMI project would temporarily limit marine activities such as fishing or vessel traffic from their project areas and could temporarily displace marine species due to small, short-term increases in turbidity and noise during project activities. All impacts on marine activities would be temporary, and marine activities would return to normal following project installation.

The WSDOT New Hybrid-Electric Ferries project proposes no changes to usual WSDOT ferry routes in the San Juan Island region, so there it would not impact marine activities.

The Samish Indian Nation Bull Kelp restoration project could increase exclusionary areas due to restoration efforts, which would be off-limits for fishermen or recreational vessel to access. The long-term effects of bull kelp forest restoration could benefit marine species populations and benefit fisheries in the future.

7.2.7.4 *Summary*



The cumulative impact on marine activities of the projects in the ROI includes limits to project areas due to the temporary presence of vessels, project installation and removal equipment, and proposed Project components. Once the Project activities are finalized in coordination with regulatory agencies and Tribal Nations, the complete impact on fisheries can be determined.

Bull kelp restoration areas would likely be small, temporary, and if successful support marine species population growth and stability into the future, thus supporting and improving local fisheries activities.

7.2.8 Tribal and Cultural Resources

7.2.8.1 Past and Present Project Impacts

The project activities associated with the DNR DMMP and the OPALCO Submarine Power and Fiber Optic Cable project likely had a minimal impact on Tribal resources, specifically Tribal fishing and Tribal treaty fishing rights, in the ROI. Dredge material deposition operations and cable laying operations created a temporary increase in turbidity that displaced marine species from the deposition site, but once project activities ended, marine species returned to the area and the area was again accessible.

All past and present projects temporarily increased vessel traffic in their proposed Project areas and therefore limited Tribal treaty fishing access to project locations during project activities. The impacts of increased vessel traffic were short-term.

There are no known cultural resources so therefore, a cumulative effects discussion is not included.

7.2.8.2 Proposed Project Impacts

The proposed Project would impact Tribal treaty fishing rights and fishing activities, as they would have limited access to the proposed Project area due increased vessel presence during the installation and removal activities, and due to the presence of the Orbital O2-X and its anchoring components during operations. The proposed Project area is outside of vessel traffic lanes, shipping areas, and WSDOT ferry routes.

The proposed Project would not impact cultural resources. The Project would use an existing cable conduit on the south shore of Blakely Island to connect to OPALCO's grid, so no terrestrial construction would occur and there are no known cultural resources, including submerged cultural resources present.

7.2.8.3 Future Project Impacts

Future activities in the ROI such as the DNR DMMP, OPALCO Submarine Power and Fiber Optic Cable project, and the Whidbey Telecom PRMMI project would temporarily limit Tribal fishing activities such as fishing or vessel traffic from their proposed Project areas and could temporarily displace marine species due to small short-term increases in turbidity and noise during project activities. This would likely impact Tribal treaty fishing rights. These impacts to Tribal resources would be temporary, and access would return to normal following project installation. There are no known cultural resources so therefore, a cumulative effects discussion is not included.

The WSDOT New Hybrid Electric Ferries project currently proposes no changes to usual WSDOT ferry routes in the San Juan Island region, so there it would not impact Tribal or cultural resources, including Tribal treaty fishing rights. The addition of the WSDOT New Hybrid-Electric Ferries project, depending on the timing of deploying new ferries to the San Juan Islands, could create a decrease in noise from ferry vessels that transverse the ROI and provide benefits to habitat and species; therefore, indirectly benefiting Tribal fishing.



The Samish Indian Nation Bull Kelp restoration project could temporarily limit access due to restoration efforts, which would restrict fisherpeople or vessel access. The long-term benefits of bull kelp forest restoration could benefit marine species populations and benefit fisheries in the future.

7.2.8.4 Summary

The cumulative impact to Tribal Resources of the projects in the ROI, specifically Tribal treaty fishing rights, includes an increase in areas that may have temporary limited access due to the Orbital O2-X Project activities, temporary limitations to access during implementation of the bull kelp restoration projects, and temporary increases in vessel traffic due to project activities. Bull kelp restoration exclusion areas would likely be small, temporary, and if successful support marine species population growth and stability into the future, thus supporting and improving local fisheries activities.

7.2.9 Aesthetic Environment

7.2.9.1 Past and Present Project Impacts

The DNR DMMP and OPALCO Submarine Power and Fiber Optic Cable project impacted visual, acoustic, and light aesthetics. These impacts were due to the increased vessel traffic from project activities. The increased presence of vessels included an increase in noise, an increase in vessels in the visual landscape, and an increase in artificial light due to navigation lights.

