GEMTEC

# DRAFT Condition Assessment
# Structures 302 and 304
# Le Goulet Wharf
# (Call Up EC015-121187)

Le Goulet, New Brunswick
15 May 2012

Prepared for PWGSC
**Project No. 5426.98-R01**

GEMTEC
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15 May 2012

File: 5426.98 – R01

Public Works and Government Services Canada
1045 Main Street, Unit 100
Moncton, NB
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Attention: Garth Holder, Project Manager

**Re: DRAFT Condition Assessment, Structures 302 and 304**
**Le Goulet Wharf (Call Up EC015-121187), Le Goulet, New Brunswick**

Enclosed is our DRAFT copy of our condition assessment report for Structures 302 and 304 at the Le Goulet Wharf in Le Goulet, New Brunswick.

If you have any questions or concerns do not hesitate to contact the undersigned.

Serge Bourque, M.Sc.E, P.Eng

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**DRAFT Condition Assessment**
**Structures 302 and 304, Le Goulet Wharf**
**Le Goulet, New Brunswick**

# Table of Contents

## Appendices



## List of Figures

**DRAFT Condition Assessment**
**Structures 302 and 304, Le Goulet Wharf**
**Le Goulet, New Brunswick**

## Executive Summary

GEMTEC Limited was retained by Public Works and Government Services Canada (PWGSC) to undertake a condition assessment of steel sheet pile (SSP) Structures 302 and 304 at the Le Goulet Wharf located in Le Goulet, New Brunswick. Structure 302 is about 550 metres long and ranges in width from about 7.0 to 7.6 metres. Structure 304 is a wedged shaped structure connected at the south end of Structure 302. Structure 304 extends along the channel about 60 metres, varying in width from about 8 to 50 metres.

Based on our condition assessment we offer the following comments and recommendations:

- The condition assessment of Structure 302 and Structure 304 has confirmed that repairs are required in order to maintain these structures in a safe condition for continued use.
- Ultrasonic thickness measurements on the SSP along both the outside channel and harbour faces of the structures indicate significant section loss in the low tide zone. There is severe pitting and perforations along the top sections of some areas of the SSP faces.
- No significant holes have as yet developed in the SSP below the tidal zone. Below the mud line the SSP section is close to original thickness.
- Dredging and/or scour in the channel has lowered the seabed significantly below that which existed when Structure 302 was first constructed.
- The overall stability of the breakwater structure has been affected by this lowering of the seabed to the extent that some remedial rip rap should be installed to reinstate the design factor of safety in several sections along the channel face.
- The present condition of Structures 302 and 304 is such that concrete encasement of the upper sections of the SSP would be a viable option to reinstate the structures to a capacity to adequately resist the required design loads to allow for continued use.
- The concrete encasement option is expected to prolong the usable life of the structures in the order of 20 years.

**DRAFT Condition Assessment**
**Structures 302 and 304, Le Goulet Wharf**
**Le Goulet, New Brunswick**

# 1.0 Introduction

GEMTEC Limited was retained by Public Works and Government Services Canada (PWGSC) in November 2011 to undertake a condition assessment steel sheet pile (SSP) Structures 302 and 304 at the Le Goulet Wharf located in Le Goulet, New Brunswick. Structure 302 is about 550 metres long and ranges in width from about 7.0 to 7.6 metres. Structure 304 is a wedged shaped structure connected at the south end of Structure 302. Structure 304 extends along the channel about 60 metres, varying in width from about 8 to 50 metres.

Prior to this investigation, a preliminary assessment of the concrete deck on Structure 302 was carried out in December 2010 by GEMTEC (File 5426.80-E01). This investigation identified severe deterioration of the SSP at and above the tidal zone in several localized areas. In addition, voids were noted below the concrete slab-on-grade deck that were up to 1.5 metres thick. Twelve random locations were cored as part of our 2010 investigation. Due to the length of the structure (340 metres) and the limited number of core locations, it is likely that voids are present at other locations. Based on our preliminary 2010 assessment, we recommended that Structure 302 be closed for vehicle traffic until repaired.

Between 28 November 2011 and 5 April 2012 the field condition assessment was undertaken for Structures 302 and 304.

Our investigation consisted of:

- Detailed site condition assessment of existing structures 302 to 304
- Underwater dive inspection with ultrasonic thickness measurements of SSP at regular intervals (Plongee Northeast Diving)
- Test Pit investigation to expose tie back system and assess their condition (Plongee Northeast Diving)
- Topographic survey (Figure 1)
- Conditions assessment report (GEMTEC and Valron)
- Conceptual design of repair option (GEMTEC and Valron)

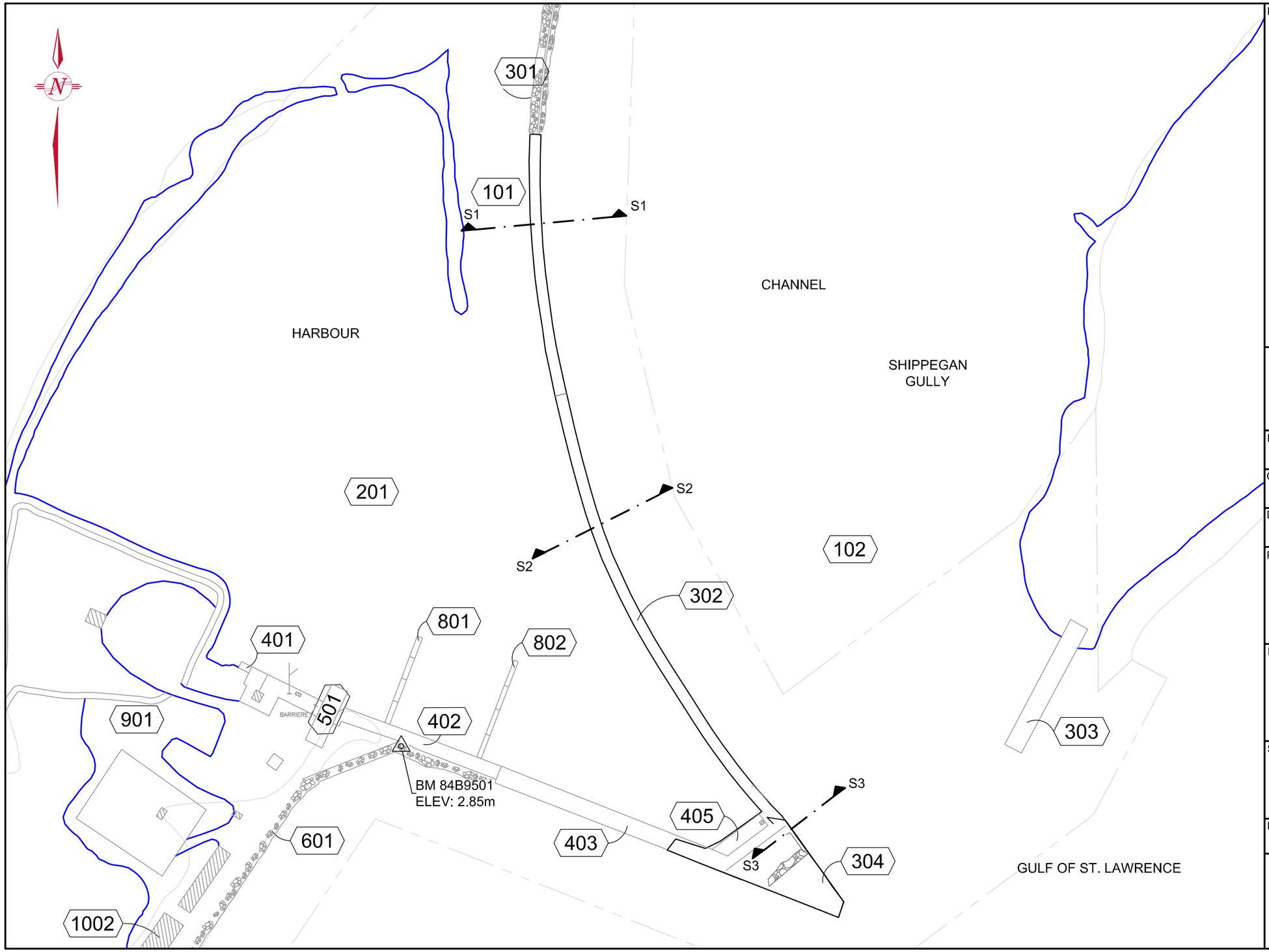
Our evaluation of the existing structures were based the field data collected and on soils information and construction details provided on the following ‘As-Constructed’ drawings supplied by PWGSC:

1. Plan No. 100, Sheet 1 and 2 of 2, West Breakwater Reconstruction, as prepared by Acres Atlantic Ltd. for public Works of Canada, dated 1966.

2. Drawing No. 1 and 2 of 2, West Breakwater Reconstruction, Phase II, Shippagan Gully, Department of Public Works, Job. No. D3-554, dated 1969.

3. Drawings 1 to 9, Reconstruction of Western Breakwater, Shippagan Gully, Public Works

4. Canada, Project Number 657315, dated 1987.




Legend

CHART DATUM BENCHMARK

Ingénieurs en structure

VALRON

Structural Engineers

| Drawn By | Checked By |
|---|---|
| CHG | TS |
| Calculations By | Checked By |
| | |

Date: APRIL 2012

Project: LE GOULET WHARF ASSESSMENT
STRUCTURE 302 AND 304
LE GOULET, NB

Drawing: SITE PLAN

Scale: 1:2500

0 50 100 150m

| File No. | Drawing | Revision No. |
|---|---|---|
| 54269802 | FIGURE 1 | 0 |

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## 2.0 Background

The development of this site as a harbour facility dates back to the 1800's. Breakwater structures were constructed both to the east and the west of the current channel between the 1880's and the 1940's. These structures ended up creating re-circulation of the natural flows causing shoal build-ups in some areas and erosion of beach materials in others.

