Parlee Beach Provincial Park Channel Assessment Study & Report

NB Department of Tourism, Heritage and Culture

TECHNICAL REPORT

FINAL SUBMISSION

Submitted by:

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February 14, 2019

Legal

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1 Introduction

1.1 Background

As part of Steering Committee for Parlee Beach Water Quality recommendations, Crandall Engineering Ltd. was retained by the NB Department of Tourism, Heritage and Culture (NBDTHC) to study the hydrology of the tidal channel just south of the Parlee Beach Provincial Park located in Pointe-du-Chêne, NB, a Local Services District near Shediac, NB in the south eastern portion of the province.

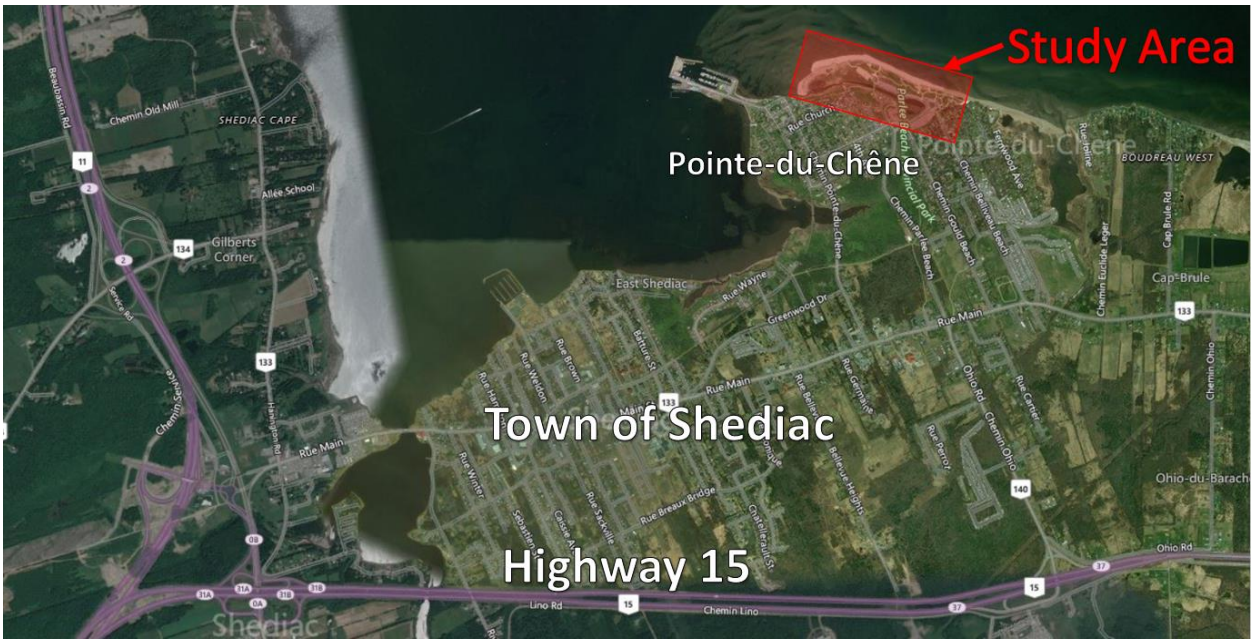

Figure 1-1: Location Plan

The study will evaluate the potential impact from this waterbody, if any, on the water quality at the beach nearby. In particular, the following report focuses on the channel characteristics, external input sources and water/ soils quality to determine if there is any action required at estuary channel in order to mitigate any potential impacts.

1.2 Study Objectives

The specific objectives of this study are as follows:

1. **Review of Project Information:** Review the existing information provided by the NB Department of Tourism, Heritage and Culture (NBDTHC) and include in this work where relevant.
2. **Assessment of Dunes and Channel Inlet:** Comment on the coastal erosion/dune migration at the channel inlet based on aerial photos dating back from the 1950s to present and compare this to present erosion data from GEONB.
3. **Land Use:** Review the License of Occupation Application process in NB and identify the present land uses, private properties, existing easements and other existing features.
4. **Determine Bathymetry of Channel and Present Channel Characteristics:** Assess the bottom of the channel and lagoon to determine if any restrictions can be observed. Evaluate the channel profile to determine if there are any irregular natural or human-made features that may be affecting the channel hydraulics.
5. **Correlate Tides with Channel Inlet:** Assess the effects the tide and precipitation have on the flow going in and out of the channel during both rain events and dry periods.
6. **Determine the Lagoon Water Shed Basin**: Determine the area that discharges to the lagoon by creating a drainage basin map with available survey and LiDAR data.
7. **Water and Soil Sampling:** Perform water quality testing for Escherichia coli (E. coli) and Enterococcus of all outfall pipes discharging into the lagoon during major rainfall events. Complete soil sampling of the channel bottom material at select locations.
8. **Assessment of Existing Culvert (Between the Lagoon and the Channel):** Evaluate the existing culvert condition, present theoretical capacity and determine if the replacement of the culvert is warranted.

9. **Recommendations:** Summarize the findings in a report and provide recommendations and next steps.

1.3 Exclusions and Other Considerations

This scope of this study does not include the following:

- Any evaluation of the biological condition or wildlife health of the ecosystem of the tidal inlet channel and lagoon;
- Any in-depth correlation with long-term global warming (climate change)) or flood zones;
- The study data only evaluates the channel based on data collected from September to November 2018 and results may vary during other times of the year;

2 Site Observations and Land Considerations

2.1 Site Description

Figure 2-1: Aerial Photo of the Site

The tidal channel and lagoon are located to the south of the Parlee Beach Provincial Park. The lagoon and channel have a combined length of just over **1,050 metres** from the point of intersection between the channel and the Northumberland Strait to the most western point of the southern water basin of the lagoon.

The total average surface area of the lagoon and channel is approximately **1.38 ha. (3.2 acres)**. Although this is considered a Provincially Significant Wetland (PSW), it is surrounded by man-made structures within its 30 m buffer as follows:

- A chipseal parking lot and an asphalt road surround the lagoon;
- The channel is bound by a residential area on the south side and by a parking lot and open field on the north side;

- The closest house is approximately 5 metres away from the channel, well within the Provincially significant Wetland as well as other grandfathered structures;
- A culvert divides the lagoon and the channel and allows the vehicles to exit the parking area on the north side of the channel and lagoon;
- There are pipes discharging to the lagoon and channel;
- The channel is crossed by a pedestrian bridge;
- The natural marsh vegetation buffer around the channel and the lagoon is an average six (6) metres with as little as two (2) metres at some places.

These are shown on **Drawing 18292-00P-C01.**

Figure 2-2: Residential Area Proximity to Channel

2.2 Site Assessment and Data Collection

Site visits were performed, and the necessary survey, sampling and data collection were completed as follows:

- Confirmation of existing pipes outfall locations in the channel and lagoon;
- Bathymetric survey of the channel and lagoon bottom;

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NOTES

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New Nouveau Brunswick CANADA

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PROJECT TITLE

PARLEE BEACH TIDAL CHANNEL ASSESSMENT STUDY

SHEDIAC N.B.

DRAWING TITLE

OVERALL SITE PLAN

Scale	Drawn By	Design By
20m 0 40m (1:2000 FULL SCALE)	JMB	CJG
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	Sheet 1 of 11	

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- Topographic survey of the channel and lagoon bottom;
- Measurement of the water levels in the channel and the Northumberland Strait;
- Recording of daily precipitation (Environment Canada records were also used);
- Select sampling of water and soil to complement past data;
- Assessment of the existing large culvert; and,
- Ground truthing to confirm survey and LiDAR of the drainage basin.

2.3 Existing Pipe Discharges

Crandall completed a visual inspection around the perimetre of the channel and lagoon on October 4, 2018, to identify any outfalls or sanitary cross connections discharging to the channel. A total of **seven (7) pipes** were found. In addition, one (1) sanitary lift station overflow pipe was identified on the most eastern point of the lagoon. This pipe was since removed during this study as part of a separate construction project by the Greater Shediac Sewerage Commission.

The following identified discharge pipes condition, material and size can be found on the following **Table 2-1** and **Figures 2-3 to 2-9**.

Table 2-1: Summary of Pipe Inlets

OUTFALL ID NO.	FLOW Y/N	ODOR (Y/N)	PIPE MATERIAL	PIPE DIAMETRE (mm)	CONDITION
No. 1	Y	N	Corrugated Steel (CSP)	1200	*Fair
No. 2	Y	N	Corrugated Steel (CSP)	350	*Poor
No. 3	Y	N	Corrugated Steel (CSP)	750	*Poor
No. 4	Y	N	High-Density Polyethylene (HDPE)	450	Good
No. 5	Y	N	High-Density Polyethylene (HDPE)	600	Good
No. 6	Y	N	Polyvinyl Chloride (PVC)	250	**Removed
No. 7	Y	N	High-Density Polyethylene (HDPE)	300	Good
No. 8	Y	N	High-Density Polyethylene (HDPE)	300	Good

*Poor	Extensive surface corrosion, deep pitting, perforations and overall thin weak metal.
*Fair	Corrosion and scaling, however, no major structural damage
**Removed	Pipe was removed during the study

Figure 2-3: Culvert no. 1 (1200mm Diameter Corrugated-Steel Pipe (CSP))

Figure 2-4: Storm Outlet No. 2 (350mm Diameter CSP)

Figure 2-5: Storm Outlet No. 3 (750mm Diameter CSP)

Figure 2-6: Storm Outlet No. 4 (450mm Diameter High-density polyethylene (HDPE))

Figure 2-7: Storm Outlet No. 5 (600mm Diameter HDPE)

Figure 2-8: Sanitary Overflow No. 6 (250mm Diameter PVC)

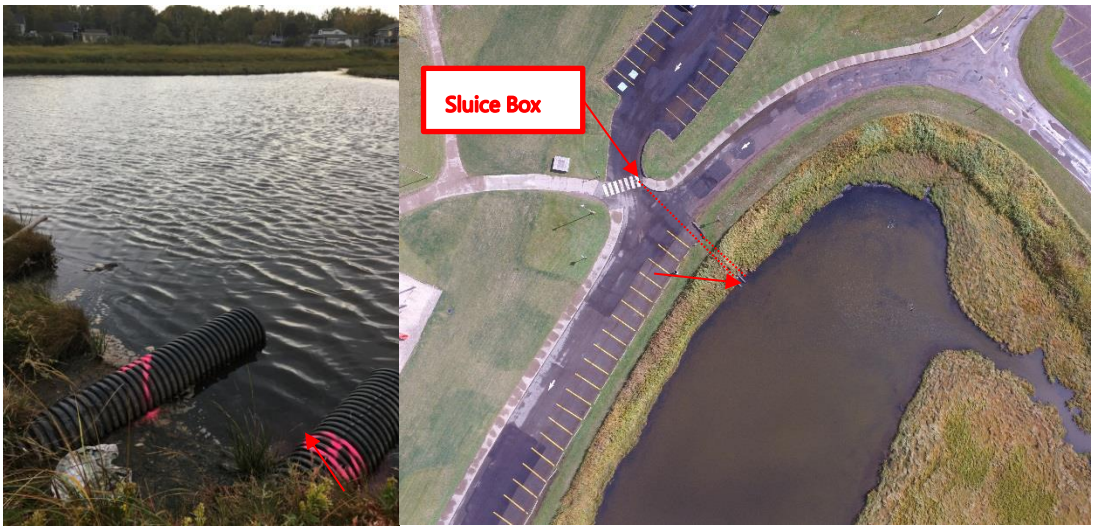

Figure 2-9: Storm Outfall No. 7 and No. 8 (300mm Diameter HDPE)

2.4 Other Features

A human-made rock wall is located on PID 00864322 at the inlet of the channel and was constructed sometime around 2001 in order to protect private property from erosion, as determined by the aerial photo also attached in Appendix C. Prior to rock wall existed a timber wall for erosion protection. The wall is approximately less than 2 m in height and extended less than 3 m seaward from edge of SNB property lines. Armour stone (large rip rap) with an average diameter of 500mm to 1,000mm in size was used, as shown in **Figure 2-10**. The rock wall is located outside the PSW buffer.

