REPORT TO:	Council	FOR:	COW
REPORT FROM:	Community Planning; Engineering		
PRESENTED:	July 25, 2023	FILE:	
SUBJECT:	Mamquam Blind Channel Maintenance and Funding Strategy Update		

Recommendation:

That Council approve the following resolutions:

THAT the District of Squamish receive the Mamquam Blind Channel Maintenance and Funding Strategy Discussion Draft document and provide feedback on the draft principles, options and funding considerations presented in the July 25, 2023 Staff Report, as follows:

- ;

AND THAT the District of Squamish direct Staff to solicit comment from the community on the Discussion Draft prior to bringing the strategy back to Council for further discussion.

---

1. Objective:

To seek Council input on an early draft of the Mamquam Blind Channel (MBC) Maintenance and Funding Strategy prepared in consultation with a community working group and to obtain endorsement for public engagement activities prior to developing financial scenarios and finalizing recommendations for future Council consideration.

2. Background:

Development of the MBC Maintenance and Funding Strategy was initiated in late 2021. This project was identified as a high priority action in the Squamish Marine Action Strategy (2020). In April 2022, Staff presented an update on project scope and initial technical review stage. Council endorsed the proposed engagement plan and recruitment of a stakeholder working group to support development of the strategy (April 12, 2022 Council Report; Meeting Minutes) and approved the following motion on May 3, 2022:

> THAT the District of Squamish receive the April 12, 2022, project update on the Mamquam Blind Channel Dredging Strategy; AND THAT the District of Squamish endorse the proposed engagement plan and initiate recruitment for a dredge program stakeholder working group as outlined in the April 12, 2022 staff report and feedback provided at the April 12, 2022 Committee of the Whole meeting.

The working group was recruited by September and engaged in a first meeting in October 2022. Further detail on project engagement to date is presented in Section 6.

3. Project Information:

A preliminary Discussion Draft showing progress on the strategy is presented in Attachment 1. The strategy outlines channel maintenance needs, and context for the MBC, strategy objectives

and guiding principles, as well as project engagement activities and inputs on channel maintenance options and funding tools and approaches. Case studies for channel maintenance and habitat enhancement projects in other coastal communities are provided.

Overall, the key findings and strategy recommendations are as follows:

- The MBC supports important coastal ecological functions and human health, social, cultural and community values as well as broader regional economic activities. Collaboration with Squamish Nation in the planning, delivery and monitoring of the project will be essential.
- The ongoing sedimentation (upwards of 2,500m^3 of sediment per year) and current deposits in the MBC pose a risk to navigation safety. The MBC does not meet the designated navigation channel dredge depth and channel width design standards for two-way small boat traffic in a protected waterway. Channel maintenance and restoration are needed over the long-term to sustain a healthier balance for the waterway. A -2.6m (Chart Datum) design depth is generally recommended to allow most recreational and industrial vessels to safely navigate at the average low water level.
- Based on a preliminary review of sediment data, total polycyclic aromatic hydrocarbons (PAHs), arsenic, cadmium, copper, and mercury appear to have elevated levels in some areas that will require the sediment from these locations to be disposed in a certified landfill. Additional testing will be required for permitting and disposal.
- Beneficial reuse of dredged material includes habitat restoration, land reclamation, construction and landscaping, coastal nourishment and site remediation and there are many examples of successful reuse projects. Squamish Nation is supportive of balancing environmental needs and navigation considerations and focusing on habitat enhancement in the Stawamus estuary area for habitat restoration.
- Of the maintenance options reviewed with the working group to date, Option A: Status quo/do nothing was not supported due to the navigation safety risk at present and lost opportunity to enhance channel health as well as social and economic potential. The preferred options identified include:
    - Option B: Stop-gap (@St'á7mes River only to -2.6m CD)
    - Option C: Focused Dredge (entails dredging to a depth of -2.6m CD in South Channel and -1.6m CD in the North Channel).
- Initial estimated costs are $650K for Option B: Stop-gap, and upwards of $3.5M+ for Option C: Focused Dredge.[1] Due to significant costs and the absence of senior government funding for local channel maintenance, facilitating a community-based approach and collaborative dredging strategy and funding program is needed.

[1] This costing assumes disposal at sea and is recognized as a minimum; other disposal options such as those involving disposal at a certified landfill, or potential for land creation and habitat restoration would increase costs substantially.

- The District is responsible for maintaining a significant asset base with a replacement value of over $883M as identified in the District's Asset Management Plan (AMP). Given significant shortfalls to maintain existing assets and facilitate required upgrades to manage community growth, it will be challenging to secure significant funding for dredge maintenance. For the preferred options identified in the strategy, associated financing scenarios with external funding sources will need to be assessed for future Council consideration. This would be a new service that would need to be aligned with the municipality's financial plan and legislative requirements.
- Funding approaches and tools for an initial dredging program and future, regularly scheduled maintenance dredging for further examination are listed below:
    - General property taxation;
    - A Local Service Area tax for specific properties with navigation channel users that benefit from navigation channel dredging;
    - Voluntary contributions from commercial operators and/or community organizations utilizing the MBC; and
    - Partnering with provincial and federal government and pursuing potential grant opportunities, including combining with habitat restoration works.

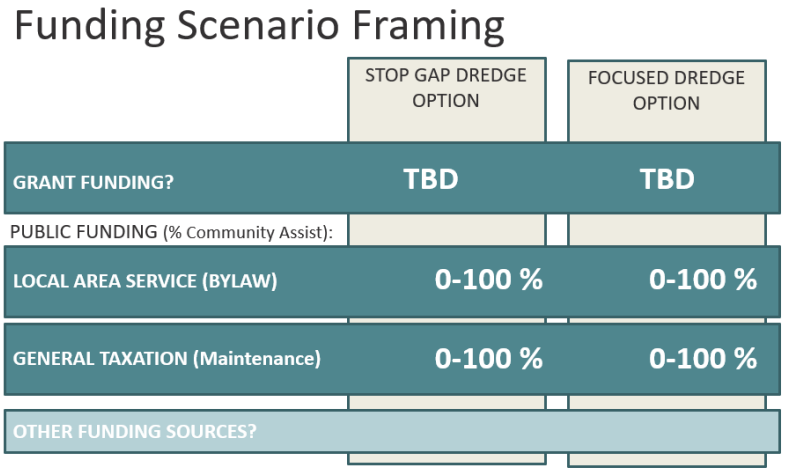
Financing Options Discussion

The costs for maintenance options presented in the draft strategy are estimates prepared by Westmar Advisors and based on current market construction costs and assumptions based on disposal and habitat compensation requirements that are likely to be required; they provide order of magnitude costing for this stage in the strategy development and will need to be confirmed with detailed plans, permitting approvals (with associated conditions) and further sediment analyses.

In the absence of dedicated federal funding for channel maintenance activities outside of core harbours and ports, coastal communities are faced with serious challenges in developing joint funding approaches for initial dredging, as well as establishing long-term reserves for maintenance over time. Some have successfully pursued public funding such as the Ladner-Steveston local channel dredging project between Delta, Richmond, the Province (MoTI) and Port of Metro Vancouver in 2013.[2] The multi-party contribution agreement set the funding framework and proportional costs for phased maintenance activities; Delta and Richmond's contribution to the $6.5M (2013) project was approximately one third of the total costs, and the Port and Province funded the additional (two-thirds) of the remaining costs. Delta capped its contribution at $2M and allocated funds from accumulated reserves to avoid impact on municipal property tax.

[2] See Corporation of Delta Council Report: Ladner Steveston Channel Dredging Contribution Agreement: delta.civicweb.net/document/88847/

As discussed with the working group, there are broad beneficiaries of channel maintenance in terms of the overall community benefit (general safe water access for all; recreation and commerce), as well as specific water users benefiting from enhanced navigation capability (water lot lease holders and business users).



Through further engagement, community expectations for MBC navigation access and willingness to support through Local Service Area and/or general property taxation will be reviewed such that future financial scenarios may be framed for wholistic review in the Five Year Financial Plan.

Related Marine Impact Assessment work

Of further note, the Marine Sector Study (Economic Development) to be initiated in early 2024 will be vital to contribute knowledge and assess the value and benefit of channel maintenance activities (or lost opportunity if not pursued) to marine and other sectors in the community and region. Impacts to waterfront properties and developments, local marinas and yacht clubs, marine tourism, major industrial operators on and off the water, and public recreation and transportation and logistics will be considered.

4. Implications:

a. Budget:

Special project funds of $50K have been allocated and utilized for this project; no additional budget is required to complete the remaining stage of engagement and finalization of the strategy.

The District's current Five-Year Financial Plan does not include channel maintenance funds for capital works and/or budget for leveraging grant funding where it may be available for a future community-based strategy drawing upon multiple funding sources. However, special project funds of $50K are being proposed in the budget for 2024 to complete further sediment testing for contaminants to support a future channel maintenance application, should grant funding prove available in the near-term. These funds will need to be analyzed during 5YFP planning against other District project priorities.

b. Cross department collaboration:

The project is jointly led by Engineering and Planning Staff with support from the District's Environment, Economic Development, and Finance teams. Support from the Communications team is being sought to collaborate on public engagement activities planned for the final stage of the project.

Finance and Legislative Services expertise and resourcing will be needed to advance any future financing and community-based funding scenarios, as determined through remaining stage of the strategy development and subject to future Council consideration through the District financial planning process.

c. <u>Policy:</u>

Squamish 2040 OCP policies pertinent to and guiding the project:

Squamish River Estuary. *Policy 10.10 j.* Continue to support re-watering of the Mamquam Blind Channel and its tributary systems to improve flows and enhance environmental features by reconnecting the Mamquam River with the Mamquam Blind Channel and the lower portion of the Squamish River Estuary.

Coastal / Marine Planning. *Objectives 10.11 a.* Recognize, value and promote ecosystem services provided by coastal and marine environments; and *b.* Protect, restore and enhance the ecological features and functions of coastal and near shore areas.

Policy 10.12 b Continue to build partnerships and collaborate to monitor and protect waterfront and marine areas. Establish a Marine Working Group to coordinate and align efforts of all coastal stakeholders and agencies with jurisdictional authority and interests in the local marine environment.

Marine, Rail + Air Transport. *Objective 20.23* Consider long-term intermodal needs and necessary infrastructure for viable marine and rail transportation connections.

Policy 20.24 e. Develop a dredging strategy for the Mamquam Blind Channel as needed in order to address navigability for transportation, recreation and commerce, while minimizing impacts to marine habitats and biodiversity.

*Policy 23.*4 e. Undertake dredging where necessary within navigable waterways (primarily Mamquam Blind Channel) within limits established for shoreline protection, and in consultation and partnership with regulating agencies and marine stakeholders, to ensure continued navigation access.

Employment Lands Maximization *Objectives 14.1 and Policy 14.1f* – Advocate for improved, safer access to and from Site B and support use of Site B for expanded specialized water-dependent industrial and port terminal uses.

Port Facilities + Marine Activities *Objective 14.5 and Policies 14.6b* – Encourage expansion and diversification of marine, and 14.6e (coordinated waterfront land uses that support economic development.

Water-Based Recreation *Objectives 18.9* (assets and stewardship of local blueways and marine areas), *Policy 18.10a* Promote marine-based recreation opportunities and low impact, water-based recreation access in and around the ocean, channels, and rivers.

d. <u>Bylaws:</u>

The Squamish 2040 OCP Bylaw 2500, 2017 contains important guidelines respecting environmental protection (See Section 34.8 DPA1 Aquatic Marine Guidelines for marine

and estuarine areas). Core direction for dredging is prescribed in Guideline 34.8 o. *Dredging activities, for new or maintenance of existing facilities, in compliance with senior agency requirements and authorized by the District, should be limited to the minimum area necessary to maintain the existing facility. Where within proximity to sea dike structures, dredging should be done with use of silt curtains to prevent siltation/sedimentation of adjacent areas.*

5. Strategic Plan

Increasing employment on land and in marine areas is a strategic objective in the District's 2023-2026-Strategic-Plan.pdf (squamish.ca). Channel maintenance efforts contribute in various ways to the following strategic outcomes:

Connected and Livable Community: Marine accessibility connects the community to the ocean, improves navigation safety and strengthens cultural, recreational and economic opportunities in Squamish.

Prepared for the Future: Channel maintenance is central to the communities' long-term resilience and focus on sustainable development and fiscal, social and environmental co-benefits.

Resilient People and Relationships: The Mamquam Blind Channel is significant to Skwxwú7mesh Úxwumixw; the health and maintenance of this important waterway in line with the values of the Skwxwú7mesh Úxwumixw is part of strengthening relations and ongoing stewardship of marine areas together in their core homelands and unceded territory.

Reliable Service Delivery: Marine waterway accessibility and maintenance connects to District's natural asset management program. Natural assets such as marine and estuary areas provide important ecological services to the community.

6. Engagement:

Public participation to date has followed the *Consult* IAP2 level, with initial engagement of the community working group to collect representative stakeholder interests and access needs, as well as feedback on identified channel maintenance options. Engagement and inputs are further detailed in Section 3 of Attachment 1. Broader community engagement activities are planned next to:

a) Raise awareness and inform the wider community about the considerations and technical aspects of channel maintenance works, and then;

b) Consult on the preferred options and impacts involved, including environmental and fiscal impacts with any municipal financial contribution scenarios.

Engagement activities will include several community in-person pop-ups in August and early September, an online survey and direct outreach efforts. A key focus will be to collect community perspectives on funding approaches (assessment of value, costs and benefits of channel maintenance, as well as the public's expectations for accessibility and enhanced service delivery). Further community involvement in the project would be initiated through specific

financial and partnership proposals (e.g., parcel taxes, local service area creation, and/or partnerships) where they may be advanced as directed by Council.

Engagement with Squamish Nation has occurred early through initial project referral and ongoing through participation in staff-to-staff meetings as well as at Working Group Meeting #3. Inputs from the Squamish Nation to date have been incorporated in the Discussion Draft.

Additional engagement and advocacy (subject to Council endorsement) is proposed with senior governments to discuss the prospect of greater collaboration on long-term local channel maintenance program planning and funding, as has been acutely raised by the City of Delta (Attachment 2). Delta has called on the Federal government to confirm its jurisdiction for secondary channel dredging on the Fraser River, provide permanent annual funding for dredging local channels and provide exemption from ocean disposal fees, and to confirm that the Canadian Coast Guard will continue to fund annual surveys of secondary channels. Project and issue familiarization and discussions with the local West-Vancouver-Sunshine Coast-Sea to Sky Member of Parliament (MP) is a recommended first step.

7. Next Implementation Steps:

Subject to Council support for continued public engagement, Staff will take the following next steps:

1. Post the MBC Maintenance Strategy & Funding Discussion Draft to the project page and advertise for public engagement activities and online survey deployment;
2. Facilitate continued intergovernmental engagement and outreach on long-term funding program planning; and
3. Summarize final engagement and strategy for Council review.

8. Attachments:

1. MBC Maintenance & Funding Strategy – Part 1 Discussion Draft (July 2023)
2. Local Channel Dredging Challenges and call to Action - Letter to MP Parm Bains February 14, 2023

9. Alternatives to Staff Recommendation:

THAT the District of Squamish refer the Mamquam Blind Channel Maintenance and Funding Strategy Discussion Draft document to another Committee of the Whole for further analysis and direction prior to any broader public engagement on the draft.

10. Staff Review

Prepared By:

Sarah McJannet, RPP MCIP, Planner
David Roulston, P.Eng, Manager of Municipal Infrastructure

Reviewed By:

Jonas Velaniskis, Senior Director of Community Development

Reann Sousa, Acting General Manager, Financial Services
Robin Arthurs, General Manager of Corporate Services

CAO Recommendation:

That the joint recommendations of the Community Planning and Engineering departments be approved.

Linda Glenday, CAO

WESTMAR ADVISORS

SQUAMISH

District of Squamish

Long-Term Mamquam Blind Channel Maintenance & Funding Strategy

1210165-RPT-0001 Revision B

28 June 2023

Table of Contents

Appendices

List of Tables

List of Figures

Executive Summary

To come.

1 Introduction

The Mamquam Blind Channel within downtown Squamish holds vital cultural and community importance. The channel supports critical ecological functions, aquatic marine and riparian habitats, and represents a critical marine gateway for the community's health and vitality: for the Sta'7mes community and village site, for recreational boating and watersport key to the tourism sector, as well as industrial, commercial and marine transportation services essential to local and regional economies.

Facilitating a community-based maintenance and funding program is needed to address natural sedimentation and navigation safety of the channel. Historic dredging in the MBC has occurred over time to facilitate use of the waterway. However, in the past 30 years there has been limited dredging; the last significant channel maintenance was undertaken by federal agencies in 1986. In the absence of senior government funding, several community initiatives were launched to organize and seek funding for major maintenance dredging of the MBC (2006-08 and 2012-13). These campaigns were not successful, prompting further advocacy by the Squamish Chamber of Commerce requesting federal, provincial and municipal governments to take action to address marine safety, community economic development and quality of life affected by navigation channel constraints. Developing a long-term dredge management program was subsequently identified as a priority action in the District's 2018 Marine Action Strategy based on community inputs and objectives, and the dredge program development project received initial funding in the 2021 Financial Plan.

Figure 1 – Study Area

The study area for the dredging strategy (see Figure 1) was established with the objective of prioritizing and focusing on navigational safety within the most actively used reaches of the channel and the area classified as a navigable waterway (the CN Rail and Highway 99 bridge crossings effectively limit boat traffic and the MBC beyond them is not considered a navigable waterway by Transport Canada).

The upper channel (north of the CN Rail Bridge) has not been included in the initial dredge review area. The available funding envelope, lack of readily available data for this geographic area (bathymetry and sediment quality sampling) and additional cost to acquire it, coupled with high environmental sensitivity and significant sediment volumes and associated costs that would result from its inclusion, resulted in the area being considered out of scope at this time. Some level of future review is expected to be undertaken by third parties as part of the detailed design for the future proposed pedestrian bridge and public dock facilities associated with the Redbridge project just north of the Highway 99 bridge.

1.1 Land and Waters Acknowledgement

The local lands and waters considered in this strategy are the ancestral, unceded, core territory and homelands of the Skwxwú7mesh Uxwumixw (Squamish Nation). These lands and waters are subject to the inherent rights and the governing laws, policies, customs and land and water use plans of Sḵwx̱wú7mesh Úxwumixw. Sḵwx̱wú7mesh Úxwumixw is currently developing a X̱aẏ Shḵw'eṅ Marine Use Plan for the territory. In addition, the Sḵwxwú7mesh Úxwumixw Strategic Plan 2022-2026 outlines the Nation's priorities, values and goals for Squamish people to connect with their land and waters, protect fish and marine habitat and deliver services and economic development to ensure a better future for Skwxwú7mesh Stélmexw (Squamish people).

Figure 2 – Skwxwú7mesh Territory

St'á7mes Village is situated at the oceans edge at the base of Siyám Smánit (Stawamus Chief) along side the Stawamus River estuary that drains into the Mamquam Blind Channel. See Sub-section 4.1 for more detail.

