

FINAL REPORT

Cobourg Harbour

Breakwaters and Basin Walls Condition Assessment



prepared by

**Shoreplan
Engineering Limited**

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SHOREPLAN

**Cobourg Harbour
Breakwaters and Basin Walls Condition Assessment
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Prepared for

Town of Cobourg

by

SHOREPLAN

SHOREPLAN ENGINEERING LIMITED

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1 EXECUTIVE SUMMARY

The inspection and assessment of the Cobourg Harbour structures, completed in the fall of 2019, included the east and west breakwaters, the centre pier and the north and east basin walls. This inspection reviewed above and below water conditions and rated them in four categories. A summary of the rating, suggested repair option for each section of the harbour and associated cost are summarized in Table 1.1. All the structures are showing some signs of failure and require repair. This table attempts to set priority with the highest total score being the most urgent. It also briefly describes the suggested repair and provides an estimate of the construction cost. The construction cost estimates do not include contingencies or taxes.

Table 1.1 - Summary of Rating, Suggested Repair and Associated Cost

AREA	RATING / 20	SUGGESTED REPAIR	REPAIR COST
East Breakwater	16	Remove the concrete cap and place an armour stone cover over the existing crib, filling any voids to bring it up to an appropriate elevation over 130m.	\$ 1,750,000.00
West Breakwater	16	Short Term - Place armour stone on the approximately 100m of failed sections of the structure. Long Term – Removed concrete cap and place armour stone cover over the existing crib, filling any voids to bring it up to an appropriate elevation over 180m.	\$ 975,000.00 \$3,250,000.00
Centre Pier	11	Repair the failed concrete blocks for 6m - place flat steel sheets along the damaged section in front of the existing timber crib and concrete cap, fill area behind the plate with clear stone and grout any voids.	\$ 75,000.00
North Wall SSP	14	Install a steel sheet pile wall in front of the existing timber crib and concrete cap wall, fill the space between with clear stone, grouting any voids and install a concrete cap along the wall's length.	\$ 1,950,000.00
East Wall SSP	17	Replace the steel sheet pile wall with a new sheet pile wall, fill the small area behind with clear stone, grout any voids and install a concrete cap along the wall's length.	\$ 1,170,000.00
			TOTAL
			\$9,170,000.00

2 INTRODUCTION

Shoreplan Engineering Limited (Shoreplan) was retained by the Town of Cobourg to complete the inspections of 5 structures within Cobourg Harbour. The work described in this report was undertaken to assess the condition of the structures and to provide recommendations for their repairs or maintenance, where warranted. To complete the inspection a dive team from Dundee Marine used real time video recording to convey underwater conditions to a Shoreplan engineer supervising the team above water. The dive inspections were completed over 3 days, August 19th, September 5th and October 18th 2019. The water levels on those days were 75.5m, 75.3m and 75.0m respectively. Underwater photos presented in this report are screen shots taken from the video recorded on these dates.

2.1 SITE LOCATION

The five areas inspected within the harbour were:

- The East Breakwater
- The West Breakwater
- The Centre Pier
- The Basin North Wall
- The Basin East Wall

The locations of the five areas are identified on the location plan on Figure 2.1. Both sides of the breakwaters and pier were inspected.

2.2 REPORT STRUCTURE

Chapter 2 describes the purpose of the study and identifies site locations. Chapter 3 presents a description of the inspection findings and assesses the condition of each structure. Chapter 4 presents suggested repairs, priority sites and cost estimates. Chapter 5 provides a summary of the finding and recommendations.

Figures are provided at the end of each chapter. A series of photos for each structure is provided in Appendix A. Notes taken during the inspection are found in Appendix B.

Drawing Location: S:\Shoreplan Project Files\3000-3099\19-3097 Cobourg Breakwaters Inspection\Drawings\19-3097 - R0.dwg



Project # 19-3097
Scale 1:4000
SHOREPLAN

Figure 1
Cobourg Breakwaters Inspection
Site Plan

3 STRUCTURE INSPECTION FINDINGS

This chapter provides a brief description of the structure at each location. An assessment of each structure is provided following the descriptions. The assessment is based on the rating system presented in Table 3.1. The system provides a rubric to evaluate various aspects of the shoreline protection. An assessment score between 1 and 4 is given for each category. The lowest score, 1, indicates the best conditions within the category. The highest score, 4, indicates the worst conditions within the category. The word descriptions associated with the ratings have been modified to a single word; best, good, fair or worst. The overall assessment is based on the sum of the scores in categories 1 to 4. Therefore, the site with the highest score is the highest priority site with respect to the need for improvements. Table 3.1 provides the assessment score parameters for each category.

A remaining functional life of the structure is estimated for each shoreline structure. This estimate is based on the known or estimated age of the structure and the observed condition of the structure. Typically shoreline structures are designed for a 25 to 50 year design life. The remaining life is typically estimated by subtracting the age of the structure from the design life. In this study, the remaining functional life of the structure is estimated based primarily on the conditions observed during our site visits. It is our experience that some structures can be beyond their design life but still be functioning as intended. If this is the observed condition, it is noted in the text. The Public Works and Transport Canada guidelines (PWC 1985) provide recommendations for type and frequency of inspection based on the type and age of a structure. We recommend following these guidelines for inspections.

Based on the assessments presented in this section, priority sites are identified and recommendations for shoreline protection improvements are provided in Section 3.

Table 3.1 - Rating System Table

	Description	1 – BEST	2 – GOOD	3 – FAIR	4 – WORST
1 – Risk of Damage due to Failure	The risk of potential impact to adjacent areas with respect to the danger of the structure failing and the resultant loss.	Unimproved land or passive use, no buildings near the structure, natural park areas.	Non-habitable structures near the structure; active recreational park areas, walkways, garages, sheds, decks, pools.	Industrial or commercial buildings or areas within 30 metres of shoreline. Some outlets may be in this category depending on their importance to the infrastructure, location and ease of ability to repair.	Habitable, occupied and/or public use structures/buildings, infrastructure; residential, institutional within 30 metres of shoreline.
2 – Personal Safety	The risk of personal safety by injury to pedestrians as a result of exposure to unsafe conditions or materials (e.g. exposed rough steel or rebar), structure configuration, (e.g. walking, tripping hazards), likelihood of access.	Pedestrian access to areas that have flat easy, safe and un-restricted access. Areas of no possible access by pedestrians, regardless of restrictions.	Well maintained sheet pile or concrete walls with walkways in very good condition and physical separation from water where required. Restricted access to areas where pedestrian access could be hazardous.	Seawalls with uneven backshore due to damage or deterioration. Structures that are not designed for public access and don't have signage restricting access but are in good condition.	Structures with loose or damaged concrete with exposed steel, re-bar or areas with exposed and unsafe steel or other materials. Structures severely deteriorated with large gaps, undermining, slope failures, etc. are also included in this category. These areas may or may not have signage restricting access but access is still possible and notably hazardous.
3 – Material Condition	The general condition of the structure material, ranging from good condition (e.g. as new condition retaining walls, well placed armour stone structures) to poor quality materials (eroded or completely degraded materials, retaining walls with severe damage or deterioration)	Excellent quality materials, new or have not shown any signs of deterioration or degradation.	Stable structures with good sound, quality materials. May be showing minor signs of deterioration.	Materials are missing or poor quality due to either degradation or deterioration. Structures that have been poorly constructed or have damage that may cause function/stability concerns.	Material conditions which are non-functional, severely degraded or highly unstable.
4 – Structure Effectiveness & Performance	The general ability of structure and the materials to perform and function effectively. As a result of the effectiveness and performance of the structure it may or may not require monitoring/maintenance/repairs/replacement.	Structure and materials are functioning and performing very well and are effective from a design perspective for today's standards.	Structure and materials are functioning with minor signs of substandard effectiveness; monitoring, and/or repairs/maintenance may be required but are not essential to performance.	Showing signs of poor performance or minimally functional; requires regular, ongoing monitoring, or minor repairs/maintenance are required. Structures with poor design or outdated design parameters that require monitoring or minor upgrades to maintain functionality.	Eroding, unstable and not effective or functional structures. Severely under designed for either intended or actual use. New construction, replacement of either entire structure or significant sections of existing structure required to provide performance required at this time.

3.1 EAST BREAKWATER

The east breakwater extends from the end of the pier on the east side of Cobourg Harbour protecting the harbour from waves from the open lake. Inspection of this structure started on the north east side on September 5th 2019 and concluded at the south end on that day. The inspection of the inner portion of the breakwater was conducted on October 18th 2019 starting from the south end and progressing north along the harbour side face.

3.1.1 Description of Shore Protection

The north end of this structure includes an approximately 75m long section of the pier that is formed from steel sheet pile walls with a concrete deck. From this section the breakwater extends south and consists of timber cribs with a sloped concrete cap. At the south end of breakwater and on the west face of the timber crib section stone material has been piled up against the cribs. These sections will be discussed separately.

Steel Sheet Pile Wall

The north end section which forms part of the pier is composed of two different pile shapes. There is z-pile for approximately the first 45m on the north end before it switches to u-pile. There is no cap on these sheet piles however there is a concrete deck between the east and west sheet pile wall. On the east side, from 45m to 75m, there is a tie every 3rd in-pan near the top of the wall. Wailer bolt locations are visible between ties, but many are missing. The sheet pile section ends at approximately 75m where it is not closed off. Looking north on the east side behind the sheet pile you can see timber cribs and a concrete cap.

Timber Cribs (East Face)

Starting at chainage 0+75 and progressing south, the breakwater consists of a 1.0 to 1.5m thick sloping concrete cap with a vertical wall approximately 74cm tall. A joint in the concrete cap is located approximately every 6m. The concrete cap sits on timber cribs. Fill material inside the cribs was observed to be a mix of smaller 100 to 150mm and larger 200-300mm stone material. The top of crib elevation is approximately 73.8m IGLD. Although many timbers were missing, it appears that the original crib had on average 3 or 4 horizontal timbers exposed above current lakebed elevations. Timbers measure approximately 17cmx17cm. Cross timbers running east-west were seen at regular intervals of approximately 1.0m and between crib sections, and the cap sits on these members where the north-south top timbers are missing. Three 12mm steel plates extending from lakebed or just above lakebed up to the concrete cap were observed near the south end of the east face of the crib. They varied in length from 1.4m to 3.4m long and were secured to the timber north-south members, although no pins could be seen.

Revetment (South End and West Face)

A lighthouse is located at the south end of the breakwater. Starting near the lighthouse and continuing south on the east face, 2 to 3 tonne stone material has been piled up tightly against the timber cribs. Around the south end the stones are larger and estimated to be in the 5 to 8 tonne range. The revetment continues on the west face between chainage 0+200 and 0+120.

After this point and continuing south up to the steel sheet pile wall there is no protection in front of the timber cribs with a concrete cap.

3.1.2 Structure Assessment

Risk of Damage due to Structure Failure

The marina would be vulnerable to wave action from easterly storms if damage or failure of the breakwater protection were to occur. The rating system considers the risk of damage due to structure failure 2 – Good because the risk to critical infrastructure is minimal.

Personal Safety

The breakwater has pedestrian access restricted by signage. Access is still possible though as physical restrictions are limited. Personal safety is rated 4 – Worst as the surface of the structure is uneven and sloped, making walking difficult. There are also large sections of deteriorated concrete and gaps in the concrete surface.

Material Condition

This breakwater consists of sections of steel sheet pile wall, timber cribs with a concrete cap and a section of armour stone revetment at the opening to the harbour and inner face. The steel sheet pile wall is in good condition with only minor signs of deterioration. The timber cribs are showing severe deterioration. Timber sections are missing 1/2 to 3/4 of the vertical face on the outside east facing crib wall. Fill material inside the cribs no longer touches the underside of the cap with visible gaps of 20cm 80cm between the cap and the top of fill. The cap is supported by timber cross members, many of which are showing signs of disintegration. On the surface of the breakwater, large sections of the cap have spawled away. Sections of concrete are also missing from the cap at the waterline. This may be due to damage caused by ice. A large section of concrete over 2m wide previously forming part of the cap appears to have rolled into the lake near the lighthouse.

The revetment on the west side is showing signs of damage. Between chainage 0+200 and 0+130 numerous gaps were found at or above the waterline and stones were found rolled out past the toe 5 or more metres. The northern 10m of the breakwater between chainage 0+130 and 0+120 appeared to be in good condition. The section of exposed timbers cribs on the west side had gaps in the wall near the base with strong flow in and out. This would indicate that there are voids within the core of the structure. The gaps in the wall were noted at approximately chainage 0+90, 0+80 and 0+70.

With the exception of the steel sheet pile wall, this structure is at its end of its functional life and should be repaired or replaced. The material condition is rated as 4 – Worst.

Structure Effectiveness and Performance

Although it provides protection against oncoming waves in its current state, signs of significant damage and deterioration do not allow it to be considered stable or functional in the long term.

During our site visit we observed flow through the breakwater, indicating notable voids in the core. It is our opinion that the structure should be rated 4 – Worst as it requires significant repairs to maintain its effectiveness and long term performance.

Remaining Structure Life

The remaining structure life is estimated to be less than 5 years. Major damage to the structure has occurred which will require repair or replacement. Further damage or complete failure of sections of the breakwater is expected if no action is taken.

