Director	CAO

COUNCIL AGENDA

Date: December 15, 2025 Item: 3.

DISTRICT OF WEST VANCOUVER
750 17TH STREET, WEST VANCOUVER BC V7V 3T3

COUNCIL REPORT

Date:	November 26, 2025
From:	Heather Keith, Senior Manager, Climate Action & Environment
Subject:	Coastal Adaptation Planning for Public Areas, Infrastructure, and Assets
File:	0332-04

RECOMMENDATION

THAT the Coastal Adaptation Planning Report, attached as Appendix A, to this report titled Coastal Adaptation Planning for Public Areas, Infrastructures, and Assets, dated November 26, 2025, be received for information.

RECOMMENDATION

THAT staff be directed to complete engagement with other levels of government, key stakeholders and partners, and the community to develop a prioritized phased implementation plan with funding options and report back to Council.

1.0 Purpose

To provide strategies to adapt the District's public waterfront areas to coastal flooding and sea level rise and receive direction to engage with the community and stakeholders in order to develop a prioritized phased implementation plan for Council consideration.

2.0 Legislation/Bylaw/Policy

Legislation

Section 488(1)(a)(b) of the *Local Government Act* enables the District to identify locations that need special consideration under certain objectives, including the protection from hazardous conditions and the protection of the natural environment.

BC Head Lease No. 242266 is an agreement between the Province and the District to provide the District with the authority to: (a) maintain and improve the shoreline within the Land (i.e., foreshore); (b) grant and administer subtenures; (c) control private improvements (i.e., structures) on the Land (i.e., foreshore); and (d) use and improve the Land for community purposes within the foreshore area adjacent to the District's boundaries.

Bylaw

Parks Regulation Bylaw No. 4867, 2015 is a bylaw to regulate the use of parks. The definition of a park includes "the land held under any lease

granted to the Municipality by Her Majesty the Queen, the foreshore, and land covered by water".

Zoning Bylaw No. 4662, 2010 is a bylaw to regulate permissions, restrictions, and conditions of land use in the municipality. The use of the public foreshore area adjacent to private property is regulated by the Zoning Bylaw.

Policy

The Coastal Marine Management Plan is a policy framework informed by past and recent initiatives to guide District Council and staff in the management of coastal areas and assets.

The Flood Hazard Area Land Use Management Guidelines (Province of BC, 2004, updated 2017), provides guidelines intended to help local governments, land-use managers, and approving officers develop and implement land-use management plans for flood hazard areas.

3.0 Council Strategic Objective(s)/Official Community Plan

Council Strategic Objective

Objective 1.3 under 'Environment and Climate Change' in Council's 2024-2025 Strategic Plan is to "Take steps to protect our foreshore and flooding", with the following relevant deliverables:

- Deliverable 1.3.2 - Implement Coastal Marine Management Plan recommendations.
- Deliverable 1.3.3 - Continue to adapt waterfront projects for sea level rise and coastal flooding.

Official Community Plan

The Official Community Plan provides high-level policies regarding the protection, restoration, and enhancement of natural assets and the incorporation of adaptation measures to create a resilient community. In relation to providing direction to enable the community to adapt to, and manage the risk of coastal flooding and sea level rise, the following policy applies:

- Policy 2.6.11 - Update shoreline protection strategies and flood construction level requirements to further increase protection from sea level rise, reduce shoreline erosion, preserve and enhance habitat and improve public access.

4.0 Financial Implications

This report provides recommended strategies to guide Council and staff to adapt the public waterfront areas to minimize impacts from coastal flooding and sea level rise. The recommendations outlined in the report have significant construction costs, which will require the need to prioritize strategies and implement through a phased approach over time and as funding allows. There are several funding strategies that the District can

draw on to support the cost of implementing the proposed options, including the potential use of the District's Environmental Levy, grant programs available from the federal and provincial governments and non-profit organizations, and potential partnerships with other stakeholders. If the adaptation strategies in this report are supported by Council, staff would work with the community, external stakeholders, and partners to develop a phased implementation plan with associated financing options.

5.0 Background

5.1 Previous Decisions

Council, at its February 14, 2022 meeting, passed the following resolutions:

THAT:

1. *the Coastal Marine Management Plan Final Draft Report, attached as Appendix A to the report dated January 17, 2022 from the Parks Environmental & Ecosystems Manager and the Parks Stewardship Manager, be approved.*
2. *the Coastal Marine Management Plan Final Draft Report be incorporated into District of West Vancouver work plans and into the budget process for 2022 and subsequent years.*

Council, at its September 19, 2022 meeting, passed the following resolutions:

THAT Staff be directed to utilize $100,000 from the Environmental Reserve Fund for the implementation of short-term actions in the Coastal Marine Management Plan to address impacts from sea level rise and coastal flooding.

5.2 History

Globally, sea levels rose by ~0.2 m over the 20th century (1901–2018) and are projected to continue to rise at an accelerating rate. Provincial guidance to local governments recommends planning for a one-metre sea level rise by the year 2100. In addition, climate models predict increased storm frequency and intensity in coastal regions, which pose a direct threat to low-lying areas of West Vancouver, especially during high tide events. The District has already observed more frequent coastal flooding causing damage to assets and infrastructure, temporary closures of waterfront areas, and beach erosion. Given that existing infrastructure and assets were not designed to accommodate future sea levels and storm conditions, the damage that continues to occur will be at a significant cost to the District and community and impact the sustained use and condition of public areas, infrastructure, assets, and the natural environment of the foreshore area.

In recent years, the District has begun to prioritize coastal hazard resiliency through the following initiatives:

1. North Shore Sea Level Rise (NSSLR) Strategy

   The North Shore Sea Level Rise Strategy (2021) was a collaborative initiative to develop an increased understanding of sea level rise risk and vulnerability to establish a set of coordinated action areas to build resiliency across the North Shore. The District was one partner in developing the strategy along with the District of North Vancouver, City of North Vancouver, Squamish Nation, Vancouver Fraser Port Authority, and North Shore Emergency Management. The NSSLR Strategy includes sea level rise flood mapping, a consequence and risk assessment to define priorities and key resources and guidance for adaptation planning for each municipality. It also sets a framework for North Shore partners to continue working together on coastal adaptation through a coordinated approach across jurisdictional boundaries.

2. Flood Mapping Analysis and Foreshore Development Permit Area

   Accounting for the updated guidance from the Province on land use management with respect to projected sea level rise, the District completed a flood mapping analysis to determine areas at risk of coastal flooding. In 2022, Council adopted a Foreshore Development Permit Area (DPA), delineated through the flood mapping analysis, requiring new homes to be built at an elevation to minimize risk to people and property from coastal hazards, while also preserving and enhancing the foreshore environment.

3. Coastal Marine Management Plan (CMMP)

   The Coastal Marine Management Plan, approved by Council in 2022, is a framework to guide the management of coastal areas and assets in West Vancouver. The CMMP addresses three policy areas: (a) preserving ecosystems and managing coastal dynamics such as sea level rise and erosion; (b) protecting built infrastructure, parks, and natural assets in coastal areas; and (c) managing development at the public-private interface. Short-, medium-, and long-term actions were recommended under each of these policy areas.

While the Foreshore DPA was a policy developed to protect private properties from sea level rise impacts, this project focused on the protection of public areas, infrastructure, and assets and responds to short-term actions outlined in the CMMP. The following section provides an overview of recommended adaptation strategies and associated costs to reduce the impacts of sea level rise and coastal flooding. The detailed analysis is provided in **Appendix A**.

6.0 Analysis

6.1 Discussion

Background and Planning Objectives

This project evaluated public spaces and infrastructure susceptible to sea level rise and coastal flooding and provided adaptation strategies to ensure their continued use accounting for sea level rise projected to the year 2100. Suitable adaptation measures for waterfront parks, amenities, and built infrastructure, and shoreline habitat enhancement were considered to address the following objectives:

1. Short-term strategies to reduce damage and impacts from coastal flood events that are increasing in frequency, duration, and severity.
2. Long-term strategies to alleviate permanent inundation of the waterfront areas due to sea level rise.

A review of existing background information (NSSLR Strategy, Flood Mapping Analysis, CMMP, Shoreline Protection Plan, previous coastal projects, ortho-imagery, bathymetric data, Ambleside Waterfront Concept Plans, climate data, asset and infrastructure inventory) was first completed to gain a better understanding of work previously completed and progress made to date.

The project area included approximately 3.5 km of shoreline from the Dundarave Pier to the Capilano River. The project area was selected due to its low-lying geography and vulnerability to impacts of coastal flooding as identified in the risk assessment completed for the NSSLR Strategy. Within the project area, three distinct segments with unique shoreline characterises were identified: (i) Centennial seawalk, (ii) Ambleside and John Lawson parks, and (iii) beaches. Adaptation options recommended for each segment were tailored depending on the characteristics of the shoreline, wave exposure, existing assets, and public use. In alignment with the objectives of the CMMP, the evaluation of coastal adaptation strategies used the following guidance:

1. Determine potential options to protect public realm/amenity areas and built infrastructure from coastal flooding and sea level rise to alleviate permanent inundation of low-lying public areas and damage during storm surge and flooding events.
2. Explore various scenarios of adaptation measures to inform future discussions on risk tolerance.
3. Preserve/enhance existing intertidal habitat and beach buffer zones.
4. Establish that all necessary information has been collected to ensure that shoreline protection projects/initiatives have limited impacts on upland properties and coastal habitats.
5. Align the Ambleside Waterfront Plan with recommended coastal adaptation options.

Coastal Adaptation Strategies

Through an evaluation of possible adaptation strategies, two options were determined to be the most effective in minimizing the impacts of costal flood events and sea level rise while providing benefits to the waterfront area:

1. Beach Nourishment for areas with low to moderate wave energy:
    - Wave energy dissipation and buffer formation - A wider, gently sloped beach acts as a buffer to waves breaking on the beach.
    - Addresses sediment deficit - Adding sediment replenishes what has been lost over time due to scour and erosion against existing hard armouring (e.g., seawalls).
    - Flexibility and long-term adaptation - Adding beach materials to develop a new beach slope allows flexibility to adjust as sea levels change over time and allows a natural and seasonable adjustment of beach slopes and habitat use.
    - Recreational, economic, and ecological co-benefits.
    - Complementary to other measures - Beach nourishment often works well with other shoreline stabilization measures.
2. Breakwaters for areas with high wave energy:
    - Direct wave energy reduction - Breakwaters intercept and break up incoming waves, reducing their energy before they hit the beach or shore, to minimize erosion and storm damage.
    - Sediment trapping or accretion - Behind breakwaters (on their shore side), calmer waters allow sand and sediments to settle rather than being carried away. This can lead to beach widening or formation of pocket beaches.
    - Protection of infrastructure - By reducing wave heights and forces, breakwaters can protect roads, buildings, seawalls etc., from storms and flooding.
    - Ecological benefits - If designed with a goal of creating habitat, breakwaters can provide refuges for aquatic life (e.g., fish, shellfish), stabilized environments for invertebrates, and calm water areas to support the restoration of seagrass beds.
    - Long lifespan and durability - Properly built hard structures like breakwaters can last for many years, with relatively low maintenance after initial construction.
    - Synergy with other adaptation options - Breakwaters often work well with beach nourishment to supply the sand which sediment can accumulate behind them.

