

Georgian Yacht Club Dock Condition Inspection Report

Prepared For:

The Georgian Yacht Club

SHOREPLAN

FINAL
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Prepared for

The Georgian Yacht Club

by



SHOREPLAN

SHOREPLAN ENGINEERING LIMITED

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1 Introduction

The Georgian Yacht Club (GYC) is in the city of Owen Sound. The harbour is located on the west side of the inlet near the south end of Georgian Bay known as Owen Sound Bay. Figure 1.1 shows a location plan of GYC.

Shoreplan Engineering Limited (Shoreplan) was retained by the Georgian Yacht Club to determine the condition of the existing GYC dock walls, docks and, navigation depths in the harbour. In addition, the project included a high level review the marina basin dock layout to determine if there was a more efficient layout for the docks. The project included an above and underwater inspection of the dock to determine the current condition of the dock walls, an assessment of the structural capacity and stability, and remaining design life of the structures. A geotechnical investigation was not included in the scope of work.

Shoreplan subconsultant, AGUAV, conducted both topographic and bathymetric surveys on April 1, 2025. Shoreplan representatives visited the site on October 18, 2024 and April 10, 2025 to conduct the diving inspection. Shoreplan employed the services of Galcon Marine (Galcon) to conduct the diving inspection. Photographs taken during those site visits are included in the report. The date of the photo is included in the caption.

This report provides a summary of the existing marina conditions and proposed rehabilitation based on our assessments. Section 2 provides a brief description of the topographic and bathymetric information surveys obtained for this project. Section 3 presents a description of the existing harbour structures, findings of field investigations, and our assessment of their condition. Section 4 provides description of the rock structures and assessment of their condition. Section 5 provides details of the marina layout and possible layout improvements. Section 6 discusses rehabilitation options for the marina and finally Section 7 is a summary of our findings and recommendations.

The horizontal datum used for this project is UTM zone 17N, NAD83. Elevations are in metres above Canadian Geodetic Vertical Datum of 1928:78, which for this report is referred to as CGVD28. Water levels are commonly referenced to International Great Lakes Datum (IGLD 1985). The conversion between CVGD28 and IGLD 1985 at Owen Sound is +0.100 m.

2 Topographic and Bathymetric Surveys

GYC provided plan showing the legal boundary of its property. On April 4, 2025, AGUAV carried out a bathymetric survey of the underwater areas surrounding GYC's property that would be navigable. They also carried out a topographic survey of the property and drone photographs. Figure 2.1 shows a view of the survey prepared with the orthophotos included. The data from this survey available at this link:

https://shoreplanengineering-my.sharepoint.com/:f/g/personal/jgraham_shoreplan_com/Eji3uyEZP7JDvltE_RgBZQ8BZAviW0hE7HeS9_QTJv65tg?e=1cslek

The surveyed elevation data of the land and lake bottom immediately adjacent to the dock walls were used to assess their capacity. The data was also used to determine the depth of water in the basins and at the marina entrance to assess if areas required dredging to maintain navigation for recreational boats in the harbour. GYC also asked for soundings east of the east shore (outside the existing to harbour) to see if additional moorings could be accommodated east of the existing harbour within their water lot. The following provides a description existing conditions in the marina, dredging requirements and lake bottom depths outside the harbour.

2.1 Existing Topography

In general, the land elevations adjacent the dock walls and adjacent access road ranges from elevation 177.5 m to 177.8 m. For the most part landside of the access road is above the top of the dock wall, so water flows overland to the dock wall. One exception is at the northwest corner of the West Basin, where there is a catch basin that is lower than the top of the dock wall. The diving inspection found a large diameter corrugated steel pipe (CSP) at this location. It appears that the site is either graded to have water flow to the catch basin and outlet through the wall in that corner or flow overland to the lake over the wall. Existing landside elevations are provided in Figure 2.1.

The rock protection along the shoreline generally has a crest elevation at or above elevation 178.0 m. The highest point is at the north entrance breakwater where the crest elevation is approximately elevation 179.0 m. The south entrance breakwater has a crest elevation of 178.3 m. Further discussion of the shore protection and breakwaters is provided in Section 4.

2.2 Harbour Bathymetry and Dredging

The GYC harbour has three navigable areas: South Basin, West Basin, North Basin and Entrance. Figure 2.1 shows the lake bottom elevation contours within the harbour. Recreational harbours are typically designed to have a navigation depth of 1.8 to 2 m below chart datum. Chart datum on Georgian Bay is elevation 176 m IGLD85 or 175.9 m CGVD28. Figure 2.1 shows the areas above elevation 174.0 m shaded. The contours are in 0.25 m intervals.

The South Basin has depths that range from elevation 175.25 m near the dock walls to below 174.00 m in the center of the basin. The north finger docks have the shallowest depths being between 174.25 and 174.5 m in the berthing area (or 1.5 m to 1.75 m below chart datum).

Generally, the higher depths adjacent the walls are acceptable if the boats are tied off with the draft is shallowest (bow in). Dredging is not recommended in the South Basin at this time. The dock walls should be rehabilitated before dredging the South Basin.

The West Basin has harbour bottom elevations that range from 173.50 to 174.75 m. The highest elevations are near the dock walls. Overall, the West Basin has sufficient depths below chart datum for recreational basin except for two locations. The shallowest areas in along the south dock wall are where the 174.00 m contour is up to 5 m from the wall. It is also shallower than recommended in the slips between the west side of the mast crane dock wall (segment S14 for the dock wall inspection) where the 174.00 m contour is 14 m from the north dock wall between the finger dock and the wall. Dredging would not be recommended at this time. However, if water levels should recede to chart datum or lower as it did in the late 2000's then dredging should be considered. This work should be considered with any dock wall improvements in the future or if other dredging is required in the harbour (Entrance).

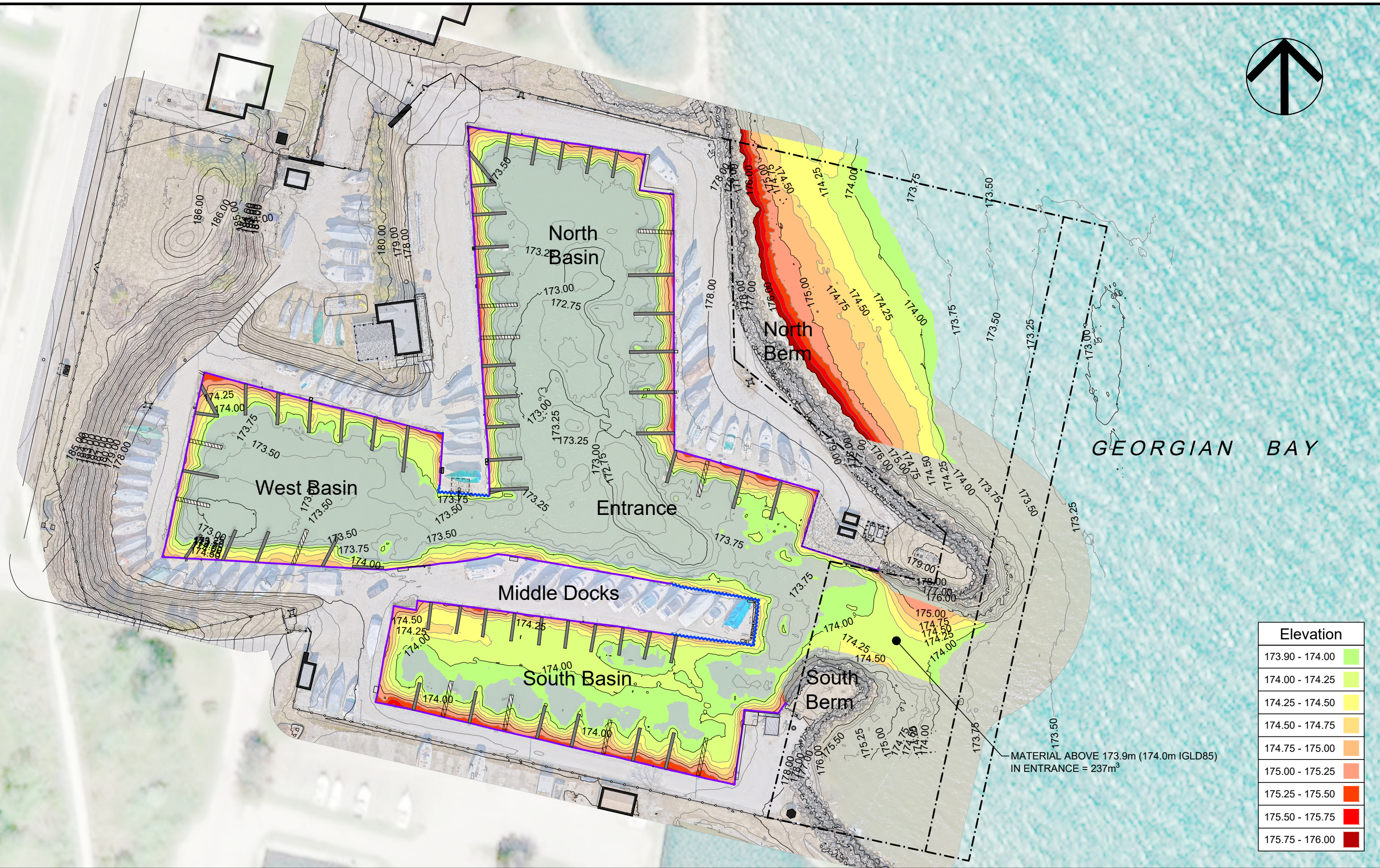
The North basin has elevations that range from 172.75 to 174.00 m. This basin is the deepest and has sufficient depth for navigation. The deepest GYC draft boats should be considered for this basin.

The Entrance Area has a bottom elevation higher than 174.00 m. It is highest on the north side of the entrance south of the rock berm. The entrance channel extends is approximately 35 m long by 21 m wide. The survey shows that the entrance channel filled in on the north side leaving a 12 m wide channel between elevation 174 and 174.25 m on the south side. On the north side the bottom elevations rise from 174.25 to 175.0 m over 9 m. This is too shallow for most boats to navigate unless they are small motorboats or jet boats. In addition, the entrance width (21 m) is narrower than is typically recommended for recreational harbours. We recommend that entrance is dredged. Approximately 250 m³ of dredge material would need to be removed from this area to achieve a harbour elevation of 174.0 m.

2.3 East Bathymetry

The bathymetric survey also included the water lot east of the North Berm. Overall, the lake bottom contours are at or below elevation 174 m approximately 35 m offshore of the North Berm. A triangular area 65 m east of the 174 m contour and 90 m north of the north entrance breakwater would have sufficient depths for a recreational harbour. Additional area for mooring maybe for achieved by excavating or dredging the lake bottom. Further discussion of marina layout is provided in Section 4.

Drawing Location: S:\Shoreplan Project Files\3900-3999\24-3972 Georgian Yacht Club\Drawings\3972 R0e.dwg



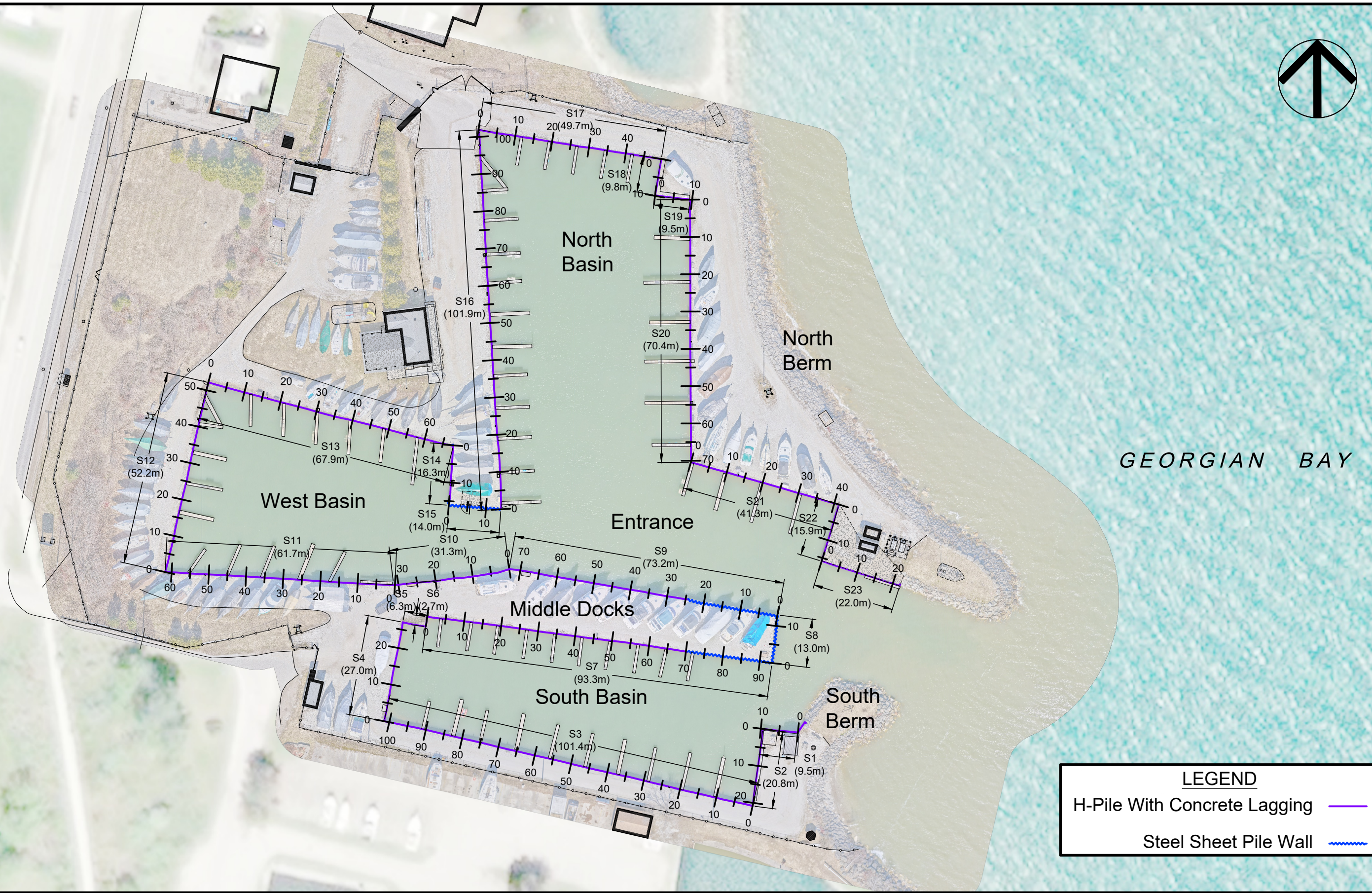
Elevation	
173.90 - 174.00	Light Green
174.00 - 174.25	Light Yellow-Green
174.25 - 174.50	Yellow
174.50 - 174.75	Light Orange
174.75 - 175.00	Orange
175.00 - 175.25	Dark Orange
175.25 - 175.50	Red-Orange
175.50 - 175.75	Red
175.75 - 176.00	Dark Red

Project #24-3972
Scale 1:1000
SHOREPLAN

Figure 2.1
Site Plan Topography and Bathymetry
Georgian Yacht Club

3 Dock Wall Condition

The objective of the inspection was to determine the overall condition of the dock walls and docks and provide recommendations for repair or rehabilitation if required. For the inspection the shoreline was divided into 23 segments (S1 to S23) starting at the south side of the harbour entrance and traveling clockwise through the harbour. Figure 3.1 shows a plan of the harbour with the shoreline segments. The following provides a brief description of the existing features of the marina basins and docks, summary of our findings above and below water and assessment of the dock walls.



LEGEND

H-Pile With Concrete Lagging ————

Steel Sheet Pile Wall ————

Drawing Location: S:\Shoreplan Project Files\Files\3900-3999\24-3972 Georgian Yacht Club\Drawings\3972 R0e.dwg

3.1 General

The dock walls that surround the shorelines of the GYC's harbour are either of king piles (KP) with lagging or steel sheet pile (SSP) walls. For these the walls the king piles are steel W sections (also known as an "I" beam) of various sizes. The KP are driven into lake bottom and precast concrete panels are used as lagging between piles. The KP is driven to a sufficient depth below the harbour bottom to resist soil pressure applied to both the pile and the lagging. Tie rods or anchors are attached to the king pile to help resist the force. Tie rods are secured near the top of the wall and sometimes near the bottom of the lagging if sufficient embedment depths cannot be achieved. The anchor for the wall is buried landward of the wall. It is anticipated that the wall anchor is approximately the height of the lagging back from the face of the dock wall. No details of the KP wall were available at this time to determine the anchoring system or embedment of the existing walls.

Steel sheet piles are typically steel profiled sheets that are driven into the lake bottom a sufficient depth to resist the soil pressure or toe pinned to bedrock. The wall is typically anchored in a similar way as the KP wall with a tie rod located at just below the top of the wall. A lower tie rod would not be expected with a SSP wall here.

3.1.1 South Basin (S1 to S7)

The South Basin has approximately 261 linear meters of dock wall and include segments S1 to S7. The dock walls are constructed of either KP or SSP walls. Most of the wall is a KP wall with only 23 m of SSP wall along the north wall west of chainage 70.5 m in segment S7. Photo 3.1 shows a view of the south basin, looking west. Photo 3.2 shows a view of the SSP dock wall in segment S7.

20 finger docks are located in the south basin, 16 are timber decks supported on piles and 4 are floating docks with timber decking and plastic floats. Three boats are berthed against the dock wall in segment S1 and S2. Two berths are against the dock wall in segment S4 and two against the wall at the west end of S7. Boats are stored in the winter along the walls of S5 and S7.



