APPENDIX A3

WHEY-AH-WICHEN / CATES PARK SHORELINE RESTORATION PROGRAM

OVERVIEW EFFECTS ASSESSMENT

VFPA PER #24-174

Prepared for:

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Canadian and owner-operated

MAY 2025

TWN12545
VERSION 5.0

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LIST OF ACRONYMS

BC	British Columbia
BMP	Best Management Practices
CEMP	Construction Environmental Management Plan
CGVD28	Canadian Geodetic Vertical Datum of 1928
DFO	Fisheries and Oceans Canada
DNV	District of North Vancouver
EM	Environmental Monitor
HADD	Harmful Alteration, Disruption, or Destruction
HHWLT	Higher High Water Large Tide
HHWMT	Higher High Water Mean Tide
LiDAR	Light Detection and Ranging
OHWM	Ordinary High-Water Mark
NHC	Northwest Hydraulics Consultants
PER	Project And Environmental Review
QEP	Qualified Environmental Professional
SARA	*Species at Risk Act*
TWN	səlilwətaɬ/Tsleil-Waututh Nation
VFPA	Vancouver Fraser Port Authority

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AMENDMENT RECORD

This report has been issued and amended as follows:

Issue	Description	Date	Approved by	
1	First version of Whey-ah-Wichen / Cates Park Shoreline Restoration Program – Overview Effects Assessment	20241128	Stewart Wright Project Director	Becca Kordas, RPBio Project Manager
2	Second version of Whey-ah-Wichen / Cates Park Shoreline Restoration Program – Overview Effects Assessment	20241206	Stewart Wright Project Director	Becca Kordas, RPBio Project Manager
3	Third version of Whey-ah-Wichen / Cates Park Shoreline Restoration Program – Overview Effects Assessment	20250328	Stewart Wright Project Director	Becca Kordas, RPBio Project Manager
4	Fourth version of Whey-ah-Wichen / Cates Park Shoreline Restoration Program – Overview Effects Assessment	20250404	Stewart Wright Project Director	Becca Kordas, RPBio Project Manager
5	Fifth version of Whey-ah-Wichen / Cates Park Shoreline Restoration Program – Overview Effects Assessment	20250521	 Stewart Wright Project Director	 Becca Kordas, RPBio Project Manager

1.0 INTRODUCTION

The District of North Vancouver (DNV) and səlilwətaɬ/Tsleil-Waututh Nation (TWN) are seeking to implement a shoreline protection and restoration program at Whey-ah-Wichen / Cates Park: the Whey-ah-Wichen / Cates Park Shoreline Restoration Program ("the Program"). Whey-ah-Wichen (meaning "facing the wind") has been an active part of the traditional and unceded territory of the Tsleil-Waututh for thousands of years and continues to hold strong cultural and archaeological significance to the Tsleil-Waututh people. Now a large waterfront park, Whey-ah-Wichen ("the Site") has been co-managed by DNV and TWN since 2001. The shoreline of the Site has been eroding and this is likely to worsen with sea level rise and climate change. Impacts to and loss of this shoreline continue to threaten archaeological resources, shoreline habitat, park infrastructure, and Tsleil-Waututh cultural sites. The Program aims to implement long-term strategies to restore the shoreline of the Site and enhance its resilience to climate change while preserving its cultural and historical significance.

The Program involves the design and construction of nature-based shoreline protection and stabilization measures in combination with habitat restoration and enhancement. The proposed works align with TWN's overall vision for Burrard Inlet and are part of larger initiatives by TWN and DNV to mitigate coastal erosion and restore shoreline habitat on the North Shore. DNV has partnered with other North Shore stakeholders to develop a sea level rise adaptive management strategy (KWL 2021). This strategy document is intended to provide guidance for the next ten years and is considered an initial step in what will likely be a multi-decade collaborative initiative. The strategy aims to address sea level rise adaptation from a variety of perspectives, but a major focus is on flood risk assessment and reduction through the application of a variety of policies, land use planning, building floodproofing, and structural flood protection measures. Sea level rise adaptation and shoreline protection at Cates Park is one of the priorities within this strategy.

In parallel, TWN has partnered with municipalities, representatives from regulatory agencies, grant agencies, academic institutions and environmental NGOs to develop a Collaborative Shoreline Adaptation Visualization (SAVZ) Report that describes a set of values and a vision of shoreline adaptation (TWN 2022). Options for shoreline adaptation that reflect the identified vision and values include a blend of nature-based and infrastructure measures for the area stretching from Maplewood Flats to Whey-ah-Wichen (Figure 1). The proposed Program is one of two initiatives born out of the SAVZ report, the second being the TWN Reserve Shoreline Adaptation and Restoration Project (SARP; PER #24-112) led by TWN.