3.2 WEST BREAKWATER

The west breakwater extends from the shoreline on the west side of Cobourg Harbour protecting the harbour from waves approaching from the south quadrant. Inspection of this structure started on west end of the north side on September 5th 2019 progressing towards the east around the end and back towards the west concluding at the south west side on that day.

3.2.1 Description of Shore Protection

The west breakwater runs from the shoreline on the west side of the harbour in south east direction for over 175m before turning north east towards the mouth of the harbour for 63m. The breakwater consists of a section of timber cribs with a concrete cap from chainage 0+00 to 0+110 and from chainage 0+143 to 0+175. The lake side of the cribs is further reinforced with armour stone along its length. The harbour side of the cribs only has armour stone between chainage 0+143 and 0+175. All other sections of the west breakwater do not have any visible cribs and appear to consist of only an armour stone berm; this includes chainage 0+110 to 0+143 and chainage 0+175 to 0+238.

3.2.2 Structure Assessment

Risk of Damage Due to Structure Failure

The marina would be vulnerable to wave action from storms if damage or failure of the breakwater protection were to occur. The rating system considers the risk of damage due to structure failure 2 – Good because the risk to critical infrastructure is minimal.

Personal Safety

The west breakwater does not restrict pedestrian access. Personal safety is rated 4 – Worst, as the surface of the structure is uneven and sloped making walking difficult. There are also large sections of deterioration and gaps in the concrete surface.

Material Condition

The timber crib sections of the breakwater are showing significant signs of deterioration. This includes large gaps in the timbers that allowed full penetration of a metre stick. There is evidence of water flow through the cribs at gaps in the toe. This flow was observed during the inspection and areas of scour indicate that it is not a new condition. The condition is occurring in

areas where timbers that run north-south across the breakwater are missing a significant amount of cross section or have large gaps where they were meant to butt up against longitudinal members. There is one section of the breakwater at approximately chainage 0+85 where there is a gap almost 1m wide between the cribs. Above the waterline much of the concrete cap on the north side has spawled away. There were also many cracks and spawled sections of the cap that extended below water.

Sections of the stone revetment are showing signs of damage. We observed large gaps between stones and missing stones that have likely rolled off the top or the slope of the protection. There is a gap in the crest of the stone material for 20-25m starting at approximately chainage 0+185. We found armour stones located 10 to 15m offshore from the toe of the breakwater. These stone were likely placed on the structure and removed by wave action. This has left gaps in the stone material above as well as below water. Placement of stone in areas with no obvious voids and gaps appears to be random with smaller gaps between stones.

With so many signs of damage and deterioration the western breakwater is at the end of its functional life and should be repaired or replaced. As this is the case, the material condition is 4 – Worst.

Structure Effectiveness and Performance

Although it may provide protection against oncoming waves in its current state, signs of significant damage and deterioration do not allow it to be considered functional in the long term. During our site visit we observed flow through the protection works and areas of significant damage. It is our opinion that the structure should be rated 4 – Worst in terms of effectiveness and long term performance.

Remaining Structure Life

Major damage has occurred to the structure. The remaining functional life of the structure is estimated to be less than 5 years. Further damage or failure of additional sections is expected if no action is taken.

3.3 CENTRE PIER

The Centre Pier is located on the west side of the active marina basin. Although it is orientated in a south-east to north-west direction, for the purpose of this report it will be described as running in a north, south direction with east and west faces. Chainage for the pier has been laid out from the south end (0+00) to the north end (0+187). The pier provides access to docks that extend from the east face. Inspection of the pier was completed on October 18th, 2019. It started on the north end of the west face progressed south around the end and continued north along the east face.

3.3.1 Description of Shore Protection

The pier consists of a timber crib sub-structure with a row of concrete blocks and a poured concrete cap above it. On the day of the inspection the top of the timber cribs sat approximately

15cm below the waterline with the concrete above it. The pier is approximately 187m long with 110m extending from land with water on both the east and west sides. This section of the pier is 6 to 8m wide. Another 77m of the pier on the north end is adjacent to land with water on the east side only. In this section, from approximately chainage 0+100 to 0+187, there is 100mm rip rap material piled up against the wall and sloping into the water at an approximate slope of 4h:1v. Approximately 4 to 5m from the face of the wall the slope drops off significantly, varying from 2h:1v to 1h:1v, to the lakebed of the harbour.

3.3.2 Structure Assessment

Risk of Damage Due to Structure Failure

Damage or failure of the pier would cut off access to the docks that extend from the east face. Failure of the north section, adjacent to the marina offices, could result in impacts on the building. The rating system considers the risk of damage due to structure failure to be 2 – Good. We note that the only building located within 30 m of the shoreline protection is the marina office which is approximately 14m from the water's edge.

Personal Safety

The pier and north end wall provide public access to the waterfront with no railing separation from the water's edge. The walkway paver stones provide an even walking surface. Personal safety is evaluated as 2 – Good.

Material Condition

A large void below the concrete cap was observed on the west face at chainage 0+102. It extends horizontally for approximately 4m and is approximately 1.7m high. The concrete blocks in this area appear to have fallen into the cribs and have broken the top timbers. In this area the reinforcing steel in the cast in place concrete cap is exposed. The corresponding location on the east face of the pier does not have exposed timbers as the lakebed is higher and covers the crib.

Beyond this area the timbers and the concrete blocks and cap are in good condition with only minor signs of wear. This includes minor spawling of concrete blocks at the waterline. When probed with a knife, penetration into the timber is minimal. Pins observed along the face of the timber cribs are corroded.

Overall the material condition is evaluated as 2 – Good because of the section where the concrete blocks have failed and fallen into the cribs.

Structure Effectiveness and Performance

The structure appears to be functioning well, however the damage near chainage 0+100 requires repair to maintain functionality and prevent further damage. The structure should be monitored and regularly inspected to determine any negative effects of the flow through the toe.

The structures effectiveness is 2 – Good with the exception of the stability concerns around chainage 0+100.

Remaining Structure Life

The failure of the structure near chainage 0+100 results in this section having no remaining life as it requires repairs to avoid failure. For the rest of the structure, the remaining life of the timber cribs and concrete cap is estimated to be 10 years. This estimate is provided as a precaution as the timber crib structure is old and at the end of its intended design life but is only showing one area of failure. There is a possibility that the functional life could be much longer given the observed condition. The structure requires monitoring and regular maintenance to ensure deterioration is repaired as the structure ages beyond its design life.

3.4 BASIN NORTH WALL

Inspection of this structure was completed on August 19, 2019. This wall, located at the north end of the marina, consists of approximately 210m of timber cribs with a concrete cap. There is a small section, approximately 10m long, of steel sheet pile that sits in front of the timber cribs. The backshore provides pedestrian access along the waterfront. Further inland is park space and two parking lots.

3.4.1 Description of the Shore Protection

The shoreline structure consists of a timber crib with a concrete cap that consists of 1m high concrete blocks with a cast in place concrete layer on top. The top of the timber of the cribs is at an elevation of approximately 74.4m IGLD. Water depth in front of the cribs varied between 3.5m and 4.5m with the exception of the east and west ends of the wall. The water was much shallower at the ends and is generally less than 2.0m.

The backshore north of the wall's concrete cap consists of a paver stone pedestrian walkway with a lawn area to the north. A railing separates pedestrians from the water. Parking lots are located behind the lawn area on the west and east ends. A lawn extends further inland in the middle section between the parking lots. North of the parking areas is a roadway and further north is residential and commercial property. These properties sit more than 40m back from the face of the wall.

3.4.2 Structure Assessment

Risk of Damage Due to Structure Failure

Failure of the wall would impact the public use of the harbour wall which provides pedestrian access to the waterfront. The wall is also used for mooring of boats. It is possible that if a failure were to occur, the adjacent parking lot which starts approximately 10m from the wall, could also sustain minor damage. Damage to the residential and commercial buildings north of the wall are not expected. Due to the condition of the wall the risk of damage due to structure failure has been evaluated as 3 – Fair.

Personal Safety

The wall provides public access to the waterfront however the railing provides separation between the walkway and the water's edge. The walkway paver stones provide an even walking surface and regular maintenance has allowed this surface to remain in good condition. Personal safety has been evaluated as 2 – Good.

Material Condition

Above water the walkway is showing few signs of deterioration. The paver stones adjacent to the concrete cap are slightly depressed along the edge of the cap, however this depression is minor and located on the water side of the railing.

Below water, damage and deterioration to the timber cribs is significant in some areas. On the west end, at approximately chainage 0+06, a large void over 2m long and 0.7m high was observed. Sand and $\frac{3}{4}$ " stone was observed on the lakebed in front. This is the bedding material for the walkway. The depth of this void varied from 0.5m up to 1.2m. Further along the wall at approximate chainage 0+16, gaps between the timbers allowed probing up to 0.9m behind the wall. It was noted that the timbers were soft and, at a chainage of approximately 0+25, the timbers could be pulled away from the wall by hand. Another large void, 2.2m wide and 0.7m to 1.3m high, was observed at chainage 0+35. Disturbed sand and zebra mussels were observed inside the cribs. The back of the void could not be seen however it extended at least 3m north. Another void, 1.2m wide and 0.35m high, was observed extending at least 3m deep at chainage 0+41.

A steel sheet pile wall was observed in front of the cribs between chainage 0+51 and 0+61. The sheet piles were 11mm thick. Dents and one rip 0.42m long that started 0.34m below the waterline were noted in the piles. East of the sheet piles the timber wall continues with another void 0.25m high and 0.20m wide that extends in to the wall at least 1m. At this point the cap sits inside the timbers by 0.15m. A shallower 0.6m wide by .25m high void only 0.25m deep was observed at 0+66m.

At chainage 0+77 the cribs appear to be in good condition. Starting at 0+80 there were small piles of sandy material on the lakebed and small voids that could be probed up to 0.2m behind the crib wall. Further along, at chainage 0+86, a gap between the concrete blocks allowed for probing over 1m and there was a timber missing. At chainage 0+93 there was another void and timbers pulled away from the wall just below the cap. Material was again observed on the lakebed. Progressing east the wall was again in good condition with only penetration at the location of cross north/south members. Gaps between timbers at 0+130 and 0+135 allowed full penetration of the metre stick. This was again observed at 0+160, 0+166 and 0+175, but the voids associated with the penetration were narrow.

Cracks in the concrete and spawling were observed along the entire wall and was most severe at locations between chainage 0+15 and 0+25, at 0+41 and between 0+135 and 0+185.

At chainage 0+210 the wall turns south and transitions to steel sheet pile wall. The timber wall sits behind the concrete cap and the steel sheet piles butt up to the concrete cap, creating a gap between the timber and steel wall.

Structure Effectiveness and Performance

The underwater condition requires major repairs or replacement to continue functioning properly. The current condition of the structure requires regular maintenance in the backshore to maintain a functional safe walkway. This will be ongoing until the deteriorated timber cribs are repaired or replaced. This area is involved in lifting activities for the marina. Restrictions communicated previously should stay in place until the deficiencies in this wall are resolved. Structure effectiveness and performance has been rated as 3 – Fair.

Remaining Structure Life

The north wall is at the end of its design life. It will continue to provide the same level of performance as it is currently providing and deterioration is expected to continue. Backshore maintenance needs will increase as deterioration continues. Voids observed under the cap will continue to lead to sink holes in the backshore. Loading behind the wall in the area of chainage 0+00 to 0+100 should be restricted to pedestrians only.

Inspection of the structure above water is recommended to be carried out monthly, to monitor for failures in the backshore.

3.5 BASIN EAST WALL

The east side of the basin consists of a steel sheet pile wall along its entire length of approximately 115m. Inspection of the wall was completed from the north end to the south. This wall connects to the North Wall at the north end and at the south end runs into the Coast Guard pier that extends towards the west. The backshore consists of a walkway along the length of the wall with a parking lot east of the walkway on the north end and a paved driving surface on the south end. Underwater review of the wall was completed on August 19th 2019.

3.5.1 Description of the Shore Protection

The steel sheet pile connects to the concrete cap of the north wall. The sheets along the entire length of the wall are similar to an Algoma section A which has the connection between the sheets at the end of an open u-shape. Along the wall are multiple culverts and pipes that extend through the wall above and below water. These openings varied in diameter from approximately 0.20m at chainage 0+50 to between 0.55m and 0.70m at chainage 0+07, 0+11 and 0+19. Tie backs near the lakebed spaced every 4 in-pans were found in the first 60 meters of the wall. There was no evidence of a wailer on the outside of the wall. A custom steel section is located at approximately 75.5m IGLD elevation that extended along most of the wall, but was not continuous. The water depth along the wall varies from just under 3m at the north end to almost 5m mid wall and back to approximately 3m at the south end.

The backshore includes a concrete cap along the waters' edge with an adjacent paver stone walkway from chainage 0+00 to approximately 0+65. There is a railing barrier between the pavers and concrete surfaces. At chainage 0+35 there is a crane lift that sits on a concrete pad. South of the end of the concrete and paver stone path there is no cap to the sheet pile and the backshore is paved with asphalt up to the wall. There is a section of vegetation approximately 10m long between where the concrete ends and the pavement begins.