The waters that connect to Átl'ka7tsem (Howe Sound) are also the shared territory of the Tsleil-Waututh, xʷməθkʷəy̓əm (Musqueam) and shíshálh (Sechelt) Nations. The ocean and the rivers play a vital role in the provision of food, transportation and forms an essential spiritual and cultural landscape for Indigenous Peoples.

1.2 Coastal Planning Policy Directives and Priority Marine Actions

In consideration of long-term community objectives to support marine and multimodal transportation options, continued use of Squamish's 'working harbour', marine-based recreation and economic development, the intention to develop a strategy for MBC maintenance was first presented in the District of Squamish Squamish2040 Official Community Plan (Bylaw 2500):

> *Policy 20.24 e.* Develop a dredging strategy for the Mamquam Blind Channel as needed in order to address navigability for transportation, recreation and commerce, while minimizing impacts to marine habitats and biodiversity.
>
> *Policy 23.*4 e. Undertake dredging where necessary within navigable waterways (primarily Mamquam Blind Channel) within limits established for shoreline protection, and in consultation and partnership with regulating agencies and marine stakeholders, to ensure continued navigation access.

The Squamish Marine Action Strategy (MASt) (2018) later identified a cluster of strategic directions and actions to protect marine areas and resources and maximize the waterfront as an important community asset providing ecological services and social, cultural and economic benefits. Respecting water access and marine user needs, Focus Area 3 (Marine Economy) prioritized work to initiate scoping, collaboration and engagement on an ecosystem based dredge program, priority navigation maintenance activities, and funding strategy (Action 3.1.3 A1).

For integration within this channel maintenance strategy, District of Squamish Official Community Plan Bylaw 2500, 2017, contains protection objectives, policies, and guidelines for environmental best management practices for Development Permit Area 1, including the direction to:

- Protect areas of highest biodiversity and ecological sensitivity within Squamish including ground and surface water, shorelines, forests, wildlife habitat features and rare and endangered ecosystems and species;
- Ensure that ecosystem protection and enhancement values are elevated and prioritized, and to specify where and how lands are developed in and around environmentally sensitive areas;
- Conserve and steward the natural environment, ecosystems and biodiversity within the community;
- Support the movement of various species by connecting ecosystems through undisturbed open space corridors;
- Protect and enhance watercourse ecosystems such as stream corridors, lake or pond edges, wetlands, and other riparian areas and fish habitat, in accordance with the BC Fish Protection Act, and identify Streamside Protection and Enhancement Areas (SPEAs), also known as riparian buffer areas, which must remain free of development, including the disturbance of soils and vegetation;
- Restore, protect and enhance the health of the Squamish River Estuary and marine ecosystems;
- Minimize and mitigate the environmental and visual impacts of development;
- Accommodate recreational and complementary land uses, where appropriate that contribute to the above objectives;
- Restore and enhance sites previously degraded or denuded of vegetation; and
- Ensure that no development of any kind takes place within designated ecological reserves (Baynes Island Ecological Reserve).

2 Purpose

The purpose of this strategy is to develop a community and ecosystem-based channel maintenance, dredging and funding program to support navigation safety, accessibility, habitat and coastal protection and restoration, and community, cultural and regional economic vitality of the marine/gateway area.

2.1 Reasons for Maintenance

The ongoing ecological, cultural, and community importance of the MBC to the Squamish community is acknowledged. It supports important coastal ecological functions and human health, social, cultural and community values as well as broader regional economic activities. As discussed within this strategy, the channel is culturally significant for the Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and represents a critical marine gateway for ocean access for Sta'7mes community/village site, and for recreational industrial, commercial and marine transportation activities and services. As natural processes continue to bring sediment to the lower reaches of the channel, for continued human use, channel maintenance and restoration are needed over the long-term to sustain a healthier balance for the dynamic waterway. Past community initiatives and advocacy by the Squamish Chamber have called on federal, provincial and municipal government action to address marine safety, community economic development and quality of life affected by navigation channel constraints. Due to significant costs and the absence of senior government funding for local channel maintenance, facilitating a community-based approach and collaborative dredging strategy and funding program are needed.

Figure 3 – View of Mamquam Blind Channel (Canadian Coastal Sailing)

2.2 Objectives and Guiding Principles

The primary objective of the strategy is to establish channel maintenance needs and priorities and devise a long-term plan to provide safe and functional navigation within the MBC while limiting environmental and cultural impacts and enhancing coastal ecosystem function.

Development of the strategy has considered a series of Guiding Principles based on commitment to sustaining ecological and Indigenous cultural values and rights, as well as community values and existing policy directives, and ideals respecting integrated systems-thinking, adaptation, accessibility and equity. The compiled principles below establish a foundation to guide the strategy and future decisions on channel maintenance activities. Future channel maintenance should aim to:

- Acknowledge the cultural and ecological importance of the lands and waters and Sḵwx̱wú7mesh Úxwumixw's relationships with them.
- Respect Sḵwx̱wú7mesh Úxwumixw rights & title and advance reconciliation.
- Progressively restore and enhance the environmental health of the MBC (ecological and social foundation for all).
- Preserve safe access for the community's marine gateway and balance needs of diverse marine users in the MBC while respecting core needs and values of the Sta'7mes community.
- Prioritize waterway safety and channel maintenance for navigational purposes and minimize impacts.
- Adopt a long-term channel maintenance program that is sustainable and financially viable.
- Design for future needs, climate adaptation and marine opportunities.
- Ensure benefits and costs are shared amongst the broadest group of beneficiaries.
- Explore partnerships and cost-sharing opportunities wherever possible.
- Consider secondary dredging (i.e. private water lots) as a cost and responsibility for specific beneficiaries.

3 Project Engagement

3.1 Engagement Program and Working Group

Engagement on the strategy has involved early and ongoing engagement of the Squamish Nation, as well as soliciting guidance from governmental agencies in the marine realm, and inputs from key stakeholders and the broader community. A cross-departmental municipal project team (Engineering/Environment, Planning, and Economic Development) led engagement activities with project technical and administrative support by Westmar Advisors.

Upon initiating the strategy in 2021, the District formed a project-specific cross-sector community Working Group (WG) with the mandate to identify values, needs and priorities for MBC marine access and coastal stewardship and to provide input, evaluate options and make recommendations to staff and Council. The working group included representation from a cross section of the community to advise on directions and recommendations (see Terms of Reference in Appendix A). Members represented the following groups:

- Squamish Chamber of Commerce
- Tourism Squamish
- Downtown Squamish Business Improvement Association
- Business/Industrial Interests (Forestry, Short-sea Shipping, Marine Sector e.g. boat repair, marine tech etc, Clean Tech, other sectors with shipping interests)
- Local Marina Representative (Commercial Water Lot Tenure Holder)
- Mariners / 'Squamish Needs a Boat Launch Cttee' rep
- Waterfront Upland Owners
- Squamish Terminals/Port
- Community Organizations (Harbour Authority, Public Safety (RCMSAR, RCMP), Stewardship /Environmental Conservation
- Marine Recreation (Community and/or Commercial Recreation)
- Community Member-at-Large

Three separate WG meetings were held in October 2022, late November 2022 and March 2023. The WG reviewed background and technical information, and provided input on priority maintenance areas, impacts, options and funding aspects. A summary of meeting discussions and inputs is presented in the following section.

For broader community information and knowledge sharing, a project website was created in 2022.

Following a workshop with Council in Summer 2023, engagement with the broader community will be conducted to share information gathered to date, and share a Discussion Draft of the strategy document for comment.

3.2 Summary of Discussions, Themes, and Priorities

Working Group meetings allowed for initial review of baseline information and identification of values, access issues and insights about historic and current use of the channel, environmental conditions, specific marine vessel traffic, commercial and recreational activities, sensitive areas and cultural considerations. A summary of the three meetings, their purpose and discussion topics, as well as key learnings, perspectives of the WG members and emerging themes is provided in Table 1.

Table 1 – Working Group Meetings Summary

Meeting 1 (October 2022)	Meeting 2 (November 2022)	Meeting 3 (March 2023)
Purpose: • Review scope, objectives and desired outcomes • Review and discuss baseline information about the channel, historic dredging, current bathymetry and observations, as well as to discuss regulatory requirements for maintenance activities	Purpose: • Discuss Guiding Principles for maintenance activities • Preliminary Options Review (per Matrix shown in Section 8)	Purpose: • Share inputs from Squamish Nation • Review additional sediment testing information and costing assumptions for the options review • Review and discuss funding tools and potential scenarios for future consideration
Questions, Inputs and Key Themes: • Importance of Squamish Nation involvement from the beginning • Recognition that along with channel depth reduction, channel navigation width is getting narrower • Channel is a community asset that needs maintenance and care; there is consequence to continued inaction (safety hazard) • Interest in the vision for the channel (mixed use, economic activities and vessels anticipated) • Baseline information on sediments reviewed; disposal on land anticipated for some of the sediments (higher cost compared to disposal at sea) • Recognition that navigation safety and emergency response is critical need • Note that -2.6m dredge depth would provide access for majority of vessels most of the time • Regular maintenance dredging program should be planned and continued for ease of permitting • Dredging needs for Site B are anticipated in next 5 years • Major funding gap exists due to MBC outside of major port • Larger projects (>2ha or 1000 m3) trigger Environmental Assessment	Questions, Inputs and Key Themes: • Discussed marine zoning and continued mixed use working waterfront conditions • Important to consider non-motorized and motorized users in the channel • Contaminate removal will benefit the waterway, but unlikely to remove all given extent of industrial use • There is cost-benefit to removing more material at once (save mobilization costs) • Limited funding for dredging; if tied to habitat restoration works there could be potential to access greater funding • Many precedents for using dredgeate for habitat restoration • Status Quo (do nothing) option has negative return and risk to safety; there is also greater benefit to consider long-term over another Stop-Gap measure, although it was helpful to remove some material in 2013 • Importance of expanded sediment testing now to confirm disposal options and costs (works must occur within 5 years of testing) • Option C likely highest cost-benefit ratio; need to establish vision and support with community (maintaining current channel, not enabling	Questions, Inputs and Key Themes: • Sediment testing snapshot shows some hot spots will require certified landfill disposal; vast majority of dredge materials under threshold; will still need robust sampling program • Disposal location variable will influence cost (potential for disposal sites in Seattle WA) • For habitat projects significant time/cost for monitoring which is now extended and up to 10years • Discussed local receiving sites to be examined including Stawamus estuary, Sta'7mes island land raising, Site B and Cattermole • Funding tools mainly local service areas and service tax however difficult to determine benefiting parties and relies on elector assent to approve • Concern raised about development and affects on salmon; need to explore how to find best solution for both communities and restore balance for health of waterway and habitat • Naming beneficiaries – broad community benefit for access but also specific users that rely on channel access; currently no user pay system in place. • Potential to consider a phased approach, with stop gap works then further dredging where

Meeting 1 (October 2022)	Meeting 2 (November 2022)	Meeting 3 (March 2023)
	wildly larger vessels or vessel traffic)	funding is secured; some challenges with permitting and determining cumulative impact with this approach • Concept of creating a reserve fund for future dredging • Specific scenarios are required showing impact to tax payers where some general taxation revenue is being considered

Early inputs received during internal engagement through the Sḵwx̱wú7mesh Úxwumixw referral comments as well as staff's participation in Working Group Meeting 3 are noted in the following section 4.1. This engagement does not constitute or represent any form of formal consultation with the Squamish Nation.

4 Mamquam Blind Channel Background

4.1 Importance to Squamish Nation

Sḵwx̱wú7mesh Úxwumixw is deeply connected to the land and waters that encompass their traditional territory. The territory includes permanent and seasonal villages, meeting places, and hunting, gathering and harvesting areas both on the land and in the marine environment since time immemorial (Squamish Nation Community Profile 2021). The MBC holds immense cultural significance. St'á7mes village, one of the oldest and permanent village sites in this area, is situated at the mouth of the Stawamus River on the MBC where marine resources were abundant. Amongst many activities, fishing is vitally important and well over 60 species of fish, beach foods, and marine mammals are known to the Squamish people. Once the east branch of the Squamish River, along what is now the MBC there were many known Sḵwx̱wú7mesh seasonal village sites that existed. At the Mamquam delta waters the channel was prime spawning habitat for eulachon. Before contact with European settlers, salmon were also plentiful, referenced as "existing as millions of fish of all species," as were other environmental resources.[1] The Squamish Nation has highlighted the importance of these land and resources to be protected, managed, and utilized for the benefit of present and future generations. Regarding fish and aquatic habitat, stream and channel restoration is identified as an ongoing priority for Squamish Nation members.

Other significant sites with Sḵwx̱wú7mesh placenames associated with the MBC include:

- X̱wúṅeḵw: a landmark on the west side of the north end of the Squamish docks, on about the site of Galbraith's store. Meaning "derived from the term xwi̱lḵ̓wa̱ntm 'behead a person'" (Kwi Awt Stelmexw 2022)
- Saẇá7elt: a waterway on the east side of the Mamquam Blind Channel. Meaning "little creek" (Kwi Awt Stelmexw 2022).

St'á7mes community on the MBC continues to grow in population and area, with additional lands returned to the Nation and added to the federal reserve in 2021. St'á7mes island is also a place providing direct ocean access for the community, including many canoe families.

South of St'á7mes village lies 'Site B', an industrial site on the east side of the MBC also holds importance to the Nation. In June 2000, ownership interest of Site B along MBC was transferred to the Nation as part of a BC Rail, Squamish Estuary, and Porteau Cove lands agreement between Squamish Nation, BC Rail and the provincial government. Squamish Nation is also a partner in the Squamish Community Forest, which is managed by Sqomish Forestry LP (a wholly owned subsidiary of the Squamish Nation). Currently three areas of Site B are under long-term lease to forest industry companies: Howe Sound Log Services Ltd., Squamish Mills Ltd./ Ministry of Forests and West-Barr Contracting Ltd. Seven First Nations owning a large majority of timber rights within the Sea to Sky District are dependent on facilities at Site B. Log transfers at the site are reliant on adequate water depths for vessels used as part of operations. Logging operators have advised that transporting logs over land is not considered feasible due to that higher transportation costs. Transportation over land also consumes more fuel compared with transport in water.

Specific to the MBC maintenance strategy process, the Squamish Nation has further highlighted:

- Importance and protection of Sḵwx̱wú7mesh lands and waters St'á7mes community and rights and title
- Option C viewed as 'middle ground' balancing environmental needs with other considerations

[1] Pacific Salmon Foundation. "Squamish River Watershed Salmon Recovery Plan," May 13, 2005. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/332825.pdf

- The need for archeological assessment prior to any works on shorelines and mitigations to reduce turbidity (such as utilizing silt curtains as an example measure), avoiding impacts to fisheries and eelgrass recommended
- Squamish Nation ACE monitoring (archeology, culture and environment) throughout the continuum of works related to this strategy
- Encourages beneficial reuse of uncontaminated dredge material rather than disposal at sea
- Habitat enhancement focus and Stawamus estuary restoration – opportunity to keep materials close; also general fill potential for various sites to be evaluated.

4.2 Ecological / Fluvial Snapshot

The MBC is part of the wider Squamish Estuary which features extensive marshland, sand and mudflats intersected by the main river channel, the Mamquam Blind Channel, smaller flood channels and intertidal drainage channels. Mixed deciduous and coniferous trees have established themselves on the higher, periodically flooded uplands. Toward the sea grow both pure and mixed plant communities dominated by the sedges, grasses and rushes typical of areas inundated by fresh or brackish water. Wildlife found in the estuary include swans, ducks, shorebirds, eagles, hawks, songbirds, field mice, muskrats, rabbits, raccoons and occasionally deer, coyotes and black bears. Fish found in the Squamish River system include chum, chinook, coho and pink salmon, steelhead trout, sea run cutthroat trout, and Dolly Varden char.

Prior to 1921, the Mamquam River followed a different course and discharged directly into the north end of the east branch of the Squamish River (near the location of the Squamish Adventure Centre). In 1921, the Mamquam River flooded and changed its' course to the current alignment where it flows into the Squamish River. This diversion was made permanent in 1922 when the lower portion of the Mamquam River was diked north of Brennan Park along what is now known as Centennial Way. This diking offered flood protection for the Loggers East area, but dried out tidal channels, wetlands and critical fish spawning habitat. In 2005, the Mamquam Reunion Project was initiated as a joint effort between the District, the Squamish River Watershed Society (SRWS), and the Department of Fisheries and Oceans (DFO). Its main goal was to reconnect the Mamquam River with the MBC and the lower portion of the Squamish River estuary to improve the environmental health of the upper MBC and Loggers Creek. Major works have included: installation of an intake and large culvert under Centennial Way to divert flows from the Mamquam River into Loggers Creek and a network of watercourses to connect the Mamquam River with its historical outlet in the Upper MBC near the Adventure Centre; and an intake structure to connect the Central Estuary Channel (Crescent Slough) with Wilson Slough along with new culverts under Highway 99 and Logger's Lane to connect the estuary with the MBC. These works have improved water quality and fish habitat somewhat by connecting flows from the Mamquam River and Squamish Estuary to the MBC.

The MBC is influenced by the following freshwater tributaries: Loggers Creek and Britannia/Wilson Slough, as well as the St'á7mes (Stawamus) River. Stawamus River drains more than 62 km^2 into the MBC and Howe Sound (Átl'ka7tsem); past estimates are that the Stawamus River contributes 2500 m^3 of sediment to the channel per year. These creeks and rivers and the marine environment within the estuary host many resident and transient fish. Notably, the MBC serves as a migratory corridor for juvenile and adult salmon, and contains spawning areas for Pacific Herring within intertidal and shallow subtidal areas (on rockweed, piles and other hard surfaces), which are important for Indigenous cultures and commercial fisheries.

The MBC has been significantly altered over time by historic industrial/commercial uses over the last 130 years (railway, logging, heavy industrial use, navigation and shipping). Today it is dominated by commercial marinas along the western channel and marine shipping, log handling and storage in the southernmost reach. Waterfront redevelopment of many former industrial uplands is underway, integrating coastal flood hazard protection measures against flooding and sea level rise to protect Downtown Squamish. The MBC is a designated Navigable Waterway under the *Canadian Navigable*

Waters Protection Act. Due to ongoing sedimentation at the confluence of the St'á7mes (Stawamus) River Delta, there have been ongoing issues with safety and maintaining channel navigability, particularly during low tides.

The MBC is abundant in suspended silts (fine sediments) and the water is brackish; much of the intertidal and sub-tidal areas are almost completely devoid of aquatic vegetation and other marine biota and offer relatively little habitat complexity. The seabed within much of the MBC is comprised of muddy fines, silty sands and small gravel and exhibits anoxic odours. Through the channel maintenance strategy, the project aims to respect cultural and ecological values and explore ways to enhance the marine coastal environment.

Figure 4 – View of St'á7mes (Stawamus) River as it exits into the Mamquam Blind Channel (ShoreZone 2017)

Figure 5 – View of Mamquam Blind Channel (ShoreZone 2017)

4.3 Historic Navigation Channel Maintenance Context

Colonial settlement and infrastructure development in the Squamish downtown area forever transformed the natural rivers and the wider estuary to make way for shipping and commerce. The transfer of goods and people between Howe Sound (Átl'ka7tsem) and the Pacific Great Eastern (PGE) Railway was enabled via a long timber pier built out to deep water in 1902. The original PGE docks, also used by the steamship ferries, were built in 1913-14, east of the current location of Squamish Terminals.