Table 1 includes adaptation strategies for each project segment, tailored to the specific characteristics and needs of that segment. Each segment includes a combination of beach nourishment and/or breakwaters as well as raising pathways to create a nearshore berm to protect adjacent areas from flooding.

Project Segment	Location	Current Issues	Adaptation Strategies
Centennial Seawalk	Dundarave Pier to 18th Street	• Damage and high cost of repairs needed along seawalk after intense storm events • Closure of seawalk • Risk of flooding onto adjacent private properties	• Elevated multi-use seawalk (2.5 m higher) • Rock armouring for wave protection • Series of offshore breakwater/habitat islands (visible at low tide) • Beach nourishment at pocket beaches • Elevated Dundarave Pier
John Lawson and Ambleside Parks	18th Street to 14th Street	• Damage and repairs needed for piers after intense storm events • Flooding in parks • Storm outfalls clogged with debris • Pathway and park structures at risk	• Beach nourishment to raise crest elevation • Raised setback berm pathway (2 m higher) • Rock channels for storm outlets (creek daylighting) • Removal of John Lawson Pier • Elevated Ambleside Pier
Ambleside Beaches	14th Street to Capilano River	• Pathway and adjacent buildings /structures are below the anticipated future water levels • Flooding in parking and road areas	• Beach nourishment to raise crest elevation • Raised setback berm pathway (2 m higher) • Relocated parking and road • Vegetated slope

Table 1 Summary of adaptation strategies for each project segment.

Financial Implications

Table 2 provides a summary of the estimated construction costs for the proposed adaptation strategies for each project segment. The cost estimates include all construction activities, materials, and restoration of each area (i.e., landscaping, signage, fixtures, etc.). These are high level cost estimates based on the cost of materials and costs of comparable projects and should be used as guidance of anticipated funding requirements. If the recommended adaptation strategies are supported,

detailed designs for each strategy would be developed to further refine each construction project and actual costs. The projects do not need to be completed in any order and can be flexible depending on budget availability. It should be noted; however, that the offshore breakwater and improvements to the park areas will help to address coastal flood impacts that are already being observed and require costly repairs or temporary shutdowns on an ongoing basis.

Project Segment	Project Description	Probable Costs[1]
Centennial Seawalk	Offshore Breakwater (12 reef systems)	$13,662,000
	Elevated Seawalk	$21,005,000
John Lawson and Ambleside Parks	Beach Segment (18th Street to 14th Street)	$5,536,250
	Pier Replacement	$4,047,500
Ambleside Beaches	Beach Segment (14th Street to Ambleside Pond)	$7,163,750
	Realigned Trail (Ambleside Pond to Railway Crossing)	$4,326,000
	Total	$55,740,500
	40% Contingency Costs[2]	$22,296,200

Table 2 Summary of probable construction costs for each of the proposed adaptation strategies.
[1] A breakdown of the probable costs and what was included in each estimate is provided in Appendix A.
[2] Contingency costs cover unexpected expenses or risks that may arise during a project and account for any uncertainties such as timing, design changes, material cost increases, unexpected delays, and ensuring the project can continue without major disruption.
Note: these costs do not include detailed engineering design, permitting, public engagement, legal fees or land negotiations for construction access or improvements, where applicable.

Next Steps

To continue to the implementation (construction) stage of these adaptation strategies, the following steps will be required:

- Community, First Nations, and stakeholder engagement – Prior to project implementation, engagement will be necessary to prioritize project segments, collaborate with other levels of government and First Nations, and ensure that the community supports and understands the benefits of coastal adaptation.
- Integrate adaptation strategies with other District plans (e.g., Ambleside Waterfront Plan, Parks Master Plan) to ensure the strategies are incorporated into ongoing planning and decision making.

- Determine implementation schedule and funding options – Develop a phased implementation timeline based on priority areas and needs and determine associated funding options through grant opportunities from external sources, partnerships, and the District's Environmental Reserve Fund.
- Complete detailed designs – Complete the engineering design drawings for each project segment, including hydraulic modeling to finalize reef dimensions, geotechnical design for the berm (ensuring stability and settlement control), and landscape architecture to shape the berm.
- Permitting – provincial and federal permits (environmental, archaeological, etc.) for construction activities.

6.2 Sustainability

Protection of the natural and built environment is a responsibility shared by federal, provincial, and local governments. Proactive coastal adaptation planning seeks to understand and protect valued infrastructure and assets as well as ecological services. Improving resiliency to climate change, especially along the District's vulnerable coast, can help reduce the costly repairs, temporary closures of high-risk areas, and ensure continued and sustainable access to public spaces and use of infrastructure.

6.3 Public Engagement and Outreach

If the recommended adaptation strategies are supported, staff will develop an engagement and outreach plan to discuss the proposed adaptation strategies with the community, senior levels of government, relevant stakeholder groups, and local First Nations to determine priorities, funding sources, and feasibility of the projects. Engagement and education with all of these groups will form a critical part in securing the long-term success of coastal adaptation planning.

6.4 Other Communication, Consultation, and Research

The consultant that completed the project, ISL Engineering and Land Services Ltd. (ISL), consulted with District staff from various departments, including Parks, Facilities, Engineering, and Planning, Development and Environment Services. Staff worked with the consultant on an ongoing basis throughout the development of the recommended adaptation strategies.

7.0 Options

7.1 Recommended Option

THAT:

1. the Coastal Adaptation Planning Report be received for information.
2. staff be directed to complete engagement with senior levels of government, key stakeholders and partners, and the community to

develop a prioritized phased implementation plan with funding options and report back to Council.

7.2 Considered Options

Council may:

1. request further information (to be specified); and/or
2. not approve the recommendations.

8.0 Conclusion

The Coastal Adaptation Planning project provides a set of adaptation strategies that can be implemented in phases to protect and safeguard public areas, infrastructure, and assets along the waterfront from sea level rise and coastal flooding. The next steps in the implementation of these adaptation strategies, including engagement, detailed design, seeking funding, and construction, will continue to support the District's goal of adapting the community to become more resilient in a changing climate.

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Appendices:

Appendix A - Coastal Adaptation Planning Report, ISL Engineering and Land Services Ltd., June 2025.

District of West Vancouver

Coastal Adaptation Planning

FINAL REPORT

September 2025

ISL Engineering and Land Services Ltd. is an award-winning full-service consulting firm dedicated to working with all levels of government and the private sector to deliver planning and design solutions for transportation, water, and land projects.

At ISL, your identity is part of our identity. Diversity, Equity, and Inclusion (DEI) speaks to our core values and provides space for our teams to bring their authentic selves to work. ISL believes DEI creates the best outcomes for our clients while sustaining a happy and thriving work environment that allows for career development opportunities for all staff. ISL is committed to a focused effort on continuous improvement and development of a respectful and safe workplace.

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1.0 INTRODUCTION

This report evaluates public spaces and infrastructure susceptible to sea level rise and coastal flooding, offering adaptation strategies to ensure their continued use in line with various sea level rise scenarios projected by the Province of British Columbia. The scope of this evaluation is approximately 3.5km of shoreline from Dundarave Pier to Capilano River. It outlines suitable adaptation measures for waterfront parks, amenities, and built infrastructure, including shoreline protection initiatives that the District could implement, while ensuring that these measures do not harm sensitive foreshore habitats.

Developing a coastal adaptation plan for Ambleside Park in West Vancouver is essential to address the challenges posed by climate change, particularly sea-level rise and increased storm frequencies.

Figure 1.1: Project Overview Map

2.0 PROJECT GOALS AND OBJECTIVES

In 2022, the District adopted the Coastal Marine Management Plan (CMMP), which is a policy framework informed by past and recent initiatives to guide District Council and staff in the management of coastal areas and assets. The following three key policy areas of the CMMP include:

1. Coastal Dynamics and Ecosystems;
2. Built Infrastructure and Parks; and
3. Public-Private Interface.

This project includes the implementation of short-term actions outlined in the CMMP as they relate to coastal protection for parks, amenities, and built infrastructure. The primary goals of this project are aligned with the goals of the District's (CMMP). To accomplish these goals, this report provides solutions to five key project objectives:

1. Determine potential options to protect public realm/amenity areas and built infrastructure from coastal flooding and sea level rise to alleviate permanent inundation of low-lying public areas and damage during storm surge and flooding events.
2. Explore various scenarios of adaptation measures to inform future discussions on risk tolerance.
3. Preserve/enhance existing intertidal habitat and beach buffer zones.
4. Establish that all necessary information has been collected to ensure that shoreline protection projects/initiatives have limited impacts on upland properties and coastal habitats.
5. Align the Ambleside Waterfront Plan with recommended coastal adaptation options.