Figure 2-10: Human-Made Rock Wall

According to the Coastal Areas Protection Policy for New Brunswick that was developed around this time (2002), erosion control works such as rip rap, sea walls and bulk heads do not require a formal environmental review, provided they met the following criteria:

1. They are located landward of the ordinary high-water mark and up against the landward limit of coastal lands with no backfill required;
2. They have a maximum height of 2 m above the elevation of the beach at the landward limit of coastal lands, or 2 m above the ordinary high-water mark if no beach exists (e.g., cliff), and extended no more than 3 m seaward from landward limit of coastal lands;
3. They follow the contours of the landward limit of coastal lands;

4. No construction debris of other refuse is used;
5. Sloped structure (max. 45° slope), which help dissipate waves, are used rather than vertical structures; and
6. Rock is used as construction material with voids and irregular surfaces that help dissipate wave energy.

Based on the above criteria, our field investigation of the rock wall and considering the Coastal Areas Protection Policy only develop in 2002, it does not appear that formal environmental reviews would have been required in 2001 to construct this erosion protection. Crandall also confirmed no permit with the Beaubassin-Est Planning Commission was required for the rock wall prior to construction.

It should be noted that the above policy was developed only in early 2002 in order to inform New Brunswick residence about the provinces plan to protect the provinces coastal areas.

Present day requirements, for similar coastal features, would require a more in-depth screening process through Environment and Local Government (i.e. a unique feature designation) on a case by case basis, prior to approval of construction.

2.5 Existing Easements for Private Property and Review of License of Occupation Application.

A land ownership review was completed by MacAulay Surveys Ltd. of Moncton, NB. Presently, there are three parcels of private property north of St. John Street that cross the channel and ends at the Northumberland Strait high-water mark as shown in red on the Private Property Easement Identification **Drawing 18292-00P-C02**. Records from each parcel (PID 70464888, 70287461 and 01049980) from the Service New Brunswick Property Data Base do not show or describe any easement in place through these properties. Further legal investigation of these properties is recommended to confirm any early easements that may have been in place from previous owners.

As a result, there does not appear to be legal access along the high-water mark from Parlee Beach property to the westernmost point of the beach (i.e. channel inlet). However, the License of Occupation Application may be issued to allow work activity to use crown land (Provincial Parks) below the high-water mark as a legal agreement authorizing a non-exclusive use of crown land for a specific period under certain conditions.

NORTHUMBERLAND STRAIT

SHALLOW SAND BAR

PRIVATE PROPERTY (TYP.)

70464888

70287461

01049980

EXISTING BEACH VOLLEYBALL COURT

EXISTING CANTEEN AND WASHROOMS

EXISTING RESTAURANT

EXISTING PROPERTY LINE (TYP.)

EXISTING LIFE GUARD BUILDING

EXISTING PROVINCIALLY SIGNIFICANT WETLAND 30m BUFFER

SHALLOW SALT WATER MARSH

TIDAL CHANNEL

TIDAL CHANNEL

LAGOON

EXISTING CANTEEN AND WASHROOMS

EXISTING RIGHT OF WAY (TYP.)

EXISTING CHANNEL INLET

EXISTING ROCK WALL

EXISTING PEDESTRIAN BRIDGE

ABANDONED AND DEMOLISHED SANITARY SEWER LIFT STATION

EXISTING PARK EXIST

EXISTING PARK ENTRANCE

ST. JOHN STREET

POINT DU CHÊNE ROAD

RAILWAY AVENUE

ST. ANDREWS ROAD

CHURCH STREET

1st AVENUE

2nd AVENUE

3rd AVENUE

4th AVENUE

LEIGHTON LANE

GARY AVENUE

AGNEW LANE

DOWNEY STREET

MACKENZIE ROAD

WILLIAM AVENUE

BRYDGES STREET

ST. JAMES STREET

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SHEDIAC N.B.

DRAWING TITLE

PRIVATE PROPERTY EASEMENT IDENTIFICATION

Scale: 20m 0 40m (1:2000 FULL SCALE)

Drawn By	Design By
JMB	CJG
Checked By	Cadd Check
CJG	TWA

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The application requires the following:

- An approximation of how long its anticipated use is;
- Description of activities or work to be completed;
- Type of equipment to be used;
- Description of potential effects on adjacent landowners;
- Environmental impacts;
- Adjacent property information;
- Moreover, a description of the Crown lands present use.

The application process begins with an initial application as described above at the cost of $300+HST. The application is then reviewed by the Department of Energy and Resources Development (ERD) for a period between 6 to 12 weeks. Once approved, a letter is issued that includes a preparation fee and rental fee based on the area required and approved.

3 Channel Hydraulic Analysis

3.1 Bathymetry and Channel Feature Characteristics

3.1.1 Bathymetry and Channel Profiles

A detailed bathymetric survey was completed on October 4, 2018 by Crandall using a raft equipped with an echosounder to collect the measurements at the bottom of the channel. The echosounder alone was not capable of collecting the entire profiles for the channel and lagoon due to its minimum depth requirements. Some areas, even at high tide, were too shallow for the equipment. These areas where then picked-up manually with a topographic survey equipment and a flat bottom boat on October 12, 2018 for a complete survey.

The low tide level in the channel and lagoon on October 4th, 2018 was elevation +0.30m geodetic.

Drawing 18292-00P-C03, illustrates the bathymetry of the channel:

- The centre of the channel bottom elevation varies between 0.30 m and -0.90 m (geodetic) to the bottom of the sediment;
- During high tides the water depth can range from 1.1 m to 2.0m;
- The lagoon has an average depth of 0.7 metres and a maximum water depth of 2.0 m based on the October 4th survey.
- The lagoon water volume was calculated and is shown on **Figure 3-4** (water level vs. water volume curve)

Drawings 18292-00P-C08 to 18292-00P-C11 in Appendix A, displays cross-sections at 50m intervals showing the average water elevation during low and high tides within the channel and lagoon.

Channel Bottom Profile

As shown on **Drawing 18292-00P-C03**, the channel bottom elevation at the Northumberland Strait is higher than upstream in the channel. Consequently, the water remains in the channel and lagoon when the tides fall below the inlet bottom elevation of +0.20 m geodetic. When the tide level exceeds +0.20 m in elevation, the inlet begins to fill the channel and lagoon. Alternately, when the tide falls, the water above the elevation of +0.20 m is then flushed back to the Northumberland Strait.

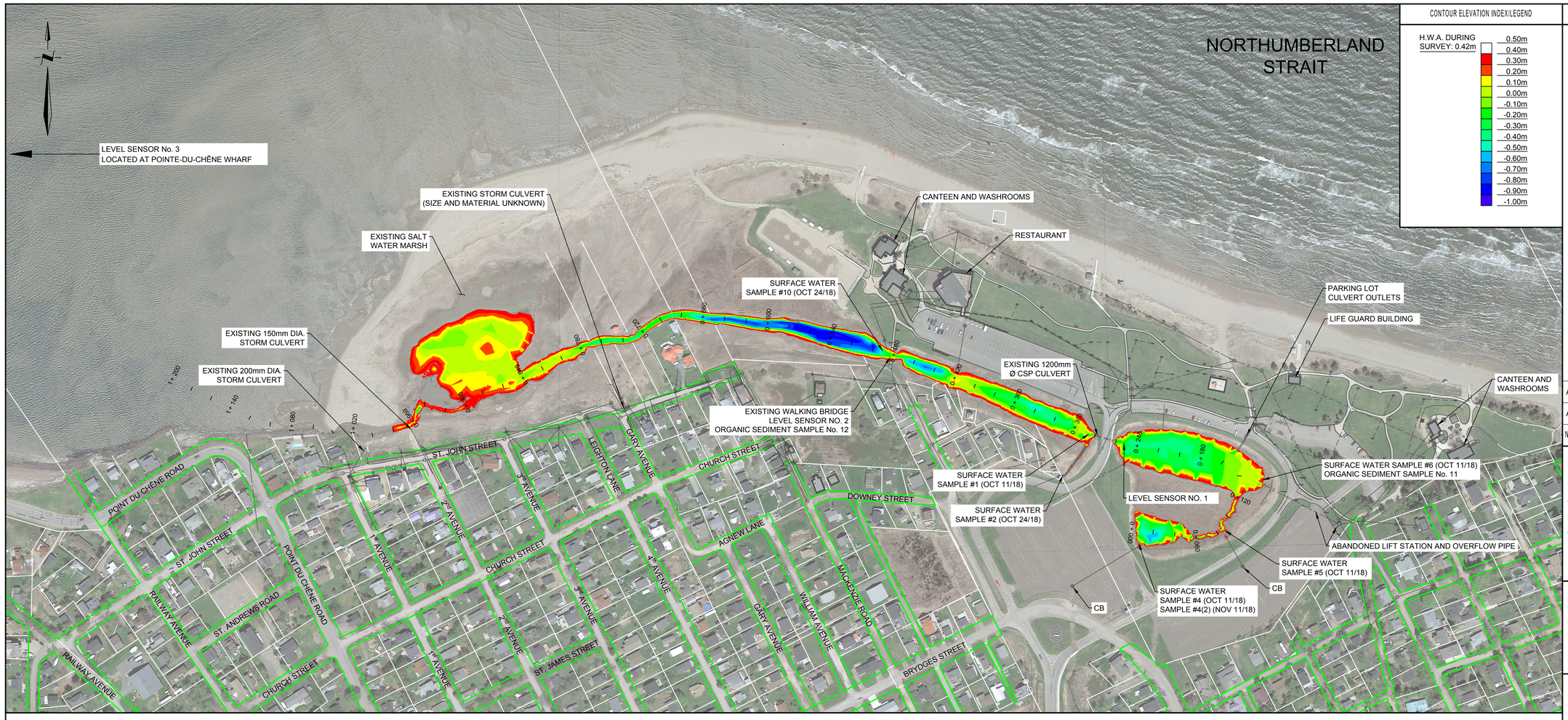
The flow of the water in the channel and lagoon is limited and at times throughout the day remains stagnant. The water level is regulated by a high point in elevation between the tidal channel and the Northumberland Strait. As a result, there is always water pooling in the channel and lagoon.