The first dredging recorded in the Squamish area was in 1912-14 for PGE railway docks at the harbour mouth to accommodate ocean-bound vessels. The first major dredging in the MBC was in 1953 for the new small boat harbour (federal small craft harbour).

Today's Oceanfront peninsula, the Cattermole Slough and the Squamish Terminals facilities were created through major railway sponsored dredging projects in the late 1960s and early 1970s. The Lower MBC at the "salt docks" was dredged in 1966 to handle very large oceangoing ships arriving to unload salt and, on a few occasions, to load liquified petroleum gas as well as lumber from the Empire Lumber sawmill. And beyond the waterfront, downtown sloughs were filled in to create land for streets, buildings and parks, including Stan Clarke Park. The upper Loggers Lane north from the Adventure Centre was also constructed with dredge spoil from the harbour, in 1963.

Extensive dredging and fill for forestry and log sort operations radically changed the Mamquam Blind Channel. As the channel became polluted from logging waste over time in the 1970s and 1980s a plan was established to move log handling activities from the water to consolidated, dry land facilities. Creation of new land for water dependent industry at "Site B" south of the Stawamus River further opened up redevelopment of the Downtown waterfront along Loggers Lane.

The last comprehensive dredging of the Mamquam Blind Channel waterway, all the way up to the railway bridge, was organized by the Squamish Chamber of Commerce in 1986. This enabled a new dock to be established at the foot of Main Street.

Figure 6 – Blind Channel dredging operations, March 1986 (Squamish Historical Society)

Dredging local channels was under the purvey of the federal government from 1901 to 1982. It was then transferred to the Canadian Coast Guard. In 1998, this responsibility was again transferred to commercial users and ports.

In 2013, a dredge review was completed that estimated approximately 80,000 to 100,000 cubic metres of material would need to be removed to allow safe navigation of the MBC at low tides. A minor dredge project was completed in 2013 removing approximately 4,700 cubic metres of material near the mouth of the Stawamus River as a short-term stopgap measure to improve navigability. Consequently, the need for a long-term ecosystem-based dredge maintenance program was identified. Ongoing channel sedimentation is affecting industrial, commercial, and marine transportation services essential to the local and regional building and forest industries, as well as recreational boating accessibility and the tourism sector. However, prior to this strategy, no recent studies have established the desired dredge depth.

Figure 7 – Blind Channel dredging operations 2013 (Squamish Streamkeepers)

5 Navigation Channel Snapshot and Maintenance Needs

5.1 Current Channel Activities and Uses

Today the MBC supports a variety of evolving land and marine uses as part of a 'working waterfront':

- Downtown mixed use waterfront redevelopment along the west and eastern middle reaches of the channel
- Waterfront parks and public access infrastructure
- 6 marinas, with approximately 240+ moorage slips
- 1 Small Craft Harbour (non-core, recreational), with an adjacent, informal boat and barge ramp (private upland)
- Log handling and storage sites on the west and eastern sides of the MBC
- Marine transportation services and marine search and rescue (MSAR Station 4)

Due to limited marine access infrastructure outside the MBC and community growth in marine recreational and commercial activity within the waterway, during low low water (especially in the summer months) shared use and navigation of the channel is increasingly tricky during peak times in the pinch point near the Stawamus River. Community engagement as part of the downtown Marine Access Review (2022-23) has highlighted that navigation safety, sedimentation and water depths in the channel are a growing concern. Currently increased transportation and logistics connected to the Woodfibre LNG project are also impacting marine traffic in the channel.

In 2017 the District of Squamish established an MOU and cost-sharing agreement with several waterfront land owners and Transport Canada to clean up and mark a Navigation Channel in the MBC. The partnership aimed to increase navigational safety, facilitate removal of and deter illegal mooring within the channel, improve environmental stewardship, and enhance community use and enjoyment of the waterway. The delineated Navigation Channel from the Pemberton rail bridge to Howe Sound now visibly shows the area that must remain clear for navigation, and enables Transport Canada to order anchored vessels to relocate outside of the channel. The lateral buoy markers are maintained by the District of Squamish. For development of the maintenance strategy, the layout of the navigation channel was re-reviewed, and no specific concerns nor changes to the horizontal alignment are recommended at this time. The channel has been optimized based on water lot leases/ownership and navigational aids are recommended to guide vessels through the channel.

5.2 Existing Bathymetric Conditions

The Canadian Coast Guard/Canadian Hydrological Service (CCG/CHS) completed a bathymetric survey of the MBC in 2020, overlaid with the Transport Canada (TC) designated navigation channel. Westmar's review of the available data indicates that while there is a designated navigation channel, significant extents of the channel do not meet the indicated dredged depth. Figure 8 shows the areas where the existing channel does not meet the designated navigation channel dredge depth and channel width based on international design standards for two-way small boat traffic in a protected waterway (World Association for Waterborne Transport Infrastructure, known as PIANC).

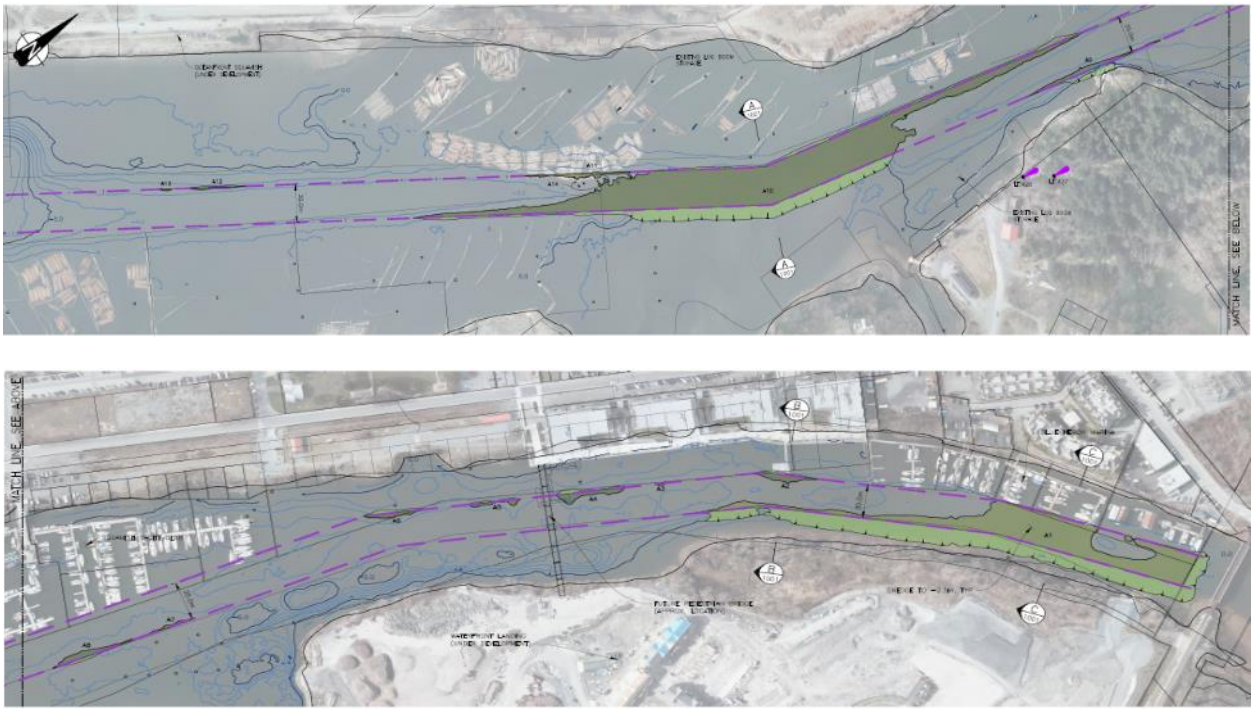


Figure 8 - Areas not meeting navigational depth as per CCG/CHS data from 2020 in dark green. Approximate side slopes for dredging shown in light green. CCG/CHS designated navigational channel in dashed purple.

There are two aged range markers for the approach into the MBC, located north of Site B on the east side of the MBC. On the Oceanfront peninsula, two privately owned and operated aids have been decommissioned as part of the re-development of the peninsula. CCG/CHS are reviewing navigational aids in the MBC and are looking at adjustments to improve placement and visibility.

5.3 Design Parameters

Determining an acceptable channel depth and width is based on the following parameters:

- **Vessel Under Keel Clearance (UKC)** is the clearance between underside of the boat (i.e., the deepest portion of the boat such as the propellor or rudder) and the channel bed. UKC is required for a variety of reasons, such as:
  - Changes in water density
  - Squat of boat when under power
  - Dynamic heel due to wind and turning
  - Wave response
  - Allowances for sedimentation between dredging programs
  - Allowances for bed level uncertainties
- **Design Vessels.** Westmar has reviewed the reference information, specifically from TyPlan (2018) where an inventory of the current and future vessels at and upstream of the Waterfront Landing has been reviewed.
- **Water Levels**. The design water level is typically the lower low water level (LLWL), ensuring that the channel can be navigated by all vessels throughout all tide cycles, however, in this case it is likely uneconomical to dredge to the full depth for all vessels in consideration of the extreme low water level. Instead, the dredge depth should be selected to allow a minimal acceptable amount of down time when larger vessels cannot navigate the channel. This will decrease capital and maintenance dredging costs, while still significantly enhancing use of the channel for all users.

The available water depth will increase with sea level rise. For flood planning purposes, the District has adopted the Provincial guidelines to plan for an estimated 1.0 m of sea level rise by the year 2100, which is approximately 0.2 m over the 20-year timeframe of this study.

5.4 Water Levels and Recommended Dredge Depth

To determine an appropriate dredge depth based on implementation costs versus increased availability of sufficient water depth, three scenarios have been compared:

1) -2.6 m Chart Datum (CD) dredge depth throughout. This allows most recreational and industrial vessels using the channel to safely navigate with sufficient UKC at the average low water level. There will be times in the year (during the lower low water level, which is only reached a few days in the summer and a few days in the winter) when only ~80% of recreational vessel can navigate the channel. During these low tides, the largest industrial vessel will also be unable to safely navigate the channel.
2) -3.2 m CD dredge depth throughout. This allows all recreational and industrial vessels using the channel to safely navigate with sufficient UKC at the average low water level. Only the largest recreational vessels and the infrequent, largest barge will be unable to navigate at the lower low water level.
3) -3.2 m CD dredge depth in northern section, -4.3 m in southern section. This allows all vessels to safely navigate the southern section at all tides, and all vessels to navigate the northern section at most tides, except for the lower low water level.

5.5 Channel Maintenance Program Means and Methods

Various methods of dredging can be employed for channel maintenance programs, including trailer hopper suction dredging, cutter suction dredging, and mechanical dredging with excavators or clamshell buckets:

- Trailer Hopper Suction Dredging: This method utilizes a specialized vessel known as a trailer hopper suction dredger. It employs trailing suction pipes equipped with powerful suction pumps. The trailing suction pipes are lowered to the channel bed, and the pumps create a vacuum, sucking up sediment and water. The mixture of sediment and water, called slurry, is transported through the pipes and deposited into the hopper, a large storage container on the vessel. Once the hopper is filled, the dredger sails to a designated area where the sediment is discharged by opening bottom doors or pumping it out.
- Cutter Suction Dredging: Cutter suction dredging involves a self-propelled vessel called a cutter suction dredger. The vessel is equipped with a rotating cutterhead at the suction inlet and suction pipes. The cutterhead, driven by hydraulic power, loosens and cuts the sediment from the channel bed. The suction pipes then draw the loosened material into the dredger. The sediment is mixed with water to form a slurry, which is transported through the pipes to a designated discharge location. Cutter suction dredgers are capable of handling a wide range of sediment types and can operate in different water depths.
- Mechanical Dredging: Mechanical dredging methods employ equipment such as excavators or clamshell buckets to physically remove sediment from the channel bed. Excavators fitted with specialized dredging attachments, such as buckets or hydraulic grabs, are used to excavate and lift the sediment. Clamshell buckets, which are large, hinged buckets with jaws, are another commonly used tool. The bucket is lowered to the channel bed, opened to capture sediment, and then raised to deposit the material onto barges or other vessels for transportation and disposal.

Mechanical dredging is often employed in areas with limited access or where precision is required, such as around structures or in shallow water.

Cutter suction and both types of mechanical dredging noted above have been used in MBC previously. It is anticipated that both types of mechanical dredging will be used in the future.

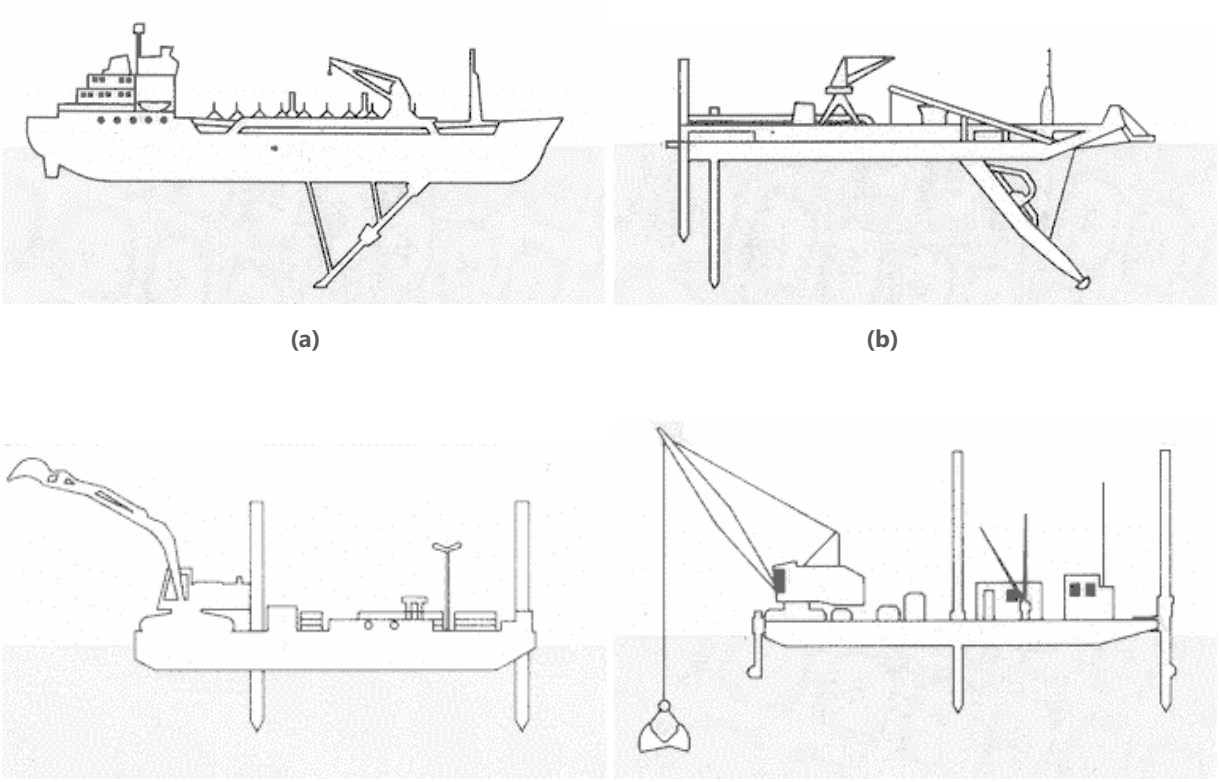


Figure 9 – Schematics of channel maintenance equipment: (a) Trailer Hopper Suction Dredging, (b) Cutter Suction Dredging, (c) Excavator Mechanical Dredging, and (d) Clamshell Mechanical Dredging.

6 Sediment Characterization & Permitting

6.1 Available Data

As part of a disposal options analysis for the MBC dredging strategy, Disposal at Sea (DAS), upland disposal, and beneficial reuse options are being considered. The application for DAS includes a pre-approved Sampling Plan and a Characterization Report that summarizes and tabulates sample results in comparison to DAS criteria, among several other components (described in more detail by Environment and Climate Change Canada at https://www.canada.ca/en/environment-climate-change/services/disposal-at-sea.html). Core6 completed a preliminary review of available sediment chemistry data from past investigations to provide a recommendation on consideration of DAS for the current MBC dredging project. The review included investigations completed between 2008 and 2022 (Envirochem Services Inc. 2008, Hemmera 2011, Envirochem Services Inc. 2021, Keystone Environmental 2022) and primarily occurring in the "southern" section the MBC. Sample locations can be seen in Appendix B. The constituents analyzed included total metals (arsenic, cadmium, chromium, copper, lead and mercury), polycyclic aromatic hydrocarbons (PAHs), light and heavy extractable, petroleum hydrocarbons (LEPH/HEPH), and polychlorinated biphenyls (PCBs). Sediment toxicity testing was also completed by Envirochem Services Inc. (2021) to determine DAS eligibility. Placing dredgeate in an inland streambed would require a Change Approval from the province under the Water Sustainability Act to make a Change in and About a Stream (CIAS). These are typically more complex applications and require several months (more than a year is likely) to get approval after preparing the application. The application will need some biophysical studies and detailed plans. If there is diversion or storage of water then a licence may also be needed.

Based on a preliminary review of the data with current DAS criteria, total PAHs, arsenic, cadmium, copper, and mercury appear to have elevated levels that may prevent the sediment from those locations from being considered suitable for DAS in some locations. Toxicity was also observed in two samples collected by Envirochem Services Inc. (2021) for an assessment of a site in a southern portion of MBC, indicating that sediment from this assessment area is ineligible for DAS. It is noted that total PAHs (Keystone sample SD22-01and Hemmera sample location SED11) possessed two locations in exceedance and mercury (Hemmera sample location SED11) exceeded criteria at only one location, separated by approximately 250 metres, and can be seen in Appendix B. For total PAHs, Hemmera suggested that the location was associated with log booming operations and creosote pilings that occurred on the west side of MBC. Copper concentrations consistently exceeded DAS criteria across the investigation area. Levels of copper are known to be elevated in northern Howe Sound (Átl'ka7tsem) from the spread of heavy metal contamination from Britannia Mine. Squamish Terminals received a DAS permit for the Watts Point Disposal Site, an ECCC approved disposal site located approximately 6 km directly south of the terminal within Átl'ka7tsem/Howe Sound despite copper concentrations exceeding DAS criteria because of the elevated levels already present at the disposal location. However, no other constituents, including mercury and total PAHs, exceeded DAS criteria in the Squamish Terminals dredge area.

Relocation of contaminated sediment (disposal) on land in British Columbia is regulated under Part 2 of the Environmental Management Act (EMA) (waste discharge authorizations) and Part 4 of EMA (Contaminated Sites Regulation (CSR) tools, such as Approvals in Principle). Section 55 (1.1) of EMA (as amended under Bill 3) now states that a person must not remove soil from a site that has been used for a specified industrial or commercial use unless the person has: (a) analyzed the quality of the soil, in accordance with the regulations, if any; and (b) provided notice of the removal to the persons identified in the CSR, in accordance with subsection (1.2). If relocated sediments are marine sediments then these sediments are subject to Technical Guidance 20 on Contaminated Sites Applicability of Sodium and

Chloride Ion Soil Relocation Standards to Dredged Marine and Estuarine Materials, in addition to that noted above. Analytical testing has identified sodium and chloride concentrations above CSR Schedule 3.1 soil standards.