In the 1960's, plans were prepared and the construction of a west channel training wall, (breakwater), part of what is now designated as Structure 302, took place. The most northerly section of the structure was constructed initially and included the outermost end of the channel training wall. This end structure consisted of a somewhat unique buttressed steel sheet pile wall system. This wall was protected with armour stone on the east, (channel), face and was rock filled on the west, (back), face. In addition to guiding the channel flow, this structure acts to protect the entrance channel to the inner small craft harbour. Very little but a skeleton remains of the SSP wall above low water on this section of the structure.

The initial, (north), section of structure was constructed in or shortly after 1966. This section is approximately 7 metres in width and has a length of approximately 137 metres. It is a SSP structure. The channel and harbour faces are held together with tie-rods located approximately 1.9 metres on centre. The two SSP end walls of this section of the structure are anchored back to SSP cross-walls, located approximately 10.7 metres in from the ends.

The 1966 structure has no deck and has exposed granular fill at the surface. Some wash out has taken place and crushed stone has been used to replace fills where voids have developed from loss of material through holes in the SSP channel face.

The remaining section of Structure 302 was added to the south end in 1968. The construction of this section, approximately 312 metres in length to where it meets the previously constructed West Breakwater, (Structure 304), at the south end, is built to almost the same details as the 1966 structure. The elevation of the top of this section of the breakwater ramps up 600 mm toward the south end. The width of this section also increased to approximately 7.6 metres. This section has a reinforced concrete deck. The only other observed difference between this area and the 1966 structure is that the double channel walers were reduced from C 10 x 25 to C 10 x 20. The reason is not apparent, as this structure is slightly higher and wider than the previous.

Structure 304 was constructed in 1987. This project created a corner to complete the nose at the original west breakwater structure and marry it up to the 1968 section of the west training wall, (breakwater), of Structure 302. This structure was built around, and encapsulated, a timber pile return pier, the structure of which was removed down to the mud line. A new SSP wall was installed along the east, (channel), face, tied back to a concrete anchor wall and the

SSP wall of the original West Breakwater. A concrete cope wall, (wave break), was built on top of this existing SSP seaward wall. Just recently, this south face of Structure 304 has been lined with rip rap / armour stone slope protection. The east, (channel), SSP wall face remains unprotected. Like the SSP wall faces of Structure 302, the SSP along the channel has visible perforations and severe pitting along the upper portions.

# 3.0 Site Work:

## 3.1 General:

The field investigation phase of the structural assessment was completed over a number of months (November 2011 to April 2012). Winter conditions, weather, and strong channel currents caused a number of delays in completing the work.

Several unsuccessful attempts were made to carry out the underwater portion of the field inspection. To evaluate the structure it was necessary to obtain measurements of the remaining thickness of the SSP along both the harbour side and the channel side of the breakwater. This entailed the coordination and mobilization of a dive team to obtain the necessary ultrasonic measurements along the submerged portions of the exposed faces of these structures.

Upon approval to proceed with the investigation, in early November 2011 arrangements were made with the diving company to mobilize as soon as they were available. The first visit was made to the site by the inspection team from GEMTEC, North East Dive, and Valron, on November 28, 2011, with the intent to complete the above water survey, inspection, and the diving work. High seas, strong winds, and heavy rain prevented the diving operation from proceeding. These conditions seemed to be specific to Le Goulet Harbour as, a short distance from the site, weather conditions were relatively calm.

The team returned to the site on the next day. Some layout work was completed to locate test pits and establish locations along the SSP walls for thickness measurements. Diving operations were started on the harbour side. Failure of the ultrasonic equipment forced the inspection team to abort the work without obtaining any measurements. The problem was determined to be a short in the ultrasonic sensor. Field repair was not feasible, forcing postponement of the underwater work. Replacement ultrasonic testing equipment had to be purchased and shipped from the US and did not arrive for several weeks.

As soon as possible after Christmas, arrangements were made for a third visit. The inspection and dive team returned to the site on 3 January 2012. Ice and strong currents foiled all efforts to put a diver in the water to do any work on the channel side. This attempt had to be aborted for safety reasons.

On 16 January 2012, despite cold temperatures, ice conditions and high winds, the team re-mobilized, and a number of SSP thickness profiles were obtained. The production rate was very low as the currents and ice flows only allowed short periods when the diver could work on the

channel side of the structure. Surface ice also had to be removed on the harbour side to allow the diver to enter the water. In addition, ice had to be removed from the SSP in the tidal zone in order to prepare the SSP surface for the ultrasonic testing. Over 4 days, vertical thickness profiles on the SSP were obtained at 16 locations on the structure. At each location, 3 profiles were taken, at the outer flange, inner flange, and web of a typical Z-section.

Test locations were dispersed throughout the length of the structure and the corrosion pattern appears to be relatively consistent between profiles. A site plan showing the ultrasonic testing locations along with a table of the test results are appended (Appendix B).

Due to the presence of the stockpiled rip rap on Structure 403 at the time of the site inspection, there was limited wharf access to the SSP face for taking thickness profiles. Ice conditions and currents made this work unsafe along the corner structure at that time of year. However, the dive team obtained three profiles at one location along the north end of the structure.

As soon as the spring thaw allowed for the excavation of test pits, the contractor re-mobilized and completed the site work. This was completed on 5 April 2012.

## 3.2 Test Pits:

Four test pits were excavated in order to evaluate the condition of the SSP wall tie back system. Test pit locations are shown on the site plan presented in Appendix C, with the corresponding test pit logs.

**Test Pit 1**

Test pit TP1 was excavated behind the SSP wall along the channel face of Structure 304. The tie-rods, walers, plates and bolts were determined to be in very good condition with negligible loss of section. Field measurement verified that members were as called up on the 'As-Built' drawings of Structure 304. Anchor rod spacing was not identified. Outer tie-rod ends are connected to the waler behind the SSP wall at this location. The tie-rod distance below the top of wall is 350 mm ± higher then indicated on the 'As-Built' drawings. The fill behind the SSP wall was observed to be coarse sand with some gravel (i.e. beach sand fill).

**Test Pit 2**

Test Pit TP2 was located along the back face of the SSP wall of the 1968 section of structure 302. This test pit confirmed that the waler channels, tie-rods and connection plates were as indicated on the 'As-Constructed' drawings. The tie-rods were found to be approximately 410 mm higher than the plans indicated, as measured from the top of the SSP wall.

The spacing of the tie-rods in this location was found to be approximately 1000 mm on centre. This is closer than the 1800 ± indicated on the plans. No significant section loss has occurred to any of these components; tie-rods, walers, or connection plates. Unlike the detail indicated

on the ‘As-Constructed’ drawings, the ends of the tie-rods extend to the outside of the SSP wall. The SSP wall is sandwiched between the channel-walers and the bearing plate and nut at the end of the tie-rod. Beach sand fill was found in this test pit as well.

**Test Pit 3 and 4**

Test pits TP3 and TP4 were excavated along the back faces of the SSP channel and harbour walls, respectively, of the 1966 section of Structure 302. The tie-rod and waler system components exposed by these excavations of the beach sand fill found the steel to be in very good condition with no significant section loss. The tie-rod spacing was found to be approximately 1930 mm. This is slightly higher than the 1830 mm ± called up on the ‘As-Constructed’ drawings. The tie-rod elevation on this section matched the drawing details as measured from the top of the SSP walls. The tie-rods extend outside of the SSP face, with the bearing plate and nut and threaded rod end exposed. These exposed ends show very little sign of deterioration.

## 3.3 SSP Thickness Testing:

Ultrasonic thickness measurements were taken at 16 stations along the SSP walls along Structures 302 and 304. These were located along the length of the two structures. Results were found to be relatively consistent. A plan of the test locations along with ultrasonic test results is appended (Appendix B).

## 3.4 Depth Soundings:

Depth soundings were taken along both the harbour and channel faces of the structures. These are indicated on the appended site plan (Appendix B).

On Structure 302, the soundings determined that the current elevation of the harbour bottom along the west face of the breakwater closely reflects the top of overburden as indicated on the 1966 and 1968 ‘As Constructed’ drawings. The soundings taken on the channel side indicates that there is a significant drop (i.e. about 1 metre) in the channel bottom from that which existed at the time of construction. Based on underwater observations, it appears that this channel has been dredged to this increased depth.

The soundings along the east face of Structure 304 indicate that the current channel bottom is at a similar depth to that which is indicated on the original ‘As-Built’ contract drawings.

## 3.5 Steel Sheet Pile Sections:

## 3.6 Structure 302:

Raised lettering found on the steel sheet piling on Structure 302, (both the 1967 and the 1969 portions of the breakwater), identified it to be a Frodingham section 1 BXN. This information allowed us to source the manufacturer’s table for the section properties used in the evaluation

analysis. The SSP has a 140 mm, (5 ½"), deep profile. The original thickness of this section was 12 mm.

### 3.7 Structure 304:

The steel sheet piling on Structure 304 is a much deeper section than the SSP at Structure 302. The depth of the SSP measures about 345 mm, (13.5 inches). The geometry mapped out from the site measurements failed to match any sections in catalogues checked from the 1980's. Section properties used for the analysis were calculated from the field evaluation measurements.

## 4.0 Present Condition:

### 4.1 Structure 302:

#### 4.1.1 SSP Channel Face (East):

Corrosion at the low water zone has reduced the steel thickness to an average of about 6 mm from an original 11-12 mm. There are few, if any, areas of perforations on this face at and below low water. At the mud line, the SSP thickness is typically greater than 10 mm. The top section is severely pitted in many areas. Steel thickness between pits would typically be in excess of 10 mm. Localized areas of complete section loss, (at the south end), appear to be restricted to above the tidal zone.