3.5.2 Structure Assessment

Risk of damage Due to Structure Failure

Failure of the wall would impact the public use of the harbour wall which provides pedestrian access to the waterfront and parking space. It is likely that if a failure were to occur, the adjacent parking lot which starts approximately 3m from the wall, would also sustain damage. Due to the shoreline nature of the wall the risk of damage due to structure failure has been evaluated as 3 – Fair.

Personal Safety

The wall provides public access to the waterfront however the railing provides separation between the walkway and the water's edge. The walkway paver stones provide an even walking surface when maintained. Personal safety has been evaluated as 2 – Good.

Material Condition

Many small holes were found in the SSP approximately 5cm in diameter. They appeared to be cut into the SSP wall and were present above and below waterline but mostly near the top of the wall. Some of the holes had eye-bolts in them or a rod like element, while others were free from obstruction with sand and sediment behind them. Over 100 were counted along the length of the wall. What appeared to be tie back rods with a plate and nut at their ends were pulled out of the wall and often bent down or to the side. These tie backs were located near the lakebed. Around the tie back rods, holes were observed that were approximately 10cm in diameter. Piles of soft sediment material were noted accumulating in front of the holes in the sheet pile wall. The toe of the wall was observed to be fully embedded during the inspection.

The culverts and pipes observed in the wall often have a gap around the joint between the wall and the pipe element. Penetration of a metre or more was possible in the gap at chainage 0+11. The pipe at chainage 0+07 has a gap with visible stone fill material approximately 100-200mm in size. Zebra mussels were found at chainage 0+19 between the pipe and the wall and there is fill material accumulated inside the pipe. The gap around the pipe at chainage 0+50 is approximately 3cm and allows the fill material to be removed by hand.

Signs of settlement in the backshore were observed where fill material has been lost. Paver stones have been removed for approximately 5m at the north end of the wall and around the corner heading west for 2m. They have also been removed around the mast crane just before chainage 0+35 and at chainage 0+11 in line with the 0.6m pipe that come through the wall underwater. Removing the paver stones has exposed large voids under the walkway. It was

evident during the inspection that sand material was leaking through the holes in the wall. Sections of the SSP wall nearing chainage 0+60 were leaning in at the top.

Structure Effectiveness and Performance

The structure requires major repairs or replacement to continue functioning properly. The current condition of the structure requires regular maintenance in the backshore to maintain a functional and safe walkway. This will be ongoing until the sheet pile wall is repaired or replaced. This area is involved in lifting activities for the marina. Restrictions communicated previously should stay in place until the deficiencies in this wall are resolved. Structure effectiveness and performance has been rated as 3 – Fair.

Remaining Structure Life

The east wall is at the end of its functional life due to number of holes, material loss around outlets and a section that is leaning. It will continue to provide the same level of performance as it is currently providing and deterioration is expected to continue. Backshore maintenance will increase as deterioration continues.

Inspection of the structure above water is recommended to be carried out monthly, to monitor for failures in the backshore.

4 SUGGESTED REPAIRS

This section presents our suggested repair options for the damage observed during inspection. Costs presented herein are preliminary and do not include contingency, tax or design fees.

4.1 East Breakwater

The suggested repair for the breakwater is to remove the concrete cap and place an armour stone cover over the existing crib, filling any voids in the core of the structure and bringing the crest up to an appropriate elevation. A typical section of the proposed repair is presented on Figure 4.1

The estimated cost associated with these works is \$1,750,000. This includes costs of completing the works from a floating plant.

The armour stone placed along segments of the toe of the east breakwater was found it to be in functional condition.

4.2 West Breakwater

The suggested near term repair for the breakwater is to place additional armour stone on the approximately 100m of failed sections of the structure. A typical section of the proposed repair is illustrated on Figure 4.2. The armour stone creates a stable outer surface that protects the existing core of the breakwater.

The estimated cost associated with these works is \$1,000,000. This includes an associated cost of completing the works from a floating plant.

Ultimately, we expect that the entire west breakwater structure will need to be brought to a higher standard of stability. These improvements are mostly associated with additional placement of armour stone on the section of the breakwater that extends 180m from the western shore. The improvements will ensure long term stability of the structure under design wave conditions. The work will include an increase in crest height of the breakwater and additional material along the harbour side. A typical section of the breakwater repair is shown on Figure 4.3. A preliminary construction cost estimate indicates that the works would be approximately \$3,250,000. This assumes re-use of existing armour stone material including armour stone placed during the suggested repair on the outside. It includes only the additional material required on the lakeside to attain the desired slope, the material on top of the crib to raise the elevation and material on the inside slope down to an elevation that would allow navigation if the basin was dredged. This price does not include the portion of the breakwater that forms the entrance to the marina. This area is assumed to be adequately addressed during the repair.

4.3 Centre Pier

At this time it is suggested that a repair for the failed concrete block section at the north end of the west side be completed. The small gaps at the lakebed on the south side should be

monitored but do not need to be immediately addressed. Our suggested repair for the failed concrete blocks includes placing flat steel sheets along the damaged section in front of the existing timber crib and concrete cap, filling the area behind the plate with clear stone and grouting any voids along this section of the wall. A typical section of the proposed repair is illustrated on Figure 4.4.

An estimated construction cost of the steel sheet repair is \$75,000. This assumes that an approximately 6 m long section of the pier will require repair.

4.4 Basin North Wall

The suggested repair for the timber crib walls includes installing a steel sheet pile wall in front of the existing timber crib and concrete cap wall, filling the small area between with clear stone, grouting any voids and installing a concrete cap along the wall's length. A typical section of the proposed repair is illustrated on Figure 4.5.

An estimated construction cost of the sheet pile walls is \$1,950,000. This assumes a uniform wall height of approximately 4.5m along the 210m length.

4.5 Basin East Wall

The suggested repair for this structure includes replacing the steel sheet pile wall with a new sheet pile wall, filling the small area behind with clear stone, grouting any voids and installing a concrete cap along the wall's length. The existing outlets will need to be incorporated within the new wall and properly sealed and connected to the new wall. A typical section of the proposed repair is illustrated on Figure 4.6.

An estimated order of magnitude cost for materials and installation of the sheet pile walls is \$1,170,000. It assumes a uniform wall height of approximately 4.5m along the 115m length. This cost does not include contingency, taxes or design fees.

4.6 Priority

The Basin East Wall appears to be deteriorated to the greatest degree and likely should be the highest priority. The west and east end of the Basin North Wall are high priority however we recommend repairing the entire length as a patchwork approach may be difficult to complete and may increase the repair cost due to multiple mobilizations and increased complexity of the works. We also recommend completing the North and East walls at the same time for additional cost savings. Restoring the Basin North and East Wall sections would allow normal functions along the edge of the harbour basin to carry on, including public access and boat storage and loading.

The 6m of failure identified on the Centre Pier should be considered a high priority. Repairs will ensure continuous safe use of the pier and reduce the risk of additional failures.

The East Breakwater should be considered a high priority. The deterioration of the entire length south of the steel sheet pile wall has resulted in a recommendation for repair to this 100m of

length to ensure functionality. The deteriorated 100m sections of the West Breakwater should be also considered high priority since it is conceivable that severe storms at high lake levels could cause a substantial failure of a section of the breakwater and allow wave penetration into the harbour.

4.7 Cost Estimate Summary

Cost estimates prepared for each structure described above are summarized in Table 4.1. This table includes the cost of the suggested repairs of the length recommended. It does not include tax, contingency, or design fees.

Table 4.1 - Cost of Recommended Repair

AREA	LENGTH (m)*	REPAIR COST
North Wall SSP	210	\$ 1,950,000.00
East Wall SSP	115	\$ 1,170,000.00
Centre Pier	6	\$ 75,000.00
West Breakwater	100	\$ 975,000.00
	180	\$ 3,250,000.00
East Breakwater	130	\$ 1,750,000.00
	TOTAL	\$ 9,170,000.00

