

7.2 Marine Transportation

7.2.1 Introduction

This section of the Environmental Assessment Certificate (EAC) Application/Environmental Impact Statement (EIS) (hereafter referred to as the EA.) has been prepared by Golder Associates Ltd. (Golder). It addresses the effects of the Proposed BURNCO Aggregate Project (hereafter referred to as the 'Project') identified in the construction, operation, reclamation and closure phases on valued components (VCs) related to Marine Transport. Consideration has been given to mitigation measures proposed to mitigate any identified effects to acceptable levels and any residual effects have been characterized. Additionally, consideration has also been given to cumulative effects of other reasonable foreseeable future projects in combination with the residual effects of the Proposed Project.

Marine navigation and vessel wake have been selected as VCs as Project-related activities may interact with the public's right to navigate within Howe Sound. The construction and operation of Project-related marine infrastructure (e.g., load out jetty) may interfere with navigation and could affect the public's right to navigate or add a hazard to navigation. In addition, Project-related barging and water taxi traffic may interfere with navigation by vessels transporting cargo or passengers, fishing and recreational vessels.

Navigable waters are defined as "any body of water capable of being navigated by any type of floating vessel for the purpose of transportation, recreation or commerce" (Transport Canada 2014a). This section has considered the potential of the Project to disrupt the movement of commercial and non-commercial marine traffic in navigable waters and also the associated wake effects of Project vessels.

This section should be read in conjunction with the following technical baseline report(s) provided in Volume 4, Part G - Section 22.0.

- Appendix 7.2-A - Vessel Wake Wash Analysis
- Appendix 7.2-B - Large Vessel Movements 2011 to 2013

Other assessments that relate to marine transportation have been considered in the following sections of EAC Application/EIS:

- Volume 2, Part B - Section 5.2 (Marine Resources) - addresses the effects of marine transportation on marine water quality and wake effects on shoreline habitats;
- Volume 2, Part B - Section 7.3 (Non-Traditional Land and Resource Use) - addresses marine recreation and tourism activities, areas, access and use levels;
- Volume 2, Part B - Section 7.4 (Visual Resources) - addresses the visual effects of marine transportation; and
- Volume 3, Part D - Section 14.0: (Accidents and Malfunctions) - addresses the potential environmental effects as a result of accidents and malfunctions related to marine transportation.

7.2.2 Regulatory and Policy Setting

The regulatory and policy setting for marine transportation is governed by the physical construction of marine related Project infrastructure and marine transportation activities connected with the Project. The *Navigation Protection Act* and other maritime legislation, and voluntary measures applicable to the Project are outlined in the following sections.

7.2.2.1 Navigation Protection Act

The *Navigation Protection Act*, as amended in 2014, protects the public's right to navigate waters of Canada and regulates construction work that may infringe on this right. This statute specifically prohibits the unauthorised construction or placement of work on, over, under, through or across scheduled Canadian navigable waterways. The term 'work' is defined as any structure, device or thing temporary or permanent, made by a human that is 'in, on, over, under, through or across' any navigable water. The term 'work' also includes the dumping of fill, or the excavation of materials from the bed of any navigable water (Transport Canada 2014a).

The Navigation Protection Program is a Transport Canada (TC) program that administers and enforces the *Navigation Protection Act*. Under the *Navigation Protection Act*, a 'Notice to the Minister' (of Transport) will be required for the Proposed Project to identify likely interferences with commercial shipping and recreational boating activities (Transport Canada 2014b). Subsequently, prior approval from TC must be obtained before construction of marine infrastructure associated with a project. Approval is subject to a review of the final design and development, and may include specific stipulations for navigational safety, lighting requirements, along with the addition of navigational aids and updating Canadian Hydrographic Service (CHS) charts.

7.2.2.2 Applicable Marine Legislation

Legislation and other maritime requirements applicable to Proposed Project-related vessel movements may include, but should not be limited to the following:

- **Canada Shipping Act (2001)** – is the principal statute governing safety in marine transportation and recreational boating and applies to all Canadian vessels operating in all Canadian waters. Proposed Project-related marine activities must be undertaken in accordance with all applicable parts of this act. The *Canada Shipping Act (2001)* is the enabling legislation for the following regulations (Transport Canada 2014a):
 - *Anchorage Regulations*;
 - *Collision Regulations*;
 - *Charts and Nautical Publications Regulations*;
 - *Navigation Safety Regulations*;
 - *Steering Appliances and Equipment Regulations*;
 - *Vessel Traffic Services Zones Regulations*;
 - *Voyage Data Recorder Regulations*; and
 - *Vessel Operation Restriction Regulations*.

- **Marine Liability Act** (2001) - makes the owner and/or operators of vessels liable for that vessel and the specific consequences of its operation.

7.2.2.3 Marine Transport Authorities

The main authorities with maritime responsibility in Howe Sound are:

Transport Canada (TC) - TC is responsible for transportation policies and programs that promote safe, secure, efficient and environmentally responsible transportation (Transport Canada 2014c). In the context of marine transport, TC provides jurisdiction in the following areas (Transport Canada 2014c):

- Responding and investigating marine accidents within Canadian waters;
- Enforcing marine acts and regulations;
- Establishing and enforcing marine personnel standards and pilotage;
- Marine safety;
- Marine security; and
- Regulating the operation of marine vessels in Canadian waters.

Transportation Safety Board of Canada (TSB) - The TSB is an independent agency that is responsible for investigating safety through investigation of collision occurrences, including those in marine environments (TSBC 2014). The *Canadian Transportation Accident Investigation and Safety Board Act* (1989) provides the legal framework that governs TSB activities.

Canadian Coast Guard (CCG) - The CCG is mandated by the *Canadian Shipping Act* and provides marine programs and services such as search and rescue, boating safety, environmental response, icebreaking services, marine navigation services, marine communications and traffic services (MCTS) and navigable waters protection (CCG 2014a). The CCG's MCTS branch in Vancouver is responsible for all waters located within Howe Sound, including the local study area (LSA). MCTS and the Regional Marine Information Centre located in Vancouver provide marine safety and communications co-ordination to all marine vessels for (CCG 2014b):

- Vessel Traffic Services (VTS);
- Waterway management;
- Weather conditions and safety information;
- Sail plan services;
- Marine safety and navigation information; and
- Notices to Shipping (NOTSHIP).

Pacific Pilotage Authority (PPA) - is dedicated to providing safe, efficient pilotage by working in partnership with pilots and the shipping industry to protect and advance Canadian interests (PPA 2013). Under the *Pilotage Act*, international vessels of 350 gross tonnes or larger, travelling in Canadian waters, are legally obliged to use the services of a Canadian marine pilot. The PPA provides regulatory control, including dispatch and communication, for British Columbia (BC) Coast Pilots and the Fraser River Pilots (PPA 2013). A marine pilot is a professional licensed mariner whose role is to advise the captain of a ship on the safest route to be taken to bring a vessel into its port of call (BC Coast Pilots 2014).

7.2.3 Assessment Methodology

This section provides a description of the methodology used in preparing the marine transportation effects assessment. The effects assessment methodology is further described in Volume 2, Part B - Section 4.0.

7.2.3.1 Valued Component Selection and Rationale

This section describes the VCs and measurable indicators related to marine transportation. The VCs reflect issues identified by BC EAO and CEA Agency, Aboriginal groups, other stakeholders, and professional judgment and key sensitive resources, species or social and heritage values. All identified candidate marine transportation VCs were carried forward in the effects assessment (e.g., no marine transportation VCs were excluded from the assessment). Additional details regarding the methods used to select VCs is provided in Part B, Volume 2 – Section 4.2.4.

Potential issues to be assessed include the potential effects of Proposed Project-related infrastructure and vessel traffic during the construction, operation and reclamation and closure phases of the Proposed Project on commercial and recreational marine users within Howe Sound. Potential effects from construction and operation of marine infrastructure and associated shipping activities on current Aboriginal uses for traditional purposes will be assessed in Part C.

The identified VCs and their rationale and measurable indicators used to describe existing conditions and Proposed Project-related effects for the marine transportation VCs are presented in Table 7.2-1.

Table 7.2-1: Valued Components and Measurable Indicators: Marine Transportation

Valued Component	Rationale	Measurable Indicators
Marine Navigation	<ul style="list-style-type: none"> Proposed Project-related marine infrastructure (e.g., load out jetty) and vessel traffic from the Proposed Project could affect the ability of the various marine users to navigate within the LSA. 	<ul style="list-style-type: none"> Marine corridors, routes and anchorages. Navigation use (i.e., marine vessel and watercraft traffic, including type, volume and seasonality). Proportion of navigable channel affected by construction, operation and removal of marine infrastructure. Location of fisheries, including fishing vessel access routes overlapping with Proposed Project infrastructure and barging routes. Recreational destinations and access routes overlapping with Proposed Project infrastructure, barging and water taxi routes.

Valued Component	Rationale	Measurable Indicators
Vessel Wake	<ul style="list-style-type: none"> Wake associated with Proposed Project vessels within the barging route may lead to adverse effects to shoreline infrastructure. Wake associated with Proposed Project may affect other vessels. 	<ul style="list-style-type: none"> Wave intensity based on vessel characteristics.

7.2.3.2 Assessment Boundaries

7.2.3.2.1 Spatial Boundaries

The spatial boundaries for the EA have been selected to take into account the physical extent of the Proposed Project-related effects and any key environmental systems. The specific study areas for marine transportation are provided in Table 7.2-2.

Table 7.2-2: Spatial Boundaries: Marine Transportation

Study Area	Description
Local Study Area (LSA)	<p>The LSA encompasses the marine-based portion of the Proposed Project, including water taxi routes and the barging route from the Proposed Project site through Howe Sound, Ramilles Channel, Thornbrough Channel, and Queen Charlotte Channel to south of Passage Island.</p> <p>A 1 km assessment buffer in the marine environment will be applied. The LSA is inclusive of all current and Proposed Project-related marine infrastructure, control and approach zones.</p>
Regional Study Area (RSA)	Same as for LSA
Cumulative Effects Assessment Area	Same as for LSA

The spatial extent of the LSA includes the footprint of Proposed Project-related marine infrastructure and is inclusive of control zones and a 100 m approach zone (Figure 7.2-1). The LSA also includes the proposed water taxi routes and the barging routes from the Proposed Project site through Howe Sound, Ramilles Channel, Thornbrough Channel, and Queen Charlotte Channel to south of Passage Island.

The RSA is the same as the LSA as it encompasses the area within which the residual effects of the Proposed Project are likely to combine with the effects of other projects and activities to result in a cumulative effect on marine transportation. The LSA and RSA account for potential effects from the Proposed Project-related barge and water taxi movements along the entire route in Howe Sound reflecting the concerns of key stakeholders and Transport Canada (Figure 7.2-1).

Proposed Project-related barges that are transiting to and from existing BURNCO facilities outside of Howe Sound will replace existing BURNCO vessel traffic in the Strait of Georgia and the South Arm of the Fraser River, and therefore this area has not been included in this assessment. The spatial scope of the assessment was agreed to by CEAA on November 12, 2013 (CEAA 2013 pers. comm).

7.2.3.2.2 Temporal Boundaries

Based on the Proposed Project schedule, the temporal boundaries for the effects assessment related to marine transportation are as follows:

- Project construction – up to 2 years following approval;
- Project operations – 16 years; and
- Project reclamation and closure – on-going and 1 year beyond operations.

See Volume 1, Part A - Section 2.0 for a description of activities proposed during these phases of development.

7.2.3.2.3 Administrative Boundaries

DFO's harvest and vessel activity data reporting structures present minor limitations for analysing fish and seafood historical activity data within the marine transportation LSA. DFO fish and seafood harvesting data are publicly reported at the Pacific Fisheries Management Area (PFMA) and PFMA sub-area levels (sub-area).

7.2.3.2.4 Technical Boundaries

The assessment with respect to small vessel traffic within the LSA has been based primarily on DFO data and information collected through interviews because it is not mandatory for commercial vessels under 20 metre (m) to install and use an Automatic Identification System (AIS). This automatic tracking system is employed by vessel operators and vessel traffic services for identifying and locating vessels by electronically exchanging data with other nearby vessels and AIS base stations. While the purpose of these communications is primarily for vessel traffic control, collision avoidance, and other maritime safety and security applications, the system's aggregate data also provides an extremely detailed history of vessel traffic movements that can be applied to determine patterns of vessel movement and establish numbers of vessels in traffic lanes, port areas, and regions by vessel type.

The navigation and safety risks related to marine accidents (boating accidents and barge shipping accidents) are considered in Volume 3, Part D - Section 14.0.

7.2.3.3 Assessment Methods

7.2.3.3.1 Existing Conditions

Marine transportation baseline information was obtained from available public reports, government produced statistics, marine safety and vessel traffic reviews, which included the following sources:

- Fisheries data from DFO's Statistical Service Unit;
- VTS data from the CCG;

- Marine activity and recreational feature data from BC Marine Conservation Association (BCMCA) and the BC Ministry of Environment EcoCat database GeoBC - Coastal Resource Information Management System (CRIMS);
- Ferry schedules from BC Ferries;
- Marine transport statistics from Statistics Canada;
- Nautical charts of Howe Sound from the CCG's Canadian Hydrographic Service;
- Existing marine safety and vessel traffic reviews;
- Submitted EA applications and studies under the *British Columbia Environmental Assessment Act* (2002) and the *Canadian Environmental Assessment Act* (2012); and
- Peer-reviewed academic literature.

The desktop studies and interviews summarised in Table 7.2-3 were also undertaken to provide further information on marine transportation.

Table 7.2-3: Summary of Desktop Studies Related to Marine Transportation

Study Name	Study Purpose
Marine Traffic Analysis	ArcMap Geographical Information Systems (GIS) software was used to perform marine network analysis of available Satellite Automatic Identification System (AIS) and CCG MCTS VTS calling in point data.
User Group Interviews	Informational interviews were conducted with key informants to inform the baseline study, especially in the area of recreational boating use patterns.
Time Lapse Photography	Time lapse photography was used to identify recreational boating traffic in the vicinity of the Proposed Area.

7.2.3.3.1.1 Marine Traffic Analysis

Available VTS 'calling in point' data for the Howe Sound portion of the Vancouver traffic regulating zone for the 2011-2013 period was obtained from the CCG. This data was sorted by date, route and vessel type¹. To supplement this information, satellite AIS data was also obtained from a third party vendor for a one year period (2013) for an area encompassing the LSA. Using data from these two sources as inputs, ArcMap GIS software was used to perform marine network analysis to construct routes of existing marine traffic in the LSA by connecting each sequenced data point along the proposed marine corridor.

7.2.3.3.1.2 User Group Interviews

Interviews were undertaken to understand historical, present, and future uses of the LSA related to marine transportation. Interviewees were selected based on their marine use of the area and their knowledge of different

¹ CCG (2013) data only includes commercial vessels 20m or >, required to report their position to call in as they arrive, depart or move within Howe Sound.

factors or variables that influence marine-based activities. Interviews were conducted either in-person or over the phone. Individuals who were interviewed or provided data for this report included representatives from marine operators, recreational groups, tourism operators, DFO and other marine stakeholders.

7.2.3.3.1.3 Time Lapse Photography

Three time lapse cameras were installed at the following two locations: Woolridge Island, orientated south towards Thornbrough Chanel, and McNab Point, orientated southeast towards Ramillies Channel. The cameras were installed between October 11, 2012 and November 13, 2012, mounted approximately 2.5 m from ground level, and switched to continuous shooting mode with a picture interval of 5 minutes. The camera had a maximum resolution of 3.1 megapixels enabling the identification of vessels up to 3 km away. A 5 minute interval was set to capture vessel movements. As a result of the 5 minute photo interval, the cameras did not consistently capture fast moving vessels, such as motor boats. The limited timeframe of one month for data gathering during the fall season means that the collected data is indicative of only traffic during that season.

7.2.3.3.1.4 Vessel Wake Assessment

A full description of the methods used for the vessel wake assessment has been provided in the Vessel Wake Wash Analysis Report presented in Volume 4, Part G – Section 22.0: Appendix 7.2-A.

As described in this report, an empirical model was used to calculate wake wash parameters from each Proposed Project-related vessel including characteristic wave height, characteristic wave period, and wave energy. A data review of existing vessel information was performed to obtain the vessel characteristics for input into a model. The cumulative annual wave energy flux and the spatial distribution of the annual wave energy flux for wind-waves and wake wash were compared to determine the potential for effects on community resources. The two navigation routes shown in Figure 7.2-1 were considered for the wake wash analysis. A wind wave analysis was performed to compare the energy produced by potential worst case storm events in the area to the wake wash energy generated by Proposed Project vessels.

7.2.3.3.2 Identifying Project Interactions

A preliminary evaluation of identified interactions between the various physical works and activities and the selected VCs across all spatial and temporal phases of the Proposed Project was undertaken to characterize interactions as:

- a) Positive, none or negligible, requiring no further consideration; or
- b) Potential effect requiring further consideration and possibly additional mitigation.

This evaluation is presented in Section 7.2.5. A rationale is provided for all determinations that there is no or negligible interaction and that no further consideration is required. For those Proposed Project-VC interactions that may result in a potential effects requiring further consideration, the nature of the effects (both adverse and positive) arising from those interactions is described.

All Proposed Project interactions within the marine environment, including the construction of the load out jetty and the proposed shipping route, were considered in this analysis.

7.2.3.3 Evaluating Residual Effects

Potential Proposed Project-related residual effects were characterized as the basis for determining their significance for each VC. The characterization of effects was undertaken following the application of mitigation measures designed to reduce potential effects.

An overview description of the criteria used to characterise potential effects for all disciplines is provided in Volume 2, Part B - Section 4.0. The standard evaluation data has been summarised below:

- **Context** – the current and future sensitivity and resilience of the VC to change;
- **Magnitude** – the expected size or severity of the residual effect;
- **Extent** – the spatial scale over which the residual physical, biological and/or social effect is expected to occur;
- **Duration** – the length of time the residual effect persists;
- **Reversibility** – whether the effect is fully reversible, partially reversible or irreversible; and
- **Frequency** – how often the residual effect occurs.

A search of available literature identified no direct regulations or guidance directly applicable to the characterisation of marine transportation residual effects. Residual effects assessment criteria adopted for the purpose of this assessment are presented in Table 7.2-4 and Table 7.2-5.

The likelihood of potential residual effects occurring was also characterized for each VC using appropriate quantitative or qualitative terms. To derive a likelihood rating that indicates the probability of a certain effect to occur, implementation of mitigation measures were considered. For example, the likelihood of a certain effect is low, if there is a low potential of the event leading to the effect to occur, or if there are effective controls in place that can eliminate or reduce the magnitude or frequency of the effect. The following criteria were used to define likelihood:

- Low - likelihood of occurrence (0 to 40%) – Residual effect is possible but unlikely;
- Medium - likelihood of occurrence (41 to 80%) - Residual effect may occur, but is not certain to occur; and
- High - Likelihood of occurrence (81% to 100%) - Residual effect is likely to occur or is certain to occur.

Characterization of likelihood was based on professional judgement considering the available qualitative and quantitative data for each potential residual effect.

7.2.3.3.4 Evaluating Significance of Residual Effects

The significance of potential residual adverse effects on marine transportation was determined based on residual effect criteria described in and the likelihood of a potential residual effect occurring Section 7.2.3.3.3, a review of background information and available data, consultation with government agencies and other experts, and professional judgement. The rationale and determination of the significance of potential residual effects on marine transportation are provided in Section 7.2.5.5. All non-negligible residual adverse effects (i.e., significant and non-significant) will be considered for inclusion in a cumulative effects assessment.