#### 4.1.2 SSP - Harbour Face (West):

Similar loss of section as at the channel face was found at the low water zone. More perforations exist in this area with adjacent steel reduced to 4 to 6 mm in some test locations. The mud line is close to this zone due to a higher bottom elevation. The thickness of the SSP quickly returns to close to original just below the mud line.

#### 4.1.3 Tie-Rod System:

The tie-rod end connections are exposed on the outer face of the SSP. They show minimal deterioration. As previously noted, it was determined that the condition of the buried walers, plates and fasteners behind the SSP is good with very little loss of section.

### 4.2 Structure 304:

#### 4.2.1 SSP – Channel Face (East):

Severe perforations exist along the top 2 metres of the SSP at the south end of the channel face. There is severe pitting at the north end with steel in the non-pitted areas having a 7-8 mm thickness. The SSP section is reduced to about 6 mm at the low tide zone. The section thickness returns to close to 10 mm at the mud line.

### 4.3 Structural Assessment:

The existing structural systems were analysed for both Structures 302 and 304 to determine if it would be feasible to repair the SSP and extend the useful life of the structure. A number of sections had to be analysed as the SSP toe elevations vary throughout the length of the structure, as do the geotechnical conditions. The increased depth measured to channel bottom compared to the original drawings required that the overall stability of Structure 302 also be verified.

The analysis of the SSP wall system for the current conditions was carried out using the published section properties for the 1 BXN Frodingham SSP section used on Structure 302. The SSP section for Structure 304 was not matched to the manufacturer. This section was modeled based on site measurements and properties calculated.

With the exception of several sections along the wharf where the sheet pile toe elevation was quite shallow, and the dredge depth was deeper than originally designed for, it was determined that the wall system has adequate factors of safety. The sections that do not have adequate factors of safety are located at test locations C5.0 and C10.0. The sections of wall that does not meet an acceptable factor of safety can be made to do so by adding a rip rap material along the bottom. The top of this protection would still be lower than the required channel depth for boat traffic.

## 5.0 Repair Option:

The analysis of the SSP in its current condition determined that it would be feasible to consider a repair that could allow for the SSP to remain in the work and reinforce the upper areas where the major deterioration has occurred.

The repairs considered for reinstatement of the SSP to a capacity that would extend its usefull life for an acceptable period of time included two options: Firstly, the use of a steel plate, concrete-filled patch similar to that developed for Bouctouche and, secondly, the use of a formed cast-in-place reinforced concrete encasement anchored to the outside face of the steel sheet piling similar to that used for the repair of the Pigeon Hill Wharf, Phase II, in 2009.

Because the reconstructed breakwater structure is intended to be utilized for the fisheries and boats will be moored to its SSP face, the steel plate option is not considered very user friendly. The incorporation of ladders and fenders would be problematic. In addition the thin, 140 mm deep, profile of the SSP found on Structure 302 does not allow for the development of adequate strength using the steel plate concept. This method was therefore ruled out as being a feasible repair option.

The use of the concrete encasement repair option was evaluated and determined to be a viable solution. Similar to the design of the repairs developed for Structure 408 at the Lameque Wharf,

the concrete encasement would be designed to strengthen the section, not just perform as a patch to protect the SSP from further deterioration.

The concept for the encasement of the wall section is shown on the sections and details provided in Figure S4, Appendix B. The encasement of the SSP on Structure 302 will be thicker and more heavily reinforced than that on Structure 304 due to the relatively shallow depth of the SSP profile. The encasement would extend down to varying depths along the channel face due to the differences in SSP section and location of competent material below areas of major deterioration.

The present condition of the SSP faces of both structures is such that the corroded section no longer has the required theoretical thickness to resist the design stresses with an acceptable factor of safely. Therefore, in its present condition, if not repaired, the structure must now be considered to have theoretically reached the end of its usable life.

The post-repair life expectancy for the various sections of structure was calculated based on the rates of corrosion determined from the age of the structure and the loss of section of the various members to date. These extrapolated corrosion rates were then applied to the remaining steel thicknesses, (beyond the areas of repair), to determine the expected number of years before the section is reduced to below the critical thickness required to resist the design loads. With the repairs to the deteriorated zones by encasement as described above, it is felt that the useful life of the structure can be prolonged for another 20 years.

## 6.0 Conclusions:

The condition assessment of the Le Goulet Structures 302 and 304 determined that the SSP walls have significant loss of section in the tidal and splash zones. This has compromised the integrity of the breakwater system to a point where repairs are required to restore the design factors of safety to an acceptable level, and allow for continued use.

Dredging of the channel and/or scour action subsequent to the 1960's construction of Structure 302 has lowered the seabed significantly from the elevations indicated on the 'As-Constructed' drawings. This has reduced the design factor of safety. The installation of a rip rap material along the base of the wall should be considered for the critical areas.

A structural evaluation of the stability of the breakwater structure indicates that, with the exception of the sections noted above at test locations C5.0 and C10.0, the SSP wall system of Structures 302 and 304 has an acceptable factor of safety.

Structural analysis of the steel sheet piling, in its present condition, indicates that the remaining sections in the zones beyond the severely corroded areas at and below LNT, are sufficient to make it feasible to consider a concrete encasement repair option. The concrete encasement

will have to be adequately designed and reinforced to reinstate the capacity of the SSP wall system in shear and bending.

The encasement must extend down to below the zone of major corrosion a sufficient depth to allow the transfer of loads from the remaining competent steel section to the reinforced concrete section.

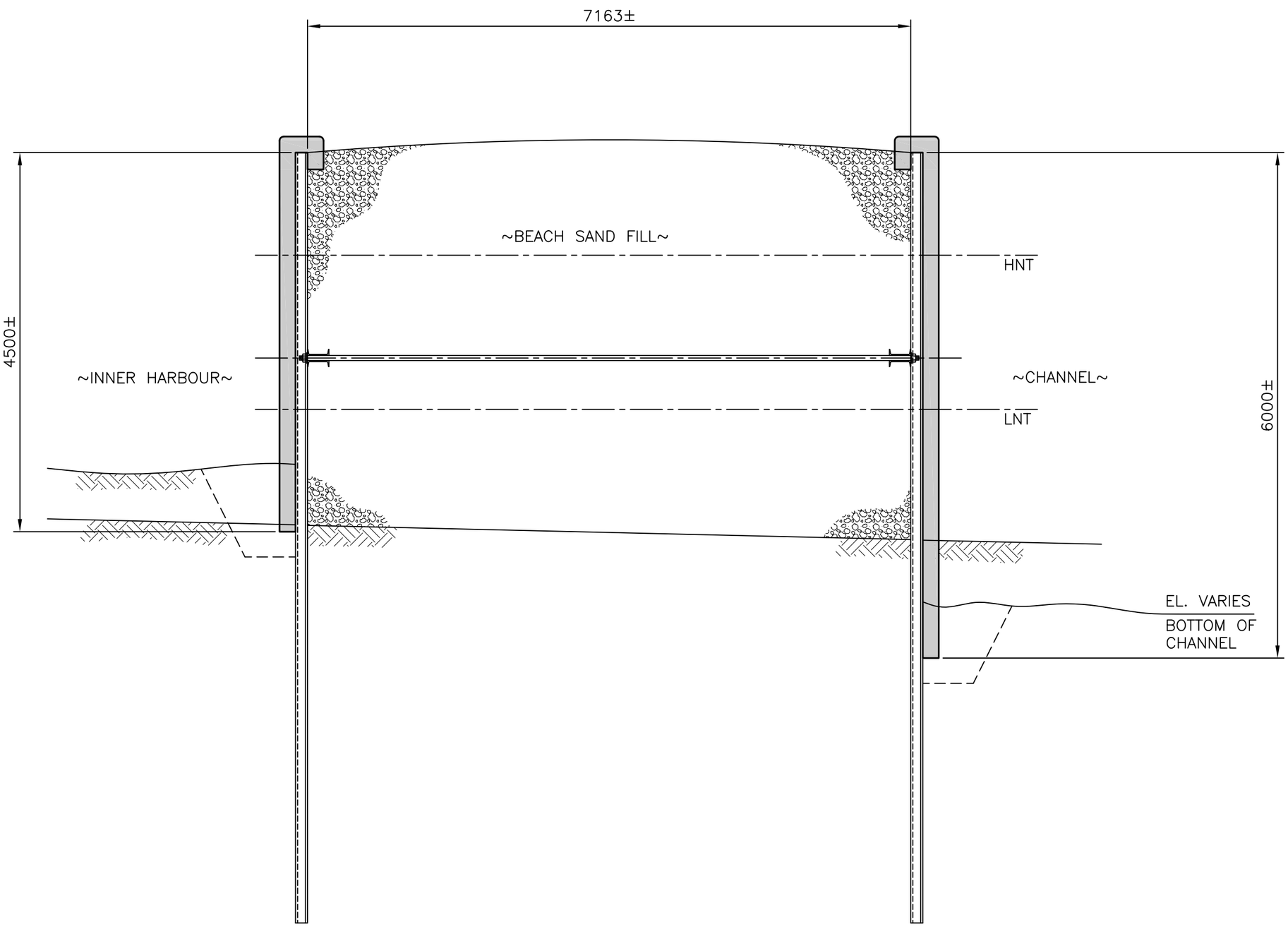
It is recommended that the top of the encasement extend up beyond the top of the SSP and incorporate a barrier / wheel guard. Ladders and mooring cleats can be incorporated into the concrete encasement along both the harbour and channel faces of the reconstructed structures.