*Length of suggested repair not the total structure

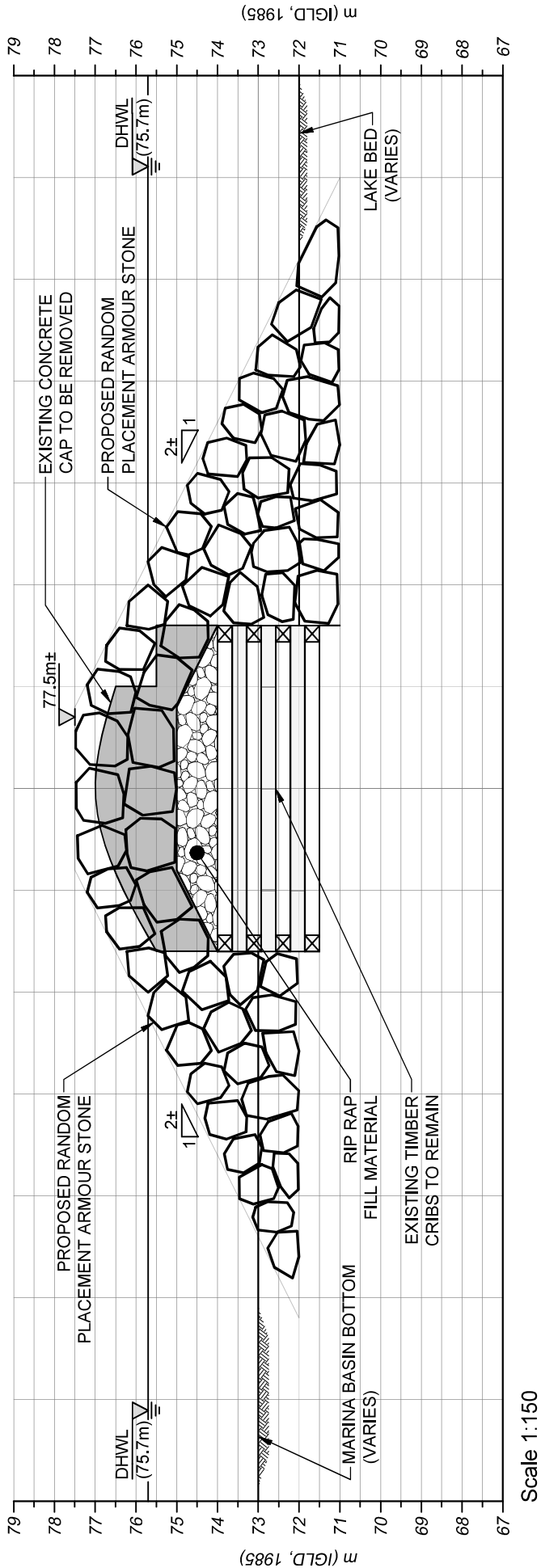


Figure 4.1
East Breakwater
Suggested Repair

Project: 19-3097
Scale 1:150
SHOREPLAN

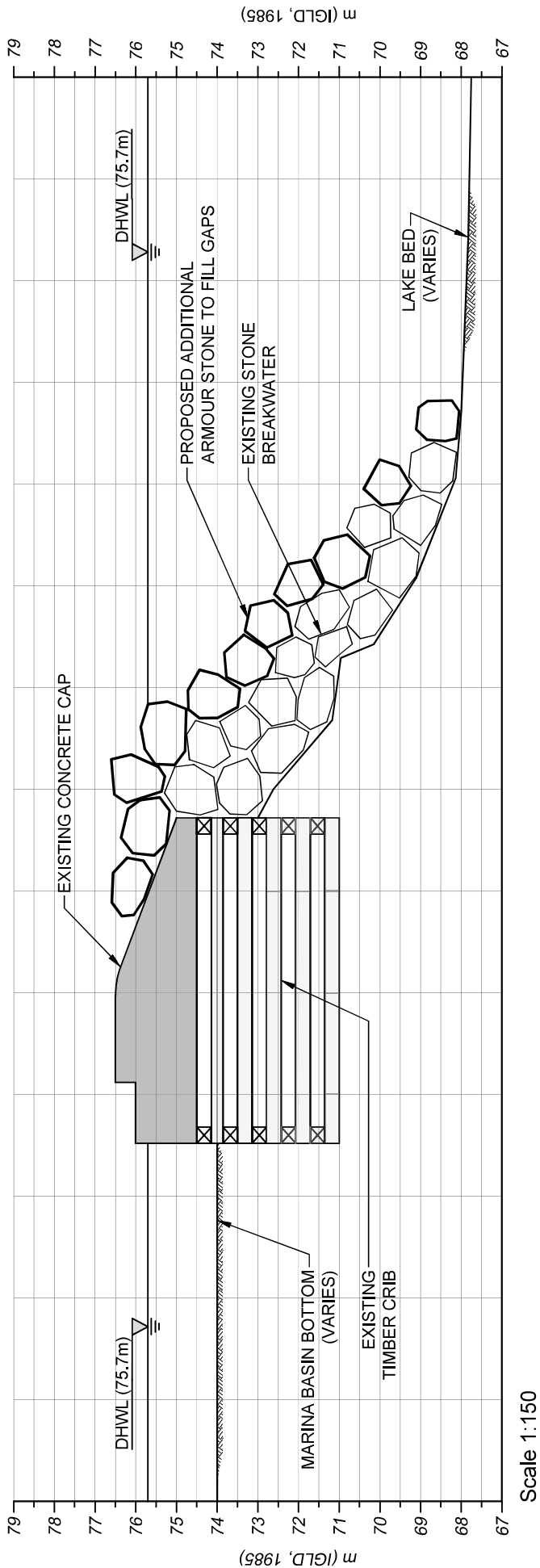
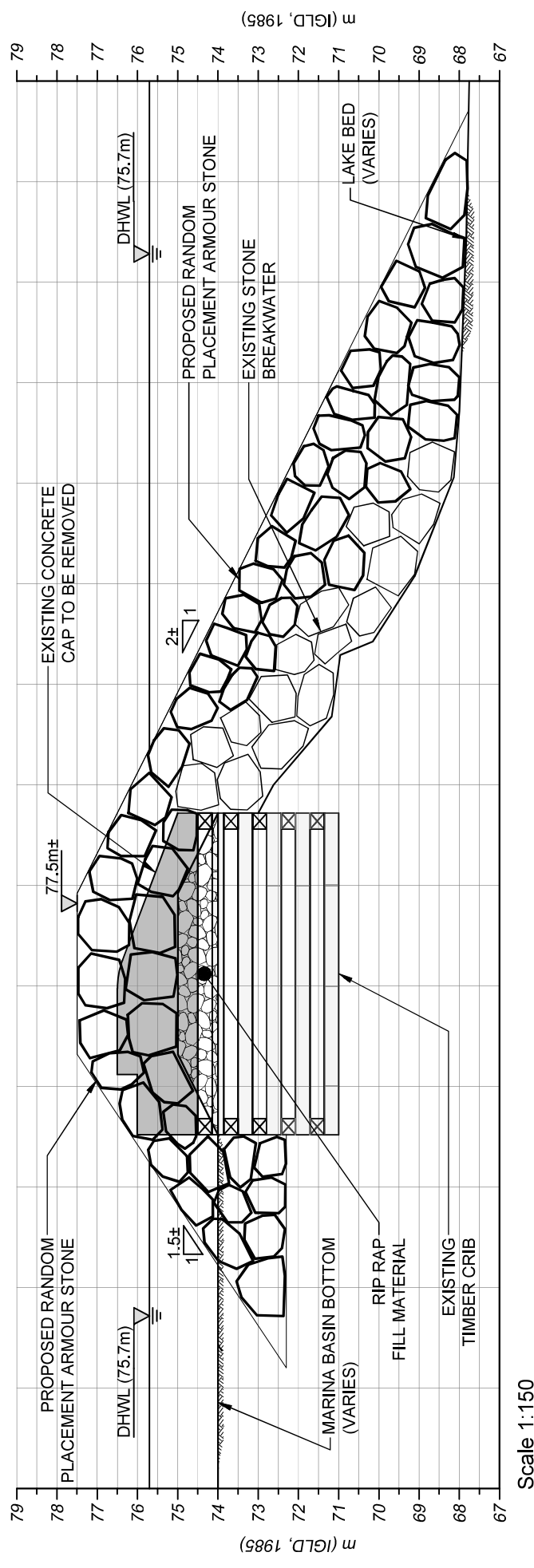
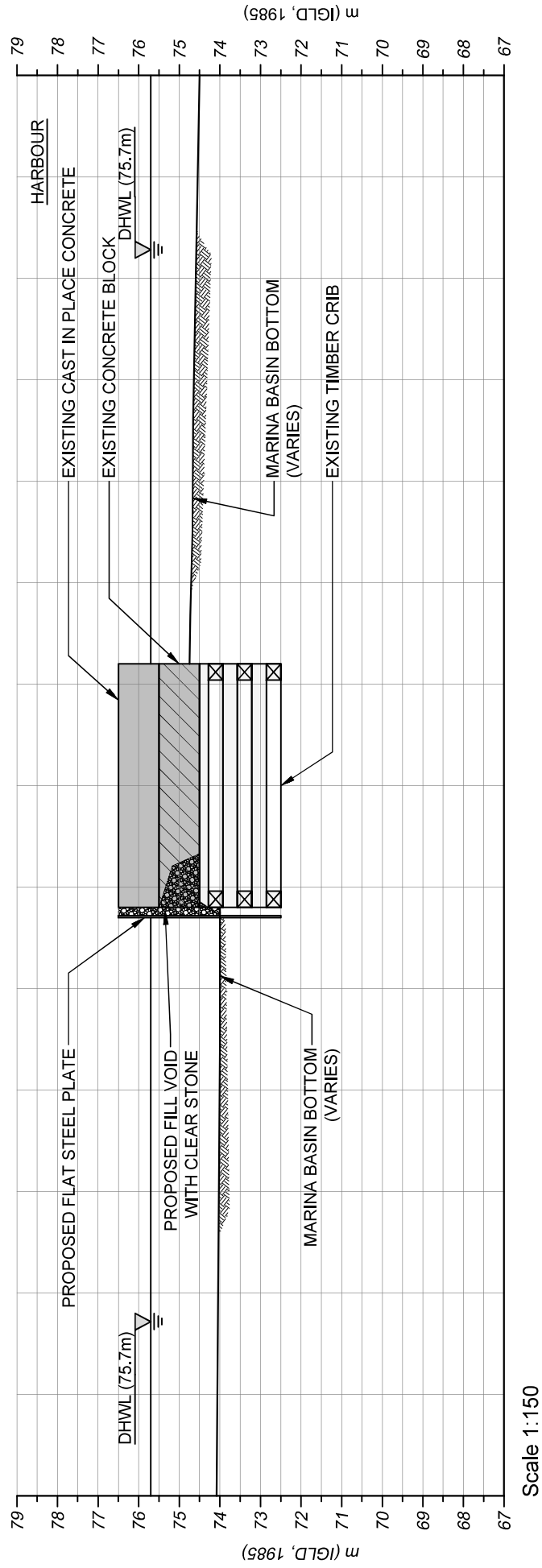


Figure 4.2
West Breakwater
Suggested Repair



Project: 19-3097
Scale 1:150
SHOREPLAN

Figure 4.3
West Breakwater
Longterm Repair Option



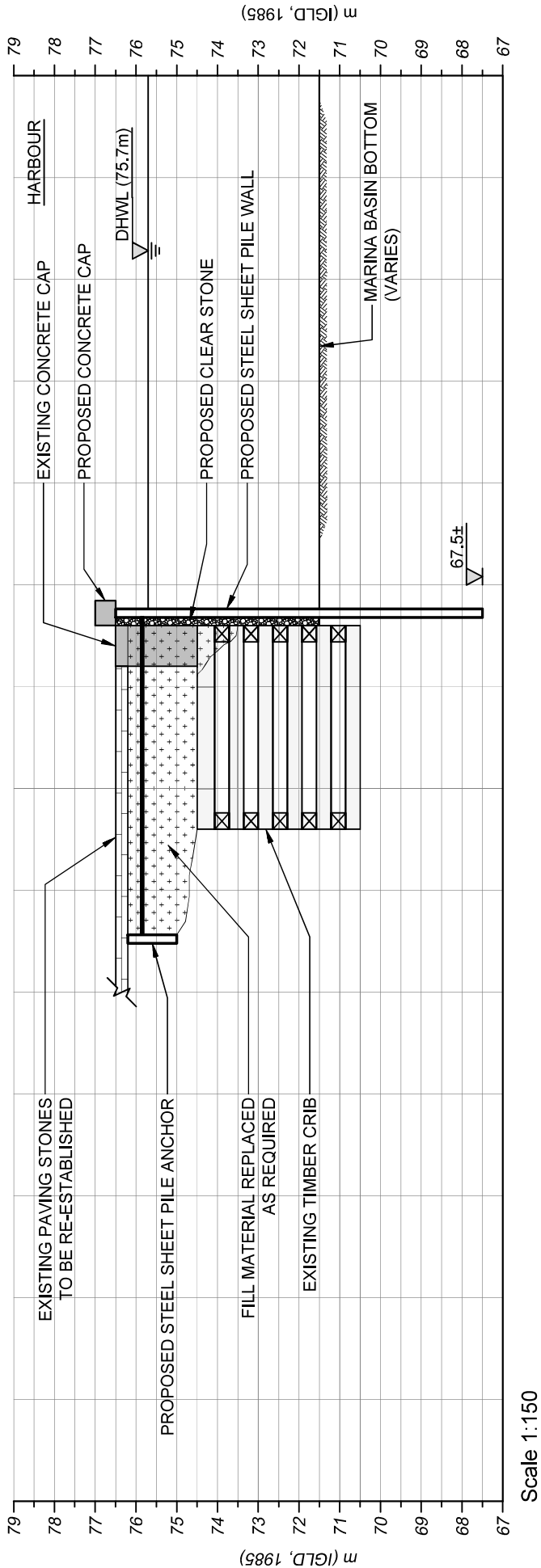


Figure 4.5
Basin North Wall
Suggested Repair

Project: 19-3097
Scale 1:150
SHOREPLAN

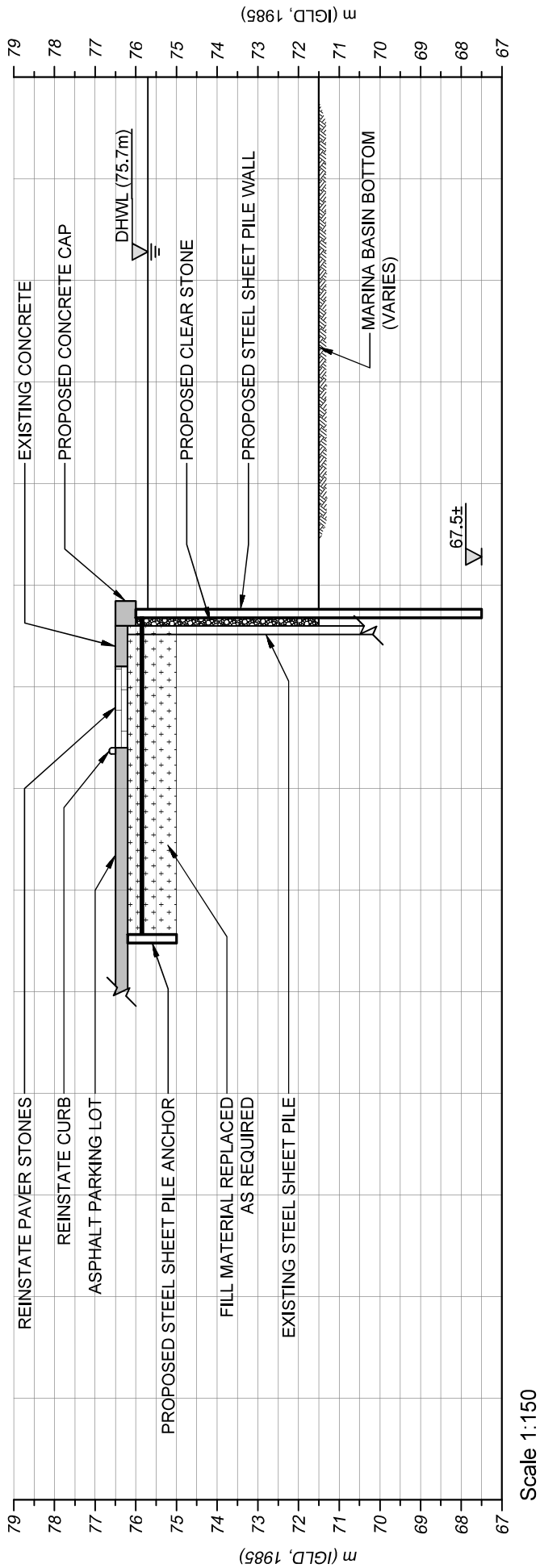


Figure 4.6
Basin East Wall
Suggested Repair

5 CONCLUSIONS AND RECOMMENDATIONS

Five distinct areas of the Cobourg Marina infrastructure were reviewed. Structural makeup and condition is unique to each area. Following site inspections, an assessment of the structures was completed according to a rating system which established 4 areas of concern. A summary of the rating for each area is presented in Table 5.1. Priority is further summarized after this table and should not be automatically given to the areas with the highest overall score.

Table 5.1 - Summary Rating Table

	Risk of Damage due to Structure Failure	Personal Safety	Material Condition		Structure Effectiveness & Performance	Total out of 20
			Above Water	Below Water		
East Breakwater	1	4	4	4	3	16
West Breakwater	1	4	4	4	3	16
Centre Pier	3	2	1	2	3	11
North Wall	3	2	2	4	3	14
East Wall	3	3	4	4	3	17

Based on the assessment, the conclusion and recommendations are as follows:

1. Priority should be given to the Basin East Wall to allow for continued use. These repairs should be paired with the suggested repairs for the Basin North Wall if budgeting allows.
2. Repairs to the breakwaters are required to provide protection to the Marina. They are both at an advanced level of deterioration and should be monitored for additional damage after major storm events. The East Breakwater requires repairs along its entire length while the West Breakwater requires repair of approximately 100m to ensure functionality.
3. Repairs are required to the Centre Pier for a small area 6m long to protect against further deterioration and ensure stability.

Table 5.2 presents the findings for each site. The table summarizes the type of structure, estimated remaining life and recommended monitoring, recommendations for rehabilitation or repairs, and construction budget estimates for the recommended rehabilitation structure or maintenance if applicable.