Amendments to the EMA and CSR have also come into effect (March 1, 2023) that require additional analytical testing and BC Ministry of Environment and Climate Change Strategy (BC ENV) notification for the re-location of uncontaminated sediments, where current or historical commercial / industrial CSR Schedule 2 activities have been identified. The analytical results must meet the soil standards that are applicable for the designated land use at the receiving location. Testing requirements are based on potential contaminants and the volume of sediment that is being re-located, and, if greater than 20,000 m^3, also require the development of management plan and registration with BC ENV as a High Volume Soil Receiving Site. Sediment that is considered to be contaminated continues to be regulated with permits and approvals as before under the EMA and CSR, and some exceptions to the testing and notification requirements in the new amendments are in place, such as to receiving sites that are on federal land or are outside of BC.

If the decision is made to pursue DAS, it is recommended that communication with the ECCC Regional Office is initiated to discuss the potential for MBC as a DAS Project and confirm the application requirements (a recommended first step under ECCC DAS guidance). The potential exists for a focused sampling program to identify portions of the proposed dredge area for DAS. However, it should be noted, that since some of the previous investigations were completed more than 10 years ago, additional DAS criteria exceedances may be observed that would further reduce the eligible dredge footprint. The absence of data from some sections of the MBC precludes any recommendation regarding the suitability of sediment from this area for DAS. If the decision is made to pursue disposal at sea, Core6 recommends completing a preliminary investigation prior to initiating communication with the ECCC Regional Office if DAS is being considered for this area.

6.2 Recommended Approaches

The following table summarizes expected permits required prior to completing dredging activities.

Table 2 - Regulatory Requirement Summary

Government Level	Governing Agency	Act or Regulation	Purpose	Notes:
Federal	Fisheries and Oceans Canada (DFO)	Federal Fisheries Act	Request for Review	The Interim code of practice: Routine maintenance dredging is not applicable to the initial works.
	Impact Assessment Agency Canada	Impact Assessment Act	Determine impacts of a project to the environment and the public.	Dredging is not considered a physical activity within the Impact Assessment Act and Physical Activities Regulations.
	Environment and Climate Change Canada (ECCC)	Canadian Environmental Protection Act	Dispose of dredging materials at sea	The permit application process guide lists up to 114 days for assessment and processing if satisfactory information is submitted. Additional time may be necessary and is recommended.

Government Level	Governing Agency	Act or Regulation	Purpose	Notes:
	Transport Canada (TC)	Navigation Protection Act	Works will be completed within a navigable channel.	A Minor Works application must be completed for dredging works.
Provincial - BC	Environmental Assessment Office (EAO)	Environmental Assessment Act	To receive an environmental assessment certificate or exemption order.	Periodic maintenance dredging activities are not reviewable activities under the Reviewable Projects Regulation. However, as the Project is becoming newly established and is greater than 2 hectares it may be subject to review.
	BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD)	Land Act	Land Tenure Application	The proposed dredging program does not currently occur within lot leases/licenses and therefore the need for tenure applications is not anticipated.

7 Beneficial Reuse Considerations and Case Studies

7.1 Local and Regional Disposal Options

Historically, most dredgeate from the Squamish area has been disposed of at sea at the Watts Point Disposal at Sea site (Figure 10).

Figure 10 – Watts Point Disposal at Sea Site (GoogleEarth).

There are several options for the beneficial re-use of dredged material from the Mamquam Blind Channel:

- Habitat Restoration: Dredged sediment can be used to restore or create new habitats such as wetlands, marshes, or tidal flats. These habitats provide essential ecosystems for various plant and animal species, including birds, fish, and invertebrates. Dredged material can be used to reshape and elevate areas to create suitable conditions for habitat establishment. A case study is described in Section 7.2.1.
- Land Reclamation: Dredged sediment can be used for land reclamation projects, particularly in coastal areas. The sediment can be deposited in designated areas to expand landmass or restore

eroded shorelines. This can be beneficial for creating new public spaces, recreational areas, or even industrial sites. Case studies are described in Sections 7.2.3 and 7.2.4.

- Agriculture and Landscaping: Dredged material can be suitable for agricultural purposes and landscaping projects. With proper testing and treatment, the sediment can be used as topsoil or for land rehabilitation in areas such as mine reclamation or construction sites. This can help improve soil quality, enhance water retention, and support vegetation growth.
- Construction and Infrastructure: Dredged material can be used in construction and infrastructure projects. It can be processed and utilized as fill material for road embankments, building foundations, or levee construction. By using dredged sediment as a construction material, it reduces the need for extracting and transporting virgin resources, thereby conserving natural resources and reducing environmental impacts.
- Coastal Nourishment: Dredged sediment can be beneficially used for beach nourishment or coastal erosion control. By placing the material on eroded or vulnerable coastlines, it can help restore and stabilize the beach, protect coastal infrastructure, and enhance recreational areas. A case study is described in Section 7.2.5.
- Contaminated Site Remediation: In some cases, dredged material can be used in the remediation of contaminated sites. If the sediment meets specific criteria, it can be utilized as a capping material to isolate and contain pollutants in areas affected by industrial or chemical contamination.

7.2 Case Studies

7.2.1 North Vancouver Habitat Restoration Project

Recently, Seaspan constructed a new marine habitat beside Vancouver Shipyards, at the mouth of MacKay Creek in North Vancouver. Completed with help from a number of community partners, work on the site included creating a more natural sloping shoreline, constructing productive marine habitat and populating the area with native species of kelp, grass and plants. The improvements encourage marine biodiversity and improve water quality, while providing food and shelter to fish and other marine life. Dredgeate was used to create a stepped shoreline profile with varying types of indigenous plantings over the full tidal range.

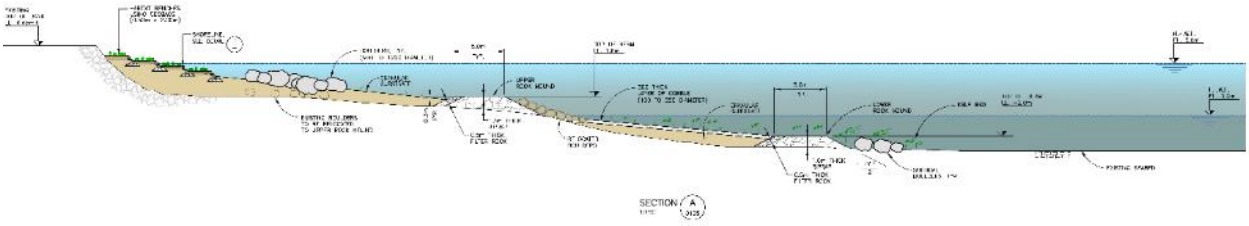


Figure 11 – North Vancouver Habitat Restoration Project (https://www.seaspan.com/stories/protecting-and-enhancing-marine-life-in-burrard-inlet/).

7.2.2 Sturgeon Bank Sediment Enhancement

Over the years, the Fraser River in B.C. has been highly modified through dredging and other human activities, changing its natural processes. As part of the Sturgeon Bank Sediment Enhancement Pilot Project, Ducks Unlimited Canada (DUC) is hoping to reverse some of those impacts through a unique project designed to rebuild tidal marsh resilience and support coastal flood protection.

Supporting an abundance of wildlife, the Fraser River Estuary is the last stop for migratory birds on their way to the far north. The largest salmon-bearing river in Canada, it is also one of the most productive bird habitats for migrating waterfowl and shorebirds in the country.

Led by DUC and partners, the recent completion of the first phase of the Sturgeon Bank pilot project will benefit fish, wildlife and people who use this important ecosystem.

Figure 12 – Sturgeon Bank Sediment Enhancement (https://youtu.be/TYn_kghPva0).

7.2.3 Land Reclamation in the Port of Prince Rupert

The Port of Prince Rupert, a major trade gateway on the northern coast of BC, experienced significant expansion in recent years. To accommodate this growth, the port undertook a dredging project to deepen and widen its harbor. The dredged material was then repurposed for land reclamation, creating new areas for port infrastructure development. By utilizing the dredged material for reclamation rather than disposing of it, the project minimized environmental impacts and reduced the need for resource extraction from other locations. The reclaimed land now serves as a site for additional container terminals, storage yards, and logistics facilities, facilitating increased trade while preserving natural habitats and reducing pressure on undeveloped areas.

7.2.4 Roberts Bank Terminal 2 Project

Roberts Bank Terminal 2 is a large container terminal project proposed to be built on reclaimed land adjacent to the existing export terminals at Roberts Bank in Delta, BC. In addition to the land reclaimed at the terminal, dredged sediment from the Fraser River is proposed to create new marsh habitat in the Roberts Bank area. By re-using the dredged material, the project will achieve multiple environmental benefits. It will restore and enhance important habitat for various plant and animal species, including migratory birds and fish. Additionally, the re-used sediment will contribute to the preservation of the overall ecological balance in the region.

7.2.5 Beach Nourishment in Victoria

The City of Victoria faced erosion and loss of beach sediment due to natural processes and coastal development. To combat these issues, the municipality collaborated with the local harbour authority to repurpose dredged material for beach nourishment. The dredged sand was deposited along eroding

shorelines, restoring and widening the beaches. This project not only enhanced coastal protection but also improved recreational opportunities and contributed to tourism, as wider and more stable beaches attract visitors and support local businesses. Additionally, the project reduced the need for importing sand from distant sources, saving costs and minimizing carbon emissions associated with transportation.

Figure 13 – Beach Nourishment in Victoria (https://www.archipelago.ca/halting-erosion-and-monitoring-habitat-restoration-along-victorias-ross-bay-seawall).

8 Capital and Maintenance Dredging Options Review

8.1 Options Analysis

Several options were investigated and reviewed by the Technical Working Group. These included the following, which are expanded upon in Table 3:

A. Do Nothing (Status Quo)
B. 'Stop Gap' (@ St'á7mes River only with narrow one-way traffic width of 20m)
C. Focused Dredge (-2.6m CD in South Channel and -1.6m in North Channel)
D. Dredge All to -2.6m CD
E. Dredge All to -3.2m CD

Table 3 – Capital and Maintenance Dredging Options

Dredge Option		Estimated Volume (m3)	Estimated Costs	Benefitting Areas/Uses/Users/Sectors (existing and future)	Opportunity Costs (Foregone Benefits)	Impacts and Risks
A	Do Nothing (Status Quo)	0	$0	No specific benefitting users; access limited to tidal conditions	No contaminated sediment removal. No beneficial reuse of material for land creation or habitat enhancement. Reduced marine access/navigation window for all MBC users Potential economic loss for commercial operators	Navigational safety risks; potential for more incidents requiring emergency response and reduced emergency access/egress Will require Coast Guard realignment of navigation aids to address navigational hazard/low water
B	'Stop Gap' (@ St'á7mes River only with narrow one-way traffic width of 20m)	5,000m^3	$650,000	All existing MBC uses/users Shorter-term benefit (stop gap)	Reduced capacity of MBC due to width restrictions Reduced marine access/navigation window for MBC users upstream of future pedestrian bridge Reduced economic/development potential in the upper MBC	Higher potential for accidents due to reduced width

Dredge Option		Estimated Volume (m3)	Estimated Costs	Benefitting Areas/Uses/Users/Sectors (existing and future)	Opportunity Costs (Foregone Benefits)	Impacts and Risks
C	Focused Dredge (-2.6m CD in South Channel and -1.6m in North Channel	~55,000m^3	$3,500,000	Existing and future marinas south of future pedestrian Bridge Public recreational users Marine Industrial (refit + repair, shipping/barging, forestry/Log handling)	Reduced marine access/navigation window for MBC users upstream of future pedestrian bridge Reduced economic/development potential in the upper MBC	Navigational safety risks; potential for more incidents requiring emergency response and reduced emergency access/egress.
D	Dredge All to -2.6 m CD	68,000m^3	$4,400,000	Existing and future marinas north of future pedestrian bridge; Waterfront Commercial Village and Sirocco project Public recreational users Marine Industrial (refit + repair, shipping/barging, forestry/Log handling)	Larger recreational and industrial vessels will experience slight reduction of navigability with depth of -2.6m compared to -3.2m	Significant permitting efforts and habitat compensation requirements Significant costs and funding challenges
E	Dredge All to -3.2m CD	117,000m^3	$7,200,000	Existing and future marinas north of Victoria St Bridge; Waterfront Commercial Village and Sirocco project Public recreational users Marine Industrial (refit + repair, shipping/barging, forestry/Log handling)	N/A	Significant permitting efforts and habitat compensation requirements Significant costs and funding challenges

The following table provides a breakdown of the high-level cost capital cost estimates for the options described above.

Table 4 – High-Level Capital Cost Estimates

Item	Description	Option A	Option B	Option C	Option D	Option E
1	Mobilization	$0	$45,000	$45,000	$45,000	$45,000
2	Bathymetric Surveys (allowance)	$0	$50,000	$50,000	$50,000	$50,000
3	Demobilization	$0	$30,000	$30,000	$30,000	$30,000
4	Navigation Aids	$0	$0	$45,000	$45,000	$45,000

Item	Description	Option A	Option B	Option C	Option D	Option E
5	Dredging	$0	$100,000	$1,100,000	$1,360,000	$2,392,000
6A	Disposal (DAS)	$0		$525,000	$737,500	$1,495,500
6B	Disposal (Upland Disposal)	$0	$75,000	$200,000	$225,000	$250,000
7	Revetment and Slope Protection	$0	$0	$0	$0	$0
8	Habitat Enhancement	$0	$150,000	$500,000	$667,500	$900,000
Subtotal		**$0**	**$450,000**	**$2,495,000**	**$3,160,000**	**$5,207,500**
Contingency (30%)		$0	$135,000	$748,500	$948,000	$1,562,250
Engineering and Permitting		$0	$65,000	$ 256,500	$292,000	$430,250
Total		**$0**	**$650,000**	**$3,500,000**	**$4,400,000**	**$7,200,000**

Based on the above, suggested notes following Table 3 in the report include:

- A division of contaminated dredgeate that must be disposed of on land and dredgeate that can be disposed of at sea or used for land creation/habitat enhancement without further treatment has been assumed based on limited sediment sampling information. If time is not available to receive permission to dispose at sea, costs could increase to dispose all dredgeate upland.
- Some habitat offsetting has been assumed for each option.
- Estimates are based on in-house experience and budget price quotations from local Contractors and suppliers for this project.
- A competitive bidding process with multiple bidders involved.
- A contingency allowance of 30% of the total estimated cost is included. The contingency is not a reflection of the accuracy of the estimate but covers undefined items of work which must be performed, and elements of cost incurred, but which are not explicitly detailed or described due to the level of engineering and estimating which has been completed to date.
- An engineering and permitting allowance has been included for all options.
- The following are excluded:
  - Escalation costs for capital dredging beyond 2023.
  - Any applicable taxes.
  - Owner's cost such as financing, project management, stakeholder engagement, permit reviews, etc.
- The total estimated cost, included contingency, is considered accurate from -20% to +40%.

8.2 Preferred Option(s)

Based on a review of the matrix above, Option A (Do Nothing) was not supported by the Working Group primarily due to the navigational safety risks the current situation presents in the waterway. The Working Group preferred the two following options to be progressed for further development and funding (Appendix C):

B. 'Stop Gap' (@ St'á7mes River only with narrow one-way traffic width of 20m) (see Figure 14).

C. Focused Dredge (-2.6m CD in South Channel and -1.6m in North Channel (see Figure 15)

The following feedback on the options matrix was received from the Squamish Nation:

- Option C viewed as 'middle ground', balancing environmental needs with other considerations
- Beneficial reuse of uncontaminated dredge material rather than disposal at sea is encouraged (non-support for disposal at sea)
- Habitat enhancement focus and Stawamus estuary restoration – opportunity to keep materials close; also general fill potential for various sites to be evaluated

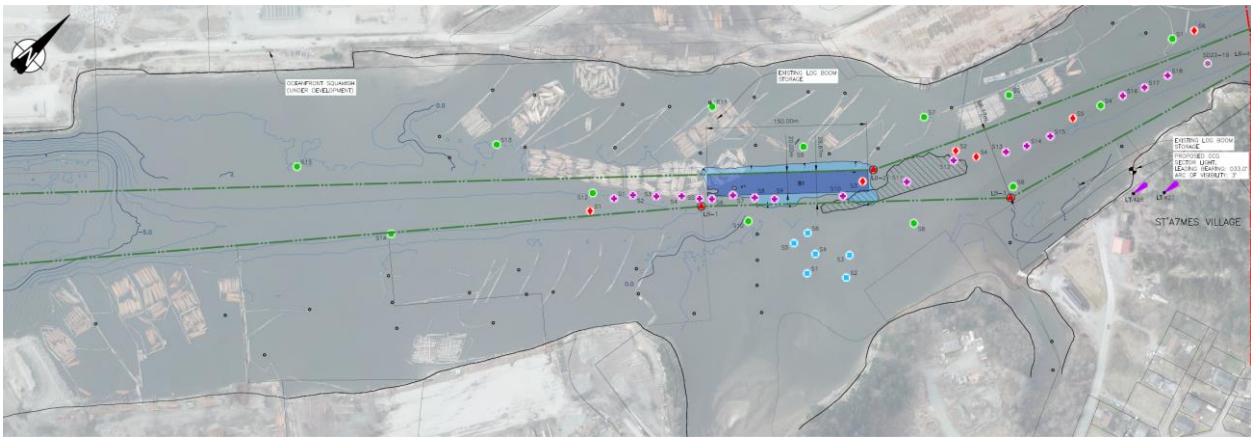


Figure 14 – Option B – 'Stop Gap'

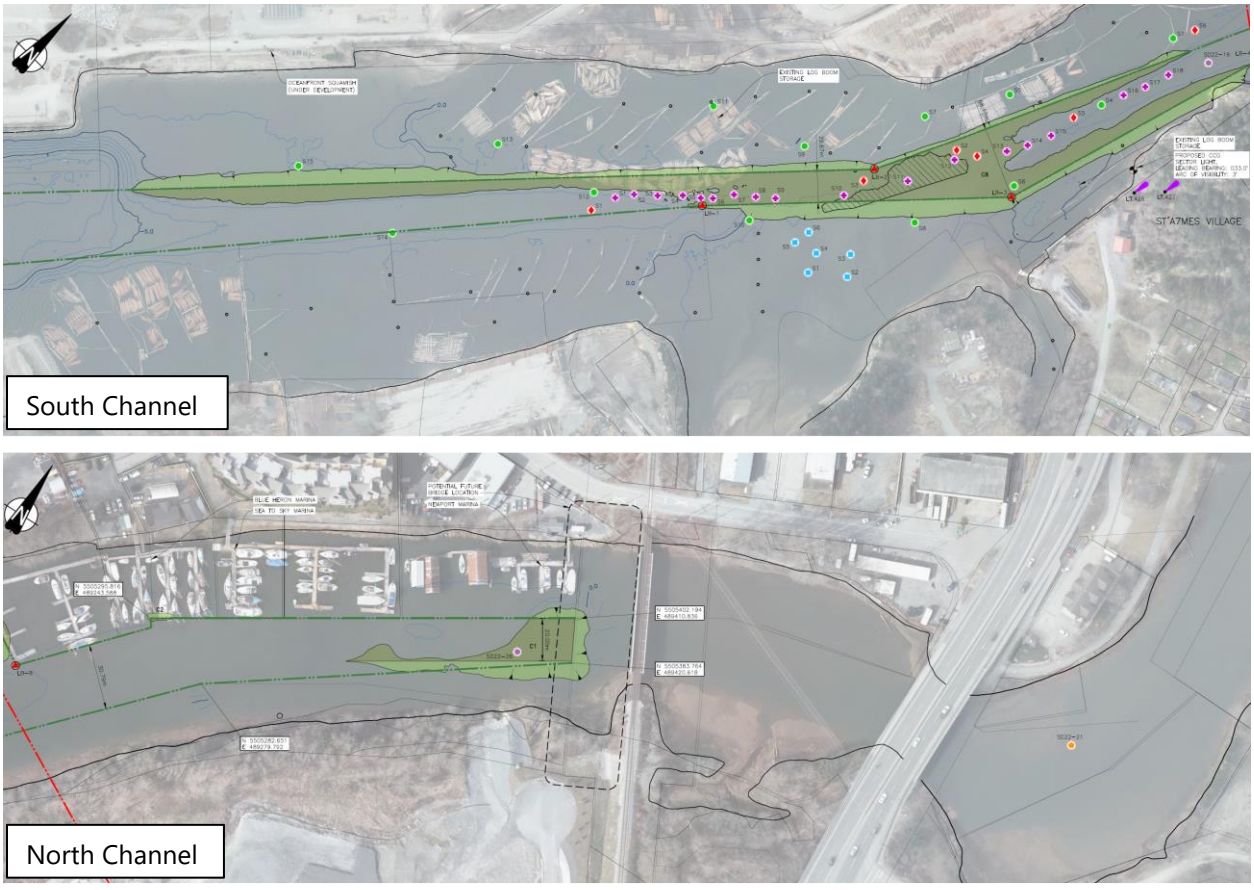


Figure 15 – Option C – Focused Dredge (-2.6m CD in South Channel and -1.6m in North Channel)

9 Funding Strategy

9.1 Financial Context

Some of the tools described in the next section may be used in combination to achieve the total funding requirements for an initial dredging program and future, regularly scheduled maintenance dredging, which is shown at a high-level in Figure 16 below. Depending upon the rate of sea level rise, the amount of dredging may lessen over the next 30 years.

