Our File: McElhanney Project #2121-00992-00

TECHNICAL MEMO

To	From
Kyle Armstrong, M.Sc., Restoration Coordinator Peninsula Streams Society	Nigel Lindsey, Hydrotechnical Engineer Vancouver / Water Resources
Re	**Date**
Roberts Bay Tidal Marsh Restoration	June 28, 2023

1. Introduction

Peninsula Streams Society (PSS) retained McElhanney Ltd (MCL) to develop further and oversee the implementation of a preliminary restoration concept for the Mermaid Creek delta salt marsh in Roberts Bay, Sidney, BC. The DHI Water & Environment Inc (DHI) developed the restoration concept to rehabilitate the salt marsh to previously documented extents. **Figure 1** provides the general project site arrangement.

Figure 1. General Arrangement of the Project Site, Image Source: GoogleEarth

1.1. BACKGROUND

The Marsh is predominately *Sarcocornia pacifica* (American Glasswort or pickleweed) and part of the Shoal Harbour Migratory Bird Sanctuary. Over the past 50 years, the Marsh has been receding. The cause of the Marsh's loss is related to the inability to rebuild after disturbances. Waves erode the leading edge of the Marsh, and without sediment inputs, the Marsh shrinks. Naturally, sediment from the creek bank and shoreline erosion would balance the losses. However, this process has been reduced by urbanization of the creek watershed and shoreline armouring. PSS intends to stabilize and expand the salt marsh, enhancing its ecological value.

The preliminary design developed by DHI consists of expanding the Marsh to previously documented extents. The total marsh area to be expanded is 3,810 m^2, with 1,350 m^2 for the northwest Marsh and 2,460 m^2 for the southwest. The main design elements are the following:

- Marsh sloped at 6 to 100:1 with an elevation that ranges from 1.0 to 1.5 m CGVD2013.
- Importing a marsh substrate of 1 to 20 mm sand and gravel mixed with fine organic material.
- A series of low-lying intermittent rock berms protect the leading edge of the Marsh
- Channels to promote drainage of the Marsh.
- Installation of a pedestrian crossing at the mouth of Mermaid Creek to allow passage and prevent damage to the Marsh.
- A pile of marsh substrate is located at the south end of the beach to act as a nourishment source.

Figure 2 provides a screen capture of the preliminary design developed by DHI.

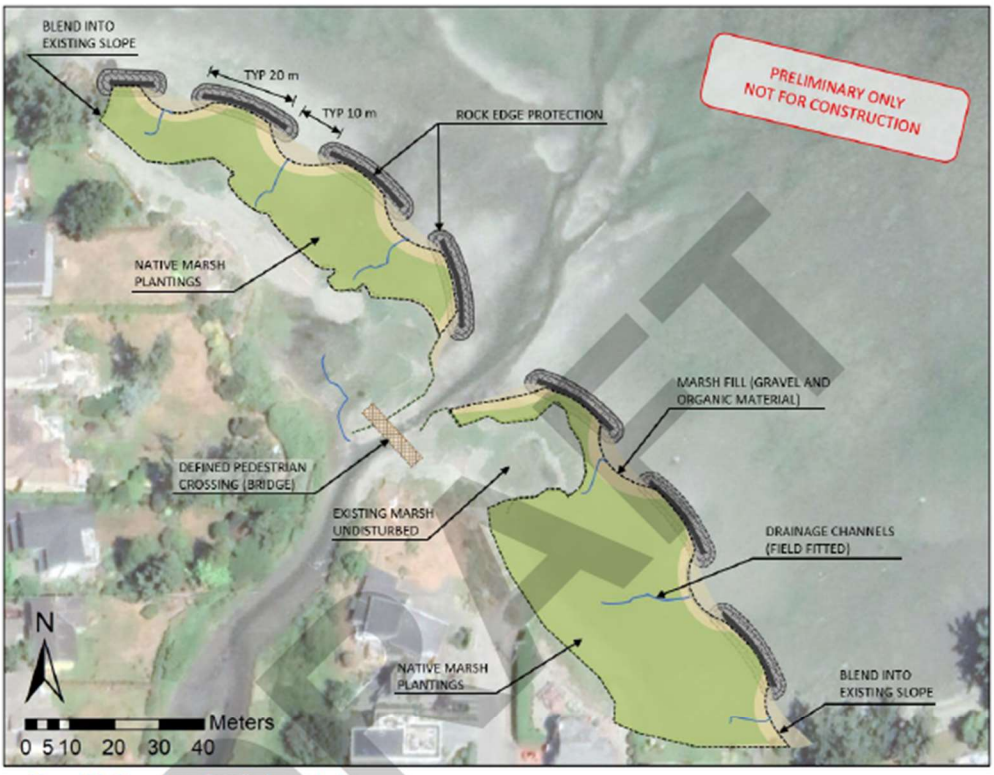

Figure 20 Plan view of preliminary design

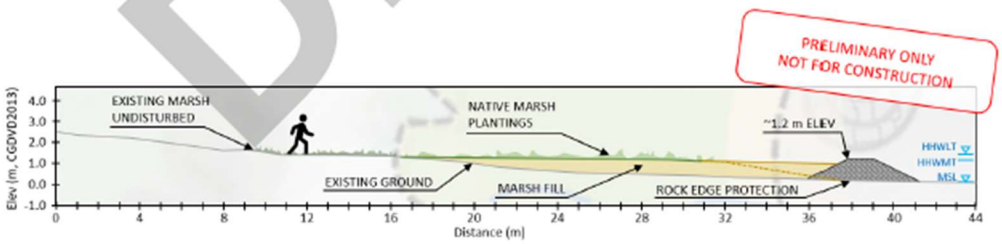

Figure 21 Cross-sectional view of preliminary design

Figure 2. Excerpt for the DHI report depicting the preliminary design (DHI 2022)

For the Project, MCL reviewed the following information provided by PSS:

- Analysis of Current and Historic Conditions in Roberts Bay, BC. Coastal and Oceans Resources, November 2021.
- Coastal Engineering Analysis and Marsh Restoration Preliminary Design, Roberts Bay Draft Memo, DHI Water & Environment Inc, October 21 2022.
- July 2021 Roberts Bay Sieve Analysis, conducted by WSP for PSS.
- Pat Bay Butlers Smelt Blend 2015.
- Songhees Beach – Pocket Beach Blending Sheet.

1.2. SCOPE OF WORK

MCL's scope of work included the following:

1. Develop the detailed design of the marsh restoration project that includes:

    a. Collaborating with DHI to refine the crescent headland's geometry, location, and rock sizes.
    b. Design the tidal marsh slope, elevation, substrate, and drainage channels.
    c. Develop the material specifications for the required substrates. The marsh medium will attempt to match the existing material the *Sarcocornia pacifica* inhabits and be a blend of existing quarry materials.
    d. Locating and dimensioning marsh nourishment source piles located on the North and South marshes using the marsh material.
    e. A stepping stone crossing feature for the Mermaid Creek channel.