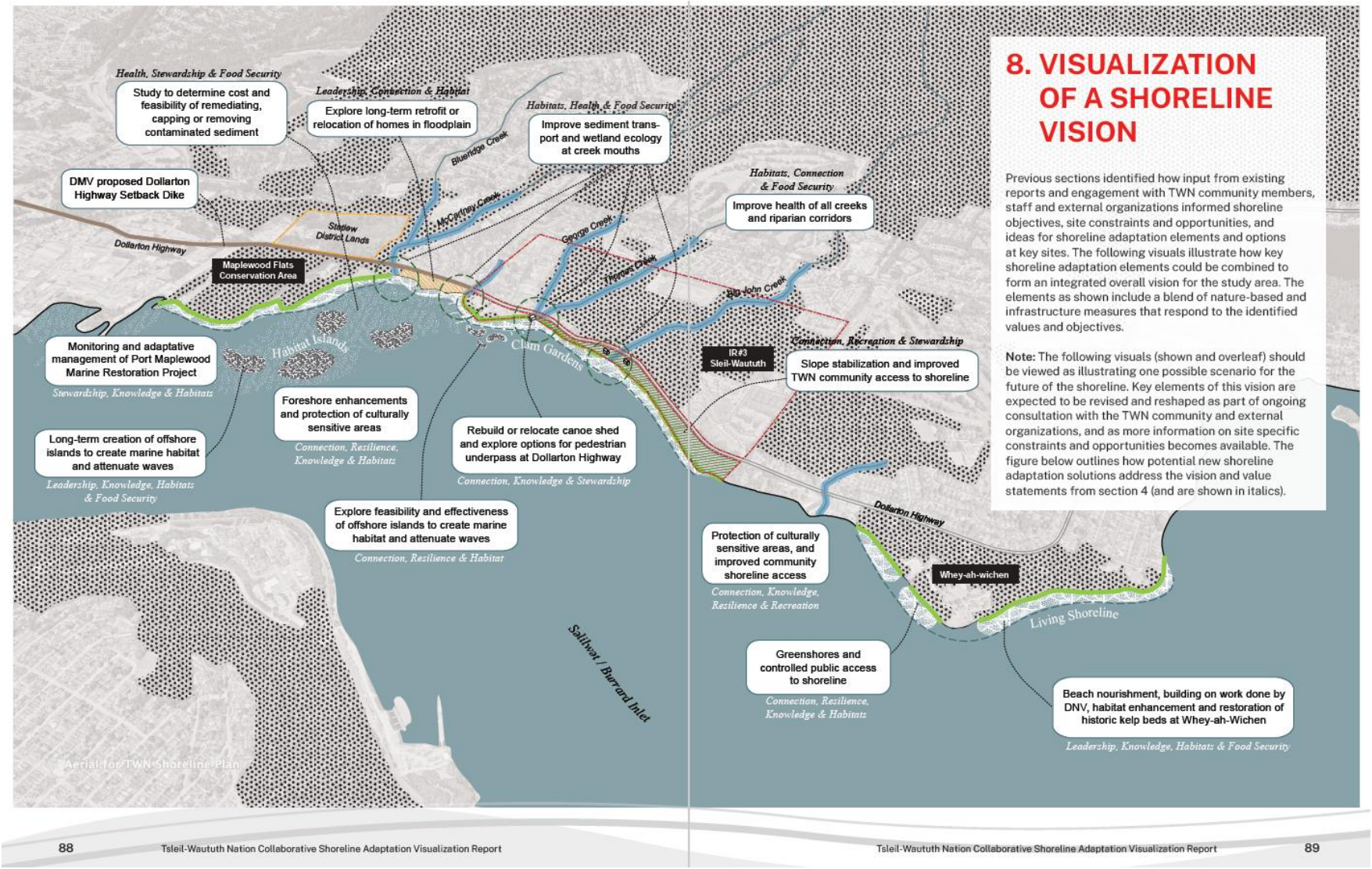
DNV and TWN have developed these key objectives for the Program:

- Enhance resilience to climate change using nature-based solutions.
- Preserve the historical significance and enhance Tsleil-Waututh's cultural use of the Site.
- Integrate visitor usage and education.

The shoreline protection and restoration works will be combined with improvements to park amenities and shoreline access. These additional design features are located in upland areas and thus outside the scope of this assessment. This assessment focuses on Program components located in the marine environment.

Hatfield has prepared this Overview Effects Assessment for the defined Study Area (Figure 2) to support a Fisheries and Oceans Canada (DFO) Request for Review under the *Fisheries Act* and *Species at Risk Act* (SARA) and Vancouver Fraser Port Authority (VFPA) Project and Environmental Review (PER) application. Hatfield has assessed the potential for the death of fish and HADD (harmful alteration, disruption, or destruction) to fish habitat under the *Fisheries Act* and defined avoidance and mitigation measures for the Program. This includes construction methodology inputs, Best Management Practices (BMPs), and environmental monitoring and mitigation measures to be implemented during the construction phase.

Figure 1 Sample visualization of shoreline vision from Maplewood Flats to Whey-ah-Wichen.



Source: TWN. 2022.

2.0 LOCATION

The Site is located in the Central Harbour of səl̓ilw̓ət (Burrard Inlet) in southwest British Columbia (BC) within the DNV, approximately 5.0 km east of the Ironworkers Memorial Bridge at the point where the Inlet curves north and becomes Indian Arm (Figure 2). The Site falls along the shoreline of Whey-ah-Wichen / Cates Park, which is the largest waterfront park in North Vancouver with an area of 22.3 hectares (TWN 2006). The Site covers approximately 1.3 km of linear shoreline and is characterized by a beach and shallow subtidal area bordered by riparian vegetation and managed parkland (Figure 3). A public boat launch and pier are also present on the western shore of the Site (Figure 3). The TWN Reserve (səlilw̓ətaʔɬ, Burrard Inlet IR#3) is located approximately 500 m west of the Site and occupies approximately 112 hectares of land on the north shore of the Central Harbour (Guttmann 2022). The waters of Burrard Inlet, including the intertidal area of the Site, fall within federal lands and waters that are managed by the VFPA.

3.0 PROGRAM OVERVIEW

3.1 CONCEPT DESIGN

The Program uses a multi-disciplinary approach to understand existing environmental conditions at the Site, develop design concepts with community input, test the design through coastal process modelling, and evaluate the success of the design via post-construction monitoring. DNV and TWN have retained a diverse team of professional coastal engineers, marine biologists, and landscape architects to complete this work. The Program involves the design and construction of nature-based shoreline protection and stabilization measures in combination with preserving and enhancing forage fish spawning habitat and native plant revegetation to help restore habitat health and biodiversity. The Program's design elements reflect TWN values and aspirations for the shoreline, as well as current visitor data and park uses, incorporating feedback from local tourism operators and community engagement. Key design criteria for the Program are to:

- Emphasize nature-based solutions, including living shorelines;
- Minimize or avoid any potential harmful impacts to existing habitat, and include opportunities for habitat enhancement;
- Protect archaeological resources and park assets;
- Incorporate opportunities to enhance Tsleil-Waututh cultural use of the Site, including traditional stewardship practices, food harvest, and access to the water;
- Provide education opportunities, potentially including interpretive signage, guided tours, or outreach to schools and other groups;
- Incorporate requirements from local tourism operators; and
- Consider stakeholder and public feedback.

Figure 2 Regional context.