Ambleside Waterfront

3.0 RELEVANT BACKGROUND INFORMATION

The review of background information provided by the District included the following;

Table 3.1: Background Data

Reports Reviewed	Key Message
North Shore Sea Level Rise -Risk Assessment and Adaptative Management Strategy KWL - 2021	Dike corridor @ Bellevue Avenue (raise road, dike or floodwall) Creek bank dikes Floodproofing sanitary pump stations Storm pump stations for outfalls
Coastal Adaptation Study – Sea Level Rise WSP - 2020	Established FCL (2100 and 2200) 2 options • Berm at beach with fully raised park area behind • Setback berm between Argyle and beach
Coastal Marine Management Plan - 2022	Policy framework to guide the management of coastal areas and assets
Shoreline Protection Plan, Compensatory Habitat Monitoring – Hatfield 2020	• Rock boulders at low intertidal/sub tidal areas have greatly increased habitat value • Poor performance at Marr Creek outlet diversion at seawall and John Lawson Pier drift sill – shifting boulders and rock accumulation back to preconstruction conditions • Wave energy and dynamics along with existing currents make “soft” shoreline protection challenging
Completed Projects - 2008, 2012 to 2015	• Shoreline protection features are generally **physically stable,** successful at raising beach profile/elevations and provide **enhanced habitat value** • Improvements at storm outfalls are working but protection armouring will need to be raised
Shoreline Protection Projects – 2012 to 2015	• Short to mid-term improvements (0-20 years) are expected • Re-scoping required for long term benefits • Elevation of Piers are too low (replacement needed) • Proposed riparian enhancement work to consider sea-level rise • Constructed tombolos provide best overall protection but limited in scope and will require raising to provide long term effects
Files collected	Dates
Ortho imagery	2000 to 2020
Lidar	2018 is most current
Ambleside Waterfront Park PWL - 2020	90% design Dec 23, 2020, CAD and PDF
Bathymetric survey	2010 is most current
Record drawings	Storm outfalls on 15th Street, 16th Street and 24th Street

3.1 Review Summary

A summary of assessments related to information reviewed include the following;

- **Climate Change and Sea-Level Rise:** Globally, sea levels rose ~0.2 m over the 20th century (1901–2018) and are projected to continue rising at an accelerating rate. Provincial guidance for British Columbia calls for planning for about **1 metre of sea-level rise by year 2100**. This poses a direct threat to low-lying public areas in West Vancouver, especially during high tides and storm surge events. The District has already observed more frequent coastal flooding and foreshore erosion during winter storms.
- **Storm Frequency and Intensity:** Climate models predict **increased storm frequency and intensity** in the region. Heavy rain events and windstorms can drive powerful waves onto the shoreline. A notable historical example was a *winter 2007 rainstorm*, when debris from McDonald and Lawson Creeks deposited **over 600 m³ of sediment on the beach**, illustrating the magnitude of natural forces at work. Storm surges, coupled with higher base sea levels, threaten to overtop existing seawalls and flood parkland.
- **Urbanized Shoreline and Legacy Infrastructure:** Over a century of development in West Vancouver has "hardened" much of the waterfront with **concrete seawalls and riprap revetments**. Creeks have been channelized and their sediment supply to beaches altered. While these structures historically protected property, they are aging and were not designed for future sea-level conditions. The **existing seawalk and seawalls** are at increasing risk of being overtopped or undermined during extreme events. Additionally, key infrastructure like **storm sewer outfalls** are experiencing blockage and damage from beach cobbles and driftwood mobilized by storms. For instance, an inspection in January 2023 found the 15th Street culverts 90% buried by gravel due to storm action. This reduces drainage capacity and elevates flood risk to upland areas.
- **Previous Coastal Projects:** The District has undertaken shoreline protection projects between 2008 and 2015 to address erosion hotspots. These included installing *"soft"* measures like intertidal rock boulders, pocket beaches, and large woody debris to dissipate wave energy and enhance habitat. **Early results were mixed** – while these interventions improved beach height and habitat in places, some features (e.g. the Marr Creek drift sill) suffered **shifting boulders and sediment loss back to pre-construction conditions** under strong wave action. These lessons indicate that purely soft approaches struggle under the high-energy environment of Ambleside – **wave dynamics and currents can challenge soft shoreline protection**. Conversely, those projects demonstrated benefits such as increased intertidal complexity and improved salmon habitat where they remained stable. These projects, however, are relatively small in scale and generally do not reduce impacts due to sea level rise.
- **Environmental and Community Values:** West Vancouver's shoreline hosts critical habitat (eelgrass beds, intertidal zones) and is highly valued by the community for recreation. **Protecting these values is a priority**. The District's 2022 Coastal Marine Management Plan emphasizes nature-based solutions and maintaining ecosystem function alongside flood protection. Moreover, the Ambleside Waterfront is a central community hub – including Ambleside Park, John Lawson Park, Millennium Park, and the popular seawalk – collectively drawing residents and visitors year-round. Background documents underscore that any adaptation must **balance engineering with ecology and public access**, avoiding simply building high concrete walls which could reflect wave energy (worsening erosion elsewhere) and diminish the natural beauty of the shoreline.
- **Existing Plans and Data:** Several foundational reports fed into this project. The *North Shore Sea Level Rise Risk Assessment (2021)* provided region-specific flood risk modeling. It identified potential measures like a continuous **dike or floodwall along Bellevue Avenue** to protect upland areas and raised concerns about existing infrastructure (e.g., a sanitary pump station) needing floodproofing. A *2020 Coastal Adaptation Study by WSP* established *Flood Construction Levels (FCLs)* – recommended minimum elevations for flood defenses (for years 2100 and 2200) – and suggested two conceptual approaches: **(1) a berm along the beach coupled with raising the parkland behind it, and (2) a setback berm along Argyle Avenue** (inland of the beach). These prior concepts and FCL benchmarks provided critical background for the design phase. Additionally, the District's **Ambleside Waterfront Concept Plan (2020)** – 90% designed by PWL Partnerships – envisions park improvements and was considered background; notably, it allowed periodic flooding in some areas at king tides but anticipated new shoreline protections to guard against storm damage.

4.0 SHORELINE STABILIZATION TECHNIQUES

Shoreline stabilization techniques range from hard measures such as structural walls and rock placement to soft measures such as bio-engineered vegetated slopes and beach nourishment. The table below indicates the main types of shoreline techniques that are considered for many shoreline protection projects.

Table 4.1: Types of Shoreline Stabilization Techniques

Green and gray techniques to stabilize and protect shorelines

	Technique	Permanence	Cost	Adaptability to RSLR*	Wave Energy Reduction	Benefits and Drawbacks
"Green" (Softer) Techniques	Vegetation Only	low	low	mod	low	**Benefits:** stabilizes and captures sediment, assists in additional plant colonization, improves habitat for marine and benthic species, aesthetics **Drawbacks:** low permanence unless coupled with structures, susceptible to RSLR
	Vegetated Crib Wall	mod	low	low	low	**Benefits:** anchors sediment, assists in plant colonization, small footprint, unobtrusive, aesthetics **Drawbacks:** requires periodic adjustment for maximum effect, may become a safety or debris concern once deteriorated
	Oyster Reef	mod	low	mod	mod	**Benefits:** provides natural estuarine habitat, recreation opportunities, and water filtration **Drawbacks:** may be limited in the amount of vertical relief attained
	Nearshore Berm	low	mod	mod	mod	**Benefits:** can create additional protected space for habitats, such as marsh grass, and estuarine species, berms can act sacrificially and add sediment to the nearshore system **Drawbacks:** low permanence unless coupled with structures, susceptible to RSLR, may become a safety or debris concern once deteriorated
	Beach Nourishment	low	high	high	high	**Benefits:** provides recreational opportunities, able to adapt to wave climate and recover from losses **Drawbacks:** causes disruption to beach microbiome, turtle nesting, and beach recreation during construction; cyclical sand losses are expected
	Horizontal Levee	high	high	mod	high	**Benefits:** provides transitional estuarine habitat area, adaptive to RSLR, reduces need for structure height and hardening when compared to a traditional levee **Drawbacks:** requires larger footprint than a traditional levee to construct, requires maintenance
	Nearshore Engineered Reef	mod	mod	low	mod	**Benefits:** provides interstitial estuarine habitat **Drawbacks:** requires periodic adjustment for maximum effect, may become a safety or debris concern once deteriorated
	Breakwater	high	high	mod	mod	**Benefits:** allows leeward sediment accretion, creates sheltered estuarine areas, can be coupled with natural features to create a living shoreline **Drawbacks:** downdrift & updrift erosion, may become a safety or debris concern once deteriorated
"Gray" (Harder) Techniques	Revetment**	high	high	mod	mod	**Benefits:** anchors shoreline location, prevents upland erosion **Drawbacks:** downdrift erosion, disallows shoreline migration, vulnerable to flanking and scouring, difficult to permit
	Bulkhead	mod	mod	low	mod	**Benefits:** anchors shoreline location, prevents upland erosion, small footprint **Drawbacks:** profile deflation; vulnerable to flanking, erosion, and overwash; disrupts aesthetics; cuts off upland habitat from water
	Groin**	high	high	low	low	**Benefits:** updrift accumulation **Drawbacks:** downdrift erosion, vulnerable to flanking
	Levee	high	high	low	high	**Benefits:** anchors shoreline location, flood and storm surge control **Drawbacks:** downdrift erosion, vulnerable to flanking and scouring, disruption to shoreline access during construction, requires maintenance, may require more armoring when compared with a horizontal levee
	Seawall**	high	mod	low	high	**Benefits:** anchors shoreline location, prevents upland erosion, small footprint **Drawbacks:** profile deflation, downdrift & updrift erosion, vulnerable to flanking, vulnerable to destabilization from overwash, disrupts aesthetics, cuts off upland habitat from water, requires maintenance

From the above table, two techniques (beach nourishment and breakwaters) stood out as good candidates to explore for protection and coastal adaptation of the project corridor. These two techniques are suited for the project study area for following reasons:

Beach Nourishment – for low to moderate wave energy

1. **Wave energy dissipation and buffer formation**
   A wider, gently sloped beach acts as a buffer to waves breaking on the beach. Waves lose energy as waves runup the beach slope
2. **Addresses sediment deficit**
   Adding sediment replenishes what has been lost
3. **Flexibility and long term adaptation**
   Adding beach materials to develop a new beach slope allows flexibility to adjust as sea levels change over time and allows a natural and seasonable adjustment of beach slopes and habitat use.
4. **Multiple co-benefits (social, economic, ecological)**
   - Tourism and recreation benefit: wide, attractive beaches help recreation, visitor appeal.
   - Ecological habitat: for example, nesting for turtles, habitat for beach organisms, possibly better dune systems.
   - Property protection: by maintaining beaches, one can protect coastal infrastructure, reduce flood risk, insurance costs, etc.
5. **Can complement other measures**
   Beach nourishment often works well with other shoreline stabilization measures

Breakwaters – for high wave energy

1. **Direct wave energy reduction**
   Breakwaters intercept and break up incoming waves, reducing their energy before they hit the beach or shore. This helps limit coastal erosion and storm damage.
2. **Sediment trapping or promoting accretion**
   Behind breakwaters (on their lee side), calmer waters allow sand and sediments to settle rather than being carried away. This can lead to beach widening or formation of “pocket beaches.
3. **Protection for infrastructure and inland zones**
   By reducing wave heights and forces, breakwaters can protect coastal roads, buildings, seawalls etc., reducing damage from storms and reducing flood risk.
4. **Ecological and amenity benefits (especially for “living” breakwaters)**
   If designed with habitat in mind, breakwaters can provide marine habitat, refuges for aquatic life (e.g. fish, shellfish), stabilized environments for oysters or corals, etc. Also, calm water zones can help restoration of marshes or seagrasses.
5. **Long lifespan and durability**
   Properly built hard structures like breakwaters can last for many years, with relatively low maintenance after initial construction. For many situations, they are robust.
6. **Synergy with other adaptation options**
   Breakwaters often work well with beach nourishment (to supply the sand which sediment can accumulate behind them). They can be part of a combined/coastal systems-based approach.