2. Provide part-time construction support services for the implementation of the Project that includes:

    a. Site layout.
    b. Kick-off meeting attendance.
    c. Coordination with PSS full-time field engineer to source materials and field any questions.
    d. Engineering field reviews checking conformance to design and quality assurance. Reviews will be at key points that coincide with crescent headland construction, marsh infilling, and placement of nourishment piles.

3. Prepare record drawings and a report documenting the constructed conditions and a monitoring plan to track the long-term physical changes of the Marsh.

1.3. DESIGN CODES AND GUIDELINES

There are no formal design codes, but the following design guidelines were adhered to for the analysis:

1. *HEC-11 Design of Riprap Revetment*, Federal Highway Administration, (1989).
2. *The Rock Manual*, Construction Industry Research and Information Association (CIRIA), 2007.
3. *Coastal Engineering Manual*, US Army Corp of Engineers (USACE), 2003.
4. *Armour Damage of Overtopped Mound Breakwater in Depth-Limited Breaking Wave Conditions*, Mares-Nasarre (2021). And
5. *Extension of Shallow water rock armour stability formulae to non-linear waves*, Anderson (2019).

1.4. LIMITATIONS AND ASSUMPTIONS

In addition to the limitations outlined in Appendix A, the following project-specific limitations and assumptions are also applicable:

1. The constructed salt marsh is a natural system expected to perform dynamically and adapt to changing environmental conditions. Regular maintenance, inspections, or adaptive management are required.

2. Site Visit

On November 21 2022, Kyle Armstrong and Ian Bruce of PSS, Sarah Cook of SeaChange, Jacklynn Barrs of World Wildlife Canada, Tim Clermont, and McElhanney Staff Nigel Lindsey attended a site visit at Roberts Bay. The meeting intended to discuss the concept design developed by DHI and provide McElhanney staff an opportunity to gain familiarity with the site.

The following are the key observations made by McElhanney during the site visit, reference images are provided below:

- The lower reach of Mermaid Creek is a trapezoidal channel with a bank full width[1] of approximately 8 m, bottom width of 1.8 m and side slopes of 3H:1V. The bed material consists of gravel and fine sediments (**Image 1**).
- The existing salt marsh is on both sides of the Mermaid Creek delta and is primarily composed of Salicornia Pacifica.
- The leading edge of the Marsh is severely degraded, exposing the peat layer that supports the Marsh. Gravels are intermixed within the peat layer (**Image 2**).
- The beach surface primarily consists of gravel with a D50 of 100 mm. Beneath the gravel layer is a mixed substrate of gravel and fine sediment (**Image 3**).
- No erosion is noted along the foreshore behind the Marsh.
- Immediately to the southeast of the Marsh, the foreshore consists of fine sands with dune grasses. Further south, the shoreline is a series of private seawalls (**Image 4**).
- Northwest of the march, the foreshore is nearly entirely armoured with a mix of concrete seawalls and rock walls (**Image 5**).

[1] Distance measured between the vegetation line on opposing banks.

Image 1. The outlet of Mermaid Creek.

Image 2. The leading edge of the Marsh.

Image 3. Beach substrate, Scale: The field Book is 190 mm long.

Image 4. The foreshore to the southwest of the Marsh

Image 5. The foreshore northwest of the Marsh.

3. Design Overview

The Roberts Bay Tidal Marsh Restoration project will re-establish the low salt marsh to the previously documented extent while mitigating the future loss of the Marsh by protecting the leading edge with a series of rock berms. The aim is to develop a pseudo-natural system, mimicking the natural system and shoreline processes with as few 'hard' components as possible. The expansion and re-establishment of the Marsh will reduce the wave energy along the foreshore by frictional drag introduced by the vegetation and by bottom friction from the shallow water – therefore protecting the few unarmoured properties along the shoreline behind the proposed Marsh. The detailed design of the Roberts Bay Tidal Marsh Restoration builds upon the concept developed by DHI.

In support of the design, McElhanney completed a topographic survey of the project location on March 14, 2023, confirming elevations and documenting the extent of the existing low salt marsh. The survey was collected in the following coordinate system:

- Horizontal Datum: NAD83 (CSRS)
- Projection: UTM10
- Vertical Datum:CGVD2013
- Geoid Model: CGG2013.

The design features are described below and depicted in 50% of design drawings in Appendix B, with all elevations expressed in Geodetic Datum.

3.1. SALT MARSH

The restoration plan re-establishes the Mermaid Creek delta salt marsh to documented 1964 extents with an extension of the southern portion. The elevation of the marsh expansion targets the upper range of the

dominant plant species Sarcocornia pacifica in the existing Marsh, which lives from elevation 1.3 m to 0.55 m. This method allows for subsidence of the material, keeping the Marsh within that habitual range of the marsh vegetation. As well as provides a degree of climate resiliency by enabling the Marsh to persist as water levels rise and giving it time to adapt and recruit sediment. The restoration plan is delineated as two areas: North and South Marshes.

Drainage is provided by sloping the marsh bench from the foreshore to the rock berms, sloping the Marsh between the rock berms, and eight channels that discharge onto the existing tidal flat between the rock berms.

The projected new marsh area is 3,965 m^2, with 1,566 m^2 for the North Marsh and 2,399 m^2 for the South Marsh. The Marsh conforms to the following attributes:

- Foreshore marsh elevation: 1.2 m
- Marsh elevation at the berm: 1.0 m
- North Marsh bench slope: 0.6% to 1.2%.
- South Marsh bench slope: 0.3%.
- Marsh slope between rock berms: 4H:1V.
- Drainage channel geometry: 4H:1V side slopes, thalweg sloped at 0.5%.

The existing Marsh consists of peat intermixed with gravel to sand with a D_{50} of 1 to 20 mm, founded on a similar alluvial material as within the organic substrate. **Figure 3** provides an image of the existing marsh material.

Figure 3. The leading edge of the existing salt marsh and the material present, notebook is 19 cm high.

As the existing Marsh is founded on an alluvial material and the natural cycle has periods of disturbance and deposition, which the *Sarcocornia pacifica* grows through, it is reasonable to assume the alluvial material is a suitable substrate for the Marsh. Furthermore, constructing a marsh of entirely organic material is not recommended, given the public use of the area and its mobility. Therefore, the marsh expansion will import bulk fill closely resembling the existing substrate. However, select areas in the Marsh are proposed to incorporate a 200 mm thick topsoil layer overlaid with 200 mm of bulk fill. The topsoil layer will jump-start the peat development process and provide nutrients for *Sarcocornia pacifica*. While burying the topsoil prevents the mobilization of the material while still being within reach of the plant's roots for nutrients. The areas for topsoil incorporation are 470 m^2 in the North March and 320 m^2 in the South Marsh.