Photo 3.1 South Basin (10/04/2025)

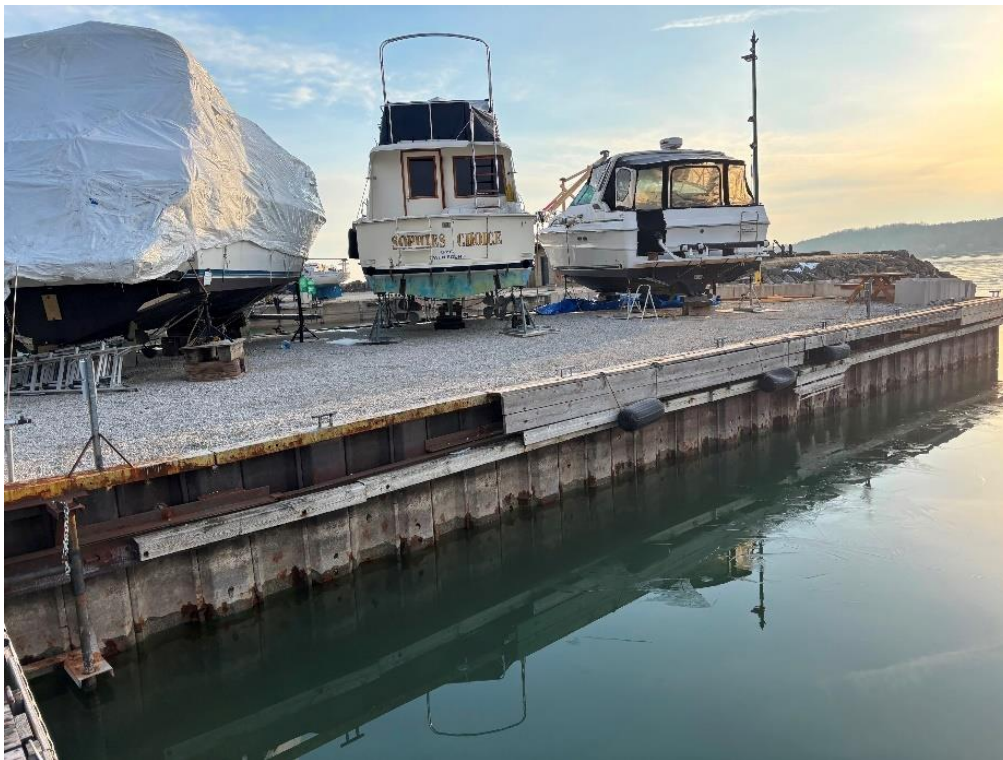


Photo 3.2 South Basin SSP Wall (10/04/2025)

3.1.2 West Basin (S10 to S15)

The West Basin has approximately 243 linear meters of dock wall. The West Basin includes the shoreline west of the south wall (S10) along the entrance channel and extends along the shoreline to the SSP south of the club house (S15). The dock walls are KP walls except for segment S15 where the dock wall is constructed with SSP. Segment S15 is approximately 15.9 m long. Photo 3.3 shows a view of the west basin, looking west. Photo 3.4 shows the SSP segment of dock wall.

The northwest corner of the basin is a corrugated steel pile (CSP) that outlets into the basin.

Along the north shore of the West Basin (S15) is the mast crane. 16 finger docks are in the west basin, 13 are timber pile-supported docks with one sharing a support pile. Three (3) are floating timber docks with plastic floats. Three (3) berths along the walls (S10 and S11). Boats are stored in the winter along the S10 to S12 and at the west end of S13.

3.1.3 North Basin (S16 to S20)

The north basin has approximately 241 linear meters of dock wall. The dock walls are KP walls. Photo 3.5 shows a view of the north basin, looking south.

22 finger docks located in the north basin. 19 are timber decked pile-supported dock, and three (3) are floating. 45 boats are currently berthed in the North Basin. However, one slip is not occupied. Boats are stored in the winter along the south end of segment S16 and S18 to S20.

3.1.4 Entrance Area

The entrance area dock walls were divided into the South Entrance (segments S8 and S9) and North Entrance (Segment S16 to S20). The South Entrance has approximately 86 linear meters of dock wall. The dock walls are constructed with SSP and KP. The east end of the wall in segment S9 are SSP. Approximately 24.5 m along the south wall (S9), the dock wall changes to KP with concrete lagging. No finger docks located along the entrance area south dock walls. Five (5) boats berth against the dock wall. Boats are stored for the winter along the top of the wall.

The North entrance area (Segments S21 to S23) has approximately 79 linear meters of dock wall constructed with KPs and concrete lagging. Four (4) finger docks are located along the entrance area north dock walls. Three (3) are pile-supported and one (1) is floating. Nine (9) boats berth at these docks. One is berthed against the dock wall in segment S22.

On the north side of the entrance (S23) is the gas dock and pump out. The gas dock facilities are set back from the shoreline. A timber dock is suspended from the face of the dock wall to tie of boats at the dock. The fuel dock has two above ground tanks and a building. Photo 3.10 shows a view of the tanks. Pump out tanks are also located here north of the fuel dock building (Photo 3.10).

Photo 3.6 to Photo 3.9 show views of the entrance area dock walls.



Photo 3.3 West Basin (10/04/2025)

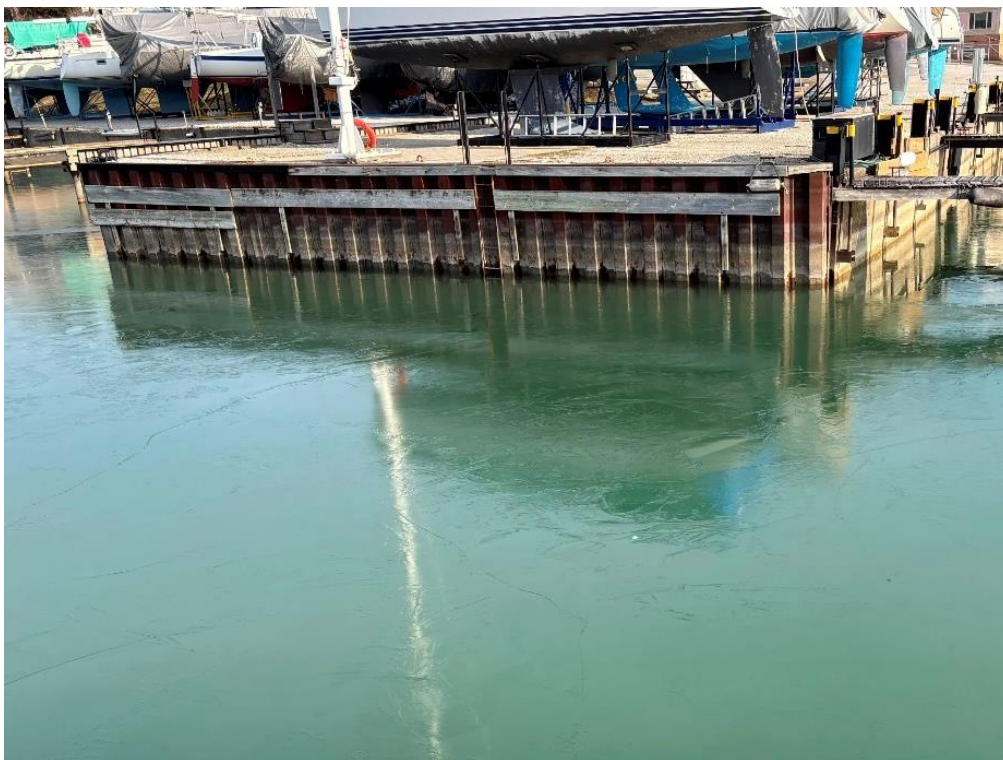


Photo 3.4 West Basin SSP Wall (10/04/2025)



Photo 3.5 North Basin (10/04/2025)



Photo 3.6 Entrance Area (10/04/2025)



Photo 3.7 Entrance Area North (10/04/2025)



Photo 3.8 Entrance Area South (10/04/2025)

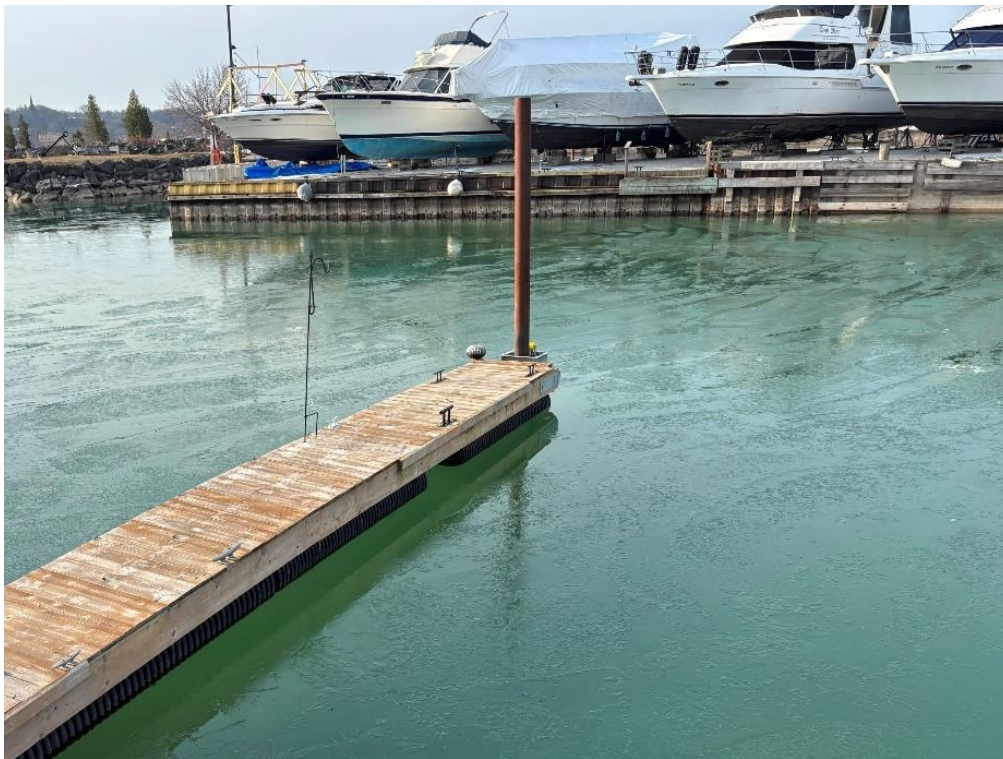


Photo 3.9 Entrance Area South SSP (10/04/2025)

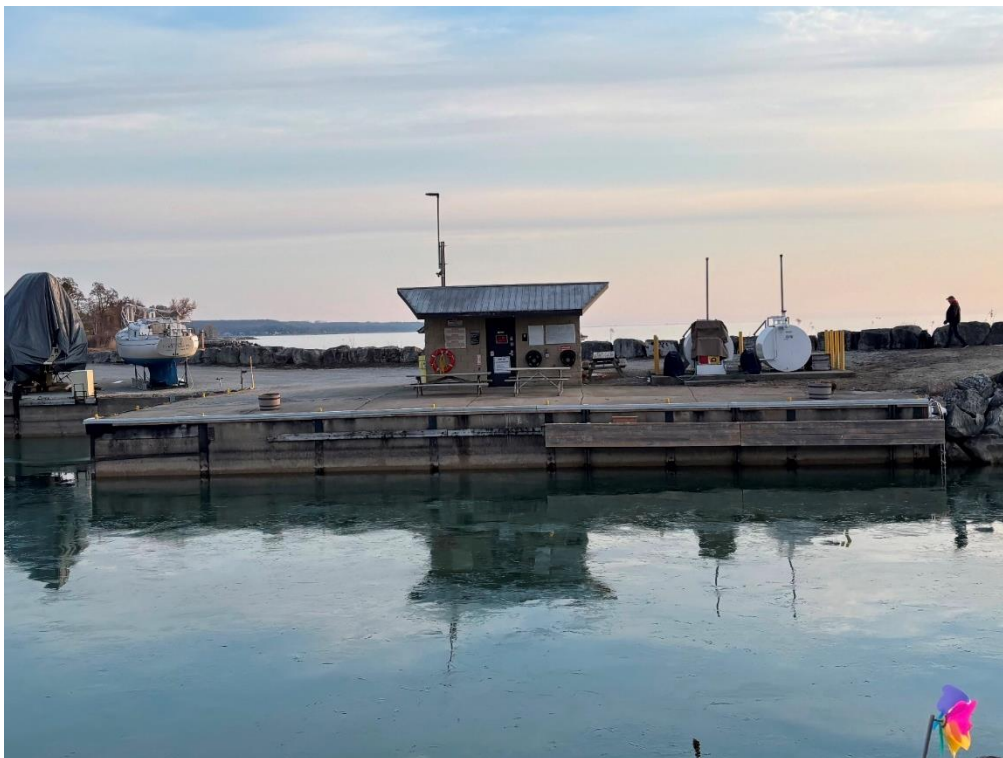


Photo 3.10 Fuel Tanks and Pump House (10/04/2025)

3.2 Field Investigations

Shoreplan carried out an above and below water (diving) inspection of the dock. The inspection took place on April 10th, 2025. The average water level at the time of the dive was approximately 0.18 m above chart datum or 176.18 m (IGLD85). The diving inspection was completed by a commercial dive crew from Galcon. The diver was equipped with a helmet mounted video camera and two-way communication with an on-board monitoring station. Both Shoreplan and Galcon representatives directed the diver. Audio recordings were overlain on the video and included the diver's observations, questions and instructions to the diver, and generation notes relevant to the project.

The inspection of the dock walls started at the southwest side of the South Basin, segment S1 and proceed clockwise through the harbour to segment S23 at the north side of the harbour entrance. Figure 3.1 below shows the location of the diving inspection and the associated chainages. The findings of the inspection are presented below. Table 3.1 provides the overall rating system used to describe the structure in the report. Appendix A has inspection notes taken by Galcon that were provided after the diving inspection. The diving video and photographs can be found at this link:

https://shoreplanengineering-my.sharepoint.com/:f:/g/personal/jgraham_shoreplan_com/EIP2F5nom-VNt3QEco_kCugBd8rTr5uqiRYzdUnQrIUscA?e=mUPJTP

Table 3.1 Condition Rating System

Overall Condition Rating	
Poor	At end of life, may have significant structural or functional deterioration
Fair	Nearing end of life/Functional but not showing concerning signs of deterioration
Good	Structurally sound but showing minor signs of deterioration
Excellent	New or as-new condition

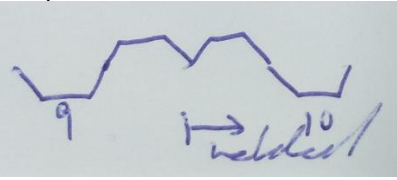
The following provides our findings of the above and below water inspections of the shore structures including the king pile and concrete lagging wall, steel sheet pile (SSP) wall, and finger dock structures.

3.2.1 Above Water Review

The condition of the structure’s king piles reinforced concrete slab, SSP, and other miscellaneous elements were recorded during the investigation. The observations are presented in Table 3.2 below. Photo 3.11 to Photo 3.16 show views of the structures taken above water.

Table 3.2 Above Water Findings

Chainage	Above Observations
South Basin	
S1 0+00	Minimal surface rust CS2 2' long crack along WL
S1 0+10	
S2 0+00	
S2 0+10	
S2 0+20	
S3 0+00	CS14 crack with piece chipped, spalling
S3 0+10	KP15 minimal rust
S3 0+20	CS18 horizontal crack at WL 4" wide, 1" deep chipped section gap between CS19 & KP19
S3 0+30	CS22 slight chipping K23 slight pitting CS23 vertical crack
S3 0+40	KP24 slight rusting CS24 vertical crack KP26 slight rusting
S3 0+50	KP27 slight pitting CS27 1" deep vertical cracks KP28 slight rusting
S3 0+60	CS30 vertical cracks
S3 0+70	CS35 diagonal cracks
S3 0+80	CS36 large crack running along corner KP37 slight rusting KP38 slight rusting
S3 0+90	KP40 slight rusting & pitting KP41 Slight rusting
S3 0+100	
S4 0+00	CS45 5 holes, 2" dia., 5" deep; one drain hole KP47 slight rust
S4 0+10	CS50 1" gap from KP51 CS51 6"x6" section chip at corner triangle
S4 0+20	CS52 Concrete in 1" of BB52
S4 0+26.2	CS53 large horizontal crack
S5 0+00	CS54 is the corner KP55 slight rust, is in the middle
S5 0+6.7	KP56 is the outer corner CS56 slight gap between concrete and P56
S7 0+00	CS59 top corner chipped KP61 slight rust

Chainage	Above Observations
S7 0+10	CS62 1" gap to KP62
S7 0+20	
S7 0+30	Shoe prints from CS68- CS71
S7 0+40	KP69 slight rust CS71 piece of concrete missing from the top of slab
S7 0+50	
S7 0+60	
S7 0+70	
S7 0+80	SSP wall begins SSP2 slight pitting SSP3, slight rust, hole cut in sheet showing 1" rocks SSP9 slight rust and pitting SSP15 heavy rust at WL SSP19 rust at WL SSP21 heavy rust at WL
S7 0+92.8	SSP28 heavy rust at WL
Entrance Area South	
S8 0+00	SSP wall continues SSP1 heavy rust near WL SSP5 heavy rust on knuckle at WL SSP7 mild rust at WL Access ladder at approximately 0+6.5
S8 0+10	SSP9 foldable ladder SSP10 heavy rust at knuckles SSP14 slight rust at WL
S8 0+13.6	SSP15 last out pan SSP16 corner in pan
S9 0+00	WS10 (SSP wall continues) SSP0 heavy rust at WL SSP3 minimal rust at surface
S9 0+10	SSP8 tilted inshore slightly, 2 in pans between SSP9 and SSP10 are welded together:  SSP13 mild rust at WL
S9 0+20	SSP17 mild rust at WL
S9 0+30	SSP20 the next 3 SSP sheets are all outpans SSP20 is the "last outpan" SSP21 is the "first full outpan" 3" gap between 20 inpan and SSP21 Outpan corner welded down center to a half inpan SSP24 mild rust SSP26 welded to plate then I-beam
S9 0+40	CS80 extends behind SSP wall KP83 heavy rust at WL CS83 gap between P84 CS84 diagonal crack