7.2.3.3.5 Level of Confidence

The level of confidence for each predicted effect is discussed to characterize the level of uncertainty associated with the significance and likelihood determinations. Level of confidence is typically based on expert judgement and is characterized as:

- Low: Limited evidence is available, models and calculations are highly uncertain, and/or evidence about potential effects is contradictory.
- Moderate: Sufficient evidence is available and generally supports the prediction.
- High: Sufficient evidence is available and most or all available evidence supports the prediction.

The lack of data on recreational boating traffic in the LSA presents an element of uncertainty in the marine transport assessment.

Table 7.2-4: Criteria for Characterizing Potential Residual Effects: Marine Transportation – Marine Navigation VC

VC	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Marine Navigation	<p>Refers primarily to the sensitivity and resilience of the VC to change caused by the Proposed Project:</p> <p>Resilient: The area and its resources are resilient to change and can resist imposed stresses appropriately;</p> <p>Moderately Resilient: The area and its resources are moderately resilient to change and can resist imposed stresses appropriately;</p> <p>Sensitive: The area and its resources have little resilience to change and would resist imposed stresses poorly.</p>	<p>Negligible: Proposed Project will have a minor or no measurable change to navigation;</p> <p>Low: Low measurable change to navigation;</p> <p>Medium: Medium measurable change to navigation; or</p> <p>High: High measurable change to navigation.</p>	<p>Local: Effect restricted to LSA;</p> <p>Regional: Effect extends beyond the LSA; or</p> <p>Beyond Regional: Effect extends beyond the RSA</p>	<p>Short-term: <1 year;</p> <p>Medium-term: 1 year to life of Proposed Project; or</p> <p>Long-term: >life of Proposed Project.</p>	<p>Fully reversible: Effect reversible with reclamation and/or over time;</p> <p>Partially Reversible: Effect can be reversed partially; or</p> <p>Irreversible: Effect irreversible and cannot be reversed with reclamation and/or over time.</p>	<p>Low: Occurs rarely or during a specific period;</p> <p>Medium: Occurs intermittently; or</p> <p>High: Occurs continuously.</p>

Table 7.2-5: Criteria for Characterizing Potential Residual Effects: Marine Transportation – Vessel Wake VC

VC	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Vessel Wake	<p>Refers primarily to the sensitivity and resilience of the VC to change caused by the Proposed Project:</p> <p>Resilient: The area and its resources are resilient to change and can resist imposed stresses appropriately;</p> <p>Moderately Resilient: The area and its resources are moderately resilient to change and can resist imposed stresses appropriately;</p> <p>Sensitive: The area and its resources have little resilience to change and would resist imposed stresses poorly.</p>	<p>Negligible: Proposed Project will have no measurable effects;</p> <p>Low: Proposed Project will result in small effects in areas with minor shoreline infrastructure;</p> <p>Medium: Proposed Project will result in moderate effects areas with moderate shoreline infrastructure; or</p> <p>High: Proposed Project will result in high effects in high use areas with major shoreline infrastructure.</p>	<p>Local: Effect restricted to LSA;</p> <p>Regional: Effect extends beyond the LSA; or</p> <p>Beyond Regional: Effect extends beyond the RSA</p>	<p>Short-term: <1 year;</p> <p>Medium-term: 1 year to life of Proposed Project; or</p> <p>Long-term: >life of Proposed Project.</p>	<p>Fully reversible: Effect reversible with reclamation and/or over time;</p> <p>Partially Reversible: Effect can be reversed partially; or</p> <p>Irreversible: Effect irreversible and cannot be reversed with reclamation and/or over time.</p>	<p>Low: Occurs rarely or during a specific period;</p> <p>Medium: Occurs intermittently; or</p> <p>High: Occurs continuously.</p>

7.2.4 Baseline Conditions

7.2.4.1 *Traditional Ecological and Community Knowledge Incorporation*

TEK/CK information was gathered from a Project-specific study undertaken by *Skwxwú7mesh* (Squamish Nation) and from publicly-available sources. The TEK/CK information available at the time of writing was used to inform existing conditions and this effects assessment.

TEK/CK informed BURNCO's understanding of marine transportation. The main sources of this information include:

- Occupation and Use Study (OUS) undertaken by *Skwxwú7mesh* (Traditions 2015 a,b)
- An expert report produced on behalf of Tsleil-Waututh Nation for another project (Morin 2015)
- Regulatory documents for other projects in close proximity to the Proposed Project Area (e.g., Eagle Mountain – WGP 2015 a,b; PMV 2015; WLNG 2015).

Based on these sources of and additional information provided during consultation, TEK/CK sources were reviewed for information on the following:

- General location of harvesting areas
- Marine travel corridors
- Marine use and planning

TEK/CK sources available at the time of writing provided no specific information on routes used for marine transportation in the RSA. Following is a general discussion of Aboriginal Groups' use or marine transportation routes within Howe Sound.

Skwxwú7mesh's seasonal round that has developed over many generations and continues in modified form today includes Howe Sound. Seasonal movements to harvest resources from the land and sea remain of central importance to *Skwxwú7mesh* culture and economy. *Skwxwú7mesh* reports that travel sites in Howe Sound were important in traditional times for travel, providing access to harvesting and cultural sites. Most of these routes continue to be of importance to *Skwxwú7mesh* and are used to access fishing grounds, for hunting and resource gathering purposes and to access cultural and spiritual sites. Travel routes are also used for cultural purposes. Many of the travel routes identified connect to a network of main routes that run from the head of Howe Sound through both land and water, connecting to both sides of Howe Sound, across the sound and extending into Burrard Inlet, up the Sunshine Coast and across the Strait of Georgia. *Skwxwú7mesh* report harvesting in the waters surrounding McNab Creek and throughout Thornbrough Channel (Traditions 2015 a,b). More recently *kw'ech'tenm*, a village site on McNab Creek, has become one of the stopover places for the youth annual cultural journeys by canoe (Traditions 2015a; Traditions 2015b).

Tsleil-Waututh Nation reports that waterways within their Consultation Area were the principal means of travel between sites, summer camps, and hunting, fishing, and gathering locations. Their traditional land use studies record several canoe routes from Burrard Inlet to Squamish, where members travelled to the Squamish River estuary. Tsleil-Waututh report that waterways remain important travel corridors for their members for harvesting marine resources; their members seasonally travelling up Howe Sound to access the Squamish Valley (WLNG 2015).

Skwxwú7mesh's Land Use Plan, *Xay Temíxw*, describes part of *Skwxwú7mesh's* vision for the future of the territory. While it is predominantly focused on terrestrial portions of the territory, a *Skwxwú7mesh*-led marine use planning process has been initiated. While it is not sufficiently advanced to provide specific management guidance, the Land Use Plan represents an exercise of the Nation's governance rights, and the objectives therein provide guidance against which proposed uses of the territory may be evaluated.

For a full summary of Aboriginal Group use and occupancy of Howe Sound refer to Part C.

7.2.4.2 Navigation

7.2.4.2.1 Overview

Howe Sound is an estuarine, fjord-like, body of water that extends approximately 42 km north from its entrance at Passage Island on the Strait of Georgia, to its head at the Squamish River mouth. The islands of Bowen, Gambier, Keats, Anvil and a number of smaller islands intersect navigable channels in the Sound.

Tides within Howe Sound are mixed semi-diurnal and have a mean range of 3.2 m between tidal highs, and a maximum range of 5 m (Worley Parson 2013). Strong winds are frequent with the dominant prevailing directions from the north-northwest and south-southeast. There are areas, sheltered by nearby topography, where winds speeds are lower.

Proposed Project-related barges and water taxis will transit along established shipping routes used by other commercial vessels in Howe Sound (Figure 7.2-1) and will include passage through:

- Ramillies Channel (Route #1: preferred route);
- Thornbrough Channel (Route #2: alternate route); and
- Queen Charlotte Channel.

Ramillies Channel is situated east of the Proposed Project site between Gambier and Anvil Islands. It connects Thornbrough Channel with Queen Charlotte Channel. Ramillies Channel narrows to approximately 2,200 m between Gambier and Anvil Islands. Queen Charlotte Channel connects the eastern edge of Howe Sound with the much larger Strait of Georgia. BC Ferries terminals are situated in Horseshoe Bay and Snug Cove on the east coast of Bowen Island. The channel narrows to approximately 2,000 m between Snug Cove and Lookout Point.

Thornbrough Channel is located on the west side of Howe Sound, between McNab Creek in the north to Langdale on the Sunshine Coast and Gambier Island to the south. The channel is approximately 1,600 m in width at its narrowest point and is approximately 2,800 m in width between the Proposed Project site and the north shore of Gambier Island. There are deep-sea vessel berthing facilities in the channel at Port Mellon, situated approximately 7.5 km west of the Proposed Project site, and at the BC Ferries terminals located at Langdale on the Sunshine Coast and New Brighton on Gambier Island. The Thornbrough Channel route from the Proposed Project site to Queen Charlotte Channel will be used during times of poor weather conditions as it is more sheltered and less susceptible to strong winds and unfavourable sea conditions than Ramillies Channel.

7.2.4.2.2 Aids to Navigation

Aids to navigation are devices or systems, external to a vessel, that are provided to assist mariners in determining position and course, to warn of dangers or obstructions, or to advise mariners of the location of the best or preferred routes (CCG 2011). Aids to navigation can include:

- Fixed aids on the shoreline such as, lighthouses, radar reflectors, and fog signals;
- Other navigational lights and beacons; and
- Floating based navigational aids such as buoys.

CCG publishes annual information in *Notices to Mariners* that provides an up-to-date list of lights, buoys and fog signals along the Pacific Coast (CCG 2014c). Based on this list, key navigational aids in the LSA have been identified in Table 7.2-6.

All ships that meet the requirements for operating in Canadian Waters must obtain CCG MCTS VTS clearance before beginning a voyage from a Canadian location, or before entering Canadian waters. The CCG MCTS branch in Vancouver monitors ship traffic using radio communication, radar detection and AIS and documents ships position and speed approximately every four minutes with details on ship identification, flag-state, type of ship and size (BCMCA 2011). MCTS utilises real-time satellite, AIS and calling in point (CIP) information in providing VTS. When participating vessels are entering or exiting Howe Sound they must use one of two VTS radio CIPs when passing either Cape Roger Curtis/Gower Point (CIP 15C) or Cowan Point/ Point Atkinson (CIP 18) (Figure 7.2-2). Vessels must also call in at Halkett Point (CIP 16) when entering/exiting Ramillies Channel or Montagu Channels and call in at Grace Island/Langdale when entering/exiting Thornbrough Channel.

Table 7.2-6: Key Aids to Navigation

Name	ID Number	Location/Coordinates	Description
Ekins Point	428 G5423.6	49° 32' 06.5"N; 123° 22' 49.4" W	White cylindrical tower.
Grace Islands	429 G5423.3	On southwest extremity. 49° 25' 49.9"N;123° 26' 52.9"W	White cylindrical tower year round.
Point Atkinson	386 G5426	North point of entrance to Burrard Inlet. 49°19' 49.4" N;123 ° 15' 52.9"W	White hexagonal tower, red band at top with buttresses.
Point Cowan	418 G5419	49° 20' 08.2"N;123° 21' 39"W	White cylindrical tower. Radar reflector. Year round.
Snug Cove	419 G5422.5	49° 22' 47.8"N; 123° 19' 19.6"W	White cylindrical tower, green band at top.
Snug Cove North	419.5 G5422.6	49° 22' 52.4N; 123° 19' 34.4"W	White cylindrical tower, red band at top. Radar reflector. Year round.
Finisterre Island	420 G5423	On north extremity of island. 49° 25' 05.2"N; 123° 18' 31"W	White cylindrical tower. Radar reflector. Year round.
Hope Point	420.4 G5423.1	South end Gambler Island. 49° 25' 50.6"N; 123° 22' 05.3"W	White cylindrical tower. Year round.
Fishermans Cove	421 G5421.3	49° 21' 15.9"N;123° 16' 35.7"W	White cylindrical tower, with a red band at the top .Radar reflector. Year round.

Name	ID Number	Location/Coordinates	Description
Grebe Islets	421.2 G5421.35	49° 20' 27.9"N; 123° 16' 33.7"W	White cylindrical tower, red band at top. Year round.
Bird Islet	421.4 G5421.4	49 ° 21' 46.2"N; 123 ° 17' 31.4"W	White cylindrical tower, red band at top. Radar reflector. Year round.
Lookout Point	422 G5421.5	49° 22' 36.4"N; 123° 17' 25.7"W	White cylindrical tower, red band at top. Radar reflector. Year round.
Tyee Point	423 G5422	On west side of entrance to Horseshoe Bay. 49° 22' 49.6"N; 123° 16' 24.1"W	White cylindrical tower. Radar reflector. Year round.
Pam Rock	424 G5423.4	On rock. 49° 29' 16.6"N; 123 ° 17' 57.8"W	White cylindrical tower. Radar reflector. Year round.

Source: CCG (2014c) Notices to Mariners Pacific Coast – List of Lights, Buoys and Fog Signals – for the Strait of Georgia (last correction edition 07/2014) and Vancouver Harbour (last correction edition 06/2014). Notes: (1) while every effort has been made to capture all aids to navigation within the LSA, some aids may not be captured that are outside of the data reviewed.

7.2.4.2.3 Marine Accidents

The Transportation Safety Board of Canada publishes marine investigation reports for marine accidents across Canada. Three marine accidents have been identified in Howe Sound since 2001 (Table 7.2-7). All investigated accidents occurred between 2003 and 2005 and involved BC Ferries. No ongoing investigations are taking place within the LSA or Howe Sound. The potential of vessels collisions has also been discussed in Volume 3, Part D - Section 14.0.

Table 7.2-7: Marine Accidents in the LSA

Investigation Number	Occurrence Date	Report Title	Occurrence Location
M05W0111	6/30/2005	Loss of Propulsion, Subsequent Striking of Berthed Pleasure Craft and Grounding, Roll-on/Roll-off Ferry Queen of Oak Bay.	Horseshoe Bay, BC
M04W0006	1/11/2004	Collision, Between the Roll-on/Roll-off, Vehicle/Passenger Ferry Queen of Surrey, and Assist Tug Charles H. Cates V, Horseshoe Bay Terminal, British Columbia.	Horseshoe Bay Terminal, BC
M03W0073	5/12/2003	Engine Room Fire and Subsequent, Failure of the CO2 Distribution Manifold, Roll-on/Roll-off Passenger Ferry Queen of Surrey.	Queen Charlotte Channel, BC

Source: TSBC 2013

7.2.4.3 Marine Traffic and Activities

Howe Sound waterways are currently shared by a wide range of commercial, government and recreational vessels. Commercial and government vessels identified in Howe Sound include: ferries, tugs and barges, deep-sea bulk and cargo ships, Canadian Navy and other government ships, fishing boats and water taxis. Recreational vessels include yachts, pleasure boats, and self-propelled watercraft. A description of commercial, government and recreational-related traffic is provided in the following sections.

7.2.4.3.1 Large Vessel Traffic

Large vessel traffic within the LSA includes BC Ferries movements² along scheduled routes, deep-sea shipping traffic to Squamish Terminals and Port Mellon and tug and barge traffic (which is primarily related to forestry operations). There was a total of 12,909³ large vessel movements in Howe Sound in 2013 (Volume 4, Part G – Section 22.0: Appendix 7.2-B). BC Ferries accounted for the majority of vessel movements (73%) and tugs and barges accounted for the second highest number of movements (22%). Between 2011 and 2013, commercial traffic increased in Howe Sound by 724 movements (6%), due to a 13% increase in tug and barge traffic, and a 5% increase in the level of BC Ferries traffic.

The density of marine traffic within the LSA is presented in Figure 7.2-3. Areas of highest commercial marine traffic density within the LSA reflect ferry vessel traffic between Horseshoe Bay and Snug Cove on Bowen Island and between Horseshoe Bay and Langdale.

In Thornbrough Channel, traffic density is high between Gibsons and Port Mellon, but declines north of Port Mellon. Thornbrough Channel has a higher number of large vessel movements than Ramillies Channel and is the busier commercial route. There were 800 movements in Ramillies Channel in 2013 compared to 3,550 vessel movements in Thornbrough Channel. Tug and barge traffic accounts for approximately 59% of total barge traffic in Montagu/Ramillies Channels and 96% of total of large vessel traffic in Thornbrough Channel.

7.2.4.3.1.1 Ferries

The CCG data shows that BC Ferries vessels accounted for 9,438 (73%) of all vessel movements in Howe Sound in 2013. Horseshoe Bay is the largest BC Ferries terminal in Howe Sound and the terminal provides passenger and vehicle ferry services across the Strait of Georgia to Departure Bay in Nanaimo and across Howe Sound to Snug Cove (Bowen Island) and Langdale (located on the Sunshine Coast). During summer weekdays, there can be 77 ferry daily arrivals and departures, on average, at Horseshoe Bay. Typically, ferries depart and arrive at Horseshoe Bay between 0540 hours and 2200 hours, seven days a week (BC Ferries 2014).

Elsewhere in Howe Sound, there are ferry docks located on Keats Island and at New Brighton on Gambier Island. BC Ferries traffic movements are shown to be highest during the summer months of July and August, which corresponds with the main vacation season. The lowest periods for ferry traffic are the months of January and February.

All ferry routes are marked on CHS nautical chart 3536 (CHS 1995). BC Ferries vessels travelling on the Horseshoe Bay to Departure Bay route depart Horseshoe Bay and bear south off Lookout Point and transit through Queen Charlotte Channel exiting Howe Sound to enter the Strait of Georgia between Point Cowan and Passage Island. Vessels used for ferry services from Horseshoe Bay to Departure Bay are between 160 m to 139 m in length, and have a vessel displacement of 10,034 to 6,465 tonnes (BC Ferries 2014).

² "Movements" refer to every time a ship (or vessel) commences and ceases to be underway. Underway is defined as a vessel that is not at anchor, or made fast to the shore, or aground.

³ Source: CCG (2013) MCTS data from 2011 to 2013 and combined with satellite AIS data for 2013 for Howe Sound provided by Exact Earth (2013).

Notes: (1) data includes all movements within Howe Sound, including arrivals and departures from a site within Howe Sound, and movements within Howe Sound (2) only includes commercial vessels 20m or >, required to report their position to call in as they arrive/depart Howe Sound and move within Howe Sound.

7.2.4.3.1.2 Tugs and Barges

Tugs and barges accounted for 2,905 (22%) of total large vessel movements in Howe Sound (the second highest number of movements after BC Ferries) in 2013.⁴ Tug and barge traffic accounts for approximately 59% of total barge traffic in Montagu and Ramillies Channels and 96% of total of large vessel traffic in Thornbrough Channel.

The majority of the tug and barge vessel traffic in Thornbrough Channel is connected to forestry operations, such as the movement of logs to and from sorting booms and the movement of wood chips and pulp (Photograph #1 shows a typical tug towing a barge of wood chips through Thornbrough Channel; Photograph #2 shows a tug towing a log boom also in Thornbrough Channel). Photos from time lapse cameras installed on Woolridge Island and at the Proposed Project site over a period of twenty-nine days between October and November 2012 indicate that there was an average of 4.9 barge movements per day. An average of 0.4 barge movements per day were observed transiting past the Proposed Project site and the north shore of Gambier Island.

Tugs and barges also provide cargo transportation (e.g., food, petroleum and construction products) to the islands in Howe Sound. The main barging activity is concentrated at docks located on Gambier Island and Bowen Island. Tug and barge operators located within Howe Sound include Squamish Marine Services in Squamish, Mercury Transport in Horseshoe Bay and Crosby Marine Services in Gibsons. However, a large proportion of tugs and barges in Howe Sound are operated by Seaspan Marine, which is based in Vancouver.