These concepts are illustrated in the figure below.

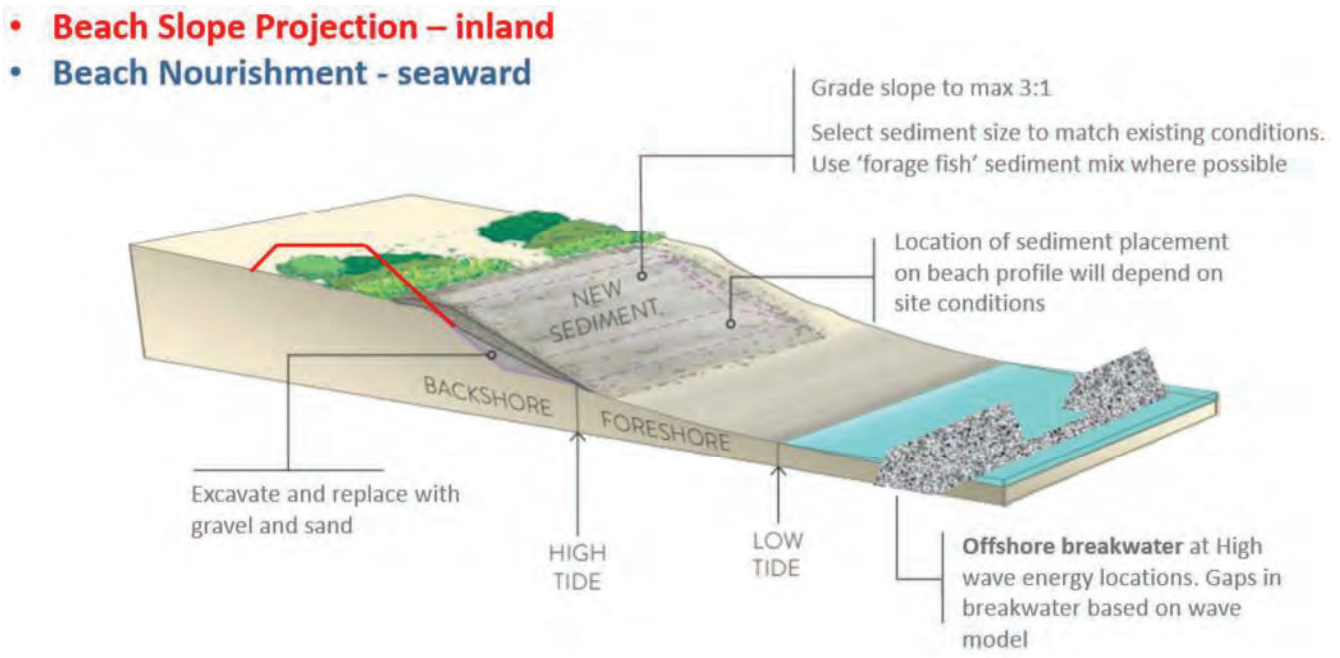


Figure 4.1 Illustration of Selected Shoreline Techniques

5.0 COASTAL DYNAMICS AND PROJECT SEGMENTS

5.1 Coastal Dynamics

Six cross sections of the existing shoreline and offshore seabed were generated to understand the coastal dynamics and wave runup. **Appendix A** shows the location of the six sections and **Appendix B** shows the elevations of the cross sections.

Through wave modelling, it was confirmed that the wave energy and wave height is strongest along the seawalk portions of the project corridor. The wave energy and wave height reduces as waves move east toward Capilano River.

The tidal regime in the study area is most suitable from the tide gauge from the Pt. Atkinson site operated by the Canadian Hydrographic Services (CHS station #7795). Table 5.1 provides the tidal statistics for Pt. Atkinson, which describe average and extreme tide conditions.

Table 5.1: Tidal Statistics

Tide Statistic	Description	Pt. Atkinson, Elevation (m, CGVD28)
Lower Low Water Large Tide (LLWLT)	The average of the lowest low waters, one from each of 19 years of predictions	-3.0
Lower Low Water Mean Tide (LLWMT	The average of all the lower low waters from 19 years of predictions	-1.9
Higher High Water Mean Tide (HHWMT)	The average from all the higher high waters from 19 years of predictions. Typically considered the average high tide	1.4
Higher High Water Large Tide (HHWLT	The average of the highest high waters, one from each of 19 years of predictions. Typically considered the extreme upper end of the tide cycle	1.9
		Range (m, not an elevation)
Extreme Tide Range	Difference in LLWLT and HHWLT	4.9
Average Tide Range	Difference in LLWMT and HHWMT	3.3

The West Vancouver shoreline is particularly vulnerable to longshore drift, which occurs because the waves approach the shore from the Strait of Georgia at an oblique angle. Waves typically move laterally along the beach from west to east, carrying fine sediments along the shoreline until they reach a structure that blocks their path causing them to settle or until there is no more shoreline and they drift to deeper waters.

5.2 Project Segments

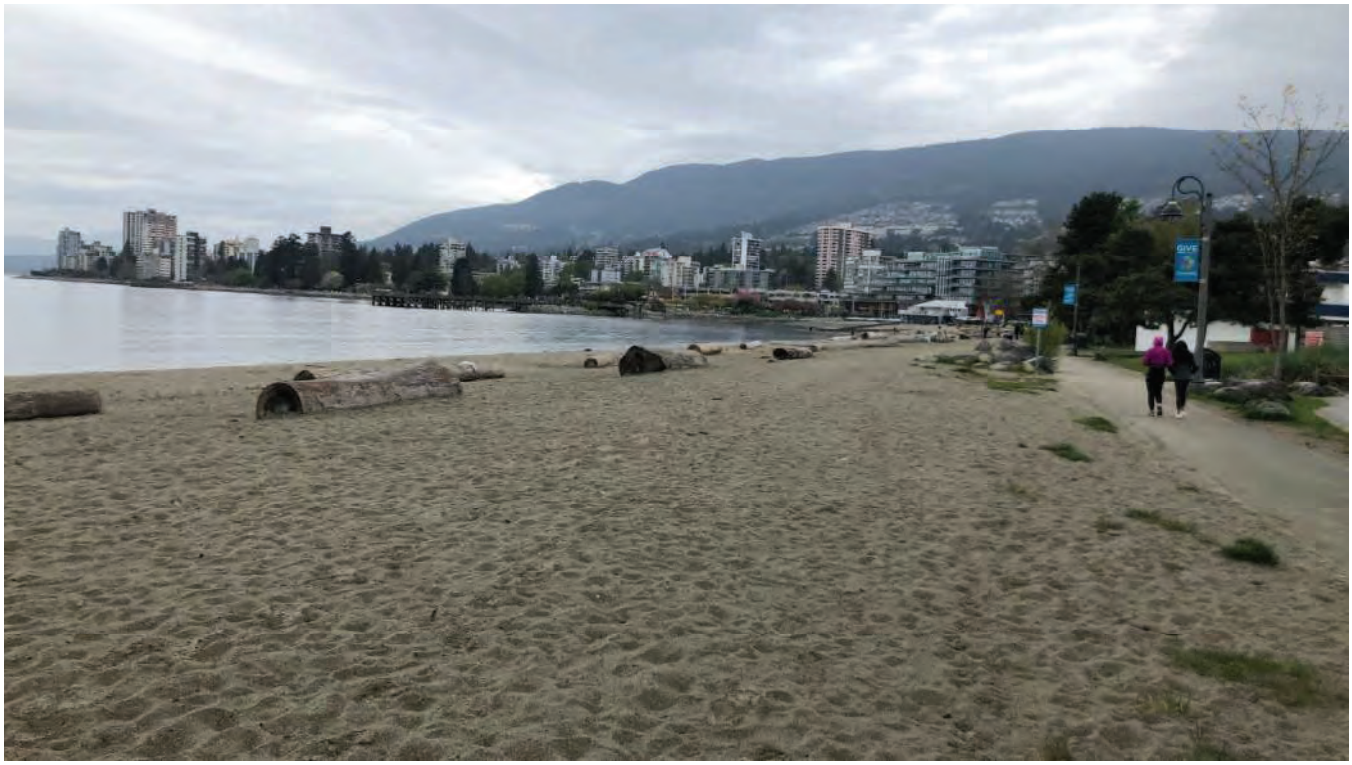
In developing the Coastal Adaptation Plan, the team recognized that there are **three distinct project segments** within the project study area. These project segments have very different shoreline characteristics and are generally shown below within the e project area.

Figure 5.1: Project Segments

Photo examples demonstrating the typical shoreline form in each of the project segments are provided below.

Project Segment - Seawalk

Project Segment - Parks



Project Segment - Beaches

Due to these distinct shoreline characteristics, each of the three project segments would require their own type of shoreline stabilization technique.

5.3 Design Elevations

Future shoreline improvements need to consider a number of design elements such as tide levels, sea level rise, storm surge and wave runup. These elements vary throughout the project corridor due to the varied shoreline cross sections and types. Recommended design elevations of the top of bank for shoreline improvements along the project corridor are shown below.

Figure 5.2: Recommended Design Elevations

(Elevations shown in red)

Source of background image: *WSP 2023 Coastal Planning Flood Construction Levels*

6.0 ADAPTATION PLAN

6.1 Overall Plan

The **Coastal Adaptation Plan** is illustrated in the figure below and recommends a phased implementation of the project segments described above, tailored to specific shoreline reaches. A full-scale drawing of this plan is available in **Appendix C**. A digital model of the full scale adaptation plan along the project corridor can be found here: Coastal Adaptation Planning

Figure 6.1: Coastal Adaptation Plan

The plan employs the use of the following key adaptation strategies;

Table 6.1: Current Issues and Proposed Adaptation Strategies

Project Segment	Location	Wave Energy	Current issues	Adaptation Strategies
Centennial Seawalk	Dundarave Pier to 18th Street	High	• Damage and high cost of repairs needed along Seawalk after intense storm events • Closure of Seawalk • Risk of flooding into private properties	• Elevated structural seawalk • Rock armouring • Offshore Breakwater / Habitat Islands • Beach nourishment at pocket beaches
John Lawson and Ambleside Parks	18th Street to 14th Street	Moderate	• Damage and repairs needed for Piers after intense storm events • Flooding in parks • Storm outfalls clogged with debris • Pathway and park structures at risk	• Beach nourishment • Raised earth berm • Rock channels for storm outlets • Removal of John Lawson Pier • Elevated new pier at Ambleside Peir
Ambleside Beaches	14th Street to Capilano River	Low	• Pathway and adjacent buildings/structures are below the anticipated future water levels • Flooding in parking and road areas	• Beach nourishment • Raised earth berm • Relocated parking and road • Vegetated earth slope

6.2 Design Cross Sections

Incorporating the proposed design elevations described in Section 5.3, four typical cross sections are proposed for the project. Each cross section considers the specific site conditions, seabed profile, adjacent land use and coastal dynamics such as wave energy and wave runup.