Chainage	Above Observations
S9 0+50	CS85 top corner is missing CS86 top corner is chipped, crack in the middle near P86 CS87 gap between P87 and slab
S9 0+60	P90 ¼" deep pitting at WL CS93 wood panels
S9 0+70	
S9 0+73	
West Basin	
S10 0+00	KP97 Plate welded to cover of CS97
S10 0+10	
S10 0+20	KP101 light rust CS102 1" deep hole
S10 0+30	
S10 0+31.3	
S11 0+00	KP109 light rust near waterline
S11 0+10	CS110 2 holes drilled just below the top CS111 3ft water depth
S11 0+20	
S11 0+30	
S11 0+40	Slight rust on piles
S11 0+50	
S11 0+60	
S12 0+00	7" drain hole located on third concrete panel KP128 6" plate welded over CS128 CS128 cracked
S12 0+10	KP130 surface rust at WL
S12 0+20	
S12 0+30	KP138 light surface rust CS138 vertical/horizontal cracking
S12 0+40	Slight rust and cracking
S12 0+50	CS143 600 mm diameter outfall culvert in corner, cut into the concrete
S13 0+00	CS144 runs behind WS14 CS146 ¾" gap between P146
S13 0+10	CS147 horizontal crack
S13 0+20	
S13 0+30	
S13 0+40	Slight rusting, little cracking
S13 0+50	Slight rusting, little cracking
S13 0+60	6.5" diameter pipe located on last concrete panel
S13 0+65	KP165 corner with 2 SSP sheets CS165 1 ½" gap from KP165
S14 0+00	KP167 rust near WL, plate welded on face of I-beam
S14 0+10	KP168 ¼" pitting near WL
S14 0+16.2	Slight rust & slight cracking

Chainage	Above Observations
	CS170 SSP anchored by 3 points, 3 outpans to corner
S15 0+00	WS17 Outpan 1 surface rust Outpan 17 ladder to surface (approx. 0+08) surface rust near waterline
S15 0+15	Outpan 27 light surface rust, end of SSP wall
North Basin	
S16 0+10	*KP171 start/corner – C.S. **light cracking/chipping near waterline KP173 pitting & rusting throughout
S16 0+20	
S16 0+30	KP182 rusting & pitting near water line, consistent along wall
S16 0+40	CS184 diagonal crack throughout slab, 2" wide ½" deep CS185 diagonal crack throughout slab, 2" wide ½" deep
S16 0+50	
S16 0+60	
S16 0+70	CS195 very little chipping/cracking at WL P196 very little rust CS197 little damage
S16 0+80	CS198 chipping above WL, big cracking throughout sections diagonally from top to bottom
S16 0+90	CS201 cracking on the right corner, otherwise no damage
S16 0+101.3	CS203 light chipping
S17 0+00	KP204 in the corner, flush with W518 KP204-KP206 little to no rust
S17 0+10	C207 & 208 slight chipping KP209 slight pitting
S17 0+20	
S17 0+30	KP213 Light surface rust Concrete slab consistent across these slabs
S17 0+40	
S17 0+47.5	Wall ends, I-beam butts into next wall
S18 0+00	KP220 was the corner KP222 corner plate welded to next wall to pair them
S18 0+10	
S19 0+00	Could not fit under floating docks
S19 0+10	
S20 0+00	
S20 0+10	KP229 – P231 minor chipping, cracking, pitting or rusting (for both the concrete slab and I-beams)
S20 0+20	CS233 light chipping at WL CS234 chipping worsens
S20 0+30	KP237 light surface rust & pitting at WL
S20 0+40	KP238 pitting at WL KP240 light pitting at WL & light cracking in the CS
S20 0+50	CS242 light chipping at WL, 3/8" deep, 2' dia. CS243 2" dia. holes

Chainage	Above Observations
S20 0+60	CS 246 Hairline cracks
S20 0+70	CS248 Divots, chipping, minor deterioration, end with an angle iron welded into I-beam of next section
Entrance Area North	
S21 0+00	KP250 little pitting & rust, consistent
S21 0+10	KP252 little pitting & rust, consistent
S21 0+20	
S21 0+30	CS256 consistent chipping/pitting across concrete blocks
S21 0+40	
S21 0+41.4	CS261 light chipping, wall runs behind
S22 0+00	CS263 light chipping at WL, all very consistent KP263 pitting 1/10" – 1/8", light surface rust
S22 0+10	Backshore is a reinforced concrete slab. Slab is cracked.
S22 0+15.9	
S23 0+00	CS267 light chipping KP267 light rusting/pitting KP268 light rust, mild pitting, plate welded over top of it 3/8" top to bottom
S23 0+10	CS270 light chipping
S23 0+23.4	Ladder at the end

*KP = King Pile; SSP = Steel Sheet Pile; CS = Concrete Slab

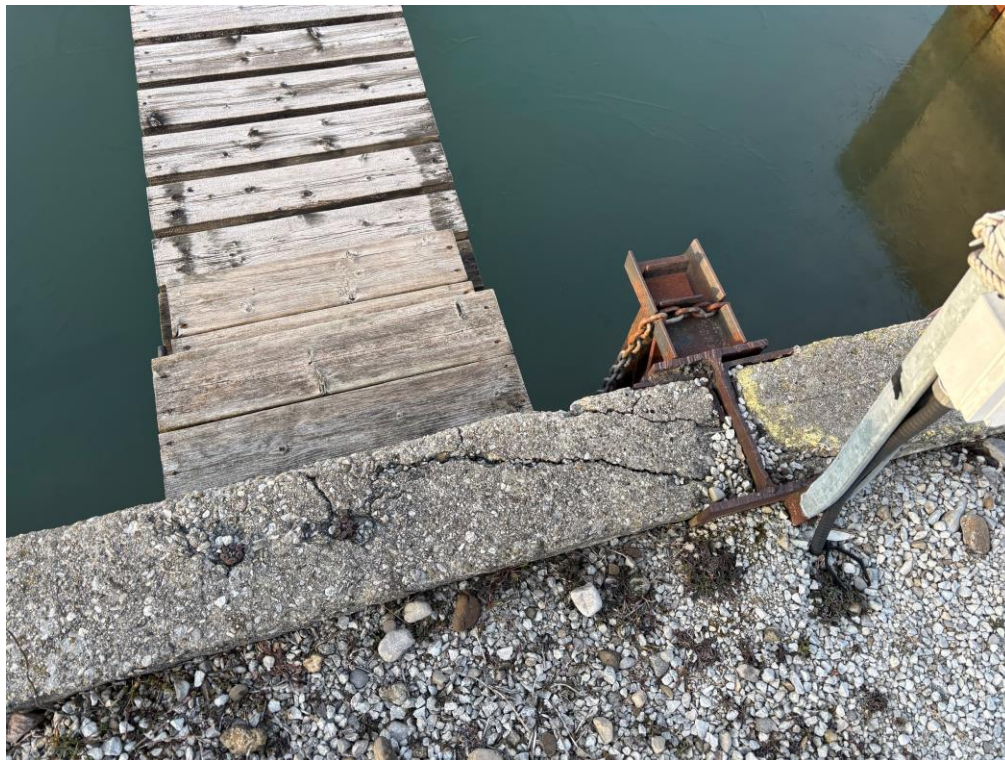


Photo 3.11 Cracking of Concrete Panel at S7 (10/04/2025)



Photo 3.12 Exposed Concrete Panel Rebar at S9 (10/04/2025)



Photo 3.13 Spalling of Concrete Panel at S10 (10/04/2025)



Photo 3.14 Cracking and Tilting of Concrete Panel (10/04/2025)



Photo 3.15 Tilted Concrete Panel (10/04/2025)



Photo 3.16 Leaning of Basin Walls at S4 (Left) and S13 (Right) (10/04/2025)



Photo 3.17 Leaning of North Basin Wall at S16 (10/04/2025)



Photo 3.18 Splitting of SSP Knuckles (10/04/2025)



Photo 3.19 Pipe Outlet at S12 (10/04/2025)

3.2.2 Underwater Review

A summary of the diving inspection findings is presented in Table 3.3. Photo 3.20 to Photo 3.27 show views of the structure taken from the diving video.

Table 3.3 Underwater Findings

Chainage	Thickness WL (mm)	Batter (degrees)	Underwater Observations
South Basin			
S1 0+00	12.6	1.75" 1.75"	KP1 Hard sand bottom, MG CS2 MG CS3 1" gap between slab and lake bottom, 2 cracks full height of section
S1 0+10	10.8	1"	CS4 1/2 – 4" gap from lake bottom KP4
S2 0+00	7.1	2.75"	KP5 ends at WL CS5 crack from WL to 5' below CS6 slight MG KP7 slight pitting CS7 1" – 6" gap from lake bottom
S2 0+10	10.9	2 1/4" 2.5"	KP8 CS8 1" gap from the lake bottom, crack in center full height CS9 crack in center full height, slight MG CS10 crack in center full height
S2 0+20	10.6		KP11
S3 0+00		-1 3/8"	CS12 gap between the corner of slab and lake bottom CS13 vertical crack through full height
S3 0+10			CS15 Clayey bottom Dock 1 slight movement CS16 hard stone bottom CS17 2" wide horizontal crack 1 1/2" under WL with chipping
S3 0+20	10.1	1"	CS18 diagonal crack full height of slab KP20 CS20 horizontal/vertical cracks 2' below WL
S3 0+30			CS21 slight marine growth, 2" wide, 1" deep crack CS22 vertical crack full height
S3 0+40			CS25 vertical/horizontal crack full length of slab, 4" deep spall CS26 2"x2" spall with vertical cracks
S3 0+50	7.6	2 1/2"	KP28 KP29 slight chipping 2" gap at lake bottom

Chainage	Thickness WL (mm)	Batter (degrees)	Underwater Observations
S3 0+60			
S3 0+70			CS35 cracks on slab near lake bottom
S3 0+80	11.1	plum	KP36 CS36 sand bottom
S3 0+90			C39 crack along the bottom CS42 1"x1" hole, vertical cracks CS43 water depth 6"
S3 0+100	8.3	-1/2"	KP44
S4 0+00	10.2	3 3/4"	KP46 CS46 vertical cracks
S4 0+10	10.1	3 1/4"	KP49
S4 0+20			
S4 0+26.2	10.6	plum	KP53
S5 0+00	12.7	plum	CS54 5" gap from lake bottom KP55 MG, ends 4" below WL
S5 0+6.7			
S7 0+00	10.4	-3"	KP57 Gap between wall S6 & S7 CS58 3-6" gap between the slab and lake bottom, hard clay bottom with stones
S7 0+10			
S7 0+20	10.8	1 1/8"	KP65 Footprints are visible, stamped into the concrete panel
S7 0+30			CS68 MG, 3" gap from lake bottom
S7 0+40	11.1	1 3/8"	CS69 3" gap from lake bottom KP71
S7 0+50			CS73 1" gap from lake bottom, diagonal crack
S7 0+60			CS78 diagonal crack, 2" gap from lake bottom
S7 0+70	9.9	2 1/4"	KP79 CS79 diagonal crack, end of piles and concrete slabs, down to lake bottom
S7 0+80	11.1	7"	All sheets are 2 stack and welded 4'-6' from lake bottom SSP0 SSP4 holes cut 2" under WL SSP5 slight MG SSP9 slight rust and pitting SSP11 pitting 1/4" deep SSP13 SSP18 MG SSP20 slight pitting
S7 0+92.8	9.1	1 1/2"	
Entrance Area South			

Chainage	Thickness WL (mm)	Batter (degrees)	Underwater Observations
S8 0+00	8.1 10.8	-1" (halfway up 6ft level) 2"	SSP0 heavy pitting SSP1 MG SSP2 mild pitting SSP3 MG at bottom SSP6 algae & rust spots SSP7 heavy rust spots, 4ft water depth
S8 0+10			SSP8 heavy rust begins below WL SSP10 & corner 6ft water depth SSP11 rust & pitting ¼" deep SSP14 heavy rust 2' - 4' below WL, heavy MG
S8 0+13.6	10.1	-3 ¼"	SSP15 heavy rust 2' below WL
S9 0+00	8.7	-2 ½"	SSP0 SSP3 heavy rust 4 ft below WL SSP5 heavy rust 4' below WL, heavy rust consistent 3' - 4' below WL
S9 0+10			SSP12 1" gap from lake bottom SSP13 2" gap from lake bottom, rust throughout, welds +/- 6" above/below WL
S9 0+20	11.2	3.5"	SSP14
S9 0+30	8.9	-5"	SSP25 slight MG SSP26
S9 0+40	10.0	-2"	KP81 2" spall, minimal MG KP82 rust above lake bottom KP83 sandy lake bottom CS83 mussel growth near lake bottom
S9 0+50			KP86 slight pitting/rusting
S9 0+60	8.1	1"	KP89 CS93 2" gap from lake bottom
S9 0+70			CS94 left side is touching lake bottom, right side has a 6" gap from lake bottom (on inshore side)
S9 0+73			
West Basin			
S10 0+00	10.0	-2" to -3"	KP96 Hard sand bottom CS97 divot 2' below WL, diagonal crack from WL to lake bottom
S10 0+10			CS100 sand/silt lake bottom, light MG
S10 0+20	11.8	3"	CS101 stone bottom KP102 CS103 2" wide crack from waterline to bottom
S10 0+30			
S10 0+31.3			
S11 0+00	13.3	2 ¾"	KP107 CS107 light MG, mussels at the bottom of the concrete slab CS108 hard sand bottom
S11 0+10			

Chainage	Thickness WL (mm)	Batter (degrees)	Underwater Observations
S11 0+20			
S11 0+30	13.3	3"	KP117 hard sand bottom
S11 0+40			CS121 mussel growth on the bottom of the concrete slab
S11 0+50			
S11 0+60	10.1	4"	KP126
S12 0+00		2"	CS127 concrete butts into WS13 CS129 cracked
S12 0+10			CS130 2" gap from lake bottom
S12 0+20			
S12 0+30	10.2	4 ½"	KP136 CS136 slight cracking ¼" below WL
S12 0+40			
S12 0+50			
S13 0+00	10.1	Plum 3"	KP144 CS144
S13 0+10			CS149 vertical crack full length of slab
S13 0+20			
S13 0+30	10.5	-6"	CS153 horizontal crack, chipped on inshore side P155 diagonal crack full height, chipped at bottom
S13 0+40			CS157 hard sand bottom CS158 ½" gap from lake bottom, light MG
S13 0+50			
S13 0+60			CS162 rocky bottom
S13 0+65	9.7	1 ¼"	CS165 wood debris on the bottom, 1 inpan and outpan on corner P165
S14 0+00		1 ½"	CS166
S14 0+10			
S14 0+16.2	12.9	plum	KP170
S15 0+00	10.7	plum	Heavy rust 2' above bottom (common among all sheets) SSP1 MG SSP5 heavy rust on knuckle SSP16 hard stone bottom
S15 0+15	12.5	plum	SSP27 MG
North Basin			
S16 0+10	10.4	5.25" kick-out	KP171 start/corner – Hard sand bottom, slight marine growth near waterline, I-beam welded to outer I-beam and sheet pile

Chainage	Thickness WL (mm)	Batter (degrees)	Underwater Observations
			KP173 pitting & rusting throughout, C.S. slight chipping from WL to 3 ft deep KP174 ¼ thick marine growth
S16 0+20			CS175 has chipping and 2" crack CS 176 has a crack throughout CS 177 Consistent marine growth KP178 has consistent pitting
S16 0+30	10.8	plum	KP181 CS 180- Hairline cracks, slight chipping CS 181- hard sand bottom 2 ½ ft deep
S16 0+40			Consistent marine growth CS184 diagonal crack throughout slab, 2" wide ½" deep CS185 diagonal crack throughout slab, 2" wide ½" deep
S16 0+50	11.2	plum	KP188 I-beams consistent light rust & pitting CS188 consistent chipping, tight to lake bottom, hard sand bottom
S16 0+60			CS191/192 light chipping, consistent marine growth
S16 0+70	10.4	2 5/8"	KP197 CS195 diagonal cracking KP196 minor chipping and cracking CS197 light chipping
S16 0+80			CS198 Bottom right corner damaged
S16 0+90			
S16 0+101.3		1"	CS203 No visible I-beam at the corner, concrete slab past P204/W519
S17 0+00	9.8	-1.25"	KP204 CS205 Light marine growth, hard clay bottom CS206 light chipping ≥ 2.25" deep, tight to floor
S17 0+10			C208 MG ≥ 1/8"
S17 0+20	10.1	1.25"	KP211 Hard sand bottom
S17 0+30			
S17 0+40			
S17 0+47.5	9.8	-1"	KP219
S18 0+00	10.0	1"	KP220 no imperfection, light MG, hard sand bottom CS222 consistent MG 5" under WL KP222
S18 0+10			
S19 0+00			Could not fit under floating docks
S19 0+10			
S20 0+00			
S20 0+10	9.4	½ "	KP229, shallow 18"
S20 0+20			Hard clay bottom Light MG

Chainage	Thickness WL (mm)	Batter (degrees)	Underwater Observations
S20 0+30			CS235 6" off the bottom face
S20 0+40	9.9	-1.125"	KP238 CS239 horizontal crack across the full width CS240 horizontal crack full width 2 ½ ' deep
S20 0+50			CS243 large spalling 2.5" wide, 20" long, ½ " deep,
S20 0+60	10.1	plum	KP246 Hard rock bottom
S20 0+70	8.9	2"	CS249 bottom right corner large crack
Entrance Area North			
S21 0+00			
S21 0+10			
S21 0+20	8.9	-1/2"	KP254
S21 0+30			
S21 0+40			
S21 0+41.4	9.9	Plum	KP261 Hard rock bottom
S22 0+00	9.8	-1"	KP262 cut in half, butted to previous wall, MG, hard bottom
S22 0+10			CS265 slight mussel growth
S22 0+15.9	10.2	-1.75"	CS266 I-beam butted to angle iron and welded, light MG KP266
S23 0+00	8.6	-3/8"	KP267 is in corner, angle iron butted and welded, 6ft deep, MG CS heavier MG P269 MG ½" thick, mussel growth starting at the lake bottom Hard sand bottom
S23 0+10			CS270 mussel growth heavier towards the bottom, angle iron to cap the corner that is welded to the I-beam
S23 0+23.4	9.7	5/8"	KP273

*KP = King Pile; SSP = Steel Sheet Pile; CS = Concrete Slab



Photo 3.20 Typical Rusting of KP at Water Line (10/04/2025)



Photo 3.21 Gap Between Concrete Panel and Lake Bottom (10/04/2025)



Photo 3.22 Spalling of Concrete Panel (10/04/2025)



Photo 3.23 Cracking of Concrete Panel (10/04/2025)



Photo 3.24 Cracking of Concrete Panel (10/04/2025)



Photo 3.25 Footprints in Concrete Panel at S7 (10/04/2025)



Photo 3.26 Rusting and Pitting of SSP (10/04/2025)



Photo 3.27 Weld Seam and Lift Holes in SSP (10/04/2025)

3.2.3 Summary of Findings

King Pile and Concrete Lagging Wall

Multiple types of KPs and SSP dock walls were observed along the marina. Most of the dock walls are constructed with KPs and concrete panel lagging. The concrete panels varied in thickness, between 190 mm to 200 mm. The panels were between 3 to 3.2 m wide and 3 to 3.5 m deep. Most KPs were measured to be 200 mm wide and 247 mm deep. The flange and web thickness were approximately 11 and 8 mm thick, respectively. Based on these measurements, the KPs are W250x49 sections. Larger KPs were also observed, but in smaller quantities and scattered around the basin. These larger KPs were found around the west basin and were measured to be 254 mm wide and 259 mm deep. The flange and web thickness were approximately 19 and 10 mm thick, respectively. Based on these measurements, these KPs are W250x73 sections. The KPs are anchored to tie rods measuring 30 mm in diameter. The tie rods are welded to a square gusset plate that is also welded to the flange of the KP. The tie rods appear to be relatively shallow or near the top of the wall as they are visible in some areas of the marina. Their elevations ranged from 177.4 to 177.8 m.