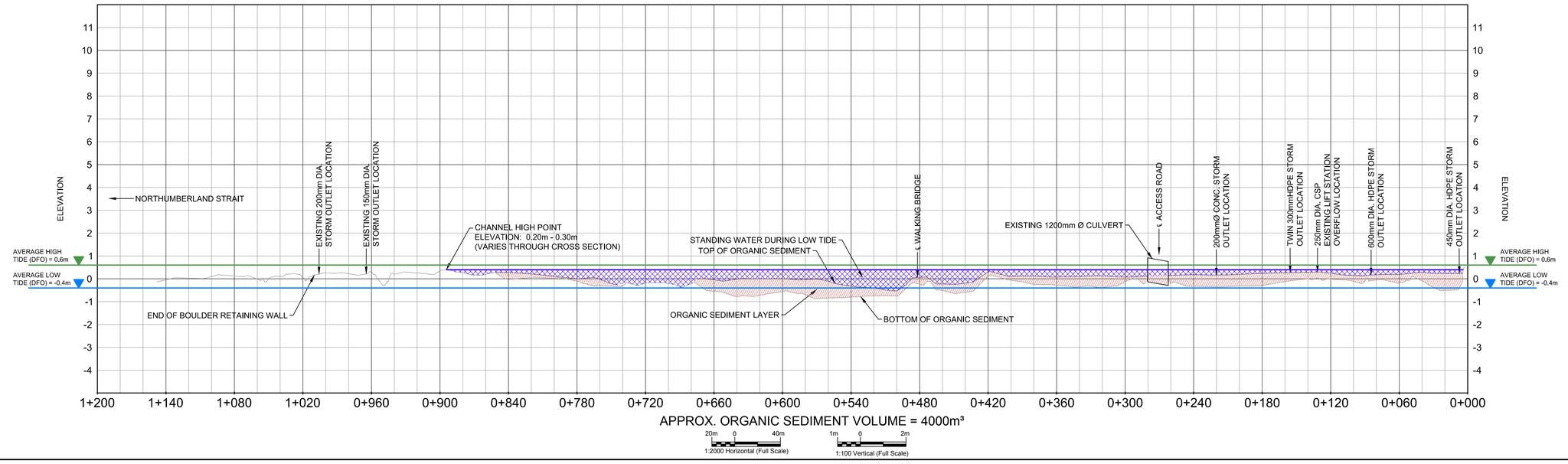
Significant increases in the channel and lagoon water level usually occur as a result of major precipitation events and storm surges were observed through the study. This was observed on October 24th, 2018 where the lagoon water level increased to +0.8 m geodetic with a rainfall of 38 mm in 24 hours as well as a storm surge shown on **Figure 3-2.**

3.1.2 Organic Sediment Material at Bottom

There is a black organic sediment layer in areas of the lagoon and channel bottom, shown on the profile of **Drawing 18292-00P-C03.**

Crandall determined the sediment thickness to range from 0.0 m to 0.90m in the channel and lagoon. The total volume of sediment in the channel and lagoon was calculated to be approximately **4,000 m^3** based on sludge gun depth measurements, bathymetry and GPS survey cross sections.





CONTOUR ELEVATION INDEX/LEGEND

H.W.A. DURING SURVEY: 0.42m

0.50m
0.40m
0.30m
0.20m
0.10m
0.00m
-0.10m
-0.20m
-0.30m
-0.40m
-0.50m
-0.60m
-0.70m
-0.80m
-0.90m
-1.00m

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BATHYMETRIC SURVEY AND CHANNEL PROFILE

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20m 0 40m (1:2000 FULL SCALE)	JMB	CJG
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3.2 Channel Hydraulics and Correlation with Tides

Tide Cycles were monitored from three (3) locations as shown on **Drawing 18292-00P-C03:**.

- Pointe-du-Chêne Wharf (Red on Tidal Curve Graphs);
- Channel at Pedestrian Bridge (Blue on Tidal Curve Graphs);
- Lagoon at Central Culvert (Green on Tidal Curve Graphs).

Flows in and out of the channel are governed by tidal water level changes.

The inlet conveys water between the Parlee Beach Lagoon and the Shediac Bay, near the Shediac wharf. The exchange of water is driven by freshwater flow toward Shediac Bay, resulting from precipitation and runoff or groundwater, and the periodic - tidal - inflow and outflow of seawater or brackish (mixed fresh and saline) water. The tides are the driving force behind the in and outflow of saline water. During rising tides (when water levels are higher in the Bay than in the Channel), water flows landward toward the lagoon. During falling tides, the flow is in a seaward direction. The outflow of water (fresh and saline), is considered to flush the estuary to a geodetic elevation of +0.20m.

Figure 3.2 - 1 shows the predicted tides for Shediac Bay for October 2018 and November, 2018, covering the period when field measurements were carried out by Crandall at the Parlee Beach channel. In addition to the measured tides at the Shediac wharf, the DFO Canada predictions and those by the University of South Carolina Department of Marine Sciences (USCMS) were applied. Both sources show identical frequencies but slightly different amplitudes, at times. Since the USCMS tides predict a more harmonious tidal performance, those values were used primarily in this study.

The tidal amplitude in the study area, seaward of the channel, was found to be 1.0 m for Spring Tides, and 0.2 m for Neap Tides. The average tidal range was 0.6 m. Those measurements match well with the DFO and USCMC predictions but are lower than the values given by the CHI Hydrographic Chart No CA 4909 for Shediac Harbour. The chart lists the spring tide amplitude as 1.4 m and the average tide amplitude as 0.9 m for Shediac Bay. The chart states the difference between chart datum and geodetic as 0.9 m.

A comparison of actual measured tidal water levels, with measured water levels, shows that tidal water levels are significantly affected by wind forces. On October 24, 2018, the measured tide was close to 1.2 m, resulting from a small storm surge, while the predicted tide would have been only at 0.6m. Conversely, on November 4, the measured high tide was at +0.1 m geodetic where the predicted tide was at +0.5m geodetic.

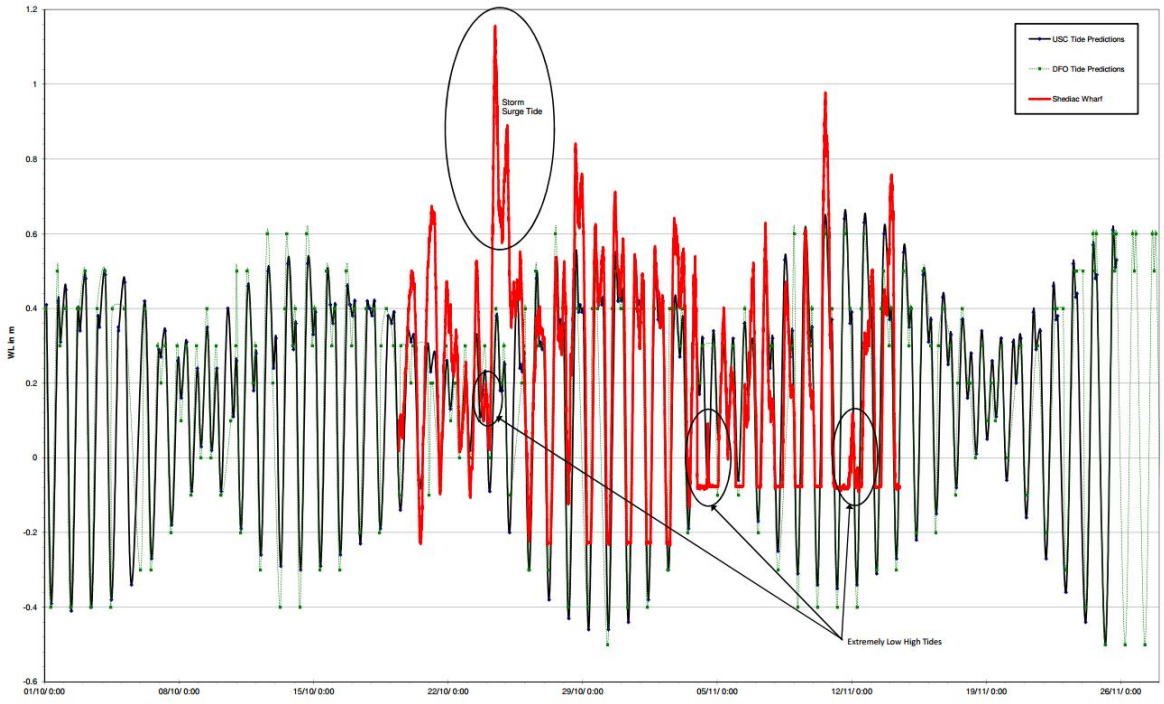


Figure 3-1: Measured Tide vs. Tide Predictions (October and November 2018)