6.2.1 Centennial Seawalk

Coastal Resilience Strategy: Structural Seawalk and Hard Armouring

For the 1.7km portion of shoreline pathway that exists along the Centennial Seawalk between Dundarave Peir and 18th Street, the proposed cross section includes an elevated pathway generally in the same location as currently exists but approximately 2.5m higher that the current seawalk elevation. The proposed cross section includes retaining walls or sheetpile walls with new pathway at approximately 6.0m. Rip rap and intertidal habitat enhancements are proposed to armour and provide wave protection to the proposed seawalk. The cross section in Figure 6.2 shows the general arrangement of the proposed seawalk. This segment currently experiences very high use of daily pedestrian traffic.

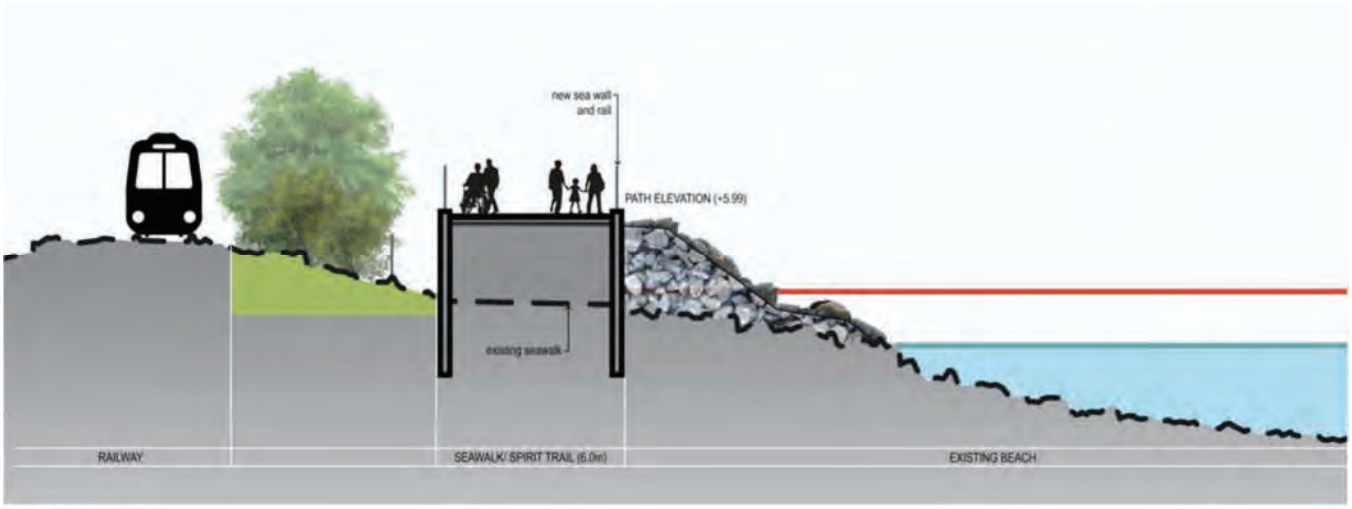


Figure 6.2: Proposed Cross Section –Structural seawalk with rock armour protection

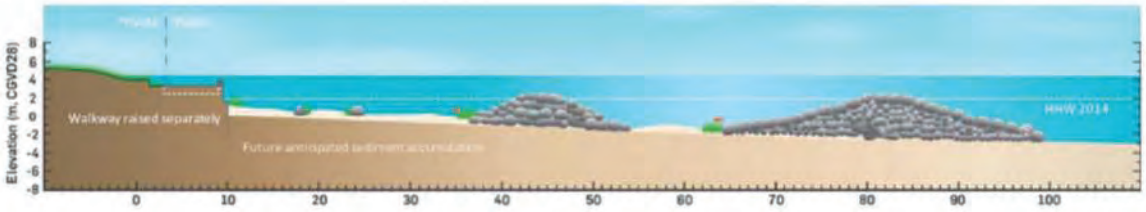
In addition to the elevated seawalk, **beach nourishment** is proposed to maintain the small pocket beaches along the seawalk as well as at the western end at Dundarave. Rehabilitation of the **Dundarave Pier** is also required as the deck sits too low considering anticipated sea level rise with more frequent and more intense storm events. Replacement or modification of the pier should include elevating its deck and approach to above future design flood levels. The recommendation is to integrate these changes into the upcoming pier capital project (the plan indicates the piers need replacement to meet long-term adaptation needs). By doing so, Dundarave's key structures become resilient. Meanwhile, modest nourishment and **expanded gravel berms at the foot of 25th Street** would reduce splash-over onto the walkway. The **historic character of Dundarave** is to be respected: materials for the raised seawalk should match or complement existing (wood or concrete with a similar look), and seating areas should be added to the top of the new seawall to maintain amenity value.

Coastal Resilience Strategy: Offshore Breakwater/Habitat Island (adjacent to Centennial Seawalk)

The plan advises constructing an **offshore breakwater** – likely a low-crested rock reef, roughly near 18th Street or near Dundarave Pier where prior shoreline projects indicated vulnerability. This reef would be designed to promote sediment deposition (potentially forming a natural tombolo that further widens the beach) and to serve as proof-of-concept for the effectiveness of offshore structures here. If the pilot reef proves successful in calming waves and collecting sand (monitored over a few storm seasons), the District could extend or add **additional breakwaters** spaced along the 1.7km section adjacent to the Centennial Seawalk.. The full build-out of the Coastal Adaptation Plan includes a chain of these reefs that would act as a semi-continuous offshore break, substantially shielding the shore. The reefs should be built with ecological features (surface complexity for habitat) and at a height that is submerged at high tide (to reduce visual impact, emerging only in low tide or during big wave breaking). The recommendation is to pursue environmental permits and partnerships (perhaps with DFO or

coastal research programs) for these reefs, as they align with habitat creation – e.g., kelp beds could be encouraged on them, boosting marine life.

An offshore breakwater was also recommended in a June 2014 report by SNC-Lavalin *"Greening Shorelines to Enhance Resilience: An Evaluation of Approaches for Adaptation to Sea Level Rise*" prepared for the Green Shores technical committee under the Stewardship Centre for BC. The figure below is sourced from this report and shows a general arrangement of an offshore breakwater adjacent to the Seawalk with a predicted water level at High High Water Level with 1.0m sea level rise and storm surge. This figure shows the existing Seawalk being underwater during this event and demonstrates the need to raise the existing Seawalk as proposed in this Coastal Adaptation Plan.



Source: Greening Shorelines to Enhance Resilience: An Evaluation of Approaches for Adaptation to Sea Level Rise

Figure 6.3: Offshore Breakwater

(1.0m sea level rise and storm surge – waves not shown)

6.2.2 Park Segments - John Lawson Park and Ambleside Park

Coastal Resilience Strategy: Beach Nourishment & Berm Construction

Between 18th Street and 14th Street, the proposed shoreline pathway includes a raised pathway, gravel beach nourishment to raise the elevation of the shoreline and rock berm channels at the existing storm sewer outlets. The cross section in Figure 6.3 and Figure 6.4 illustrates the general arrangement of the proposal shoreline pathway.

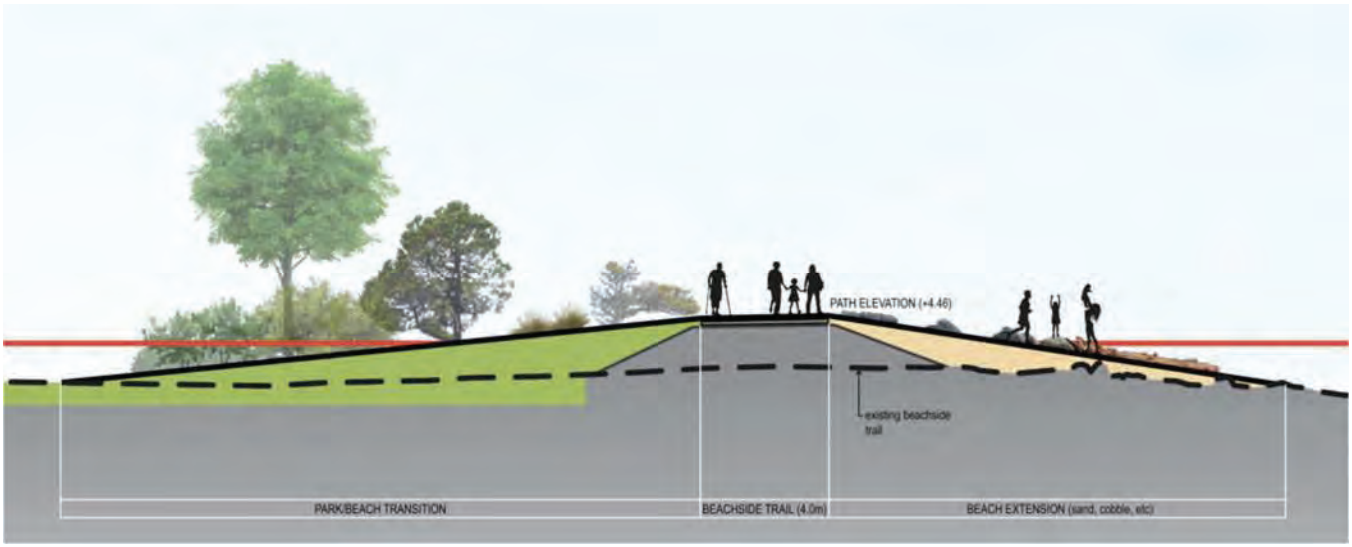


Figure 6.4: Proposed Cross Section – Ambleside Park

Ambleside, being the largest low-lying area, is most vulnerable to flooding. The plan recommends placing a substantial volume of **cobble/sand fill along Ambleside Beach** to raise the crest elevation of the beach by approximately 0.5–1.0 m. This will create a broader storm berm that can naturally dissipate wave energy. In tandem, a **setback earth berm** (~2.0 m tall) should be constructed along the inland edge of Ambleside Park (roughly following the grass line just seaward of the parking and playground areas). The berm would be landscaped (grass and salt-tolerant plantings) and could incorporate a **slightly elevated pedestrian promenade** on top, linking to the existing seawalk. These measures combined will provide a dual layer of defense: the beach berm reduces normal storm impacts, and the setback berm catches any extreme overtopping. It's recommended to integrate **access paths and viewing areas** into the berm design, This proposed work is anticipated to

address the area most frequently flooded in recent memory (portions of Ambleside saw seawater pooling during king tides), thereby **alleviating immediate risk to park infrastructure and user safety**.