3.2. CRESCENT HEADLANDS

A series of seven discontinuous crescent-shaped low rock berms located along the periphery of the expanded Marsh provide erosion mitigation of the imported marsh medium. The rock berms are set at locations to resist the prevailing wind-generated waves while mitigating the potential for sediment trapping.

The general arrangement for the rock berms, known as the 'Crescent Headland' are the following:

- Top width:1.2 m
- Top Elevation: 1.0 m

- Side Slopes: 3H:1V
- Length: 20 and 21 m; northernmost is 6 m.

Northernmost rock berm ties into an existing rock outcrop; all others are discontinuous from each other and the shore.

Between the marsh medium and the Crescent Headlands is a granular filter (GF). The GF is an intermediate layer of angular rock material that prevents the marsh material from being pulled through the voids in the rock berm.

3.3. MERMAID CREEK CROSSING

A pedestrian crossing of Mermaid Creek is located at the creek's mouth aligning with the existing footpath along the foreshore consisting of stepping stones. The stepping stones intend to allow pedestrians to cross the creek closer to the foreshore, reducing the impact of people walking on the salt marsh.

The stepping stones will utilize the largest fraction of rocks used for the Crescent Headlands. Rocks will be oriented with a flat face upwards, embedded at least 200 mm into the substrate with a spacing of 0.8 m between rocks.

3.4. BEACH NOURISHMENT SOURCES

Two beach nourishment sources will be incorporated into the restoration plan to augment the loss of natural sediment nourishment of the beach from the once-historic inputs, which included beach shoreline erosion and riverine deposition. The beach nourishment sources are located at the northern and southern extents of the marsh infill area. The northern source infills the area on the north side of a bedrock outcrop, and the southern source infills the area between the southernmost Crescent Headland and 2404 Lovell Ave's concrete seawall.

The nourishment sources will consist of the marsh medium; each source's extent and volume depend on the remaining material from the marsh infill and are directly related to the available funding to purchase material. The sources will infill the areas, creating a smooth transition from the existing ground and gently sloping onto the tidal flat or shoreline at a maximum slope of 4H:1V.

4. Material Specification

The restoration plan requires importing three materials that include:

1. Marsh Medium.
2. Crescent Headland Rock. and
3. Granular Filter.

Material specification efficiencies are realized by utilizing Marsh Medium and Cresent Headland Rock for more than one project element. The Marsh Medium is used for infill and nourishment, and the Crescent Headland rock is used for rock berms and the Mermain Creek crossing.

4.1. MARSH MEDIUM

The marsh medium is designed to match the existing material on-site, following the grain size analysis of the beach material completed by WSP on July 2021. The material is to be from an alluvium source of sand and gravel, conforming to the gradation in **Table 1**. In addition to the material specification in **Table 1**, a garden blend topsoil is required for the buried topsoil layer.

Table 1. Marsh Medium gradation

% FINER UPPER	% FINER LOWER	DIAMETER (mm)
100	100	25
95	100	19
90	100	12.5
80	95	9.5
50	75	4.75
30	55	2.36
15	40	1.18
0	30	0.6
0	20	0.3
0	15	0.15

Depending on the source and materials available, blending two or more materials may be required to develop the marsh medium.

4.2. CRESCENT HEADLAND ROCK

DHI completed the stability analysis for the rock sizing of the crescent headlands for a design storm event with a 1 in 50-year return interval following the methods outlined in the following:

- CIRIA (2007)
- USACE (2003).
- Mares-Nasarre (2021).
- Anderson (2019)

Table 2 presents a custom gradation developed for the Roberts Bay coastal conditions and the Crescent Headlands' geometry, which uses the average of all four methodologies.

Table 2. Custom Crescent Headland rock

% FINER UPPER	% FINER LOWER	DIAMETER (mm)
90	100	570
70	100	480
20	50	380
0	20	310
0	5	210

MOTI riprap was assessed to improve material procurement and flexibility to work within the Project budget. MoTI is readily available and will be a cheaper alternative to the custom gradation. **Table 3** specifies the MoTI class that matches the custom rock best; it's a well-graded matrix and will be a stable matrix; however, the smaller fraction will likely mobilize and may appear to be failing.

Table 3. Selected MoTi Riprap class and gradation

Class	Approximate Avg. Dimension (mm)			
	15	50	85	<100
250-kg	260	565	815	965

In either case, the rock is to be angular to semi-angular and blocky in shape.

4.3. GRANULAR FILTER

The GF is designed to prevent flow piping through the marsh material and the custom crescent headland rock, limiting the loss of marsh material. The required material follows the guidance outlined in Federal Highway Administration, Hydraulic Circular No. 11, Design of Riprap Revetment. **Table 4** provides the gradation for the required GF.

Table 4. Granular Filter gradation required for the Roberts Bay Tidal Marsh Restoration

% PASSING	UPPER DIAMETER (mm)	LOWER DIAMETER (mm)
100	150	110
85	100	75
80	85	65
50	55	35
20	30	15
15	15	10

5. Construction Methodology

Due to the tidal nature of the Project, the success and timely implementation depends on having a readily available sediment marsh material nearby that can be efficiently delivered to the site and selecting a period with low enough tides to complete the works.

As the site has no staging area on the beach or near the site, construction will require a daily import of the required material. There is limited daily construction windows, so the Project's duration is influenced by transporting the material onto the site.

Additionally, for tidally dependent work, the preferential window is for day-time low tides, removing the need for lighting and impacts to nearby residents. For the Saainch Peninsula, day-time lows typically occur from Late June until Early October, which aligns with the least harmful window for aquatic organisms and outside the migratory bird season.

The proposed general construction methodology is the following and is to be undertaken during favourable low tides and work windows:

1. Construct a site access route at the terminus of 5th Ave – retain the existing vegetation for replanting.
    - Construction vehicles are to avoid the existing extents of the salt marsh.
2. Construct the Crescent Headlands.
3. Install the Mermaid Creek Stepping Stone crossing rocks.
4. Infill the North Marsh starting at the northernmost extent, working in the north-south direction.
    - Infilling should be completed in rows to the design height, grade and bucket packed per tidal window.
    - After each high tide, confirm the elevation and grade of the previously infilled marsh area.
    - Add additional marsh medium if placed material has subsided below the design elevation.
    - Install drainage channels as the Marsh is infilled.
5. Infill the South Marsh starting at the southernmost extent, working in the south-north direction.
6. When the Southern Marsh is infilled to the access route, pause the Southern marsh infill and construct both Nourishment Source piles.
7. Complete South Marsh infilling by starting at the northernmost extent, working north-south.
8. Complete remedial works of the site access route.