Above water inspections of the walls found that the concrete panels are in poor condition. Numerous diagonal and horizontal cracks can be seen running across the panel. The top face of the concrete is also showing signs of significant deterioration, cracking, and spalling of material. Concrete panels with significant spalling also exposed the rebar inside.

The KPs were observed to be in fair condition. No major damage to the pile was observed. The piles had signs of corrosion that are typical of marine environments. Some of the pile flanges have minor deformations, possibly due to blunt impacts from vessels in the basin. The dock wall condition is relatively consistent except for several areas. There are some sections of the dock wall where the KPs and concrete panels appear to lean forward into the basin. The batter measurements taken show that most of the piles are leaning forward by 2-3 degrees. Some sections of the dock wall also had concrete panels that appear to have settled into the lake bottom. Some panels are much lower than the adjacent panels. Some panels are also tilted in between KPs, possibly due to loss of fill or differential settlement. Observations of the backshore behind the concrete panels also show that there may be loss of backfill material through the bottom of the concrete panels. Several locations, such as the southwest corner of the south basin, appear to be sunken. These areas also coincide with locations of the marina with higher lake bottom.

The underwater inspection reviewed that the KPs and concrete lagging panels are in poor condition. The diver noted that all piles appeared to have quite consistent signs of rusting, especially at the waterline. The thickness measurements show that corrosion thickness was between 1-4 mm on the flanges of the KPs. The diver noted that many of the concrete panels had severe cracking and/or spalling. All concrete panels had some degree of cracking visible. The diver also noted that some of the panels were not sitting directly on lake bottom. The gap between the lake bottom and the panel ranges from 12.7 mm to 150 mm.

Steel Sheet Pile Wall

Two types of SSP were encountered along the marina. The SSP that is installed around the south basin and most of the entrance area are U-sections (S7 0+70 to 0+93, S8, and S9 0+00 to 0+20). The SSP that is installed along the entrance area (S9 0+20 to 0+25) and S8 are L-sections.

The U-shaped sheets were measured to be approximately 450 mm wide, 100 mm deep, and 12.7 mm thick. These measurements would make the SSP profile similar to a thicker Larssen SL3 sheet. The L shaped sheets were measured to be 500 mm wide, 100 mm deep, and 6.7 mm thick. These measurements would make the SSP equivalent/similar to an L50 sheet. The L-section sheets appear to have been driven in front of the existing KP and concrete lagging wall. Segment S9 and S15 appear to be driven in front of the existing KP and concrete lagging wall. Tie rods were only observed for the U-section sheets. The tie rods were measured to be approximately 25 mm in diameter and were installed at in-pans or against an external L102x102x9.5 waler. The elevation of the tie rods was at approximately 177.3 m. An L150x150 steel angle cap ran across the top of all of the SSP walls.

The SSP appears to be in fair condition. Typical rusting of the sheets was observed, but no significant damage was noticed. Separation of the SSP knuckles at the top of the wall was observed on the south entrance area sheets. Weld seams and lifting holes were observed on most of the U-section SSP. It appears that the SSP was not driven with full length sheets and cut down, but rather shorter lengths of sheets were welded together to form longer piles for construction. The L-section sheets appeared to be in better condition than the U-section sheets.

Based on the underwater inspection, the SSP around the south basin and entrance area appears to be in fair condition. Similar to the KPs, the diver noted that the SSP has signs of corrosion mainly around the waterline. The thickness measurements show that the corrosion on the sheet piles are between 1-4 mm. The SSP at S15 appeared to be in much better condition. The thickness measurements taken at waterline at this location appeared to be thicker than the SSP at the top of the pile.

Several drain holes and pipe outlets can be found around the marina. A 50 mm diameter drain can be found along S4 at approximately 0+02. A 178 mm diameter drain can be found along S12 at approximately 0+08. A large 600 mm diameter corrugated steel pipe (CSP) can be found along S12 at approximately 0+52. A 165 mm diameter drainpipe can be found along S13 at approximately 0+65.

3.3 Dock Assessment

The following is a summary of the applicable codes and design conditions used to assess the dock wall. The applicable codes and standards for design of the dock wall structure include:

- National Building Code of Canada, latest edition
- CSA A23.3 – Design of Concrete Structures, latest edition
- CSA S16 – Design of Steel Structures, latest edition

The dock was analyzed to determine the theoretical remaining functional life. Recommended solutions are provided if the existing dock was determined to be nearing or at the end of its functional life.

Various types of loading were considered in the design of the dock wall. This includes dead loads, such as the weight of the structure, live loads from pedestrian use and vehicular traffic, and soil pressures caused by material placed on either side of the wall and ice loads applied to either side of the dock.

Hydrostatic pressures imposed by various possible water levels onto the dock wall was also considered. The design high water level on Georgian Bay at Owen Sound is 178 m IGLD85.

This section describes the parameters used in the assessment of the structure. Table 3.4 provides a summary of the design parameters.

All elevations presented in the table and this report are with reference to IGLD85 unless otherwise noted.

Table 3.4 Design Parameters

Design Water Levels	
High Water Level (DHWL)	178 m
Low Water Level (DLWL)	176 m
Live Loads	
Pedestrian	5 kPa
Vehicle/ Boat Storage	12 kPa
Dock Wall Elevations	
KP & Concrete	177.5~178.1 m
Steel Sheet Pile	177.6~177.8 m
Harbour Bottom Elevations	
KP & Concrete	173.1~175.1 m
Steel Sheet Pile	173.4~ 174.1 m

No geotechnical soil parameters were available to us at the time of the dock wall assessment. As such, typical soil parameters were assumed and used in the analyses of the dock walls. These properties are presented in Table 3.5 below. It is recommended that geotechnical investigations be completed for a more reliable analysis of the dock wall condition.

Table 3.5 Geotechnical Design Parameters

Soil	Saturated Unit Weight (kN/m ³)	Internal Angle of Friction ϕ	Ka	Kp
Soil Backfill	20	30	0.33	3.00

3.3.1 Dock Wall Analysis

SPW911 v2.40 (Pile Buck, 2001) was used to assist in computing the forces and moments on the wall for different load cases. The design low water level was used to analyze the dock wall as this condition produces the most critical effects on the system. The site plan and cross sections of the structure that was analyzed are presented in Figure 3.2 and Figure 3.3.

Loads applied from moored boats were not included in this assessment. Table 3.6 provides a summary of the unfactored design loads on the existing dock wall.

Table 3.6 Bending Moment and Loads on Existing Dock Wall

Location/Case	Max Bending Moment	Tie Rod Load
KP (DLWL; 12 kPa)	207 kNm	131 kN
SSP (DLWL; 12 kPa)	117 kNm/m	61 kN/m

These loads were compared to the capacity of the king piles and SSP. Based on the measurements obtained during the diving inspection, the KPs are determined to be W250x73 and W250x49 sections. Assuming a typical yield strength of 350 MPa, the corresponding moment resistance at the time of installation for the king piles are 310 and 180 kNm, respectively. Based on the measured thickness of the pile flanges and applying an additional 1.2 mm of rust to account for the 50-year functional life, the moment capacity is recalculated. The new design capacity of the piles are determined to be 269 and 149 kNm, respectively.

The SSP appear to be similar to an SL3 and L50 for the U and L-sections, respectively. Assuming a typical yield strength of 350 MPa, the corresponding moment resistance at the time of installation for the sheets is 173 and 70 kNm/m, respectively. As mentioned previously, the thickness of the U-sheets observed were thicker than an SL3 sheet. Adjusting for the thickness, the moment resistance of the U-sheets would be approximately 263 kNm/m. Based on the measured thickness of the sheets and applying an additional 1.2 mm of rust to account for the 50-year functional life, the moment capacity is recalculated. The new design capacities of the sheets are determined to be 187 and 53 kNm/m, respectively.

Based on the preliminary analysis of the dock walls, the larger king piles will have the sufficient capacity even after an additional 50-years, but they would no longer have a sufficient factor of safety. The smaller king piles do not have sufficient capacity at design conditions in the future. The U-sheets will have sufficient capacity even after an additional 50-years service life. The

smaller L-sheets have low capacities, but since they are driven in front of an existing king pile wall, the moment on the sheets are low. Table 3.7 below summarizes the dock wall moments and the expected capacities.

Table 3.7 Summary of Moments and Dock Wall Capacities

Type/Case	Max Bending Moment	Original Capacity	Future Capacity
KP (DLWL; 12 kPa)	207 kNm	310 kNm 180 kNm	269 kNm 149 kNm
SSP (DLWL; 12 kPa)	117 kNm/m	263 kNm/m 70 kNm/m	187 kNm/m 53 kNm/m

Similar calculations were performed for the tie rods, and they were determined to not have the required factors of safety for an additional 50-year service life.

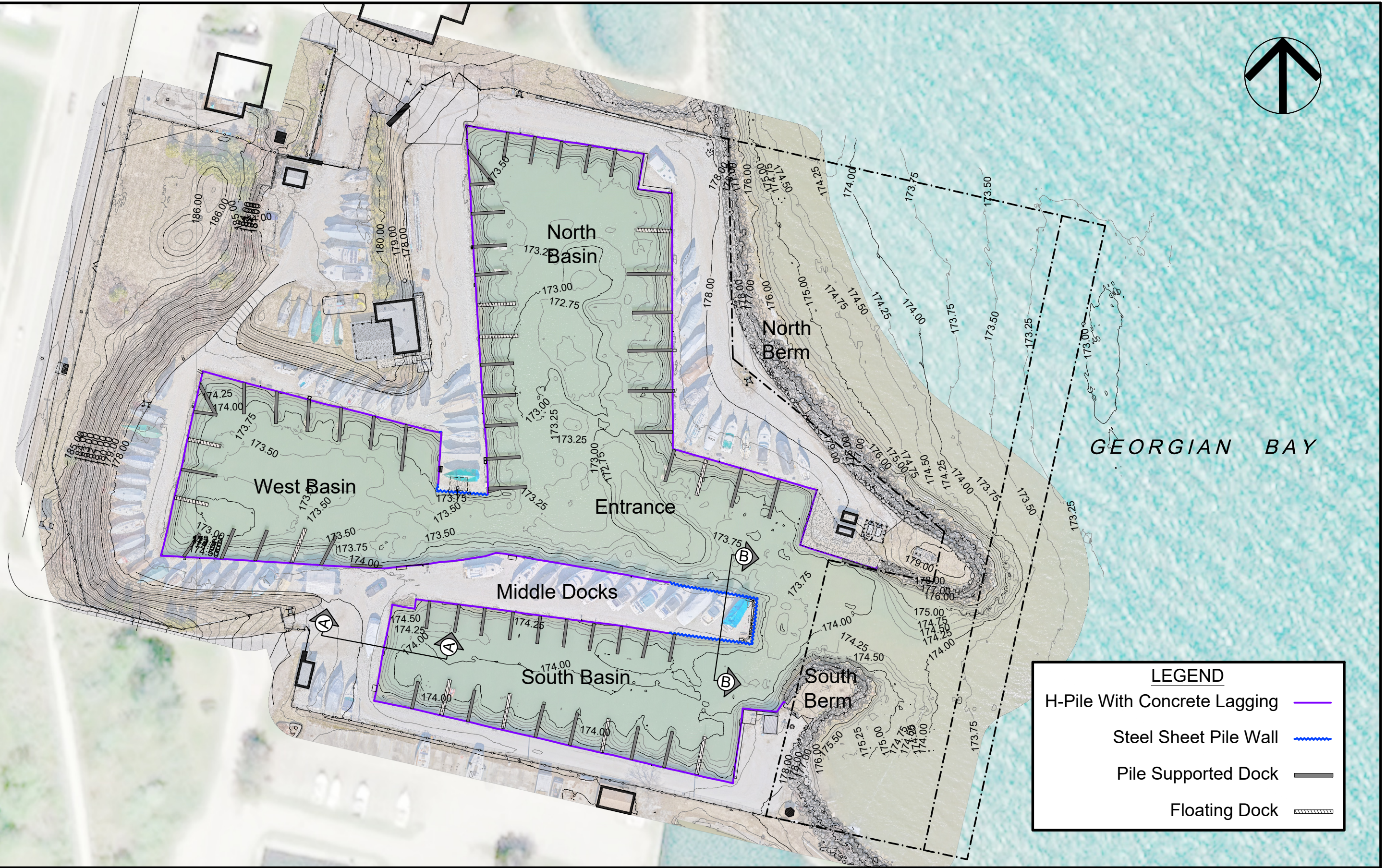
The overturning stability of the middle pier was also checked. It was determined that the SSP and KP dock walls required a total depth of approximately 9 and 10 m, respectively. As the diver did not observe toe pins, it is assumed that the piles were driven to the required depth to prevent overturning. Thermal ice forces are generally between 75 and 150 kN/m depending on site conditions. Based on this range, the pier has adequate resistance. Dynamic ice forces due to the movement of ice caused by water current and/or wind were ignored as this would be unlikely to occur within the marina.

The dock walls were assessed at low water conditions along with an anticipated 12 kPa surcharge due to heavy vehicles such as cranes. During normal service conditions and where the height of the wall above the lake bottom is less than 3m (10'), the moments on the dock walls would be lower, giving some factor of safety. Today if the water level was at 176.5 m and a 5 kPa surcharge (pedestrian live load) were applied, the smaller piles would currently have a factor of safety of 1.1. If the water level were to rise to 177.0 m the factor of safety increases to 1.2. The larger king piles have a greater factor of safety today.

GYC should monitor the dock walls especially during periods of low water levels. Indicators of wall movement includes

- tilting of the wall,
- cracks in the ground adjacent the wall,
- lowered fill material or needing to “top up” the gravel along the wall, and/or
- broken tie rods.

We recommend GYC restrict access along the back of the wall. No live loads (vehicles, boat storage or other concentrated loads) should be located within 3 m of the back of the wall where the walls are constructed with the smaller king piles (W250x49). We also recommend that GYC make plans to replace the KP walls.