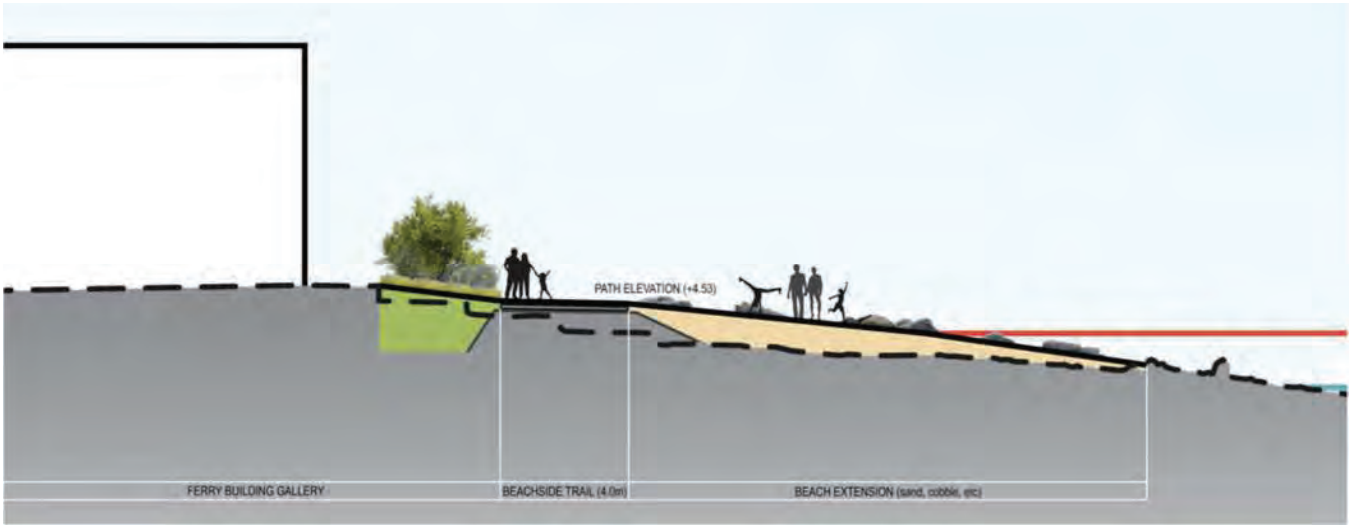


Figure 6.5: Proposed Cross Section – Ferry Building

Implementing the proposed work of the Coastal Adaptation Plan will require adjustments to the Ambleside Waterfront Concept Plan. These adjustments are primarily at the landside (north) interface with the proposed elevated berm and walking pathway. Grading transition back to existing ground will be required in the interim and over the long term, filling of area behind the berm and shoreline pathway is recommended to alleviate flooding.

Ambleside Peir Replacement and Removal of John Lawson Peir

The Coastal Adaptation Plan recommends the removal of the John Lawson Pier as a long term measure as the deck and railings of this peir are at an elevation lower than anticipated future storm events and sea level rise and the structure is vulnerable to storm damage.

Replacement of the Ambleside Peir is recommended however, due to the historic nature and use of this structure. The deck and railings of the Ambleside Pier will need to be raised to above future sea level and storm events. Keeping this pier is also part of the Ambleside Waterfront Plan.

6.2.3 Ambleside Beaches

The project segment within the Ambleside Beach areas is defined between 14th Street and Capilano River. This segment generally includes an expanded beach area with low sloped beach nourishment to raise the elevation of the existing beach a new pathway setback from the existing pathway location. A key component to this adaptation plan is the relocation of the parking area east of the skate park.

Between the storm pond at the terminus of Pound Creek and the railway line the proposed adaptation plan includes a vegetated sloped wall and to maintain the existing riprap along the mouth of the Capilano River.

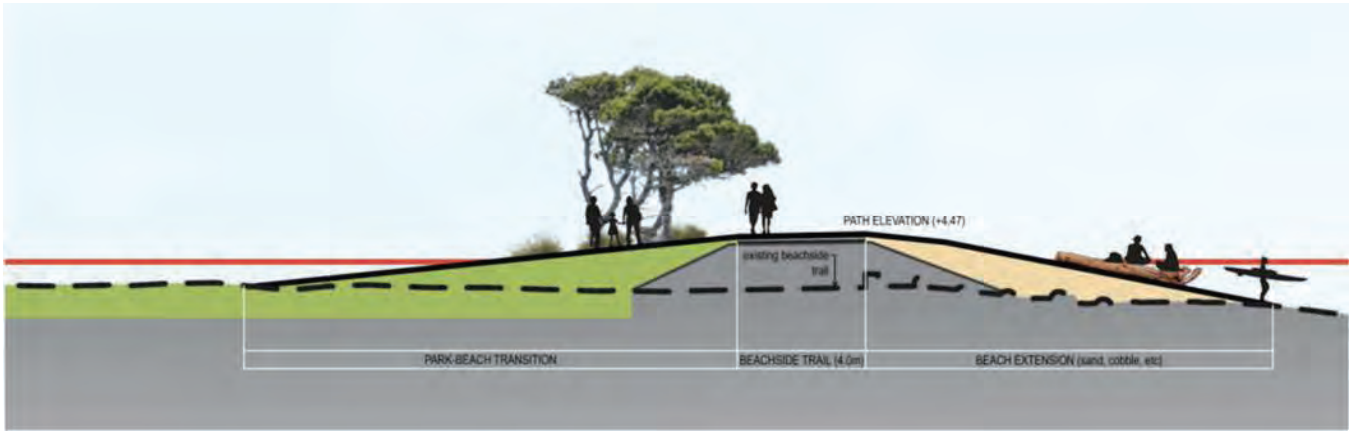


Figure 6.6: Proposed Cross Section – Ambleside Beaches

Monitoring and Adaptive Management Program

A key recommendation of the plan is establishing a **monitoring regime** to track shoreline changes, structure performance, and environmental health. This includes annual beach profile surveys (measuring beach width and height at set transects), inspections of the berms after major storms, and ecological monitoring of the new reefs (checking for kelp growth, invertebrate colonization, etc.). The plan emphasizes an adaptive approach – for instance, **if monitoring shows beach erosion beyond expected**, the District should promptly renourish that section to the design template. Or if a particular low spot on a berm consistently sees overtopping, it should be raised. This flexible management ensures the strategy remains effective under changing conditions.

The plan suggests forming a local stewardship group possibly involving community members (e.g., the Streamkeepers) to assist with observational monitoring (like photographing high tide events). Additionally, the District should do a **comprehensive plan review in ~10 years** (by 2035) to incorporate new climate data and adjust the plan actions for 2040–2050 accordingly.

6.3 Statement of Probable Costs

A summary of probable construction costs for the proposed adaptation plan according to each project segment is shown below. These costs do not include engineering, permit costs, public engagement, legal costs or any land negotiations for construction access or improvements. Detailed breakdown of items and quantities can be found in **Appendix E**.

Table 6.2: Summary of Probable Costs

Item	Project Segment	Description	Amount
1.0	Centennial Seawalk	Offshore Breakwater	$19,673,280
2.0	Centennial Seawalk	Seawalk	$29,407,000
3.0	John Lawson and Ambleside Parks	Park Segment (18th Street to 14th Street)	$7,750,750
4.0	John Lawson and Ambleside Parks	Ambleside Pier Replacement	$5,666,500
5.0	Ambleside Beaches	Beach Segment (14th Street to Pond)	$10,029,250
6.0	Ambleside Beaches	Realigned Trail (Pond to Railway Crossing)	$6,056,400
		TOTAL (including 40% Contingency)	**$78,583,180**

The order of which of the above items gets completed is flexible and they can be completed separately as budget becomes available and in alignment with District priorities. Item 3.0 and 4.0 may be prudent as the first of these projects to prioritize as this would address the flooding that is occurring in the John Lawson and Ambleside park areas. Implementing item 1.0 would however protect the Centennial Seawalk from further storm damage and expensive repairs that have temporarily shutdown the Seawalk in recent years. Item 1.0 is anticipated to have a longer design and permitting approval timeline.

6.4 Next Steps

To implement these recommendations, the plan outlines several next steps the District should undertake:

- **Secure Funding:** Leverage senior government programs (e.g., Federal Disaster Mitigation and Adaptation Fund, provincial climate adaptation grants, Disaster Resilience and Innovation Funding program) to fund the major works. The report's cost estimates and benefit analysis provide the basis for grant applications.
- **Detailed Design & Permitting:** Initiate engineering design for the first projects, especially **Ambleside's nourishment and berm**. This involves hydraulic modeling to finalize reef dimensions, geotechnical design for the berm (ensuring stability and settlement control), and landscape architecture to shape the berm attractively. Concurrently, apply for necessary permits: e.g., a Section 11 Permit under BC's Water Sustainability Act for in-stream (foreshore) work, and DFO review for fish habitat (though adding habitat should ease approval). Early engagement with **First Nations** is a next step as well – parts of the project near the Capilano River and foreshore will warrant consultation and possibly archeological monitoring, so reaching out proactively is recommended.
- **Community Engagement and Communication:** Before construction, the District should run a communication campaign to inform the public about what to expect. For example, an **open house or info session** in the community to show final designs of the Ambleside berm/promenade and reef locations, highlighting the benefits (illustrating how a wider beach will look, etc.). Garnering public support will smooth construction inconveniences and encourage community stewardship. The plan specifically suggests installing **educational signage** once projects are built – such as signs explaining the offshore reef's purpose or the native plants on the berm, tying into West Vancouver's broader public education on climate adaptation.