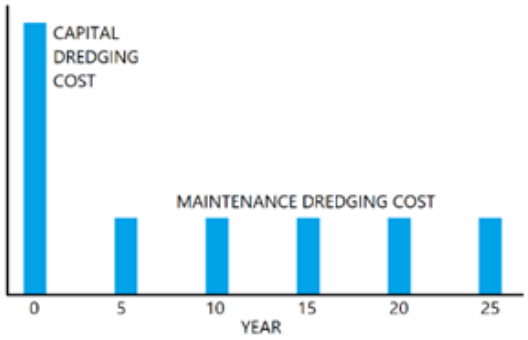


Figure 16 – High-level funding requirements

9.2 Municipal Context

The District of Squamish is responsible for maintaining a significant asset base with a replacement value of over $883 million dollars as identified in the District's Asset Management Plan (AMP)[2]. This equates to over $42,000 per capita. Assets fall under a broad range of infrastructure classes including sewer, water, stormwater, flood protection, roads and bridges, facilities, parks, fleet and information technology. The AMP identified significant shortfalls between current funding levels and the recommended funding levels to adequately maintain assets. In addition, the District has over 20 infrastructure master plans that identifies replacements and upgrades required to accommodate community growth and address the needs of the community. Asset management and long-term infrastructure costs place significant pressure on the District's financial capacity which requires the District to assess the priority of various costs in relation to risk, community needs, legislative requirements and other considerations.

The District is currently preparing a Long-Term Financial Plan (LTFP) to provide a holistic view of financial requirements to address asset management and infrastructure needs. The LTFP will help the District prioritize recommendations from various master plans and strategies, including the Mamquam Blind Channel Maintenance and Funding Strategy. Given significant shortfalls to maintain existing assets and provide required upgrades to manage community growth, it will be challenging to secure significant funding for dredge maintenance and it is therefore required to assess funding strategies and options.

9.3 Financial Tools Review

The following table summarizes potential project funding options, whether each option is recommended for future consideration, and the likelihood of that funding being able to fund the two primary phases of the project.

[2] District of Squamish 2022 Asset Management Plan: 2022-05-31-District-of-Squamish-2022-AMP_Final.pdf

Table 5 – Project funding summary table

Funding Option	Recommended for Future Consideration ✓ = Yes X = No	Initial Capital Dredging Funding Rating		Maintenance Dredging Funding Rating		Comments
		Better Option	Medium Option		Poorer Option	
Development Cost Charges	X	---				Not considered likely to be an eligible DCC project.
Local Service Area	✓					Parcel tax but engagement is required to mitigate the potential for a counter-petition
Specified Areas	✓					One-time parcel tax with less flexibility for adjustment over time
User Fees and Charges	✓					Alternate means to charge property owners based on usership or boat launch users or charge for access
Short-Term Borrowing	X			---		Partial initial capital funding only; taxation or use of reserves is also an option
Long-Term Borrowing	X	---		---		Not applicable
Latecomer Charges	X	---		---		Not applicable
Development Works Agreement	X	---		---		Not applicable
Density Bonusing	X	---		---		Not applicable
Comprehensive Development Agreements	X	---		---		Not applicable
Public-Private Partnerships	X	---		---		Where project not large or complicated
Public-Public Partnerships	✓					Provincial/Federal Government partnership
General Property Taxation	✓	---				Maintenance dredging only
Provincial Grants	✓					Combine with restoration project
Federal Grants	✓					Combine with restoration project

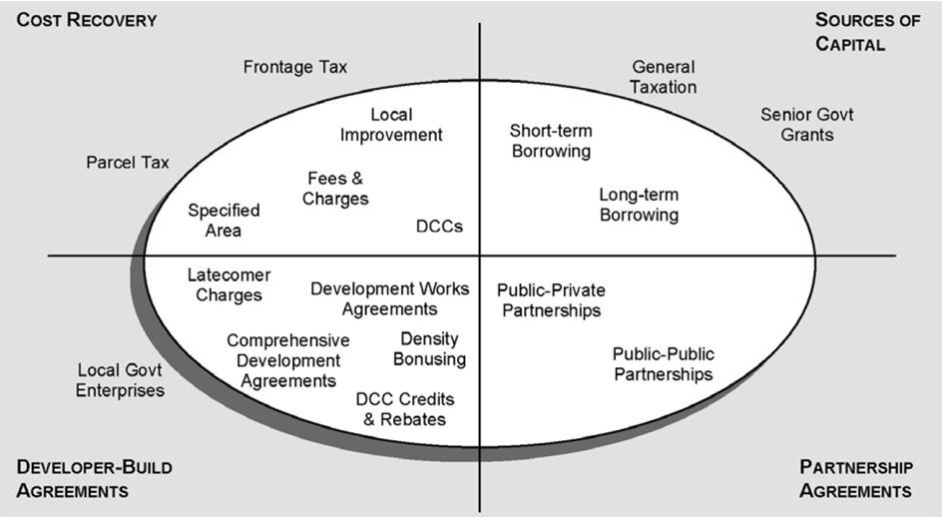


Figure 17 – Potential funding options.

9.4 Case Studies

9.4.1 Steveston Harbour Dredging

The Province of BC and the City of Richmond are helping improve access to Steveston Harbour by supporting dredging that will maintain the Cannery Channel approach to the harbour, the largest commercial fishing harbour in Canada. Both level of governments committed $2.125 million in April 2023.

A buildup of sediment in the south arm of the Fraser River is beginning to interfere with navigation into Steveston Harbour. The Steveston Harbour Authority has requested funding from all levels of government to undertake the planning, dredging and disposal work to improve safe access to the harbour.

This dredging project will support the economic benefit of Steveston Harbour to Richmond and the Metro Vancouver region. Between 22 million and 45 million kilograms of seafood is offloaded every year at the harbour, supporting thousands of jobs in the fishing industry, and benefiting tourism in Steveston Village, which had 1.7 million visitors in 2019.

The Steveston Habour Authority estimates the job would cost about $8.5 million and hopes that all stakeholders can come up with a long-term plan to regularly dredge the channel.

9.4.2 City of Victoria and District of Oak Bay Boulevard Frontage Taxes

The City of Victoria and the District of Oak Bay levy boulevard frontage taxes. Properties identified in bylaws pay a tax based on taxable frontage. Municipal crews maintain wide, landscaped boulevards adjacent to these properties. These municipalities have an administrative policy of setting boulevard tax revenue budgets to recover approximately 75% of the boulevard maintenance costs.

9.4.3 Saanich Local Improvement Charges

The District of Saanich, BC has local and specified area charges for local infrastructure improvements, such as watermain extensions, roads, sidewalks, curb and gutter, and street lighting. The charges cover the costs of the improvements and are paid by property owners whose property directly abuts the street where the work is performed. The municipality may grant partial financial assistance. The improvements may be initiated either by property owners or by the municipality. Initiatives from the property owners must be in the form of a petition signed by at least two thirds of the owners of parcels liable to be

charged and having a value of at least 50 percent of the value of all parcels. Initiatives from the municipality are in the form of a recommendation to the Council. Once approved by the Council, the benefiting property owners are advised of the municipal initiative. The initiative is defeated if the majority of owners representing at least 50 percent of the value of the affected parcels petition Council against the initiative.

9.5 Financial Approach and Scenarios

The following are areas of funding that are recommended to be examined further:

- Some form of a cost-sharing arrangement with property owners that will benefit from navigation dredging that can be applied through either:
  - A yearly parcel tax (Local Service Area).
  - Charges to specific properties with identifiable navigation channel users (user fee revenue potential).
  - Donations from businesses/sectors that are highly dependent upon MBC navigation access
- Partnering with the Provincial and/or Federal Governments in recognition of the importance of the navigability of the MBC to the Provincial/Federal economy and taxation revenue
- Reviewing and pursuing potential grant opportunities including consideration of combining the dredging phases with habitat restoration projects that are eligible for current provincial and federal funding programs to share one-time costs between project parts.
- Collaboration with the Squamish Nation to assist with the planning and delivery of the project to ensure that the project is completed successfully.

10 Recommendations

To come.

11 Implementation of Next Steps

To come.

Glossary of Terms

Aggradation: the increase in the level of a river bed as a result of sediment deposited by the river.

Alluvial: of or relating to material left by water flowing over land; for example, alluvial deposits are those materials, such as silt and sand, dropped by a river as it flows toward the ocean.

Area Designation: the assignment of particular use(s) to a specified location.

Artificial Watercourse: a constructed watercourse made for drainage purposes, such as a ditch or swale, and does not include fish habitat constructed to compensate for or restore damaged fish habitat.

Assessment Methods: mean the assessment methods set out in the Schedule to the Riparian Areas Regulation.

Assessment Report: a report prepared in accordance with the assessment methods to assess the potential impact of a proposed development in a riparian assessment area and which is certified by a QEP.

BCR: BCR Properties and BC Rail.

Brackish: somewhat salty; for example, fresh water mixed with salt water becomes brackish.

Buffer Area: an area adjacent to a stream or ESA that links ecosystems, the size and configuration of which are determined according to these guidelines on the basis of an assessment report prepared by a QEP in relation to a development proposal.

Chart Datum (CD): is the water level surface serving as origin of depths displayed on a nautical chart.

Coarse Fish: fish that are determined by the Provincial government not to have regional significance.

Commercial: in relation to development means business or commercial use or activity, including without limitation commercial, retail, office, professional or other business uses described in the Zoning Bylaw.

Conservation: the act of protecting from loss, waste, injury or decay.

Culvert: a small tunnel constructed to carry water under a railway, embankment or road.

Delta: a fan-shaped and nearly flat plain made from alluvial deposits between the branches of a river at its mouth.

Dendritic Channels: a name for the smaller river channels that branch off the main river and spread over the delta.

Dredging: the process of removing materials such as silt or gravel from the bottom of a water body using various methods, such as scooping or suction.

Ecosystem: the interaction of a community of interdependent organisms with its environment.

Effluent: outflow, usually of waste water, from a pipe into a stream or river.

EIA: Environmental Impact Assessment; an evaluation of the environmental effects of a proposed development.

EIS: Environmental Impact Statement; a detailed description of the current condition of the environment in a given area and of the expected impacts of a proposed development.

Enhancement: improvement.

Ephemeral Stream: a stream that typically flows for six months or less per year but has prolonged periods of continuous flow, as determined by a QEP.

Estuary: the mouth or lower part of a river where the river's freshwater current meets and mixes with the ocean's saltwater tide.

Fill: material, such as sand, gravel or earth, placed to change a slope or depression to a raised or level surface.

Fish Habitat: the areas in and about a stream, such as spawning grounds and nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes.

Floodplain: an area designated in Section 3 of the District of Squamish Floodplain Management Bylaw.

Fluvial: of or relating to a river.

Foreshore: part of the shore between the high water mark and the low water mark.

Habitat: the environment in which an animal or plant lives.

Habitat Channel: a waterway which is newly created or modified to provide habitat.

Hectare: a metric unit of measurement;_ equivalent to about 2.47 acres.

High Water Mark: the visible high water mark of a stream where the presence and action of the water are so common and usual, and so long continued in all ordinary years, as to mark on the soil of the bed of the stream a character distinct from that of its banks, in vegetation as well as in the nature of the soil itself, and includes the active floodplain.

Intermittent stream: a stream that flows only during periods of heavy rainfall not exceeding 30 consecutive days per year, as determined by a QEP; could be described as "flashy".

Intertidal Zone: of or relating to the marine or estuarine foreshore.

Lead Agency: the government body primarily responsible for completion of an activity such as the implementation of a management plan.

Mitigation: action taken to avoid or reduce adverse impacts.

Natural Stream: any stream that is not an artificial watercourse.

Non-permanent Stream: includes any ephemeral or intermittent stream.

Qualified Environmental Professional (QEP): an applied scientist or technologist, acting alone or together with another QEP, who is registered and in good standing with an appropriate B.C. professional organization constituted under an Act. The QEP must be acting under that association's code of ethics, and subject to the organization's disciplinary action. QEPs must have an area of expertise that is recognized as one that is acceptable for the purpose of providing all or part of an assessment for the particular development proposal that is being assessed.

Riparian: pertaining to or situated on the bank of a water body.

River Mouth: where the river meets the ocean.

Streamside Protection and Enhancement Area (SPEA): an area adjacent to a stream that links aquatic to terrestrial ecosystems and includes both existing and potential riparian vegetation and existing and potential adjacent upland vegetation that exerts an influence on the stream, and the size of which is identified in an assessment report prepared by a QEP in respect of a development proposal.

Stream includes any of the following:

i. a watercourse, whether it usually contains water or not;
ii. a pond, lake, river, creek or brook;

iii. a wetland;
iv. a ditch or spring that is connected by surface flow to something referred to in i., ii., or iii.

Sub-tidal: a region located below the low water mark in a tidal area.

Tenure: the holding of an office or land for a specified period of time.

Vessel Under Keel Clearance (UKC): the clearance between underside of the boat (i.e., the deepest portion of the boat such as the propellor or rudder) and the channel bed.

WMA: ·Wildlife Management Area under the provincial Wildlife Act.

Appendix A
Working Group Terms of Reference

28 June 2023
1210165-RPT-0001 Revision B

Mamquam Blind Channel (MBC) Long-Term Maintenance and Dredging Strategy Working Group

Terms of Reference 2022

The project aims to recruit and engage a cross-sector community working group to advise on the technical channel maintenance and dredge strategy development for the project period.

Mandate: The mandate of the MBC Working Group is to work with the Project Team to review information, identify the relevant values, needs and community priorities for marine access and coastal protection and stewardship, and provide input, evaluate options and make recommendations on the development of a long-term ecosystem-based dredge management and funding strategy for the Mamquam Blind Channel.

Structure. The working group is to be advisory with broad representation from the community, voluntary (serving without remuneration), and time-limited (disbanded upon completing identified tasks).

Term. Appointment to the working group is for one year, or until the group completes its work, whichever is earlier.

Membership/Representation. The working group is proposed to consist of approximately 10-15 members with representation from the following groups/organizations:

- Squamish Chamber (board appointment and recommendation of candidate)
- Tourism Squamish (board appointment and recommendation of candidate)
- Downtown Squamish BIA (board appointment and recommendation of candidate)
- Business/Industrial Interest (Including but not limited to Forestry, Short-sea Shipping, Marine Sector e.g. boat repair, marine tech etc, Clean Tech, Other sectors with shipping interests) *
- Local Marina Representative (Commercial Water Lot Tenure Holder)
- Mariners + grass roots 'Squamish Needs a Boat Launch Cttee' representative
- Waterfront Upland Owners
- Squamish Terminals/Port
- Community Organizations representing:
    - Squamish Harbour Authority
    - Public Safety (RCMSAR, RCMP)
    - Stewardship /Environmental Conservation
    - Marine Recreation (Community and/or Commercial Recreation)
- Community Member at Large

Roles. To support the working group through the series of meetings, the District will act as Chair and will provide leadership to maintain orderly conduct of working group meetings and any relevant input from observers at the end of meetings. District staff will work directly with the project team, intergovernmental agencies and the working group to solidify agendas and meeting materials in advance of upcoming meetings.

Meeting Facilitation + Administrative Support. District staff (project team leads) will provide facilitation and administrative support to the working group for meeting scheduling and logistics, minute taking etc. Staff and the project consultant will bring subject matter expertise and liaise with governmental agencies (see below).

Governmental and technical advisor participation. The working group will be open to and invite governments/agency representatives and technical advisors where needed to join to support and guide the project.

Appointment. Candidate members for the working group will be invited by the District of Squamish. Appointments will reflect the diversity and experience of candidates and be reflective of the broad spectrum of the community.

Meetings. A majority of the members is required to constitute a quorum. The quorum will be confirmed with the final membership list/# of sitting working group members.

Code of Conduct. The working group shall follow the procedures as set out in the District's Council and Committee Member Code of Conduct Policy. Working group members must devote the necessary time and effort to prepare for meetings, arrive at meetings on time, provide feedback in keeping with the working group mandate, and be respectful of others' thoughts and opinions. Members of the working group are not permitted to speak to the media or post to any social media platform as representatives of the working group unless authorized to do so by the District of Squamish.

Public/Observers. The public are welcome as observers, sitting at the periphery of the working group. The District will provide opportunity for members of the public to ask questions and offer points of information at the end of meetings. Observers will also exercise good faith and respect, mindful that they are in a working environment, where ideas and findings are in development and are works in progress. Working group meetings are not a forum for lobbying, speeches or demonstrations.