6. Community Outreach

On May 6, 2023, Kyle Armstrong and Ian Bruce of PSS, Sarah Cook of SeaChange, and McElhanney Staff member Nigel Lindsey attended a community meeting to discuss the Project. The following is a summary of concerns voiced by the community about the design with the team's response:

- Will the marsh infill cover the drains of the southeastern seawalls?

- No, the Marsh will be below the drains, and a ditch will be located between the Marsh and seawall to direct flows away from the Marsh.

- Residents at 10239 Fifth Street are concerned that the Marsh material will mobilize and block their seawall drain as the Dunegrass along the foreshore is trapping sediment and growing towards the drain.

    - Sediment movement and mobilization is expected to occur as the Project seeks to emulate a natural process. The sediment capture and expansion of the Dune grass are expected to continue. If the flow from the drain becomes impeded by sediment, the area can be cleared.

Image 6. Foreshore adjacent to 10239 Fifth Street,

- When is the period and duration of construction?

    - Targeting the least impact window with favourable tides that occur during the summer, date dependent on permitting. The estimated duration is 6 weeks.

- Are the berms visible, and what will the Marsh look like?
    - Only about 20 cm of the top of the berms is expected to be visible from shore. Post-construction, the Marsh will look similar to the existing beach; the substrate is based on the existing material. Over time, as the plants establish it will resemble the existing Marsh.
- What are the impacts of launching kayaks?
    - During low tides, kayaks will need to be walked an additional 18 – 20 m and launched between the rock berms.

CLOSING

Please contact the undersigned if you have any questions or require further clarification.

Sincerely,
McElhanney

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APPENDIX A

Statement of Limitations

Statement of Limitations

Use of this Report. This report was prepared by McElhanney Ltd. ("**McElhanney**") for the particular site, design objective, development and purpose (the "**Project**") described in this report and for the exclusive use of the client identified in this report (the "**Client**"). The data, interpretations and recommendations pertain to the Project and are not applicable to any other project or site location and this report may not be reproduced, used or relied upon, in whole or in part, by a party other than the Client, without the prior written consent of McElhanney. The Client may provide copies of this report to its affiliates, contractors, subcontractors and regulatory authorities for use in relation to and in connection with the Project provided that any reliance, unauthorized use, and/or decisions made based on the information contained within this report are at the sole risk of such parties. McElhanney will not be responsible for the use of this report on projects other than the Project, where this report or the contents hereof have been modified without McElhanney's consent, to the extent that the content is in the nature of an opinion, and if the report is preliminary or draft. This is a technical report and is not a legal representation or interpretation of laws, rules, regulations, or policies of governmental agencies.

Standard of Care and Disclaimer of Warranties. This report was prepared with the degree of care, skill, and diligence as would reasonably be expected from a qualified member of the same profession, providing a similar report for similar projects, and under similar circumstances, and in accordance with generally accepted engineering and scientific judgments, principles and practices. McElhanney expressly disclaims any and all warranties in connection with this report.

Information from Client and Third Parties. McElhanney has relied in good faith on information provided by the Client and third parties noted in this report and has assumed such information to be accurate, complete, reliable, non-fringing, and fit for the intended purpose without independent verification. McElhanney accepts no responsibility for any deficiency, misstatements or inaccuracy contained in this report as a result of omissions or errors in information provided by third parties or for omissions, misstatements or fraudulent acts of persons interviewed.

Effect of Changes. All evaluations and conclusions stated in this report are based on facts, observations, site-specific details, legislation and regulations as they existed at the time of the report preparation. Some conditions are subject to change over time and the Client recognizes that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site may substantially alter such evaluations and conclusions.. McElhanney should be requested to re-evaluate the conclusions of this report and to provide amendments as required prior to any reliance upon the information presented herein upon any of the following events any changes (or possible changes) as to the site, purpose, or development plans upon which this report was based.

Independent Judgments. McElhanney will not be responsible for the independent conclusions, interpretations, interpolations and/or decisions of the Client, or others, who may come into possession of this report, or any part thereof. This restriction of liability includes decisions made to purchase, finance or sell land or with respect to public offerings for the sale of securities.

APPENDIX B

IFP Design Drawings

CLIENT

PENINSULA STREAMS SOCIETY

ADDRESS / CONTACT INFO.

9860 WEST SAANICH RD.,
NORTH SAANICH, BC, V8L 4B2

PROJECT NAME

ROBERTS BAY TIDAL MARSH RESTORATION

DESCRIPTION

WATER RESOURCE DESIGN ENGINEERING

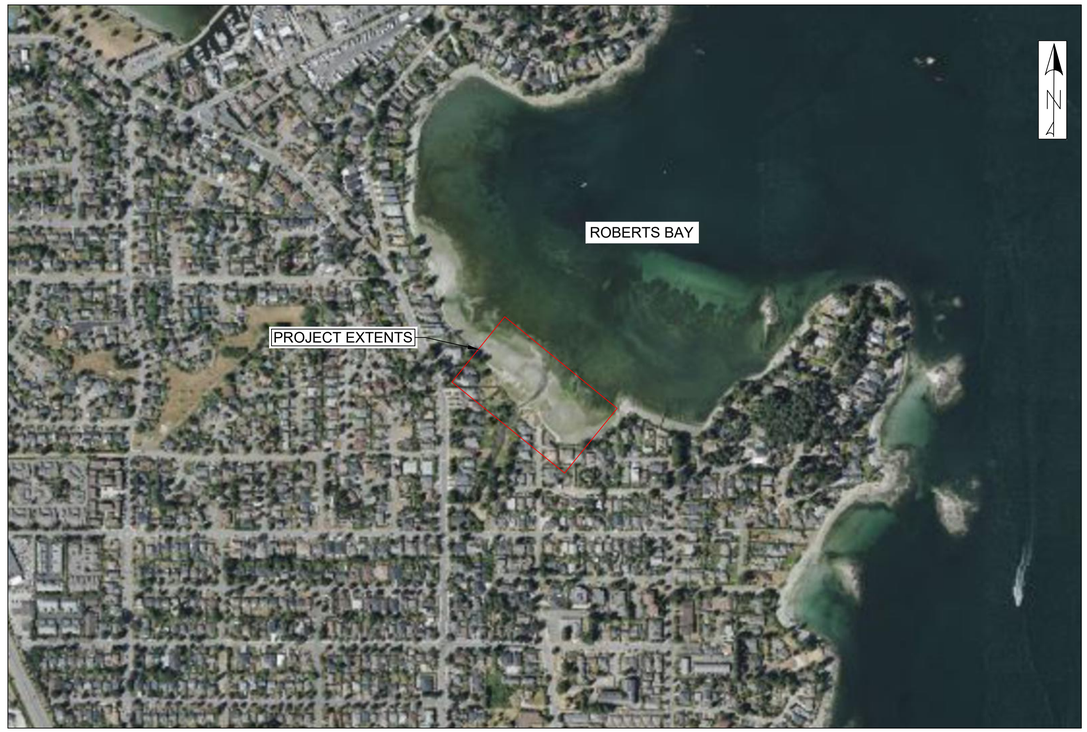
McELHANNEY PROJECT

2121-00992-00

OTHER REFERENCE

STATUS

ISSUED FOR PERMIT DRAWINGS



AREA	MARSH AREA (m²)	REQUIRED MATERIAL VOLUME			
		CRESCENT HEADLAND ROCK (m³)	MARSH MEDIUM (m³)	GRANULAR FILTER (m³)	TOP SOIL (m³)
NORTH MARSH	1566	269	666	-	-
SOUTH MARSH	2399	322	1411	-	-
TOTAL	3965	591	2077	130	160