Based on the findings of the condition assessment as reported herein, the concrete encasement of the SSP harbour and channel faces is expected to prolong the usable life of the structures by a further 20 years.

Due to the size of the breakwater, and the difficult conditions posed by high currents, ice and weather, the results of the thickness testing, although consistent along the length of the structures, should be supplemented by additional testing for the detailed repair design phase. This is most critical along the south end of the east, ‘seaward’, face of Structure 304 where storage of armour stone prevented access for testing at the time of the site investigation.

# Appendix A

Conceptual Repair Option Drawings

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| Drawn By: JAM, MH | Checked By: |
| Calculations By: | Checked By: |

Date: MAY, 2012

Project:

LE GOULET STRUCTURES
WHARF EVALUATION

Drawing:

TYPICAL SECTION THROUGH
STRUCTURE 302 - 1966 SECTION

Scale:

1:50

| File No. | Drawing | Revision No. |
|---|---|---|
| - | FIGURE S1 | 0 |

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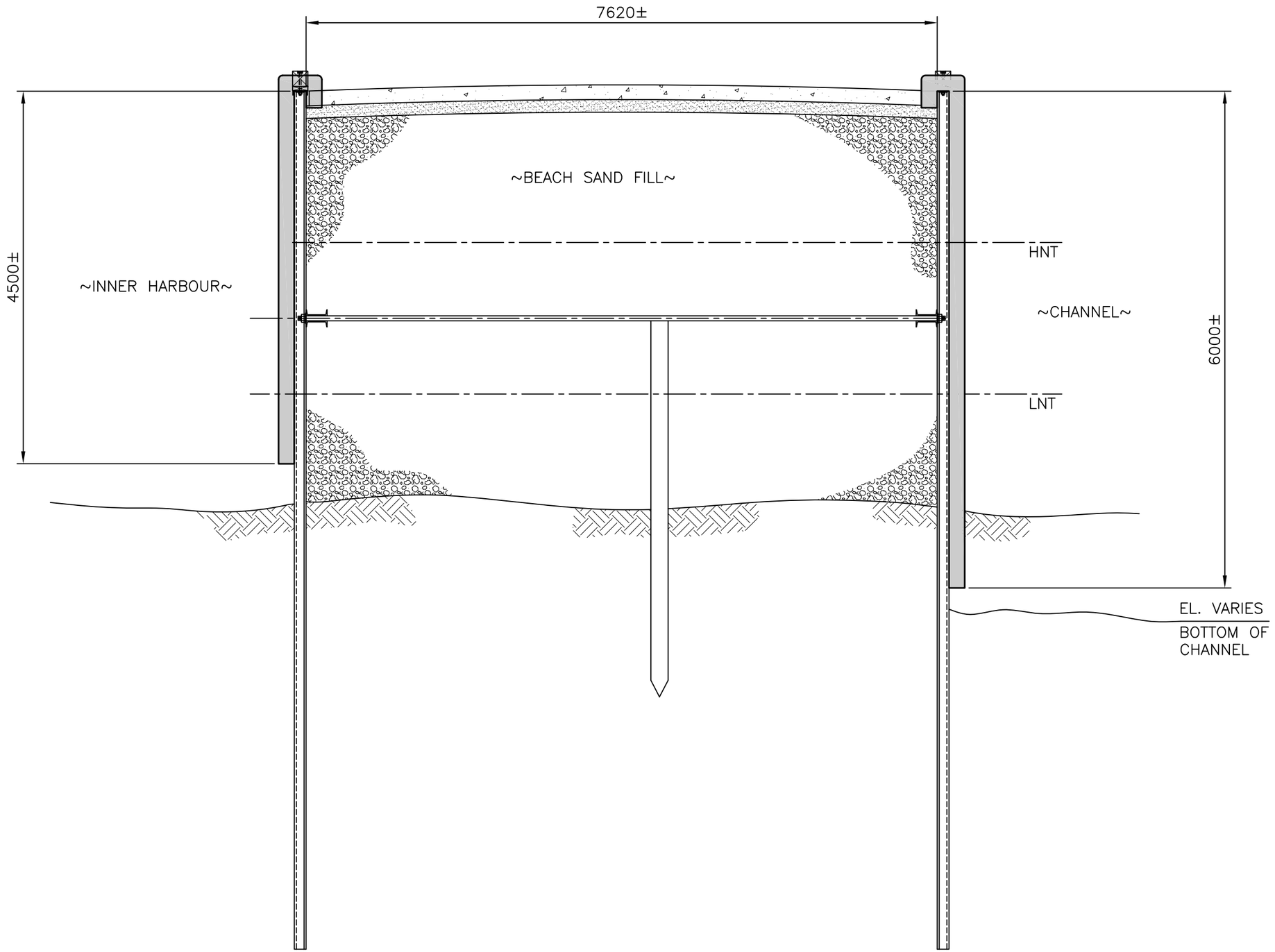


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| Drawn By: JAM, MH | Checked By: |
| Calculations By: | Checked By: |

Date: MAY, 2012

Project:
LE GOULET STRUCTURES
WHARF EVALUATION

Drawing:
TYPICAL SECTION THROUGH
STRUCTURE 302 - 1968 SECTION

Scale: 1:50

| File No. | Drawing | Revision No. |
|---|---|---|
| - | FIGURE S2 | 0 |

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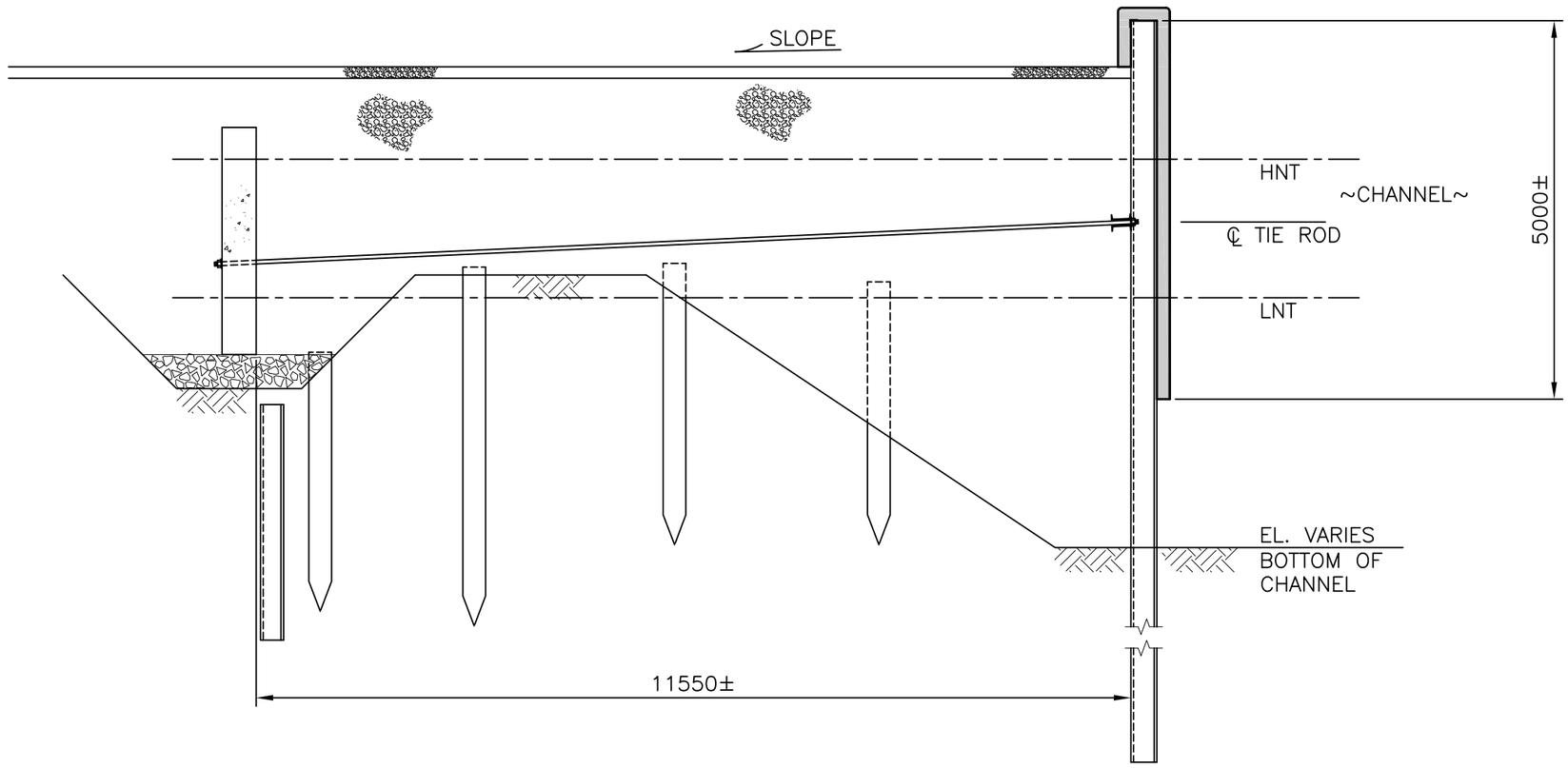


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| Drawn By: JAM, MH | Checked By: |
| Calculations By: | Checked By: |