Legend

- Watercourse
- VFPA-managed federal lands and waters
- Study Area
- Tsleil-Waututh Reserve

0 150 300 600 m

N

Scale: 1:20,000

Projection:NAD 1983 UTM Zone 10N

Data Sources:

a) First Nation Reserve, Government of BC 2020.
b) Study area, Hatfield 2023.
c) Phase 1 and 2 polygons, Northwest Hydraulic Consultants 2024.
d) Watercourses, Fresh Water Atlas 2011.
e) VFPA-managed federal lands and waters, Vancouver Fraser Port Authority 2018.
f) Background, Aerial photo 10 cm, 13 April 2021, Esri Online Service.

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TWN12545_SiteOverview_20241115_v0_4_VP

Figure 3 Study area.

Legend

- Watercourse
- Existing Bathymetry Contour (m GD)
- Study Area

0 50 100 200 m N

Scale: 1:6,500

Projection:NAD 1983 UTM Zone 10N

Data Sources:
a) Study area, Hatfield 2023.
b) Watercourses, Fresh Water Atlas 2011.
c) Orthophoto 5 cm, and contours (CGVD28), Spitfire Drone Survey 2023.
d) Background, Aerial photo 10 cm, 13 April 2021, Esri Online Service.

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TWN12545_StudyArea_20241114_v0_3_LC

The design approach is driven by the principles of eco-cultural restoration, emphasizing the interconnectedness of ecological biodiversity and human health and equity, and centering the importance of Indigenous values and culture in habitat restoration. The design also acknowledges the need for habitat connectivity between upland, riparian, and intertidal zones, and involves strategies to enhance and restore this relationship. The nature-based approach to shoreline protection takes cues from existing habitat features and substrate types and proposes "soft" solutions using more natural materials as an alternative to more conventional hard armouring and structural engineering solutions. The Program design (Appendix A1 in the Supplemental Report) is data-driven and informed by both western science and Indigenous Knowledge, incorporating engagement with TWN community members, local municipalities, and technical experts (Appendix A6 in the Supplemental Report); an assessment of existing biophysical conditions (Section 5.0 and Hatfield et al. 2023); and coastal process modelling.

Program design criteria, informed by the Program objectives, have been integrated into the concept designs to ensure that the Program performs as intended and to reduce any potential impacts to neighbouring shorelines. In practice, design criteria and baseline study findings have led the design team to adopt an approach of:

- Avoiding the use of man-made engineered structures (wherever possible);
- Avoiding structures that will trap additional longshore sediment above what is already being provided to the shore as part of the design (i.e., avoid becoming a sediment sink);
- Using sediment types and vegetation that are similar to what was there historically to avoid drastic changes to the character of the Site or to adjacent sections of shoreline; and
- Planning for adaptive management, to support optimization of the design and further avoiding negative impacts.

The concept design (Appendix A1 in the Supplemental Report) is informed by the existing habitat features, coastal geomorphology, and the desired cultural and recreational use of the Site. The Program footprint is divided into five subsections, the (1) West Beach, (2) Central Beach, (3) East Beach, (4) Roche Point and (5) Little Cates, the latter two are areas particularly popular for recreational use (Figure 4). The design of all five sections is driven by the priority objective of the Program, which is to mitigate historic shoreline erosion and future erosion expected from sea level rise and to protect parklands and archaeological sites. The design makes use of beach nourishment (mixed sand-gravel), and boulder headlands placed at strategic locations to stabilize and retain the new fill. At the top of the beach, along the edge of the riparian zone, mixed gravel-cobble berms will be placed to stabilize the eroding bluffs. In addition to shoreline protection, design elements include:

1. **Enhancement of forage fish spawning habitat:** Forage fish spawning has been documented at the Site (refer to Section 5.0 and Hatfield et al. 2023 for further details). Surf smelt (*Hypomesus pretiosus*) and Pacific sand lance (*Ammodytes personatus*) will spawn on beaches that contain specific sediment grain-size distributions of sand and pebble, within 2 to 3 metres above mean low tide level (WWF-Canada 2020). A study of forage fish spawning beaches in BC (Tomlin et al. 2021) found that surf smelt prefer a coarse sand to fine pebble mix ranging from 1 to 7 mm in diameter. Pacific sand lance typically spawn in medium-sized sand sediments ranging from 0.25 to 0.5 mm in diameter, with spawning also documented in coarse sand and fine pebble sediments (1 to 7 mm). The mixed sand-gravel material used for the beach nourishment material will have a size gradation suitable for spawning (refer to Appendix A1 in the Supplemental Report for material specifications).

2. **Planting native vegetation:** The upland area along the shoreline at Roche Point and Little Cates is primarily managed parkland with limited habitat value for fish and wildlife (refer to Section 5.0 and Hatfield et al. 2023 for further details). This area will be planted with native riparian vegetation that will include ecologically and culturally important plant species (Figure 5, Figure 6), but will remain low in stature so as not to disrupt views. Planting will be coordinated with TWN's archaeology team to avoid or minimize ground disturbance of native soils. Saltmarsh is largely absent from the shoreline, likely due to the steep slope and relatively high wave exposure. However, there is evidence that the upper foreshore at Roche Point can support high marsh / coastal dune vegetation, suggesting there are opportunities to increase the extent of this habitat by increasing the area of suitable substrate and reducing trampling from foot traffic. Dunegrass (*Leymus mollis*) and other coastal dune species will be planted along the upper edge of the foreshore at Roche Point (Figure 5) between +2.0 m and +3.20 m Geodetic Datum (GD[1]). Refer to Appendix A2 in the Supplemental Report for a detailed planting plan.
3. **Removal of invasive vegetation:** The riparian area of the shoreline has been impacted by invasive vegetation (refer to Section 5.0 and Hatfield et al. 2023 for further details). An Invasive Species Management Plan has been developed in collaboration with vegetation management specialists (Inlailawatash Limited Partnership) and TWN's archaeology team that will ensure vegetation removal will not adversely impact existing habitat and archaeological resources (Appendix A5 in the Supplemental Report).

Together these strategies form a cohesive and balanced approach to shoreline protection and habitat restoration at the Site.