Photograph 7.2-1: Tug and Barge loaded with wood chips in Thornbrough Channel



⁴ For some vessel types such as tugs and warships there are a higher number of vessel movements that have been captured in the location specific data for Montagu/ Ramillies and Thornbrough Channels than what is captured in the overall total vessel movement data for Howe Sound.

Photograph 7.2-2: Tug towing a log boom in Thornbrough Chanel

7.2.4.3.1.3 Deep-Sea Bulk/Cargo Ships

The active deep-sea port facilities within Howe Sound are located at Port Mellon and at Squamish. In 2013, there were a total of 179 deep-sea merchant bulk/general vessel movements in Howe Sound. Port Mellon has deep-sea berthing facilities, and handles an average of 50 vessel calls per year. Finished pulp and paper products are shipped from the terminal using specialised carrier vessels or Handymax sized vessels.⁵ Deep-sea vessels calling at Port Mellon generally access Howe Sound through Collingwood Channel and transit Thornbrough Channel to the Proposed Project site.

Squamish Terminals, located approximately 22 km northeast of the Proposed Project site provides deep-sea berthing, loading and unloading facilities that service pulp mills in the BC Interior, in-bound steel and other cargo products (Squamish Terminals 2014). Port facilities include two berths designed to handle up to Panamax sized vessels.⁶ The east berth has an apron of 137 m and a depth of 11.7 m and the west berth has an apron length 152.4 m and a depth of 12.4 m (Squamish Terminals 2014). Vessels calling at Squamish Terminals transit through Queen Charlotte Channel or Collingwood Channel and travel north through Montagu Channel to Squamish. Deep-sea vessels calling at Squamish Terminals would intersect the LSA in the waters of Queen Charlotte Channel.

⁵ Handymax vessels are typically between 150 m and 200 m in length, and between 40,000 to 50,000 dead weight tonnes (DWT) (IMC 2014).

⁶ Panamax vessels are typically between 180 m and 220 m in length, and between 50,000 to 80,000 dead weight tonnes (DWT) (IMC 2014).

7.2.4.3.1.4 Canadian Forces and Government Vessels

Canadian forces and government vessels accounted for 1% (176) of the large vessel movements in Howe Sound in 2013, but represent 18.5% of movements in Montagu and Ramillies Channels and less than 1% of movements in Thornbrough Channel.⁷

7.2.4.3.2 Small Vessel Traffic

Small vessel traffic in the LSA includes commercial fishing vessel and water taxi movements. It is not mandatory for commercial vessels under 20 m or pleasure yachts less than 30 m to participate in VTS or install AIS, therefore small vessels are not been captured in CCG vessel movement data.

7.2.4.3.2.1 Commercial Fisheries

The LSA lies within Pacific Fisheries Management Area (PFMA) 28 (Figure 7.2-4). The shipping route crosses through the following PFMA sub-areas:

- sub-area 28-2 (from Queen Charlotte Channel to Ekins Point);
- sub-area 28-3 (from Langdale to Ekins Point in Thornbrough Channel); and
- sub-area 28-1 (from Langdale to Hood Point).

Commercial seafood fisheries in the LSA include prawn, shrimp and crab. Fishing for prawn, shrimp and crab is typically carried out by using traps that are set and retrieved at a later time. Pink salmon was also fished commercially in 2013 for the first time since 1962. During the three day opening period, all commercial Pink Salmon fishing was outside of the LSA in the upper reaches of Howe Sound close to Squamish.

The number of seafood harvesting vessels operating in each sub-area on an annual basis between 2008 and 2012, as well as opening periods, is presented in Table 7.2-8. These data provide a ceiling for the maximum number of vessels that are likely to be active in a given sub-area at any one time. Vessels fishing for prawn had the highest number of boat days across the fishing areas.

Within the LSA, sub-area 28-1 (waters south of Gambier Island) had the highest concentration of vessel counts across all three shellfish species, with 40% of the LSA total. In comparison, sub-area 28-3, including waters close to the Proposed Project site, had 27% of the LSA vessels.

⁷ Based on the CCG (2013) data for Montagu/Ramillies Channels which shows a higher number of movements than the overall CCG movement data for Howe Sound (see Volume 4, Part G – Section 22.0: Appendix 7.2-B).

Table 7.2-8: Average Shellfish Fishing Vessel Counts in the LSA

Shell Fish Species	Opening Period	DFO sub-area	Vessel Count per year ¹	Length of shipping route in sub-area (Approx.)	Vessels count per km of shipping route in sub-area during the opening period ³
Prawn	May to the end of June Area closures occur before June.	28-3	17	17 km	1
		28-1	18	11 km	1.6
		28-2	18	11 km	1.6
Shrimp ²	Opens in June, duration dependent on the quota set for that year. Secondary opening may also occur in November.	28-3	4	17 km	0.2
		28-1	13	11 km	1.2
		28-2	6	11 km	0.5
Crab	June 15 until end of November.	28-3	0	17 km	-
		28-1	0	11 km	-
		28-2	1	11 km	0.1
Total Vessels		28-3	21		
		28-1	31		
		28-2	25		

Source: DFO 2014a; **Note:** (1) maximum number of vessels recorded per year for each sub-area based on data available from 2008 to 2012. Data also only reflects where gear is placed and therefore would not record fishing vessels crossing an area. (2): it is assumed that shrimp fishers will be catching both pink and sidestrip shrimp at the same time; therefore, the highest vessel count has been included. (3): highest number of prawn vessels that may be encountered per kilometer of the proposed shipping route in this sub-area.

7.2.4.3.2.2 Water Taxis

Within the LSA, private water taxi services are offered between Gibsons, West Vancouver and all of the inhabited islands in Howe Sound. Water taxis and crew boats are used to transport personnel to ongoing forestry operations in the McNab Creek area.

Water taxi providers operating in the LSA include: Squamish Marine Services located in Squamish; Mercury Transport located in Horseshoe Bay; Cormorant Water Taxi located in Snug Cove on Bowen Island; and Don's Water Taxi, Sunshine Coast Water Taxi and Gambier Water Taxi located in Gibsons (Figure 7.2-2). Anecdotal observations suggest that forestry accounts for between 8 to 10 water taxi movements to the Proposed Project site per day from docks situated close to Port Mellon (Don's Water Taxi 2014 pers. comm.). In addition, there are currently 6 to 8 water taxi movements to the Proposed Project site daily departing from Langdale and 4 water taxi movements departing daily from Squamish (Don's Water Taxi 2014 pers. comm.). The current level of traffic to the Proposed Project site is largely expected to continue for the next two years as timber harvesting in the McNab Creek area continues (Don's Water Taxi 2014 pers. comm.). The majority of this traffic to Proposed Project site will cease when current forestry operations in the McNab Creek area ends. However, water taxis and crew boats are likely to be required for access to future forestry activity planned for north Gambier Island and when timber harvesting resumes again in the McNab Creek area.

7.2.4.3.3 Recreational Vessel Traffic

The waters of Howe Sound are popular for recreational boating and other marine activities. It is not mandatory for pleasure yachts less than 30 m to participate in VTS or install AIS, therefore small recreational vessels are not captured in the CCG vessel movement data. However a general discussion of recreational boating within the LSA is provided in the following sections based on secondary sources and interviews with key informants.

7.2.4.3.3.1 Recreational Boating

Recreational boating routes are shown to largely follow the commercial vessel routes in Queen Charlotte, Ramillies and Thornbrough Channels (BCMCA 2011). Recreational vessels traverse the entire LSA. North Thornbrough Channel is a key recreational route in the vicinity of the Proposed Project (BCMCA 2011). The main boating season runs from May until September; however, recreational boating occurs year-round (Burrard Yacht Club 2014a, pers. comm; Thunderbird Yacht Club 2014b, pers. comm).

There is limited recreational marine activity within the marine footprint of the Proposed Project Area. Historic mooring dolphins and shallower water restrict access (Don's Water Taxi 2014 pers. comm.); however, recreational vessels regularly navigate in northern Thornbrough Channel beyond the Proposed Project Area and these waters are popular for cruising, fishing, waterskiing/wakeboarding and for access to destinations such as McNab Creek Strata, Burrard and Thunderbird Yacht Club outstations and Camp Latona children's camp: all of which are situated across Thornbrough on the north-shore of Gambier Island.

The Burrard and Thunderbird Yacht Club outstations provide overnight moorage facilities to members. Peak use of these outstations occurs between April and October, particularly on weekends. Observations from Proposed Project site visits from June 2010 to October 2012 verified this pattern of use: recreational boat moorage was observed to be highest July through September.

Winds in Thornbrough Channel are generally not conducive to sailing, and sail boats traversing the area tend to be under motor (Burrard Yacht Club 2014a, pers. comm). There are established recreational anchorages located west of the Proposed Project site at McNab Point (outside of the existing log tenure area) and east of the Proposed Project site adjacent to McNab Creek (BCMCA 2011). Based on interviews with the yacht clubs, it is understood that, during the summer, between two or three boats will be anchored near McNab Creek on any given weekend (Burrard Yacht Club 2014a, pers. comm; Thunderbird Yacht Club 2014b, pers. comm.). The area in Thornbrough Channel between Latona Passage and Ekins point is used during the summer months for water skiing and wakeboarding due to its relatively calm, protected waters (Burrard Yacht Club 2014a, pers. comm.; Squamish Yacht Club 2014b, pers. comm.).

Recreational boating routes to destinations in the LSA and associated recreational features such as marinas, boat launches and dive sites are shown in Figure 7.2-5. Key marinas and yacht clubs identified close to the LSA are presented in Table 7.2-9. Some of the popular recreational boating destinations with recreational routes intersecting the LSA (depending on where vessels are departing from) include:

- Porteau Cove Provincial Park;
- Snug Cove (Bowen Island);
- Plumper Cove Marine Park (Keats Island);

- Gambier Island Bays (West Bay, Centre Bay and Port Graves, Halkett Bay Marine Provincial Park);
- East of Bowen Island (Point Cowan to Point Atkinson);
- Collingwood Channel/Barfleur Passage; and
- Halkett Bay (Sunshine Kayaking 2014, pers. comm.; Sewell's Marina 2014b, pers. comm.; Thunderbird Yacht Club 2014b, pers. comm.; Burrard Yacht Club 2014a, pers. comm; BCMCA 2011).

As shown in Table 7.2-9 the waters of Queen Charlotte channel are also popular with recreational boating. There are six marinas and yacht clubs and two anchorages situated in Queen Charlotte Channel between Passage Island and Sunset Beach (Figure 7.2-5). The Bowen Island Yacht Club holds annual races in the spring, summer, fall and winter in the waters close to Bowen Island (Bowen Island Yacht Club, 2014a). The West Vancouver Yacht Club also hosts multiple races in these waters, including the two-day Howe Sound Regatta in September (West Vancouver Yacht Club, 2014). A further discussion of recreational marine-based activities, such as sea kayaking, waterskiing/wakeboarding and diving is included in Volume 2, Part B - Section 7.3 (Non-Traditional Land and Resource Use).

Table 7.2-9: Marina and Yacht Club Features in Howe Sound

Name	Location	Facilities	Approximate Number of Slips (where available)
Marinas			
Lions Bay Marina	Lions Bay	Dry stack storage	-
Bowen Island Marina	Snug Cove, Bowen Is.	Annual and overnight moorage	-
Gibsons Landing Harbour Authority	Gibsons	Moorage	-
Gibsons Marina	Gibsons	Moorage	400 slips
Union Steamship Co. Marina	Snug Cove, Bowen Island.	Annual and overnight moorage	-
Sewell's Marina	Horseshoe Bay	Annual and seasonal moorage	350 slips
Sunset Marina	West Vancouver, Queen Charlotte Channel.	Summer and summer moorage	110 slips in summer; 68 slips in winter
Thunderbird Marina	Fisherman's Cove, West Vancouver	Moorage	600 slips
Sea to Sky Marina	Squamish Harbour	Moorage	32 slips
Squamish Marine Services	Squamish Harbour	Moorage	40 slips
Yacht Clubs			
Thunderbird Yacht Club/ Gambier Outstation	North Gambier, Thornbrough Channel	Moorage	Capacity 50 boats; 100 members
Burrard Yacht Club / Ekins Point	North Gambier, Thornbrough Channel	Moorage	Capacity 12 boats; 400 members
Squamish Yacht Club	Squamish Harbour	Moorage(100 slips) for members (200+)	100 slips; 150+ members
West Vancouver Yacht Club/ Elliott Bay	Fisherman's Cove, West Vancouver	Moorage for members	700 members
Centre Bay Yacht Station	Centre Bay, Gambier Island	Moorage for members	100 members

Name	Location	Facilities	Approximate Number of Slips (where available)
Royal Vancouver Yacht Club/ Centre Bay	Alexandra Is., in Centre Bay, Gambier Island	Moorage for members	-
Bowen Island Yacht Club	Bowen Island	Moorage for members	-
False Creek Yacht Club / Union Steamship	Snug Cove, Bowen Island	Moorage for members	-
Vancouver Rowing Club / Union Steamship Outstation	Snug Cove, Bowen Island	Moorage for members	-
Gibsons Yacht Club	Gibsons	Moorage for members	140 members
Eagle Harbour Yacht Club	Fisherman's Cove, West Vancouver	Moorage (95 slips) and 125 members	95 slips; 125 members

Data Sources: Lions Bay Marina 2014; Bowen Island Marina 2014; Gibsons Landing Harbour Authority 2014; Gibsons Chamber 2014; Union Steamship Co. Marina 2014; Sewell's Marina 2014a; Sunset Marina 2014; Thunderbird Marina 2014; Boaters Blue Pages 2014; Squamish Marine Services 2014 pers. comm.; Thunderbird Yacht Club 2014a; Burrard Yacht Club 2014b; Squamish Yacht Club 2014a; West Vancouver Yacht Club 2014; Centre Bay Yacht Station 2014; Royal Vancouver Yacht Club 2014; Bowen Island Yacht Club 2014b; False Creek Yacht Club 2014; Vancouver Rowing Club 2014; Gibsons Yacht Club 2014; Eagle Harbour Yacht Club 2014 and Squamish Yacht Club 2014a.

7.2.4.3.3.2 Recreational Fishing

Recreational fishing boats traverse throughout the LSA. The LSA is situated in the following PFMA recreational fishing sub-areas:

- sub-area 28-A/J (Queen Charlotte Channel to Christie Islet);
- sub-area 28-E (Langdale to Hood Point);
- sub-area 28-D (Thornbrough Channel); and
- sub-area 28-B (Montagu Channel, Ramillies Channel and North Thornbrough Channel).

DFO's Creel Boat Based Survey indicated that sub-area 28-A/J (Queen Charlotte Channel/Southern Ramillies Channel) was the most popular area with 54% of boat trips recorded in this area between 2007 and 2012. Sub-area 28-B (Thornbrough Channel/ Anvil Island), was the second most popular sub-area within the LSA, accounting for 23% of the boat trips between 2007 and 2012.

Table 7.2-10: Recreational Boat Trips 2007-2013

Year	LSA Total	Sub-Area Recreational Fisheries Management Area 28 - Pacific Region			
		A/J*	B	D	E
2007	3,021	1,501	681	193	647
2008	2,725	1,643	420	368	294
2009	1,768	1,007	405	146	210
2010	2,051	952	519	230	350
2011	3,018	1,647	797	224	350
2012	1,876	941	460	320	155
2013	1,324	815	312	101	96

Source: DFO Creel Survey Data

* In 2011, subarea a became subarea J

The marine waters in front of McNab Creek are popular for crabbing and prawning and the season in Howe Sound runs June through September (Don's Water Taxi 2014, pers. comm; DFO 2014b, pers. comm). Salmon fishing also occurs in Thornbrough Channel, including in the McNab Creek area and around Anvil Island (Squamish Yacht Club 2014b, pers. comm.).

Popular salmon fishing locations with access routes traversing the LSA include the Defence Islands, Pam Rocks, Hole in the Wall (approximately 1 km north of the Horseshoe Bay ferry terminal), and waters around Bowen Island (e.g., Hutt Islands, Tunstall Bay, Curtis Point) (Squamish Yacht Club 2014b, pers. comm; Thunderbird Yacht Club 2014b, pers. comm.; Sunshine Kayaking 2014a, pers. comm.; Sewell's Marina 2014b, pers. comm). A further discussion of recreational fishing is included in Volume 2, Part B - Section 7.3.

7.2.4.4 Vessel Wake

Proposed Project-related barges will traverse Ramillies, Thornbrough and Queen Charlotte channels and water taxis use only Thornbrough Channel.

The western shoreline of Ramillies Channel contains one large riparian area that extends down to a wetland within Douglas Bay on Gambier Island. The rest of the western shoreline and the eastern shoreline are steep and rocky and consist of dense herbaceous forests with little or no development.

Thornbrough Channel includes developed shoreline recreational features, such as yacht club outstations, anchorages and McNab Strata dock (described in Section 7.2.4.3.3), in addition to deep-sea terminal facilities situated at Port Mellon and log boom grounds along the shore of Gambier between Port Mellon and Langdale. The northern section of the shoreline generally contains steep slopes and is heavily forested. Within the immediate Proposed Project Area there is a log boom ground and a number of mooring dolphins extend into the channel. The southern section of Thornbrough Channel contains a more developed shoreline including the BC Ferries Langdale Ferry terminal and a ferry terminal and marina at New Brighton on Gambier Island. In this southern section, the western shoreline is mostly low-sloping and developed while the eastern shoreline on Gambier Island is steep and heavily forested.

Queen Charlotte Channel contains a significant amount of developed shoreline recreational features (as described in Section 7.2.4.3.3) such as marinas, yacht clubs and private moorage docks. Horseshoe Bay Ferry terminal is on the eastern shore and the Bowen Island Ferry terminal is across from it on the western shoreline. A few riparian areas exist in Snug Cove and Apodaca Cove. The entrance to Queen Charlotte Channel from the Strait of Georgia contains patches of undeveloped forested lands along both the eastern and western shorelines. Shoreline slopes in this area are generally steep except in a few coves and where the ferry terminals are located.

As outlined in Section 7.2.4.3 above, a wide variety of commercial and recreational vessels transit through the LSA. Different vessel types create a wake wash with specific wave characteristics that depend on a variety of factors: vessel speed, shape and dimensions, vessel displacement of water and navigation depth. The wake wash generated by a moving vessel also varies spatially based on the local water depth that influences the transformation of the wakes as they travel to the shore⁸.

⁸ Local water depth refers to the depths that have effect on the wakes while they travel to the shoreline away from the navigation depth, also defined as the depth along the navigation line.

As described in Volume 4, Part G – Section 22.0: Appendix 7.2-A modelling of naturally occurring wind-wave energy in the vicinity of the LSA shows that winds from the north generate very small wave heights (less than 0.5 m) across channels due to the sheltering by local topography and short fetch. However, model simulations executed using a wind event from the south predicted wave heights ranging from 0.6 to 1.8 m across the channels. Wind-wave energy within the LSA varies based on the exposure of the shoreline to southerly wind events. From the assessment, wind-wave energy is largest along the shorelines of Queen Charlotte Channel because it is open to the longest southerly fetch across Strait of Georgia. Annual wind-wave energy is lower in magnitude, but still substantial along the east side of Montagu Channel and the south end of Gambier Island. Annual wind-wave energy is lowest in the LSA in Thornbrough Channel as it is more sheltered from wind-waves by local topography.