DRAWING LIST

SHEET #	SHEET TITLE	REVISIONS						
		PA	PB	PC	0	1	2	3
000	TITLE PAGE AND KEY PLAN	X	X					
100	EXISTING PLAN	X	X					
101	PROPOSED GENERAL ARRANGMENT	X	X					
102	PROPOSED PLAN - NORTH MARSH	X	X					
103	PROPOSED PLAN - SOUTH MARSH	X	X					
400	GRADING PROFILES	X	X					
401	STANDARD DETAILS	X	X					
402	STANDARD DETAILS	X	X					

GENERAL NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SPECIFIED.
2. SURFACE MODEL IS A COMBINATION OF LiDAR BC OPEN 2019 DIGITAL ELEVATION MODEL AND A SITE SURVEY COMPLETED BY MCELHANNEY LTD,. ON 14 MARCH 2023.
3. DRAWING COORDINATE SYSTEM:
   HORIZONTAL DATUM: NAD83(CSRS)
   PROJECTION: UTM10
   VERTICAL DATUM: CGVD2013
   GEOID MODEL: CGG2013
4. GEODETIC DATUM (GD) IS APPROXIMATELY 1.99 M BELOW CHART DATUM (CD) AT THE SITE. TO CONVERT A 2.5 M TIDE TO GEODECTIC SUBTRACT 1.99m, 2.5 m - 1.99 m = 0.51 m GD
5. KEY MAP (RIGHT) 2023 MICROSOFT BING SATELLITE IMAGERY
6. SHEET 100 AND 101 PLAN IMAGERY IS 2023 MICROSOFT BING SATELLITE IMAGERY

McElhanney

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LEGEND / AREAS

- CONTOURS IN METRES (0.5m INTERVAL)
- EXISTING WATERCOURSE
- LEGAL
- EXISTING SALT MARSH
- COASTLINE BOUNDARY
- MEAN WATER LEVEL (MWL)
- HIGHER HIGH WATER LARGE TIDE (HHWLT)

SAND AND GRAVEL BEACH

DOMINANT VEGETATION:
Salicornia pacifica

MERMAID CREEK

EXISTING PEDESTRIAN FOOTPATHS

5TH STREET

Rev	Date	Description	Drawn	Design	App'd
PB	2023-06-23	ISSUED FOR PERMIT	MDL	MDL	NCL
PA	2023-05-02	50% DESIGN SUBMISSION	MDL	MDL	NCL

0 1:300 15

ORIGINAL DWG SIZE: ANSI D (22" x 34")

McElhanney

PERMIT TO PRACTICE
McElhanney Ltd.
PERMIT NUMBER: 1003299
Engineers and Geoscientists of BC

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Vancouver BC
Canada V6B 1C1
T 604 683 8521

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA N. C. LINDSEY # 48067
2023-06-23
Approved Sealed

PENINSULA STREAMS SOCIETY
9860 WEST SAANICH RD., NORTH SAANICH, BC, V8L4B2

ROBERTS BAY TIDAL MARSH RESTORATION

EXISTING PLAN

Drawing No. 100

Project Number 2121-00992-00

Rev. PB

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

DATE: 2023-06-23, 08:55 FILE: \\corp\ahl\VC2\121\2121-00992-00 Roberts Bay Tidal Marsh Restoration\10.0 DRAWINGS\10.3 Engineering\10.3.1 Sheets\00992-C0x-100 - EXISTING PLAN.dwg

McElhanney ANSI D - 2021-06-10

PLANTED WITH SALT GRASS AND SALICORNIA PACIFICA. PLANTING PRESCRIPTIONS TO BE DEVELOPED BY OTHERS FOLLOWING AN ASSESSMENT OF ELEVATIONS AFTER ONE WINTER.

NORTH MARSH

CRESCENT HEADLAND

SOUTH MARSH

PLANTED WITH SALT GRASS AND SALICORNIA PACIFICA. PLANTING PRESCRIPTIONS TO BE DEVELOPED BY OTHERS FOLLOWING AN ASSESSMENT OF ELEVATIONS AFTER ONE WINTER.

DRAINAGE CHANNEL

CONSTRUCTION VEHICLES TO AVOID EXISTING MARSH

STEPPING STONE CROSSING

SITE ACCESS

VEGETATION REMOVAL AREA

5TH STREET

MERMAID CREEK

DRAIN PIPE OUTLET
100mm Ø
INV.: 1.27

DRAIN PIPE OUTLET
60mm Ø
INV.: 1.77

DRAIN PIPE OUTLET
100mm Ø
INV.: 1.31

DRAIN PIPE OUTLET
60mm Ø
INV.: 0.99

DRAIN PIPE OUTLET
60mm Ø
INV.: 1.82

DRAIN PIPE OUTLET
100mm Ø
INV.: 1.18

DRAIN PIPE OUTLETS
(A) 60mm Ø
INV.: 1.75
(B) 80 mm Ø
INV.: 1.23

LEGEND / AREAS

- CONTOURS IN METERS (0.5m INTERVAL)
- MARSH GRADING CONTOURS IN METERS (0.1m INTERVAL)
- EXISTING WATERCOURSE
- LEGAL
- EXISTING SALT MARSH
- CRESCENT HEADLAND
- MARSH MEDIUM
- BURIED TOPSOIL
- NOURISHMENT PILE
- DRAINAGE CHANNEL
- COASTLINE BOUNDARY
- MEAN WATER LEVEL (MWL)
- HIGHER HIGH WATER LARGE TIDE (HHWLT)
- REQUESTED TENURE AREA

Rev	Date	Description	Drawn	Design	App'd
PB	2023-06-23	ISSUED FOR PERMIT	MDL	MDL	NCL
PA	2023-05-02	50% DESIGN SUBMISSION	MDL	MDL	NCL

0 1:300 15

ORIGINAL DWG SIZE: ANSI D (22" x 34")

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
N. C. LINDSEY
48067
2023-06-23

Approved Sealed

PENINSULA STREAM SOCIETY
9860 WEST SAANICH RD., NORTH SAANICH, BC, V8L4B2

ROBERTS BAY TIDAL MARSH RESTORATION

PROPOSED GENERAL ARRANGEMENT

Drawing No. 101

Project Number	Rev.
2121-00992-00	PB

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

PLANTED WITH SALT GRASS AND SALICORNIA PACIFICA. PLANTING PRESCRIPTIONS TO BE DEVELOPED BY OTHERS FOLLOWING AN ASSESSMENT OF ELEVATIONS AFTER ONE WINTER.