3.2 ACTIVITY DESCRIPTION

Construction activities will involve the placement of sand, gravel, and rock materials and the planting of riparian and dunegrass vegetation. Existing boulder armouring on the foreshore will be buried by beach nourishment and disturbance to the shoreline bank (containing culturally significant materials) will be minimized as much as possible. Beach logs present in the work area will be salvaged for later reinstatement, unless removal is not possible without excavation, in which case the logs will be left in place and buried.

Materials for the design are expected to be sand, gravel, cobble, and boulder. The source and transportation route for beach nourishment materials are not yet known. Material will most likely be delivered to the Site by barge but could also be transported by truck. Details are provided in the Supplemental Report, in brief:

- If by barge, a conveyor will be used to offload beach nourishment materials from the barge onto the beach within the footprint of the Program work areas. The material would then be moved to final placement by low tire pressure haul vehicles along the upper shore. A spud barge would be used to secure the position adjacent to the shoreline of the materials barge. It is not anticipated that there would be any grounding of the barges during normal operations, and the only contact with the seabed would be the spuds in the subtidal area.

[1] Elevations are referenced to CGVD28 (Canadian Geodetic Vertical Datum of 1928) unless otherwise stated.

Figure 4 Program overview.

Legend

- Watercourse
- Existing Bathymetry Contour (m GD)
- Study Area
- Project Extent

Program Footprint

- Phase 1 (Roche Point, East Beach)
- Phase 1 (Roche Point Stairs)
- Phase 2 (Central Beach, Little Cates, West Beach)
- Riparian Planting Area
- Dunegrass Planting Area

0 50 100 200 m N

Scale: 1:6,500

Projection:NAD 1983 UTM Zone 10N

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TWN12545_DesignOverview_20241119_v0_4_LC

Figure 5 Beach nourishment and vegetation planting at Roche Point.

Legend

- Existing Bathymetry Contour (m GD)

Program Footprint

- Phase 1 (Roche Point, East Beach)
- Phase 1 (Roche Point Stairs)
- Dunegrass Planting Area
- Riparian Planting Area
- Big Leaf Maple

0 5 10 20 m

N

Scale: 1:750

Projection:NAD 1983 UTM Zone 10N

Data Sources:

a) Phase 1 polygons, Northwest Hydraulic Consultants 2024.
b) Dunegrass planting areas digitized by Hatfield 2024, based on data source b)
c) Riparian planting areas and big leaf, maple location, LEES + Associates 2024.
d) Orthophoto 5 cm, and contours (CGVD28), Spitfire Drone Survey 2023.

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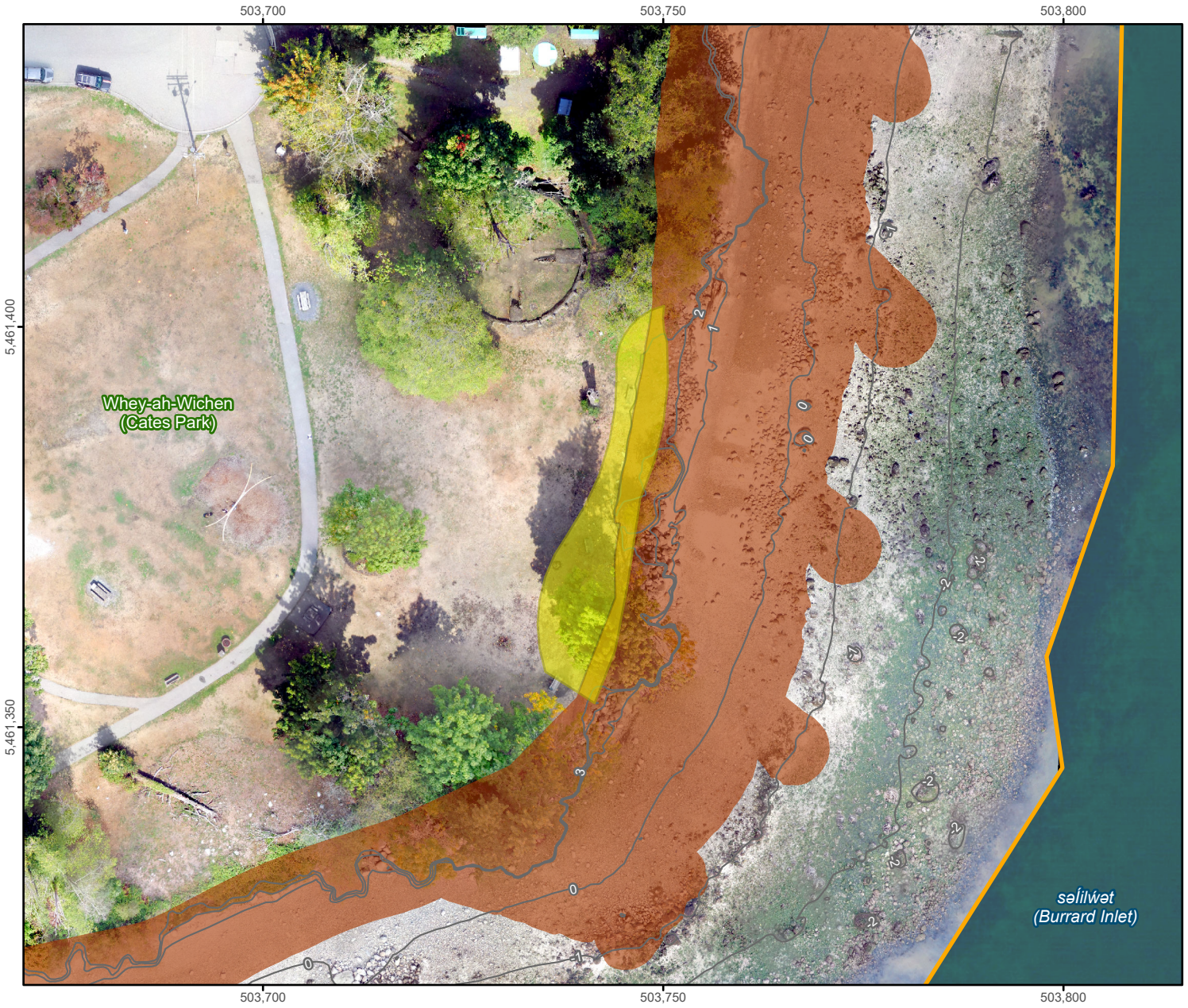
TWN12545_RochePoint_Planting_20241126_v03_LC

Figure 6 Beach nourishment and vegetation planting at Little Cates.