7.2.4.5 Summary

Commercial and government vessels identified in Howe Sound include ferries, tugs and barges, deep-sea cargo ships, Canadian Navy and other government ships, fishing boats and water taxis. BC Ferries vessel traffic accounts for the vast majority of vessel movements within the LSA; tug and barge traffic accounts for the second largest portion. Queen Charlotte and Thornbrough channels and the waters south of Gambier Island are shown to have the highest large vessel traffic levels. Vessel traffic calling at the Proposed Project site is restricted to maintenance and ongoing forestry operations in the McNab Creek area; however, the channel adjacent to the Proposed Project site is regularly traversed by recreational vessels and crab and prawn fishing occurs during opening periods. The same occurs throughout the LSA.

The intensity of vessel wake and resulting impact on shoreline infrastructure depends largely upon the size and speed of a vessel. Natural wind-wave energy is greatest along the shorelines of Queen Charlotte Channel because it is open to the longest southerly fetch across the Strait of Georgia. Annual wind-wave energy is lower in magnitude, but still substantial along the east side of Montagu Channel and the south end of Gambier Island. Annual wind-wave energy is lowest in the LSA in Thornbrough Channel as it is more sheltered from wind-waves by local topography.

7.2.5 Effects Assessment

7.2.5.1 Project-VC Interactions

An evaluation of identified interactions between the various physical works and activities and the selected VCs across all spatial and temporal phases of the Proposed Project is presented in Table 7.2-11 and Table 7.2-12. Potential Proposed Project-VC interactions are characterized as:

- a) Positive, none or negligible, requiring no further consideration; or
- b) Potential effect requiring further consideration and possibly additional mitigation.

A rationale is provided for each determination that there is no or a negligible interaction and that no further consideration is required. For those Proposed Project-VC interactions that may result in a potential direct, indirect and induced effects requiring further consideration, the nature of the effects (both adverse and positive) arising from those interactions is described in Section 7.2.5.2 below.

Table 7.2-11: Project-VC Interaction Table: Marine Transportation – Marine Navigation VC

Project Activities	Description	VC: Marine Navigation	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
Construction			
1. Crew and equipment transport	<ul style="list-style-type: none"> ▪ Daily water taxi movements ▪ Tug and barge transport of machinery/materials (est. 8 loads) ▪ Barge household and industrial solid waste barged off-site 	●	<ul style="list-style-type: none"> ▪ Interference with navigation use and navigability due to Proposed Project-related vessel traffic
2. Site preparation, including construction of the berms and dyke	<ul style="list-style-type: none"> ▪ Logging, clearing and grubbing ▪ Grading ▪ Construction of the berms and dyke ▪ Compaction and laying of gravel base ▪ Limited improvements to existing on-site road infrastructure 	○	<ul style="list-style-type: none"> ▪ No marine effect. Activity will not be considered further.
3. Processing area installation, including conveyors and materials handling system)	<ul style="list-style-type: none"> ▪ Installation and use of portable concrete batch plant for construction ▪ Installation of concrete foundations ▪ Installation of screens, crushers, wash plant, conveyor system and automated materials-handling system (i.e., reclaim tunnels) ▪ Installation of groundwater well as a source of make-up water for the wash plant 	○	<ul style="list-style-type: none"> ▪ No marine effect. Activity will not be considered further.
4. Substation construction and connection	<ul style="list-style-type: none"> ▪ Construct electrical substation adjacent to existing BC Hydro transmission line ▪ Construct outdoor switchyard, electric building, and 100 m transmission line 	○	<ul style="list-style-type: none"> ▪ No marine effect. Activity will not be considered further.
5. Marine loading facility installation	<ul style="list-style-type: none"> ▪ Remove existing mooring dolphins ▪ Steel pile installation ▪ Installation of conveyor, barge movement winch and mooring dolphins 	●	<ul style="list-style-type: none"> ▪ Interference with navigation use and navigability due to Proposed Project-related infrastructure
6. Pit development	<ul style="list-style-type: none"> ▪ Dry excavation to remove overburden/topsoil ▪ Installation of clamshell and floating conveyor 	○	<ul style="list-style-type: none"> ▪ No marine effect. Activity will not be considered further.

Project Activities	Description	VC: Marine Navigation	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
7. Other ancillary land-based construction works	<ul style="list-style-type: none"> ▪ Temporary construction infrastructure set up (trailers, temporary power, etc.) ▪ Upgrades to the existing heavy equipment maintenance shop and warehouse ▪ Upgrades to the existing fuelling facility for the storage of diesel and gasoline for on-site equipment ▪ Construct site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility and helipad ▪ Install contained washroom facilities ▪ Construct pump room for well/stream intake water distribution and fire-fighting 	○	<ul style="list-style-type: none"> ▪ No marine effect. Activity will not be considered further.
8. Other ancillary marine construction works	<ul style="list-style-type: none"> ▪ Removal of existing small craft dock; install temporary dock for worker access ▪ Construct new floating small craft dock, the with tie-up area for a float plane, serviced with 30 amp (A) 125 volt (V) shore power ▪ Barge household and industrial solid waste off-site 	●	<ul style="list-style-type: none"> ▪ Interference with navigation use and navigability due to Proposed Project-related infrastructure ▪ Interference with Navigation Use and Navigability due to Proposed Project-related Vessel Traffic
Operations			
9. Crew transport	<ul style="list-style-type: none"> ▪ Daily water taxi 	●	<ul style="list-style-type: none"> ▪ Interference with navigation use and navigability due to Proposed Project-related vessel traffic
10. Aggregate mining	<ul style="list-style-type: none"> ▪ Use of electric powered floating clamshell dredge ▪ Primary screening and conveyance of extracted material to processing area ▪ Install channel plug in WC 2 	○	<ul style="list-style-type: none"> ▪ No marine effect. Activity will not be considered further
11. Processing (screening, crushing, washing)	<ul style="list-style-type: none"> ▪ Screening to separate aggregate sizes ▪ Oversized gravels crushed ▪ Operation of wash plant fed using recycled water from two large storage tanks, supplemented with make-up water by a groundwater well. ▪ Drying and storage of fines and silt 	○	<ul style="list-style-type: none"> ▪ No marine effect. Activity will not be considered further

Project Activities	Description	VC: Marine Navigation	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
12. Progressive reclamation	<ul style="list-style-type: none"> Ongoing earth works (including site clearing, surface material removal) Fines and silt mixed with organic overburden material and used for infilling, re-vegetation and landscaping 	○	<ul style="list-style-type: none"> No marine effect. Activity will not be considered further
13. Stockpile storage	<ul style="list-style-type: none"> Processed sand and gravel conveyed to stockpile area Storage of processed materials in stockpiles 	○	<ul style="list-style-type: none"> No marine effect. Activity will not be considered further
14. Marine loading	<ul style="list-style-type: none"> Transfer of stored material using marine conveyor system Barge loading Site and navigational lighting 	○	<ul style="list-style-type: none"> No marine effect. Activity will not be considered further
15. Shipping	<ul style="list-style-type: none"> Barge traffic (delivery/collection) in Howe Sound, Ramillies Channel, Thornbrough Channel, and Queen Charlotte Channel Tug and barge transport of fuel and consumables Navigational lighting 	●	<ul style="list-style-type: none"> Interference with navigation use and navigability due to Proposed Project-related infrastructure Interference with navigation use and navigability due to Proposed Project-related vessel traffic
16. Refueling and maintenance	<ul style="list-style-type: none"> Refueling and maintenance of on-site equipment 	○	<ul style="list-style-type: none"> No marine effect. Activity will not be considered further
Reclamation and Closure			
17. Crew and equipment transport	<ul style="list-style-type: none"> Daily water taxi 	●	<ul style="list-style-type: none"> Interference with navigation use and navigability due to Proposed Project-related vessel traffic
18. Removal of land-based infrastructure	<ul style="list-style-type: none"> Remove surface facilities, including clamshell dredge, conveyor system, screens, crushers, wash plant, automated materials-handling system, heavy equipment maintenance shop and warehouse, fuelling facility, site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility, helipad and contained washroom facilities 	○	<ul style="list-style-type: none"> No marine effect. Activity will not be considered further

Project Activities	Description	VC: Marine Navigation	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
19. Removal of marine infrastructure	<ul style="list-style-type: none"> Remove marine facilities, in marine load out facility, jetty, conveyors and piles 	●	<ul style="list-style-type: none"> Interference with navigation use and navigability due to Proposed Project-related infrastructure.
20. Site reclamation	<ul style="list-style-type: none"> Final completion of the pit lake, landscaping and re-vegetation to develop a functional ecosystem in the freshwater pit Landscaping and re-vegetation of processing area, berms and dyke 	○	<ul style="list-style-type: none"> Interference with navigation use and navigability due to Proposed Project-related infrastructure Interference with navigation use and navigability due to Proposed Project-related vessel traffic

Notes:

○ = Potential effect of Proposed Project activity on VC is positive, none or negligible; no further consideration warranted.

● = Potential effect of Proposed Project activity on VC that may require mitigation/benefit enhancement; warrants further consideration

Table 7.2-12: Project-VC Interaction Table: Marine Transportation – Vessel Wake VC

Project Activities	Description	VC: Vessel Wake	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
Construction			
1. Crew and equipment transport	<ul style="list-style-type: none"> ▪ Daily water taxi movements ▪ Tug and barge transport of machinery/materials (est. 8 loads) ▪ Barge household and industrial solid waste barged off-site 	●	<ul style="list-style-type: none"> ▪ Wake effects from Proposed Project-related vessel traffic may affect shoreline infrastructure
2. Site preparation, including construction of the berms and dyke	<ul style="list-style-type: none"> ▪ Logging, clearing and grubbing ▪ Grading ▪ Construction of the berms and dyke ▪ Compaction and laying of gravel base ▪ Limited improvements to existing on-site road infrastructure 	○	<ul style="list-style-type: none"> ▪ No marine effect. Activity will not be considered further.
3. Processing area installation, including conveyors and materials handling system)	<ul style="list-style-type: none"> ▪ Installation and use of portable concrete batch plant for construction ▪ Installation of concrete foundations ▪ Installation of screens, crushers, wash plant, conveyor system and automated materials-handling system (i.e., reclaim tunnels) ▪ Installation of groundwater well as a source of make-up water for the wash plant 	○	<ul style="list-style-type: none"> ▪ No marine effect. Activity will not be considered further.
4. Substation construction and connection	<ul style="list-style-type: none"> ▪ Construct electrical substation adjacent to existing BC Hydro transmission line ▪ Construct outdoor switchyard, electric building, and 100 m transmission line 	○	<ul style="list-style-type: none"> ▪ No marine effect. Activity will not be considered further.
5. Marine loading facility installation	<ul style="list-style-type: none"> ▪ Remove existing mooring dolphins ▪ Steel pile installation ▪ Installation of conveyor, barge movement winch and mooring dolphins 	○	<ul style="list-style-type: none"> ▪ No wake effect anticipated. Activity will not be considered further.
6. Pit development	<ul style="list-style-type: none"> ▪ Dry excavation to remove overburden/topsoil ▪ Installation of clamshell and floating conveyor 	○	<ul style="list-style-type: none"> ▪ No marine effect. Activity will not be considered further.

Project Activities	Description	VC: Vessel Wake	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
7. Other ancillary land-based construction works	<ul style="list-style-type: none"> ▪ Temporary construction infrastructure set up (trailers, temporary power, etc.) ▪ Upgrades to the existing heavy equipment maintenance shop and warehouse ▪ Upgrades to the existing fuelling facility for the storage of diesel and gasoline for on-site equipment ▪ Construct site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility and helipad ▪ Install contained washroom facilities ▪ Construct pump room for well/stream intake water distribution and fire-fighting 	○	<ul style="list-style-type: none"> ▪ No marine effect. Activity will not be considered further.
8. Other ancillary marine construction works	<ul style="list-style-type: none"> ▪ Removal of existing small craft dock; install temporary dock for worker access ▪ Construct new floating small craft dock, the with tie-up area for a float plane, serviced with 30 amp (A) 125 volt (V) shore power ▪ Barge household and industrial solid waste off-site 	●	<ul style="list-style-type: none"> ▪ Wake effects from Proposed Project-related vessel traffic may affect shoreline infrastructure
Operations			
9. Crew transport	<ul style="list-style-type: none"> ▪ Daily water taxi movements 	●	<ul style="list-style-type: none"> ▪ Wake effects from Proposed Project-related vessel traffic may affect shoreline infrastructure
10. Aggregate mining	<ul style="list-style-type: none"> ▪ Use of electric powered floating clamshell dredge ▪ Primary screening and conveyance of extracted material to processing area ▪ Install channel plug in WC 2 	○	<ul style="list-style-type: none"> ▪ No marine effect. Activity will not be considered further
11. Processing (screening, crushing, washing)	<ul style="list-style-type: none"> ▪ Screening to separate aggregate sizes ▪ Oversized gravels crushed ▪ Operation of wash plant fed using recycled water from two large storage tanks, supplemented with make-up water by a groundwater well. ▪ Drying and storage of fines and silt 	○	<ul style="list-style-type: none"> ▪ No marine effect. Activity will not be considered further

Project Activities	Description	VC: Vessel Wake	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
12. Progressive reclamation	<ul style="list-style-type: none"> Ongoing earth works (including site clearing, surface material removal) Fines and silt mixed with organic overburden material and used for infilling, re-vegetation and landscaping 	○	<ul style="list-style-type: none"> No marine effect. Activity will not be considered further
13. Stockpile storage	<ul style="list-style-type: none"> Processed sand and gravel conveyed to stockpile area Storage of processed materials in stockpiles 	○	<ul style="list-style-type: none"> No marine effect. Activity will not be considered further
14. Marine loading	<ul style="list-style-type: none"> Transfer of stored material using marine conveyor system Barge loading Site and navigational lighting 	○	<ul style="list-style-type: none"> No marine effect. Activity will not be considered further
15. Shipping	<ul style="list-style-type: none"> Barge traffic (delivery/collection) in Howe Sound, Ramillies Channel, Thornbrough Channel, and Queen Charlotte Channel Tug and barge transport of fuel and consumables Navigational lighting 	●	<ul style="list-style-type: none"> Wake effects from Proposed Project-related vessel traffic may affect shoreline infrastructure
16. Refueling and maintenance	<ul style="list-style-type: none"> Refueling and maintenance of on-site equipment 	○	<ul style="list-style-type: none"> No marine effect. Activity will not be considered further
Reclamation and Closure			
17. Crew and equipment transport	<ul style="list-style-type: none"> Daily water taxi Tug and barge transport of machinery/materials Barge household and industrial solid waste barged off-site 	●	<ul style="list-style-type: none"> Wake effects from Proposed Project-related vessel traffic may affect shoreline infrastructure
18. Removal of land-based infrastructure	<ul style="list-style-type: none"> Remove surface facilities, including clamshell dredge, conveyor system, screens, crushers, wash plant, automated materials-handling system, heavy equipment maintenance shop and warehouse, fuelling facility, site office, communications building, workers lunch/dry room, caretaker's cabin, first aid facility, helipad and contained washroom facilities 	○	<ul style="list-style-type: none"> No marine effect. Activity will not be considered further

Project Activities	Description	VC: Vessel Wake	
		Potential Interaction (See Notes)	Potential Effect / Rationale for Exclusion
19. Removal of marine infrastructure	<ul style="list-style-type: none"> Remove marine facilities, in marine load out facility, jetty, conveyors and piles 	●	<ul style="list-style-type: none"> No vessel wake effect anticipated. Activity will not be considered further.
20. Site reclamation	<ul style="list-style-type: none"> Final completion of the pit lake, landscaping and re-vegetation to develop a functional ecosystem in the freshwater pit Landscaping and re-vegetation of processing area, berms and dyke 	○	

Notes:

○ = Potential effect of Proposed Project activity on VC is positive, none or negligible; no further consideration warranted.

● = Potential effect of Proposed Project activity on VC that may require mitigation/benefit enhancement; warrants further consideration

7.2.5.2 Potential Project-Related Effects

7.2.5.2.1 Marine Navigation

7.2.5.2.1.1 Construction

7.2.5.2.1.1.1 Interference with Navigation Use and Navigability due to Project-related Infrastructure

During the construction phase, access to the LSA will be restricted by construction activities including piling and support vessels and a 150 m construction control zone of approximately 87,000 m² will be established. Marine activities that may cause navigational hazards during the construction phase include:

- Removal of the existing small craft dock and the installation of a temporary dock for construction access;
- Removal of existing mooring dolphins;
- Installation of 18 x 42 cm diameter steel piles and supports;
- Installation of a load out jetty trestle supporting a loading conveyor and access walkway of 178 m in length and a load out jetty of 224 m of length;
- Installation of a marine loading conveyor, access walkway, barge winch and security gate; and
- Construction of new floating small craft dock, with a tie-up area for a float plane.

The load out jetty will extend approximately 150 m into the intertidal zone and 28 m into the channel (Figure 7.2-1). The construction is anticipated to take approximately two months to complete (within the two year construction phase). The channel between the Proposed Project site and Ekins Point is currently navigated by recreational vessel, and occasional tug and barge, traffic and is in excess of 2,900 m in width. All construction activities would be confined to the immediate Proposed Project Area and navigation in the existing channel would not be affected. Only Proposed Project-related vessel traffic would be able to navigate through the 87,068 m² control zone established during construction however, given the small size of the control zone and since no commercial or recreational traffic regularly navigates this area, any adverse effects on navigation are expected to be minor.

7.2.5.2.1.1.2 Interference with Navigation Use and Navigability due to Project-related Vessel Traffic

Vessel activity would increase in the LSA during Proposed Project construction. Support vessels (e.g., tug boats, barges, and piling vessels) would be in operation in connection with the removal and upgrading of marine infrastructure in the Proposed Project Area. During the construction phase, vessel movements would be associated with crew arrivals and departures, the transportation of machinery and materials, waste removal and Proposed Project servicing. The approximate characteristics of Proposed Project-related vessels during all Proposed Project phases are outlined in Table 7.2-13.

Table 7.2-13: Characteristics of Project-related Vessel Types

Vessel Type	Vessel Length (m)	Draught (m)
Water Taxi	8.5	1.5
Tug Boat	26	4.0
Barge	80	5.5

Expected vessel movements during the construction phase are outlined in Table 7.2-14. Machinery, materials and waste will be transported to and from the Proposed Project site in flat top 80 m barges transiting Ramillies Channel (and occasionally Thornbrough Channel) to Queen Charlotte Channel.

Smaller vessels may be required occasionally to change direction and speed in response to an oncoming tug and barge associated with the Proposed Project. Smaller vessel operators are expected to yield to larger and less mobile vessels and maintain a vigilant lookout at all times as under the *Collision Regulations*, a vessel of less than 20 m in length, including sailing vessels and vessels engaged in fishing, must not impede the passage of a vessel that can safely navigate only within a narrow channel or fairway (i.e., a vessel constrained by draught in relation to the available depth and/or width of navigable water).

The additional 32 barge movements during construction is anticipated to lead to a minor increase, less than 0.3%, in total recorded traffic in Howe Sound. In addition, construction personnel will be transported to the Proposed Project site in water taxis from a location on the Sunshine Coast (which has not yet been determined). Water taxis are expected to transit Thornbrough Channel once per day to the Proposed Project site in the morning and return via this route at the end of the day. Proposed Project water taxis would use only Thornbrough Channel and would represent 11% of current water taxi movements to the Proposed Project site, which is forestry focused. The current water taxi traffic is expected to cease following the end of forestry operations.

The Proposed Project related effects on interference with the navigation of other vessel traffic during the construction phase are carried forward in this assessment.