- **Integrate into Municipal Plans and Policies:** The adaptation plan's recommendations should be formally integrated into the District's capital plan and operations. This means updating any **Park Master Plans and Emergency Response Plans** to reflect the new flood defenses (and perhaps removal of certain emergency sandbag measures once permanent ones are in place). It also means adjusting **maintenance schedules** – e.g., Parks Ops will include berm mowing and inspection as a routine task; Utilities will add outfall headwalls to their asset management. Additionally, the District's land-use plans (OCP) and development requirements in the waterfront area might be updated: for instance, raising the minimum flood construction levels for any new building along Argyle Avenue to match the plan's design flood, or requiring any redevelopment to contribute to shoreline improvements. Essentially, the next step is to **embed this plan's measures into everyday municipal decision-making**, ensuring consistency and longevity.
- **Adaptive Review:** The plan sets a **phase-wise timeline**: immediate actions (1–3 years), medium (3–10 years), and long-term (10+ years). A critical long-term note is that around mid-century, a re-evaluation should be triggered: if sea-level rise accelerates beyond projections or if storms intensify, the District may need to consider **raising all defenses further (perhaps another 0.5 m by 2075)**. The plan's next steps include establishing those "triggers" (e.g., *"If the mean higher high water increases by X or if overtopping occurs more than Y times in a decade, then begin designing next increment of adaptation"*). By doing so, West Vancouver has a clear **adaptive pathway** – a sequence of actions now, with an eye on future adjustments.

In conclusion, the Coastal Adaptation Project delivers a set of actionable recommendations that the District of West Vancouver can implement in stages to **safeguard its coastline against climate change impacts**. By following the next steps – detailed design, funding, construction, and monitoring – the District will embark on a resilient transformation of its waterfront. This will help ensure that treasured places like Ambleside and Dundarave **remain vibrant, safe, and sustainable for generations to come**, even as the seas rise and storms batter the shores. The plan's successful execution will make West Vancouver a leader in living with the changing sea while protecting both community and nature.

A EXISTING SHORELINE MAP

LEGEND

MC - MARR CREEK INTERTIDAL REEF

NJP - NAVVY JACK POINT SHORELINE ENHANCEMENT

MaC - MACDONALD CREEK INTERTIDAL REEF EXTENSION

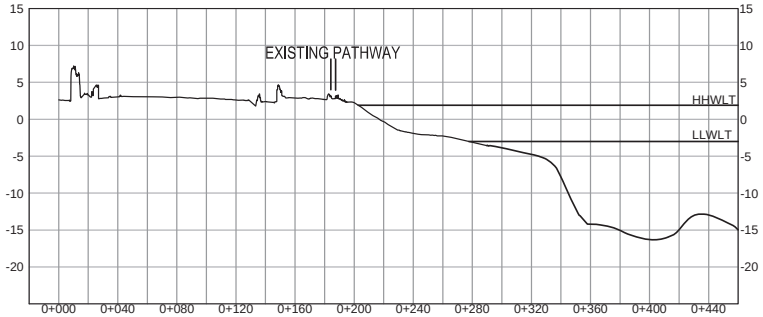
LC - LAWSON CREEK AT MACDONALD ENHANCEMENT

LP - LAWSON PARK RIPARIAN ENHANCEMENT

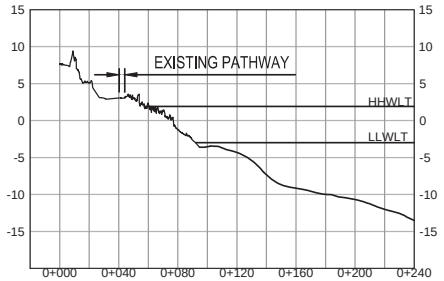
LPA - LAWSON PARK & AMBLESIDE SHORELINE ENHANCEMENT

EXISTING SHORELINE CROSS SECTIONS

B EXISTING SHORELINE PROFILE



SECTION 1



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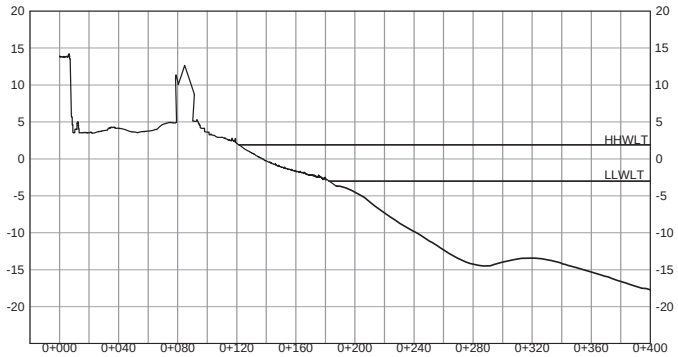

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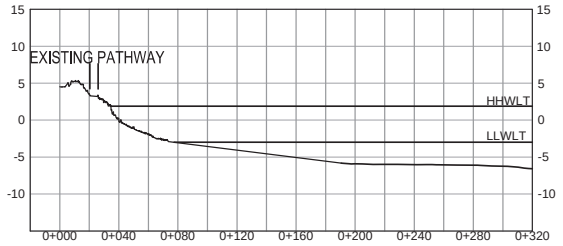

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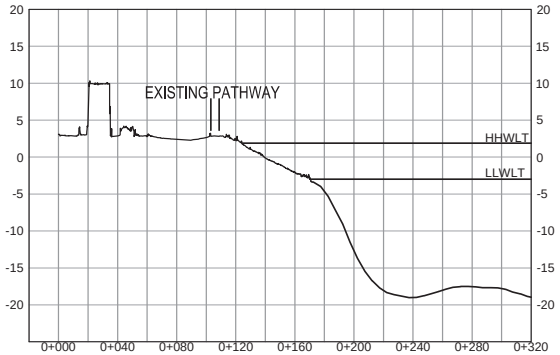

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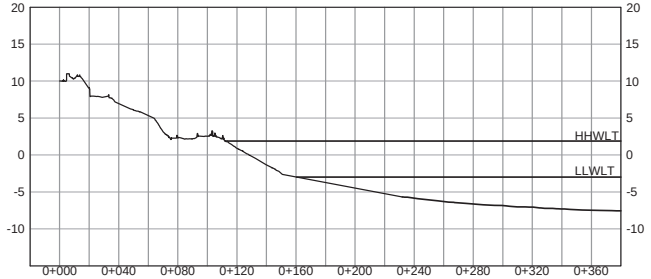
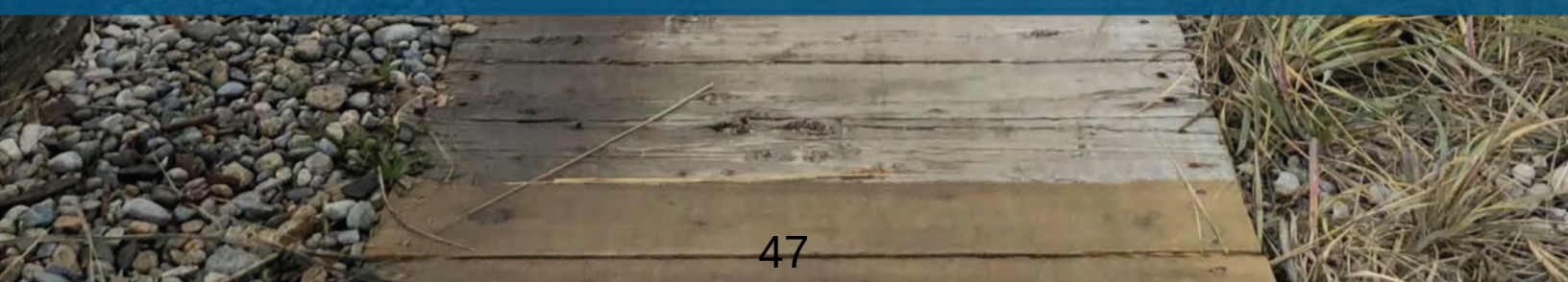
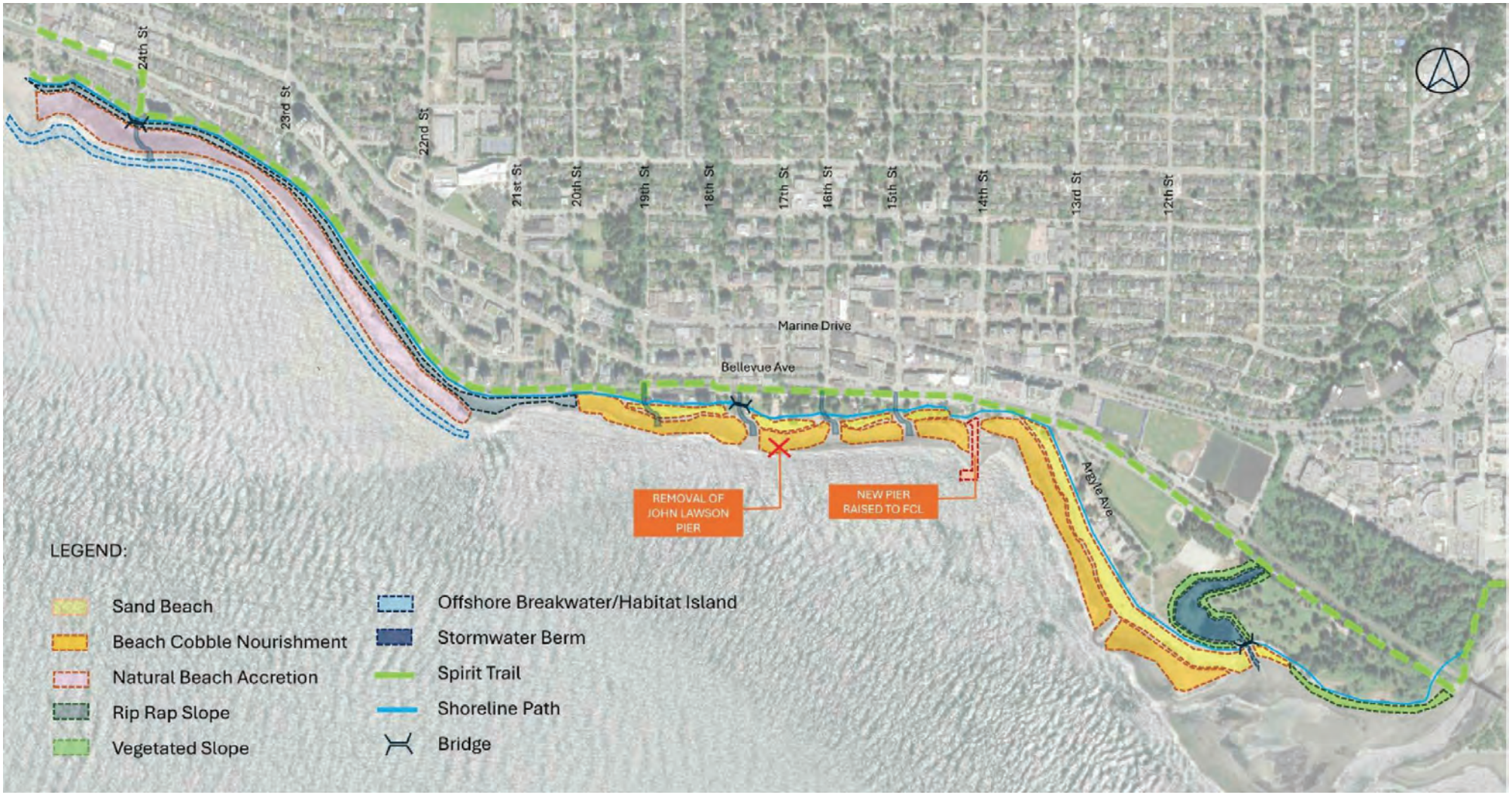