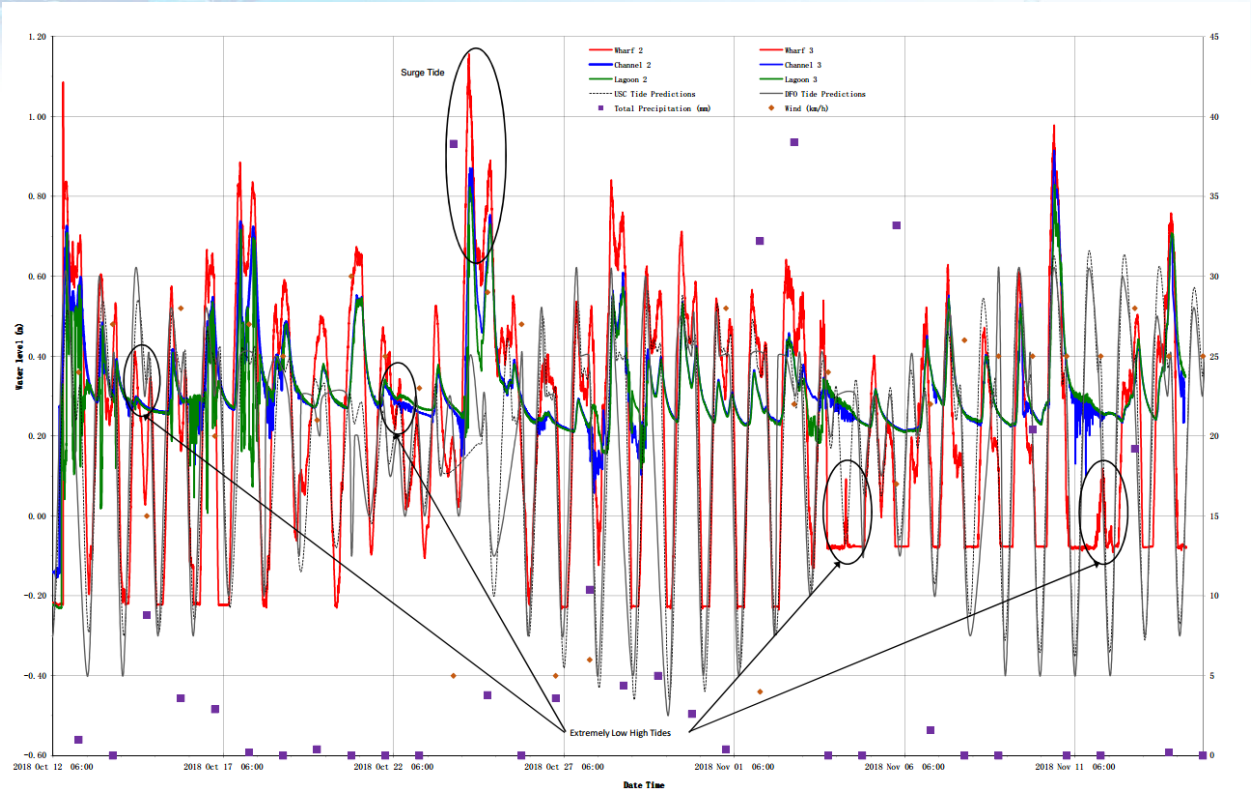


Figure 3-2: Tidal Curves from Oct 12 - Nov 14, 2018

3.2.1 Channel Restrictions

Figure 3-2 shows the typical daily tidal cycle in the study area. Once the tide rises above the channel water level, the water level inland follows suit and starts to rise. Saline water flows into the channel and toward the lagoon. Given the small size of the lagoon, in comparison to the channel cross-section, the channel and the lagoon have approximately equal water levels. Even when the tides start to recede near the wharf, the water level still increases with the landward flow, until the marine water level drops below the water level in the channel. Then the flow reverses, and the water levels start to drop there, as well.

Figure 3-3 show a more detail representation of the inlet restriction to the channel. The channel (blue) and lagoon (green) level loggers trail the Wharf logger (red line) by approximately 1.5 hours on November 7th, 2018. This time is required to build approximately 150mm of hydraulic head to drive the flow into the channel. This delay prevents the channel/ lagoon from peaking at the same level as the wharf before it is met with the dropping tide as described above. This indicates that there is a hydraulic restriction at the inlet of the channel. **Drawing 18292-00P-C03 and Drawing 18292-00P-C11, Appendix A**, shows the inlet from Station 0+850 to the end of the bathymetry at Station 1+000 the channel is both narrower and shallower than the upstream cross sections from 0+850 to the central culver near Station 0+300.

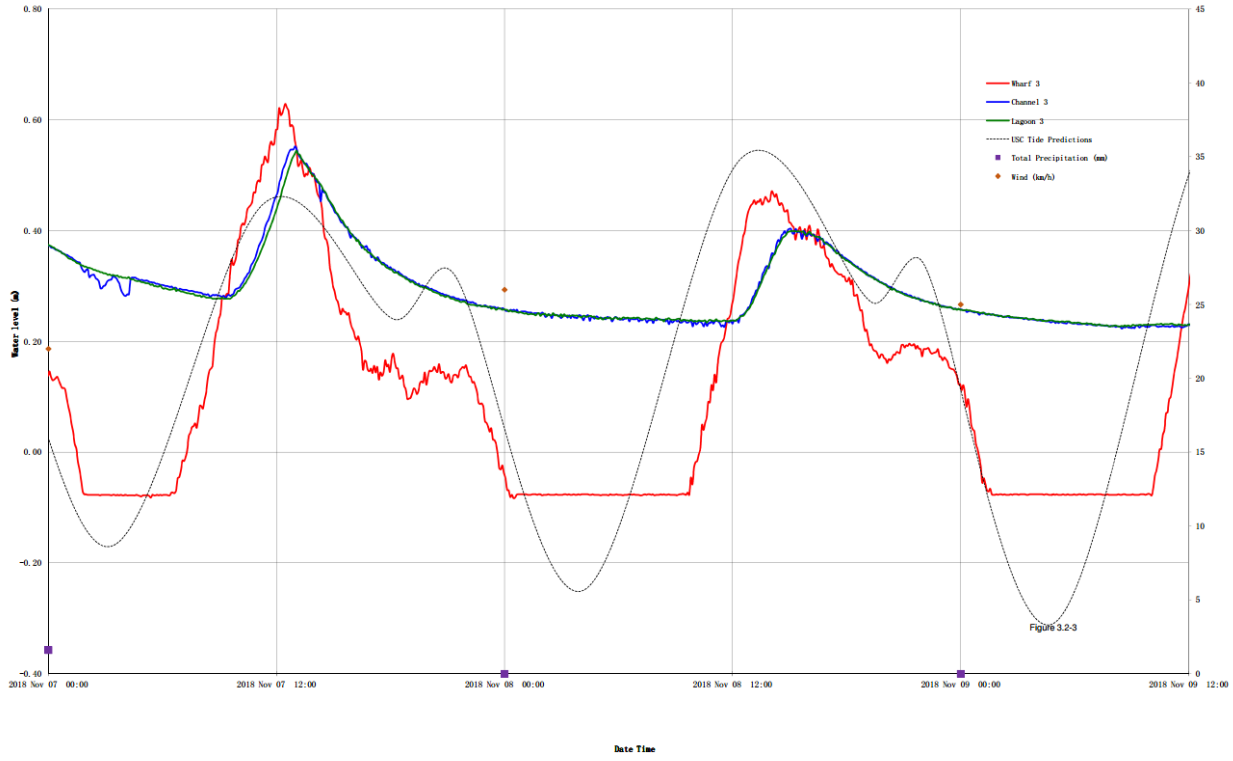


Figure 3-3: Tidal Curves from Nov 7 - Nov 9, 2018

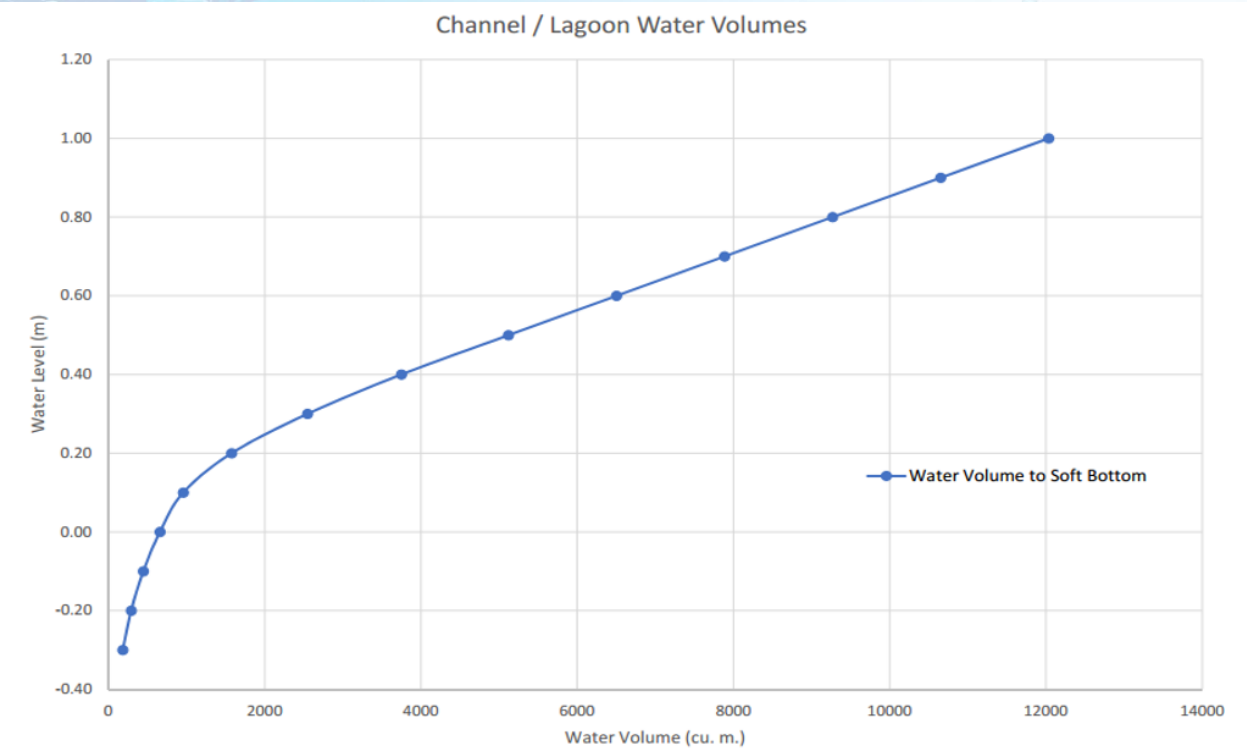


Figure 3-4: Lagoon / Channel Water Volume Curve

That being said, further up stream of the channel there is a limited hydraulic restriction between the channel and the lagoon as the water levels rise and fall almost simultaneously. Water level control is provided by the sandbar at the mouth of the channel. The bottom of the sandbar is assumed to be at an approximate elevation of +0.2 m. The typical observed tidal range in the channel is from +0.2 m to +0.6 m; however, this depends significantly on the marine high tide levels.

The amount of water flushing in and out of the channel/lagoon can be assessed using the storage volume curve shown in **Figure 3-4**. Given an average tidal range of 0.3 m – 0.4 m in the channel/lagoon results in a flushing volume of **5,000 m^3 per tide**. This translates into a flow of **660 m^3/hr or 0.2 m^3/sec**.

3.2.2 Dredging

A discussion with park maintenance supervisor described a previous dredging program approximately 25 years ago due to limited flushing and algae build up in the channel. There is no record of what the profile of the channel was at that time, however, aerial photo graphs show similar shallow inlets.