Table 5.2 - Summary of Findings

Section	Structure Description	Estimated Remaining Life & Monitoring	Rehabilitation/ Maintenance	Rating/20	Construction Budget Estimate
East Breakwater	Breakwater 200m long 70m of Steel sheet pile wall.	Structure at end of life. Many sections have missing or severely degraded structural elements. The remaining structural life is less than 5 years. The structure is in imminent risk of damage during severe storms	Remove the concrete cap and place an armour stone cover over the existing crib, filling any voids to bring it up to an appropriate elevation.	16	\$ 1,377,000.00
	130m Timber cribs with concrete cap and armour stone along portions of the structure.	Visual inspection of breakwater should be carried out annually and after severe storm events until repairs are implemented.			
West Breakwater	Breakwater 238m long	Structure showing signs of deterioration with sections of armour stone failure and severely degraded structural elements. The structure is in imminent risk of damage during severe storms	Short Term - Place armour stone on the approximately 100m of failed sections of the structure.	16	\$ 975,000.00
	Timber cribs with concrete cap and armour stone. Sections that may be only armour stone	Visual inspection of breakwater should be carried out annually and after severe storm events	Long Term – Build up armour stone to an appropriate elevation covering existing cribs and filling any voids.		
Centre Pier	Pier extending 110m from shore and seawall 77m long. Timber cribs with concrete cap.	Remaining life estimate is 15 years outside of 6m of failed concrete blocks and timbers at 0+100. Visual inspection of pier annually and after severe storm events	Repair for the failed concrete blocks along 6m - place flat steel sheets along the damaged section in front of the existing timber crib and concrete cap, fill area behind the plate with clear stone and grout any voids.	11	\$ 75,000.00
North Wall	Seawall 209m long on north side of marina basin.	Structure at end of life with many sections having a remaining structural life of less than 5 years.	Place a steel sheet pile wall in front of the existing timber crib and concrete cap wall, fill the small area between with clear stone, grouting any voids and install a concrete cap along the wall's length.	14	\$ 1,950,000.00
	Timber cribs with concrete cap.	Visual inspection of shoreline annually to monitor erosion and after severe storm events	Maintenance of the walkway is required to ensure a trip free surface and current boat storage and lifting restrictions should also remain in place until repairs are completed.		

East Wall	Seawall 115m long on east side of marina basin. Steel sheet pile wall sections with concrete cap.	Structure at end of life with sections of the wall having zero years of remaining structural life. Visual inspection of shore protection annually and after severe storm events.	Replace the steel sheet pile wall with a new sheet pile wall, fill the small area behind with clear stone, grout any voids and install a concrete cap along the wall's length. Maintenance of the walkway is required to ensure a trip free surface and current boat storage and lifting restrictions should also remain in place until repairs are completed.	17	\$ 1,170,000.00
* All measurements are approximate, estimates are for construction costs and do not include tax, contingency or engineering/permitting fees.					

Appendix A

Site Photographs

INSPECTION PHOTOS

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EAST BREAKWATER.....	2
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EAST WALL	33
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EAST BREAKWATER



Photo 1 - East Breakwater, East Face



Photo 2 - East Breakwater, East Face Small Hole



Photo 3 - East Breakwater, East Face Transition to Timber Cribs 0+075



Photo 4 - East Breakwater, East Face Transition to Timber Cribs 0+075



Photo 5 - East Breakwater, East Face Gap and Visible Fill Material



Photo 6 - East Breakwater Cap Looking South



Photo 7 - East Breakwater, East Face Missing Top Two Timbers



Photo 8 - East Breakwater, East Face Gap and Cross Members



Photo 9 - East Breakwater, East Face Cross Member Coming Through



Photo 10 - East Breakwater Bottom Cross Members



Photo 11 - East Breakwater East Face Top Two Timbers Missing 0+158



Photo 12 - East Breakwater East Face Top Two Timbers Missing 0+173



Photo 13 - East Breakwater East Face Gap Between Cribs No Fill



Photo 14- East Breakwater East Face Plate Secured to Timbers



Photo 15 - East Breakwater East Side of Lighthouse



Photo 16 - Concrete Sections On Lakebed Adjacent to Lighthouse



Photo 17 - East Breakwater West Face Revetment – South End

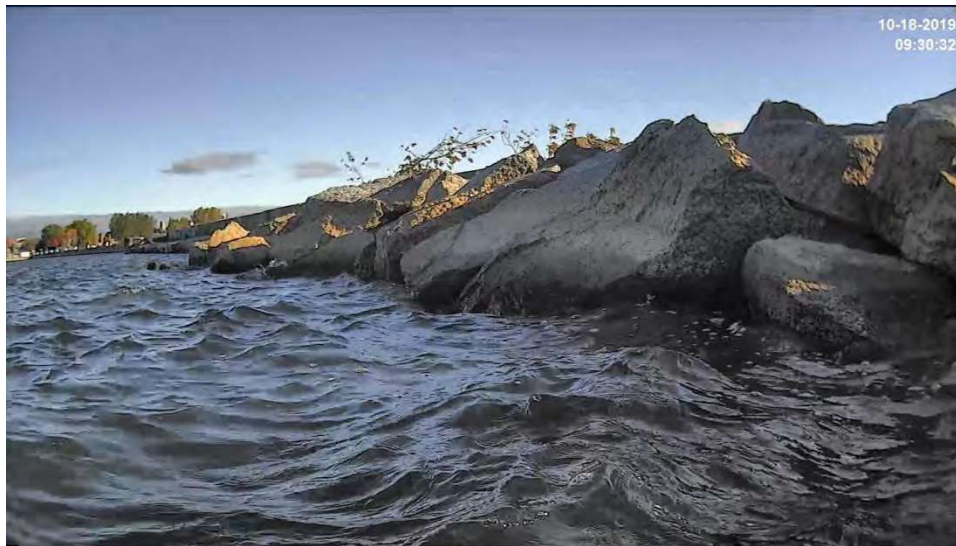


Photo 18- East Breakwater West Face Revetment – North End



Photo 19 - East Breakwater West Face Revetment – North End Connection with Cribs



Photo 20 - East Breakwater West Face Crib, Example of Cross Timber Stopping Short of Wall



Photo 21 - East Breakwater West Face - Spawling in Cap 0+97 South

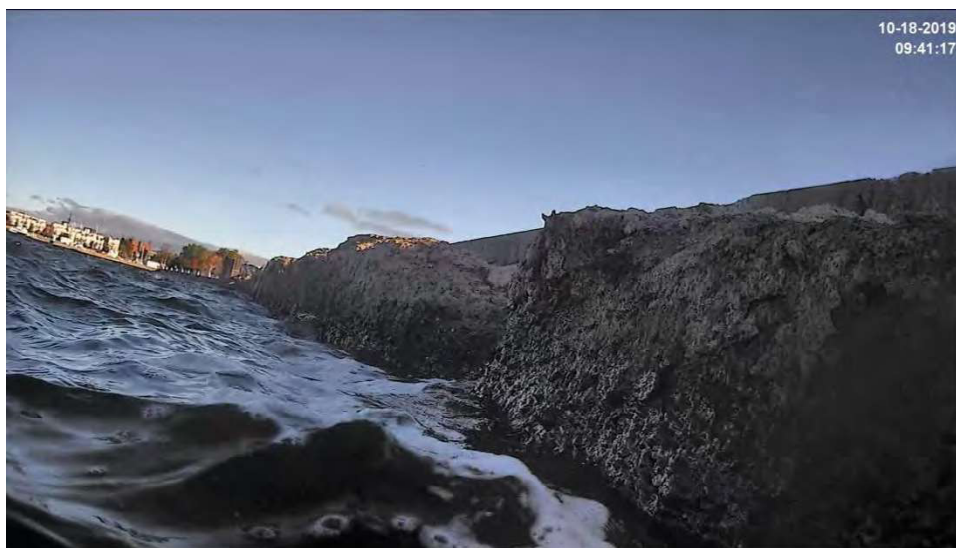


Photo 22- East Breakwater West Face - Spawling in Cap 0+97 North



Photo 23 - East Breakwater West Face - Weeds Getting Pulled into Void in Wall



Photo 24 - East Breakwater West Face - Void between Cribs and SSP Flow E to W



Photo 25 - East Breakwater West Face - SSP Wall Looking North



Photo 26- East Breakwater West Face - SSP Wall 100% Coverage



Photo 27- East Breakwater West Face Change to Z-Pile



Photo 28 - East Breakwater West Face - North End of Breakwater Start of Pier

WEST BREAKWATER



Photo 29 - West Breakwater North Side, West End Revetment



Photo 30 - West Breakwater North Side, End of Revetment



Photo 31 - West Breakwater North Side, Damage to Concrete Cap 0+20



Photo 32 - West Breakwater North Side, Sand Pushed Away at Toe Void



Photo 33 - West Breakwater North Side, Example Gap at Toe



Photo 34 - West Breakwater North Side, Form Joints & Cracks in Cap



Photo 35- West Breakwater North Side, Large Section of Cap Damage 0+70



Photo 36 - West Breakwater North Side, Large Gap Between Cribs 0+84



Photo 37 - West Breakwater North Side, Space Inside Large Gap 0+84



Photo 38 - West Breakwater North Side, Start of Stone Material 0+110



Photo 39 - West Breakwater North Side, Lakebed Adjacent to Stone



Photo 40 - West Breakwater North Side, Gap between Stones in Revetment Toe



Photo 41 - West Breakwater North Side, Concrete Section with Stones in Front, Change of Direction