Date: MAY, 2012

Project:
LE GOULET STRUCTURES
WHARF EVALUATION

Drawing:
TYPICAL SECTION THROUGH
STRUCTURE 302 - EAST WALL
1987 SECTION

Scale: 1:75

| File No. | Drawing | Revision No. |
|---|---|---|
| - | FIGURE S3 | 0 |

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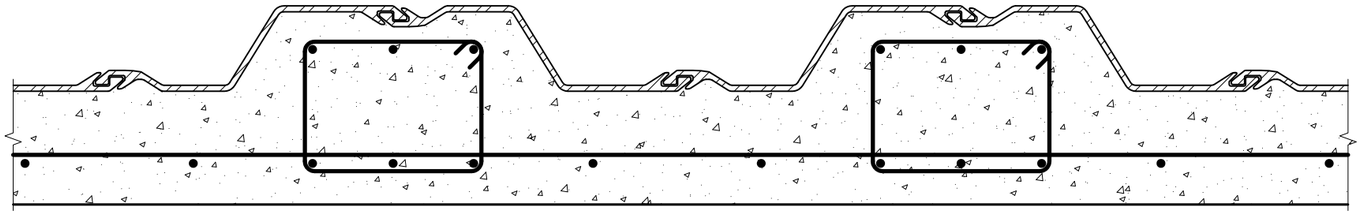
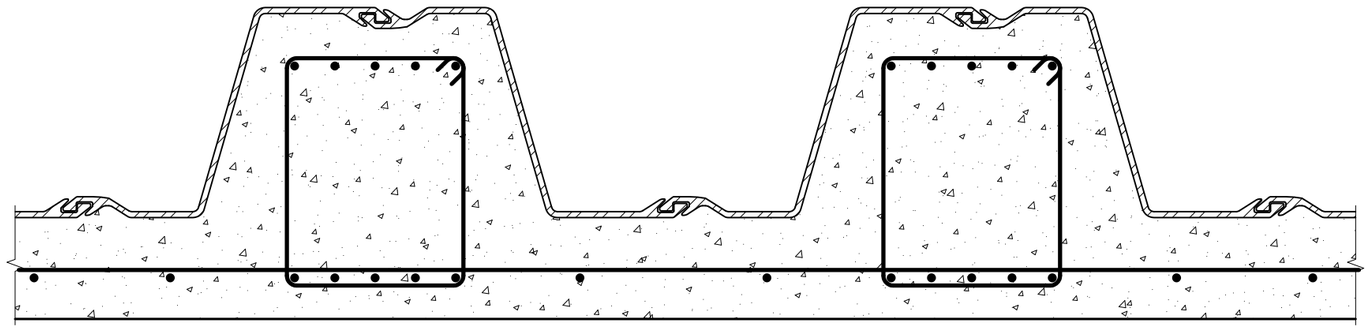


STRUCTURE 302



STRUCTURE 304

# TYPICAL SECTIONS

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|---|---|
| Drawn By: JAM, MH | Checked By: |
| Calculations By: | Checked By: |

Date: MAY, 2012

Project: LE GOULET STRUCTURES
WHARF EVALUATION

Drawing: TYPICAL CONCRETE
ENCASEMENT DETAILS

Scale: 1:10

| File No. | Drawing | Revision No. |
|---|---|---|
| - | FIGURE S4 | 0 |

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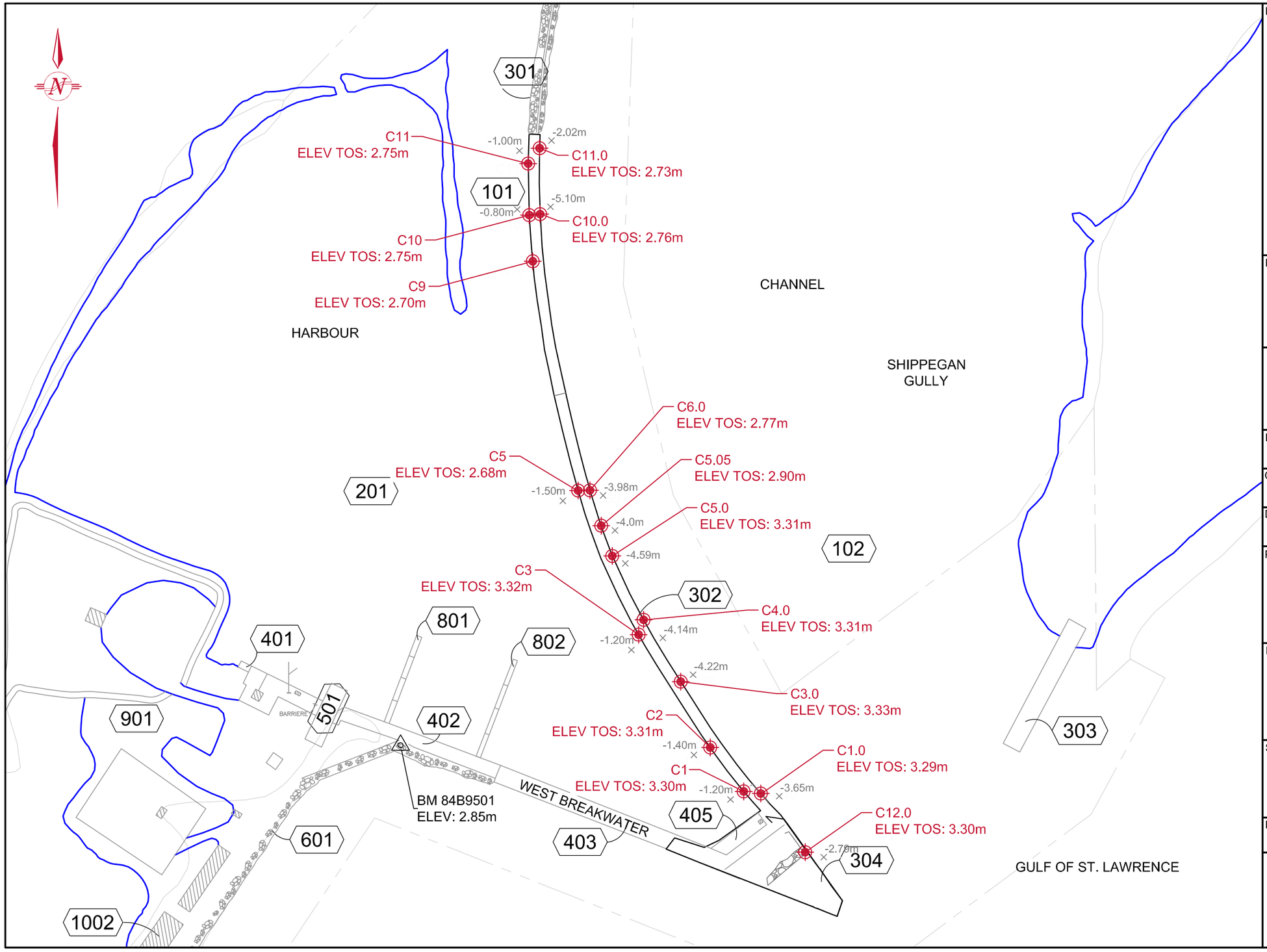
# Appendix B

Ultrasonic Testing Results and Testing Location Plan




Legend

- C1 — ULTRASONIC TEST LOCATION (HARBOUR SIDE)
- C1.0 — ULTRASONIC TEST LOCATION (CHANNEL SIDE)
- -2.00m — SOUNDING
- CHART DATUM BENCHMARK
- TOS — TOP OF STEEL SHEET PILE

Note

1. ELEVATIONS REFERENCE CHART DATUM, BENCH MARK 84B9501 WITH PUBLISHED ELEVATION OF +2.850 METERS
2. NOT TO BE USED FOR CONSTRUCTION PURPOSES.

Ingénieurs en structure
VALRON
Structural Engineers

| Drawn By | Checked By |
|---|---|
| CHG | TS |
| Calculations By | Checked By |
| | |

Date: MAY 2012

Project: LE GOULET WHARF ASSESSMENT
STRUCTURE 302 AND 304
LE GOULET, NB

Drawing: ULTRASONIC TESTING LOCATION PLAN

Scale: 1:2500

0 50 100 150m

| File No. | Drawing | Revision No. |
|---|---|---|
| 54269803 | FIGURE 3 | 0 |

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# TABLE 1

## LE GOULET SSP WALL INVESTIGATION - STRUCTURE 302 ANDS 304

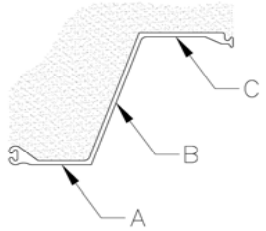
## ULTRASONIC TEST RESULTS

| | HARBOUR SIDE READINGS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pile Test Locations | C1 - 302 | | | C2 - 302 | | | C3 - 302 | | | C5 - 302 | | |
| DEPTH * (M) | A OUTER FLANGE (mm) | B WEB . (mm) | C INNER FLANGE (mm) | A OUTER FLANGE (mm) | B WEB . (mm) | C INNER FLANGE (mm) | A OUTER FLANGE (mm) | B WEB . (mm) | C INNER FLANGE (mm) | A OUTER FLANGE (mm) | B WEB . (mm) | C INNER FLANGE (mm) |
| 0.40 | | | | | | | | | | 9.7 | 11.3 | 10.7 |
| 1.00 | 10.6 | 10.5 | 6.8 | 10.5 | 10.7 | 10.8 | | | | | | |
| 1.10 | | | | | | | 10.8 | | | | | |
| 1.50 | 10.4 | 10.0 | 10.4 | 10.2 | 10.5 | 10.8 | | | | | | |
| 2.00 | 10.4 | 10.6 | 10.9 | 10.3 | 10.7 | 10.5 | 10.6 | 9.5-11 | 9.1 | 10.8 | 7.8 | 10.8 |
| 2.50 | 8.8 | 8.0 | 10.1 | 7.1 | 8.2 | 10.0 | 7.1 | 8.0 | 7.7 | 10.5 | 10.5 | 9.8 |
| 3.00 | 10.8 | 8.2 | 10.9 | 10.6 | 11.2 | 11.2 | 10.8 | 10.9 | 11.0 | 10.9 | 11.3 | 11.0 |
| 3.25 | | | | 8.4 | 11.2 | 11.0 | ** | ** | ** | ** | ** | 9.7 |
| 3.40 | | | | | | | ** | 4.0 | 11.3 | | | |
| 3.50 | 7.5 | 6.0 | 8.7 | <1 | 3-4 | 9.0 | | | 11.0 | ** | ** | 10.9 |
| 3.75 | | | | 4.3 | 11.0 | 11.1 | | | | | | |
| 4.00 | 7.6 | 9.9 | 9.9 | 7.8 | 11.2 | 10.8 | 8-10 | 11.3 | 11.3 | 5.2 | 8.6 | 11.1 |
| 4.40 | | | | | | | | | | 10.4 | | |
| 4.50 | 10.0 | 10.7 | 10.5 | | | | | | | 10.3 | 10.3 | 11.0 |
| 4.60 | | | | | | | 5.8 | 9.6 | 10.8 | | | |
| 4.65 | | | | 7.8 | 11.2 | 11.0 | | | | | | |
| 4.80 | | | | | | | | | | 11.1 | | 11.4 |
| | BOTTOM 4.5 M | | | BOTTOM 4.7 M | | | BOTTOM 4.8 M | | | BOTTOM 4.9 M | | |

* Distance in meters down from top of steel sheet piling.