Table 7.2-14: Vessel Traffic during Construction

Construction Activity	Vessel Type	Total Trips (per year)	Total Movements (per year)
Crew arrivals and departures	Water taxi	260	520
Shipping of materials	Tug/barge	8	16
Shipping of waste and Project servicing	Tug/barge	8	16

Notes: (1) Total per year based on the Proposed Project operating 260 days as year (i.e., 5 days/week) during seasonal daylight hours; (2) Total vessel movements include both arrival and departures

7.2.5.2.1.2 Operations**7.2.5.2.1.2.1 Interference with Navigation Use and Navigability due to Project-related Infrastructure**

The load out jetty and other marine infrastructure installed during the construction phase will remain in place during the operational lifespan of the Proposed Project. The load out jetty will support moorage of two tugs and two 5,500 Dead Weight Tonne (DWT) barges. All barge loading facilities will be confined to the Proposed Project Area (Figure 7.2-1), which will occupy approximately 19,259 m².

Interference with navigation use and navigability due to Proposed Project-related infrastructure is likely to be similar in the operations phase to that of the construction phase so there is considered to be a minor adverse effect in this regard during the operations phase.

7.2.5.2.1.2.2 Interference with Navigation Use and Navigability due to Project-related Vessel Traffic

The Proposed Project would lead to an increase in vessel movements during operations related to the barging of aggregate material, waste removal, Proposed Project servicing and the transport of personnel. The expected number of vessel movements is provided in Table 7.2-15. Barge movements will occur mostly on weekdays, but there may be infrequent movements during weekends depending on the operational requirements of the mine.

Table 7.2-15: Vessel Traffic during Operations

Project Activity	Vessel Type	Total Trips (per year)	Total Movements (per year)
Crew arrivals and departures	Water taxi	260	520
Shipping of aggregate	Tug and barge	182	364
Shipping of waste and Project servicing	Tug and barge	8	16

Notes: (1) based on the Proposed Project operating 260 days as year (i.e., 5 days/week) during seasonal daylight hours; (2) Total vessel movements including both arrival and departures

As shown in Table 7.2-16, Proposed Project activities are anticipated to result in a 3% increase in large vessel traffic in the overall Howe Sound area. Proposed Project traffic specific to the preferred route in Ramillies Channel would result in a 45% increase in large vessel traffic in this area if the Proposed Project utilises this route all the time. Under this assumption, the Proposed Project would increase large vessel traffic (tug and barge) through Ramillies Channel from 16.2 movements to 23.5 movements per week, for a difference of 7.3 movements per week. Proposed Project tug and barges however would occasionally traverse Thornbrough Channel. In the event that Ramillies Channel was used for 80% of Proposed Project associated movements and Thornbrough Channel for 20%, then there would be an approximate 36% increase in large vessel movements through Ramillies Channel.

As described during the construction phase, there is expected to be two Proposed Project associated water taxi movements per weekday, or approximately 520 water taxi movements per year. Water taxis would transit Thornbrough Channel once per day to the Proposed Project site in the morning and return at the end of the day.

The exact departure location for water taxis on the Sunshine Coast in Thornbrough Channel has not yet been determined. Water taxis during operation would represent 11% of current water taxi movements. However water taxi traffic to the Proposed Project site is expected to decline following the end of current forestry contracts in the McNab Creek area.

Table 7.2-16: Predicted Changes in Large Vessel Movements

Shipping Route	Existing Large Vessel Traffic (total movements per year)	Project-related Tug and Barges (annual % increase)
Ramillies Channel (based on 80% usage)	843	36%
Thornbrough Channel (based on 20% usage)	3,270	2.5%
Howe Sound	12,909	3%

Notes: (1) Based on the CCG (2013) data, average vessels movements between 2011 and 2013 (see Volume 4, Part G – Section 22.0: Appendix 7.2-B); (2) Thornbrough Channel will be used periodically so the 20% usage figure is for comparison purposes only.

In Queen Charlotte Channel the barging route would cross three scheduled BC Ferries routes that depart from Horseshoe Bay. Proposed Project-related vessels would be required to keep a vigilant look out and occasionally may have to yield or change direction and speed when ferries or deep-sea vessels are transiting in the same place at the same time. However, the channel widths along all Proposed Project barging routes far exceed TC guidance required for two-way commercial vessel traffic.

Potential navigation use effects on commercial fishing vessels from Proposed Project barges would be highest in sub-area 28-1 and sub-area 28-3 during the seasonal openings for shellfish. The Proposed Project Area marine footprint would interfere with approximately 0.04% of the available commercial catch area in the LSA. Given the expected incremental increase of 3% in commercial vessel traffic in Howe Sound due to the Proposed Project, the size of PFMA sub-areas and the intermittent nature of effects, Proposed Project-related vessel movements are considered to result in a minor adverse effect on navigation of fishing vessels.

Proposed Project-related tugs and barges would also transit through waters navigated by smaller vessels, including other water taxis and recreational craft. Recreational vessels calling at the two outstations situated in north Thornbrough Channel traverse the channel between the Proposed Project site and north Gambier Island. As described in the construction effects section, smaller vessels on occasion may have to yield, change direction and/or speed in response to a tug and barge if present in the same channel at the same time. Areas used for marine-based events, such as regattas, may also be traversed by tugs and barges during key times. Recreational boaters traversing across the path of Proposed Project barge vessel traffic would be required to change speed or direction to avoid collision. Interference to navigation of recreational watercraft in the LSA is likely to be highest during the summer months of July and August. An assessment of effects concerning the potential displacement of marine-based recreational activities is presented in Volume 2, Part B - Section 7.3.

The Proposed Project footprint is expected to interfere with a very small proportion (0.2%) of the recreational catch area in sub-area 28-B. Interference to navigation of recreational fisheries due to the Proposed Project would follow similar effects pathways as recreational boating and these navigation-related effects are likely to be highest in the waters adjacent to the Proposed Project Area and elsewhere in sub-areas 28-B and 28-A/J where recreational

fishing boats may interact with Proposed Project marine traffic during peak prawn and crabbing season in the June through September period.

The increase in barge and water taxi traffic due to the Proposed Project during operations is expected to result in occasional interference with navigation, which would require smaller non-Proposed Proposed Project vessels to alter course, and is considered to be a minor adverse effect and is carried forward in this assessment.

7.2.5.2.1.3 Reclamation and Closure

7.2.5.2.1.3.1 Interference with Navigation Use and Navigability due to Project-related Infrastructure

The marine infrastructure (including the load out jetty, all marine piling and installed mooring dolphins) will be entirely removed during the reclamation and closure phase. The access dock will remain in place for servicing during reclamation of the Proposed Project site and a temporary access dock will be installed for closure activities. The removal of the barge load out jetty is not expected to create a navigational hazard. Taking these matters into consideration the adverse effect on interference with navigation use and navigability due to Proposed Project-related infrastructure during the reclamation and closure phase is expected to be minor and is carried forward in the assessment.

7.2.5.2.1.3.2 Interference with Navigation Use and Navigability due to Project-related Vessel Traffic

Proposed Project-related vessel movements during the reclamation and closure phase of the Proposed Project are outlined in Table 7.2-17. Vessel movements would be associated with crew arrivals and departures and removal of Proposed Project site infrastructure and shipping of waste and servicing. A support vessel may be used during the decommissioning of the load out jetty.

Table 7.2-17: Vessel Traffic during Reclamation and Closure

Project Activity	Vessel Type	Total Trips (per year)	Total Movements (per year)
Crew arrivals and departures	Water taxi	260	520
Shipping of materials	Tug/barge	8	16
Shipping of waste and Project servicing	Tug/barge	8	16

Notes: (1) based on the Proposed Project operating 260 days as year (i.e., 5 days/week) during seasonal daylight hours; (2) Total vessel movements including both arrival and departures

Effects from Proposed Project-related vessel movements are expected to be short-term and limited to the reclamation period and cease during closure. Adverse effects related to interference with navigation of other vessel traffic due to the Proposed Project are expected to be minor prior to mitigation and are carried forward in the assessment.

7.2.5.2.2 Vessel Wake Effects

7.2.5.2.2.1 Construction

During the construction phase, there is expected to be an estimated 32 barge movements along the proposed routes. Vessel generated wakes of a certain size and power can have adverse effects on shoreline infrastructure and on navigation use by vessels and other watercraft. As described in Volume 4, Part G – Section 22.0: Appendix 7.2-A, wake wash energy from tug and barge movements is estimated as less than 1% when compared to the total energy from naturally occurring wind waves along both routes.

The construction phase would entail an estimated 520 water taxi movements per year for crew arrivals and departures. Although water taxis are planned to use Thornbrough Channel (between Gibsons or Port Mellon and the Proposed Project site), wake from water taxis were analyzed along the entire length of Route 1 and Route 2 for comparative purposes. Only potential effects related to vessel wake for the routes that are to be used during the Proposed Project were included in the assessment.

Overall, vessel wake wash energy would be less than 40% of wind-wave energy. The average annual vessel wake wash energy from the water taxis would be an estimated 9% of naturally occurring wind wave energy. Along the majority of shorelines, the contribution of wave energy generated by water taxi movements would be minor in comparison to naturally occurring wind-waves. The maximum calculated wake wash energy from the water taxi is typically less than wind wave energy between Gibsons and the Proposed Project Area, with the exception of one location on the eastern shoreline of Thornbrough Channel where the estimated wake wash energy is similar to the wind wave energy. The shoreline in this area is a sand and gravel beach and is identified as forestry use or undeveloped. There is no potential interaction between potential wake effects and infrastructure, therefore this effect is not carried forward in the Marine Transportation assessment.

An increase in total wave energy here could result in changes in beach shore profile and changes in grain size distribution through erosion. An assessment of the effects of the Proposed Project on shoreline characteristics and shoreline habitats from vessel wake is presented in Volume 2, Part B - Section 5.2.

7.2.5.2.2.1.1 Operations

The Proposed Project is expected to result in an estimated 364 barge movements during operations. However, as identified during construction, wake wash energy from tug and barge movements is anticipated to be less than 1% when compared to the total energy from naturally occurring wind waves along both routes.

As described during construction, operations is expected to lead to approximately 520 water taxi movements per year for crew arrivals and departures therefore potential effects will be the same as those identified during construction in Section 7.2.5.2.1.1. This effect is not carried forward in the Marine Transportation assessment.

7.2.5.2.2.1.2 Reclamation and Closure

Proposed Project-related wake effects during reclamation and closure are consistent with those described above for construction in Section 7.2.5.2.1.1. This effect is not carried forward in the Marine Transportation assessment.

7.2.5.3 Mitigation

This section provides a description of the proposed design and mitigation measures specifically related to Proposed Project effects on marine transportation. These measures are described in the following sections and summarized in Table 7.2-18. For ease of reference, each of the mitigation measures described has a unique identification number (unless the measure is being incorporated into the Proposed Project design or outlined in another section, in which case it is described in that section).

The mitigation strategy outlined below forms the basis for the commitments that the Proposed Project is making with respect to marine navigation. A detailed list of all commitments of the Proposed Project are provided in Volume 3, Part F – Section 19.

7.2.5.3.1 Measures to Reduce Interference with Navigation Use and Navigability due to Project-related Infrastructure

The effects from navigational hazards connected to the Proposed Project-related infrastructure will be mitigated through regulatory requirements, adoption and implementation of best practices and Proposed Project design features. The level of interference with navigation and navigational hazards due to the Proposed Project will be considered through the *Navigation Protection Act* review process as described in section 7.2.2.1. All recommendations proposed by TC through the Navigation Protection Program will be incorporated into Proposed Project design. Mitigation measures implemented during construction will remain in place during other parts of the Proposed Project lifecycle.

Other specific mitigation measures related to navigational hazards will include:

- A Marine Transport Management Plan will be prepared and implemented prior to construction activities. This plan will outline measures to ensure all operators of vessel traffic are aware of Proposed Project activities and that the marine control zone is established during construction. The plan will also provide details of the communications channels and the Proposed Project related safety procedures for vessels calling and loading at the terminal. A draft outline of this plan is provided in Volume 3, Part E - Section 16.0;
- The Proposed Project marine control zone will be marked using buoys subject to TC requirements;
- Proposed Project-related infrastructure, which includes aids and navigational lights, will be based on recommendations following the Navigation Protection Program review process;
- Dark sky shielded features will be installed in the Proposed Project Area where technically possible to reduce the interference from lighting on navigation;
- The relevant authorities will be notified about the Proposed Project, e.g. CCG, so that Notices to Mariners and Notices to Shipping can be issued; and
- CHS navigational charts and other appropriate nautical publications will be updated to show the terminal and other marine features, where appropriate.

7.2.5.3.2 Measures to Reduce Interference with Navigation Use and Navigability due to Project-related Vessel Traffic

All Proposed Project-related vessel movements will be conducted in accordance with the requirements of the *Canada Shipping Act (2001)* and in compliance with CCG policies and guidance. Maritime legislation and other requirements are outlined in Section 7.2.2. In addition, Proposed Project-related vessels will comply with all other applicable national and international safety regulations that have not been listed, such as requirements established by the International Maritime Organisation (IMO). Where applicable, consideration will also be given to best practice criteria for the safe operation of vessels.

Commercial shipping in Howe Sound is controlled by MCTS in Vancouver, which provides marine safety communications and co-ordination between vessels. The Proposed Project's mined aggregate will be shipped via tugs and barges that are operated by highly experienced mariners who are familiar with the navigational routes in Howe Sound and regularly service the forestry industry. All tugs will be equipped with systems to facilitate monitoring of marine traffic and navigation, follow applicable navigational rules and procedures, and have effective means of communication. Specifically tugs and barges will:

- Adhere to regulations for preventing collisions at sea, such as moving at a safe speed and keep a vigilant watch at all times;
- Possess up-to-date nautical charts and for each voyage a passage plan that respects safe navigation and the environment;
- Meet CCG reporting requirements and respect vessel routing measures that also help ensure safe navigation; and
- Be equipped with technology that, together with the passage plan (i.e., a trip plan), allows a vessel's progress to be closely monitored.

The following additional mitigation measures will also be established, to reduce Proposed Project-related effects with respect to navigation interference:

- Commitment for consultation with CCG, PPA, HPP, BC Ferries and Squamish Terminals along with other stakeholders regarding potential interference to identify operating practices or vessel route options that should be adopted;
- Commitment to investigate further passage routing options to avoid busy recreational waters and BC Ferries routes particularly during the summer months. Consideration will be given to routing tugs and barges through Collingwood Channel as an alternative to Queen Charlotte Channel during peak times where navigational and operational requirements permit;
- Marine Transport Management Plan (described above) will include a procedure for marine stakeholders to consult with the proponent regarding special events such as yacht races, regattas and marine based festivals to ensure that additional passage planning and scheduling can be reviewed; and
- Commitment to limit the number of water taxi movements traversing Thornbrough Channel and to avoid peak recreational boating times when possible.

The following table summarises mitigation measures for marine transportation.

Table 7.2-18: Identified Mitigation Measures: Marine Transportation

Potential Effect	Mitigation	Anticipated Effectiveness
Construction		
Interference with navigation use and navigability due to Project-related infrastructure	<p>Measures to reduce navigational hazard from Project-related infrastructure:</p> <ul style="list-style-type: none"> ▪ Marine Transport Management Plan. ▪ Proposed Project marine control zone will be marked using buoys subject to TC requirements. ▪ Proposed Project-related infrastructure will incorporate recommendations of the Navigation Protection Program review process. ▪ Dark sky shielded features will be installed in the Proposed Project Area, where technically possible. ▪ Relevant authorities will be notified so that Notices to Mariners and Notices to Shipping can be issued. ▪ CHS navigational charts and other appropriate nautical publications will be updated to show the terminal and other marine features, where appropriate. 	Mitigation measures are expected to be effective and will reduce potential effects to a level that is considered negligible.
Interference with navigation use and navigability due to Project-related vessel traffic	<p>Measures to reduce interference to existing vessel traffic, access routes and fisheries:</p> <ul style="list-style-type: none"> ▪ Commitment for consultation with CCG, PPA, HPP, BC Ferries and Squamish Terminals along with other stakeholders regarding potential interference to identify operating practices or vessel route options that should be adopted. ▪ Commitment to investigate further passage routing options to avoid busy recreational waters and BC Ferries routes particularly during the summer months. ▪ Marine Transport Management Plan (described above) will include a procedure for marine stakeholders to consult with the proponent regarding special events such as, yacht races, regattas and marine based festivals. ▪ Commitment to limit the number of water taxi movements traversing through Thornbrough Channel and to avoid peak recreational boating times, where possible. 	Mitigation measures are expected to be effective and will reduce potential effects.
Operations		
Interference with navigation use and navigability due to Project-related infrastructure	<p>Measures to reduce navigational hazard from Project-related infrastructure:</p> <ul style="list-style-type: none"> ▪ Marine Transport Management Plan. ▪ Proposed Project marine control zone will be marked using buoys subject to TC requirements. ▪ Proposed Project-related infrastructure will incorporate recommendations of the Navigation Protection Program review process. ▪ Dark sky shielded features will be installed in the Proposed Project Area, where technically possible. ▪ Relevant authorities will be notified so that Notices to Mariners and Notices to Shipping can be issued. ▪ CHS navigational charts and other appropriate nautical publications will be updated to show the terminal and other marine features, where appropriate. 	Mitigation measures are expected to be effective and will reduce potential effects to a level that is considered negligible.

Potential Effect	Mitigation	Anticipated Effectiveness
Interference with navigation use and navigability due to Project-related vessel traffic	<p>Measures to reduce interference to existing vessel traffic, access routes and fisheries:</p> <ul style="list-style-type: none"> ▪ Commitment for consultation with CCG, PPA, HPP, BC Ferries and Squamish Terminals along with other stakeholders regarding potential interference to identify operating practices or vessel route options that should be adopted. ▪ Commitment to investigate further passage routing options to avoid busy recreational waters and BC Ferries routes particularly during the summer months and at weekends. ▪ Marine Transport Management Plan (described above) will include a procedure for marine stakeholders to consult with the proponent regarding special events such as, yacht races, regattas and marine based festivals. ▪ Commitment to limit the number of water taxi movements traversing through Thornbrough Channel and to avoid peak recreational boating times, where possible. 	Mitigation measures are expected to be effective and will reduce potential effects on both recreational and commercial users.
Reclamation and Closure		
Interference with navigation use and navigability due to Project-related infrastructure	<p>Measures to reduce navigational hazard from Project-related infrastructure:</p> <ul style="list-style-type: none"> ▪ Marine Transport Management Plan. ▪ Proposed Project marine control zone will be marked using buoys subject to TC requirements. ▪ Proposed Project-related infrastructure will incorporate recommendations of the Navigation Protection Program review process. ▪ Dark sky shielded features will be installed in the Proposed Project Area, where technically possible. ▪ Relevant authorities will be notified so that Notices to Mariners and Notices to Shipping can be issued. ▪ CHS navigational charts and other appropriate nautical publications will be updated to show the terminal and other marine features, where appropriate. 	Mitigation measures are expected to be effective and will reduce potential effects to a level that is considered negligible.
Interference with navigation use and navigability due to Project-related vessel traffic	<p>Measures to reduce interference to existing vessel traffic, access routes and fisheries:</p> <ul style="list-style-type: none"> ▪ Commitment for consultation with CCG, PPA, HPP, BC Ferries and Squamish Terminals along with other stakeholders regarding potential interference to identify operating practices or vessel route options that should be adopted. ▪ Commitment to investigate further passage routing options to avoid busy recreational waters and BC Ferries routes particularly during the summer months. ▪ Marine Transport Management Plan (described above) will include a procedure for marine stakeholders to consult with the proponent regarding special events such as, yacht races, regattas and marine based festivals. ▪ Commitment to limit the number of water taxi movements traversing through Thornbrough Channel and to avoid peak recreational boating times, where possible. 	Mitigation measures are expected to be effective and will reduce potential effects to a level that is considered negligible.