Dredging of the inlet lower than +0.2 m geodetic will allow more flow, during rising tides, to enter the channel faster, since there is a restricted section at the inlet the water, within the channel, does not reach the same tide level as the Northumberland Strait before tides begin to drop. As a result, this maintains a lower water level within the channel and Lagoon as shown on **Figure 3-1.**

Dredging of the inlet would also require a significant portion of the shallow sandbar (elevation +0.2 m geodetic with an approximate distance length of 600 m) shown on **Drawing 18292-00P-C01** to also be dredged. The estimated dredging depth required would be to the recorded average low tide of -0.2 to -0.4 m geodetic.

Additional considerations for dredging would be as follows:

- The shallow sandbar outside the channel would have an approximate 0.6 m deep section of trench and may have an impact on public beach safety.
- Due to the longshore drift rates, shallow trench, large sandbar, geography and use of this recreational area, the channel would need to be evaluated for re-dredging each year to maintain inlet flow.
- Environmental requirements would need to be confirmed through an Environmental Impact Assessment (EIA), and Dredging could significantly alter the ecosystem of this estuary.
- Erosion through the channel may accelerate as each tide cycle would remove sediments throughout the channel and lagoon.

3.3 Coastal Erosion and Long Shore Drift

Crandall reviewed the seven (7) historical aerial photos of Parlee Beach **(Appendix B**) from 1953, 1963, 1976, 1982, 2001, 2012 and 2017 download from GNB Provincial Archives and combined them onto one **Drawing 18292-00P-C04**. In addition, coastal erosion data from GEONB was overlaid onto Drawing C03 for comparison. Some observations include:

- Longshore drift is the process in which a significant amount of sediment is transported down the coast in the direction of the prevailing winds. Parlee Beach longshore drift is predominantly influenced by the easterly wind. As a result, waves break on the beach at an angle heading west. This back and forth swash carry the material along the beach and pulls it back under gravity at right angles to the coastline. Over time this moves a significant amount of material to the westernmost part of the Parlee Beach limits as illustrated in **Figure 3-5**.
- Where the removal of beach material surpasses its supply, erosion occurs. Over time this leads to less beach material and is why the park requires a beach management plan for yearly dredging of the western part of the beach to transport this material back to the central main beach;
- The erosion data derived from the aerial photos from 1971 to 2001 correlates with the expected longshore drift process described;
- The main beach (yellow and red circles in Drawing 18292-00P-C03) is eroding slowly, and the western section (dark green circles) is accreting each year.
- From 2001 to present, there was significant growth of the dunes closing into the inlet of the channel. The photos show material moving southwest to the channel inlet at an approximate rate of 7m/year.

NORTHUMBERLAND STRAIT

1976 1.14 2.00 3.44 0.23 4.61 -0.62 5.67 6.39 6.63 0.23 5.97 0.00 -0.23 -0.23 0.00 0.33 0.00 0.04 -0.79 0.00 0.74 -0.52 -0.22 -0.29 -0.15 0.08 0.14 0.00 -0.17 0.15 0.17 0.00 1982 2001 2012 2017 1953 1963 0.00 0.00 0.20 0.00 0.00 0.19 0.15 0.19 0.00 0.22 0.30 0.34 0.00 0.20 0.22 0.29 0.21 0.20 0.16 0.16 0.08 0.13 0.13 0.25 0.37 0.44 0.38 0.39

POINT DU CHENE ROAD
ST. JOHN STREET
RAILWAY AVENUE
ST. ANDREWS ROAD
1st AVENUE
2nd AVENUE
3rd AVENUE
LEIGHTON LANE
GARY AVENUE
CHURCH STREET
AGNEW LANE
DOWNEY STREET
4th AVENUE
ST. JAMES STREET
WILLIAM AVENUE
MACKENZIE ROAD
BRYDGES STREET

O:\18292-00-C\CADD\DESIGNPRESENTATION DWGS\18292-00P-C04(COASTLINE AND EROSION DATA).DWG, 11/02/2019 2:30 PM

COASTAL EROSION INDEX/LEGEND

- HIGHER EROSION RATE NATURAL HABITAT
- HIGHER EROSION RATE MODIFIED HABITAT
- LOWER EROSION RATE NATURAL HABITAT
- LOWER EROSION RATE MODIFIED HABITAT
- RATE NOT CONCLUSIVE/RELATIVE STABILITY NATURAL HABITAT
- RATE NOT CONCLUSIVE/RELATIVE STABILITY MODIFIED HABITAT
- LOWER ACCRETION RATE NATURAL HABITAT
- LOWER ACCRETION RATE MODIFIED HABITAT
- HIGHER ACCRETION RATE NATURAL HABITAT
- HIGHER ACCRETION RATE MODIFIED HABITAT

- EROSION/ACCRETION RATES ARE MEASURED AS AVERAGE METERS PER YEAR.
- EROSION DATA IS TYPICALLY BASED ON AERIAL PHOTOS BETWEEN 1971-2001, AND HAS A TYPICAL MARGIN OF ERROR OF ±0.21 m/yr.

NOTES

NO.	DATE	REVISIONS	BY	APPR.
A.1	FEB. 11/19	ISSUED FOR FINAL REPORT	JMB	CJG
A.0	DEC 21/18	ISSUED FOR DRAFT REPORT	JMB	CJG

New Nouveau Brunswick CANADA

crandall

PRELIMINARY ONLY
DATE PLOTTED: Feb 11, 2019
NOT TO BE USED FOR CONSTRUCTION

PROJECT TITLE

PARLEE BEACH TIDAL CHANNEL ASSESSMENT STUDY

SHEDIAC N.B.

DRAWING TITLE

COAST EROSION AND COASTLINE CHANGE PLAN

Scale	Drawn By	Design By
20m 0 40m (1:2000 FULL SCALE)	JMB	TWA
	Checked By: CJG	Cadd Check: CJG
	Sheet 4 of 11	

File Name: 18292-00P-C04(COASTLINE AND EROSION DATA).DWG

Drawing No.: 18292-00P-C04

Figure 3-5: Illustration of Parlee Beach Longshore Drift (Google Image)

3.4 Channel Surface Water Drainage Basin

Using LiDAR information as shown in **Figure 3-6** and **Drawing 18292-00P-C05**, it was determined that the surface water from a large part of the Pointe-du-Chêne area naturally drains to the channel. **Figure 3-6** shows the general surface flow direction of the area that discharges to the channel and lagoon. The total contributing area is **59.3 hectares** (146.5 acres).

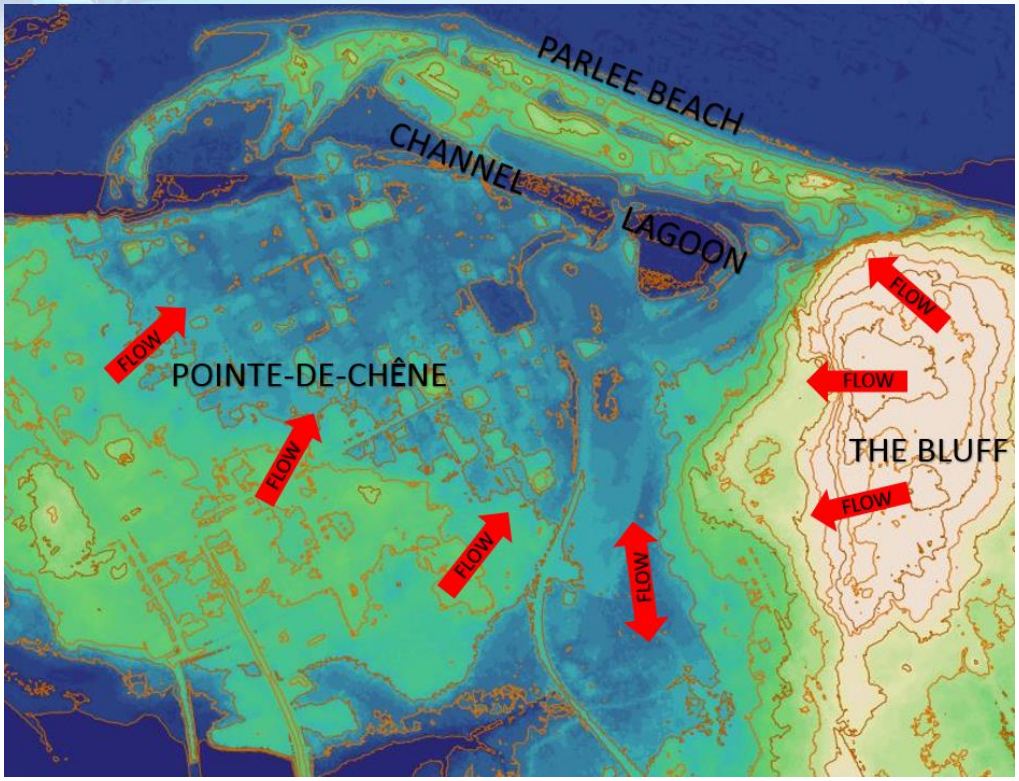
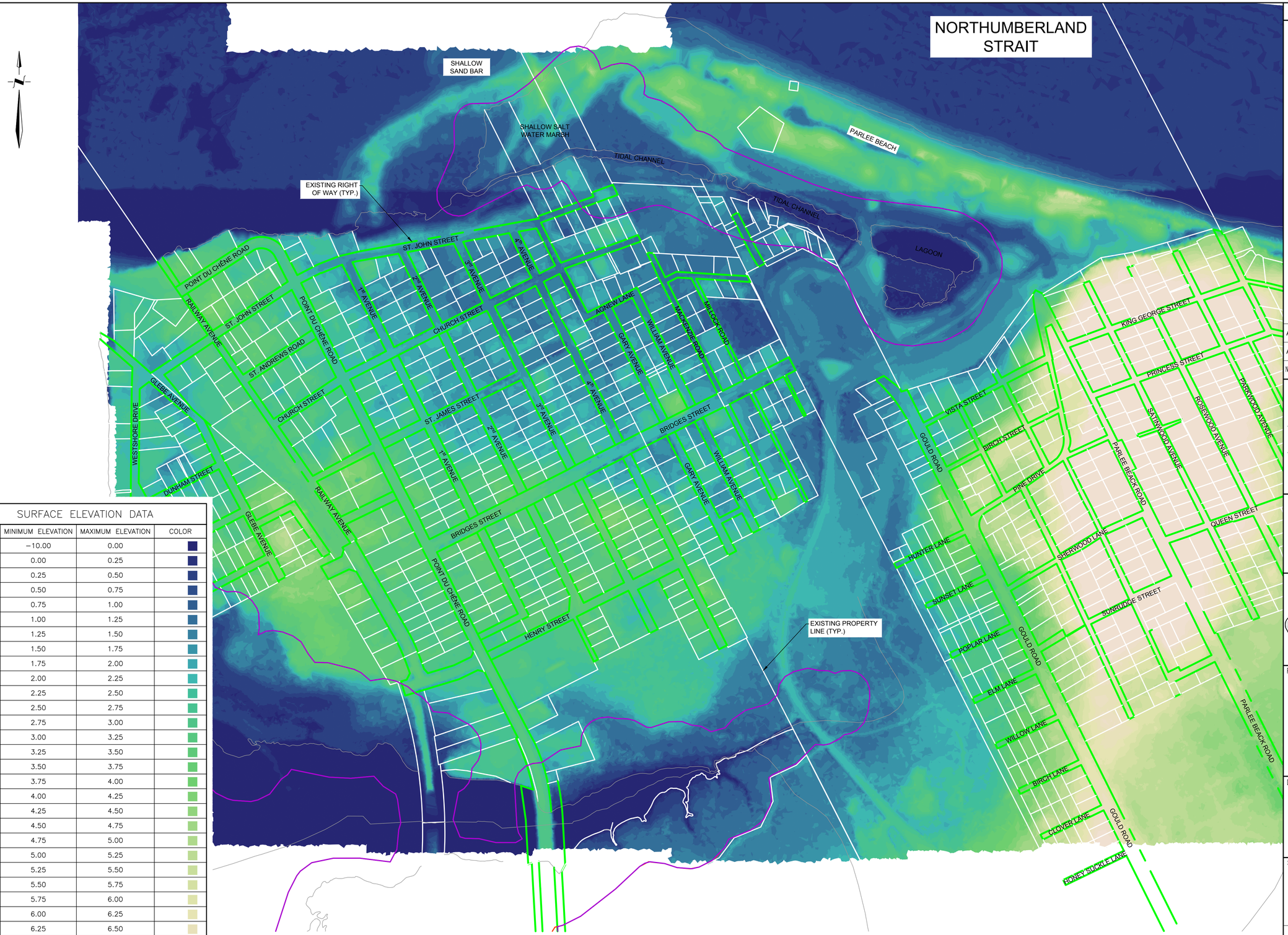