** Steel sheet piling has perforations at this depth.

Location of readings



# TABLE 1

## LE GOULET SSP WALL INVESTIGATION - STRUCTURE 302 ANDS 304

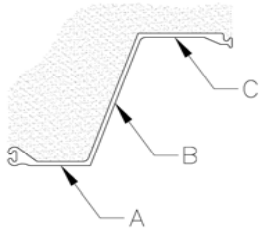
## ULTRASONIC TEST RESULTS

| | HARBOUR SIDE READINGS | | | | | | | | | CHANNEL SIDE READINGS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pile Test Locations | C 9 - 302 | | | C 10 - 302 | | | C 11 - 302 | | | C 12.0 - 304 | | |
| DEPTH * (M) | A OUTER FLANGE (mm) | B WEB . (mm) | C INNER FLANGE (mm) | A OUTER FLANGE (mm) | B WEB . (mm) | C INNER FLANGE (mm) | A OUTER FLANGE (mm) | B WEB . (mm) | C INNER FLANGE (mm) | A OUTER FLANGE (mm) | B WEB . (mm) | C INNER FLANGE (mm) |
| 1.00 | 11.1 | 11.4 | 12.0 | 11.8 | 11.6 | 11.4 | 12.2 | 10.1 | 11.6 | | | |
| 1.50 | 11.5 | 11.4 | 10.8 | 11.8 | 11.8 | 11.7 | 12.3 | 11.7 | 11.9 | | | |
| 2.00 | 12.1 | 12.2 | 12.4 | 12.3 | 12.2 | 10.7 | 12.5 | 12.2 | 12.0 | | | |
| 2.10 | | | | | | | | | | 8.9 | | |
| 2.30 | | | | | | | | | | | | |
| 2.40 | | | | | | | | | | | | 7.0 |
| 2.50 | 12.2 | 10.6 | 11.9 | 12.5 | 11.8 | 10.7 | 7.6 | 11.5 | 9.8 | 6.5 | 7.9 | |
| 3.00 | 6.0 | 9.1 | 10.7 | 7.9 | 7.3 | 8.0 | 11.4 | 5.9 | 7.8 | 6.2 | 5.6 | 7.6 |
| 3.40 | | | | | | | 12.5 | 11.9 | 11.8 | | | |
| 3.50 | 6.7 | 12.0 | 9.5 | 12.5 | 10.5 | 11.8 | | | | 7.7 | 7.8 | 10.3 |
| 4.00 | | | | | | | | | | 9.7 | 10.1 | 10.4 |
| 4.50 | | | | | | | | | | 9.2 | 5.8 | 10.8 |
| 5.00 | | | | | | | | | | 10.4 | 9.2 | 10.8 |
| 5.50 | | | | | | | | | | 10.1 | 8.9 | 10.4 |
| 6.00 | | | | | | | | | | 10.7 | 8.7 | 10.7 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | BOTTOM 3.6 M | | | BOTTOM 3.7 M | | | BOTTOM 3.6 M | | | BOTTOM 6.1 M | | |

* Distance in meters down from top of steel sheet piling.

** Steel sheet piling has perforations at this depth.

Location of readings



# TABLE 1

## LE GOULET SSP WALL INVESTIGATION - STRUCTURE 302 ANDS 304

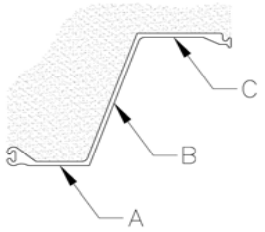
## ULTRASONIC TEST RESULTS

| | CHANNEL SIDE READINGS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pile Test Locations | C 1.0 - 302 | | | C 3.0 - 302 | | | C 4.0 - 302 | | | C 5.0 - 302 | | |
| DEPTH * (M) | A OUTER FLANGE (mm) | B WEB . (mm) | C INNER FLANGE (mm) | A OUTER FLANGE (mm) | B WEB . (mm) | C INNER FLANGE (mm) | A OUTER FLANGE (mm) | B WEB . (mm) | C INNER FLANGE (mm) | A OUTER FLANGE (mm) | B WEB . (mm) | C INNER FLANGE (mm) |
| 0.00 | | | | | | | | | | | | |
| 1.00 | | | | | | | | | | | | |
| 1.50 | | | | 7.3 | | | | | | | | |
| 2.00 | | | | 10.5 | 9.5-10.7 | 11.0 | 10.7 | 10.8 | 10.7 | | | |
| 2.50 | 7.9 | 9.4 | | 10.5 | 10.0 | 9.7 | 10.4 | 9.3 | 10.3 | 9.4 | 8.3 | 9.7 |
| 3.00 | 5.0 | 7.2 | 5.5 | 11.1 | 10.7 | 9.4 | 10.4 | 9.7 | 8.3 | 11.1 | 11.0 | 10.6 |
| 3.50 | 8.4 | 8.0 | 10.2 | 6.1 | 6.0 | 9.6 | 7.2 | 6.9 | 9.2 | 5.8 | 5.5 | 9.5 |
| 4.00 | 9.4 | 9.8 | 10.6 | 9.4 | 9.1 | 10.8 | 9.9 | 9.1 | 10.9 | 7.8 | 8.3 | 10.9 |
| 4.50 | 9.4 | 9.6 | 11.4 | 8.5 | 8.7 | 10.8 | 9.1 | 10.3 | 11.0 | 8.6 | 7.9 | 10.1 |
| 5.00 | 8.5 | 9.8 | 11.5 | 9.3 | 8.2 | 9.5 | 10.2 | 9.1 | 10.4 | 8.3 | 8.9 | 10.7 |
| 5.50 | 9.5 | 9.5 | 11.2 | 9.5 | 9.7 | 10.8 | 10.4 | 10.6 | 9.8 | 9.8 | 9.4 | 11.0 |
| 6.00 | 11.5 | 11.4 | 11.6 | 10.2 | 10.1 | 10.8 | 9.8 | 11.1 | 10.4 | 10.1 | 10.8 | 11.2 |
| 6.50 | | | | | | | | | | 10.5 | 9.2 | 11.2 |
| 6.60 | | 10.7 | 10.5 | | | | 10.3 | 10.8 | 10.8 | | | |
| 6.70 | | | | 10.1 | 10.1 | 10.7 | | | | | | |
| 7.10 | | | | | | | | | | 10.1 | 10.1 | 11.1 |
| | | | | | | | | | | | | |
| | BOTTOM 6.6 M | | | BOTTOM 6.8 M | | | BOTTOM 6.7 M | | | BOTTOM 7.2 M | | |

* Distance in meters down from top of steel sheet piling.