7.2.9.2 Proposed Project Impacts

The proposed Project would impact the visual, acoustic, and light aesthetics of the ROI. The visual aesthetic would change due to the addition of the hull of the Orbital O2-X in the water and its flashing safety lights. There would also be an increase in vessel presence for installation, maintenance, and decommissioning of the proposed Project.

The acoustic aesthetic would be impacted by an increase in noise due to increased vessel traffic due to Project activities. Additional noise is expected due to the potential installation of rock bolt anchors, and all noise due to anchor installation would be temporary (48 hours maximum). The operation of the Orbital O2-X powertrain system would generate low frequency noise, although the exact level is unknown at this time.

The light aesthetic would include changes due to the addition of marking lights on the hull on the Orbital O2-X.

7.2.9.3 Future Project Impacts

The DNR DMMP, the OPALCO Submarine Power and Fiber Optic Cable project, the Samish Indian Nation Bull Kelp project, and Whidbey Telecom PRMMI project would all change the visual, acoustic, and light aesthetic of the ROI due to temporary increases in vessel presence. While the WSDOT New Hybrid-Electric Ferries project would not change the visual or light aesthetic of the ROI, it would decrease the noise from ferries due to the quieter engines on the new hybrid ferries.

7.2.9.4 Summary

The cumulative impact of projects in the ROI are expected to impact visual, acoustic, and light aesthetics. The visual aesthetics in the ROI would change due to temporary increases in vessel traffic and the addition of proposed Project components.

The acoustic environment would increase in noise due to temporary increases in vessel traffic during Project activities and during rock bolt anchor installation, as well as due to the Orbital O2-X powertrain system. The acoustic aesthetic could also see a reduction in noise when WSDOT transitions local ferries to hybrid-electric models that emit less noise.



The light aesthetic would see small changes due to temporary increases in vessel traffic due to Project activities and the installation light markings on the Orbital O2-X.

Overall, cumulative impacts of projects on the aesthetic environment are considered to be temporary (noise or artificial light from vessels), minor (Orbital O2-X amber lights and powertrain noise), or positive (decrease in noise due to hybrid-electric ferries).

7.2.10 Economic Impact

7.2.10.1 Past and Present Project Impacts

All projects in the ROI created primary and secondary economic impacts. The OPALCO Submarine Power Cable project created primary economic impacts when they hired local construction companies and vessel operators to install new cable and perform maintenance, in addition to when it generated money from cable operation and service to the San Juan Island community. Similar primary economic impacts were created for the DNR DMMP due to hiring contractors. Secondary economic impacts of the projects were created due to spending on goods or services in the proposed Project area during project activities.

7.2.10.2 Proposed Project Impacts

The proposed Project would create primary economic impacts due to spending during the initial construction phase, and due to annual spending on operations. Secondary economic impacts are likely to result from spending on goods and services during construction and operations activities. The current impact of the Project on customer rates is not known, but the addition of marine energy to OPALCO's grid could lead to changes in operational costs. For the long term, local power generation could increase the resilience of the energy grid of the San Juan Island community since it could be better able to withstand natural and man-made disasters that can impact their power retrieval from mainland Washington State.

7.2.10.3 Future Project Impacts

Economic impacts due to the DNR DMMP and the Samish Indian Nation Bull Kelp largely include hiring contractors and, if restoration effort are successful, benefits on kelp bed biodiversity could indirectly help local and Tribal fishing industries because the long-term benefits of bull kelp forest restoration could benefit marine species populations and ultimately benefit fisheries in the future. The addition of Whidbey Telecom PRMMI project and the OPALCO Submarine Power and Fiber Optic Cable project would have primary economic impacts due to spending on construction phases and annual operations. Fiber optic cable projects have the potential to increase job and education opportunities due to improved internet connectivity capacity. The WSDOT Hybrid-Electric Ferries project would see a change in operation costs for WSDOT as they transition from primarily relying on diesel to electricity for energy, although the exact cost differences are unknown. Secondary economic impacts from all future projects also include spending on goods and services during construction and operations, and for the ferries, more reliable service from new ferries could mean more reliable business from tourists and people visiting the region.

7.2.10.4 Summary

The cumulative economic effect of projects in the ROI is positive and would contribute to the amount of money spent on activities such as construction, maintenance, and operational activities, and well as on secondary activities such as goods and services.