Photo 42 - West Breakwater North Side, Gap in Revetment



Photo 43 - West Breakwater South Side, Scattered Stone Offshore of 0+228



Photo 44 - West Breakwater South Side, Gap in Revetment



Photo 45 - West Breakwater South Side, 0+175 Looking West



Photo 46 - West Breakwater South Side, Missing Stone at Concrete East End



Photo 47 - West Breakwater South Side, Material Piled up Against Sloped Cap

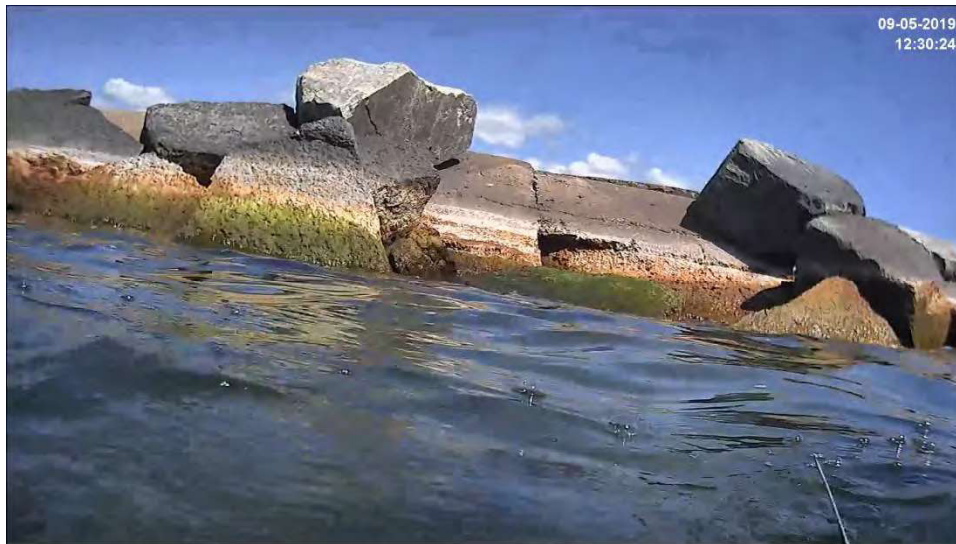


Photo 48 - West Breakwater South Side, Small Gap Onshore 0+30



Photo 49 - West Breakwater South Side, West End looking East

NORTH WALL



Photo 50 – North Wall - Timber Pulled Out From Wall 0+06



Photo 51 - North Wall Looking East from West End



Photo 52 - North Wall Steel Belting Below Cap



Photo 53 - North Wall Build Up of Material at Toe



Photo 54 - North Wall Inside Large Void at 0+35



Photo 55 - North Wall Void at 0+41



Photo 56 - North Wall Example of Cracking in Concrete Blocks



Photo 57 - North Wall Spawling in Concrete Block 0+42



Photo 58 - North Wall Transition to Steel Sheet Pile 0+51



Photo 59 - North Wall Inside Culvert at 0+90



Photo 60 - North Wall Typical Gap Between Timbers 0+135

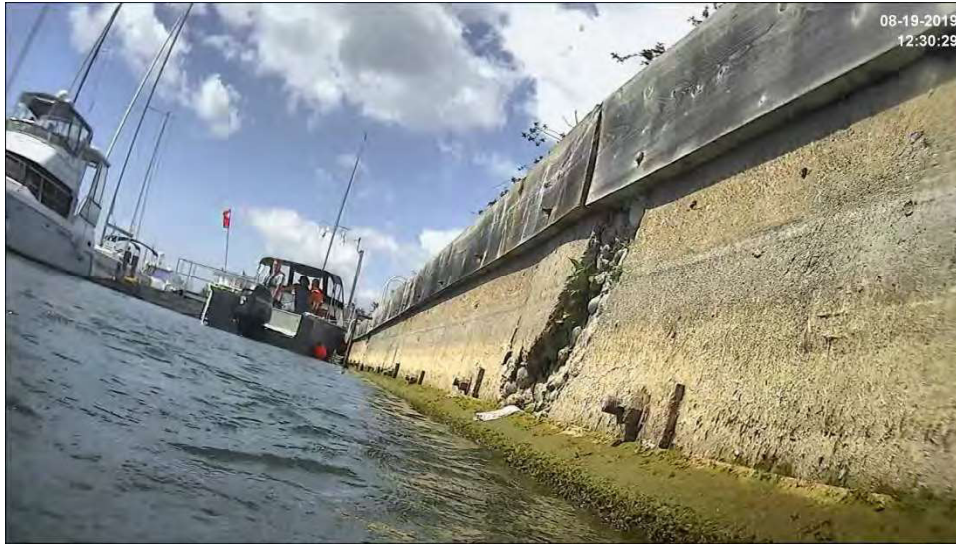


Photo 61 - North Wall View Above Water Line 0+190

EAST WALL



Photo 62 - East Wall Connection to North Wall



Photo 63 - East Wall Looking South from North End



Photo 64 - East Wall Typical Hole



Photo 65 - East Wall Tie and Bolt Pulled Away From Wall at Lakebed



Photo 66 - East Wall Example of Hole Above Tie Back



Photo 67 - East Wall Pipe Above Waterline at 0+50



Photo 68 - "Bumper" at Waterline



Photo 69 - Buildup of Material in Front of Wall



Photo 70 - East Wall Leaning at 0+65



Photo 71 - East Wall Example of Eye Bolt in Wall with Small Gap Around



Photo 72 - East Wall Leaning Piles Above Water

CENTRE PIER



Photo 73 - Centre Pier West Face North End



Photo 74 - Centre Pier Cap Condition



Photo 75 - Centre Pier West Face Gap at Toe With Flow 0+47



Photo 76 - Centre Pier West Face Scour from Flow Through Wall



Photo 77 - Centre Pier West Face Spawling 0+61



Photo 78 - Centre Pier West Face Typical Scour at Toe Due to Small Gaps



Photo 79 - Centre Pier West Face Typical Scour at Toe Due to Small Gaps



Photo 80 - Centre Pier West Face Sudden Stop of Zebra Mussel Growth 0+105



Photo 81 - Centre Pier Steel Belting Around Corners at East End



Photo 82 - Centre Pier Crack and Spawling in Cap



Photo 83 - Centre Pier East Face Looking South



Photo 84 - Centre Pier East Side to Sloped Embankment 0+100

Appendix B

Site Inspection Notes

Breakwaters and Basin Walls Condition Assessment		Inspection Date
19-3097	EAST BREAKWATER OUTER	05-Sep-19
Town of Cobourg	Water Level (IGLD)	75.3 m

*all measurements are approximate

Chainage	Notes	Water Depth (m)
Start	Sheet pile wall east side - starts as Z-pile	
0+00	Minor rust <1mm pitting, 80% algae coverage starting below water line, bottom sandy	2.3
0+27	Hole above waterline 4cm diam. 53cm from top of deck on out pan.	
0+34	Another hole same as above	
0+39		0 2.64
0+43	Hole ripped appearance, 60cm from top of deck, 5cm diam. Right on in-pan seam	
0+45	Switches to U-pile shape, a tie every 3rd in-pan at top. Ties intact but wailer bolts near end missing - total 12 missing. Thicker marine growth bottom 1m covered in zebra mussels	
0+65	Pin at top of wall pulled out, knuckles interlocked well	
0+75	End of sheet piles open at end and can see timber cribs behind	
0+75	Start of concrete cap breakwater 1-1.5m out from waterline concrete cap turns vertical & sits on cribs, Concrete vertical 74cm -80cm Water line to top of crib 1.48m, 1m height of exposed crib. 30 to 50 cm vertical gap 3.8m long at top of crib with no fill Fill - 14x16x8cm smaller material(measured), 30x20x15 larger material (estimated)	
0+85	Additional timber missing - 2 at top instead of just one, Only one timber on bottom Fill material missing 86cm from bottom of concrete cap to fill No material on bottom, just sandy lakebed	
0+86	Spawling 50cm high along waterline consistent, 35cm depth	
0+88	60cm between cap and fill back to only missing top timber	
0+90	All timbers present for approx. 90cm then back to missing one of the top 2 timbers with 30cm fill missing Cap resting on E/W timbers not on N/S timbers	
0+91	Form joint in concrete (Joints every 6m) Cross members every 1m, can see 4 ends stacked, act as secondary wall east/west inset 20cm behind East Face wall Timbers measured at 17x17cm	
0+93	Only bottom 2 timbers running N/S present	
0+95	Vertical timber every other E/W line which happens every 1m, only 2cm gap between cap and fill material	
0+97	Joint	
0+99	Large Spawled section 63cmH 2.65m long, depth varies avg. 92cm measured at edge of vertical face. At joint between cribs. No fill visible	
0+103	New cribbing 28cm gap between cribs, missing 2 timbers for 50cm then only top timber for 80cm, then 2 timber missing again.	
0+105	Cross (E/W) top timber 60% deteriorated, gap 26cm concrete to fill. Then 1m of all present/good N/S timbers	
0+106	missing top timber	
0+108	gap between N/S sections of timber. can stick hand in, top timber inset, hole in timber smaller than fist size.	
0+109	Joint	
0+123	small gaps in timbers running N/S 35cm sections 15cm high one below top timber inline with cross section	
0+125	2nd timber down, 35cm gap space between 94cm	
0+126	Another gap	
0+135	Chunk of cap missing 2.59m long, 66cm high 78cm depth, Top timber present back to typical 75cm (instead of 50cm) section missing at waterline	
0+140	35cm gaps still present	
0+143	Joint Chunk of cap missing at edge of joint 2.4m N/S, 61cm High, 69cm deep	
0+145	Missing top N/S timber, One cross E/W timbers coming right to outer face sitting on top of N/S timbers below	

0+147	Missing 3 timbers for 1m	
0+148	From here only missing top timber, Spawling start 2.42m long, 62cm high 78cm deep	
0+158	Missing top 3 timbers 1 m, then 2 top timbers missing, 58cm between cap and fill	
0+163	Spawling 87cm high, still missing top two timbers	
0+170	Missing only 1 timber N/S	
0+173	back to missing 2 top timbers , lakebed slopes back towards cribs	
0+174	Joint between cribs - no fill	
0+175	Spawling in concrete cap 1.41m wide, 82cm high, 76cm deep, All 4 timbers running E/W & N/S gaps around E/W timbers	
0+178	approx.1/2" Plate 1.15m tall by 2.38m 2cm off bottom up to concrete cap - very secure to wall Slight slope towards toe of lakebed	
0+181	Approx. 11cm gap between plates, 2.35m long 2nd plate, timbers behind plate. Extends into lakebed and all the way to cap. Ends at 0+183	2m
0+183	Spawling 54cm at waterline - consistent along breakwater	
0+185	E/W all 4 timber present	
0+187	E/W top 2 timbers present, Missing second timber from top N/S	
0+189	All timber present - 4 high	
0+192	Second timber from top missing deteriorated 1.55m long 95% gone	
0+195	Plate 1.36 long 1/2" thick in front of timbers	
0+197	At lighthouse north end - Pieces of concrete on lakebed (concrete cap?), lighthouse formed in to concrete cap. Void 2.9mm piece x 60cm x94cm deep, timber crib below. 2.6m long piece on Lakebed - could have fallen out of wall/cap 38cm gap concrete cap to fill material	
0+200	Another plate - wedged behind stone - 1.4m exposed then hidden behind stone Toe of stone 3-4m off waterline, completely hides any timbers that might be present	
END	Stone average size in front of crib 1.65mx 1.25mx 50cm Forming revetment protection toe approx. 5m from waterline around end random placement (loose placement) more stacked than sloped especially at toe. Some larger stone may have fallen down.	

Breakwaters and Basin Walls Condition Assessment		Inspection Date
19-3097	EAST BREAKWATER INNER	18-Oct-19
Town of Cobourg		Water Level (IGLD) 75.0 m

*all measurements are approximate

Chainage Recorded During Inspection	Corresponding East Chainage	Notes	Water Depth (m)
0+00	0+200	Stone 2x2x0.75m, sandy bottom, toe 5m off waterline	
0+10	0+190	Stone missing - rolled out, space on shore at waterline 2x2m	
0+14	0+186	Toe 1.5m out from waterline, stones random placement	
		stone rolled out 3 out from waterline, 3x0.45x0.75m No obvious holes on shore	
0+25	0+175	Void just below water line	
0+27	0+173	Stone 2m away 1.25x2x0.6m	
		another stone rolled out 3m, 3x1.1x0.65m - Void on shore	
0+30	0+170	Another two stones, one 3m from waterline, second rolled out stone beyond - similar size to previously observed stones	
0+35	0+165	Toe 5m from waterline - 2 stones deep	
0+40	0+160	Stones 7m off waterline	
0+45	0+155	Stones 7m off waterline - 1.25x3x0.72	
0+50	0+150	Smaller stone material offshore 1.5x0.7x thickness un-determined - buried	
0+52	0+148	Broken cap on surface, only one rock underwater at toe, remainder of revetment above waterline	
0+55	0+145	Missing stones at waterline found 6m out one 0.4thick and buried another offshore of that.	
0+60	0+140	Change in revetment more stone going north slope 3 to 4m off waterline to toe. Slope is uniform. Fewer missing stones/ gaps	
0+65	0+135	Toe is closer back to 1.5m	
0+66	0+134	voids where stones have rolled out away from revetment	
0+70	0+130	Good condition - 1.5m out to toe consistent	
0+75	0+125	Good condition - 1.5m out to toe consistent	
0+80	0+120	End of revetment - Cribs continue North	
0+90	0+110	Concrete cap on cribs, cap overhangs timbers 14cm, 1.5m from deck to timbers (cap thickness) Cribs 1.1m exposed face, timbers 25x22cm, covered in mussels, solid only 6.5cm penetration, small amount of splitting Cross timber doesn't come all the way through at top, creates gap in wall, stone in crib, no evidence of stone on bottom. Bottom to cross members come all the way through - style is continuous for this side. Silt and Mussels on lakebed only a few stones	
0+91	0+109	Concrete on surface spawled, 20cm missing completely horizontal Continuous until the north end of the cap - start of SSP	
0+100	0+100	Timber on bottom, 49x20H missing 60cm from bottom	
0+103	0+97	Chain on face of crib	
0+109	0+91	Can reach in crib. No stone above 50-60cm from lakebed. No signs of stone on lakebed	
0+110	0+90	Undermined - Flow at toe through wall (45x25H void), Cap damaged on top but covering crib/ can't see in, can't feel anything in void	
0+113	0+87	Drawing water in to crib through similar void	
0+115	0+85	Exposed pin - Void 39x20Hcm, 55cm off bottom can't feel anything when probed	
0+120	0+80	Void pulling in material (weeds) 40cm off bottom, high flow	
0+121	0+79	Missing timber below cap	
0+123	0+77	Exposed timber 40cm before cap, 91cm cap to waterline	
0+130	0+70	Start of Sheet pile wall, gap between cribs and start of SSP, strong flow East to West. U-Pile sheets, minor pitting, small rust blooms, mussels coverage 100% 1.5m off bottom, no scour or undermining. Ties at top every 4 in-pans, interlocks tight	1.41
0+140	0+60	Knuckle to knuckle width 42cm depth 15.5cm, Cap is steel between chainage 0+130 & 0+160	2.66
0+154	0+56	Missing wailer pin, Still rust blooms in "freeze-thaw" zone knuckles tight	
0+160	0+40	Transition to z-pile 42.5cm width, 18cm depth (out pan 37cm)	
0+165	0+35	Piles in good condition. Mussel coverage the same. Toe full penetration	2.77
0+171	0+29	"Corner" - Change in direction of wall	
0+184	0+16	Sandy bottom - pushing metre stick in, resistance after 51cm, no scour or undermining, 1.5mm pitting closer to waterline	1.37
0+200	0+00	Changes to concrete cap	2.36

		Water depth notes	
		ssp corner to cap section	11ft
		a south end	8ft
		Then	7ft
		until 1/2 way down revetment	9-10ft
		The back to	7-8ft
		At transition to crib up to (for 5m)	12ft
		back to	9ft
		Slopes up to ssp	6ft

Breakwaters and Basin Walls Condition Assessment

19-3097

Town of Cobourg

WEST BREAKWATER

Inspection Date

05-Sep-19

Water Level (IGLD)