** Steel sheet piling has perforations at this depth.

Location of readings



# TABLE 1

## LE GOULET SSP WALL INVESTIGATION - STRUCTURE 302 ANDS 304

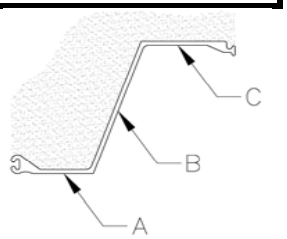
## ULTRASONIC TEST RESULTS

| | CHANNEL SIDE READINGS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pile Test Locations | C 5.0.5 - 302 | | | C 6.0 - 302 | | | C 10.0 - 302 | | | C 11.0 - 302 | | |
| DEPTH * (M) | A OUTER FLANGE (mm) | B WEB . (mm) | C INNER FLANGE (mm) | A OUTER FLANGE (mm) | B WEB . (mm) | C INNER FLANGE (mm) | A OUTER FLANGE (mm) | B WEB . (mm) | C INNER FLANGE (mm) | A OUTER FLANGE (mm) | B WEB . (mm) | C INNER FLANGE (mm) |
| | | | | | | | | | | | | |
| 1.50 | | | | 11.7 | 11.0 | | 11.4 | 11.4 | 11.4 | 11.7 | 11.5 | 10.4 |
| 2.00 | 9.7 | 11.0 | | 11.4 | 11.2 | 11.1 | 12.1 | 12.1 | 11.5 | 12.1 | 12.1 | 12.0 |
| 2.50 | 11.4 | 11.5 | 11.6 | 11.0 | 5.6 | 5.8 | 10.8 | 10.5 | 12.0 | 12.2 | 12.1 | 11.4 |
| 2.75 | | | | | | | ** | ** | 9.2 | 6.0 | 5.7 | 8.1 |
| 3.00 | 11.1 | 6.0 | 9.2 | 5.8 | 6.4 | 8.9 | ** | 6.1 | 10.3 | 7.2 | 7.0 | 8.7 |
| 3.25 | | | | | | | 6.8 | 8.9 | 11.3 | 6.0 | 8.5 | 9.4 |
| 3.50 | 6.9 | 6.8 | 8.6 | 9.0 | 9.5 | 11.5 | 8.2 | 10.4 | 11.3 | 11.4 | 8.9 | 8.9 |
| 4.00 | 8.3 | 10.5 | 11.0 | 9.2 | 10.7 | 11.7 | 9.4 | 10.6 | 10.2 | 10.3 | 10.4 | 11.8 |
| 4.50 | 8.8 | 10.2 | 11.1 | 11.4 | 12.0 | 11.9 | 8.9 | 10.0 | 11.4 | 11.0 | 11.9 | 12.0 |
| 5.00 | 10.1 | 10.6 | 11.2 | 10.9 | 11.4 | 11.4 | 10.1 | 10.4 | 11.8 | 11.2 | 11.3 | 11.8 |
| 5.50 | 10.0 | 11.2 | 11.4 | 11.7 | 12.0 | 11.8 | 11.5 | 10.8 | 11.8 | 11.2 | 11.1 | 11.2 |
| 6.00 | 10.4 | 11.4 | 11.4 | 11.8 | 11.6 | 12.0 | 11.7 | 11.0 | 11.1 | 11.2 | 11.0 | 11.4 |
| 6.50 | 10.9 | 11.2 | 11.4 | 12.1 | 12.3 | 12.1 | 11.7 | 11.2 | 11.7 | 11.8 | 11.4 | 11.5 |
| 7.00 | 11.0 | 11.0 | 11.1 | | | | | | | | | |
| 7.1 | | | | | | | 11.8 | 11.5 | 11.8 | | | |
| | | | | | | | | | | | | |
| | BOTTOM 7.3 M | | | BOTTOM 6.6 M | | | BOTTOM 7.5 M | | | BOTTOM 6.5 M | | |

* Distance in meters down from top of steel sheet piling.

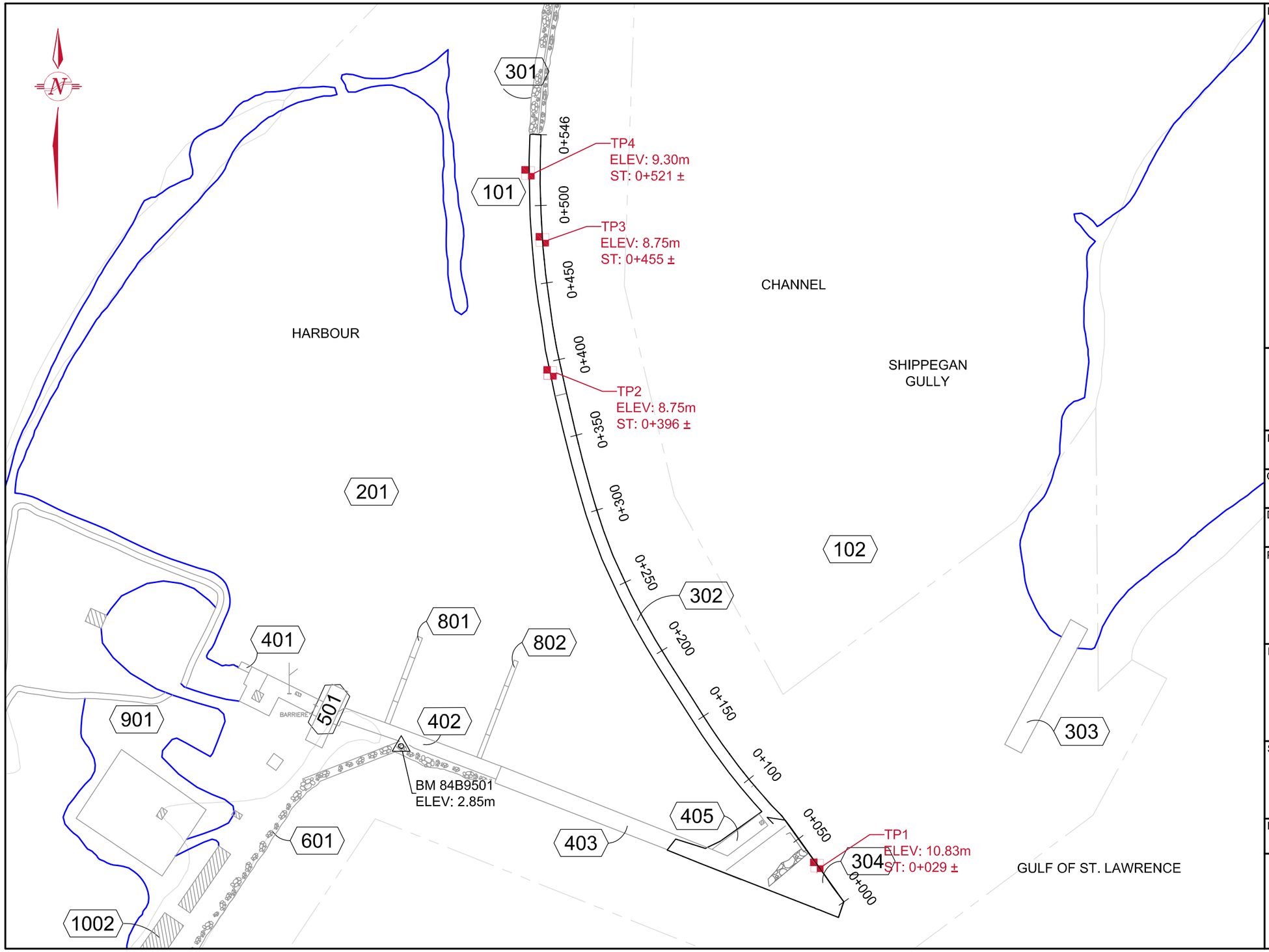
** Steel sheet piling has perforations at this depth.

Location of readings



# Appendix C

Detailed Test Pit Logs and Test Pit Location Plan




Legend

TP TEST PIT LOCATION

CHART DATUM BENCHMARK

Ingénieurs en structure

VALRON

Structural Engineers

| Drawn By | Checked By |
|---|---|
| CHG | TS |
| Calculations By | Checked By |
| | |

Date: APRIL 2012

Project:

LE GOULET WHARF ASSESSMENT
STRUCTURE 302 AND 304
LE GOULET, NB

Drawing:

TEST PIT LOCATION PLAN

Scale: 1:2500

0 50 100 150m

| File No. | Drawing | Revision No. |
|---|---|---|
| 54269802 | FIGURE 2 | 0 |

GEMTEC

Consulting Engineers and Scientists

N:\drawings\54001\5426.96\54269803.dwg

**GEMTEC** LIMITED
GROUND ENGINEERING
& MATERIALS TECHNOLOGY
Fredericton, Moncton, Bathurst N.B. Canada

# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works Government Service Canada | Proj No. 5426.98 | Test pit TP 1 |
| Project | Test Pit Investigation - Structures | Date End 5.April.2012 | Page 1 of 1 |
| Location | Le Goulet New Brunswick | | |
| Ground Level, m 2.75+/- | Datum: Chart | Logged By TDS | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | TYPE | N (RQD) | REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | 0.10 Crushed Rock FILL |
| | | | | | | Coarse sand with some gravel (BEACH SAND FILL) |
| 1 | | | | | | |
| 2 | | | | | | - Tie-Rod at 2.31+/- metres below top of sheet pile. |
| | | | | | | 2.62 |
| | | | | | | End of test pit at 2.62 metres below top of sheet pile.<br>General Information<br>- Tie Rod = 75+/- mm<br>- Waler channel = 300+/- mm<br>- Web thickness = 12.5+/- mm<br>- Nut = 50+/- mm<br>- Bolt = 30+/- mm<br>- Web Depth = 85+/- mm<br>- Spacing between upper and lower Whaler = 100+/- mm<br>- Back plate = 345 mm long X 170 mm wide x 25 mm thick |

TEST PIT WITH GRAPH 542698.GPJ GEMTEC 2004.GDT 5/15/12

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works Government Service Canada | Proj No. 5426.98 | Test pit TP 2 |
| Project | Test Pit Investigation - Structures | Date End 5.April.2012 | Page 1 of 1 |
| Location | Le Goulet New Brunswick | | |
| Ground Level, m 2.85+/- | Datum: Chart | Logged By TDS | |

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

□ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded

Water Content & Atterberg Limits ($w_P$, $w$, $w_L$)
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m

0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | Coarse sand with some gravel (BEACH SAND FILL) |
| 1 | | | | | | |
| 2 | | | | | | - Tie-Rod at 2.03+/- metres below top of sheet pile. |
| | | | | | 2.34 | End of test pit at 2.34 metres below top of sheet pile. |

General Information
- Tie Rod = 65+/- mm
- Waler channel = 250+/- mm
- Web thickness = 9.1+/- mm
- Nut = 47+/- mm
- Bolt = 33.5+/- mm
- Web Depth = 85+/- mm
- Spacing between upper and lower whalers = 100+/- mm
- Back plate = 300 mm long X 200 mm wide x 25 mm thick
- Tye Rod Spacing 1.0 +/- metres

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works Government Service Canada | Proj No. 5426.98 | Test pit TP 3 |
| Project | Test Pit Investigation - Structures | Date End 5.April.2012 | Page 1 of 1 |
| Location | Le Goulet New Brunswick | | |
| Ground Level, m 2.68+/- | Datum: Chart | Logged By TDS | |