DRAINAGE CHANNEL. REFER TO SHEET 402 FOR DETAILS.

CRESCENT HEADLAND. REFER TO SHEET 401 FOR DETAILS.

ALL FACES SLOPED AT 3H:1V.

NOURISHMENT PILE EXTENTS. REMAINING MARSH MEDIUM MATERIAL TO BE PLACED IN THIS AREA, SLOPING INTO THE TIDAL FLAT OR SHORELINE AT MAXIMUM SLOPE OF 4:1.

LAYER OF BURIED TOPSOIL

MERMAID CREEK

LEGEND / AREAS

- 14 — CONTOURS IN METERS (0.5m INTERVAL)
- 14 — MARSH GRADING CONTOURS IN METERS (0.1m INTERVAL)
- EXISTING WATERCOURSE
- LEGAL
- EXISTING SALT MARSH
- CRESCENT HEADLAND
- MARSH MEDIUM
- BURIED TOPSOIL
- NOURISHMENT PILE
- DRAINAGE CHANNEL
- COASTLINE BOUNDARY
- MEAN WATER LEVEL (MWL)
- HIGHER HIGH WATER LARGE TIDE (HHWLT)
- ×1.00 — PROPOSED TOP OF IMPORTED MATERIAL ELEATION

Rev	Date	Description	Drawn	Design	App'd
PB	2023-06-23	ISSUED FOR PERMIT	MDL	MDL	NCL
PA	2023-05-02	50% DESIGN SUBMISSION	MDL	MDL	NCL

0 1:150 6

ORIGINAL DWG SIZE: ANSI D (22" x 34")

McElhanney

PERMIT TO PRACTICE
McElhanney Ltd.
PERMIT NUMBER: 1003299
Engineers and Geoscientists of BC

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PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA N. C. LINDSEY # 48067
2023-06-23
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PENINSULA STREAMS SOCIETY
9860 WEST SAANICH RD., NORTH SAANICH, BC, V8L4B2

ROBERTS BAY TIDAL MARSH RESTORATION

PROPOSED PLAN - NORTH MARSH

Drawing No. 102

Project Number 2121-00992-00

Rev. PB

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

LEGEND / AREAS

- 14 — CONTOURS IN METERS (0.5m INTERVAL)
- 14 — MARSH GRADING CONTOURS IN METERS (0.1m INTERVAL)
- EXISTING WATERCOURSE
- LEGAL
- EXISTING SALT MARSH
- CRESCENT HEADLAND
- MARSH MEDIUM
- BURIED TOPSOIL
- NOURISHMENT PILE
- DRAINAGE CHANNEL
- COASTLINE BOUNDARY
- MEAN WATER LEVEL (MWL)
- HIGHER HIGH WATER LARGE TIDE (HHWLT)
- ×1.00 — PROPOSED TOP OF IMPORTED MATERIAL ELEATION

MERMAID CREEK

CRESCENT HEADLAND. REFER TO SHEET 401 FOR DETAILS.

ALL FACES SLOPED AT 3H:1V.

DRAINAGE CHANNEL. REFER TO SHEET 402 FOR DETAILS.

PLANTED WITH SALT GRASS AND SALICORNIA PACIFICA. PLANTING PRESCRIPTIONS TO BE DEVELOPED BY OTHERS FOLLOWING AN ASSESSMENT OF ELEVATIONS AFTER ONE WINTER.

LAYER OF BURIED TOPSOIL

SITE ACCESS

EXISTING VEGETATION TO BE REMOVED AND STORED NEARBY FOR REINSTATEMENT AFTER.

DRAINAGE CHANNEL CONSTRUCTION ALONG EDGE OF MARSH AND SEAWALLS, 0.2m BELOW MARSH.

NOURISHMENT PILE EXTENTS. REMAINING MARSH MEDIUM MATERIAL TO BE PLACED IN THIS AREA, SLOPING INTO THE TIDAL FLAT OR SHORELINE AT MAXIMUM SLOPE OF 4:1.

5TH STREET

DRAIN PIPE OUTLET
100mm Ø
INV.: 1.27

DRAIN PIPE OUTLET
60mm Ø
INV.: 1.77

DRAIN PIPE OUTLET
100mm Ø
INV.: 1.31

DRAIN PIPE OUTLETS
(A) 60mm Ø
INV.: 1.75
(B) 80 mm Ø
INV.: 1.23

DRAIN PIPE OUTLET
60mm Ø
INV.: 0.99

DRAIN PIPE OUTLET
60mm Ø
INV.: 1.82

DRAIN PIPE OUTLET
100mm Ø
INV.: 1.18

Rev	Date	Description	Drawn	Design	App'd
PB	2023-06-23	ISSUED FOR PERMIT	MDL	MDL	NCL
PA	2023-05-02	50% DESIGN SUBMISSION	MDL	MDL	NCL

0 1:150 6

ORIGINAL DWG SIZE: ANSI D (22" x 34")

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PENINSULA STREAMS SOCIETY
9860 WEST SAANICH RD., NORTH SAANICH, BC, V8L4B2