8. Summary of Effects

8.1 Unavoidable Negative Effects

Based on the information reviewed, collected, and analyzed in support of this DLA, the following potential unavoidable adverse impacts have been identified:

- Underwater noise - underwater noise will be generated due to vessel presence during the installation, operation, maintenance, and removal activities. Additionally, underwater noise will be generated due to the Orbital O2-X device's power generating operations.
- Pelagic habitat - habitat alteration and spatial displacement of species in the water column during the installation, operation, maintenance, and removal activities of proposed Project components.
- Benthic habitat – habitat alteration and spatial displacement of species on the seafloor from the Project's anchor system and subsea cable during installation, operation, and removal activities.
- Aesthetics – effects on the viewshed from the Orbital O2-X and safety marking at the water's surface during installation, operation, maintenance, and removal activities.
- Turbidity - temporary turbidity caused by anchor and new subsea cable installation and removal. Additionally, temporary turbidity may occur in the mooring chain sweep area during operations.

Testing of the Orbital O2, an earlier model than the proposed Orbital O2-X, at Orkney Islands has indicated no observed significant negative impacts on the environment. Monitoring would contribute further to the understanding of potential cumulative effects.

8.2 Positive Effects

Based on the information reviewed, collected, and analyzed in support of this DLA, the following beneficial effects have been identified:

- Energy resilience - increased resiliency of the OPALCO energy grid during operation activities, leading to reduced dependence on mainland power, particularly during power outages.
- Socioeconomic benefits – generation of renewable energy and economic stimulation via regional services during Project installation, operation, maintenance, and removal activities.
- Environmental benefits – investments in energy efficiency and renewable tidal energy, contributing to the reduction of reliance on fossil fuels.



9. Conclusions and Recommendations

9.1 Fish and Wildlife Recommendations

If Section 10(j) recommendations are submitted, then pursuant to the Federal Power Act (FPA), FERC would be required to make a determination that the recommendations of the federal and state fish and wildlife agencies are consistent with the purpose and requirements of Part I of the FPA and applicable law. Section 10(j) of the FPA states that whenever FERC believes that a fish and wildlife agency recommendation may be inconsistent with the purposes and requirements of the FPA or other applicable law, FERC and the agency shall attempt to resolve any such inconsistency, giving due weight to recommendations, expertise, and statutory responsibilities of such agency.

9.2 Consistency and Comprehensive Plans

Section 10(a)(2)(A) of the FPA, 16 USC section 803(a)(2)(A), requires FERC to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the Project. The Project is consistent with the goals outlined in these documents.

9.2.1 Federal Plans

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9.2.2 State Plans

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Project Boundary Map

Exhibit G - Draft License Application

Rosario Strait Tidal Energy Project

San Juan Islands, Washington

FERC Project No. 15368



Federal Energy Regulatory Commission



Orcas Power & Light Cooperative (OPALCO)

183 Mount Baker Road

Eastsound, Washington 98245

26 March 2025

For the purposes of this DLA, the proposed Project boundary defines an area of approximately 500 m x 760 m (1,640 ft x 2,494 ft), or 380,000 square meters (m²) (~94 acres), to encompass the footprint of the Orbital O2-X, its anchoring components, and a buffer area. The footprint of the proposed Project components within the boundary could range from a minimum of 280 m x 480 m (919 ft x 1,575 ft) to a maximum of 322 m x 552 m (1,056 ft x 1,811 ft), depending on the final deployment configuration.

Additionally, the proposed boundary includes an adjacent corridor area of 25,300 m² (~6.25 acres) for the proposed new subsea cable that would be approximately 5.3 km (3.3 mile) in length. In total, the proposed Project area would be 325,300 m² (~80.38 acres) before adding a buffer area. However, final determination of the area is subject to consultation with Tribal Nations and regulatory agencies.

Table 1. Approximate Boundaries of the Proposed Project Area

Corner (Cardinal Direction)	Latitude (°N)	Longitude (°W)
Northwest	48.566277	-122.769801
Northeast	48.566209	-122.762983
Southwest	48.559339	-122.769742
Southeast	48.559429	-122.762922