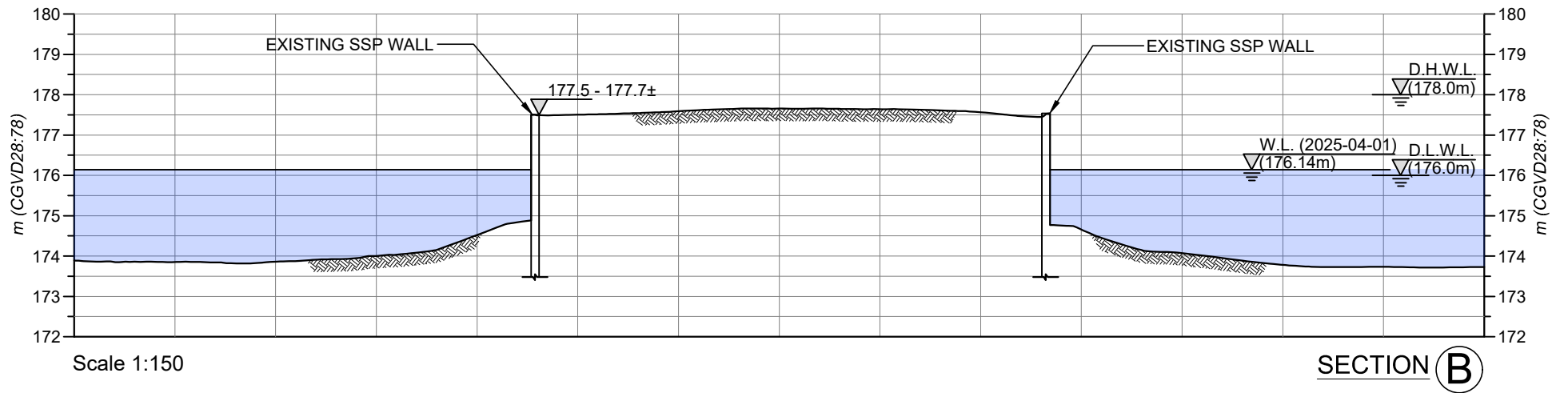
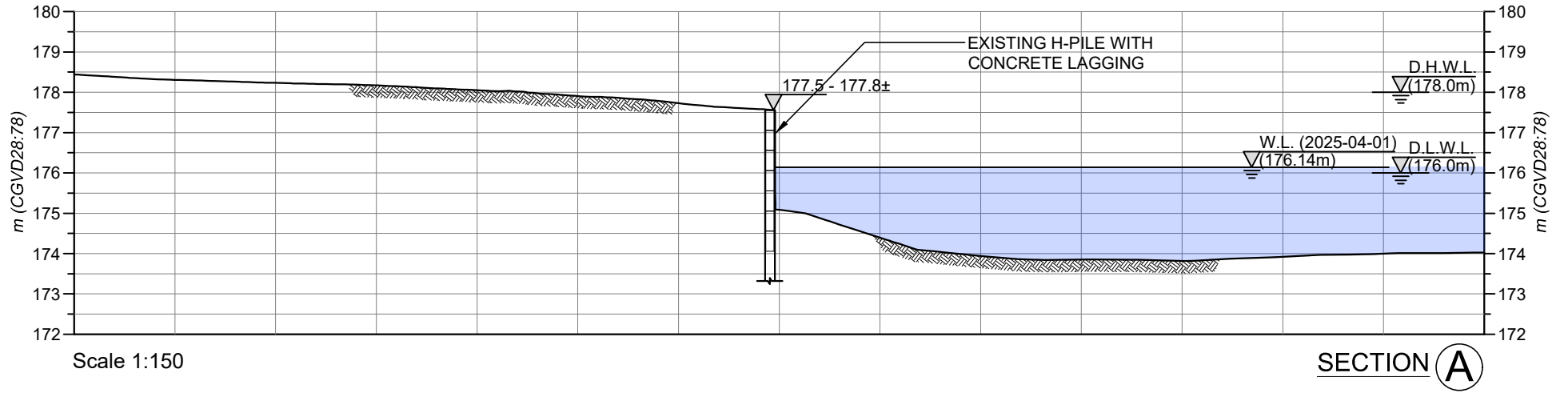


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Project #24-3972
Scale 1:1000
SHOREPLAN

Figure 3.2
Existing Site Plan
Georgian Yacht Club

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Project #24-3972
Scale 1:150
SHOREPLAN

Figure 3.3
Existing Typical Sections
Georgian Yacht Club

4 Rock Protection

4.1 North Berm

The north berm is located east of the north basin along a peninsula/breakwater that shelters harbour forming the entrance channel. It is exposed to wave action from Georgian Bay (Owen Sound) and is protected with a revetment. Details of the structure's construction are not available to us. The revetment has various sized stone material ranging from rip rap (200 to 600mm diameter), boulders (600 to 900mm) and armour stone (1 to 3 tonnes pieces). Mixed in the revetment is a small amount of concrete rubble, timbers/logs and debris. Along the crest of revetment is a row of amour stone. Photo 4.1 to Photo 4.3 shows view of the north berm shoreline.

The front face sloped at approximately 2 to 1.5 horizontal (h):1vertical (v). The stone material is irregularly placed and appears to have shifted and moved either due to wave action or ice. The slope flattens where the structure curves toward the entrance. It is steepest at the entrance to the harbour. Midway along the structure there is a large quantity of rip rap and boulder material on the upper slope. Its not clear if this material was part of the original structure or placed later as a repair. Underwater the slope appears to be a mixture of gravel and stone that extends to the lake bottom. The gravel is likely a deposit which covers the placed rock material.

Along the sheltered side of the breakwater (entrance channel) the revetment slope is steep approaching 1.5h:1v. Finer material appears to cover the stone material forming the breakwater underwater.

The peninsula has a perimeter gravel road that provides vehicular access to the gas dock. Where the peninsula extends out into the Sound forming the entrance breakwater it has a grassed area. The gas dock and pump out are in this area.

Overall, the rock structure is in fair to good condition. It appears to be functioning adequately with some areas requiring addition stone along the north side of the entrance breakwater. No signs of wave damage were noted along the back side of the structure during the site visit. The structure would benefit from addition stone in the steeper areas.



Photo 4.1 View of North Berm (2024 10 18)

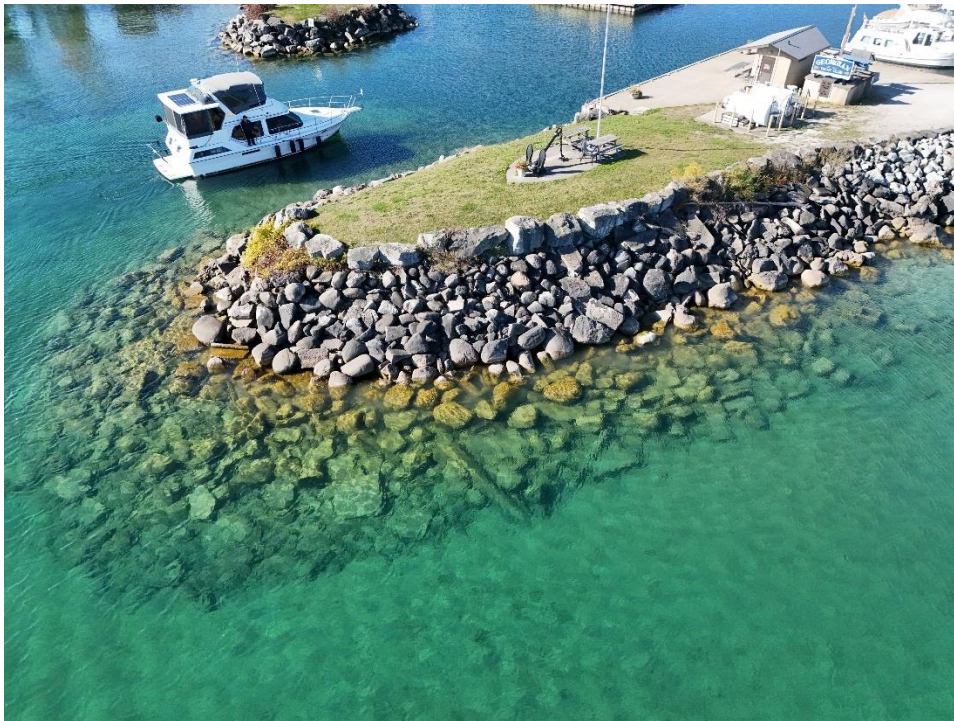


Photo 4.2 View of North Breakwater (2024 10 18)



Photo 4.3 View of South Side of North Breakwater (2024 10 18)

4.2 South Berm

The South Berm is located along the south side of the entrance channel east of the south basin. The shorelines of this peninsula/breakwater are protected with a stone revetment with similar sized material as the north berm. The revetment is flattest on the lakeside and steepens as it turns into the entrance channel. The north side of the berm appears to be over-steepened and may have been damaged due to wave action or ice. This is the only face that is exposed to wave action. South of the entrance along the toe of the revetment is an accumulation of gravel and fine sediment which is used as a beach/ swimming area at low water levels. Access steps to the water are provided over the revetment to the beach. Adjacent the harbour entrance is a grassed landscaped area and picnic shelter. The south berm is accessed by a gravel access road that runs along the south property line. Photo 4.4 and Photo 4.5 show views of the South Berm.

Overall, the rock structure is in good condition except the north face at the entrance which is in fair condition. It appears to be functioning adequately with no signs of wave damage were noted along the back side of the structure during the site visit. Some low spots were noted along the back of the structure most likely due to loss of fill material between gaps in the stone. The structure would benefit from addition stone in the steeper area.



Photo 4.4 View of South Breakwater (2024 10 18)

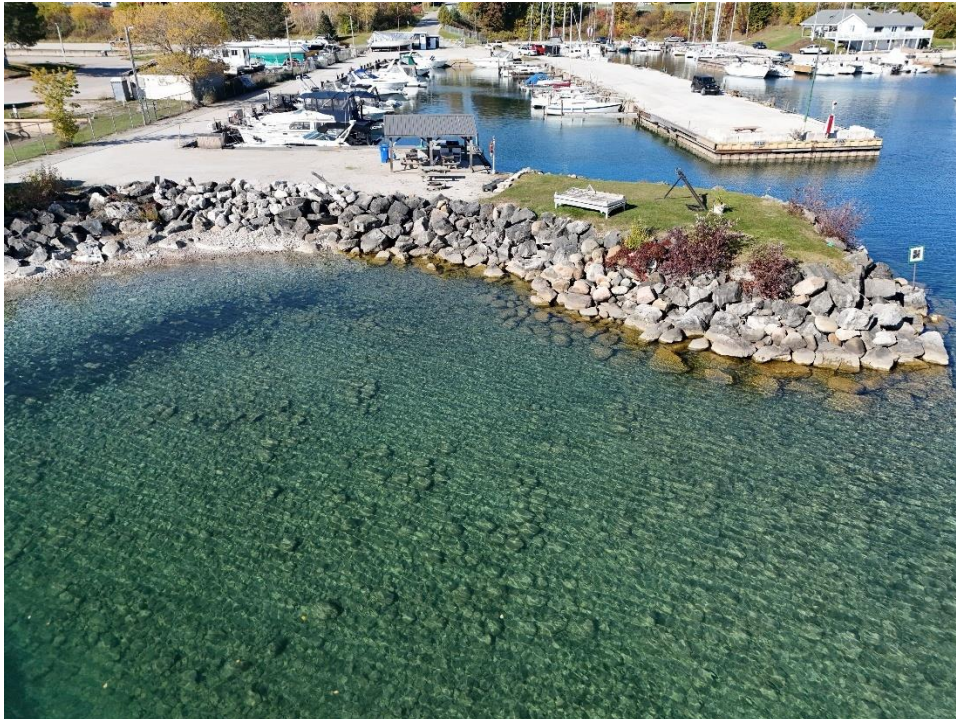


Photo 4.5 View of South Berm (2024 10 18)

5 Docks and Marina Layout

GYC is a private club that has three distinct mooring basins with additional boats docked against the entrance channel walls. GYC currently has 141 slips. Figure 5.1 shows the existing layout of the marina. Photo 5.1 shows a plan of the boats docked at each slip. The following sub-sections provide a description of the existing marina including replacement costs for the existing docks and other marina layouts that might be considered in the future.

5.1 Existing Marina Layout

The South Basin has 48 boats berthing in the basin with 2 of those boats sharing slips with another boat. Most are at finger docks with several berthed against the dock walls. The West Basin has 34 slips with 31 boats docked at finger docks and three (3) along the walls. The North Basin has 45 boats berthed at finger docks. The plan shown in Photo 3.1 shows one slip not occupied. The entrance channel has five (5) boats berth against the south dock wall. The north side of the entrance channel has nine (9) boats berth at finger docks and along the dock wall. The total number of slips in the marina is 141 including the berths that are doubled up.

Currently, most of the docks are fixed docks spanning supported between the dock wall and a pipe pile driven into the lake bottom. The connection of the dock to the wall is shown in Photo 5.2. This connection allows the dock height to be adjusted with water levels. Several docks in the marina are floating docks with plastic floats. These docks are also secured to the wall with some anchored with the vertical pile and other with concrete anchors and chain. Photo 5.3 and Photo 5.4 show the two different types of systems.

The docks are in fair to good condition. We understand that ice conditions in the harbour resulted several docks being shifted and damaged in the ice. We recommend that the GYC plan to replace the docks with a more robust system. This can be done over time as funding allows.

A similar system of fixed docks could be constructed. These docks would be manufactured by either by an Ontario dock supplier or a local contractor.

Floating docks with steel float could also be considered. They would utilize a similar anchoring system with I beams attached to the dock wall with horizontal members that can rise and fall with water levels. Adjusting stairs are used to access the docks from land. The height or number of steps can be adjusted with water levels. These docks are designed to remain in the water in the winter.

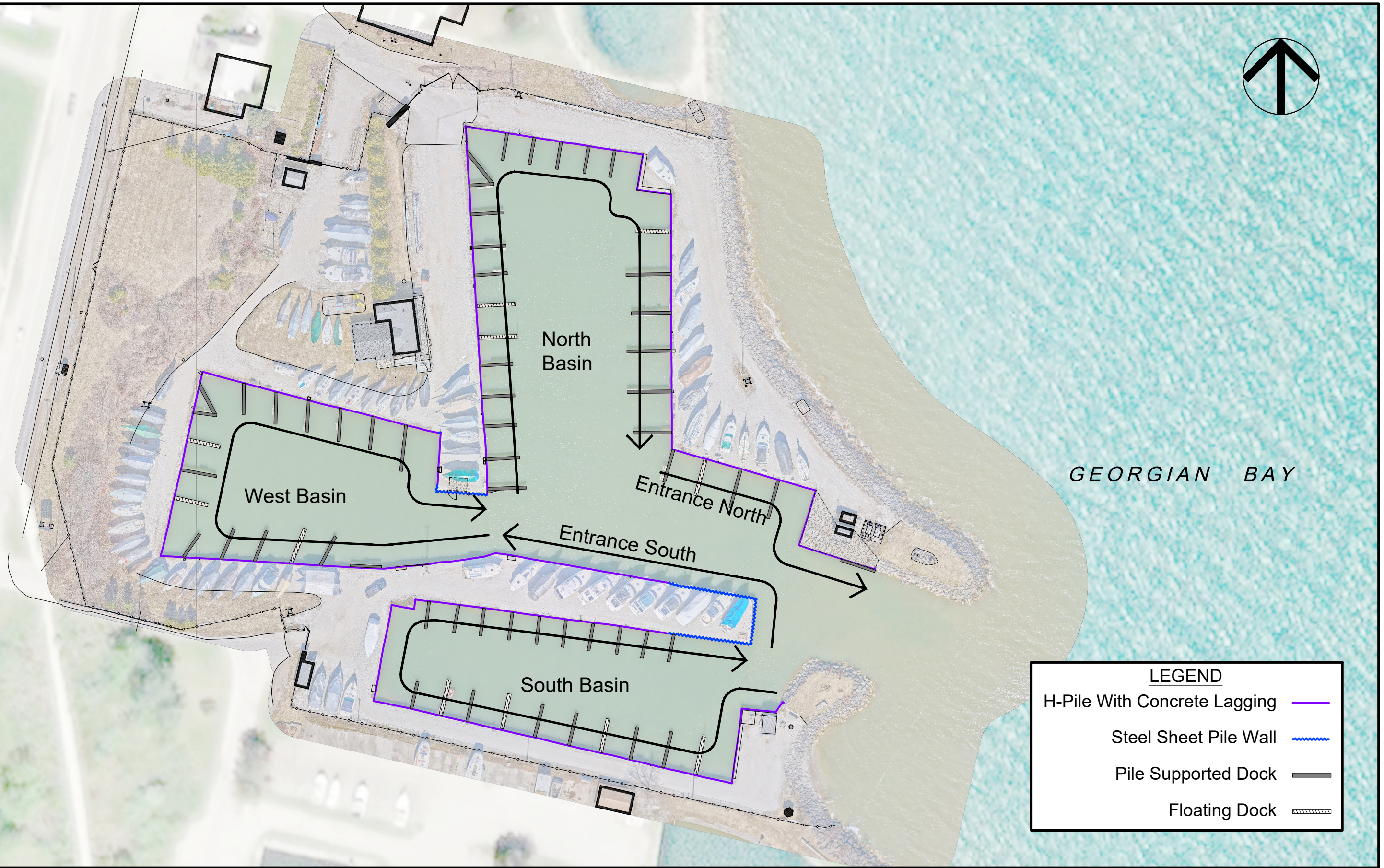
The costs of the fixed or floating docks are similar. There are advantages and disadvantages to both dock systems. Fixed docks allow for a level surface from the dock wall. Maintenance costs are typically low because the primary dock structure is out of the water. Fenders are required to prevent boats from going under the dock or damage to the hull of the boat. Fixed docks are not adjusted for water levels. Stepping down into the boat from the elevated dock or tying off to mooring cleats on a fixed dock can be challenging at low waters. Fixed docks can readily be designed and constructed by local contractors. A marine contractor is required to install the anchor piles and possibly assist with connection of the piles.

The current dock layout supports fixed docks because the anchor pile can be situated within the footprint of the dock and does not interfere with the other slips as a chain and anchor system would. The anchoring system relies on the anchor pile being drive adequately into the lake bottom to resist the applied loads which requires a marine contractor to drive the piles to a specified depth. The vertical anchor pile can be impacted by ice in the harbour. Ice impact forces can either be horizontal due to thermal expansion or vertical forces ice adhesion. We understand that GYC currently has fixed docks and have not reported issues with the piles in the harbour. If a pile is jacked or loosened by ice forces, it can be more challenging to replace the anchoring system because it requires marine based equipment.

Floating docks also have advantages and disadvantages. A floating dock provides a level surface that adjusts with the water levels making getting in and out of the boat easier. However, adjustable steps or ramps are required to access shore. A floating dock system with a main dock and fingers can be an efficient use of space with a single access point via a ramp. However, the current dock layout does not support this dock configuration. Berthing against a floating dock allows the boat to lay against fenders with tie off points easily accessible from the boat.

The design life of a floating docks is typically 25 to 30 years for commercially available docks. At the end of a floating docks design life, they it will start to lose flotation. As with all docks, maintenance and repairs will be required to extend their life. For floating docks this may also include repairs to steel floats or replacement of plastic floats. Typically, this work would be done on shore or with divers. Floating docks can be designed to be anchored to fixed vertical piles like fixed docks.

Both docks and anchor piles can be damaged due to ice conditions. We understand that GYC has experienced damage to ice damage to their floating docks. Ice can adhere to fixed piles and changes in water levels can lift or 'jack' the pile. An ice suppression system such Kasco (Kascomarine.com) or "Ice Eaters" could be considered in the marina basins. These units can circulate water which can bring up the warmer water from the lake bottom. Dock manufacturers can provide recommendations for de-icing or ice suppression equipment based on their dock system and your site conditions.