Legend

- Existing Bathymetry Contour (m GD)
- Study Area

Program Footprint

- Phase 2 (Central Beach, Little Cates, West Beach)
- Riparian Planting Area

0 5 10 20 m

N

Scale: 1:750

Projection:NAD 1983 UTM Zone 10N

Data Sources:
a) Phase 2 polygons, Northwest Hydraulic Consultants 2024.
b) Riparian planting areas, LEES + Associates 2024.
c) Orthophoto 5 cm, and contours (CGVD28), Spitfire Drone Survey 2023.

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TWN12545_LittleCates_Planting_20241119_v0_2_LC

- If the material is trucked to Site, there would need to be a small stockpile area designated within Whey-ah-Wichen for delivery of materials by the road for trucks (see maps in Supplemental Report). Material would be loaded from this stockpile into a low ground pressure haul vehicle for transportation and delivery to final placement areas on the shoreline. An access route onto the shoreline would need to be established.

Regardless of delivery method, work will commence with placement of materials within the middle of the work footprint to establish a haul road for vehicles working on the beach. To the extent possible, work will be completed in the dry and the lowest tides will be used to install the lowest elevation elements such as the rock toes. Where a backshore gravel-cobble berm and boulder headlands are planned, these would be installed next. Beach nourishment materials will then be placed on top of the gravel-cobble backshore berm and behind the boulder headlands.

3.3 PHASES AND SCHEDULE

Subject to permitting approvals, the Program is expected to be constructed according to the schedule below. In-water fill placement will be completed during DFO's Least Risk Window for Burrard Inlet. Due to funding constraints, the Program must be implemented in two phases:

Phase 1 – Roche Point and East Beach (2025 – 2026)

- Pre-construction invertebrate salvage: mid August 2025 (within one week of construction).
- Mobilization and site clean up: mid August 2025.
- Placement of fill materials and construction of access points: late August – October 2025.
- Demobilization: November 2025.
- Riparian and dunegrass habitat planting: April – May 2026.

Phase 2 – West Beach, Central Beach, Little Cates (2026 – 2027)

- Pre-construction invertebrate salvage: mid August 2026 (within one week of construction).
- Mobilization and site clean up: mid August 2026.
- Placement of fill materials and construction of access points: September – October 2026.
- Demobilization: November 2026.

4.0 ENGAGEMENT

Engagement for the Program is ongoing and has been conducted throughout the design process. The memorandum "Engagement Summary for Whey-ah-Wichen/Cates Park Improvements" (Appendix A6 in the Supplemental Report) contains a full overview of the engagement conducted for this Program. Examples of engagement conducted to date include:

- Whey-ah-Wichen Cultural Cooperation Agreement Steering Committee Meetings;
- Meetings with TWN Cultural Team;

- Concept Designs Feedback with TWN Community;
- TWN Newsletter Updates;
- Engagement Sessions with TWN Community;
- Discussion with Takaya Tours at the Whey-ah-Wichen Technical Meeting;
- DNV Parks and Natural Environment Advisory Committee Meeting;
- Multi-stakeholder Shoreline Technical Advisory Group Presentation;
- Chief and Council and CAO 'Snapshot' Update;
- Presentation at Nature-based Coastal Solutions Conference, Atlantic Chapter (Halifax, NS);
- Presentation at Nature-based Coastal Solutions Conference, Pacific Chapter (Vancouver, BC);
- Consultation with Deep Cove Kayak; and
- Meeting with the Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and written communication with xʷməθkʷəy̓əm (Musqueam) Indian Band.

Ongoing engagement efforts include the use of online resources to keep the community informed and involved in the Program. The DNV has created a section of their website under Parks, Trails, and Recreation, summarizing the proposed restoration and improvements at Whey-ah-Wichen. The webpage also has a dedicated area for news and updates on the Program. Additionally, TWN has published a blog post on their website, and will continue to post updates when construction commences in August 2025.

5.0 SUMMARY OF EXISTING CONDITIONS

5.1 METHODS

Hatfield completed a detailed desktop review, a field-based site assessment of both upland and marine habitats to assess the existing environmental conditions in the Study Area along the Whey-ah-Wichen shoreline to inform the Program design (Figure 3). The desktop review used existing publicly available information to characterize marine habitat features, potential species presence, and potential migratory, refuge or spawning areas at the Site, including species-at-risk and wildlife of potential conservation concern. Ecological field studies were conducted in August and September 2023 and included a foot-based intertidal habitat survey, a subtidal towed video survey, and an upland vegetation survey. A Light Detection and Ranging (LiDAR) and imaging drone survey were carried out by Spitfire Drone Survey Ltd. (Spitfire) to collect updated orthoimagery of the Site and topographic data of areas above water. In addition, NHC has completed a geomorphological assessment, coastal processes analysis, and numerical modelling to develop an engineering design basis and characterize baseline and future potential conditions.

The results of this assessment are summarized in the following sections and detailed in the Site Assessment Report (Hatfield et al. 2023).

5.2 COASTAL PROCESSES

The Site is located uniquely within Burrard Inlet at the confluence of multidirectional tidal currents, winds from the west, east and north and is exposed to a busy vessel corridor contributing vessel generated waves (wakes) to the wave climate. Currents at the Site may be driven by both winds and tides. Water level variation at the Site due to tides and storm surge (as much as 0.4 to 0.8 m above high tide levels) affect the exposure of the beach and bluffs to wave and current action. The Site is also subject to long term relative sea level rise with up to 0.56 m of relative rise expected by 2050 and greater than 1 m by 2100.