Figure 3-6: GNB LiDAR Elevations (not to scale)

The channel and lagoon drainage have been divided into two (2) basins in order to determine culvert sizing in the following sections. Each basin has an identified major flow path shown on **Drawing 18292-00P-C06**.

The drainage basin for the channel consists of 47.7 hectares (117.9 acres) with a major flow path following down Brydges Street, then the Parlee Beach exit road and then collected and discharged from storm outlet No. 2 shown in **Figure 2-4 (p.14)**.

The drainage basin for the lagoon consists of 11.6 hectares (28.7 acres) drainage basin with a significant flow path coming from the Bluff area, through the east parking lot (Parking Area "B") and is ultimately collected and discharged from storm outlet No. 5 shown in **Figure 2-7 (p.15)**.



SURFACE ELEVATION DATA

NUMBER	MINIMUM ELEVATION	MAXIMUM ELEVATION	COLOR
1	−10.00	0.00	
2	0.00	0.25	
3	0.25	0.50	
4	0.50	0.75	
5	0.75	1.00	
6	1.00	1.25	
7	1.25	1.50	
8	1.50	1.75	
9	1.75	2.00	
10	2.00	2.25	
11	2.25	2.50	
12	2.50	2.75	
13	2.75	3.00	
14	3.00	3.25	
15	3.25	3.50	
16	3.50	3.75	
17	3.75	4.00	
18	4.00	4.25	
19	4.25	4.50	
20	4.50	4.75	
21	4.75	5.00	
22	5.00	5.25	
23	5.25	5.50	
24	5.50	5.75	
25	5.75	6.00	
26	6.00	6.25	
27	6.25	6.50	
28	6.50	6.75	
29	6.75	7.00	
30	7.00	15.00	

NOTES

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PARLEE BEACH TIDAL CHANNEL ASSESSMENT STUDY

SHEDIAC N.B.

DRAWING TITLE

GNB LIDAR ELEVATION DATA

Scale: 25m 0 50m (1:2500 FULL SCALE)

Drawn By	Design By
JHK	JHK
Checked By	Cadd Check
CJG	TWA

Sheet 5 of 11

File Name: 18292-00P-C05 (LIDAR ELEVATION PLAN).DWG

Drawing No.: 18292-00P-C05

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NORTHUMBERLAND STRAIT

LAGOON AND DRAINAGE CHANNEL DRAINAGE BASIN BOUNDARY

EXISTING CANTEEN AND WASHROOMS

EXISTING PROPERTY LINE (TYP.)

EXISTING RESTAURANT

EXISTING PROVINCIALLY SIGNIFICANT WETLAND 30m BUFFER

EXISTING LIFE GUARD BUILDING

EXISTING BEACH VOLLEYBALL COURT

EXISTING 1200mm DIA. CSP CULVERT

EXISTING CANTEEN AND WASHROOMS

TIDAL CHANNEL

SHALLOW SALT WATER MARSH

EXISTING RIGHT OF WAY (TYP.)

EXISTING CHANNEL INLET

EXISTING PEDESTRIAN BRIDGE

LAGOON

LAGOON DRAINAGE BASIN CATCHMENT AREA: 116350 sq. m.

DRAINAGE BASIN MAJOR FLOW PATH

EXISTING ROCK WALL

EXISTING PARK EXIST

EXISTING PARK ENTRANCE

TIDAL CHANNEL DRAINAGE BASIN CATCHMENT AREA: 593710 sq. m.

LAGOON DRAINAGE BASIN BOUNDARY

ST. JOHN STREET
POINT DU CHÊNE ROAD
ST. ANDREWS ROAD
RAILWAY AVENUE
GLEBE AVENUE
WESTSHORE DRIVE
DUNHAM ROAD
JARVIS STREET
SUNSET LANE
CHURCH STREET
1st AVENUE
2nd AVENUE
3rd AVENUE
4th AVENUE
LEIGHTON LANE
GARY AVENUE
DOWNEY STREET
AGNEW LANE
WILLIAM AVENUE
MACKENZIE ROAD
ST. JAMES STREET
BRYDGES STREET
SHEAS LANE
PARLEE BEACH ROAD
VISTA STREET
CHESTNUT STREET
PINE DRIVE
SHERWOOD STREET
SATINWOOD AVENUE
BELLEAU BEACH ROAD

DRAINAGE BASIN

TIDAL CHANNEL DRAINAGE BASIN
CATCHMENT AREA: 593710 sq. m.

LAGOON DRAINAGE BASIN
CATCHMENT AREA: 116350 sq. m.

NOTE:
TIDAL CHANNEL DRAINAGE BASIN AREA OF 593710 sq. m. INCLUDES LAGOON DRAINAGE BASIN AREA OF 116350 sq. m.

NOTES

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A.1	FEB 11/19	ISSUED FOR FINAL REPORT	JMB	CJG
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PARLEE BEACH TIDAL CHANNEL ASSESSMENT STUDY

SHEDIAC N.B.

DRAWING TITLE

LAGOON AND TIDAL CHANNEL DRAINAGE BASINS

Scale	Drawn By	Design By
20m 0 40m (1:2000 FULL SCALE)	JMB	CJG
	Checked By: CJG	Cadd Check: TWA
	Sheet 6 of 11	

File Name: 18292-00P-C06(DRAINAGE BASIN).DWG

Drawing No.: 18292-00P-C06

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There is no storm collection system in the residential development of Pointe-du-Chêne. Runoff from the watershed is conveyed mostly via ditches, swales and eventually discharges to the channel and lagoon. There are small areas near the entrance and exit of the Parlee Beach park that collects surface runoff of the watershed using catch basins that connect directly to the channel and lagoon via a small storm sewer system shown on **Drawing 18292-00P-C01**.

A significant portion of the roads in the residential development of Pointe-du-Chêne and the Bluff are gravel/sand, while the arterial roads are asphalt. The runoff that travels on a gravel/sand road will have a higher concentration of sediment which will eventually discharge to the channel and lagoon. *There are no stormwater treatment systems presently on any of the discharge pipes.*

3.5 Surface Evaluation of Sanitary Sewer System for Cross Connections

Crandall completed a field observation of the channel edge near all existing homes and did not locate any sewer services discharging directly to the channel. Crandall also reviewed the record drawings provided by the Greater Shediac Sewerage Commission and found that all residences that border the channel have a service connection to the sanitary sewer system. All sanitary sewer piping can be seen on **Drawing 18292-00P-C01**.

Drawing 18292-00P-C07, shows to areas where the Parlee Beach storm piping is either in proximity or crosses an existing sanitary sewer line.

NORTHUMBERLAND STRAIT

WASHROOMS

CANTEEN

RESTAURANT

PARLEE BEACH

30m PROVINCIALLY SIGNIFICANT WETLAND BUFFER

CHANNEL

PROVINCIALLY SIGNIFICANT WETLAND

CANTEEN

WASHROOMS

EXISTING GSSC LIFT STATION NO.10

GOULD STREET EXTENSION

STORM INPUT No.3

STORM INPUT No.2

LAGOON

CLOSE PROXIMITY TO SANITARY SEWER

PLACE BEAU LIEUX

EXISTING SANITARY SEWER FORCEMAIN

STORM INPUT No.4

WILLIAM AVENUE

MacKENZIE AVENUE

MILLOCK AVENUE

BRYGES STREET

LIVINGSTONE LANE

AREA WHERE STORM SEWER CROSSES FORCEMAIN AND SANITARY SEWER

EXISTING SANITARY SEWER FORCEMAIN

EXISTING SANITARY SEWER MAIN

MAIN PARK ENTRANCE

GOULD BEACH ROAD

VISTA STREET

KING GEORGE STREET

PRINCESS STREET

BAY DRIVE

EVERGREEN STREET

PARLEE

NOTES

NO.	DATE	REVISIONS	BY	APPR.
A.1	FEB 11/19	ISSUED FOR FINAL REPORT	JMB	CJG
A.0	DEC 21/18	ISSUED FOR DRAFT REPORT	JMB	CJG

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PROJECT TITLE

PARLEE BEACH TIDAL CHANNEL ASSESSMENT STUDY

SHEDIAC N.B.

DRAWING TITLE

STORM / SANITARY CROSSING

Scale: 10m 0 20m (1:1000 FULL SCALE)

Drawn By	Design By
TWA	CJG
Checked By	Cadd Check
CJG	TWA

Sheet 7 of 11

File Name: 18292-00P-C07

Drawing No.: 18292-00P-C07

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4 Existing Central Culvert

4.1 Condition Assessment

An existing 1,200mm diametre culvert is located between the tidal channel and lagoon to provide a vehicle exit from the north beach parking areas, as shown on Overall Site Plan Drawing C01, Appendix A. The existing culvert, as shown in **Figure 2-5 (p.14)** and **Figure 4-1**, is a corrugated steel pipe (CSP) installed in 2009.