GEORGIAN BAY

LEGEND	
H-Pile With Concrete Lagging	—
Steel Sheet Pile Wall	—
Pile Supported Dock	—
Floating Dock	—

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Project #24-3972
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SHOREPLAN

Figure 5.1
Marina Layout
Georgian Yacht Club



Photo 5.1 Slip Layout (2024 10 18)



Photo 5.2 View of Fixed Dock Wall Connection



Photo 5.3 View of Floating Dock with Pile Anchor



Photo 5.4 View of Floating Dock

5.2 Other Marina Layouts

Other marina layout options were considered as part of this assignment. We understand that GYC owns a water lot to the east of the harbour. The area would need to be sheltered from wave action to utilize this area to expand the marina. It would require a breakwater along the north and east sides of the property. GYC has landscape plans (see **Error! Reference source not found.**) showing a marina basin here. Based on the bathymetric data surveyed. Dredging would be required to optimize this layout. The proposed basin does not have sufficient navigable area to warrant the expense of the breakwater

5.2.1 Option 1

The South Basin has 48 boats berthing in the basin with 2 of those boats sharing slips with another boat. Most are at finger docks with several berthed against the dock walls. The West Basin has 34 slips with 31 boats docked at finger docks and three (3) along the walls. The North Basin has 45 boats berthed at finger docks. The plan shown in Photo 3.1 shows one slip not occupied. The entrance channel has five (5) boats berth against the south dock wall. The north side of the entrance channel has nine (9) boats berth at finger docks and along the dock wall. The total number of slips in the marina is 141 including the berths that are doubled up.

We have considered two preliminary options to increase the number of slips in the harbour. These options assume that the work would be considered when the dock wall replacement is planned. The first option presented in Figure 5.2 considers removal of the pier with the middle docks. When the pier is replaced, GYC may wish to consider removing the pier and replacing it with a floating main dock with fingers. This opens the entrance channel fairway and allows more boats to berth in the harbour. This option provides 24 slips along the south shore of the south basin, 39 slips along floating main dock and 21 slips in the west basin. The north basin and north side of the entrance channel remain the same, 45 slips and 9 slips respectively. The total number of slips is 138 slips. However, this total does not account for boats that currently share a slip (4 boats) or other slips along the dock walls or T head of the floating main dock. Figure 5.2 shows 7.5 m long finger docks are along the south side of the main dock and 10 and 12 m long fingers along the north side. The 10m fingers are at the west end where the fairway is more constrained. This option removes the side berthing slips along the center pier. However, the slips in the west basin are and along the north side of the main floating dock.

The work would include removal and excavation of the pier to elevation 174.0 m or lower, repairs to the end of the remaining dock walls, and supply and installation of new docks and electrical and water service. It reduces the total length of dock wall by approximately 200 m. A geotechnical investigation would be required to determine if this is feasible. The quality of the material within the pier and where it could be taken for disposal may make this option prohibitive if the fill material is found to contaminated.

Currently the pier is used for winter storage. This option eliminates this storage area. Other areas for storage, such as the area north of the club house, may exist onsite to make up for the loss. However, this would need to be assessed with GYC.

The project will require review and approval by regulatory agencies such as Fisheries and Oceans Canada, Transport Canada, Ministry of Natural Resources and Forestry, Ministry of the Environment and Grey Sauble Conservation Authority. Further discussion of the permitting requirements for any project is provided in Section 6.

5.2.2 Option 2

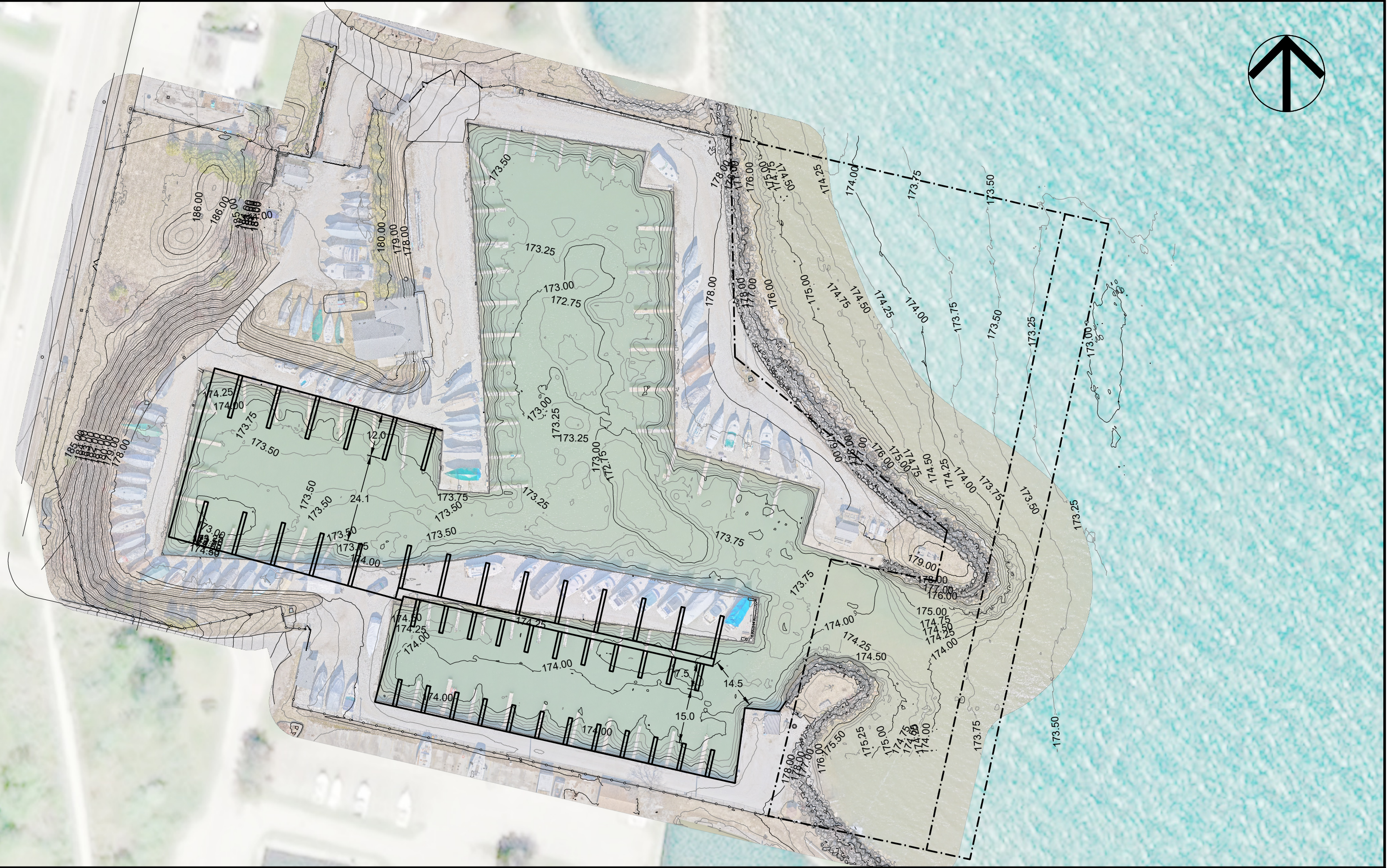
The second option is a more ambitious redesign of the marina layout to fully utilize GYC's water lot for an expanded marina. It includes realignment of the dock walls and relocation of the existing breakwater further offshore along the east property line. Figure 5.3 shows the layout of the marina. For this option North Basin is shifted east with two long main docks extending from the west shore in front of the marina building. The in front of the club house is filled to create an area for winter storage. Relocating the fuel dock to the end of the new breakwater may be possible but may be considered south of the building to allow for easier access for fuel trucks.

This layout increases the number of slips to 192 and reduces the length of dock wall from 910 m to 645 m. The main docks are 2 m wide and the fairway between the fingers is 2 times the length of the fingers. Shorter fingers are provided along the north wall which may be more challenging for boats to access. Shorter finger docks are still provided in the South Basin where it is shallower. Access to the West Basin is improved by removing the pier that extends out for the crane. The crane could be relocated east or west of the fuel dock.

The option results in an overall increase in marina basin area of 200 sq. metres. It reduces the length of the access road and creates an area in front of the club house that could be used for winter storage or other activities in the summer. The site plan shows the north and east shoreline with a road with the same width as the existing road which can also provide an area for winter boat storage. The road behind the revetment could be narrowed provide pedestrian access only.

This option only becomes viable when the docks and dock walls require replacement. Costs can be reduced if the existing fill and stone material can be reused.

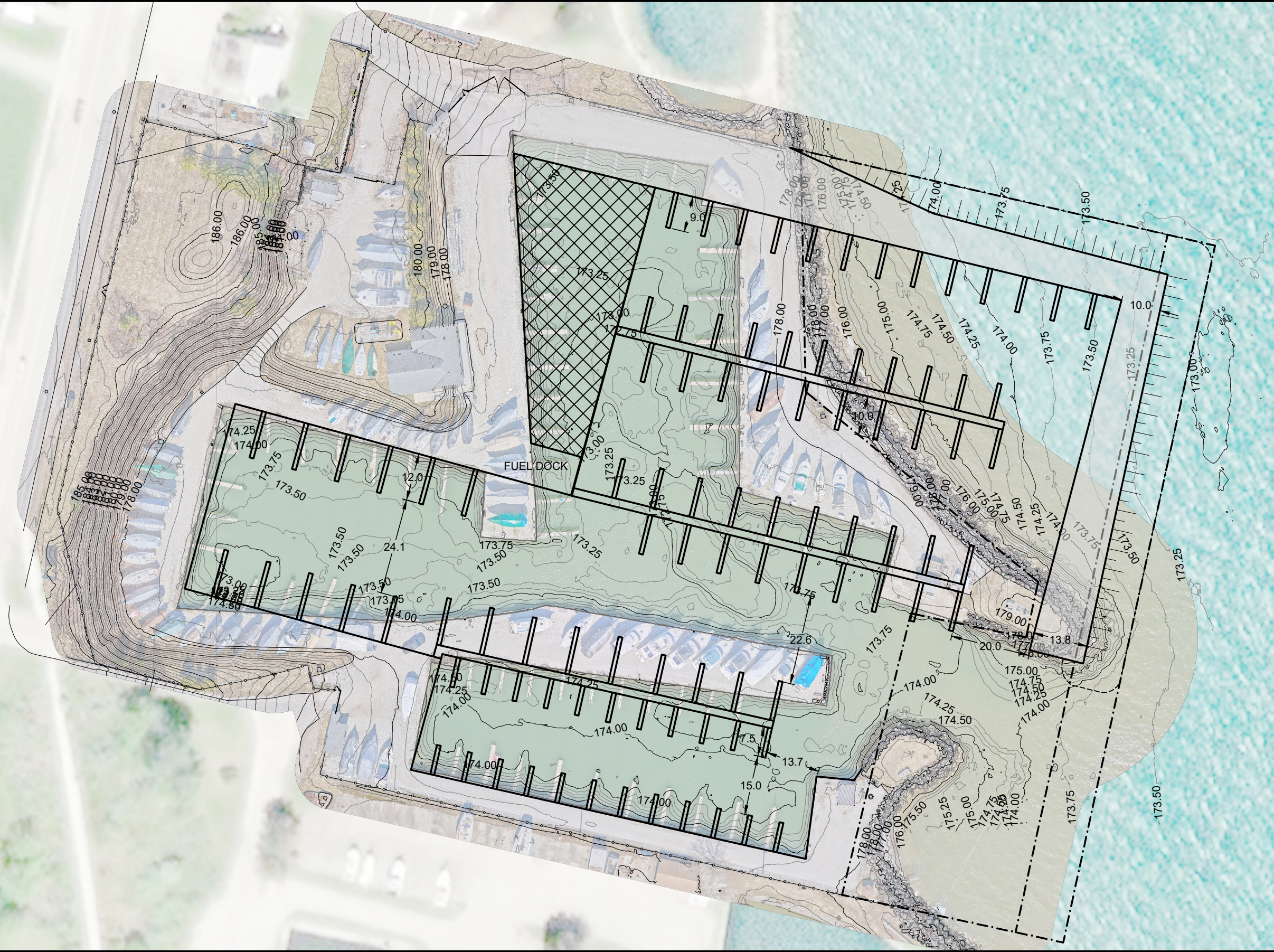
This option will require review and approval by regulatory agencies such as Fisheries and Oceans Canada, Transport Canada, Ministry of Natural Resources and Forestry, Ministry of the Environment and Grey Sauble Conservation Authority. It will be more challenging to approve because of the extensive work required. Further discussion of the permitting requirements for any project is provided in Section 6.



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Figure 5.2
Marina Layout Option 1
Georgian Yacht Club



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Figure 5.3
Marina Layout Option 2
Georgian Yacht Club

6 Rehabilitation Options

The dock walls are in fair to poor condition. The steel sheet pile pier is in fair condition. Using the expected design loads, the analyses showed that the existing SSP dock wall is capable of functioning at the expected design conditions for another 50 years. The king pile dock wall is generally in fair condition; however, the concrete panel lagging is in poor condition. A lot of cracking was observed around the marina with the diver noting that most of the panels have exhibited signs of surface cracking. The level of corrosion on the king piles are like that of the steel sheet pile. Our assessment shows the KP walls do not have a remaining design life with appropriate factors of safety for today's design standards using assumed soil design parameters. We recommend a geotechnical investigation to determine the soil parameters to more accurately assess the walls. We also recommend that GYC plan to replace/rehabilitate the KP walls as soon as possible. GYC should plan to replace all walls but could prioritize the West and South Entrance Area walls first based on our observations.

Using the expected design loads, the analyses showed that the existing SSP pier is capable of functioning at the expected design conditions for another 50 years.

GYC should consider replacing the existing walls. To compare rehabilitation options, we have used a standard design criterion of 12 kPa live load which allows vehicle access along all walls. For detailed design, GYC may could optimize the design by considering designated areas for higher live loads to haul out boats, parking and winter storage would be required.

Two options considered include:

1. Replace existing walls with king pile and concrete lagging
2. Replace existing walls with steel sheet pile

The following sections provide a description of each option considered, conceptual construction cost estimates, and advantages and disadvantages of each option.

6.1 Option 1 – King Pile and Concrete Lagging

The first option would be to replace all the existing dock walls with the king pile and concrete lagging. New king piles would be driven directly in front of the existing dock walls into the marina bottom. A new anchoring system would need to be constructed along the land side of the new dock wall. The anchoring system would not be required if the dock wall can be tied off to opposing or adjacent structures such at the middle dock area or at corners. Clear stone fill would be used to fill in between the new and existing dock walls.

This option provides an equivalent structure to when it was newly constructed. This option can be constructed relatively quickly as it only requires driving individual piles along the perimeter of the marina. The concrete panel lagging can also be prefabricated and delivered to site for immediate installation. This option would also be cheaper than going with an entirely steel dock wall structure. The expected functional life would be roughly equivalent to the functional life of the existing marina walls. Over multiple freeze-thaw cycles, the concrete panels would begin to crack and settle into the marina bottom. The shallower depth of the concrete panels also means the marina bottom

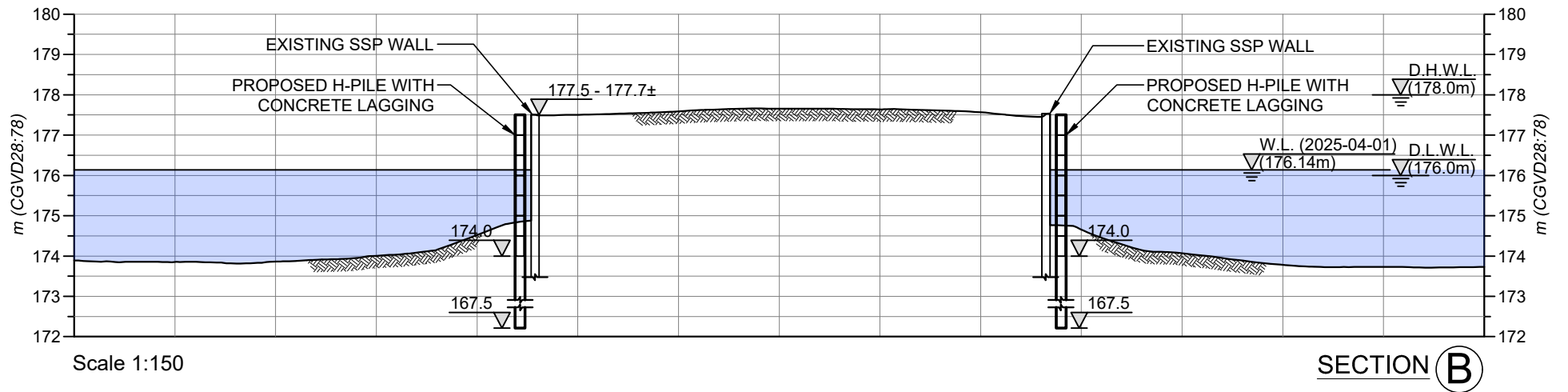
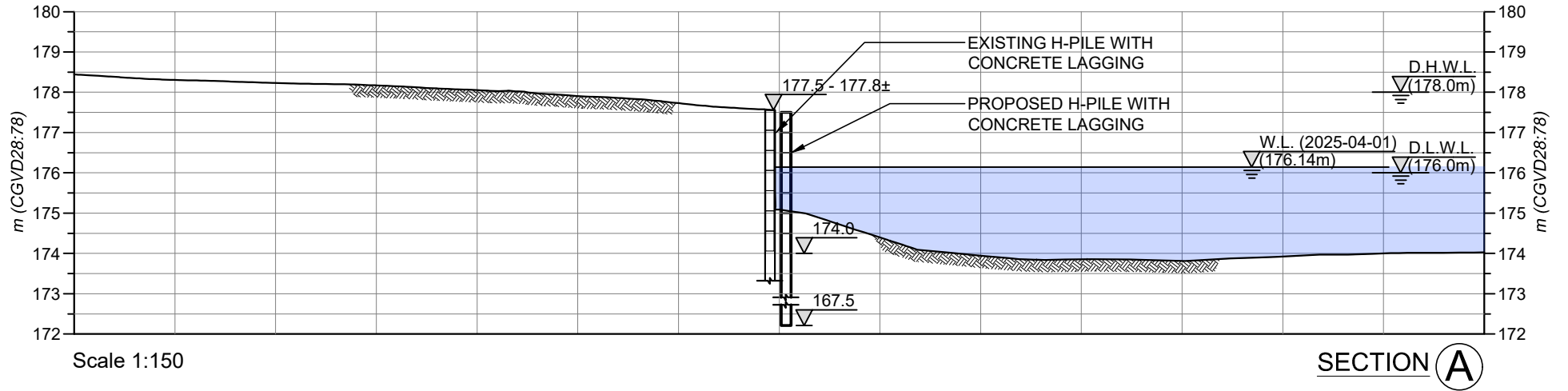
cannot be dredged as deep. Dredging below the bottom elevation of the concrete panel would cause the loss of backfill material from behind the panels.