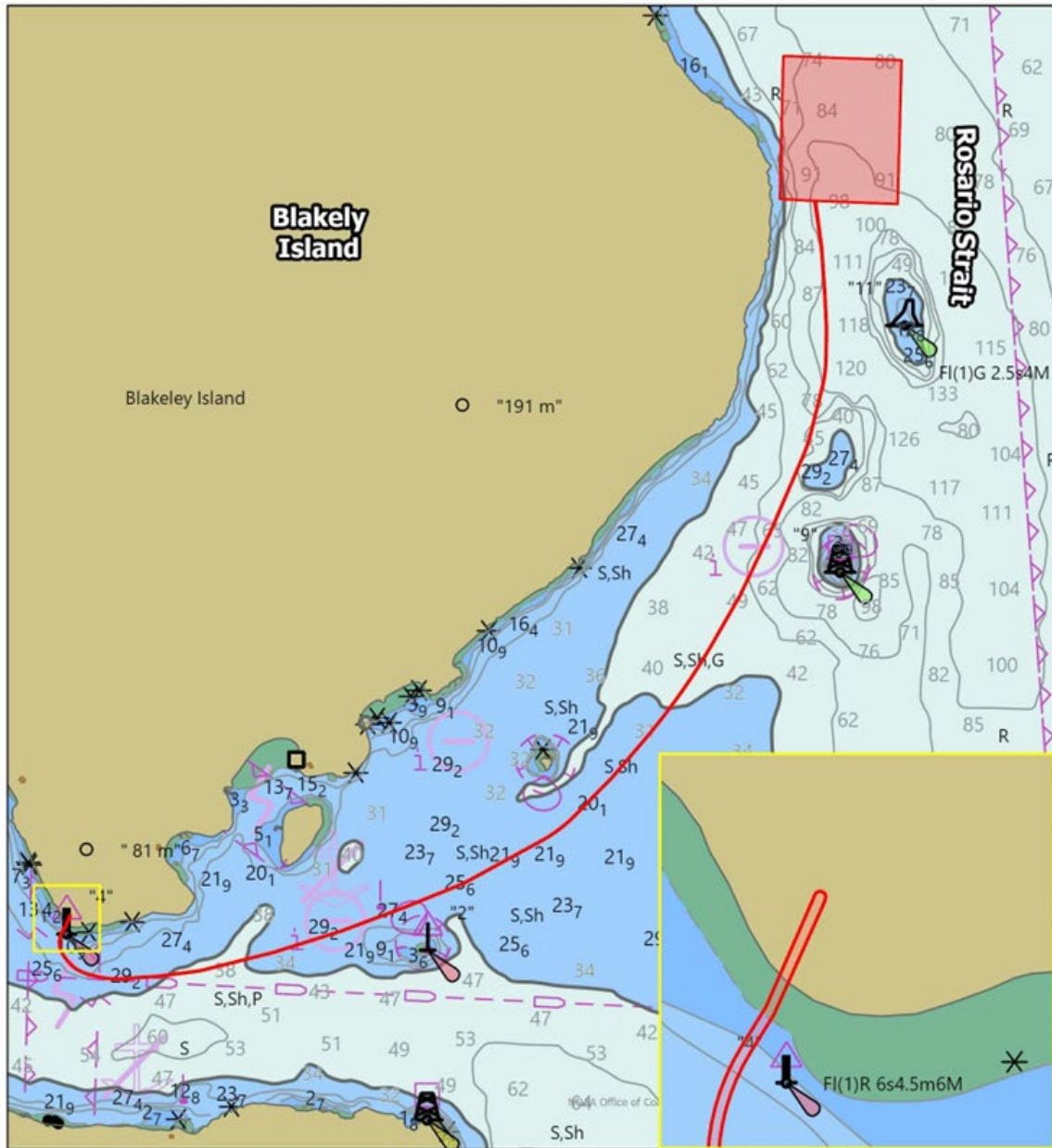
Note: Coordinates determined using Projected Coordinate System NAD 1983 State Plane Washington South FIPS 4602 [U.S. Feet]. The 2.3-m (7.5-ft) buffer around the new subsea cable is excluded from the proposed Project area coordinates in this table.

Table 2. Approximate Location of the Proposed Project Components

Project Component	Latitude (°N)	Longitude (°W)
Orbital O2-X	48.559278	-122.766336
North Point – New Subsea Cable Corridor	48.561142	-122.767909
South Point – New Subsea Cable Corridor	48.531458	-122.809621
Existing Marine Shoreline Conduit	48.531466	-122.809625
Existing Land-Based Conduit Facility	48.531896	-122.809359

Note: Coordinates determined using Projected Coordinate System NAD 1983 State Plane Washington South FIPS 4602 [U.S. Feet]

EXHIBIT G MAP



Project Boundary
Rosario Strait Tidal Energy Project
OPALCO

Scale: 1:22,000 Date: 17-Jan-2025
Source: OPALCO Preparer: SK
Spatial Reference: NAD 1983 StatePlane Washington South
FIPS 4602 Feet

Legend

- Existing Shoreline Conduit & Facility
- Proposed Project Area

0 0.1 0.2 0.4
Miles



Prepared by:

48north
solutions

DISCLAIMER

The accuracy of source information cannot be verified; therefore, all linework, labeling, and markings appearing on this figure may be subject to errors or omissions in positions, classifications, and interpretations. This figure should only be used as a visual guide for general overview purposes.

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