ROBERTS BAY TIDAL MARSH RESTORATION

PROPOSED PLAN - SOUTH MARSH

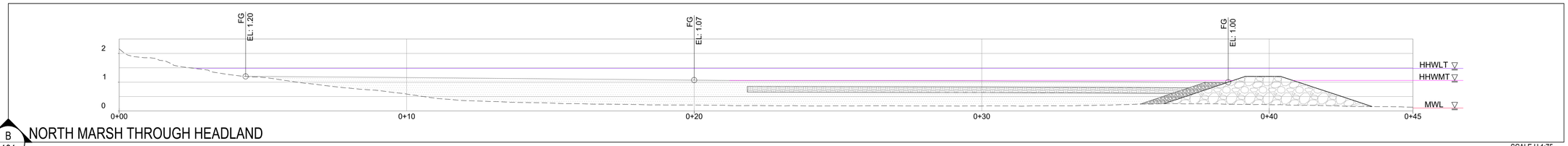
Drawing No. 103

Project Number 2121-00992-00

Rev. PB

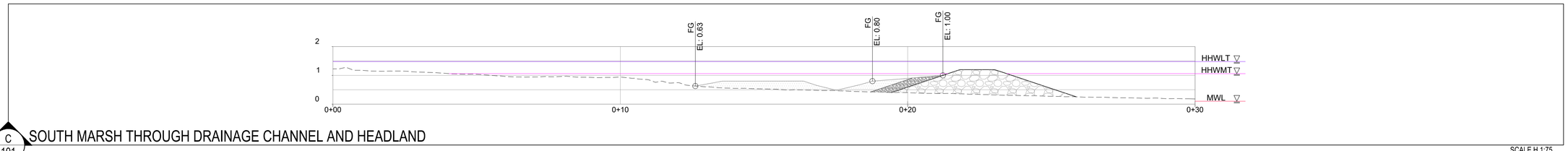
A
101
NORTH MARSH THROUGH FILL

SCALE H 1:75
V 1:75



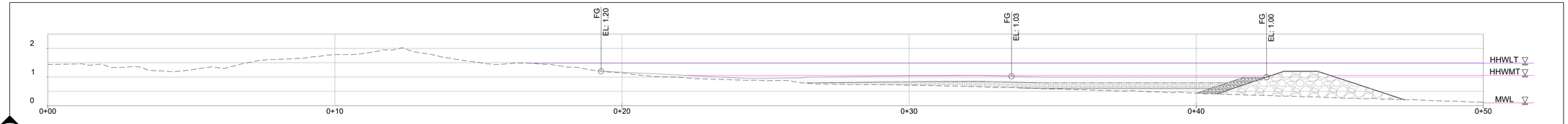
B
101
NORTH MARSH THROUGH HEADLAND

SCALE H 1:75
V 1:75



C
101
SOUTH MARSH THROUGH DRAINAGE CHANNEL AND HEADLAND

SCALE H 1:75
V 1:75



D
101
SOUTH MARSH THROUGH HEADLAND

SCALE H 1:75
V 1:75

Rev	Date	Description	Drawn	Design	App'd
PB	2023-06-23	ISSUED FOR PERMIT	MDL	MDL	NCL
PA	2023-05-02	50% DESIGN SUBMISSION	MDL	MDL	NCL

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9860 WEST SAANICH RD., NORTH SAANICH, BC, V8L4B2

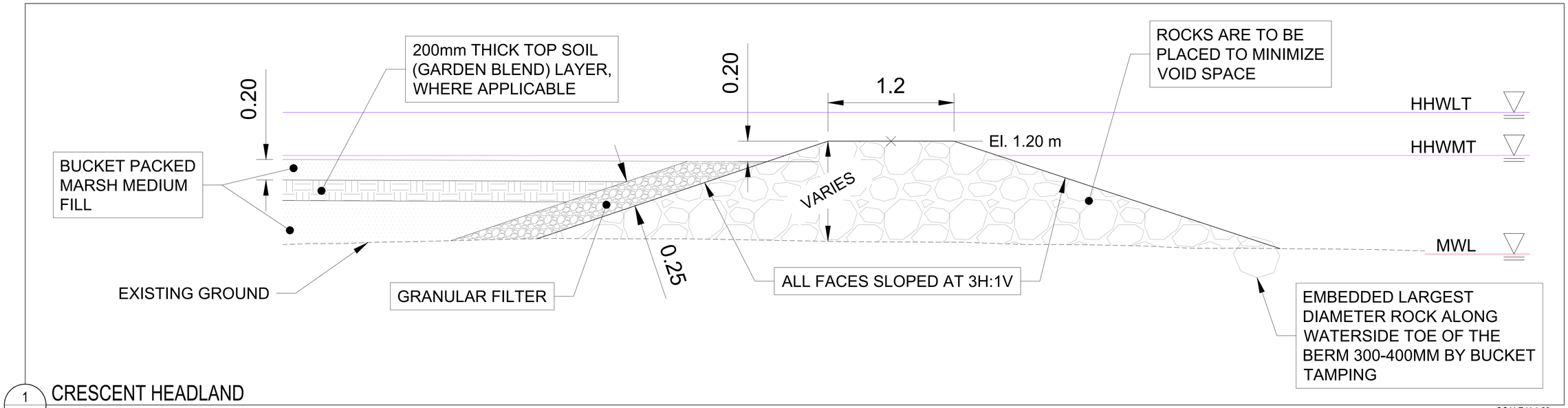
ROBERTS BAY
TIDAL MARSH RESTORATION

PROPOSED GRADING SECTIONS

Drawing No.
400

Project Number	Rev.
2121-00992-00	PB

DESTROY ALL PRINTS BEARING PREVIOUS REVISION



1
-
CRESCENT HEADLAND

SCALE H 1:20
V 1:20

GRANULAR FILTER GRADATION		
% PASSING	UPPER DIAMETER (mm)	LOWER DIAMETER (mm)
100	150	11
85	100	75
80	85	65
50	55	35
20	30	15
15	15	10

NOTE: ANGULAR ROCK

CRESCENT HEADLAND ROCK GRADATION		
% FINER UPPER	% FINER LOWER	DIAMETER (mm)
90	100	570
70	100	480
20	50	380
0	20	310
0	0	210

NOTE: ANGULAR TO SEMI-ANGULAR AND BLOCKY IN SHAPE

MARSH MEDIUM GRADATION		
% FINER UPPER	% FINER LOWER	DIAMETER (mm)
100	100	25
95	100	19
90	100	12.5
80	95	9.5
50	75	4.75
30	55	2.36
15	40	1.18
0	30	0.6
0	20	0.3
0	15	0.15

NOTE: MARSH MEDIUM IS TO BE FROM ALLUVIUM SOURCE

ALTERNATE RIPRAP SUITABLE FOR USE AS CRESCENT HEADLAND				
MOTI CLASS	APPROXIMATE AVERAGE DIMENSIONS (mm)			
	15%	50%	85%	<100%
250 kg	260	565	815	965

NOTE: ANGULAR TO SEMI-ANGULAR AND BLOCKY IN SHAPE

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9860 WEST SAANICH RD., NORTH SAANICH, BC, V8L4B2