6.2 Option 2 – Steel Sheet Pile

The second option would be to replace all the existing dock walls with a steel sheet pile wall. The dock wall would be constructed in a similar way as the king pile option. The new sheet pile would be driven directly in front of the existing dock walls into the marina bottom. A new anchoring system would also need to be constructed on the land side of the new dock wall. An anchoring system would not be required if the new sheet pile can be tied off to opposing/adjacent sheet pile such as the middle dock area or at corners. Stone fill would be used to fill in between the new and existing dock walls.

This option provides an equivalent structure to the entrance area sheets. This option takes longer to construct than the king pile option as more pile driving would be required. This option is more expensive than Option 1 but is a more rigid structure and has an expected longer functional life greater than the king pile option. The steel sheets being driven further into the marina bottom also allows for deeper dredge depths.

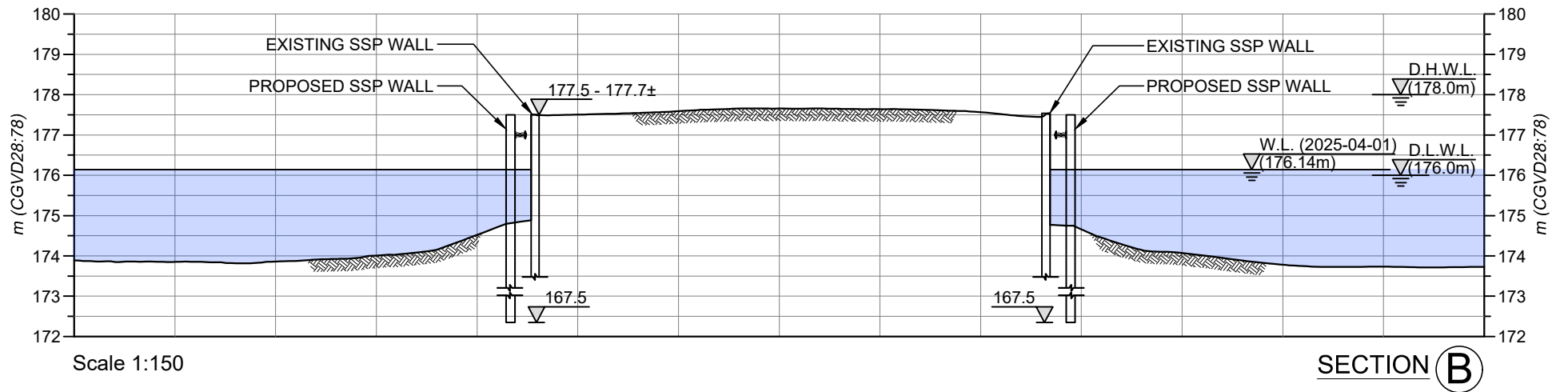
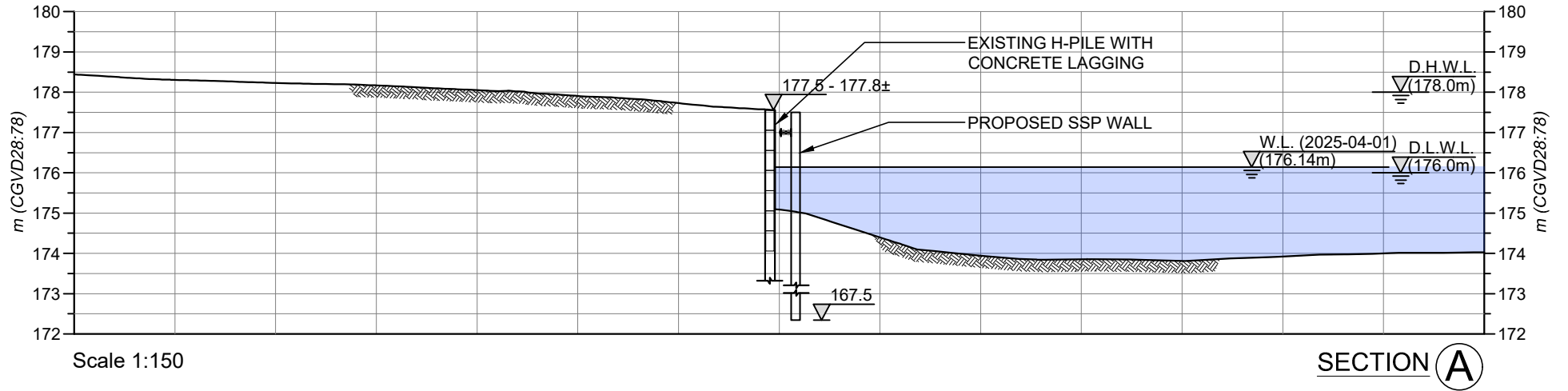
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Figure 6.1
Option 1: King Pile and Concrete Lagging - Sections
Georgian Yacht Club

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Figure 6.2
Option 2: Steel Sheet Pile - Sections
Georgian Yacht Club

6.3 Discussion and Phasing Plan

The options presented for the rehabilitation of the dock walls were developed using publicly funded project in the GTA and current economy with steel tariffs. We understand that this is a private club and rehabilitating all dock walls is not feasible. Although we believe delaying the project may result in higher costs due to inflation; however, we believe that our cost estimate does not reflect the local marine contractors that would consider project. We recommend that GYC consider phasing the project and completing the most critical areas first.

The first step in this plan is to carry out a geotechnical investigation to determine the soil design parameters and bedrock elevations at the site. A geotechnical investigation may change our conclusions. We would recommend boreholes along each of the walls. Once this is complete detailed design of the dock walls can commence, and more accurate construction cost estimate developed.

We recommend that GYC consider sequence rehabilitation of the walls as follows:

- West Basin
- North Basin
- North Entrance Channel
- South Basin
- Centre Pier

If the work is done in phases, GYC can assume that mobilization/demobilization and site access, preparation and restoration, costs would be needed for each phase.

6.4 Approvals and Permits

Several approvals or permits would be required to complete the work described above. Approving agencies with jurisdiction work near the shoreline on Lake Simcoe include:

- Grey Sauble Conservation Authority (GSCA)
- Ministry of Natural Resources (MNR)
- Ministry of Environment Conservation and Parks (MECP)
- Ministry of Citizenship and Multiculturalism Ontario (MCM)
- Fisheries and Oceans Canada (DFO)
- Transport Canada (TC)

The following provides a brief description of each agency's review and/or approval process.

The project will require review by GSCA under O. Reg. 41/24: Regulation of Prohibited Activities, Exemptions and Permits under the Conservation Authorities Act. This review is required for work within their regulated area. An application would be submitted with detailed drawings and a description of the work to be completed.

MNR reviews projects under the Public Lands Act. This permit may be required if the proposed works are being carried out on Crown land. It is our understanding that GYC owns the water lot that work would be carried out on. A Work permit under the Public Lands Act will not be required if the work is on your own property. However, the project will need to be registered with MNR because it is on or adjacent to Shorelands.

MNR is also responsible for establishing in-water work construction timing windows. Typically, no in-water work is permitted between March 15 and July 15 due to the spring spawning season for several fish species. A fall window of October 1 to May 31 can also apply. A project fisheries biologist may be required during detailed design and that biologist would review the potential timing windows.

Projects that result in excess soil leaving the site need to be carried out according to Ontario Regulation 406/19 for On-Site and Excess Soil Management. This regulation specifies sampling requirements for what is deemed to be excess soil. Removal of lake bottom material or soil on land for associated landscaping is considered excess soil if it leaves the project site.

MECP also has jurisdiction over provincially designated species at risk that may be in the area. The project may require review under the Species At Risk Act depending on the work proposed. A preliminary review of the available mapping shows that there is a species of special concern (Northern Brook Lamprey) in the vicinity of the harbour. A project biologist may be required to assist with screening for and identifying species at risk and critical habitat.

MCM reviews projects under the Ontario Heritage Act and general legislative policies governing heritage and archaeological resources. A Marine Archaeological Assessment may be requested other agencies reviewing the project.

Installation of new docks, dock wall rehabilitation or changes to the marina layout will require review under the Fisheries Act. DFO reviews project applications to ensure that aquatic habitat is not altered or destroyed. Projects need to be screened for potential habitat impacts and federally designated species at risk and then submitted to DFO for their review depending on the outcome of this initial screening. There may be loss or impacts on habitat. Depending on the scope of the work, a DFO authorization may be required which may include compensation works and/or monitoring, which have a cost implication. DFO may issue a Letter of Advice if the impacts on fish habitat are limited and can mitigate with standard best practices.

Projects that have the potential to interfere with navigation will require review by Transport Canada (TC) under Canadian Navigable Waters Act. Works that are classed by TC as “designated works” under the Act (that is complying with the requirement of the Minor Works Order) require advertisement in a local paper and registration on the Public Registry and may proceed if they comply with the legal requirements. Marina layout changes such as the modifications to the marina described would impact navigation and may require submission to the Navigation Protection Program for review and approval. A fee is required for TC to review the project. TC will also require the project to be posted for public review and comment. Smaller scale projects or projects that do not impede navigation (dock wall or dock replacement) require registration on the public registry and advertisement in the local newspaper.

7 Summary and Recommendations

The following is a summary of our findings and recommendations.

Harbour Bathymetry and Dredging

- A bathymetric survey of the marine basin was completed and harbour bottom elevations above elevation 174.0 m were found in the harbour entrance and South Basin.
- **No dredging is recommended in the South Basin at this time and should only be considered when the dock walls are rehabilitated.**
- Approximately 250 cubic metres of material needs to be removed from the entrance channel.
- **Recommend entrance be dredged to maintain access to the marina.**

Dock Walls Condition

- Dock walls have two types of construction, King Pile and Steel Sheet Pile
- King Pile walls with concrete lagging
 - Observed to be in poor condition
 - Assessed using assumed soil design parameters, design low water level (176.0 m) and 12 kPa live load along back of wall
 - King pile walls do not have the required factor of safety today that meet today's standards under design conditions
 - Checked walls for higher water levels (176.5 and 177.0 m respectively) and 5 kPa (pedestrian live load) and have factor of safety of 1.1 and 1.2 which does not meet today's standards
 - **Recommend replacing the king pile dock walls**
 - **Recommend keeping vehicles, trucks, boat storage a minimum of 3.5 m from the walls to reduce load on wall.**
 - **Recommend monitoring the walls for movement regularly especially at low water levels (late summer, fall)**
- Steel Sheet Pile walls
 - Observed to be in fair condition
 - Assessed using assumed soil design parameters, design low water level (176.0 m) and 12kPa live load along back of wall
 - **Steel sheet pile walls have the required factor of safety today and 50 years from now to meet today's standards under design conditions**
 - **Steel sheet pile walls do not require replacement**
- Rehabilitation options include
 - Replacement with new King Pile and lagging wall
 - Steel Sheet Pile Wall
- **Recommend a geotechnical investigation to determine actual soil design parameters**
- **Recommend phasing construction starting with the West Basin**

Dock and Marina Layout

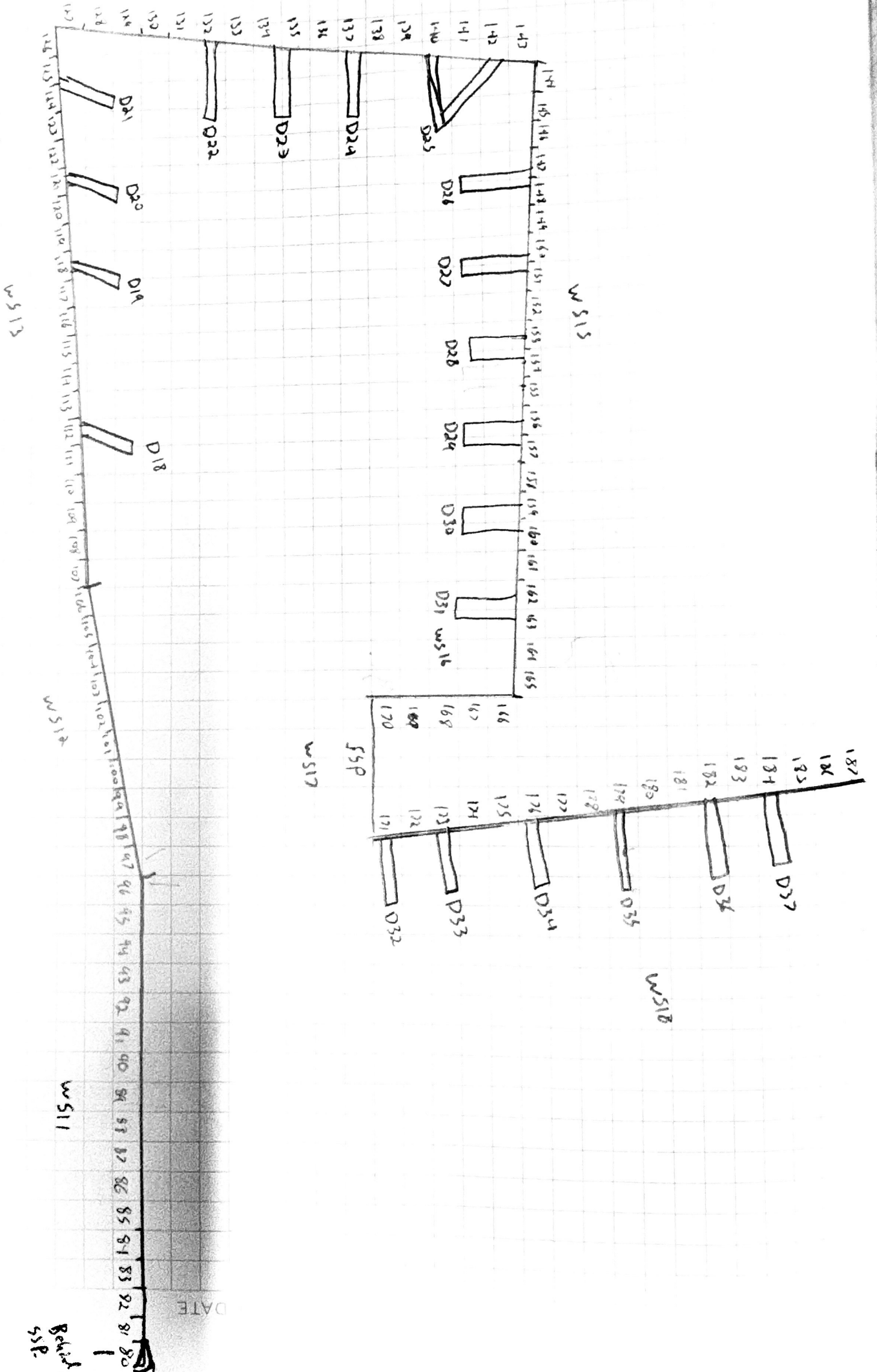
- Docks are functional but plans should be made to replace the docks at the same as the dock walls
- GYC may consider fixed for floating docks to replace the existing docks.
- Fixed docks and floating docks are a similar cost.
- Vertical anchor piles like the ones currently used in the marina could be used for either option 1 or 2, and are preferred to minimize footprint of the anchoring system
- GYC may consider removing the center pier (middle docks) and replacing it with a floating dock to increase accessibility to in the marina and increase the number of slips. This would also reduce the cost of replacing the center pier walls.
- An option to expand the marina to the east is presented which would provide more floating docks and reduce replacement costs of dock walls.