7.2.5.4 Residual Effects Assessment

Potential Proposed Project-related residual effects have been characterized using the criteria for each identified VC. The characterization of potential residual effects (i.e., following application of appropriate mitigation measures) is described below and presented in Table 7.2-19. The likelihood of occurrence of potential effects has been determined through a review of background information, consultation with government agencies and professional judgement. A summary of the significance determinations is presented in Table 7.2-21.

7.2.5.4.1 Construction, Operations and Reclamation and Closure

7.2.5.4.1.1 Interference with Navigation Use and Navigability due to Project-related Infrastructure

Mitigation measures, such as the installation of navigational lights as recommended through the Navigation Protection Program review process and the preparation of a Marine Transport Management Plan, will aid in alleviating interference with navigation use and navigability due to Proposed Project-related infrastructure during all phases.

Proposed Project-related marine infrastructure will be installed in waters that have been used in the past and are continued to be used by forestry operations therefore the context of the area is considered resilient. With the implementation of mitigation measure (i.e., adherence to regulations and management practices) in addition to the fact that the location of the marine infrastructure is located in an area of very low density for commercial vessels and does not interfere with recreational boating routes (Figure 7.2-3 and Figure 7.2-5) the magnitude of the effect of considered negligible. Proposed Project associated adverse residual effects will be restricted to a small proportion of the LSA (i.e., the barge load out jetty) and is considered local. The interaction will only occur for short and intermittent time periods only when other vessels are transiting near the Proposed Project Area, therefore the frequency of the effect is considered to be low. Effects will be medium-term in duration as they will occur for the life of the Proposed Project but will cease after reclamation and closure as the marine infrastructure will be removed. Because of this, the effects are considered fully reversible. The likelihood that Proposed Project-related infrastructure will interfere with navigation use is considered low as the marine infrastructure associated with the Proposed Project is not located within a commercial or recreational vessel route.

7.2.5.4.1.2 Interference with Navigation Use and Navigability due to Project-related Vessel Traffic

The proposed mitigation measures described in Section 7.2.5.3.2 will aid in alleviating Proposed Project effects. The barging route is presently disturbed as the route is traversed by large commercial vessels regularly, such as ferries, tugs and barges, and deep-sea vessels. Given, the width of the channels, recreational users are expected to be able to still access popular destinations and routes and to experience only occasional and minor interference when required to alter direction and/or speed while navigating the LSA at the same time as Proposed Project-related tugs and barges or water taxi traffic.

As previously noted, vessel traffic generated by the Proposed Project during construction and operations represents a minor increase of 3%. Large vessel traffic through Ramillies Channel will increase by approximately 45% (assuming all of the Proposed Project's tug and barge traffic proceeds via this channel), and the number of

movements generated by the Proposed Project will be equivalent to 7.3 movements per week. Traffic in Ramillies channel will represent less than 7% of the total traffic in Howe Sound. Tug and barge activity during weekends when recreational use is at its highest, will be minimized. During construction and operations, water taxi traffic to the Proposed Project site will increase but traffic will be limited to short arrival and departure voyages and overall water taxi traffic to the Proposed Project site will decline from current levels following the end of the current forestry operations contracts in the McNab Creek area. The context of effects is considered resilient as there are regulations, programs and practices in place to guide vessel traffic and small vessel and watercraft operators currently share the channels along this route with a range of existing commercial vessel traffic.

The magnitude of the effects is considered negligible following mitigation during the construction and reclamation/closure phases, and low during the operational phase. The Proposed Project's tug and barge route is regularly traversed by recreational and commercial vessels but the increase in traffic due to the Proposed Project is considered low when compared to existing traffic levels and the affected channels are relatively wide. Effects will be restricted to the LSA and are therefore considered local. Residual effects will only be evident when Proposed Project vessels are transiting the routes at the same time as other vessels therefore the frequency for tug and barge movements is considered low and medium for water taxi movements. Effects are considered to be medium-term in duration as they will occur for the life of the Proposed Project. They will be fully reversible and cease after closure. The likelihood that Proposed Project-related infrastructure will interfere with navigation use is considered high as traffic does, and will continue to, traverse the LSA (Table 7.2-20).

Table 7.2-19: Characterization of Potential Project-Related Residual Effects: Marine Transportation – Marine Navigation VC

Potential Residual Effect	Residual Effect Assessment Criteria					
	Context	Magnitude	Extent	Duration	Reversibility	Frequency
Construction						
Interference with navigation use and navigability due to Project-related infrastructure	R	N	L	MT	FR	L
Interference with navigation use and navigability due to Project-related vessel traffic	R	N	L	MT	FR	L to M
Operations						
Interference with navigation use and navigability due to Project-related infrastructure	R	N	L	MT	FR	L
Interference with navigation use and navigability due to Project-related vessel traffic	R	L	L	MT	FR	L to M
Reclamation and Closure						
Interference with navigation use and navigability due to Project-related infrastructure	R	N	L	MT	FR	L
Interference with navigation use and navigability due to Project-related vessel traffic	R	N	L	MT	FR	L to M

Assessment Criteria:

Context: R – Resilient, MR – Moderately Resilient; S - Sensitive;

Magnitude: N – Negligible, L – Low, M – Medium, H – High;

Geographic Extent: L – Local, R – Regional, BR – Beyond Regional;

Duration: ST – Short-term, MT – Medium-term, LT – Long-term;

Reversibility: FR – Fully Reversible, PR - Partially Reversible, IR- Irreversible;

Frequency: L – Low, M – Medium, H – High

Table 7.2-20: Likelihood of Occurrence of Potential Residual Effects

VC	Residual Effect	Likelihood	Rationale
Operations			
Marine Navigation	Interference with Navigation Use and Navigability due to Project-related Infrastructure	Low	Marine infrastructure associated with the Proposed Project is not located within a commercial or recreational vessel route.
	Interference with navigation use and navigability due to Project-related vessel traffic	High	The likelihood of the residual effect is considered high as vessel traffic does, and will continue to, traverse the LSA.
Construction			
Marine Navigation	Interference with Navigation Use and Navigability due to Project-related Infrastructure	Low	Marine infrastructure associated with the Proposed Project is not located within a commercial or recreational vessel route.
	Interference with navigation use and navigability due to Project-related vessel traffic	High	The likelihood of the residual effect is considered high as vessel traffic does, and will continue to, traverse the LSA.
Reclamation and Closure			
Marine Navigation	Interference with Navigation Use and Navigability due to Project-related Infrastructure	Low	Marine infrastructure associated with the Proposed Project is not located within a commercial or recreational vessel route.
	Interference with navigation use and navigability due to Project-related vessel traffic	High	The likelihood of the residual effect is considered high as vessel traffic does, and will continue to, traverse the LSA.

7.2.5.5 Significance of Residual Effects

The significance of potential residual adverse effects will be determined for each VC based on the residual effects criteria and the likelihood of a potential residual effect occurring, a review of background information and available field study results, consultation with government agencies, First Nations, and other experts, and professional judgement. A summary of significance determinations is presented in Table 7.2-21.

The determination of significance of residual adverse effects is rated as negligible, not significant, or significant, which are generally defined as follows:

- **Negligible - Not Significant.** Negligible residual effects are either not measurable, within the range of background conditions, or so small they may be safely disregarded. They do not warrant further consideration and are not carried forward into a cumulative effects assessment.
- **Not Significant.** Residual effects may be characterized as not significant if they are determined to be measurable but do not exceed established regulations, guidelines, or objectives and/or are not likely to result in substantial changes to the marine navigation use.

- **Significant.** Residual effects may be characterized as significant if there is a reasonable expectation that the effect of the Proposed Project would:
 - exceed established regulations, guidelines, or objectives;
 - exceed the background conditions; and/or
 - Affect marine navigation use by others.

The Proposed Project will lead to a small increase in commercial traffic. Proposed Project vessels will transit through established shipping routes in Howe Sound that are currently traversed on a regular basis by commercial vessels including tugs and barges. Residual effects related to the interference with navigation use and navigability due to Project-related vessel traffic is considered to be not-significant based on the definitions of significance provided in Section 7.2.3.3.4. Residual effects related to the Interference with Navigation Use and Navigability due to Project-related Infrastructure is considered to be negligible-not-significant based on the definitions of significance provided in Section 7.2.3.3.4.

Table 7.2-21: Significance of Potential Residual Effects: Marine Transportation

VC	Potential Residual Effect	Significance	Rationale
Construction			
Marine Navigation	Interference with navigation use and navigability due to Project-related vessel traffic	Not significant	The adverse residual effect is not significant based on the definitions of significance provided in section 7.2.5.4.1.2. The Proposed Project will lead to a relatively small increase in commercial traffic. Proposed Project vessels will transit through established shipping routes in Howe Sound that are regularly traversed by commercial vessels including tugs and barges.
	Interference with Navigation Use and Navigability due to Project-related Infrastructure	Negligible – Not Significant	The adverse residual effect is negligible – not significant based on the definitions of significance provided in section 7.2.5.4.1.2.
Operations			
Marine Navigation	Interference with navigation use and navigability due to Project-related vessel traffic	Not significant	The adverse residual effect is not significant based on the definitions of significance provided in section 7.2.5.4.1.2. The Proposed Project will lead to a relatively small increase in commercial traffic. Proposed Project vessels will transit through established shipping routes in Howe Sound that are regularly traversed by commercial vessels including tugs and barges.
	Interference with Navigation Use and Navigability due to Project-related Infrastructure	Negligible – Not Significant	The adverse residual effect is negligible – not significant based on the definitions of significance provided in section 7.2.5.4.1.2.

VC	Potential Residual Effect	Significance	Rationale
Reclamation and Closure			
Marine Navigation	Interference with navigation use and navigability due to Project-related vessel traffic	Not significant	The adverse residual effect is not significant based on the definitions of significance provided in section 7.2.5.4.1.2. The Proposed Project will lead to a relatively small increase in commercial traffic. Proposed Project vessels will transit through established shipping routes in Howe Sound that are regularly traversed by commercial vessels including tugs and barges.
	Interference with Navigation Use and Navigability due to Project-related Infrastructure	Negligible – Not Significant	The adverse residual effect is negligible – not significant based on the definitions of significance provided in section 7.2.5.4.1.2.

7.2.5.6 Level of Confidence

The level of confidence of the predicted residual effect is provided in Table 7.2-22. The prediction confidence of the assessment on each VC is based on scientific information and statistical analysis, professional judgement and effectiveness of mitigation (rated as high, moderate, and low).

Table 7.2-22: Level of Confidence in Potential Residual Effect Predictions - Marine Transportation

Residual Effect	Level of Confidence in Residual Effect Prediction	Level of Confidence Rationale
Interference with navigation use and navigability due to Project-related vessel traffic	Moderate	The confidence in the assessment is moderate given the lack of small vessel and recreational data for the LSA. Consideration of confidence in the effects assessment incorporates an examination of similar projects undergoing assessments within the CEAA and BCEAA processes. Information provided in these applications helped to ensure potential Proposed Project-related effects were identified.
Interference with Navigation Use and Navigability due to Project-related Infrastructure	Moderate	The confidence in the assessment is moderate given the lack of small vessel and recreational data for the LSA. Consideration of confidence in the effects assessment incorporates an examination of similar projects undergoing assessments within the CEAA and BCEAA processes. Information provided in these applications helped to ensure potential Proposed Project-related effects were identified. Project-related marine infrastructure will be subject to a regulatory review under the <i>Navigation Protection Act</i> .

7.2.5.7 Cumulative Effects Assessment

Cumulative effects result from interactions between Proposed Project-related residual effects and incremental effects of reasonably foreseeable projects and activities. Potential effects from past and present projects were assessed as part of the baseline conditions. Cumulative effects assessment methodology is described in Section 4.6.

7.2.5.7.1 Cumulative Effects Assessment Boundaries

As described in Section 0, the spatial boundary of the cumulative effects assessment for Marine Transportation is the same as that defined for the LSA. As such, the cumulative effects assessment boundary comprises the Proposed Project's barging route in Howe Sound and a 1 km assessment area in the marine environment on either side of this route.

The Woodfibre LNG project is the only certain and reasonably foreseeable project or activity that is anticipated to have the potential to result in cumulative effects for the Marine Navigation VC. Projects that overlap with the cumulative effects assessment boundary are shown on Figure 4-6 in Volume 2, Part B – Section 4.0.

7.2.5.7.2 Residual Effects Considered in Cumulative Effects Assessment

This section describes the assessment of potential cumulative effects associated with marine transportation. Cumulative effects result from interactions between Proposed Project-related residual effects and incremental effects of all other certain and reasonably foreseeable projects and activities. The combined effects of the Proposed Project and the effects of other past and present projects and activities are described in Section 7.2.5.1. The combination of the Proposed Project residual effects plus the effects of all other certain and reasonably foreseeable projects and activities that will be carried out comprise the total future cumulative effects.

Proposed Project-related residual effects that were considered for the cumulative effects assessment are provided in Table 7.2-23. If residual effects were excluded from the cumulative effects assessment rationale is provided. Negligible residual effects were not carried through to the cumulative effects assessment as they are not considered measurable or are within a natural variability of the system are therefore unlikely to interact cumulatively with other reasonably foreseeable projects.

Table 7.2-23: Residual Effects Considered in Cumulative Effects Assessment – Marine Transportation

VC	Residual Effect	Considered in Cumulative Effects Assessment	Rationale
Marine Navigation	Interference with navigation use and navigability due to Project-related vessel traffic	Yes	There is potential for cumulative effects between Project-related barging and the shipping activities of other projects.

7.2.5.7.3 Effects of Other Projects and Activities

Reasonably foreseeable future projects and activities are those that: (a) have been publicly announced with a defined project schedule and with sufficient detail that they can be included in the assessment; (b) are currently undergoing an environmental assessment, or (c) are in a permitting process.

The cumulative effects assessment examines only the potential for interactions between the adverse residual effects of the Proposed Project and the incremental effects of other projects and activities that are certain and reasonably foreseeable. The effects of other projects and activities that have already been implemented (under construction and operating projects) are considered as part of the baseline conditions section.

A list of certain and reasonably foreseeable projects and activities with potential effects that could interact temporally and/or spatially with Proposed Project-related residual effects are provided in Table 4-5 in Section 4.5.5. The Woodfibre LNG project is the only certain and reasonably foreseeable project or activity that is anticipated to have the potential to result in cumulative effects to Marine Transportation (see Table 7.2-24). All other projects were not considered to interact with this residual effect because:

- Insufficient project information currently available to assess potential effects from marine transportation associated with this project;
- The project has been assessed against current forestry operations that contribute to commercial traffic;
- There is insufficient activity information currently available to assess effects of future forestry activities on marine transportation. There is no indication of vessel routes, types or volume of vessels in order to undertake a cumulative assessment;
- No marine shipping component identified from the available information; and
- No marine transportation component identified from the available information.

Table 7.2-24: Potential Incremental Effects of Other Project and Activities on Marine Navigation VC

Project	Timeline	Phase of the project overlaps with the Proposed Project ⁹	Project Description	Rationale
Reasonably Foreseeable Future Projects				
Woodfibre LNG	<p>Construction to start in 2015</p> <p>Operations in the second quarter of 2017</p> <p>Assumes permit issuance in 2015/early 2016</p>	Operation	<ul style="list-style-type: none"> ▪ Development of the former Western Forest Products Woodfibre Mill; an LNG facility has been proposed. ▪ Three to four times per month an LNG carrier will travel through well-established shipping lanes to the Woodfibre LNG terminal. Each carrier will travel at 8 to 10 knots in Howe Sound, be accompanied by at least three tugboats, at least one of which will be tethered to the carrier, and have two BC Coast Pilots on board, who are experts on BC's coast. ▪ Website: http://a100.gov.bc.ca/appsdata/epic/html/deploy/epic_project_home_408.html 	<ul style="list-style-type: none"> ▪ Potential cumulative interaction identified between LNG marine transport activities and the barging activities of the BURNCO Aggregate project; and ▪ Carried forward in this assessment.

⁹ When timelines are uncertain it was assumed that the Proposed Project would overlap with both construction and operations.

7.2.5.7.4 Potential Interactions with Other Projects

Interactions between adverse effects from certain or reasonably foreseeable project activities and Proposed Project residual adverse effects that could result in cumulative adverse effects to Marine Transportation are summarized in Table 7.2-25.

Table 7.2-25: Activities Considered in the Cumulative Effects Assessment for Marine Navigation VC

Activities	Potential Effect	Potential for Interaction of Effects	Rationale
Vessel Traffic	Interference with Navigation Use and Navigability due to Project-related Vessel Traffic	Y	Potential cumulative interaction identified between LNG marine transport activities and the barging activities of the BURNCO Aggregate project

No interaction or not likely to interact cumulatively (N), Yes, Potential cumulative effect (Y)

7.2.5.7.5 Cumulative Effects Related to Interference with Navigation Use and Navigability due to Project-related Vessel Traffic

The Woodfibre LNG (WLNG) project is located approximately 15 km north of the Proposed Project and 7 km south of from Squamish on the west shore of Howe Sound. There is a marine terminal facility proposed as part of the LNG facility that will provide moorage and loading facilities for LNG carriers. The largest LNG carriers anticipated to be calling at the terminal will be 280 m long and approximately 85,000 DWT (Woodfibre 2014). From the information available, LNG carriers would travel from the Pacific Ocean through Howe Sound to the LNG processing facility at Woodfibre, using Queen Charlotte and Montagu Channels. Approximately 80 LNG carrier movements (40 calls) per year are expected during operations.

Based on these data, the Proposed Project barging route would interact with Woodfibre LNG's shipping route in Queen Charlotte Channel between Bowyer Island and Passage Island. Outside of these waters, both projects are expected to use different shipping routes, and as such there is unlikely to be potential for a cumulative interaction. Large vessel traffic in Howe Sound would increase by an estimated 3.1% per year due to the additional barging traffic from the Proposed Project combined with LNG carrier movements. Within the LSA, the combined cumulative increase in traffic density would be evident in a small section of Queen Charlotte Channel where the marine transport routes of both projects interact.

The cumulative effects from both projects where their routes interact are likely to be the same as the Proposed Project associated effects described in Section 7.2.5.2.1. The interference to navigation from the vessel traffic of the Proposed Project and of Woodfibre LNG is expected to neither prevent nor restrict existing vessel traffic in Queen Charlotte Channel. Proposed Project vessels would be required to keep a vigilant look out and would have to yield or change speed or direction when transiting Queen Charlotte Channel at the same time as Woodfibre LNG associated vessels.

7.2.5.7.6 Mitigation of Cumulative Effects

Mitigation measures that will assist in minimizing interactions between Proposed Project effects and similar environmental effects from other reasonably foreseeable project activities are described in Table 7.2-26.

LNG carriers connected to Woodfibre LNG will be subject to the same requirements of the *Canadian Shipping Act* as Proposed Project vessels. They are also likely to have additional maritime regulatory and operating requirements, such as, but not limited to, use of tug assist and BC Coast Pilots during their passage in Howe Sound.