Most CSP failures are due to corrosion of the wetted perimeter, however, during the inspection, it was difficult to determine if the culvert bottom was corroded as it was covered by 400mm of sediment and was also submerged. It was observed that the existing culverts have minor deformation with a more oval shape and surface corrosion. Condition of the submerged section could not be evaluated during this study.

Figure 4-1: Inside Photo of Central Culvert

The present culvert condition was evaluated to be in fair condition and is presently 40% full of sediment. It should also be noted that in the saline conditions CSP has a 20-year life, as a result, this culvert will likely need replacment, based on structural condition alone, by 2029.

4.2 Hydraulic Design Requirements

4.2.1 Drainage Area

The drainage area was determined based on contours created using LiDAR data with the design characteristics as follows:

- Total Area of the Lagoon Basin: 11.6 ha
- Flow Path Length: 460 m
- Highpoint Elevation: 10.86 m
- Low Point Elevation: 0.00 m
- Calculated Slope: 2.36
- C Value: 0.40

4.2.2 Time of Concentration

Time of concentration was calculated using the Bransby-Williams equation and was determined to be 17 minutes.

4.2.3 Rain Fall Intensity

Rainfall intensities were based on the concentration-time calculated from the Bransby-Williams and were selected from the Moncton International Airport Rainfall IDF from Environment Canada.

4.2.4 Peak Rainfall Run Off Flow Calculations

Peak flow volumes were calculated for various storm event return periods using the rational method.

Return Period	*Rainfall Flow*
2 Year	0.53 m^3/s
5 Year	0.749 m^3/s
10 Year	0.905 m^3/s
25 Year	1.060 m^3/s
50 Year	1.202 m^3/s

100 Year	1.357 m³/s
100 Year + 20%	1.629 m³/s

4.2.5 Tide Water Volume and Flow

In addition to the rainfall flow, a theoretical flow based on complete emptying of tidewater from the lagoon was calculated.

Tidewater volume was calculated/determined by comparing surfaces within AutoCAD. Surfaces were created at max observed high tide in the channel (1.0m) and at the outlet culvert invert (-0.1m). A volume comparison was then carried out between these surfaces and the hard bottom bathymetric survey. The difference between these volumes was determined to be the volume of tidewater to be drained during a tide cycle.

A theoretical flow was calculated by dividing the calculated volume by the length of time required to complete half (high to low) of a tide cycle. Tide cycle time was taken from Environment Canada data, in this case, a tide cycle time of 18.6 hours was selected and then cut in half to get 9.3 hours.

- Tide Water Volume (Lagoon Only): 7,741 m³
- 0.5 Tide Cycle Time: 9.3 hours → 558 minutes → 33,480 seconds
- Tidal Flow: 7,741 m3 / 33,480 seconds = 0.231 m³/s

4.2.6 Design Flow

The design flows used in the preliminary sizing of the culvert crossing were based on the sum of the Peak Rainfall Run Off Flow and the Flushing Flow of the Lagoon for each storm event.

Return Period	*Rainfall Flow*	*Tide Water*	*Design Flow*
25 Year	1.060 m³/s	0.231 m3/s	1.291 m³/s
50 Year	1.202 m³/s	0.231 m3/s	1.433 m³/s
100 Year	1.357 m³/s	0.231 m3/s	1.589 m³/s
100 Year + 20%	1.629 m³/s	0.231 m3/s	1.860 m³/s

We would recommend that the minimum culvert hydraulic capacity be based on the 1 in 100-year flow plus 20%, or 1.860 m3/s.

4.3 Existing Hydraulic Capacity

The existing culvert is partially submerged and is 40% full of sediment. Examining the profile on Drawing C04, Appendix A, the channel water level is controlled by the inlet elevation of +0.2m, consequently, this is also where the water and sediment levels settle during low tide. The profile also illustrates that the existing culvert is back graded towards the lagoon.

Using the HY-8 Culvert Hydraulic Analysis Program, we find that this pipe has a capacity of 1.3 m3/s. This capacity equates to a 1 in 25-year to 1 in 50-year storm event, based on allowing the headwater to increase to 0.300 m above the existing top of culvert. This is reduced to a 1 in 10-year storm if the condition is set to not overtop the existing culvert.

During site observations it was noted that the limited opening of the culvert appears to impede on the natural mixing of the water from the upstream "Lagoon" to the downstream "Channel". The flow levels were studied using the level logger data (October to November), during this time the maximum rain event observed on November 3rd, 2018 shown on **Graph 5-1** was when 38.4mm of precipitation fell, equalling less than a 1 in 2-year event. This relatively small event did not produce enough flow to examine the culvert capacity and the lagoon and channel levels were observed to rise and fall at the same rate.

Given the above information, the existing culvert has the theoretical capacity to maintain flow up to a 1 in 50-year storm event, however, on site it was observed that the water quality from between the channel and lagoon differed. The natural mixing between the two bodies of water using the existing culvert is not as good as if the culvert was removed. As a result, a wider span through this section would improve the natural flow of the estuary and reducing organic build-up in the lagoon.

4.4 Central Culvert Replacement Options

Due to the condition of the existing culvert, its remaining life expectancy, and to restore a more natural mixing flow between the lagoon and channel, it is recommended that the existing CMP culvert, located within a Provincially Significant Wetland, and with limited natural flow, be considered for an upgrade with the following options:

- A bridge with an open span of minimum 5 m;
- A concrete arch culvert with an open span of minimum 4.2 m wide (Shawspan);
- A multiple concrete box culvert minimum 3.6 m wide (twin 1,800mm by 1,200mm) designed for fish passage.

As previously mentioned, the culvert was installed to provide a vehicle exit from the north beach parking areas. During construction, a traffic management plan would be necessary to ensure an alternate route to exit the Park. Also, the culvert replacement should be performed outside of the tourism season to minimize the effect on the beach season.

At this stage, we estimate the culvert installation would require both an Environmental Impact Assessment (EIA) and a Watercourse and Wetland Alteration Permit (WAWA) before the commencement of construction as this is within the Provincially Significant Wetland (PSW).

Preliminary order of magnitude budget cost for each option is as follows:

- Option No. 1 - 2 X Concrete Box Culvert 1,800mm (W) by 1,200mm (H)= **$450,000 +HST**
- Option No. 2 – 4.2 m Wide Precast Concrete Arch (Shawspan) = **$600,000+HST**
- Option No. 3 – 5 m Wide Concrete Bridge = **$800,000+HST**

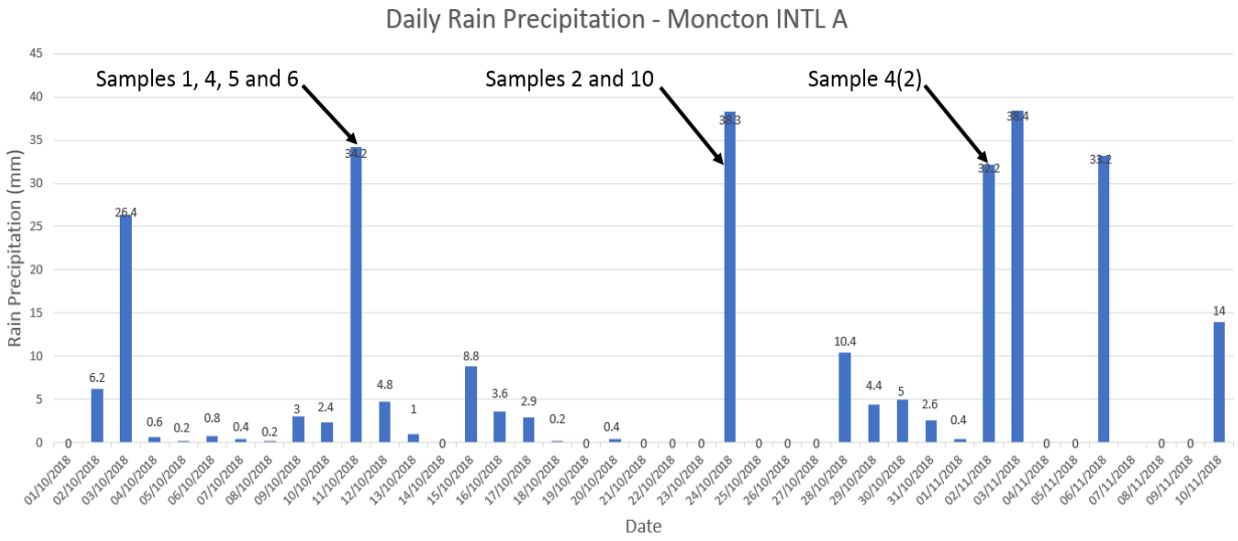
*Above cost includes engineering and environmental applications. Costs should be revaluated once geotechnical information is available.

5 Water Quality and Soil Testing

5.1 Channel and Lagoon Water and Soil Sampling

5.1.1 Water and Soil Sample Collection

Water sampling was carried out during rainfall events, indicated in Graph 5-1, for all the pipes that discharge in the channel and lagoon. Sterile 250ml PET Boston round bottle was utilized to collect the water sample for each pipe discharging in the lagoon. The water samples were kept cool in a cooler and transported and delivered the same day to the RPC Laboratory in Moncton, New Brunswick. Samples were analyzed for E. coli and Enterococci with the Most Probable Number (MPN/100 millilitres).



Graph 5-1: Daily Recorded Precipitation

Soil sampling from the lagoon sediment was also completed in October 26, 2018. A strong odour emanated from the sediment while taking samples from the bottom of the channel. The sediment samples had a dark black colour. 500ml amber glass container was utilized to collect the soil sample at two (2) different locations, see **Drawings 18292-00P-C03 (p.24)**.

Sediment was sampled from the first 5 cm below the surface of sediment similar to the sediment sampled from the Parlee beach Water Quality Report, April 2018.

The soil samples were also analyzed for E. coli and Enterococci with the Most Probable Number (MPN/g).

5.1.2 Water and Soil Sample Location

Samples location where prioritized by input sources to the Lagoon/Channel as described in section 2 and on **Drawings 18292-00P-C03 (p.24)**. The main objective was to collect a sample at the initial runoff during a precipitation event so that stormwater could be collected directly from the input source without being contaminated with the lagoon or channel water.

Storm pipe No. 3, 7 and 8 areas were not able to be sampled during the site visits as they were completely submerged. Pipe 7 and 8 could be visually inspected as these were short storm sections draining the north parking area "D", as shown on **Figure 2-9 (p.16) and Drawings 18292-00P-C03 (p.24)**. Storm No. 3 serviced the same parking area "A" drainage area as Storm no. 4. Additional investigation from these input sources shall be required to confirm all inputs to the lagoon.