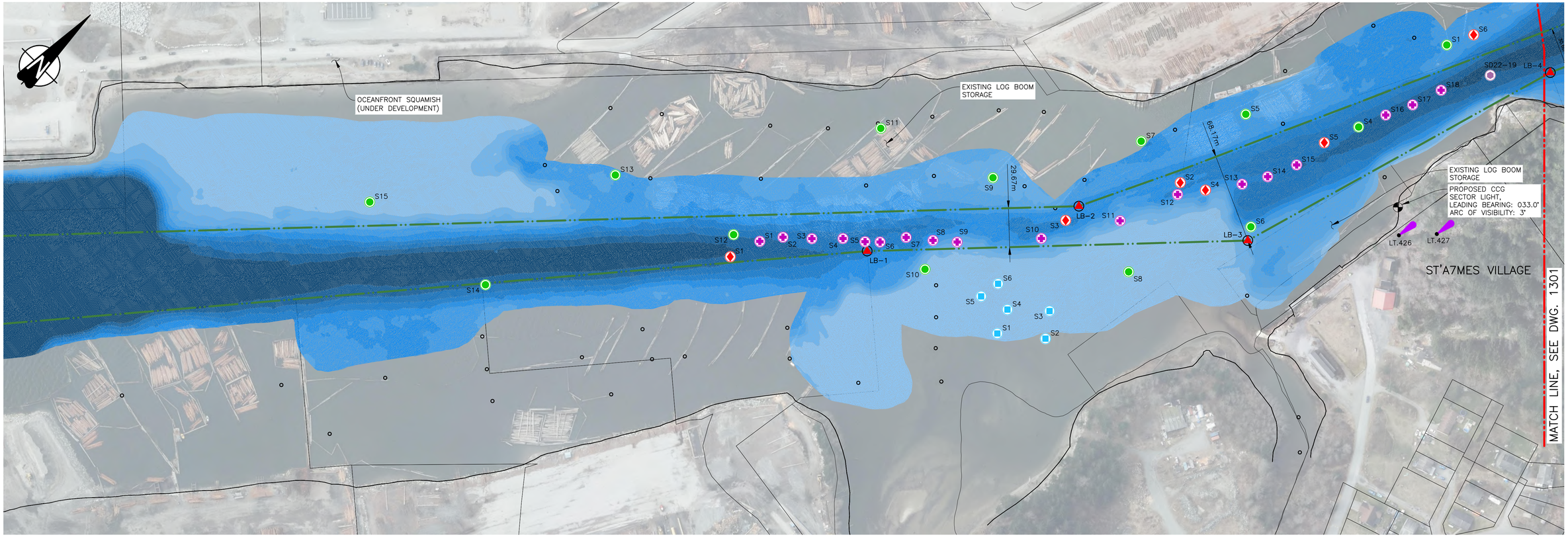
Reporting. Upon completion of its assignment, working group inputs and outcomes will be summarized in a report with key findings and recommendations to Council. District Staff will collaborate and support on the preparation of the summary report. Following review by the working group, the report will be submitted to Council.

MBC Working Group Meeting Outline *DRAFT (subject to ongoing refinement and formalized agenda setting)

Purpose / Core Objectives	**Meeting 1** (Sept/October)	**Meeting 2** (November)	**Meeting 3+** (TBD)
	Connecting and building shared understandings for channel maintenance strategy development	*Evaluating community needs, risks, impacts, and options for long-term channel maintenance program*	*Formalize maintenance and funding recommendations for community and Council consideration*
Desired Meeting Outcomes	• Project team and working group introductions, terms of reference, selection of Chair + meeting outlines • Project scope and design assumptions • Baseline Info sharing + technical documentation review • Community values-based decision framing and sharing of community impact perspective	• Discuss Navigation Channel Design + Habitat Enhancement Opportunities • MBC maintenance and dredging options deep dive • Community Impacts and Options Evaluation (Cost-Benefit)	• Develop and refine recommendations for preferred channel maintenance and funding option(s) for community consideration
Information Review	• MBC Context + History (Ecological, Cultural, Social, Economic) • Navigation Channel Design + Habitat Enhancement Areas and Opportunities • Overview of channel maintenance and funding options • Cost-benefit analysis methodology	• Current and future marine use areas within the MBC and scenarios • Dredge options matrix (review of community impacts)	• Funding mechanisms and cost sharing approaches (best practices and examples)
Key Questions for advance consideration + WG discussion	1. Have we covered all necessary information for shared baseline understanding? 2. Are there information gaps or expanded considerations (ecological, social, cultural, technical) that we need to bring forward for collective review? 3. What are the biggest barriers/constraints as well as opportunities to address within the MBC?	1. What are the top priorities and needs for channel maintenance activity? 2. Have all potential options been identified, if not, what's missing? 3. What are the impacts and benefits to community with each scenario? 4. What options should be advanced and why?	1. For the preferred option(s), what funding scenarios are most viable and acceptable to pursue? 2. What are important next steps?

Appendix B
Sampling Locations

28 June 2023
1210165-RPT-0001 Revision B



PLAN
1:1500

LEGEND:

- LB-# — TYPLAN PROPOSED LATERAL BUOY LOCATIONS TO DELINEATE INNER HARBOUR CHANNEL
- OR ○ — TIMBER PILES
- CANADIAN COAST GUARD RANGE MARKER
- S# — 1992 SEDIMENT SAMPLE LOCATION (PUBLIC WORKS)
- S# — 2008 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# — 2010 SEDIMENT SAMPLE LOCATION (GOLDER)
- S# — 2011 SEDIMENT SAMPLE LOCATION (HEMMERA)
- S# — 2021 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# — 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR STANDARDS
- S# — 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR FRESHWATER SEDs STANDARDS
- MAMQUAM BLIND CHANNEL (TYPLAN PROPOSED)

ELEVATIONS TABLE		
COLOUR	MINIMUM ELEVATION	MAXIMUM ELEVATION
	–	–3.50m
	–3.50m	–3.00m
	–3.00m	–2.50m
	–2.50m	–2.00m
	–2.00m	–1.50m
	–1.50m	–1.00m
	–1.00m	–0.50m
	–0.50m	0.00m
	0.00m	0.50m
	0.50m	–

m 0 10 20 30 40 50 100 m
1:1500

NOTES:

1. NAVIGATION CHANNEL LAYOUT IS BASED ON TYPLAN/CMO SUBMISSION FOR BOSA PROPERTIES TO SUPPORT THEIR APPLICATION TO TRANSPORT CANADA FOR THE WATERFRONT LANDING MARINA DESIGN (DATED JULY 26, 2018).
2. SAMPLE LOCATIONS DERIVED FROM DOCUMENT "FIGURE 1B" FROM KEYSTONE ENVIRONMENTAL DATED AUGUST 2022, AND "SEDIMENT SAMPLING PLAN" FROM ENVIROCHEM DATED MAY 2021.

Filename: C:\Users\Daniel\OneDrive\DanielPalo\Westmar-Daniel Palo\1210165-Squamish Dredge\1210165-SK-1300-1302.dwg
Last Saved: Feb. 28/23 1:18pm Plotted: Feb. 28/23

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D
A	FEB28/23	ISSUED FOR CLIENT REVIEW	DP	RM	–	–	–

ISSUE / REVISIONS

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D

ISSUE / REVISIONS

PRELIMINARY
DO NOT USE FOR CONSTRUCTION
Last Saved: Feb. 28/23 1:18pm

PERMITS AND STAMPS

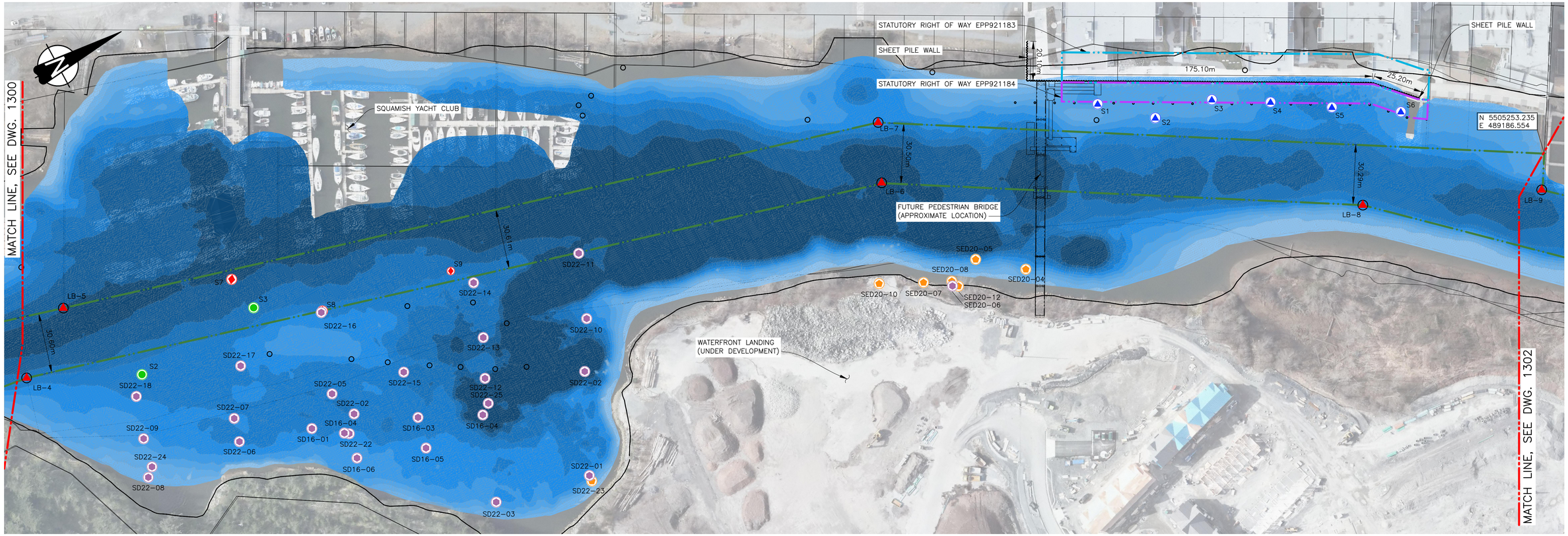
CLIENT
SQUAMISH
HARDWIRED for ADVENTURE

PROJECT
MAMQUAM BLIND CHANNEL
DREDGE STRATEGY

WESTMAR ADVISORS

TITLE
MAMQUAM BLIND CHANNEL
PLAN
SHEET 1 OF 3

DRAWING SCALE	PROJECT NUMBER	DRAWING NUMBER	REV.
SHOWN	1210165	SK–1300	A



PLAN
1:1000

LEGEND:

- LB-# — TYPLAN PROPOSED LATERAL BUOY LOCATIONS TO DELINEATE INNER HARBOUR CHANNEL
- O OR ∘ — TIMBER PILES
- CANADIAN COAST GUARD RANGE MARKER
- S# — 1992 SEDIMENT SAMPLE LOCATION (PUBLIC WORKS)
- S# — 2008 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# — 2010 SEDIMENT SAMPLE LOCATION (GOLDER)
- S# — 2011 SEDIMENT SAMPLE LOCATION (HEMMERA)
- S# — 2021 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# — 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR STANDARDS
- S# — 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR FRESHWATER SEDs STANDARDS
- MAMQUAM BLIND CHANNEL (TYPLAN PROPOSED)

ELEVATIONS TABLE		
COLOUR	MINIMUM ELEVATION	MAXIMUM ELEVATION
	–	−3.50m
	−3.50m	−3.00m
	−3.00m	−2.50m
	−2.50m	−2.00m
	−2.00m	−1.50m
	−1.50m	−1.00m
	−1.00m	−0.50m
	−0.50m	0.00m
	0.00m	0.50m
	0.50m	–

m 0 10 20 30 40 50 m
1:1000

NOTES:

1. NAVIGATION CHANNEL LAYOUT IS BASED ON TYPLAN/CMO SUBMISSION FOR BOSA PROPERTIES TO SUPPORT THEIR APPLICATION TO TRANSPORT CANADA FOR THE WATERFRONT LANDING MARINA DESIGN (DATED JULY 26, 2018).
2. SAMPLE LOCATIONS DERIVED FROM DOCUMENT "FIGURE 1B" FROM KEYSTONE ENVIRONMENTAL DATED AUGUST 2022, AND "SEDIMENT SAMPLING PLAN" FROM ENVIROCHEM DATED MAY 2021.

Filename: C:\Users\Daniel\OneDrive\DanielPalo\Westmar-Daniel Palo\1210165-Squamish Dredge\1210165-SK-1300-1302.dwg
Last Saved: Feb. 28/23 1:18pm Plotted: Feb. 28/23

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D
A	FEB28/23	ISSUED FOR CLIENT REVIEW	DP	RM	–	–	–

ISSUE / REVISIONS

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D

ISSUE / REVISIONS

PRELIMINARY
DO NOT USE FOR CONSTRUCTION
Last Saved: Feb. 28/23 1:18pm

PERMITS AND STAMPS

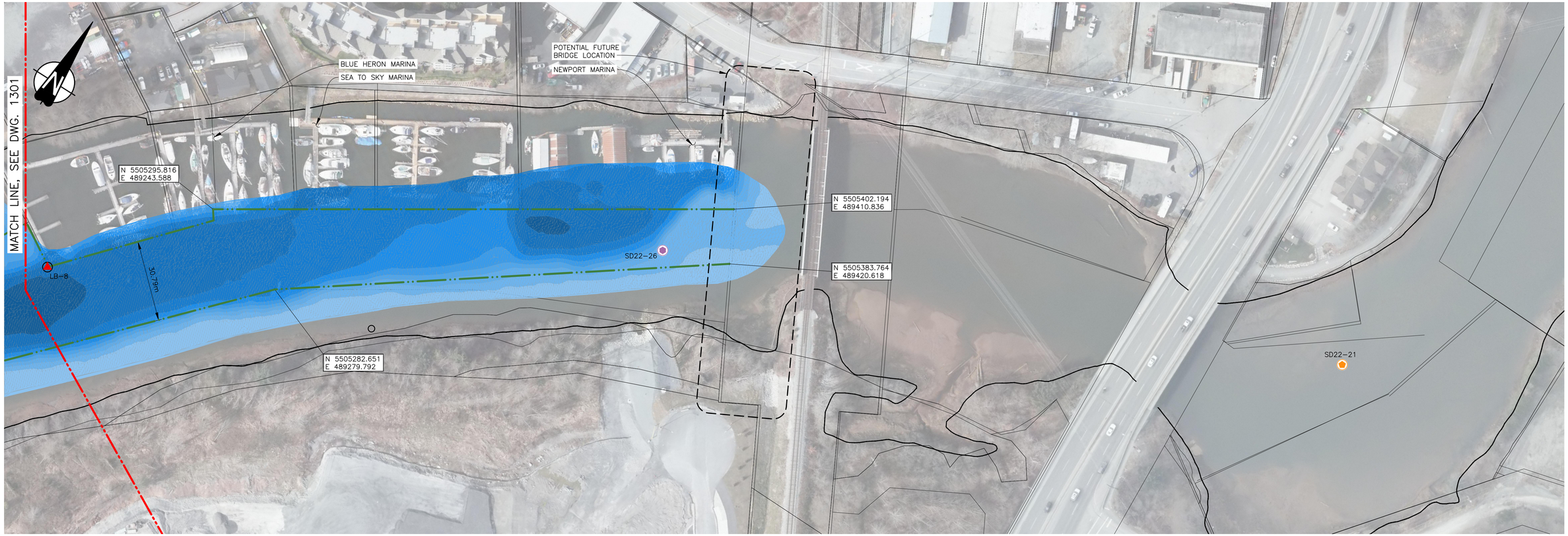
CLIENT: SQUAMISH — HARDWIRED for ADVENTURE

PROJECT: MAMQUAM BLIND CHANNEL DREDGE STRATEGY

WESTMAR ADVISORS

TITLE: MAMQUAM BLIND CHANNEL PLAN SHEET 2 OF 3

DRAWING SCALE	PROJECT NUMBER	DRAWING NUMBER	REV.
SHOWN	1210165	SK-1301	A



PLAN
1:750

LEGEND:

- LB-# — TYPLAN PROPOSED LATERAL BUOY LOCATIONS TO DELINEATE INNER HARBOUR CHANNEL
- OR ○ — TIMBER PILES
- CANADIAN COAST GUARD RANGE MARKER
- S# — 1992 SEDIMENT SAMPLE LOCATION (PUBLIC WORKS)
- S# — 2008 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# — 2010 SEDIMENT SAMPLE LOCATION (GOLDER)
- S# — 2011 SEDIMENT SAMPLE LOCATION (HEMMERA)
- S# — 2021 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# — 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR STANDARDS
- S# — 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR FRESHWATER SEDs STANDARDS
- MAMQUAM BLIND CHANNEL (TYPLAN PROPOSED)

ELEVATIONS TABLE		
COLOUR	MINIMUM ELEVATION	MAXIMUM ELEVATION
	–	–3.50m
	–3.50m	–3.00m
	–3.00m	–2.50m
	–2.50m	–2.00m
	–2.00m	–1.50m
	–1.50m	–1.00m
	–1.00m	–0.50m
	–0.50m	0.00m
	0.00m	0.50m
	0.50m	–

m 0 10 20 30 40 m
1:750

NOTES:

1. NAVIGATION CHANNEL LAYOUT IS BASED ON TYPLAN/CMO SUBMISSION FOR BOSA PROPERTIES TO SUPPORT THEIR APPLICATION TO TRANSPORT CANADA FOR THE WATERFRONT LANDING MARINA DESIGN (DATED JULY 26, 2018).
2. SAMPLE LOCATIONS DERIVED FROM DOCUMENT "FIGURE 1B" FROM KEYSTONE ENVIRONMENTAL DATED AUGUST 2022, AND "SEDIMENT SAMPLING PLAN" FROM ENVIROCHEM DATED MAY 2021.