As described in Section 7.2.5.3, consideration will be given to routing tugs and barges through Collingwood Channel during peak times as an alternative to Queen Charlotte Channel. This alternative routing would serve to avoid cumulative interactions with LNG carriers. In addition, the following measure has been identified to reduce or prevent further cumulative effects:

- Commitment for additional planning in regard to the interaction of Proposed Project vessel traffic with the LNG carriers of Woodfibre LNG, which will likely involve BURNCO, the tug operator, Woodfibre LNG, BC Coast Pilots and other key maritime stakeholders and will consider vessel routes and timing options.

Table 7.2-26: Identified Mitigation Measures for Cumulative Effects: Marine Navigation VC

Potential Cumulative Effect	Mitigation	Responsibility for Implementation	Anticipated Effectiveness
Construction and Operations			
Interference with navigation use and navigability due to Project-related vessel traffic.	Commitment for planning in regard to the interaction of Project vessel traffic with the LNG carriers of Woodfibre LNG, which will consider vessel routes and timing options.	BURNCO, the tug operator, Woodfibre LNG, BC Coast Pilots and other key maritime stakeholders	High
Reclamation and Closure			
None Identified			

7.2.5.7.7 Residual Cumulative Effects and their Significance

Potential residual cumulative effects and their significance were characterized using the same methods that were used to characterize residual effects (see Table 7.2-4).

The incremental increase in vessel traffic relative to other shipping is expected to occur in a small area where both projects may interact. Therefore, the total cumulative effect on marine transportation will occur as a result of the residual effects of the Project in combination with other projects and activities that have been and will be carried out. After the residual effects of the Project and the Woodfibre LNG project have occurred, navigability and navigation use are expected to experience infrequent interference effects of low magnitude over the medium term. The context of the marine transportation VC in the study area is resilient as there are well established navigation protocols, practices, aids and large vessel traffic monitoring systems in place on the BC coast, including in the

study area. The commitment for additional planning in regard to the interaction of Proposed Project vessel traffic with the LNG carriers of the Woodfibre LNG project, which was outlined as mitigation of cumulative effects, will serve to minimize potential interference with navigation use and navigability. The additive (cumulative) effects from past and present project and activities, Project residual effects, and residual effects from the Woodfibre LNG project are therefore considered to be not significant. The likelihood of the residual cumulative effect is considered high as vessel traffic does, and will continue to, traverse the study area. The confidence in this cumulative effects assessment is moderate given the lack of small vessel and recreational data for the study area.

Potential residual cumulative effects and their significance are summarized in Table 7.2-27.

Table 7.2-27: Summary of Residual Cumulative Effects Characterization for Marine Navigation VC

Project-Related Residual Effect	Residual Cumulative Effect Assessment Criteria						Significance	Likelihood	Level of Confidence
	Context	Magnitude	Extent	Duration	Reversibility	Frequency			
Construction and Operations									
Interference with navigation use and navigability due to Project-related vessel traffic.	R	L	R	MT	FR	L	NS	H	M
Reclamation and Closure									
None Identified									

Assessment Criteria:

Context: R – Resilient, MR – Moderately Resilient; S - Sensitive;
 Magnitude: N – Negligible, L – Low, M – Medium, H – High;
 Geographic Extent: L – Local, R – Regional, BR – Beyond Regional;
 Duration: ST – Short-term, MT – Medium-term, LT – Long-term;
 Reversibility: FR – Fully Reversible, PR - Partially Reversible, IR - Irreversible;
 Frequency: L – Low, M – Medium, H – High
 Significance: N – Negligible, NS – Not Significant, S – Significant
 Likelihood: L- Low, M - Medium, H – High
 Level of Confidence: L- Low, M - Moderate, H – High

7.2.6 Conclusions

The marine transportation section has assessed the effects of the Proposed Project in the construction, operations, and reclamation and closure phases on Marine Transportation. The following effects were identified and assessed:

Marine Navigation VC:

- Interference with navigation use and navigability due to Proposed Project-related infrastructure; and
- Interference with navigation use and navigability due to Proposed Project-related vessel traffic.

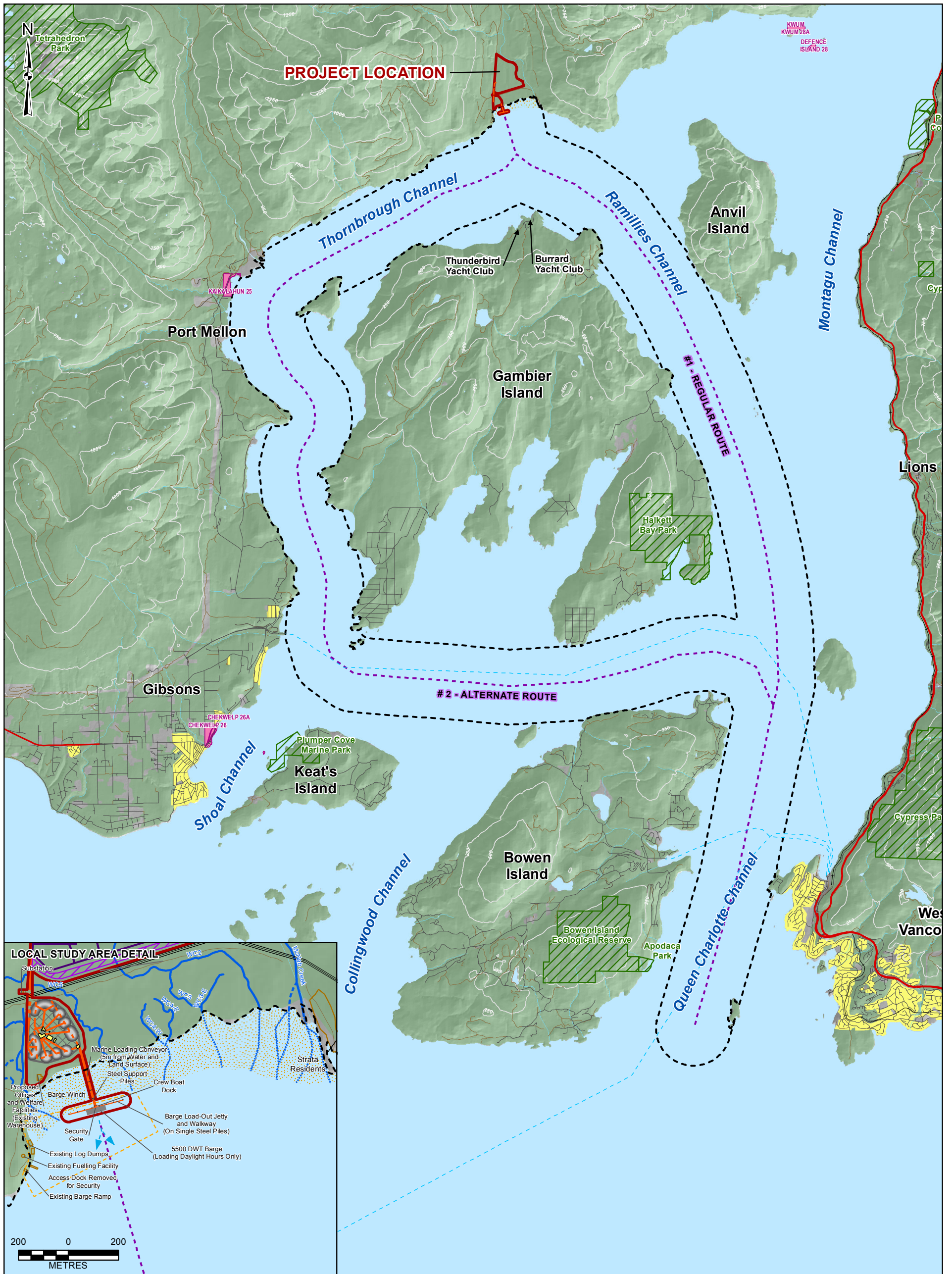
Vessel Wake VC:

- Wake effects from Proposed Project-related vessel traffic on shoreline infrastructure.

The effects of the Proposed Project on the Marine Navigation VC due to interference with navigation use and navigability associated with Project-related infrastructure are considered to be negligible following the implementation of mitigation measures. Interference with navigation use and navigability due to Project associated vessel traffic would be reduced through mitigation measures. However, a residual not significant effect associated with construction and operations of the Proposed Project is expected to remain following mitigation as the frequency of small vessels changing direction and speed in order to move out of the paths of larger vessels is expected to increase slightly in the LSA due to the introduction of Project vessels into the LSA.

The maximum calculated wake energy associated with Project vessels was typically less than wind wave energy; wake wash energy from tug and barge movements is anticipated to be less than 1% when compared to the total energy from naturally occurring wind waves along both routes. One location on the eastern shoreline of Thornbrough Channel would experience wake energy from water taxis (which would be used by the Project) that was estimated to be similar to the wind wave energy. The shoreline in this area is identified as forestry use or as undeveloped. There is no potential interaction between potential wake effects and shoreline infrastructure, therefore this effect is not carried forward in the Marine Transportation assessment.

Cumulative residual effects from Proposed Project-related barging may interact with Woodfibre LNG carriers along a small section of the Project's barging route. However, interactions between vessels associated with each project will occur intermittently when these vessels are simultaneously present in Collingwood Channel. Cumulative residual effects are expected to be not significant following implementation of mitigation measures.



LEGEND			
	Project Area		Vegetation
	Marine Transportation LSA / RSA		Residential Area
	Proposed Aggregate Pit Phase		Indian Reserve
	Processing Area		Intertidal Zone
	Existing Feature		Elevated Conveyor
	Existing Log Tenure Area		Underground Conveyor
	Product Stockpiles		Barge Load-out
	Pit Lake Containment Berm		Transmission Line
	Possible Processing Plant Configuration		Highway
	Park / Protected Area		Road
			Resource Road
			Railway
			Proposed Barging Route
			BC Ferries Route
			Permanent / Perennial Watercourse
			Intermittent Watercourse
			Intertidal Watercourse
			Contour (250m)
			Barge Route
			Pile

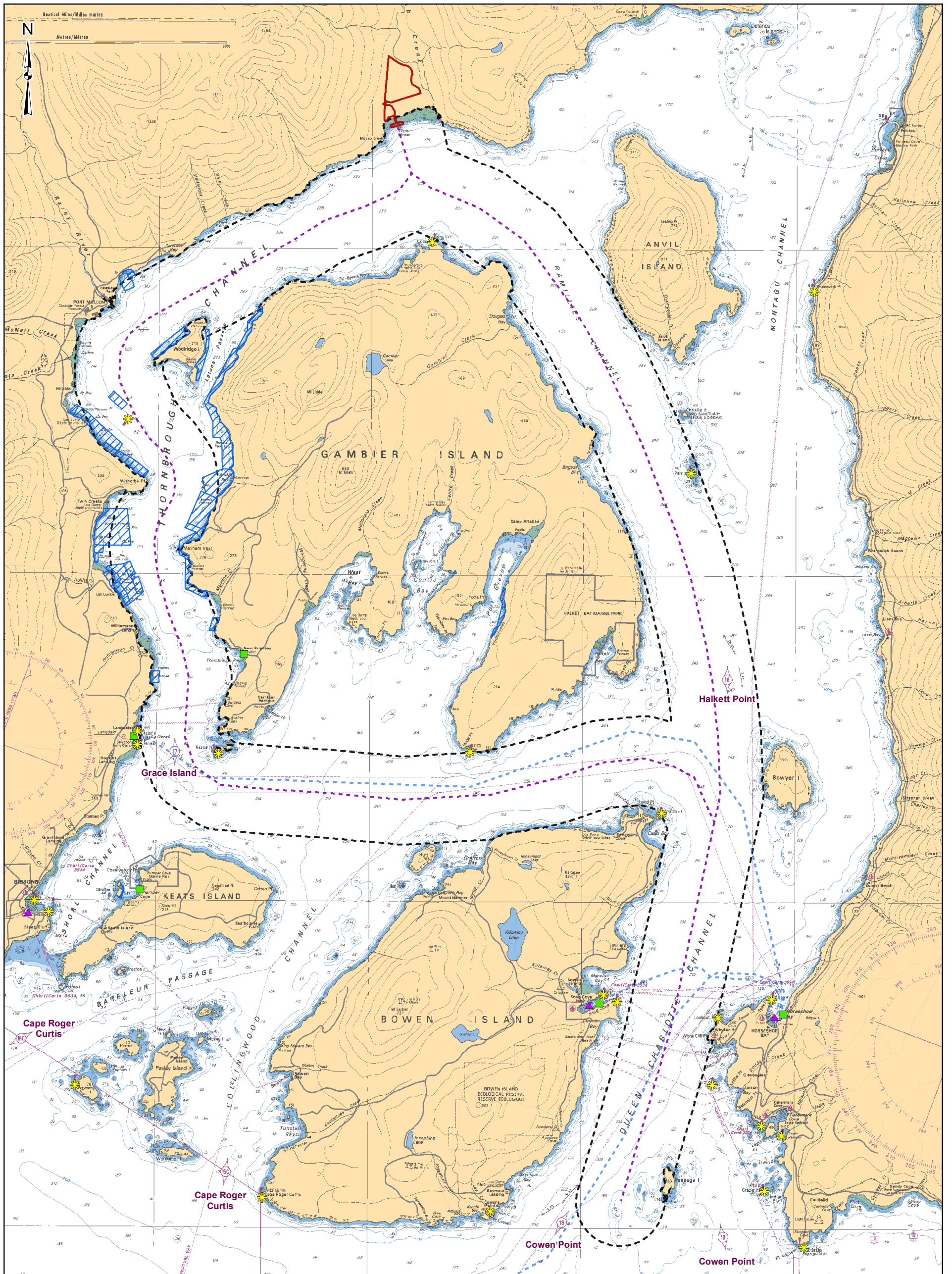
REFERENCE

Watercourses from the Province of British Columbia and field data. Parks and protected areas from the Province of British Columbia. All rights reserved. Elevation and Indian reserves from Geobase. Base data from CanVec. Projection: UTM Zone 10 Datum: NAD 83



PROJECT		BURNCO ROCK PRODUCTS LTD. BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.	
TITLE		MARINE TRANSPORTATION STUDY AREAS	
PROJECT NO. 11-1422-0046		PHASE No.	
DESIGN	MD	14 Mar. 2014	SCALE AS SHOWN
GIS	DL	09 Mar. 2016	REV. 1
CHECK	DDB	05 Mar. 2015	FIGURE 7.2-1
REVIEW	RA	05 Mar. 2015	



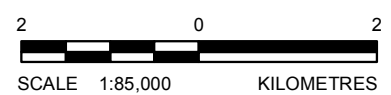


LEGEND

- Project Area
- Marine Transportation LSA / RSA
- Log Handling/Storage Crown Land Lease
- Navigational Aid with Light
- Water Taxi Base
- BC Ferries Terminal / Dock
- Calling In Points
- BC Ferries Route
- BC Ferries Terminal / Dock

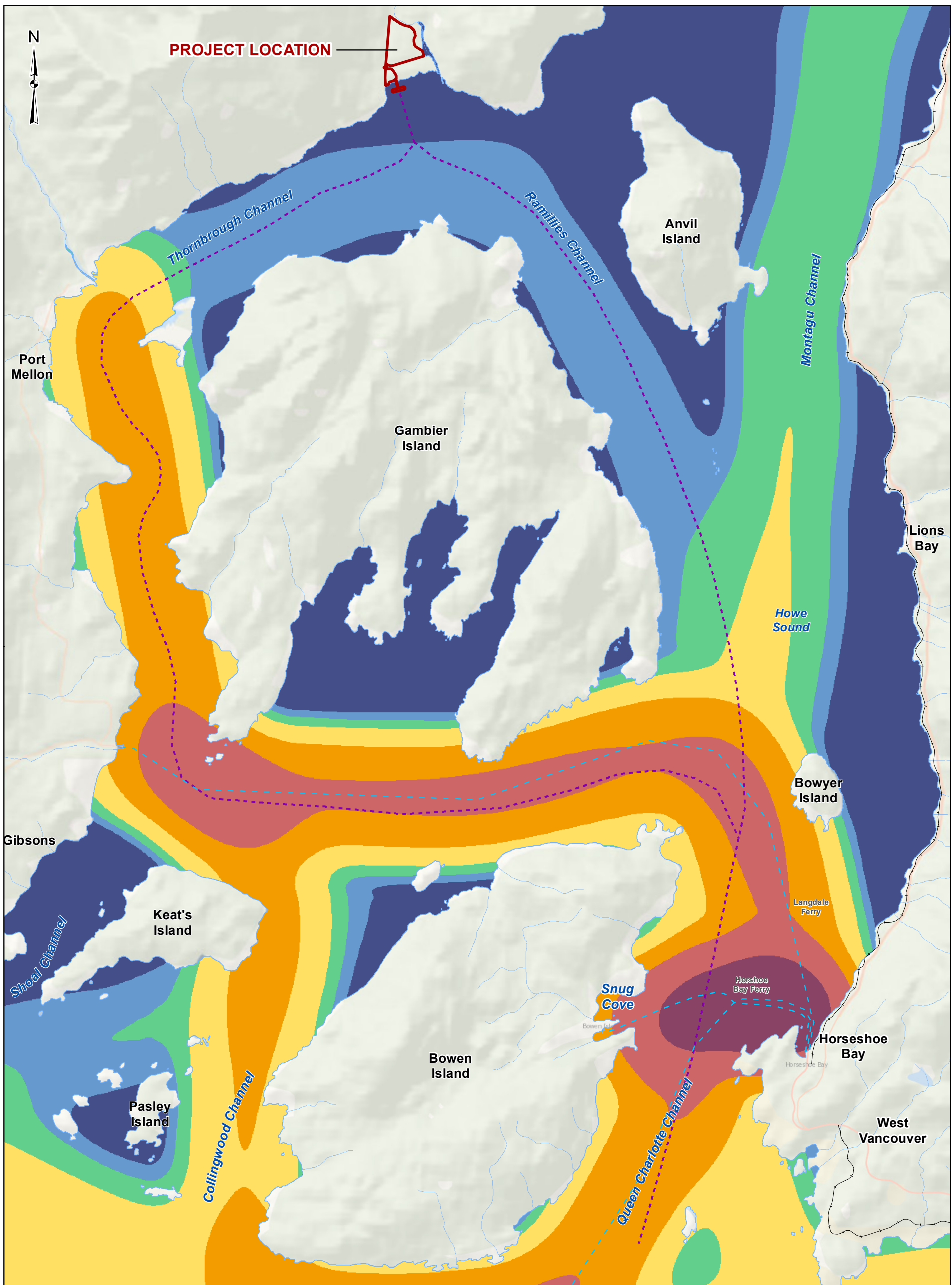
REFERENCE

Base image from Canadian Hydrographic Service digital file for chart number 3526. Navigational aids digitized based on chart data.
 Projection: UTM Zone 10 Datum: NAD 83



PROJECT		BURNCO ROCK PRODUCTS LTD. BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.	
TITLE		COMMERCIAL MARINE FEATURES	
PROJECT NO. 11-1422-0046		PHASE No.	
DESIGN	MD	14 Mar. 2014	SCALE AS SHOWN
GIS	DL	09 Mar. 2016	REV. 1
CHECK	DDB	05 Mar. 2014	FIGURE 7.2-2
REVIEW	RA	05 Mar. 2014	