SECTION 6

EXISTING SHORELINE CROSS SECTIONS

C CLIMATE RESILIENCE STRATEGIES

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Bellevue Ave
Argyle Ave
REMOVAL OF JOHN LAWSON PIER
NEW PIER RAISED TO FCL
LEGEND:
Sand Beach
Beach Cobble Nourishment
Natural Beach Accretion
Rip Rap Slope
Vegetated Slope
Offshore Breakwater/Habitat Island
Stormwater Berm
Spirit Trail
Shoreline Path
Bridge

D STATEMENT OF PROBABLE COSTS

COASTAL ADAPTATION PLAN

Statement of Probable Costs

ITEM NO.	Project Segment	DESCRIPTION	AMOUNT
1.0	Centennial Seawalk	Offshore Breakwater	$19,673,280
2.0	Centennial Seawalk	Seawalk	$29,407,000
3.0	JonnLawson and Ambleside Parks	Beach Section (18th Street to 14th Street)	$7,750,750
4.0	JonnLawson and Ambleside Parks	Pier Replacement	$5,666,500
5.0	Ambleside Beaches	Beach Section (14th Street to Pond)	$10,029,250
6.0	Ambleside Beaches	Realigned Trail (Pond to Railway Crossing)	$6,056,400
		TOTAL (including 40% Contingency)	**$78,583,180**

Offshore Breakwater

ITEM NO.	DESCRIPTION	UNIT	QTY	UNIT PRICE	AMOUNT
1.0	**Mobilization/Demobilization**				**$150,000**
1.01	Specialized Equipment and Materials	Lump Sum	1	$100,000	$100,000
1.02	Temporary Works	Lump Sum	1	$50,000	$50,000
2.0	**Core Earthworks**				**$562,500**
2.01	Rock Placement and Shaping	Cubic M.	10000	$100	$500,000
2.02	Rip Rap Armouring	Cubic M.	500	$125	$62,500
3.0	**Surface Treatments**				**$426,000**
3.01	Trees	Each	40	$2,500	$100,000
3.02	Shrubs	Each	100	$60	$6,000
3.03	Cobble Beach	Cubic M.	4000	$80	$320,000
				SUB TOTAL	**$1,138,500**
			Contingency	40%	**$455,400**
			Environmental Monitoring	10%	**$45,540**
				SUB TOTAL (EACH BREAKWATER)	**$1,639,440**
4.01	**Offshore Breakwater**	Each	12	$1,639,440	$19,673,280
				TOTAL	**$19,673,280**

Seawalk

ITEM NO.	DESCRIPTION	UNIT	QTY	UNIT PRICE	AMOUNT
1.0	**Demolition & Site Preparation**				**$2,475,000**
1.01	Wall and walkway removal	Lineal meter	1800	$1,250	$2,250,000
1.02	Temporary shoreline protection	Lineal meter	1800	$125	$225,000
2.0	**Walkway Construction**				**$17,550,000**
2.01	Pile foundations	Lump Sum	1	$5,000,000	$5,000,000
2.02	Substructure	Lump Sum	1	$5,000,000	$5,000,000
2.03	Superstructure	Lump Sum	1	$5,000,000	$5,000,000
2.04	Concrete curb	Lineal meter	1800	$250	$450,000
2.05	Asphalt Walkway	Lineal meter	1800	$750	$1,350,000
2.06	Fencing and Stairs	Limp Sum	1	$500,000	$500,000
2.07	Transitions and Tie-ins	Limp Sum	1	$250,000	$250,000
3.0	**Lighting and Furnishings**				**$980,000**
3.01	Lighting	Each	50	$16,000	$800,000
3.02	Benches	Each	10	$5,000	$50,000
3.03	Wayfinding and Interpretive Signage	Lump Sum	1	$30,000	$30,000
3.04	Landscaping	Lump Sum	1	$100,000	$100,000
				SUB TOTAL	**$21,005,000**
			Contingency	40%	**$8,402,000**
				TOTAL	**$29,407,000**

Beach Section (18th Street to 14th Street)

ITEM NO.	DESCRIPTION	UNIT	QTY	UNIT PRICE	AMOUNT
1.0	**Demolition & Site Preparation**				**$706,250**
1.01	Wall and walkway removal	Lineal meter	530	$1,000	$530,000
1.02	Clearing and Grubbing	Lump Sum	1	$60,000	$60,000
1.03	Removal of Existing Sand & Driftwood	Lump Sum	1	$50,000	$50,000
1.04	Temporary shoreline protection	Lineal meter	530	$125	$66,250
2.0	**Walkway Construction**				**$3,815,000**
2.01	Substructure	Lump Sum	1	$1,800,000	$1,800,000
2.02	Asphalt Walkway	Lineal meter	530	$500	$265,000
2.03	Reinstall Sand & Driftwood	Lump Sum	1	$50,000	$50,000
2.04	Import Material	Lump Sum	1	$1,500,000	$1,500,000
2.05	Fencing and Stairs	Limp Sum	1	$200,000	$200,000
3.0	**Lighting and Furnishings**				**$475,000**
3.01	Lighting	Each	20	$16,000	$320,000
3.02	Benches	Each	5	$5,000	$25,000
3.03	Wayfinding and Interpretive Signage	Lump Sum	1	$30,000	$30,000
3.04	Landscaping	Lump Sum	1	$100,000	$100,000
4.0	**Bridges**				**$540,000**
4.01	Bridge Deck & Railings	Each	3	$80,000	$240,000
4.02	Concrete Footings	Each	6	$50,000	$300,000
				SUB TOTAL	**$5,536,250**
			Contingency	40%	**$2,214,500**
				TOTAL	**$7,750,750**

Pier Replacement

ITEM NO.	DESCRIPTION	UNIT	QTY	UNIT PRICE	AMOUNT
1.0	**Demolition & Site Preparation**				**$600,000**
1.01	Superstructure Removal and disposal of any unusable materials	Lump Sum	1	$150,000	$150,000
1.02	Substructure and pier removals	Lump Sum	1	$300,000	$300,000
1.03	Concrete and debris waste removal	Lump Sum	1	$100,000	$100,000
1.04	Temporary shoreline protection	Lineal meter	50	$1,000	$50,000
2.0	**Pier Construction**				**$3,377,500**
2.01	Pile foundations	Lump Sum	1	$1,000,000	$1,000,000
2.02	Substructure	Square meter	450	$2,500	$1,125,000
2.03	Abutment wall and erosion protection	Square meter	45	$4,500	$202,500
2.04	Deck & railings (wood)	Square meter	450	$2,000	$900,000
2.05	Furnishings	Each	3	$50,000	$150,000
3.0	**Trail Connection and Landscape Restoration**				**$70,000**
3.01	Concrete walkway approach	Square meter	150	$400	$60,000
3.02	Landscape restoration	Lump Sum	1	$10,000	$10,000
				SUB TOTAL	**$4,047,500**
			Contingency	40%	**$1,619,000**
				TOTAL	**$5,666,500**

Beach Section (14th Street to Pond)

ITEM NO.	DESCRIPTION	UNIT	QTY	UNIT PRICE	AMOUNT
1.0	**Demolition & Site Preparation**				**$1,108,750**
1.01	Wall and walkway removal	Lineal meter	830	$1,000	$830,000
1.02	Clearing and Grubbing	Lump Sum	1	$100,000	$100,000
1.03	Removal of Existing Sand & Driftwood	Lump Sum	1	$75,000	$75,000
1.04	Temporary shoreline protection	Lineal meter	830	$125	$103,750
2.0	**Walkway Construction**				**$5,465,000**
2.01	Substructure	Lump Sum	1	$2,200,000	$2,200,000
2.02	Asphalt Walkway	Lineal meter	830	$500	$415,000
2.03	Reinstall Sand & Driftwood	Lump Sum	1	$50,000	$50,000
2.04	Import Material	Lump Sum	1	$2,500,000	$2,500,000
2.05	Fencing and Stairs	Limp Sum	1	$300,000	$300,000
3.0	**Lighting and Furnishings**				**$590,000**
3.01	Lighting	Each	25	$16,000	$400,000
3.02	Benches	Each	12	$5,000	$60,000
3.03	Wayfinding and Interpretive Signage	Lump Sum	1	$30,000	$30,000
3.04	Landscaping	Lump Sum	1	$100,000	$100,000
				SUB TOTAL	**$7,163,750**
			Contingency	40%	**$2,865,500**
				TOTAL	**$10,029,250**

Realigned Trail (Pond to Railway Crossing)

ITEM NO.	DESCRIPTION	UNIT	QTY	UNIT PRICE	AMOUNT
1.0	**Demolition & Site Preparation**				**$156,000**
1.01	Common Excavation	Lineal meter	730	$200	$146,000
1.02	Clearing and Grubbing	Lump Sum	1	$10,000	$10,000
2.0	**Walkway Construction**				**$2,515,000**
2.01	Substructure	Lump Sum	1	$2,000,000	$2,000,000
2.02	Asphalt Walkway	Lineal meter	730	$500	$365,000
2.03	Import Material	Lump Sum	1	$150,000	$150,000
3.0	**Lighting and Furnishings**				**$1,205,000**
3.01	Lighting	Each	25	$16,000	$400,000
3.02	Benches	Each	5	$5,000	$25,000
3.03	Wayfinding and Interpretive Signage	Lump Sum	1	$30,000	$30,000
3.04	Landscaping	Lump Sum	1	$750,000	$750,000
4.0	**Bridges**				**$250,000**
4.01	Bridge Deck & Railings	Each	1	$150,000	$150,000
4.02	Concrete Footings	Each	2	$50,000	$100,000
5.0	**Railway Crossing**				**$200,000**
5.01	Signage & Mechanical Crossing Arms	Lump Sum	1	$200,000	$200,000
				SUB TOTAL	**$4,326,000**
			Contingency	40%	**$1,730,400**
				TOTAL	**$6,056,400**