75.3 m

*all measurements are approximate

Chainage Recorded During Inspection	Corresponding East Chainage	Notes	Water Depth (m)
Stone breakwater		Bottom sand, 3x2x1m stone on shore, toe 3 to 4 m from waterline	1.1
0+00	0+00	Concrete starts - Stones in front of concrete 4m from end Top of deck 0.4m to water line 1.53m of concrete to timber cribs 59cm exposed face Timbers 16cm, 13or14cm - Depth 23cm (rectangle shaped)	
0+10	0+10	Crack just above water line concrete above 27cm thick	
0+20	0+20	Cribs approx. 8cm of sand fill on top of small stone material -by feel	
0+22	0+22	Damage at surface - Void 57cm tall up from top of crib 4cm width, 38cm deep	1.64
		Void - 52cm high, 4cm wide, 38cm probe in hits concrete or something hard	
0+24	0+24	Void at toe 38cm width, 34cm high probe all the way in - Flow through wall - Material pushed away on lakebed - 4" gap between N/S and E/W timbers	
0+26	0+26	Void - N/S timber 27cm x 24cm high probe all the way in	
0+30	0+30	Damage on surface might be a form joint - spawling 93cm W 8cmH 22cm probe in, 77cm from top of deck Damage 1.97m E/W 6cm at worst, avg. 4cm probe 20cm avg. 47cm max.- 58cm from top of deck	1.16
0+30.5	0+30.5	Vertical Crack 7cm wide x 13high x 9-10 cm penetration starts 80cm from top of cap	
0+31	0+31	Vertical crack - top of cap to 51cm - 5cm at widest, 4cm probe, horizontal crack 51cm down from Another crack 51cm up from bottom probe 40cm. 1.88 concrete depth - Top of deck to lakebed all concrete	1.06
0+33	0+33	36cm up from bottom 2cm wide, 5cm probe	
0+35	0+35	Timber re-appear Vertical height on exposed timbers 50cm - water seen coming through at base - 50cm high pile of sand/ lakebed pushed inside breakwater	
0+36	0+36	N/S timber with water rushing though - shells pushed through on lakebed - timbers in good condition	
0+38	0+38	N/S timber with probe goes all the way in - don't see any fill material in gap - Cap intact, regular scaling	
0+39	0+39	Probe 27cm between timbers running E/W 20-30cm above lakebed Further east, timbers are tighter, and pushed up minimum 50cm inside N/S timbers every 1.3 m - water rushing through	
0+45	0+45	Tighter N/S timbers stones along toe 15x10x3min, larger stone 52x20x13, previously bottom composition just sand	
0+48	0+48	Large spawled section - Damage on surface doesn't continue below water except as scaling	1.55
0+50	0+50	Crack - vertical 70cm x4cmx 20-37cm probe, starts at timber going up Lakebed sand and weeds N/S soft to probe but not water coming through	
0+55	0+55	E/W timber visible behind void 60cm no flow. Crack vertical bottom of cap up 74cm x 3cm wide 32cm deep average Form joint in cap 3 to 4 m long Surface damage 0+48 -0+55 - missing top of cap	
0+57	0+57	Cribbing almost disappears - full concrete except bottom crib Sand bottom again probes in 25cm - just hard packed sand Can probe between timbers and concrete 56cm	
0+65	0+65	Concrete proud of timbers 9cm - bigger than previously, timbers exposed on bottom in good condition	
0+65.5	0+65.5	Vertical crack 72cm H x 3-4cm wide 39cm probe Top of deck to waterline 38cm Top of deck to bottom of concrete 1.58m Top of deck to lakebed 2.15	1.77
0+67	0+67	Spawling 35cm down from waterline 39cm w x 25cm H depth 11-12cm Timber N/S no flow, material around timber	
0+69	0+69	N/S Timber damage - lots of surface damage 2/3 deteriorated, lots of soft soil material visible inside gap	
0+70	0+70	Surface Damage - 50cm below waterline, 2m widest Width of deck 3.1m Damage 2.6m Vertical form crack 42cm spawled Probe in 25cm hard material Height of exposed timbers 50cm	
0+76	0+76	Stones larger - 50 x70cm might be concrete broken off Probe 60cm into N/S timbers	
0+84	0+84	End of surface damage - 2 cribs meet E/W timber broken off pieces Void - 2m in face - 50cm wide E/W gets wider inside crib 90cm, 70cm height inside void at centre. Soft sediment on bottom inside w/ a few Larger 30cm stones Damage in cap above void ends going east - waterline down 1.2m to top of timbers	
0+86	0+86	NEW SIZE Timbers 30cm high -20cm deep Scaling on concrete below water not as severe.	
0+90	0+90	Surface damage - extends 70cm below waterline, 59cm wide towards east, probe 49cm deep between joint Top of deck to waterline 0.29m Top of deck to bottom of concrete 1.69m Exposed crib 0.59	1.99

0+91	0+91	Crack 83cmH x 2cm w - 25cm probe to bottom of concrete on surface, 22cm high below waterline to surface	
0+93	0+93	Crack 80cm H, 2cm wide, probe in 38cm max Damage spawling depth 35cm over 1.5m, 60cm below waterline and above to surface	
0+95	0+95	Crack 25cm H from bottom of concrete 4cm depth and spawling, Spawling below water 6x9x3cmdeep, Full surface damage, 1m below waterline before in good condition	
0+97	0+97	Vertical 73cm high crack below damage 2cm width probe in 46cm Cribbing below in good condition, bottom still sand	
0+100	0+100	End of surface damage Vertical crack 70cm x 4cm W x 28cm deep Spawling extending east 3.21m at waterline into cap 14cm then vertical spawling 90cm H x 5-6cm W, probe 38-54cm	
0+101	0+101	Timbers covered in sand	1.5
0+105	0+105	Form joint - 60cm x 2-3cm W, 35cm probe	
0+110	0+110	End of concrete visible on shore	
Revetment Section		Toe out from waterline 3m , 2x2x0.5m stone size, sandy bottom, hard packed W/D taken at toe	1.4
0+05	0+115	1.5-2m toe from waterline - void at toe - one stone width, stones not tight at toe Scour - lakebed drops adjacent to stone 35cm, 100% Marine Growth	
0+20	0+130	Toe 1-2m from waterline Gap between stones looking west, stones not tight at toe Stone size 1.7x1.8x0.75 avg	1.66
Concrete section	0+143	Concrete section approx. 32m long- scaling on concrete 1-2 rows of stone in front of concrete, lower crest elevation (approx. 1m lower)	
	0+146	Smaller stone behind large armour stone (300-600mm), sitting in front of concrete wall. Wall straight no/minor damage below waterline, Waterline to top of deck 45cm	
Midline of concrete	0+160	Softer sediment on lakebed 32cm cover of sand	
	0+165	Near step up in wall stone missing at toe 2x2m void, more sediment on lakebed 80cm deep	
Change in direction	0+175	Soft sediment but less depth - Larger stones toe 2-3m off waterline	3
Before gap 5m	0+195	Lakebed hard sand	1.7
Gap	0+200	One or two rock piled, toe less than 1m off waterline, more of a vertical pile of rocks, on row below water	1.2
around end	0+230	stones extend further out from wall, 1-2m again Stone on bottom 2x1x1m, 2m off of revetment	
	0+238	Toe stone up to 3m off waterline around end Stone 5-7m off shore in gap between breakwaters Lakebed zebras and hard bottom	
Outer side of revetment	0+230	Large stones 1x1.5x3.4m to 5m Toe 3-4m out, but large stones 5m out. Evidence they came from the revetment and have moved offshore.	
10m west of end	0+228	Missing stones above water scattered at toe and beyond, Void at toe, stones extend 7-8m from water line, Steeper slope above waterline	
Blowout section +20m	0+210	15-20m from waterline stones are scattered offshore, 20-25m wide 0+210 to 0+185	
Good section to end	0+185	Toe 6m-7m off waterline until 0+175, No missing stones but not tight together so some voids, even slope up from toe.	20-25ft
At corner	0+175	Stones missing at shoreline, on corner. Some observed sitting out from toe, Slope is flatter around corner	
At lower concrete section	0+165	Stone extend 10m off wall (toe) very few stone above waterline, stone 4-5m from toe Stones seem smaller than previous stones 1.5x1.2x1.5m some larger.	
At end of concrete	0+143	Larger stones return Toe 5m from waterline	
Start of concrete and cribs	0+110	Void to the East against concrete, Stone 9m off wall - stone could have come from wall. Very few stones above water in from of concrete for a distance of 3- to 35m along the wall, Slope consistent no longer steep Lakebed 5cm of sand then clay material	
	0+075	Flat going out - material from shoreline piles underwater 10m offshore, Just hard packed sand lakebed no clay.	
	0+055	10m good section - stones not visible off of toe	
	0+030	Section of pulled out stone flattened slope up to 10 off wall, Toe 6-7m off waterline for another 30m to end of concrete	
Revetment connection to land	0+000	"Funny" divot in land (north), toe 5-7m off waterline, no voids/missing stones	12-15ft
Outside of revetment			
lower concrete & corner everywhere else	0+140-0+180	water depth	6m
		water depth	4.5m

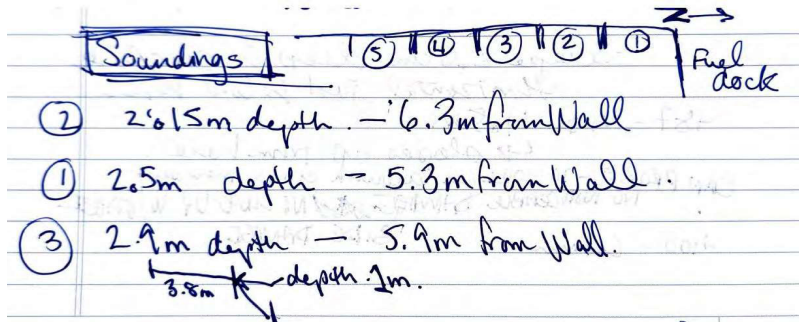
Breakwaters and Basin Walls Condition Assessment		Inspection Date
19-3097	CENTRE PIER	18-Oct-19
Town of Cobourg		Water Level (IGLD)
		75.0 m

*all measurements are approximate

Chainage Recorded During Inspection	Corresponding East Chainage	Notes	Water Depth (m)
WEST FACE		start at north end	
0+00	0+110	Shallow water Concrete cap on crib, stone extends along shore west Cap - poured concrete on blocks sitting 20cm off bottom.	0.25
0+08	0+102	Void below cap 4m x 1.67m high concrete broke and fell on to crib?	
0+14	0+96	Broken timbers, exposed re-bar Crib Face 1.26 (timbers 22x25)	
0+15	0+95	Ladder Timbers tight - Start of new crib - penetration 0.5cm pin with plate (10x10cm) 36cm from edge of crib, 93cm off bottom another one 25cm off bottom with rod & bolts, very corroded, can't make out size of rod/bolt	
0+25	0+85	Pin 10x10 again very corroded 2 m off bottom, lower pin 40cm off bottom	
0+27	0+83	exposed crib - 2.85m	3
0+30	0+80	ladder	
0+34	0+76	Gap at lakebed, no flow, small amount of scour in front Another pin 2.54m above bottom, lower pin 36cm above bottom	
0+36	0+74	Joint between cribs - vertical timber between - concrete in good condition - small amounts of spawling	
0+40	0+70	timber in good condition minimal penetration	
0+47	0+63	Void on bottom with flow - Deterioration 26wx15cmH	
0+54	0+56	Spawling 20x30cmH x 17cm deep, above waterline at block poured interface	
0+60	0+50	Bottom scour can push stick in 55cm hitting stone Pins visible lengthwise between cribs 0.82 and 2m off bottom	
0+61	0+49	3m of exposed cribbing Spawling 40x20Hx44cm depth at waterline Scour on bottom 36cm penetration, consistent at joints	4.44
0+79	0+31	Scour at lakebed with small pocket of zebras, due to timbers butting up against each other and leaving a small gap Gap between timbers up to 23cm wide x25H typical at lakebed, every couple metres gap, 1,3 and 5m apart	
0+84	0+26	concrete spawling 44x,17H x5cmDeep at waterline, 2 pins still present on wall spaced approx. 1m apart	
0+88	0+22	exposed crib - 3.21m - Approx. 1m of concrete above waterline	4.43
0+91	0+19	Scour at lakebed - joint	
0+95	0+15	Scour again at joint - 75cm penetration to hit stone material - surging flow	
0+105	0+05	at 0.5m off bottom, 1.85m long section without mussels then they reappear and missing again near corner	
0+110	0+00	Corner - 3.45m exposed crib - blocks start 14cm below waterline Again a section with no mussels,	4.8
EAST FACE		Restart chainage- corner steel belting at waterline 10cmH, 1-2m past corner on each face Pins still present in wall 37cm off bottom and 1.25m off bottom	
0+00	0+00	4m exposed crib, Waterline to start of timbers 72cm? block 1.2m starts 15cm below waterline Clear of mussels at bottom	5.5
0+05	0+05	Crack above waterline 2-3mm wide, height of cap 1.2m, joint at lakebed evidence of past flow, Old anchor points visible	
0+15	0+15	Spawling on block - 24wx6Hx8Dcm, 39wx10Hx8cmdeep Larger gap 6cm between blocks, 30-38cm penetration, 30x20cm deep spawling 90cm penetration between blocks	
0+20	0+20	Joint at Lakebed, Block crack on diagonal 79cm long 32cm deep x 13hx26cm wide missing, space between blocks, probe 90cm	
0+24	0+24		
0+25	0+25	Joint between crib - vertical timber at gap between timber sections set back 85cm, 35cm gap flow at lakebed joint sucking material in	
0+29	0+29	Blocks not tight corner broken off 49cm h 18cm deep, another lakebed joint with flow, they are approx. 3-4 m apart but some are only 1m apart	
0+40	0+40	probe lakebed joint 36cm, 20cm soft, can push in up to 78cm but it is hard packed material	
0+45	0+45	corner chipped on block 70cmHx 5x5	
0+48	0+48	gap between cribs - 48cm, 15cm between vertical and crib	
0+55	0+55	Hole in line with cross-member, 90cm off bottom - probe entire metre stick - no resistance Check & no obvious lean to wall	
0+56	0+56	edge of block chipped away 25h x 5wx 14cm deep	
0+60	0+60	joint at lakebed	