PROJECT LOCATION

Thornbrough Channel

Ranilles Channel

Montagu Channel

Anvil Island

Gambier Island

Lions Bay

Howe Sound

Bowyer Island

Port Mellon

Gibsons

Keat's Island

Snug Cove

Langdale Ferry

Horseshoe Bay

Pasley Island

Collingwood Channel

Bowen Island

Queen Charlotte Channel

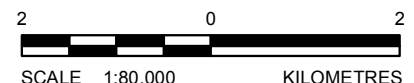
West Vancouver

LEGEND

- | | |
|------------------------|--|
| Project Area | Commercial Vessel Daily Transits 0 - 0.4 |
| Proposed Barging Route | Commercial Vessel Daily Transits 0.5 - 0.9 |
| BC Ferries Route | Commercial Vessel Daily Transits 1 - 1.9 |
| Highway | Commercial Vessel Daily Transits 2 - 4.9 |
| Road | Commercial Vessel Daily Transits 5 - 9.9 |
| Resource Road | Commercial Vessel Daily Transits 10 - 19.9 |
| Railway | Commercial Vessel Daily Transits 20 - 92.3 |

REFERENCE

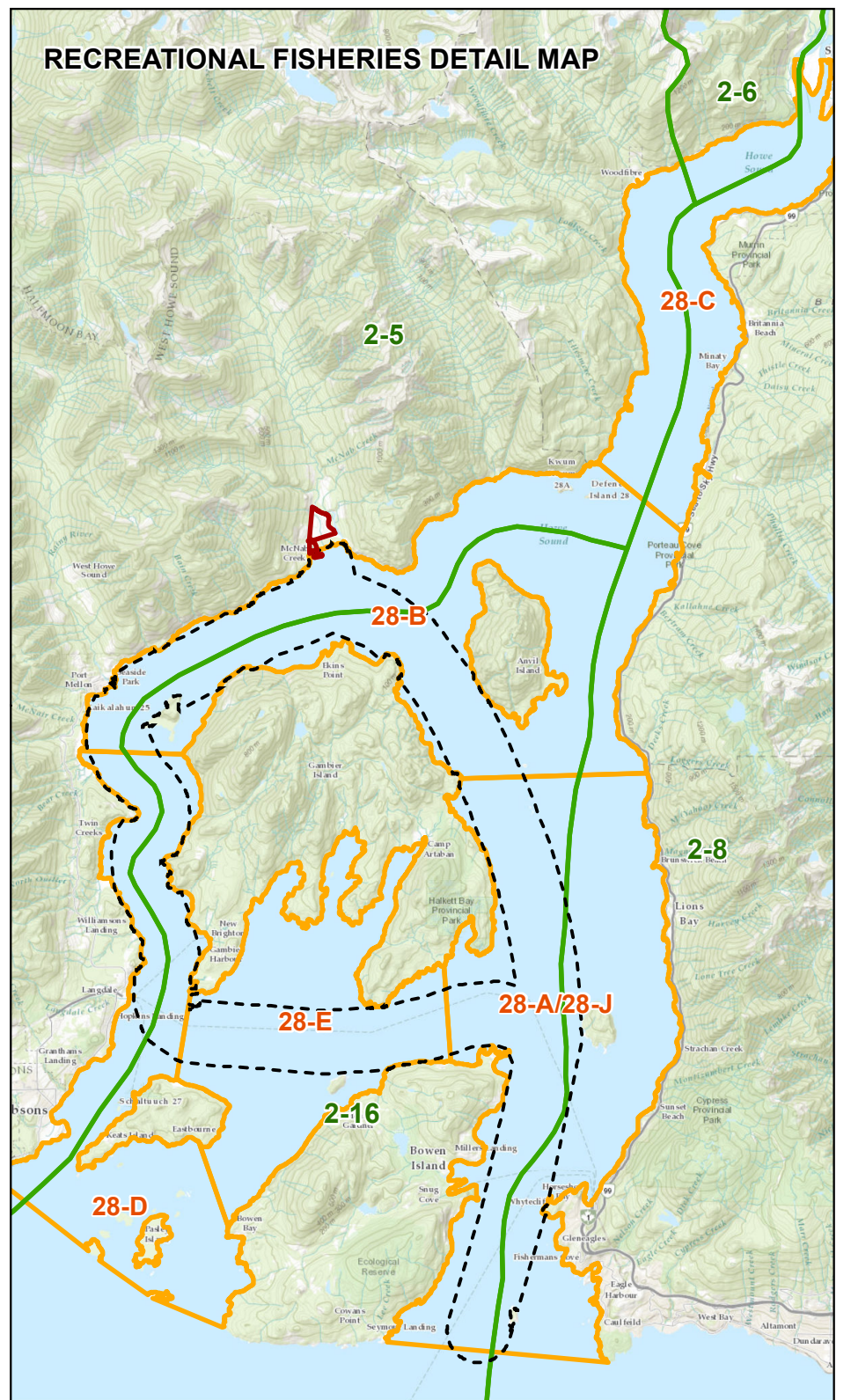
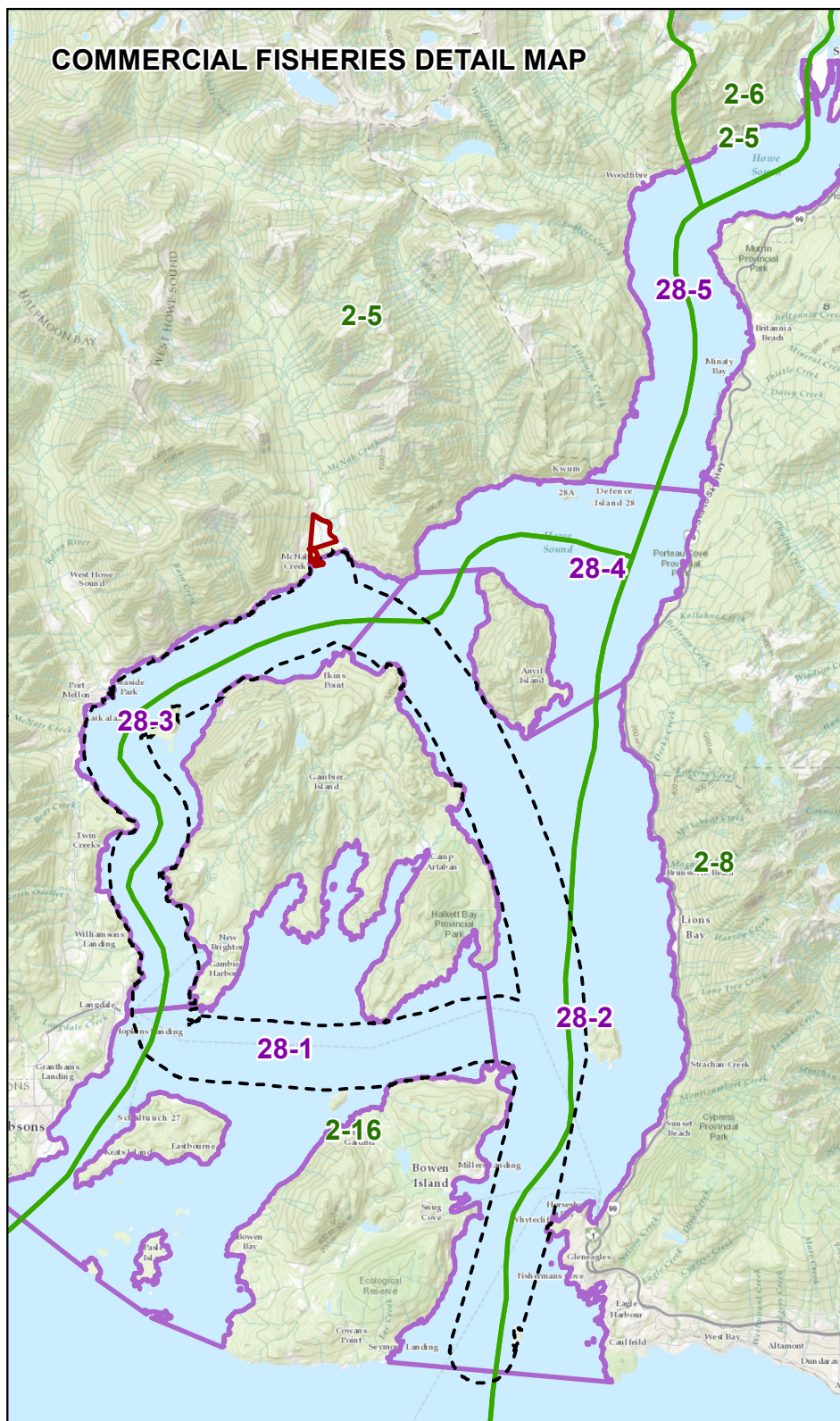
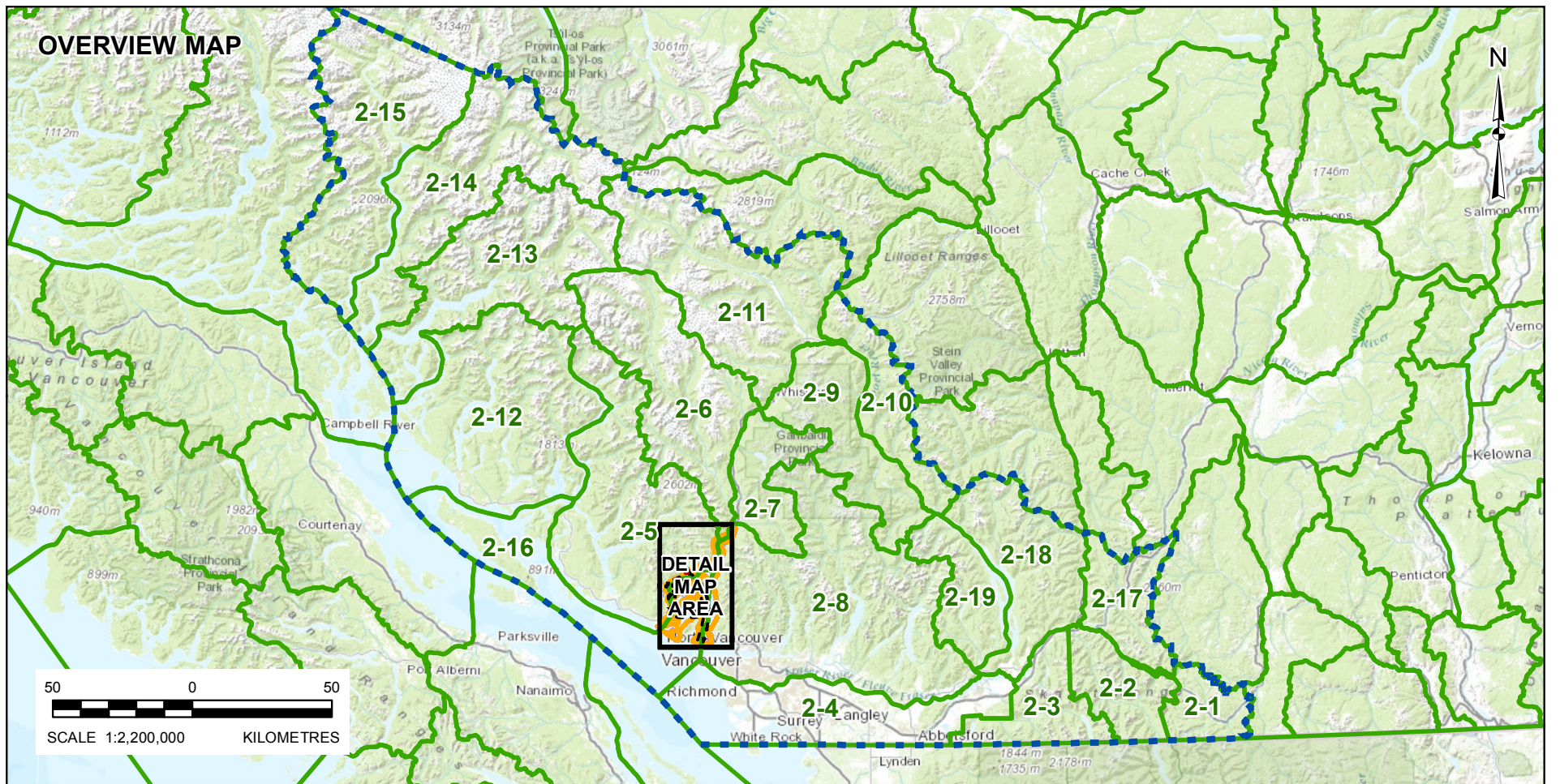
Vessel transits based on Automatic Identification System (AIS) data.
 Base data from CanVec. Ocean base map obtained from ESRI and its data suppliers, Redmond, WA, 2009.
 Projection: UTM Zone 10 Datum: NAD 83



PROJECT		BURNCO ROCK PRODUCTS LTD. BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.	
TITLE		COMMERCIAL MARINE TRAFFIC DENSITY	
PROJECT NO. 11-1422-0046		PHASE No.	
DESIGN	MD	2 Nov. 2012	SCALE AS SHOWN
GIS	DL	09 Mar. 2016	REV. 1
CHECK	DDB	05 Mar. 2014	FIGURE 7.2-3
REVIEW	RA	05 Mar. 2014	



Path: X:\Project Data\BC\Nab\Figures\WXD\Marine_Figures\Marine_Transportation_EA\BURNCO_MARINE_TRANSPORTATION_7_2-3_Commercial_Marine_Traffic_Density.mxd

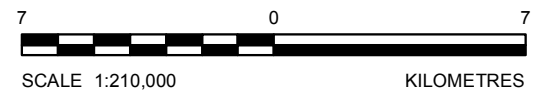


LEGEND

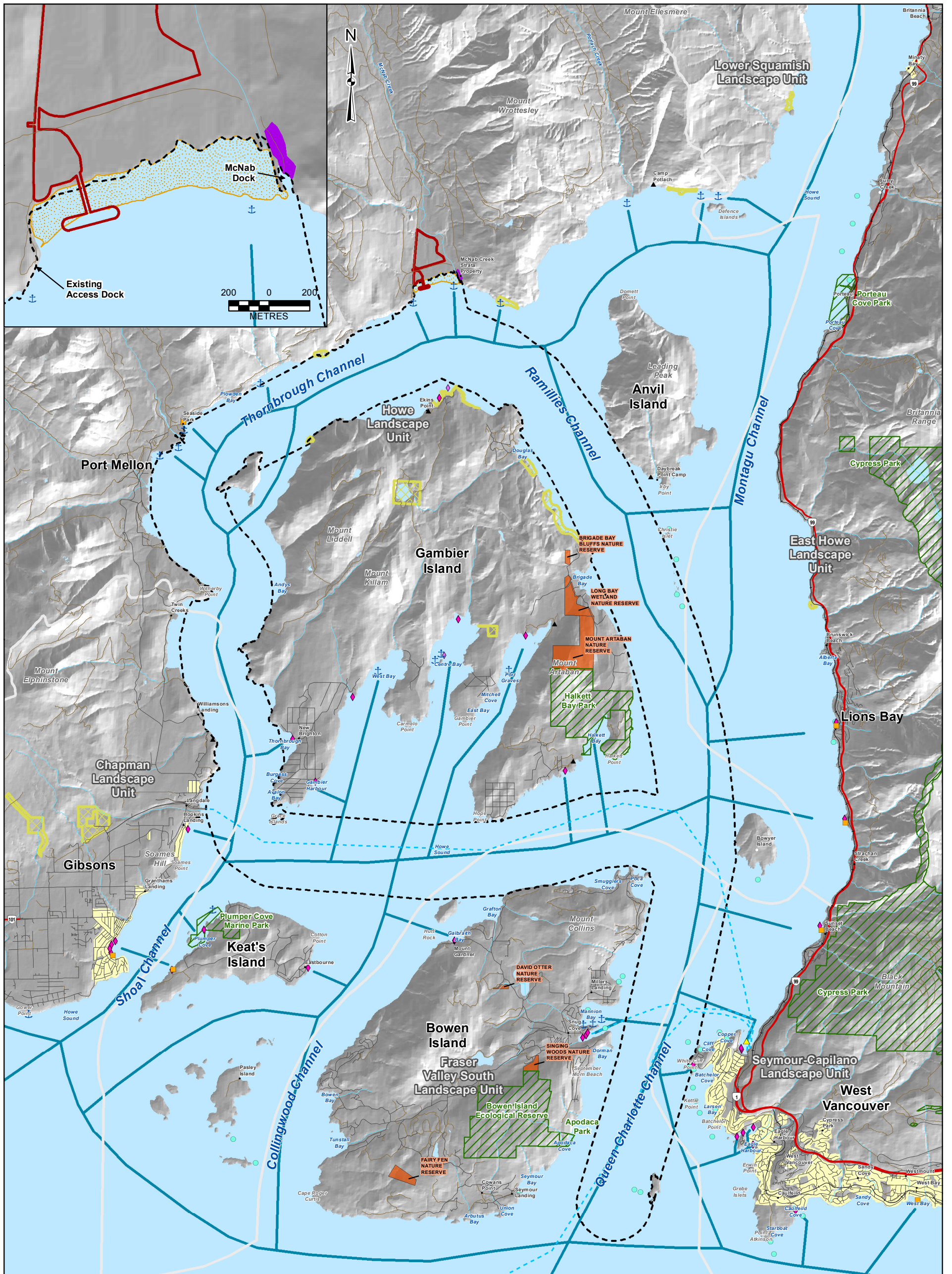
- Project
- Marine Transportation LSA /
- Commercial Fisheries Management Area 28 - Pacific Region Sub-Areas (IDs within RSA Pre-2011/Post-2011)
- Commercial Fisheries Management Area 28 - Pacific Region Sub-Areas (IDs within RSA)
- BC Fisheries Sub-Regions (ID)
- BC Fisheries Region 2 - Lower Mainland

REFERENCE

Fisheries management data digitized based on maps provided by the federal DFO. BC Fisheries data based on wildlife management units from GeoBC. Elevation data from Geobase. Base map from ESRI. Projection: UTM Zone 10 Datum: NAD 83



PROJECT		BURNCO ROCK PRODUCTS LTD. BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.	
TITLE		COMMERCIAL AND RECREATIONAL FISHING	
	PROJECT NO.	11-1422-0046	PHASE No.
	DESIGN	SR 15 Aug. 2013	SCALE AS SHOWN
	GIS	DL 09 Mar. 2016	REV. 1
	CHECK	DDB 05 Mar. 2014	FIGURE 7.2-4
REVIEW	RA 05 Mar. 2014		

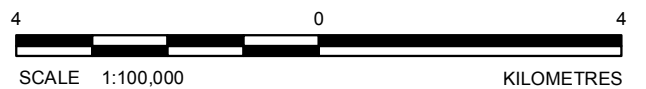


LEGEND

- Project Area
- Marine Transportation LSA / RSA
- Strata Property (Approximate)
- Park / Protected Area
- Land Use Planning Landscape Unit (Name)
- Active Recreation Polygon
- Island Trust Nature Reserve
- Residential Area
- Intertidal Zone
- Camp
- Anchorage
- Boat Launch
- Boat Rental
- Marina
- Yacht Club
- Diving Site
- BC Ferries Route
- Recreational Boating Route
- Highway
- Road
- Resource Road
- Railway

REFERENCE

Crown land tenures, forestry recreation reserves, provincial parks, anchorages, boat launches, marinas, and diving sites from the Province of British Columbia. All rights reserved. Recreational boating routes from BCMCA. Elevation data from Geobase. Base data from CanVec. Projection: UTM Zone 10 Datum: NAD 83



PROJECT				
BURNCO ROCK PRODUCTS LTD. BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C.				
TITLE				
RECREATIONAL MARINE FEATURES				
PROJECT NO. 11-1422-0046		PHASE No.		
DESIGN	SR	15 Aug. 2013	SCALE AS SHOWN	REV. 1
GIS	DL	09 Mar. 2016	FIGURE 7.2-5	
CHECK	DDB	05 Mar. 2015		
REVIEW	RA	05 Mar. 2015		



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