ROBERTS BAY
TIDAL MARSH RESTORATION

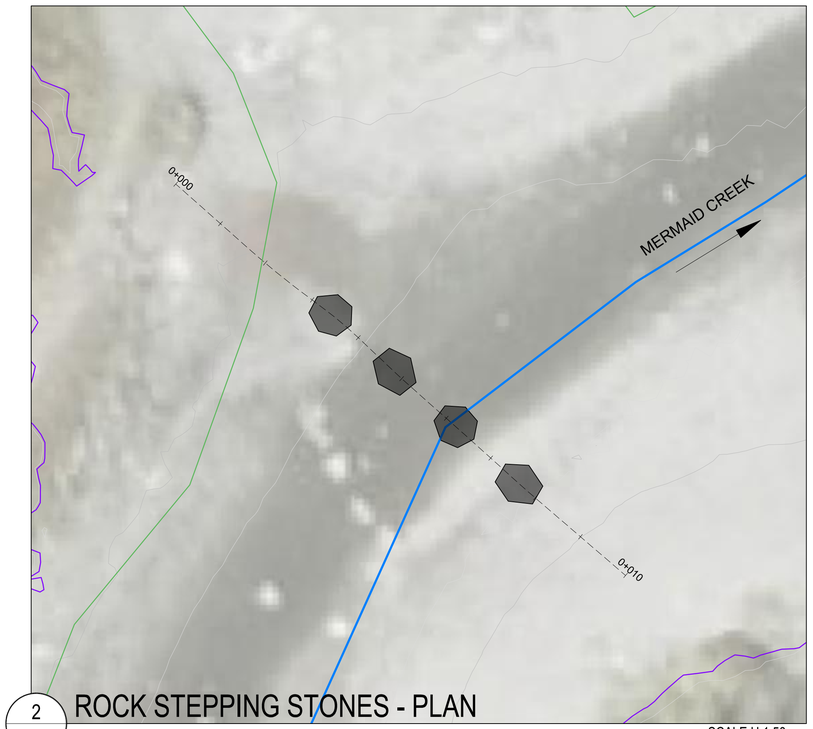
STANDARD DETAILS

Drawing No. 401
Project Number 2121-00992-00
Rev. PB

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

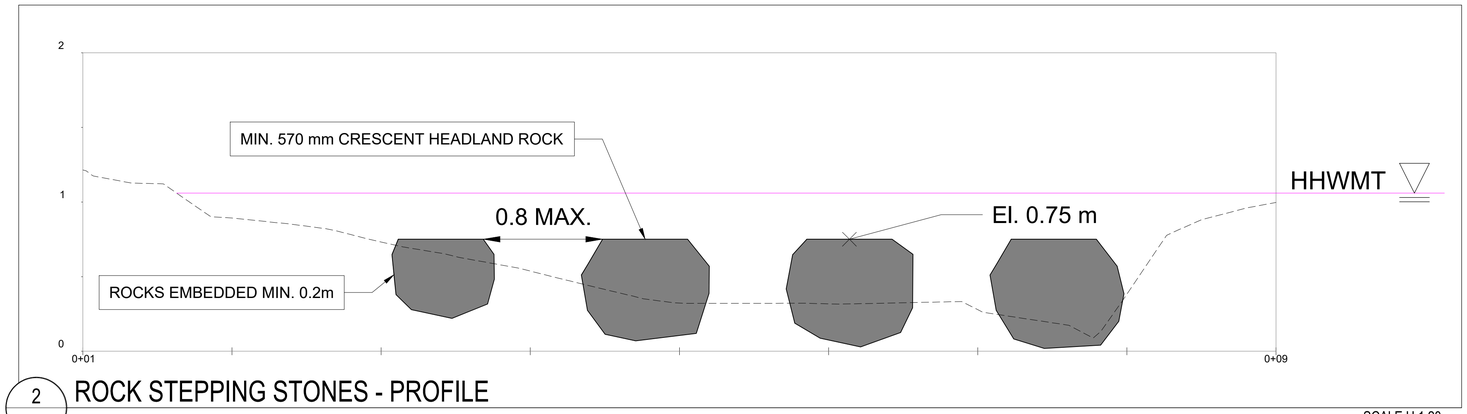
DATE: 2023-06-21, 14:00 FILE: \\corp\tal\VIC\2121\2121-00992-00 Roberts Bay Tidal Marsh Restoration\10.0 DRAWINGS\10.3 Engineering\10.3.1 Sheets\00992-C0-400 - GRADING PROFILES & DETAILS.dwg

McElhanney ANSI D - 2021-06-10



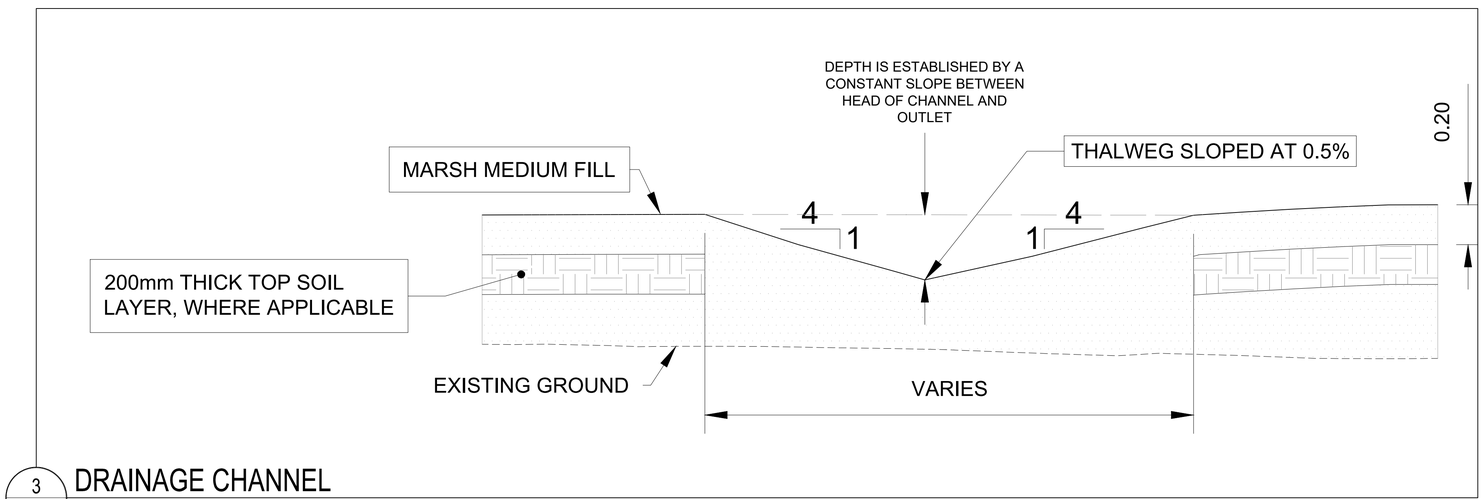
2 - ROCK STEPPING STONES - PLAN

SCALE H 1:50
V 1:50



2 - ROCK STEPPING STONES - PROFILE

SCALE H 1:20
V 1:20



3 - DRAINAGE CHANNEL

SCALE H 1:15
V 1:15

Rev	Date	Description	Drawn	Design	App'd
PB	2023-06-23	ISSUED FOR PERMIT	MDL	MDL	NCL
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ROBERTS BAY
TIDAL MARSH RESTORATION

STANDARD DETAILS

Drawing No.
402

Project Number	Rev.
2121-00992-00	PB

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

DATE: 2023-06-21, 14:04 FILE: \\corp\tall\VIC\2121\21-00992-00 Roberts Bay Tidal Marsh Restoration\10.0 DRAWINGS\10.3 Engineering\10.3.1 Sheets\00992-C0-400 - GRADING PROFILES & DETAILS.dwg

McElhanney ANSI D - 2021-06-10