Filename: C:\Users\Daniel\OneDrive\DanielPalo\Westmar-Daniel Palo\1210165-Squamish Dredge\1210165-SK-1300-1302.dwg
Last Saved: Feb. 28/23 1:18pm Plotted: Feb. 28/23

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D
A	FEB28/23	ISSUED FOR CLIENT REVIEW	DP	RM	–	–	–

ISSUE / REVISIONS

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D

ISSUE / REVISIONS

PRELIMINARY
DO NOT USE FOR CONSTRUCTION
Last Saved: Feb. 28/23 1:18pm

PERMITS AND STAMPS

CLIENT
SQUAMISH
HARDWIRED for ADVENTURE

PROJECT
MAMQUAM BLIND CHANNEL
DREDGE STRATEGY

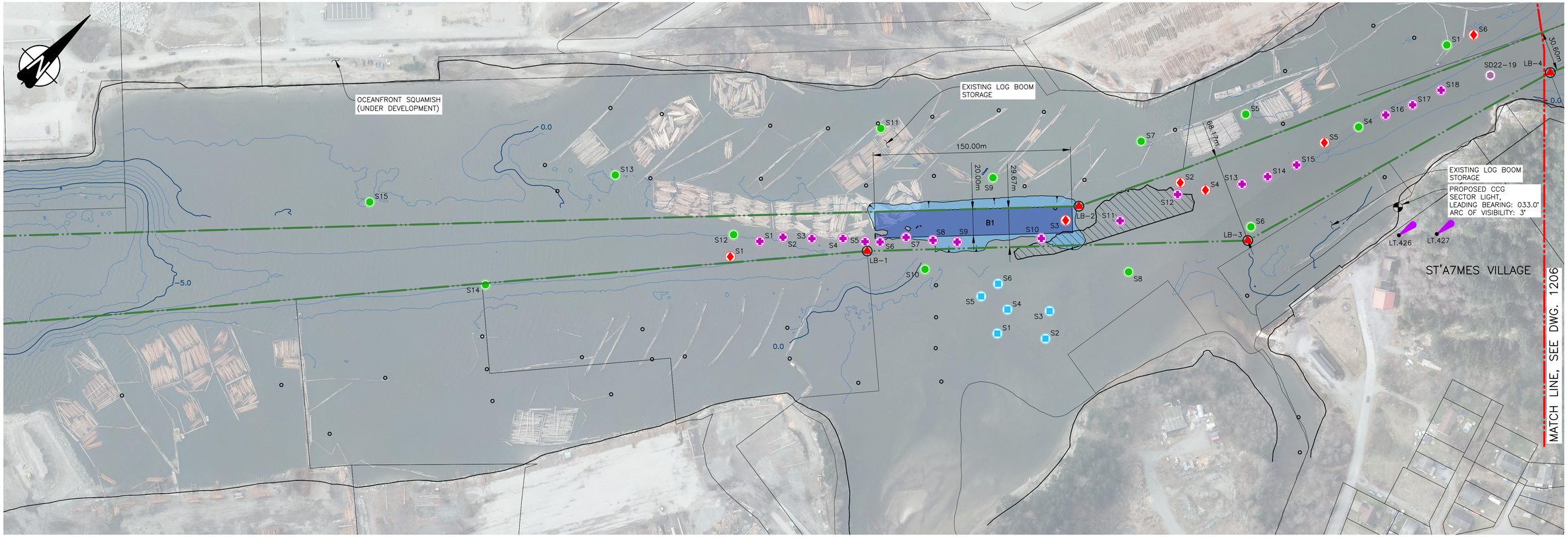
WESTMAR ADVISORS

TITLE
MAMQUAM BLIND CHANNEL
PLAN
SHEET 3 OF 3

DRAWING SCALE	PROJECT NUMBER	DRAWING NUMBER	REV.
SHOWN	1210165	SK-1302	A

Appendix C
Dredging Options B, C

28 June 2023
1210165-RPT-0001 Revision B



PLAN
1:1500

OPTION B – ESTIMATED VOLUME				
AREA NO. (A)	DREDGE AREA	DREDGE VOLUME	OVERDREDGE ALLOWANCE (300mm)	TOTAL VOLUME
B1	5204m²	3395m³	1561m³	4956m³
TOTALS:	**5204m²**	**3395m³**	**1561m³**	**4956m³**

LEGEND:

- OPTION B – DREDGE WITHIN NAVIGATION CHANNEL TO –2.6m
- OPTION B – STOP GAP SIDE SLOPES
- 2013 DREDGE AREA (2537m²)
- MAMQUAM BLIND CHANNEL (TYPLAN PROPOSED)
- 5m INTERVALS
- 1m INTERVALS
- LB–# TYPLAN PROPOSED LATERIAL BUOY LOCATIONS TO DELINEATE INNER HARBOUR CHANNEL
- OR TIMBER PILES
- CANADIAN COAST GUARD RANGE MARKER
- S# 1992 SEDIMENT SAMPLE LOCATION (PUBLIC WORKS)
- S# 2008 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# 2010 SEDIMENT SAMPLE LOCATION (GOLDER)
- S# 2011 SEDIMENT SAMPLE LOCATION (HEMMERA)
- S# 2021 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR STANDARDS
- S# 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR FRESHWATER SEDs STANDARDS

m 0 10 20 30 40 50 100 m
1:1500

NOTES:

1. DREDGE PLAN AND VOLUMES BASED ON DREDGING AS FOLLOWS:

   OPTION B – DREDGE DEPTH TO –2.6m CD.

   DREDGE DEPTH TO BE CONFIRMED.
2. DREDGE PLAN AND VOLUMES BASED ON 1V:3H SIDE SLOPE FOR DREDGING IN THE NORTHERN SECTION OF THE CHANNEL AND 1V:4H FOR DREDGING IN THE SOUTHERN SECTION OF THE CHANNEL. DESIGN SIDE SLOPE TO BE CONFIRMED.
3. NAVIGATION CHANNEL LAYOUT IS BASED ON TYPLAN/CMO SUBMISSION FOR BOSA PROPERTIES TO SUPPORT THEIR APPLICATION TO TRANSPORT CANADA FOR THE WATERFRONT LANDING MARINA DESIGN (DATED JULY 26, 2018).

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D
A	JUNXX/23	ISSUED FOR ...	DP	RM	–	–	–

ISSUE / REVISIONS

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D

ISSUE / REVISIONS

PRELIMINARY
DO NOT USE FOR CONSTRUCTION
Last Saved: Jun. 15/23 11:22am

PERMITS AND STAMPS

CLIENT
SQUAMISH
HARDWIRED for ADVENTURE

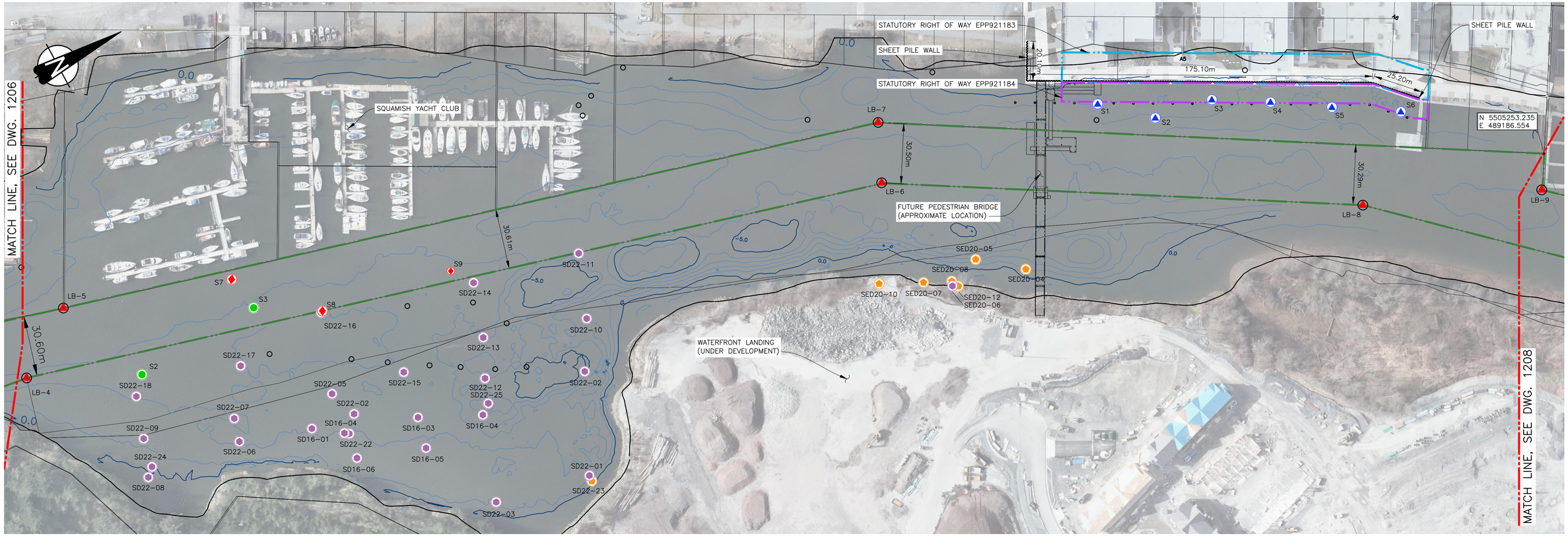
PROJECT
MAMQUAM BLIND CHANNEL
DREDGE STRATEGY

WESTMAR ADVISORS

TITLE
MAMQUAM BLIND CHANNEL
DREDGING PLAN – OPTION B
SHEET 1 OF 3

DRAWING SCALE	PROJECT NUMBER	DRAWING NUMBER	REV.
SHOWN	1210165	SK–1206	A

Filename: C:\Users\dpalo\OneDrive\DanielPalo\Westmar–Daniel Palo\1210165–Squamish Dredge\1210165–SK–1206–1208.dwg
Last Saved: Jun. 15/23 11:22am Plotted: Jun. 15/23



PLAN
1:1000

OPTION B – ESTIMATED VOLUME				
AREA NO. (A)	DREDGE AREA	DREDGE VOLUME	OVERDREDGE ALLOWANCE (300mm)	TOTAL VOLUME
B1	5204m²	3395m³	1561m³	4956m³
TOTALS:	**5204m²**	**3395m³**	**1561m³**	**4956m³**

LEGEND:

- OPTION B – DREDGE WITHIN NAVIGATION CHANNEL TO –2.6m
- OPTION B – STOP GAP SIDE SLOPES
- 2013 DREDGE AREA (2537m²)
- STATUTORY RIGHT OF WAY EPP921183
- STATUTORY RIGHT OF WAY EPP921184
- MAMQUAM BLIND CHANNEL (TYPLAN PROPOSED)
- 5m INTERVALS
- 1m INTERVALS
- LB-# TYPLAN PROPOSED LATERIAL BUOY LOCATIONS TO DELINEATE INNER HARBOUR CHANNEL
- OR TIMBER PILES
- CANADIAN COAST GUARD RANGE MARKER
- S# 1992 SEDIMENT SAMPLE LOCATION (PUBLIC WORKS)
- S# 2008 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# 2010 SEDIMENT SAMPLE LOCATION (GOLDER)
- S# 2011 SEDIMENT SAMPLE LOCATION (HEMMERA)
- S# 2021 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR STANDARDS
- S# 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR FRESHWATER SEDs STANDARDS

m 0 10 20 30 40 50 100 m
1:1500

NOTES:

1. DREDGE PLAN AND VOLUMES BASED ON DREDGING AS FOLLOWS:

   OPTION B – DREDGE DEPTH TO –2.6m CD.

   DREDGE DEPTH TO BE CONFIRMED.
2. DREDGE PLAN AND VOLUMES BASED ON 1V:3H SIDE SLOPE FOR DREDGING IN THE NORTHERN SECTION OF THE CHANNEL AND 1V:4H FOR DREDGING IN THE SOUTHERN SECTION OF THE CHANNEL. DESIGN SIDE SLOPE TO BE CONFIRMED.
3. NAVIGATION CHANNEL LAYOUT IS BASED ON TYPLAN/CMO SUBMISSION FOR BOSA PROPERTIES TO SUPPORT THEIR APPLICATION TO TRANSPORT CANADA FOR THE WATERFRONT LANDING MARINA DESIGN (DATED JULY 26, 2018).

Filename: C:\Users\dpalo\OneDrive\DanielPalo\Westmar-Daniel Palo\1210165-Squamish Dredge\1210165-SK-1206-1208.dwg
Last Saved: Jun. 15/23 11:22am Plotted: Jun. 15/23

REVISION IN PROGRESS

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D
A	JUNXX/23	ISSUED FOR ...	DP	RM	–	–	–

ISSUE / REVISIONS

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D

ISSUE / REVISIONS

PRELIMINARY
DO NOT USE FOR CONSTRUCTION
Last Saved: Jun. 15/23 11:22am

PERMITS AND STAMPS

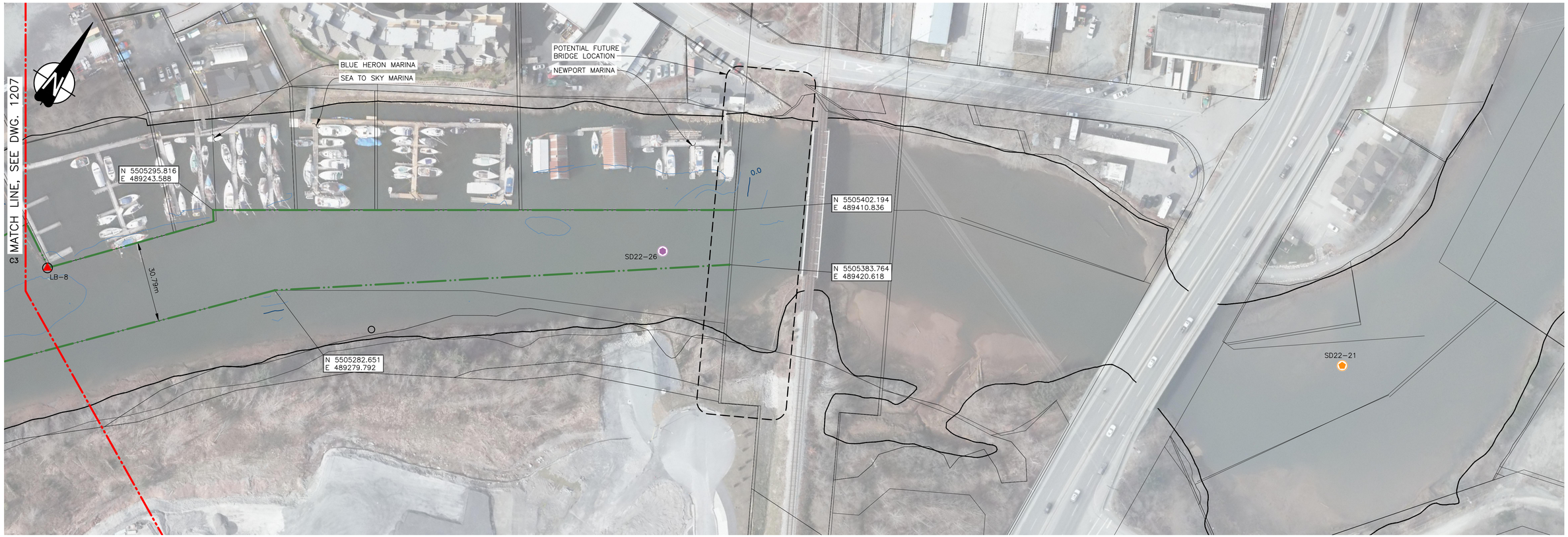
CLIENT
SQUAMISH
HARDWIRED for ADVENTURE

PROJECT
MAMQUAM BLIND CHANNEL
DREDGE STRATEGY

WESTMAR ADVISORS

TITLE
MAMQUAM BLIND CHANNEL
DREDGING PLAN – OPTION B
SHEET 2 OF 3

DRAWING SCALE	PROJECT NUMBER	DRAWING NUMBER	REV.
SHOWN	1210165	SK–1207	A



PLAN
1:750

OPTION B – ESTIMATED VOLUME				
AREA NO. (A)	DREDGE AREA	DREDGE VOLUME	OVERDREDGE ALLOWANCE (300mm)	TOTAL VOLUME
B1	5204m²	3395m³	1561m³	4956m³
TOTALS:	**5204m²**	**3395m³**	**1561m³**	**4956m³**

LEGEND:

- OPTION B – DREDGE WITHIN NAVIGATION CHANNEL TO –2.6m
- OPTION B – STOP GAP SIDE SLOPES
- 2013 DREDGE AREA (2537m²)
- MAMQUAM BLIND CHANNEL (TYPLAN PROPOSED)
- 5m INTERVALS
- 1m INTERVALS
- LB–# TYPLAN PROPOSED LATERIAL BUOY LOCATIONS TO DELINEATE INNER HARBOUR CHANNEL
- OR TIMBER PILES
- CANADIAN COAST GUARD RANGE MARKER
- S# 1992 SEDIMENT SAMPLE LOCATION (PUBLIC WORKS)
- S# 2008 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# 2010 SEDIMENT SAMPLE LOCATION (GOLDER)
- S# 2011 SEDIMENT SAMPLE LOCATION (HEMMERA)
- S# 2021 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR STANDARDS
- S# 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR FRESHWATER SEDs STANDARDS

m 0 10 20 30 40 50 100 m
1:1500

NOTES:

1. DREDGE PLAN AND VOLUMES BASED ON DREDGING AS FOLLOWS:

   OPTION B – DREDGE DEPTH TO –2.6m CD.

   DREDGE DEPTH TO BE CONFIRMED.
2. DREDGE PLAN AND VOLUMES BASED ON 1V:3H SIDE SLOPE FOR DREDGING IN THE NORTHERN SECTION OF THE CHANNEL AND 1V:4H FOR DREDGING IN THE SOUTHERN SECTION OF THE CHANNEL. DESIGN SIDE SLOPE TO BE CONFIRMED.
3. NAVIGATION CHANNEL LAYOUT IS BASED ON TYPLAN/CMO SUBMISSION FOR BOSA PROPERTIES TO SUPPORT THEIR APPLICATION TO TRANSPORT CANADA FOR THE WATERFRONT LANDING MARINA DESIGN (DATED JULY 26, 2018).