Ongoing erosion of the Whey-ah-Wichen shoreline is likely driven by dramatic changes along the shore and upland land usage in Burrard Inlet since contact in 1792, particularly near Second Narrows (for example, damming of the Seymour River and extensive infilling of Maplewood Flats). These changes have significantly impacted sediment transport and geomorphology in the area, leading to reduced sediment supply and relatively high erosion rates in the early to mid-1900s. Additionally, vessel traffic – and therefore vessel wake – has increased significantly over the past century and is expected to increase in the future. Without intervention, erosion of the shoreline is expected to continue and may be further exacerbated by sea level rise and increased storm activity.

The Site has a history of erosion of the backshore bluffs that has likely been exacerbated by high public use and interruptions to sediment delivery from both within and outside of the park. There have been previous nourishment projects as well as attempts at slowing erosional processes using large boulders. In 2014, Golder designed and constructed a beach nourishment addition at Roche Point, adding sand and gravel to protect the headland from erosion (Golder 2019). In 2019, Golder reviewed the work and found that the material had been redistributed west from Roche Point to Central Beach through longshore drift. This movement was the intention of the design and resulted in the development of a high marsh / dunegrass habitat. This successful pilot beach nourishment serves as the foundation for the Program design.

Generally, the full system shows signs of sediment starvation and lack of sediment input. The key conclusion is that the system has a sediment deficit. This is likely due to many factors outside of Whey-Ah-Wichen but is being worsened by the riprap protection of the sediment bluffs within the park. For future success, a sediment source will either need to be imported and maintained (e.g., repeated beach nourishment), or an equilibrium with the material available onsite will need to be established.

5.3 HABITAT QUALITY

The shoreline of the Site is characterized as a semi-exposed rocky beach. The intertidal substrate is a mix of boulder, cobble, gravel, and sand. There is a seaward transition from finer-grained substrates to coarser-grained substrates. Riprap and large boulders have been placed on some sections of the shoreline in response to ongoing erosion. The majority of the upper intertidal zone is unvegetated, although there are two small patches of high marsh / dunegrass vegetation (*Leymus mollis* and *Atriplex patula*) located west of the boat launch and at Roche Point (total of approximately 35 m^2). The mid to low intertidal area is vegetated with common species of macroalgae including sea lettuce (*Ulva* sp.), rockweed (*Fucus distichus*), and Turkish washcloth (*Mastocarpus papillatus*). Narrow bands of native eelgrass (*Zostera marina*) and sugar kelp (*Saccharina latissima*) also occur in shallow subtidal areas well outside the design footprint (Figure 7, Figure 8).

Figure 7 Marine habitat within the Program footprint (western shoreline).

Legend

- Upper Marsh / Dunegrass
- Existing HHWMT
- Designed HHWMT
- *Ulva* Upper Boundary
- Intertidal Macroalgae (*Ulva* + *Fucus* + *Mastocarpus*)

Forage Fish Spawning Suitability

- Suitable
- Not Suitable

Program Footprint

- Phase 2

0 25 50 75 m

N

Scale: 1:2,500

Projection: NAD 1983 UTM Zone 10N

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Figure 8 Marine habitat within the Program footprint (eastern shoreline).

Legend

- Existing HHWMT
- Designed HHWMT
- *Ulva* Upper Boundary
- Upper Marsh / Dunegrass
- Intertidal Macroalgae (*Ulva* + *Fucus* + *Mastocarpus*)

Forage Fish Spawning Suitability

- Suitable
- Not Suitable

Program Footprint

- Phase 1
- Phase 2

0 25 50 100 m

N

Scale: 1:4,500

Projection: NAD 1983 UTM Zone 10N

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TWN12545_Macroalgae_Intertidal_RochePoint_EastBeach_LittleCates_20241128_v05_LC

The foreshore of the Site is bordered by terrestrial and riparian vegetation in the uplands. Whey-ah-Wichen strikes a balance between high recreational use parkland replete with picnic tables, a boat launch, and playgrounds (Roche Point, Central Beach, Little Cates) and more pristine areas (West and East Beaches) with mature forests with walking trails. Historically the terrestrial areas were likely continuously vegetated with mature native forest. Today, the riparian slopes are impacted by invasive plants (e.g., Himalayan blackberry, *Rubus armeniacus*), and there are areas where the backshore has been heavily modified, such as the managed parkland at Roche Point. Vegetation in low disturbance areas is representative of mature forest sites in the Coastal Western Hemlock dry maritime biogeoclimatic zone, dominated by western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*), Douglas fir (*Pseudotsuga menziesii*), and big leaf maple (*Acer macrophyllum*), with understorey species such as salal (*Gaultheria shallon*) and red huckleberry (*Vaccinium parvifolium*).

There is potential for salmonids to be present in the Study Area, whether it be staging of adults prior to migration into freshwater or juveniles that recently migrated into the marine environment. The only large salmon-bearing watercourse located in proximity to the Site is the Seymour River, which discharges approximately 5 km to the west. There are two small (~0.5 m wide), unnamed ephemeral streams in the Study Area, but neither are likely to be fish bearing. Forage fish are also known to occur in Burrard Inlet. Suitable forage fish spawning habitat has been identified along much of the shoreline and Pacific sandlance and surf smelt have been reported to spawn at the Site on East Beach (Hatfield et al. 2023, Section 6.7).

Several species of seabirds and marine waterfowl, including species at risk (e.g., Pacific great blue heron; *Ardea herodias fannini*) have been documented in and around the Study Area. It is likely that waterfowl use existing marine habitat features (i.e., eelgrass beds) as feeding areas through the overwintering period. Trees in upland areas provide suitable roosting habitat for at-risk bat species, which have historical observations within 2 km of the Study Area. Forested areas near ephemeral streams provide suitable habitat for the endangered Pacific water shrew (*Sorex bendrii*), and overwintering habitat for northern red-legged frog (*Rana aurora*). Habitat modification and high visitor traffic have undoubtedly impacted both avian and non-avian wildlife at Whey-ah-Wichen.

6.0 POTENTIAL IMPACTS

6.1 IMPACTS RELATED TO DESIGN

As habitat restoration is a key objective for the Program, and solutions to address coastal erosion and sea level rise are nature-based, the Program is expected to have a net positive impact on fish and fish habitat and minor temporary negative impacts on fish habitat. The Program aims to benefit fish by enhancing forage fish spawning habitat. The Program will also remove invasive vegetation and increase the area of native riparian and dunegrass habitat in the most heavily disturbed areas. Specifically, the potential negative and positive impacts of the design on fish and fish habitat include:

- Sediment and Structural Materials:
    - Negative: Sand in the beach nourishment materials is susceptible to wave action and could be lost from the Site over time. Material brought to the Site could be contaminated or contain invasive species or noxious weeds.