0+63	0+63	Gap between timbers - probe 34cm	
0+65	0+65	missing concrete 8wide x 20high x 13cm deep	
		ladder	
0+70	0+70	cribs exposed face 4m, 1.32m top of crib to waterline , smaller corner chipped off block, more joints on bottom	5.32
0+75	0+75	35cm gap between sets of cribbing with vertical between	
0+80	0+80	ladder damaged below waterline, no evidence of flow at lakebed despite gaps	
		Crack in block 35cm tall	
0+82	0+82	Scrape 2.5cm deep in concrete horizontal just below waterline	
0+87	0+87	Lakebed slopes up from here, Can probe 70-100cm around cross members - no noticeable damage don't lineup with each other	4.5
0+96	0+96	Timbers no longer exposed underwater	
		Corner water depth less than 1ft	
0+100	0+100	After corner small material in front of wall 1:4 slope out 4m then drops off quickly 70 degree slope drop off	
		slope change to 45 degree offshore and more gradual going north 35degree, average 10cm diam stone on lakebed but ranges 3/4" to 30x70cm	
0+110	0+110	stone on lakebed but ranges 3/4" to 30x70cm	
0+125	0+125	gradual slope -est. 25 degrees soft sediment and weeds	
0+130	0+130	toe of slope 5m out from waterline	
0+140	0+140	Toe slightly closer -4m out - A few larges stones up to 1m diam.	
0+150	0+150	Gangway to dock toe is out further doesn't come above waterline (4-5m from waterline)	
0+165	0+165	Very weedy at toe	
0+175	0+175	Starting to get very shallow	0.75
0+187	0+187	Fuel dock wall	

Fuel Dock		H-piles with timber lagging SE corner 0+00	
0+05		Culvert 1.1m inside diam concrete bottom below lakebed, 11.5 wall thickness, flow out, 3cm stone and sediment and zebras inside. Lakebed slightly higher than bottom of culvert.	
		Concrete cap on timbers lagging - timbers in good condition	
0+11		Vertical timber behind rub boards	
0+15		height below rub rails 1.67m	
0+28		Corner - wall turns north	1.87
		Gap at base of wall can probe 24cm in and hit stone material	



Breakwaters and Basin Walls Condition Assessment		Inspection Date
19-3097	NORTH BASIN WALL	19-Aug-19
Town of Cobourg		Water Level (IGLD) 75.5 m

*all measurements are approximate

Chainage	Notes	Water Depth (m)
0+02	Concrete Cap 115cm below waterline on crib Repair in corner? using Channel for 10ft below cap, timbers below 27cm square	1.7
0+05	Joint in cribs, 23cm wide 14cm high cross timber, 90cm total height to cribbing	
0+06	Sand spilling out 3/4" stone and zebra mussels visible Horizontal crib timber pulled out from wall, creates 220cmx 70cmH void, depth varies 1m at centreline, 55cm east 1.2m west Channel visible below waterline just below concrete, concrete block part of cap that extends over it, can probe in all the way with stick between blocks, approx. 1m High block goes behind channel at waterline	
0+12	Ladder, Steel belting continues 108cm below waterline completely rusted	
0+16	Spawling on edge of block 20x15cm, Timber have 33cm gap between and can probe up to 90cm if forced	4
0+25	13x31cm corner chipped, cap sitting out further than wall and toe kicks out at bottom of wall Concrete damage 30cm below waterline could be ice damage - chipped	
0+27	Timbers soft for 2.5m, 1/2 a top timber can be pulled out of crib wall other half solid, Tie backs go through the channel which stops them from falling out - can wiggle bolt of tie. At toe can push through material between timbers 69cm - sandy	
0+35	Pile of material in front of wall Large Void under cap- Filled with zebra mussels and soft sand, 70cm to 1.3m high, 2.2m wide can't feel the end of the depth, minimum 3m. Can see cross timbers on east side. Top timbers below gap in good condition but timbers are "pushed in" to void, until 70cm at lakebed is in good condition Continuing east timber in good condition, channel present but rusted	3.5
0+38	New crib section - vertical timber between	
0+40	C-channel pulled out and rotated up wall - bolts now vertical Surface cracks on concrete blocks	
0+41	Void - depth at least 3m, 36cm high by 1.2m wide, Slight buildup of material at toe - zebras and sediment	
0+42	Cracking 3 to 5mm which leads to spawled section , timber intact,	
0+46	Ladder and spawled section 46cm wide	
0+51	Start of Sheet piles - spacer (H-pile) extended into cap, Void 20x18 behind steel sheet, No evidence of spilled material Sheets 11m thick, small dents in sheets (may have been hit) one rip 42cm long vertical, pile starts 34cm below waterline pan depth 13cm total width 37cm, C channel Sheets not capped	4.5
0+61	End of Sheet piles, timbers re-appear - Void 25x22cm wide depth at least 1m between crib and cap widens behind sheets Cap sitting inside timbers top stepping out 15cm. Conduit above waterline attached to cap Approx. 2m from sheets, steel channel starts again - slightly better condition- still rusted	4.3
0+66	Corner of block spawled - 60cm w x 25cmH depth 25cm, Hole in cap 5cm diam. Eye bolts and other rods drilled into cap. Appear to have 5cm holes Still gap between timbers but penetration of rod only 15cm. Lakebed still zebras and soft sediment	
0+77	Cribs in good condition, cap in good condition joints tight no spawling	3.2
0+80	Build up of material on lakebed - zebras and soft sediment, small voids, probe in 20cm	

0+82	Concrete blocks tight, no damage - timbers in good condition	
0+86	Gap between blocks 3 cm - full metre stick penetration, Missing timber below cap, metre stick and arm length penetration without hitting material, 63cm X 23cmH	
0+90	Culvert exiting across road - space 1.66h x 2.75mW - no concrete on bottom of culvert space, bedding of fill approx. 100-200mm material and sand - Could dig up in to fill 9"+ no cap on floor of culvert	
0+93	Cap material spawling on corner then in good condition going east. Timbers lean in , no channel, ties still present, 1/2 timber pulled away just below cap Some material spilling out between crib joints	
0+96	Joint between crib sections - vertical timber,	
0+100	Timbers running N/S can probe in full metre stick, but not between timbers on face on wall	
0+104	Channel broken off - Dimensions 29cm T x 7cm web	
0+108	Ladder - broken off below waterline - damage to top timber	
0+115	timbers tight minimal penetration, small gap between concrete blocks <1cm	
0+120	Channel in place but corroded completely, no material on bottom, zebras and soft sediment, damage on corners of concrete blocks	4.5
0+125	Transition between cribs, no evidence of material loss	
0+130	Full metre stick penetration through sand material	
0+135	gaps between timbers 2.5cm - 90cm penetration Blocks cracked 60cm long 7-9cm wide, Can wiggle channel	
0+140	From waterline - bottom of concrete blocks approx. 0.8m, 0.3m of cap on top below waterline, Cap formed on top and in front of block - total height below waterline 1.1m Timbers in good condition can't probe in between	
0+148	Lakebed comes up but appears to be because a log is trapping material	
0+160	Transition between cribs, 35cm gap, tight between timbers to full metre stick penetration	
0+166	gap between timbers 2cm	
0+171	Crack - 71cm long with maximum 6cm gap leading to spawled out section 22x9cm Crack continues another 71cm located 50cm down from waterline	
0+175	Stick penetration 1m (all the way in) into sandy material	4
0+178	Cracks - 40cm horizontal on east block (multiple cracks joining up), Crack 46cm on west block - both 55cm below waterline	
0+180	ladder - wall straight, corners of timbers rotted away but no gaps just make it appear not tight on face	
0+187	Crack 16cm long- spawling on corner 20x6cm wide	
0+190	Joint between crib sections - material on bottom small stones present (fill material?) - no gaps between cribs	
0+193	Shallower - channel present but corroded. Spawled section on bottom of block 20x 7cmH, 9cm deep	2.43
0+200	Very Shallow - timbers tight	1.34
0+210	Corner - gap 15wx66Hx77cm deep, Timbers behind face of concrete - Sheet Piles running N/S up to cap but don't meet timbers of wall Culvert in corner on east wall- water flowing in to culvert	

Breakwaters and Basin Walls Condition Assessment		Inspection Date
19-3097	EAST BASIN WALL	19-Aug-19
Town of Cobourg		Water Level (IGLD) 75.5 m

*all measurements are approximate

Chainage	Notes	Water Depth (m)
0+00	Damage on surface at corner between north and east wall. Sink hole - bricks have been cleared for repair. Angle welded on to sheet pile connects sheet pile to north wall concrete cap. Culvert with bars in front visible above and blow water. Flow going in to culvert. One in-pan from culvert -hole 4cm diam. Can probe in 59cm, 38cm below waterline Marine growth up to 100% at bottom with coverage 5cm thick, minimal at surface	
0+06	ladder	
0+07	Pipe coming through wall - 70cm diam. 30cm off bottom Gap at joint with wall - 100-200mm stone visible behind wall	2.8
0+10	Bolt with nut on end pulled out from wall - 30cm above lakebed	2.8
0+11	Outfall 60cm inside diam. with water flowing out and cutting trench in lakebed in front Gap between pipe and wall - fish swam in - 8-9cm wide can fully penetrate 1m stick, In line with sink hole on surface. Cutting trench 30cm deep at outfall/wall Past outfall, another bolt pulled out of wall near lakebed. What appears to be a wailer sitting on bottom but no clear indication if it was ever part of the wall.	
0+15	Small hole 5cm diam. Water washing sand fill out, 45cm below waterline on in-pan These holes become visible approx. ever 1/3 in-pan Sheet details - 13cm deep, 29cm out pan , total width 77cm left edge of outpan to left edge of next outpan	
0+19	Another Outfall 56cm diam. - no flow - fill material in pipe - in-pan sit in front of pipe 3cm gap on sides and zebra mussels behind- bottom is tight to sheet piles. 1.5m top of pipe to waterline Smaller pipe at waterline 11" diam.	
0+20	Another pulled out tie and bolt, No signs of undermining at toe	3.9
0+22	3 in-pans in a row with small holes - So far have seen 6 holes and they continue	
0+26	Bolt pulling out of wall 1m above lakebed Every 4 in pans there's a tieback bolt pulled out of wall. Hole #13 -6cm diam. 1.28m above lakebed - 2 more holes above on same wall one with eye bolt that could easily be pulled out Minor pitting in sheet piles at freeze thaw zone	4
0+35	Crane (hoist) and sink hole on shore Large hole 10cm diam. With bolt in it 17cm penetration, 2.8m below waterline 5.4m lakebed to Top of deck, 2 smaller holes	3.2
0+38	Far side of concrete pad for hoist. Tie back 8cm diam (extremely corroded) with 10cm hole above. Lakebed sandy silt and zebra mussels	
0+40	Holes #28 to #30 one with eye-bolt and another tie back bolt with gap above. Still pulled out and still every 4 in-pans. Often bent down - this one is sideways	
0+41	Ladder -intact- with hole #31 Behind (two more holes beside ladder)	
0+43	Probe at lakebed - toe of pile intact and feel it 2ft down.	
0+46	Tie back pulled out with stone visible in hole above - too big to pull out but sediment pouring out of hole when probed Hole #36 (6cm diam on out pan - first one on out pan) 99cm centre line of hole to waterline	
0+49	Channel running perpendicular to wall - but not attached anywhere at lakebed - touching wall and going in to lakebed.	

0+50	Steel "Bumper" at waterline- 13cm depth (angled), 28cm "out-pan 40cm total height Pipe above waterline - 3cm gap around - material could easily be removed - small stones	
0+53	Hole #42 - Build up of Material on Lakebed in front of wall large void above tie back at this location	
0+56	Wall appears to lean in at top to east very slightly - toe not kicked out	
0+59	Hole #47 45cm below waterline Tie back below - large gap stone could be pulled out	3.9
0+60	Hole #50	
0+63	Holes #52 No more tie backs visible in wall	
0+65	Wall leaning or toe kicked out - top leaning in towards the east - Small cut hole 13mm diam below one regular hole	
0+69	Holes #55 and angle piece attached between knuckles of sheet	
0+77	Holes #60-61 (+ one tiny and 2 small)	
0+78	Hole #64 edge of floating dock ladder	4.9
0+80	2 patched holes welded plate - Solid but some corrosion 2 instances of 2 holes one above the other - 8 formation - Hole Count #69, Hole #72 , 2 more patched holes	
0+89	Holes #74 and 2 more patched holes - no sign of tie rods at lakebed	
0+91	Toe is in good condition no separation or signs of damage	
0+96	Holes #79 - 4.9m lakebed to top of pile	4
0+102	Hole count #84	
0+108	Sheet thickness 1/2" on out pan, 3/8" on angled wall Hole #86 - 3 more holes Some more holes but a few are plugged and not counted	3.2
0+115	Corner Holes #97 total counted	
0+118	End of sheet - no holes past corner Back to timber cribs - probe in 50-90cm	
	East of corner 1m concrete spawled 50cm tall, 60cm to 1m below waterline scrapes along whole section	