Filename: C:\Users\dpalo\OneDrive\DanielPalo\Westmar–Daniel Palo\1210165–Squamish Dredge\1210165–SK–1206–1208.dwg
Last Saved: Jun. 15/23 11:22am Plotted: Jun. 15/23

REVISION IN PROGRESS

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D
A	JUNXX/23	ISSUED FOR ...	DP	RM	–	–	–

ISSUE / REVISIONS

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D

ISSUE / REVISIONS

PRELIMINARY
DO NOT USE FOR CONSTRUCTION
Last Saved: Jun. 15/23 11:22am

PERMITS AND STAMPS

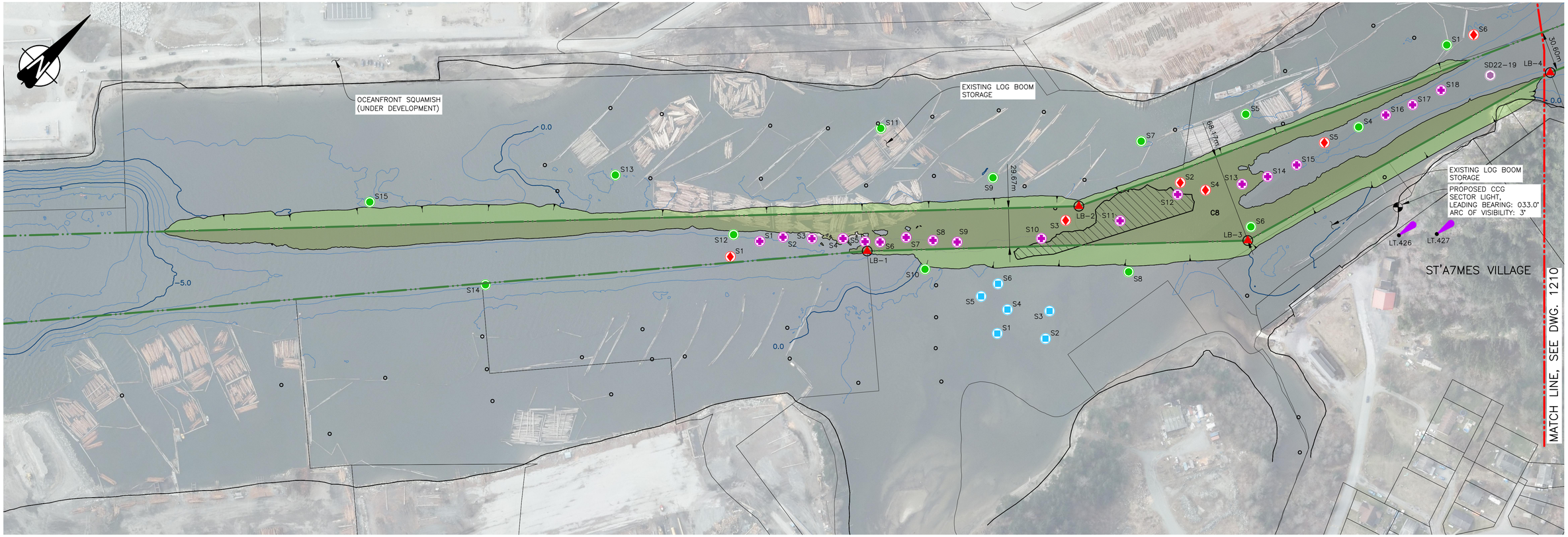
CLIENT
SQUAMISH
HARDWIRED for ADVENTURE

PROJECT
MAMQUAM BLIND CHANNEL
DREDGE STRATEGY

WESTMAR ADVISORS

TITLE
MAMQUAM BLIND CHANNEL
DREDGING PLAN – OPTION B
SHEET 3 OF 3

DRAWING SCALE	PROJECT NUMBER	DRAWING NUMBER	REV.
SHOWN	1210165	SK–1208	A



PLAN
1:1500

OPTION C – ESTIMATED VOLUME				
AREA NO. (A)	DREDGE AREA	DREDGE VOLUME	OVERDREDGE ALLOWANCE (300mm)	TOTAL VOLUME
C1	1614m²	1659m³	484m³	2143m³
C2	38m²	7m³	11m³	18m³
C3	546m²	293m³	164m³	457m³
C4	57m²	9m³	17m³	26m³
C5	806m²	276m³	242m³	518m³
C6	779m²	156m³	234m³	389m³
C7	6m²	1m³	2m³	3m³
C8	36533m²	40062m³	10960m³	51022m³
TOTALS:	**40379m²**	**42463m³**	**12114m³**	**54576m³**

LEGEND:

- OPTION C – DREDGE WITHIN NAVIGATION CHANNEL – SEE NOTES
- OPTION C – NAVIGATION CHANNEL SIDE SLOPES – SEE NOTES
- 2013 DREDGE AREA (2537m²)
- MAMQUAM BLIND CHANNEL (TYPLAN PROPOSED)
- 5m INTERVALS
- 1m INTERVALS
- LB–# TYPLAN PROPOSED LATERIAL BUOY LOCATIONS TO DELINEATE INNER HARBOUR CHANNEL
- OR ○ TIMBER PILES
- CANADIAN COAST GUARD RANGE MARKER
- S# 1992 SEDIMENT SAMPLE LOCATION (PUBLIC WORKS)
- S# 2008 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# 2010 SEDIMENT SAMPLE LOCATION (GOLDER)
- S# 2011 SEDIMENT SAMPLE LOCATION (HEMMERA)
- S# 2021 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR STANDARDS
- S# 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR FRESHWATER SEDs STANDARDS

m 0 10 20 30 40 50 100 m
1:1500

NOTES:

1. DREDGE PLAN AND VOLUMES BASED ON DREDGING AS FOLLOWS:

   OPTION C – DREDGE DEPTH TO –2.6m CD DOWNSTREAM OF THE PEDESTRIAN BRIDGE, AND –1.6m CD UPSTREAM OF THE PEDESTRIAN BRIDGE. SOME AREAS MAY OVERLAP OPTION B.

   DREDGE DEPTH TO BE CONFIRMED.

2. DREDGE PLAN AND VOLUMES BASED ON 1V:3H SIDE SLOPE FOR DREDGING IN THE NORTHERN SECTION OF THE CHANNEL AND 1V:4H FOR DREDGING IN THE SOUTHERN SECTION OF THE CHANNEL. DESIGN SIDE SLOPE TO BE CONFIRMED.

3. NAVIGATION CHANNEL LAYOUT IS BASED ON TYPLAN/CMO SUBMISSION FOR BOSA PROPERTIES TO SUPPORT THEIR APPLICATION TO TRANSPORT CANADA FOR THE WATERFRONT LANDING MARINA DESIGN (DATED JULY 26, 2018).

Filename: C:\Users\dpalo\OneDrive\DanielPalo\Westmar–Daniel Palo\1210165–Squamish Dredge\1210165–SK–1209–1211.dwg
Last Saved: Jun. 15/23 11:10am Plotted: Jun. 15/23

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D
A	JUNXX/23	ISSUED FOR ...	DP	RM	–	–	–

REVISION IN PROGRESS

ISSUE / REVISIONS

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D

ISSUE / REVISIONS

PRELIMINARY
DO NOT USE FOR CONSTRUCTION
Last Saved: Jun. 15/23 11:10am

PERMITS AND STAMPS

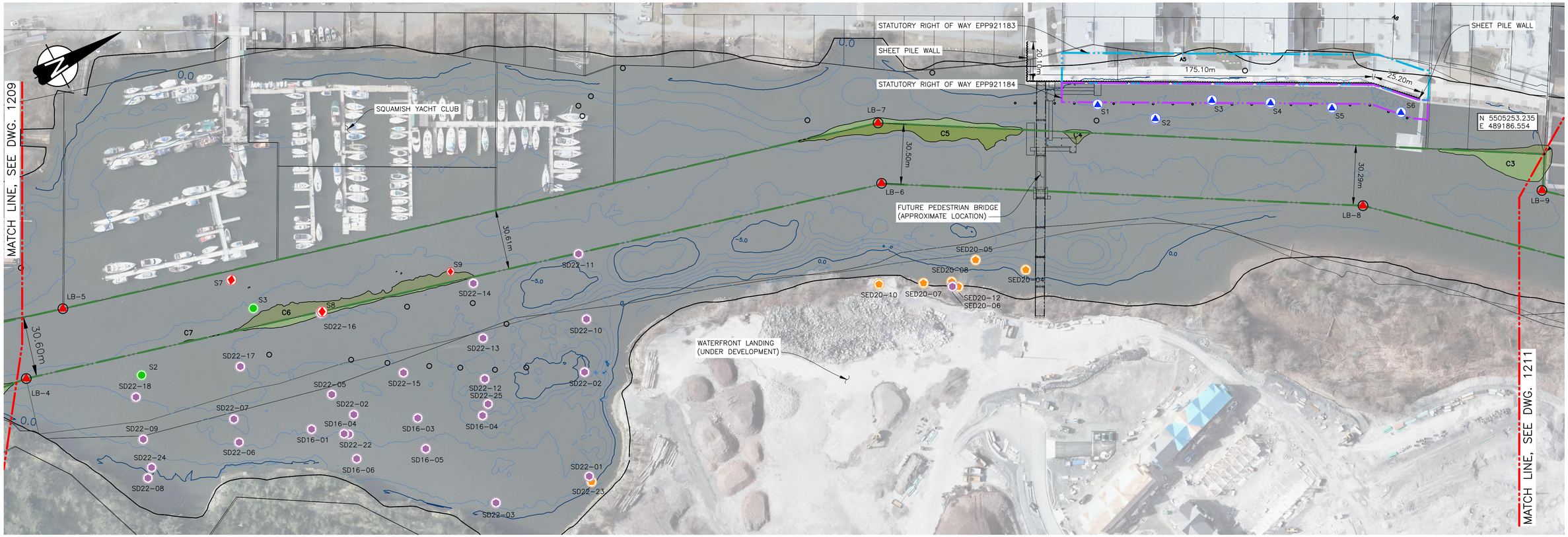
CLIENT
SQUAMISH
HARDWIRED for ADVENTURE

PROJECT
MAMQUAM BLIND CHANNEL
DREDGE STRATEGY

WESTMAR ADVISORS

TITLE
MAMQUAM BLIND CHANNEL
DREDGING PLAN – OPTION C
SHEET 1 OF 3

DRAWING SCALE	PROJECT NUMBER	DRAWING NUMBER	REV.
SHOWN	1210165	SK–1209	A



PLAN
1:1000

OPTION C – ESTIMATED VOLUME				
AREA NO. (A)	DREDGE AREA	DREDGE VOLUME	OVERDREDGE ALLOWANCE (300mm)	TOTAL VOLUME
C1	1614m²	1659m³	484m³	2143m³
C2	38m²	7m³	11m³	18m³
C3	546m²	293m³	164m³	457m³
C4	57m²	9m³	17m³	26m³
C5	806m²	276m³	242m³	518m³
C6	779m²	156m³	234m³	389m³
C7	6m²	1m³	2m³	3m³
C8	36533m²	40062m³	10960m³	51022m³
TOTALS:	**40379m²**	**42463m³**	**12114m³**	**54576m³**

LEGEND:

- OPTION C – DREDGE WITHIN NAVIGATION CHANNEL – SEE NOTES
- OPTION C – NAVIGATION CHANNEL SIDE SLOPES – SEE NOTES
- 2013 DREDGE AREA (2537m²)
- STATUTORY RIGHT OF WAY EPP921183
- STATUTORY RIGHT OF WAY EPP921184
- MAMQUAM BLIND CHANNEL (TYPLAN PROPOSED)
- 5m INTERVALS
- 1m INTERVALS
- LB-# TYPLAN PROPOSED LATERIAL BUOY LOCATIONS TO DELINEATE INNER HARBOUR CHANNEL
- OR TIMBER PILES
- CANADIAN COAST GUARD RANGE MARKER
- S# 1992 SEDIMENT SAMPLE LOCATION (PUBLIC WORKS)
- S# 2008 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# 2010 SEDIMENT SAMPLE LOCATION (GOLDER)
- S# 2011 SEDIMENT SAMPLE LOCATION (HEMMERA)
- S# 2021 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR STANDARDS
- S# 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR FRESHWATER SEDs STANDARDS

m 0 10 20 30 40 50 100 m
1:1500

NOTES:

1. DREDGE PLAN AND VOLUMES BASED ON DREDGING AS FOLLOWS:

   OPTION C – DREDGE DEPTH TO –2.6m CD DOWNSTREAM OF THE PEDESTRIAN BRIDGE, AND –1.6m CD UPSTREAM OF THE PEDESTRIAN BRIDGE. SOME AREAS MAY OVERLAP OPTION B.

   DREDGE DEPTH TO BE CONFIRMED.

2. DREDGE PLAN AND VOLUMES BASED ON 1V:3H SIDE SLOPE FOR DREDGING IN THE NORTHERN SECTION OF THE CHANNEL AND 1V:4H FOR DREDGING IN THE SOUTHERN SECTION OF THE CHANNEL. DESIGN SIDE SLOPE TO BE CONFIRMED.

3. NAVIGATION CHANNEL LAYOUT IS BASED ON TYPLAN/CMO SUBMISSION FOR BOSA PROPERTIES TO SUPPORT THEIR APPLICATION TO TRANSPORT CANADA FOR THE WATERFRONT LANDING MARINA DESIGN (DATED JULY 26, 2018).

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D
A	JUNXX/23	ISSUED FOR ...	DP	RM	–	–	–

REVISION IN PROGRESS

ISSUE / REVISIONS

ISSUE / REVISIONS

PRELIMINARY
DO NOT USE FOR CONSTRUCTION
Last Saved: Jun. 15/23 11:10am

PERMITS AND STAMPS

CLIENT: SQUAMISH HARDWIRED for ADVENTURE

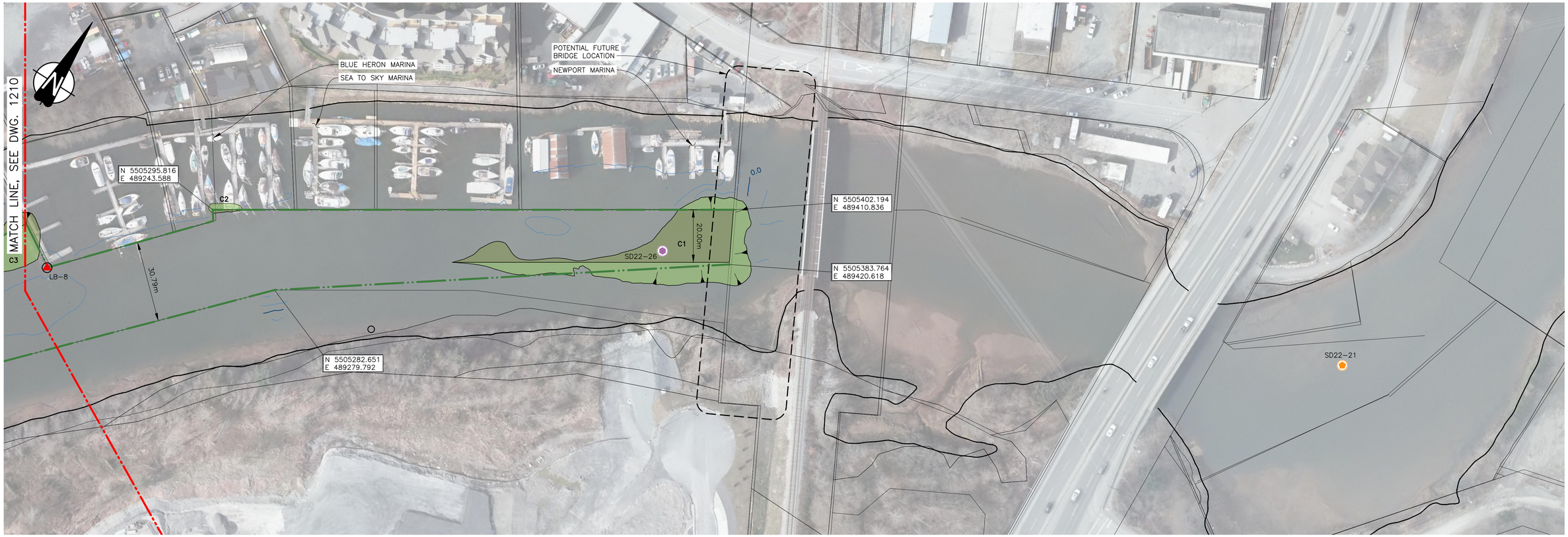
PROJECT: MAMQUAM BLIND CHANNEL DREDGE STRATEGY

WESTMAR ADVISORS

TITLE: MAMQUAM BLIND CHANNEL DREDGING PLAN – OPTION C SHEET 2 OF 3

DRAWING SCALE	PROJECT NUMBER	DRAWING NUMBER	REV.
SHOWN	1210165	SK–1210	A

Filename: C:\Users\dpalo\OneDrive\DanielPalo\Westmar–Daniel Palo\1210165–Squamish Dredge\1210165–SK–1209–1211.dwg
Last Saved: Jun. 15/23 11:10am Plotted: Jun. 15/23



PLAN
1:750

OPTION C – ESTIMATED VOLUME				
AREA NO. (A)	DREDGE AREA	DREDGE VOLUME	OVERDREDGE ALLOWANCE (300mm)	TOTAL VOLUME
C1	1614m²	1659m³	484m³	2143m³
C2	38m²	7m³	11m³	18m³
C3	546m²	293m³	164m³	457m³
C4	57m²	9m³	17m³	26m³
C5	806m²	276m³	242m³	518m³
C6	779m²	156m³	234m³	389m³
C7	6m²	1m³	2m³	3m³
C8	36533m²	40062m³	10960m³	51022m³
TOTALS:	**40379m²**	**42463m³**	**12114m³**	**54576m³**

LEGEND:

- OPTION C – DREDGE WITHIN NAVIGATION CHANNEL – SEE NOTES
- OPTION C – NAVIGATION CHANNEL SIDE SLOPES – SEE NOTES
- 2013 DREDGE AREA (2537m²)
- MAMQUAM BLIND CHANNEL (TYPLAN PROPOSED)
- 5m INTERVALS
- 1m INTERVALS
- LB-# TYPLAN PROPOSED LATERIAL BUOY LOCATIONS TO DELINEATE INNER HARBOUR CHANNEL
- OR TIMBER PILES
- CANADIAN COAST GUARD RANGE MARKER
- S# 1992 SEDIMENT SAMPLE LOCATION (PUBLIC WORKS)
- S# 2008 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# 2010 SEDIMENT SAMPLE LOCATION (GOLDER)
- S# 2011 SEDIMENT SAMPLE LOCATION (HEMMERA)
- S# 2021 SEDIMENT SAMPLE LOCATION (ENVIROCHEM)
- S# 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR STANDARDS
- S# 2016/2020/2022 SEDIMENT SAMPLE LOCATION (KEYSTONE ENVIRONMENTAL) PCOC CONCENTRATION IN SEDIMENT LESS THAN CSR FRESHWATER SEDs STANDARDS

m 0 10 20 30 40 50 100 m
1:1500

NOTES:

1. DREDGE PLAN AND VOLUMES BASED ON DREDGING AS FOLLOWS:

   OPTION C – DREDGE DEPTH TO –2.6m CD DOWNSTREAM OF THE PEDESTRIAN BRIDGE, AND –1.6m CD UPSTREAM OF THE PEDESTRIAN BRIDGE. SOME AREAS MAY OVERLAP OPTION B.

   DREDGE DEPTH TO BE CONFIRMED.

2. DREDGE PLAN AND VOLUMES BASED ON 1V:3H SIDE SLOPE FOR DREDGING IN THE NORTHERN SECTION OF THE CHANNEL AND 1V:4H FOR DREDGING IN THE SOUTHERN SECTION OF THE CHANNEL. DESIGN SIDE SLOPE TO BE CONFIRMED.

3. NAVIGATION CHANNEL LAYOUT IS BASED ON TYPLAN/CMO SUBMISSION FOR BOSA PROPERTIES TO SUPPORT THEIR APPLICATION TO TRANSPORT CANADA FOR THE WATERFRONT LANDING MARINA DESIGN (DATED JULY 26, 2018).

Filename: C:\Users\dpalo\OneDrive\DanielPalo\Westmar-Daniel Palo\1210165-Squamish Dredge\1210165-SK-1209-1211.dwg
Last Saved: Jun. 15/23 11:10am Plotted: Jun. 15/23

REVISION IN PROGRESS

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D
A	JUNXX/23	ISSUED FOR ...	DP	RM	–	–	–

ISSUE / REVISIONS

No.	DATE	DESCRIPTION	DRAWN	CHK'D	DESIGN	CHK'D	APP'D

ISSUE / REVISIONS

PRELIMINARY
DO NOT USE FOR CONSTRUCTION
Last Saved: Jun. 15/23 11:10am

PERMITS AND STAMPS

CLIENT
SQUAMISH
HARDWIRED for ADVENTURE

PROJECT
MAMQUAM BLIND CHANNEL
DREDGE STRATEGY

WESTMAR ADVISORS

TITLE
MAMQUAM BLIND CHANNEL
DREDGING PLAN – OPTION C
SHEET 3 OF 3

DRAWING SCALE	PROJECT NUMBER	DRAWING NUMBER	REV.
SHOWN	1210165	SK-1211	A