Undrained Shear Strength - kPa
0 25 50 75 100
□ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | TYPE | N (RQD) | REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | Coarse sand with some gravel (BEACH SAND FILL) |
| | | | | | | - Tie-Rod at 2.41+/- metres below top of sheet pile. |
| | | | | | | 2.72 |
| | | | | | | End of test pit at 2.72 metres below top of sheet pile.<br>General Information<br>- Tie Rod = 65+/- mm<br>- Waler channel = 250+/- mm<br>- Web thickness = 12.5+/- mm<br>- Nut = 51+/- mm<br>- Bolt = 34+/- mm<br>- Web Depth = 75+/- mm<br>- Spacing between upper and lower whalers = 100+/- mm<br>- Back plate = 300 mm long X 200 mm wide x 25 mm thick<br>- Tye Rod Spacing 1.93 +/- metres |

TEST PIT WITH GRAPH 542698.GPJ GEMTEC 2004.GDT 5/15/12

**GEMTEC** LIMITED
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Fredericton, Moncton, Bathurst N.B. Canada

# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works Government Service Canada | Proj No. 5426.98 | Test pit TP 4 |
| Project | Test Pit Investigation - Structures | Date End 5.April.2012 | Page 1 of 1 |
| Location | Le Goulet New Brunswick | | |
| Ground Level, m 2.65+/- | Datum: Chart | Logged By TDS | |

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

□ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded

Water Content & Atterberg Limits ($w_P$, $w$, $w_L$)
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m

0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | Coarse sand with some gravel (BEACH SAND FILL) |
| 1 | | | | | | |
| 2 | | | | | | - Tie-Rod at 2.03+/- metres below top of sheet pile. |
| | | | | | 2.34 | End of test pit at 2.34 metres below top of sheet pile. |

General Information
- Tie Rod = 65+/- mm
- Waler channel = 250+/- mm
- Web thickness = 12.5+/- mm
- Nut = 50+/- mm
- Bolt = 35+/- mm
- Web Depth = 75+/- mm
- Spacing between upper and lower whalers = 100+/- mm
- Back plate = 300 mm long X 200 mm wide x 25 mm thick
- Tye Rod Spacing 1.93 +/- metres

# Appendix D

Site Photos


**Photo No. 1: View to North at South End of Structure 302. (2011-11-29)**

**Photo No. 2: 1966 Section of Structure 302. View Looking North. (2011-11-29)**

**Photo No. 3: Top of Breakwater Structure 302, View Looking South. (2011-11-29)**

**Photo No. 4: Gravel Fill where Material Loss Occurred Through SSP Face at South End of 1966 Section of Structure 302. (2011-11-29)**

**Photo No. 5: Concrete Deck Slab on 1968 Section of Structure 302.**

**(2011-11-29)**

**Photo No. 6: North End of 1966 Section of Structure 302. (2011-11-29)**

**Photo No. 7: Overhanging Guard Along East Face of 1966 Section of Structure 302. (2011-11-29)**

**Photo No. 8: Portion of 1966 Construction Beyond North End of Structure 302. (2011-11-29)**

**Photo No. 9: Deteriorated SSP Wall to North of Structure 302. (2011-11-29)**

**Photo No. 10: Harbour Face of SSP on Structure 302. (2011-11-29)**

**Photo No. 11: SSP Face – Harbour Side of 1968 Section of Structure 302. (2011-11-29)**

**Photo No. 12: Perforations at Top of SSP Along Channel Face of Structure 302. (2011-11-29)**

**Photo No. 13: Top of SSP Along Harbour Face of Structure 302. (2011-11-29**

**Photo No. 14: Top of SSP at Transition between 1966 and 1968 Sections of Structure 302. (2011-11-29)**

**Photo No. 15: Top View of Guard and SSP on 1966 Section of Structure 302. (2011-11-29)**

**Photo No. 16: Voids In Fill at SSP Face at South End of Structure 302. (2011-11-29)**

**Photo No. 17: Loss of Material at Joint Between 1966 and 1968 Sections of Structure 302. (2011-11-29)**


**Photo No. 18 Top of Buried Tie-Back Wall at South End of 1966 Section ofStructure 302. (2011-11-29)**

**Photo No. 19: Deterioration at Top of SSP Channel Face at 1966 Section of Structure 302. (2011-11-29)**

**Photo No. 20: View to South Along Channel Face of Structure 304. (2011-11-29)**

**Photo No. 21: Armour Stone Stockpiled Along Edge of Structure 304.**

**(2011-11-29)**

**Photo No. 22: Top View of SSP Section Along East Wall at Structure 304.**

**(2011-11-29)**

**Photo No. 23: Severe Pitting on Back Face of SSP – East Wall of Structure 304. (2011-11-29)**

**Photo No. 24: Perforations at South End of East Face – Structure 304. (2011-11-29)**

**Photo No. 25: Severe Pitting and Perforations in Back Side of SSP East Wall - Structure 304. (2011-11-29)**

**Photo No. 26: View of Structure 302 Looking South Towards Structure 304. (2012-02-08)**

**Photo No. 27: Back Face of Perforated SSP at South-East Corner of Structure 304. (2011-11-29)**

**Photo No. 28: Concrete Cope Wall Along Top of South-west Face of Structure 304. (2012-02-08)**

**Photo No. 29: Seawall Along South-West, (Seaward), Face of Structure 304.**

**(2011-11-29)**

**Photo No. 30: Perforations at South-east Corner of Structure 304.**

**(2012-02-08)**

**Photo No. 31: Harbour Face of Structure 302. (2012-02-08)**

**Photo No. 32: Harbour Side of Structure 304, South End of Structure 302. (2012-02-08)**

**Photo No. 33: Structure 302 Looking North. (2012-02-08)**

**Photo No. 34: View of Channel at South End. Note Ice Conditions. (2012-02-28)**

**Photo No. 35: Ice Flow in Channel. (2012-02-08)**

**Photo No. 36: Condition on Structure 302 Looking Towards Structure 304 at time of Dive Inspection. (2012-02-08)**

**Photo No. 37: Channel Conditions Due to Strong Currents. (2012-02-08)**

**Photo No. 38: Strong Currents in Channel at Time of Inspection.**

**(2012-02-08)**

**Photo No. 39: Harbour Side of Structure 302. (2012-02-08)**


**Photo No. 40: Preparation for Dive on Harbour Side of Structure 302.**

**(2012-02-08)**

**Photo No. 41: North of Structure 302. Remains of SSP Wall. (2012-02-08)**


**Photo 42 - TP 1 – Tie-Rods exposed and perforations in upper portion of SSP visible.**


**Photo 43 - TP 1 – Exposed waler and back plate.**


**Photo 44 - TP 1 - Exposed tie-rod.**


**Photo 45 - TP 1 – Tie-rod and waler.**


**Photo 46 - TP 1 – Upper and lower channel of waler.**


**Photo 47 - TP 1 – Exposed Tie-Rod**


**Photo 48 - TP 2 – Exposed Beach Sand Fill**


**Photo 49 - TP 2 – Tie-rod spacing exposed.**


**Photo 50 - TP 2 – Back plate and waler in good condition.**


**Photo 51 TP 3 - Excavation**


**Photo 52 TP 3 – Exposed waler.**


**Photo 53 - TP 3 Exposed waler and back plate.**


**Photo 54 - TP 4 – Exposed waler.**


**Photo 55 - TP 4 – Exposed back plate.**

**Photo 56 – Ultrasonic thickness testing.**

**Photo 57 - Underwater ultrasonic thickness testing.**

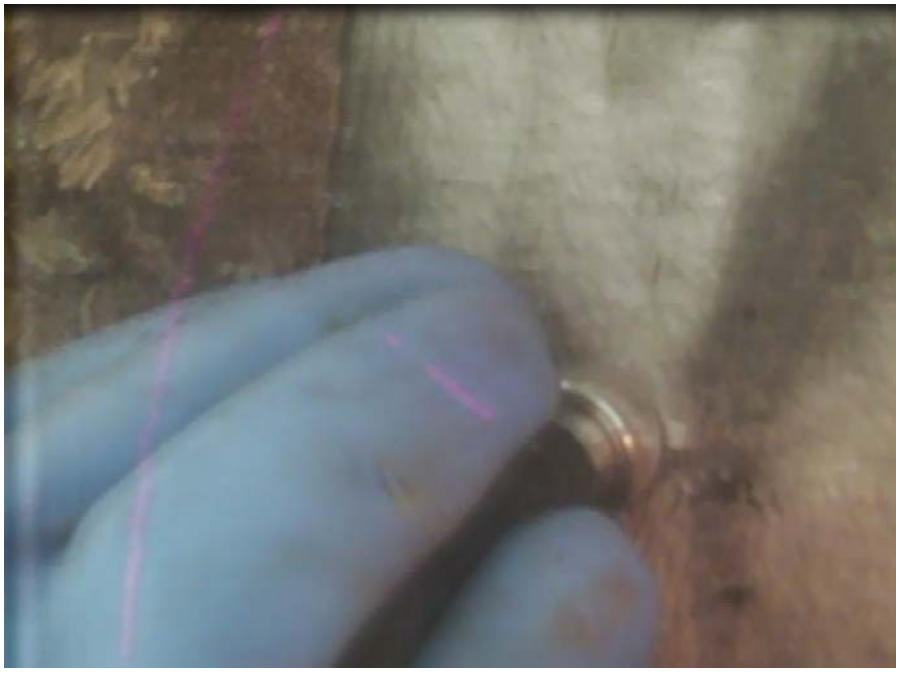

**Photo 58 – Underwater ultrasonic thickness testing.**

**Photo 59 – Perforation in SSP within tidal zone.**