- Positive: New beach nourishment material will include a more stable mix of sand and gravel that will reduce erosion. Coastal process modelling has been used to inform design to minimize the loss of fine sediments as much as possible (e.g., by using boulder headlands).

- Forage Fish:
  - Negative: Areas of the shoreline currently suitable for forage fish spawning will be temporarily disturbed by beach nourishment.
  - Positive: Beach nourishment with mixed sand-gravel will preserve existing forage fish spawning habitat and provide new potential spawning habitat in areas that are currently not suitable (Roche Point, Little Cates, and West Beach; Figure 7, Figure 8). This will increase the area of suitable forage fish spawning habitat across the shoreline.
- High Marsh / Dunegrass:
  - Negative: A small area (approximately 35 m^2) of high marsh / dunegrass habitat will be impacted by fill placement.
  - Positive: The new beach nourishment at Roche Point will provide 534 m^2 of substrate at an elevation suitable for coastal dunegrass habitat and will be planted with vegetation from local nursery stock, resulting in a net gain in dunegrass habitat (Figure 5, Appendix A2 in the Supplemental Report).
- Macroalgae:
  - Negative: The Program footprint is located in the upper intertidal and does not overlap with the majority of marine vegetation at the Site. However, a small amount of intertidal macroalgae is likely to be temporarily disturbed (Figure 7, Figure 8).
  - Positive: Seaweeds will recolonize the hard elements of the design (rock headlands) following construction resulting in a net gain in mid intertidal rocky substrate habitat.
- Riparian Vegetation:
  - Negative: There will be no negative impacts to riparian vegetation from the project.
  - Positive: Removal of invasive plants and planting of culturally important native species (herbs, shrubs, trees; Appendix A2 and Appendix A5 in the Supplemental Report) will benefit fish and wildlife. There will be a net increase in native riparian vegetation (581 m^2).
- Invertebrates:
  - Negative: Despite conducting a salvage of mobile invertebrates prior to construction, some benthic infauna and other attached invertebrates will be buried by the beach nourishment.
  - Positive: New rock headlands will be colonized by epibenthic invertebrates (e.g., mussels and barnacles) and the new beach nourishment will be colonized by benthic invertebrates.

6.2 IMPACTS RELATED TO CONSTRUCTION

Fish habitat usage may be temporarily altered during construction. Potential temporary and short-term adverse impacts could arise from:

- Accidental disturbance or destruction of marine algae and sessile invertebrates;
- Accidental spills to water (e.g., fuel and oil for machinery);
- Changes in habitat use by fish during construction;
- Increased turbidity from exposed fines during infilling; and
- Increased (out of water) noise during construction.

There may be temporary loss of intertidal algae and sessile invertebrates growing in the intertidal, but these species are expected to recolonize the rock headlands following construction. Increases in turbidity and noise are expected during infilling and will likely deter fish from using the area, but these impacts will be minimized through water quality monitoring. Increased turbidity also has the potential to impact local marine vegetation, however, eelgrass and sugar kelp can tolerate a certain degree of sedimentation and short-term increases in turbidity are unlikely to cause harmful impacts. Most works will be conducted in the dry at low tide, thus the potential for direct fish mortality because of the Program works is considered very low.

7.0 AVOIDANCE AND MITIGATION MEASURES

Program construction activities shall be completed under the guidance of an Environmental Monitor (EM) and adhere to environmental protection measures outlined in a Construction Environmental Management Plan (CEMP). The avoidance and mitigation measures in the CEMP will be developed in consideration of the Site Assessment Report (Hatfield et al. 2023) findings and will be implemented during the planning and construction of the shoreline restoration. The Contractor, their employees, and subcontractors will be required to adhere to the CEMP.

The required avoidance and mitigation measures that are proposed for inclusion in the CEMP are summarized here:

- Water quality monitoring will be conducted during beach nourishment to monitor turbidity from suspended fines. Silt curtains are not recommended in intertidal areas.
- Deleterious substances shall be prevented from entering the marine environment. Equipment used for construction will be maintained and inspections completed to verify they are clean and free of leaks prior to working near water. Preparedness for spills near water will include a drum-style spill kit adjacent to the work area and a Spill Prevention and Response Plan (to be included in the CEMP).
- Fill brought to site will meet Disposal at Sea guidelines and all newly placed materials (fill, gravel, rock, etc.) will be free from invasive species and noxious weeds.
- In-water works will occur within the DFO least-risk timing window for Burrard Inlet (Area 28; August 16 to February 28).

- Barges or other over water equipment will be prevented from grounding on the seabed.
- Equipment working over water will use readily biodegradable hydraulic fluids.
- While refuelling, all operators shall stay with the fuel nozzle. Ignition shall be turned off while the vehicle, equipment or machinery is being refuelled. The operator shall immediately shut off the source if a spill occurs.
- All applicable legislation with respect to the handling, transportation, and/or disposal of all materials (waste or otherwise) shall be adhered to. These regulations may include (but not be limited to) the BC Hazardous Waste Regulations, Spill Reporting Regulations, Workers Compensation Board Regulations, Transportation of Dangerous Goods Regulations, etc.
- An Invasive Species Management Plan has been drafted to provide guidance on how invasive plants and animals will be removed during the Program (Appendix A5 in the Supplemental Report). Non-plant invasive species management shall be included within the CEMP (Appendix A4 in the Supplemental Report) and will include proper identification, sampling methods and data collection standards for invasive European green crab, as per DFO guidelines.

8.0 POTENTIAL FOR DEATH OF FISH AND HADD

The fish and fish habitat protection provisions of the *Fisheries Act* (2019) regulate works, undertakings or activities that risk harming fish and fish habitat. Specifically, they include two core prohibitions against persons carrying on works, undertakings or activities that result in:

- The death of fish by means other than fishing; and
- HADD of fish habitat unless authorized by the Minister of DFO.