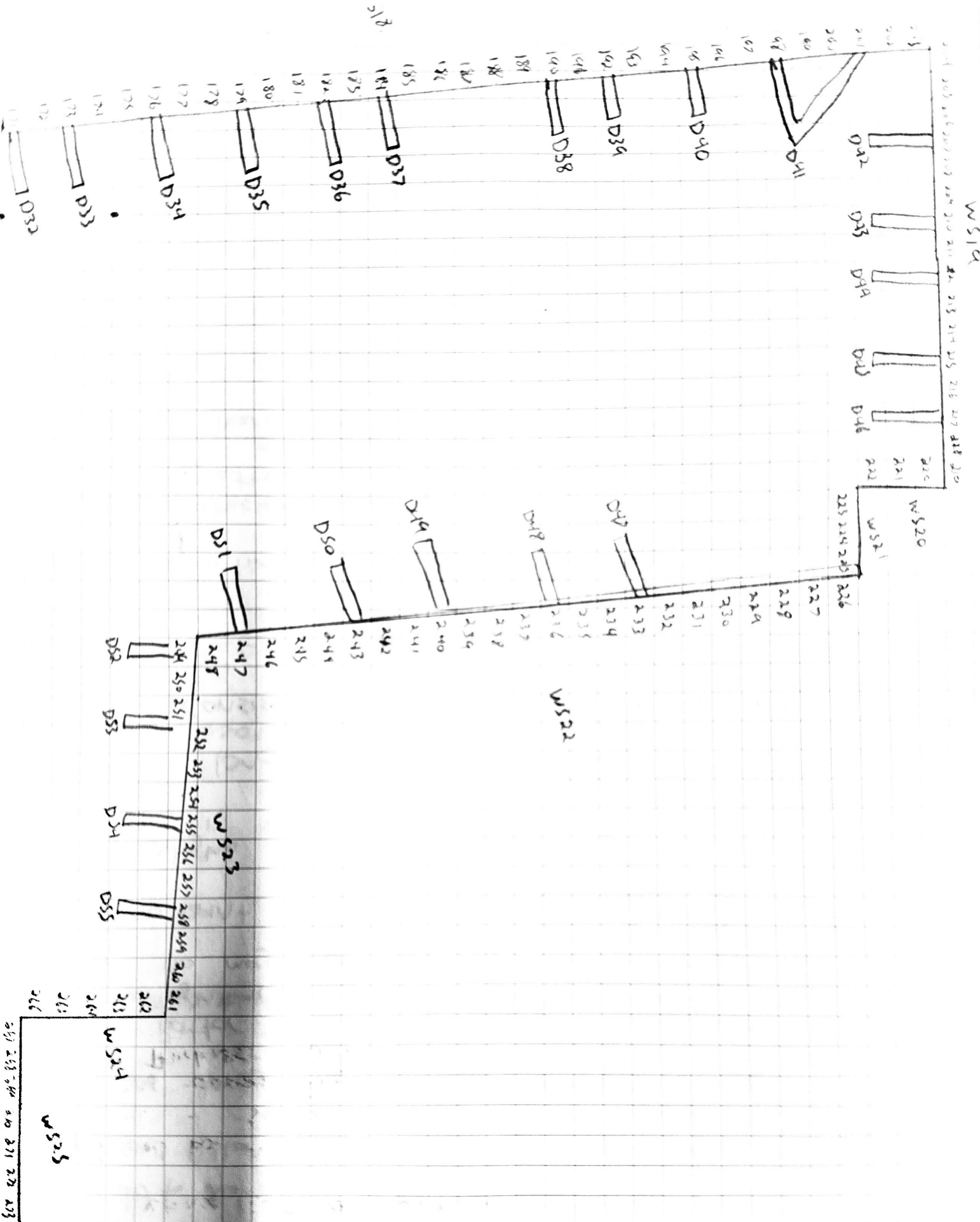
References

Arcelor, 2005. Piling Handbook 8th Edition Arcelor Group.

Pile Buck, 2001. SPW911 v2.40 by Pile Buck Inc. 2001 to 2008.

Appendix A Galcon Marine Inspection Notes





WS1

- IB1 - 12.6 thick
 CS1 - Batter TO $1\frac{3}{4}$
 - Marine growth
 - minimal surface rust
 - hard sand bottom

- CS2 - slight crack at water line 2' long
 - batter TO $1\frac{3}{4}$
 - Marine growth

- CS3 - Concrete 1" off bottom
 - crack full height of section

- CS4 - Concrete $\frac{1}{2}$ " off bottom to 4" off bottom
 - Batter 1" TI
 - thickness 10.8

IB5 - ends at waterline

WS2

- Corner - thickness 7.1
 - batter TO $2\frac{3}{4}$

- CS5 - Crack from waterline down
 - hard sand bottom

CS6 - marine growth slightly

IB7 - slight pitting

- CS7 - 1" off bottom to 6" off bottom
 - slight marine growth

IB8 - thickness 10.9

- CS8 - Batter TO $2\frac{1}{4}$
 - 1" off bottom
 - Crack in center full height

- CS9 - Crack in center full height
 - slight marine growth

- CS10 - Crack in center
 - batter TO $2\frac{1}{2}$ "

Corner - thickness 10.6

WS3
 CS12 - Better TI $1\frac{3}{4}$
 - concrete gap between cones angle

CS13 - vertical cracks full height

CS14 - crack with piece chipped

IB15 - minimal rust

CS15 -

D1 - clay bottom

- slight movement

CS16 - hard stone bottom

- no visible cracks

CS17 - $1\frac{1}{2}$ deep water

- horizontal crack

- 2" wide crack with chipping

CS18 - diagonal crack full height

- horizontal crack at water line

CS19 - gap between IB19

- 4" wide chipped section 1" deep

IB20 - Thickness 10.1

- Better TO 1"

CS20 - horizontal cracks / vertical cracks

- 2' of water depth

CS21 - slight marine growth

- 2" wide 1" deep crack

CS22 - vertical crack full height

- slight chipping

IB23 - slight pitting

CS23 - vertical crack

CS24 - vertical cracks

CS25 - vertical / horizontal crack full height
 - 4" deep gauge

IB26 - slight rust

CS26 - 2" x 2" gauge

IB27 - slight pitting

CS27 - small vertical cracks

IB28 - slight rusting
 - thickness 7.6
 - Batter TO 2 1/2"

CS29 - 2" off bottom

IB36 - thickness 11.1
 - Batter - plain

CS36 - diagonal crack above work
 - steel bottom

IB38 - slight surface rust

CS42 - 1" x 1" hole
 - vertical cracks

CS43 - water depth 6"

IB44 - thickness 8.3
 - Batter TI 1 1/2"

CS44 - horizontal crack

WS4

CS45 - 5 holes Dia 2" Deep 5"
 - diagonal crack

IB46 - Thickness 10.2
 - Batter TO 3 3/4"

CS46 - vertical cracks

IB47 - slight rust

IB49 - Thickness 10.1
- Batter TO 3 1/4

CS50 - 1" gap in from IB51

CS51 - 6" x 6" section chip at of lower corner

CS52 - concrete in 1" of BB 52

IB53 - Thickness 10.6
Batter - ~~2 1/4 TO minus 2 1/2~~ (114) plum

CS53 - large horizontal crack

WS5

CS54 - off corner floor 5"

IB55 - slight rust

- marine growth

- thickness 12.7

- plan batter

- end 4" hollow water line

WS6

CS56 - slight gap between concrete and IB56

WS7

IB57 - Thickness 10.4

- Batter TI 3"

- gap between well 6 and 7

CS58

- 3" off bottom to 6" of bottom

- hard clay bottom with stones

CS59

- top corner chipped

CS62

- 1" in from IB 62

IB65 - Thickness 10.8
 - Batter TI $1\frac{1}{8}$

CS68 - steel prints above waterline from 68-71
 - marine growth

IB69 - slight rust

CS69 - 3" off bottom

IB71 - thickness 11.1
 - Batter TI $1\frac{3}{8}$

CS71 - piece missing in top

CS73 - 1" off bottom
 - diagonal crack

CS78 - diagonal crack

IB79 - Thickness 9.9
 - Batter TI $2\frac{1}{4}$

CS79 - diagonal crack

WS8 SSP all sheets are 2 stacked and welded 4'-6" off bottom

OP0 - Thickness 11.1
 - Batter TO 7"

OP2 - slight pitting

OP3 - hole cut in sheet 1" rocks

OP4 - holes cut under water 2"

OP5 - slight marine growth

OP9 - slight rust and pitting

OP11 - 1/4" deep pitting

OP13 - thickness 9.1
 Batter TO $1\frac{1}{2}$

OP15 - heavy rust at waterline

OP18 - marine growth

OP20 - slight pitting

OP21 - heavy rust at waterline

OP28 - heavy rust at waterline

WSA SSP

OP0 - Thickness 8.1
- Batter TI 1" halfway up 6ft level
- heavy pitting

OP1 - muscle growth
- heavy rust at waterline

OP2 - mild pitting

OP3 - muscle growth at bottom

OP5 - heavy rust on knuckle at waterline

OP7 - mild rust at waterline
- Thickness 10.8
- Batter TO 2"
- 4ft water depth

OP9 - foldable ladder

OP10 - heavy rust

OP14 - slight rust at waterline
- heavy rust 2' and 4' below water line
- heavy marine growth

OP15 - heavy rust 2' below waterline
- thickness 10.1
- Batter TI 3 1/4"

WS10 SSP

OP0 - thickness 8.7
 - Batter TI 2 1/2"
 - heavy rust at waterline

OP3 - minimal rust at surface
 - heavy rust 4ft below waterline

OP5 - heavy rust 4' below waterline
 heavy rust consistent 3'-4' below waterline

OP8 - tilted inshore slightly

2 in-pans between OP9 and 10 welded together
 all sheets 10-20 and 2 stack and welded

OP12 - not touching sea floor

OP13 - 2" of bottom
 - mild rust at waterline

OP14 - Thickness 11.2
 - Batter TO 3 1/2"

OP17 - mild rust at waterline

OP20 - next 3 sheets are out pans
 - sheets steep out depth of sheet
 - 3 inch gap between 20 in-pan and 21

OP corner - weld down center to half in-pan

OP24 - mild rust

OP25 - slight marine growth

OP26 - out pan welded to plate then I-beam
 - Thickness 8.9
 - Batter TI 5"

WS11

CS80 - behind sheet pile

IB81 - Thickness 10.0

CS81 - Batter TI 2"

- 2" chip

- minimal marine growth

IB82 - rust above sea floor

IB83 - heavy rust at waterline

- sandy bottom

CS83 - marine growth at sea floor

- gap between IB84

CS85 - top corners missing

IB86 - slight pitting

CS86

- top corner broken

- crack in middle by IB86

CS87 - concrete gap between IB87

CS88 - 1/2" gap between IB88

- hard sand bottom

IB89 - thickness 8.1

- batter TO 1"

IB90 - pitting at waterline 1/4" deep

CS93 - wood panels above water

- 2" off bottom

CS94 - 6" off bottom on inshore side

IB96 - Thickness 10.0

- Batter TI 2"

CS96 - chipping at top

- hard sand bottom

WS12

IB97 - plate welded to ~~cover~~ CS97

CS97 - divot 2' below waterline
- diagonal crack from waterline to bottom

CS100 - sand/silt bottom
- light marine growth

IB101 - light rust

CS101 - stone bottom

IB102 - thickness 11.8
- Batter TO 3"

CS102 - 1" deep hole above water

CS103 - 2" wide crack from waterline to bottom

IB107 - thickness 13.3
- Batter TO 2 3/4"

WS13

CS107 - light marine growth - muscles at bottom

CS108 - hard sand bottom

IB109 - light rust at waterline

CS110 - 2 hole drilled just below top

CS111 - 3ft water depth

IB117 - Thickness 13.3
- Batter TO 3"
- hard sand bottom

CS121 - muscle buildup on bottom

IB126 - thickness 10.1
- Batter TO 4"

WS14

CS127 - Batter TO 2"
- concrete batts into WS13

IB128 - 6" plate welded over CS128

CS128 - crack above waterline

CS129 - crack below waterline

IB¹³⁰ - surface rust of waterline

CS130 - 2" off bottom

IB136 - Thickness 10.2
- Batter TO 4 1/2

CS136 - slight cracking 1/4 deep below waterline

IB138 - light surface rust

CS138 - vertical/horizontal cracking

CS143 - outfall colrest above waterline in corner cut
in concrete

IB¹⁴⁴ - Thickness 10.1
- Batter plan

WS15

CS144 - batter 3" TO
- cans behind WS14

CS146 - 3/4" gap between IB146

CS147 - horizontal crack at waterline

CS149 - vertical crack full height

CS153 - horizontal crack below water, chipped on ashore side

IB155 - Thickness 10.5
- Batter TI 6"

CS155 - diagonal crack full height chipped at bottom

CS157 - hard sand bottom

CS158 - 1/2" off bottom
- light marine growth

CS162 - rocky bottom

CS165 - 1 1/2 gap from IB 165
- wood debris on bottom
- 1 in pan and outpan on corner

corner IB - thickness 9.7
- Batter TO 1/4

WS16

CS166 - 1 1/2 TI

IB167 - rust at waterline
- plate welded on face of IB

IB68 - 1/4 pitting at waterline
- plate with 4 bolts with nuts exposed

IB 170 - thickness 12.9
- Batter plum

CS170 - SSP anchored by 3 points above waterline
- 3 outpens to corner

WS17

OP1 - thickness 10.7
- Batter plum
- surface rust
- marine growth
- heavy rust 2' above bottom common at all sheet

OP5 - heavy rust on knuckle

OP11 - heavy rust on knuckle at waterline

OP16 - hard stone bottom

OP17 - ladder to surface
- surface rust at waterline

OP27 - marine growth - light
- light surface rust
- thickness 12.5
- Better plan

↳

WS18

CS 171 Marine Growth slight chipping WL
 IB welded to outer IB than steel pile
 Hard sand bottom

CS 172 no damage slight cracking, lght + pitting
 IB 173 Thickness 10.4
 Batter TO 5' 1/2"

CS 173 slight chipping WL 3 FT deep
 CS 174 no major damage 1/4 thick marine growth

IB consistent

CS 175 slight chipping 2" small crack
 " marine growth

CS 176 long crack TOP to bottom

CS 177 consistent marine growth

IB 178 consistent pitting

CS 180 hairline cracks, small chipping

IB 181 thickness 10.8
 Batter plum

CS 181 hard bottom 2 1/2 FT deep

IB 182 chipping, pitting WL

CS 182 water line fine nothing below

IB 183 consistent with resi-

CS 183 consistent with 182 marine growth

CS 184 diagonal crack TOP to sea floor
 2" wide 1 1/2" deep

- CS 185 diagonal crack top to bottom 2" wide 1' deep
- CS 186 2ft deep / marine growth no imperfections
- CS 187 Pitting chipping consistent
- IB 188 Surface rust same as all
Thickness 11-2
Batter Plum
- CS 188 consistent chipping
tight to sea floor hard sand bottom
- CS 192 light chips underwater
still consistent
- CS 195 Very little chipping and pitting at WL
- ID 196 Very little rust
- CS 196 Very minor chipping and cracking
- ID 197 Thickness 10.4
Batter TO 2 5/8"
- CS 197 above water little damage
light chipping underwater
- CS 198 chipping above WL, big cracking in sections
diagonal TOP to bottom
bottom Right corner damage
- IS 199 same crack continues from 198
WL minor chipping, marine growth
- CS 200 light cracks
- IB 201 light surface rust
- CS 201 no major damage above or below
right core crack
- CS 203 light chipping, CS runs past WS 19
Batter - TO 1"
no visible IB on this wall

WS19

~~CS 204~~
 FB 204 Flush with WS18
 Batter TO 1 1/4"
 Thickness 98

- CS 204 - minimal damage
 IB 205 - minimal rust
 CS 205 - light marine growth, hard clay bottom
 IB 206 - consistent
 CS 206 - light chipping 7/4 dwd, tight to floor
 CS 207 - " marine growth 4 ft deep
 light chips at WL
 CS 208 - marine growth 1/8" thick
 Very little chipping at WL
 IB 209 - light pitting
 IB 210 - " surface rust
 CS 210 - light deterioration above WL
 CS 211 - similar to 210, pitting 1/8"
 IB 211 - Thickness 101
 Batter TO 1 1/4"
 CS 212 - Very consistent
 IB 213 - light surface rust
 CS 214 - no damage above or below
 consistent hard sand bottom
 → concrete consistent whole way
 IB 219 - Thickness - 98
 Batter - TI 1"
 wall ends eye beam butted into next wall

WS20

- CS 220 batter TO 1" no imperfections
 light marine growth Hard sand bottom
 IB 221 light surface below water line
 CS 222 consistent marine growth water depth 5"
 no damage
 I beam corner plate welded to
 next wall to far from
 thickness - 10.0
 batter TO 1 1/4"

WS 22

IB
CS 229

Batter TO 1/2"
thickness - 9.4
shallow 18"

no damage light chipping WL

IB 230

minor rust, pitting at WL

CS 230

no major damage

IB 231

staying constant pitting at WL

CS 231

constant cracking

CS 233

light marine growth light chipping at WL

CS 234

slightly heavier chipping. hard clay bottom

CS 235

6" off bottom at face

CS 236

no major imperfections

IB 237

light surface rust, pitting at WL

IB 238

pitting at WL

Thickness - 9.9

batter TI 1/8

CS 239

horizontal crack full width

IB 240

light pitting WL

CS 240

horizontal crack full width 2 1/2 FT deep

CS 242

light chip WL 3/8" deep 2' dia

CS 243

large chunk missing below WL

2" wide 20" long, 2 holes above water line

2 inch diameter

CS 244

no visible damage

IB 246

thickness 10.1

Batter Plum

CS 246

hairline cracks above WL

hard rock bottom

CS 248

divots, chipping above WL

minor deterioration, end with an angle iron

welded into I beam of next section

DATUM/DATE

WS23

IB 249 welded into previous wall with angle iron
Thickness - 8.9
Batter TO 2'

CS 249 no damage, bottom corner light large
crack

IB 250 light surface - rust light pitting

CS 250 no damage above WL, light chipping at WL

all very consistent
CS 252 - nothing to note
all damage consistent at WL

IB 254 Thickness 8.9
Batter TO 1/2

CS 256 Consistent chipping across all concrete blocks
identical chipping and pitting across all CS

IB 261 Thickness 9.9
Batter Plum

CS 261 no damage, rans behind next wall IB

WS24

IB 262 I beam cut in-half and butted to previous
wall

Thickness - 9.8
Batter - TI 1'

CB 262 marine growth, hard rock bottom

IB 263 Pitting 1/10 - 1/8 at WL light surface rust

CS 263 light chipping at WL
all very consistent

CS 265 slight muscle growth

CS 266 I beam butted to angle iron and welded
Thickness - 10.2
Batter - TI 1 3/4

W525

DATE: _____

IB 267

angle iron butted and welded
thickness - 8.6
Batter TI $3/8"$

CS 267

6ft deep light chipping @ WL
marine growth

ID 268

light rust mild pitting
plate welded over top of it $3/8"$ TOP to bottom

CS 268

heavier marine growth

IB 269

covered in $1/2"$ marine growth

→

no major damages
muscle growth beginning at sea floor

CS 270

no visible cracking, light chipping
muscle getting heavier towards bottom

angle iron to cap flange corner welded to
I beam

IB 273

thickness 9.7
batter TO $5/8"$

011 720 P.m