Hatfield's opinion of whether there will be death of fish or HADD, as defined under DFO's Fish and Fish Habitat Protection Policy Statement (DFO 2019), is discussed below.

8.1 DEATH OF FISH

The potential for fish mortality as a result of the Program is considered very low. Death of fish will be prevented via several avoidance and mitigation measures, including environmental monitoring of construction activities, preventing adverse effects on water quality by taking measures to prevent deleterious substances and sediments from entering the water, and undertaking construction within the Least Risk Window. Infilling activities will be limited to the upper intertidal and thus can be conducted primarily at low tide. Any motile species (such as crabs) within the work area will be salvaged prior to construction. Although sessile organisms will be susceptible to burial and crushing during infilling activities, they will readily recolonize following construction.

8.2 HADD OF FISH HABITAT

HADD is interpreted as “any temporary or permanent change to fish habitat that directly or indirectly impairs the habitat’s capacity to support one or more life processes of fish” (DFO 2019). Hatfield does not expect there to be any impairment to fish as a result of the Program. The disturbance and alteration of intertidal habitat associated with the Program are not considered a HADD as the beach nourishment is expected to enhance, rather than harm fish habitat.

Consistent with TWN’s philosophy, this design utilizes nature-based approaches to shoreline protection and restoration. The Program would provide a net gain in fish habitat diversity, area and quality by (1) preserving and enhancing beach conditions suitable for forage fish spawning; (2) increasing the area of high marsh / dunegrass vegetation; (3) enhancing degraded riparian areas by removing invasive plants and replacing with native, culturally important shrubs and trees that will provide shade to forage fish spawning habitat.

8.2.1 Phase 1: Roche Point and East Beach

The footprint for Phase 1 of the Program is approximately 15,291 m^2 (Figure 7, Figure 8), including approximately 9,459 m^2 of existing vegetated and unvegetated habitat below the Ordinary High Water Mark (OHWM), defined in this assessment as higher high water mean tide (HHWMT; +1.5 m GD). The existing marine habitat will be temporarily altered by the beach nourishment. Existing high marsh / dunegrass vegetation within the Phase 1 footprint is limited (~30 m^2) and the restoration is expected to provide a net gain in high marsh / dunegrass habitat (534 m^2). Phase 1 impacts on marine algal populations are expected to be small and temporary. The marine algae currently growing on the foreshore is common in Burrard Inlet, seasonal (e.g., *Ulva*) and readily recruits and grows in the spring and summer (Thom 1980). Therefore, marine algae are expected to recruit and reestablish on the foreshore at a similar level of productivity following restoration with no net loss of habitat area. Similarly, sessile invertebrates such as mussels and barnacles are also expected to colonize intertidal rocky substrates after construction. Beach nourishment with mixed sand and gravel is intended to preserve existing (East Beach) suitable forage fish spawning habitat and create new (Roche Point) suitable forage fish spawning habitat within the upper one third of the tidal range, which at the Site is approximately 0 to +1.5 m GD. Riparian vegetation in the footprint will not be impacted, with the exception of the removal of some invasive species, and planting at Roche Point will provide a net gain in native riparian habitat (225 m^2).

8.2.2 Phase 2: West Beach, Central Beach, and Little Cates

The footprint for Phase 2 of the Program is approximately 10,654 m^2 (Figure 7, Figure 8), including approximately 6,369 m^2 of existing vegetated and unvegetated habitat below the OHWM. The existing marine habitat will be temporarily altered by the beach nourishment. Existing high marsh / dunegrass vegetation within the footprint is limited (~ 5 m^2) and the restoration from Phase 1 (at Roche Point) is expected to provide a net gain in marsh habitat. As in Phase 1, the impacts of Phase 2 on marine algal populations are expected to be temporary and beach nourishment with mixed sand and gravel is intended to preserve existing (Central Beach) and create new (West Beach and Little Cates) suitable forage fish spawning habitat. Riparian vegetation in the footprint will not be impacted, with the exception of some invasive species removal, and planting at Little Cates will provide a net gain in native riparian habitat (356 m^2).

9.0 MONITORING AND MAINTENANCE

TWN and DNV will undertake annual monitoring of the constructed habitats for at least three years (sampling to occur in years 1 and 3) post-construction, under the direction of a Qualified Environmental Professional (QEP). Monitoring will assess the following criteria for each habitat type:

- Sediment retention;
- Vegetation establishment and survivability;
- Habitat use by marine and terrestrial wildlife; and
- Presence of invasive species.

Monitoring will determine the overall success of the design and determine if adaptive management strategies are required. Standard landscape maintenance and management measures (e.g., mowing) will also be implemented as needed. Long-term management of the Site will be conducted in accordance with traditional Indigenous stewardship practices and knowledge. It is anticipated that beach nourishment will need to be repeated within a 10 to 15 year timeframe.

10.0 SUMMARY AND CONCLUSIONS

Since time immemorial, TWN has lived, travelled, and protected the waters and land around Burrard Inlet. Tsleil-Waututh means “People of the Inlet” and connection to the shoreline and healthy marine ecosystems are integral to TWN well-being and way of life. Shoreline erosion driven by changes to local sediment dynamics from urban and industrial development, as well as increased wave action associated with heavy boat traffic, continues to threaten archaeological sites and recreational assets in the park. Without intervention, these issues will continue to impact the Whey-ah-Wichen shoreline and are likely to worsen with sea level rise. The Program aims to mitigate the impacts of shoreline erosion, using data-driven research, Indigenous Knowledge, nature-based design principles, and community engagement. The design also aims to reconnect TWN community members to the shoreline, facilitating intergenerational knowledge transfer and promoting TWN interactions with nature, stewardship, place-based learning, and future harvesting. The Program advances TWN’s overall vision for improving the health of Burrard Inlet and takes action to restore marine habitat and build community resilience to sea level rise and other climate change impacts. The Program is not anticipated to cause residual harmful impacts to fish and fish habitat, but rather benefit fish by improving habitat quality and enhancing habitat connectivity in Burrard Inlet.

11.0 REFERENCES

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