Sediment was collected from the first 5 cm of the top of the sediment layer in the channel at the pedestrian bridge crossing and just in front of the Parlee Beach Sanitary Lift Station Outfall. From the Bathymetry survey, these areas were measuring the most significant depth of organic sediment material.

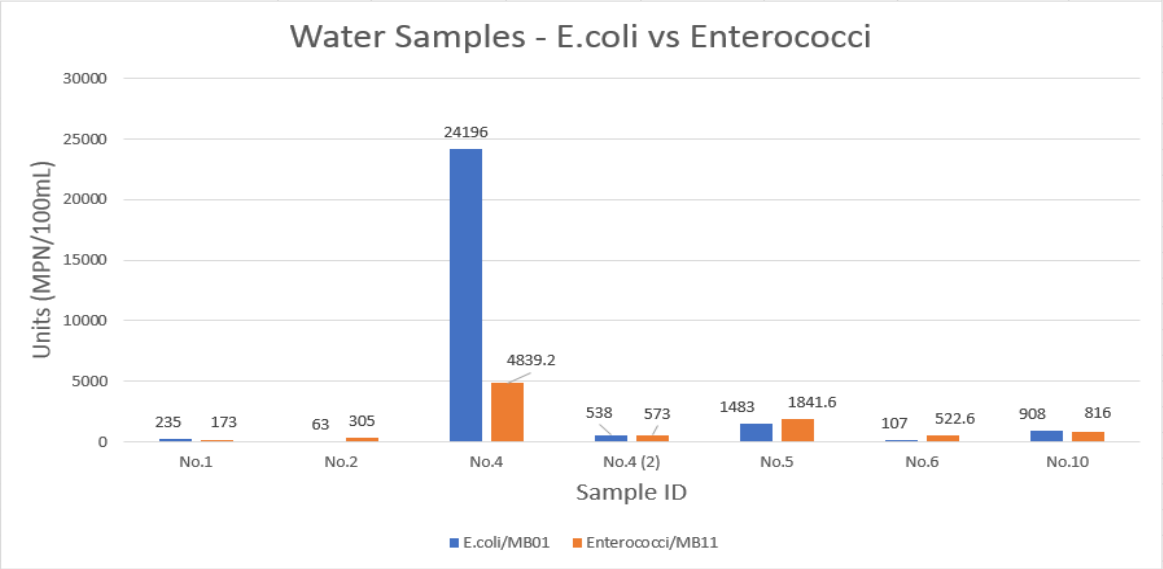
5.1.3 Lab Testing Result and Discussion

Water samples were delivered to the RPC laboratory in Moncton, NB for water samples and Fredericton, NB for the sediment sample analysis. Results are summarized in **Table 5-1, Graph 5-2 and 5-3.**

As described in the Parlee Beach Water Quality Report by the Steering Committee for Parlee Beach Water Quality, dated April 2018, bacteria such as E. coli and enterococci are not uncommon in a natural watercourse, however, the Guidelines for Canadian Recreational Water Quality have established guidelines for these types of fecal contaminants. A single sample maximum value for E. coli and enterococcus becomes a protentional health risk when it exceeds 400 and 70 MPN/100ml respectively.

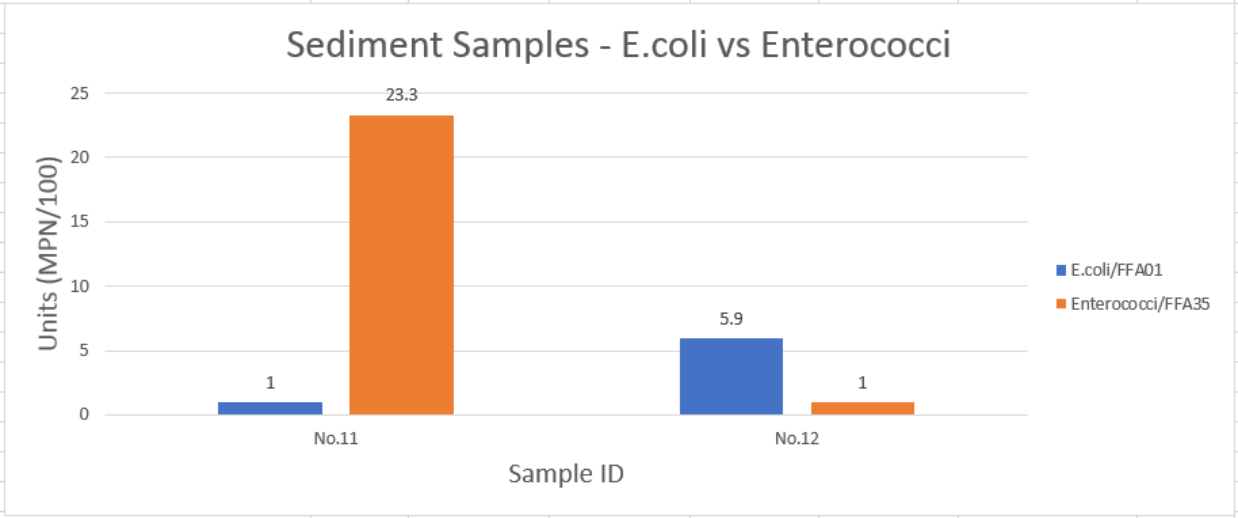
Table 5-1: Summary of Lab Testing Results

Water Samples						
Type of Sample	Sample ID	Date Collected	Time Sampled	Units	Analysis/Method	
					E.coli/MB01	Enterococci/MB11
Water sample @ Central Culvert	No.1	11-Oct-18	1:00:00 PM	MPN/100mL	235	173
Water sample @ Storm Outfall	No.4	11-Oct-18	1:05:00 PM	MPN/100mL	>24196	>4839.2
Water sample @ Storm Outfall	No.5	11-Oct-18	1:10:00 PM	MPN/100mL	1483	1841.6
Water sample @ Storm Outfall	No.6	11-Oct-18	1:15:00 PM	MPN/100mL	107	522.6
Water sample @ Storm Outfall	No.2	24-Oct-18	10:30:00 AM	MPN/100mL	63	305
Water sample @ Mid Channel	No.10	24-Oct-18	10:45:00 AM	MPN/100mL	908	816
Water sample @ Storm Outfall	No.4 (2)	2-Nov-18	10:00:00 AM	MPN/100mL	538	573
Sediment Samples						
Type of Sample	Sample ID	Date Collected	Time Sampled	Units	Analysis/Method	
					E.coli/FFA01	Enterococci/FFA35
Sediment sample @ Sanitary Overflow	No.11	26-Oct-18	12:00:00 PM	MPN/g	<1	23.3
Sediment sample @ Mid Channel	No.12	26-Oct-18	11:05:00 PM	MPN/g	5.9	<1



Graph 5-2: Summary of Water Sample Results

Sampling results identified four (4) out of the eight (8) water samples collected to contain E. coli counts higher than the Guidelines for Canadian Recreational Water Quality of 400 MPN/100ml (Sample 4, 5, 10 and 4(2)). Sample 4(2) was collected to confirm the first sample (4) as this sample was result was considerably high. Sample No. 4 was taken at the beginning of the rain event on October 11th, 2018 whereas the sample No. 4(2) was taken midway through the rain event of November 2, 2018. All sample locations are shown on **Drawings 18292-00P-C03 (p.24)**.



Graph 5-3: Summary of Sediment Sample Results

Table 5-2 summarizes selected samples relevant to this lagoon collected in 2017 from The Parlee Beach Water Quality Final Report (April 2018). The exact locations of sample within the pond is not described in report, only a general area of the "pond" or as referred herein as the "lagoon".

Table 5-2: Summary Parlee Beach Water Quality Final Report - Lagoon Tests

Water Samples					
Type of Sample	Sample ID	Date Collected	Units	Analysis/Method	
				E.coli	Enterococci
Lagoon Water sample	SED4	6-Sep-17	MPN/100mL	>10,000	>24,196
Storm Water Sample	SW6	21-Aug-17	MPN/100mL	<400	<2,500
Storm Water Sample	SW6	22-Sep-17	MPN/100mL	<400	<1
Storm Water Sample	SW6	10-Oct-17	MPN/100mL	<400	≈500
Sediment Samples					
Type of Sample	Sample ID	Date Collected	Units	Analysis/Method	
				E.coli	Enterococci
Lagoon Sediment Sample	SED3-A	6-Sep-17	MPN/g	13	≈7
Lagoon Sediment Sample	SED3-A	30-Oct-17	MPN/g	≈7	13

Comparing results from this study with samples tested in 2017 with the Parlee Beach Water Quality Final Report there are some similarities to the sediment results. Sediment in both studies did not show high counts of E. coli or Enterococci. Both studies resulted in one extremely high-

water result, however, it is not clear where this sample from 2017 was taken in relation to the lagoon.

This study (2018) focused on the input sources (i.e. storm systems collecting surface water runoff). The Parlee Beach Water Quality Final Report suggested, based on results, that the high bacterial counts are related to the surface water runoff. This was also understood from this study as the samples with the highest counts were collected from pipes that collect surface runoff from the 11.6 ha (drainage basin discharging to the lagoon shown in **Drawing 18292-00P-C06 (p.36)**

5.2 Examination of Water Sample from the Potable Water Wells

Crandall has taken a sample from each potable water well of the homes neighbouring the channel to the South. The houses were mainly on St. John Street, however, selected homes on Beach Street, Church Street, Downey Street and Agnew Lane were also included. The water samples were analyzed for Total Coliforms and E. Coli. A total of 30 potable water wells that serve 32 houses were analyzed during that project. The water sample results were then matched with the Civic address specific potable water well and put on a drawing to have a better understanding of the effects. **Upon review, there was no E. Coli present, and no significant presence of Total Coliforms in all 30 potable water wells that were analyzed.**

5.3 Summary

Overall, water samples collected indicate levels of E. coli and enterococci, above the Guidelines for Canadian Recreational Water Quality, are present within the natural watercourse and entering via the input sources identified. However, there is no apparent E. coli or enterococci within the sediment sampled. Further investigation is warranted upstream from these input sources.

6 Conclusion and Recommendations

6.1 Channel and Lagoon Hydraulics

1. The channel and lagoon do not presently completely flush due to sediment accumulation that has created a high point at the opening of the channel as well as the large shallow sandbar leading to the Northumberland Strait.
2. The high point in the channel near its outlet has led to an accumulation of organic sediment material in the channel and lagoon below the elevation at the inlet.
3. The sediment was tested for E. coli and enterococci and these levels were below the limits of recreational water quality described in Section 3.
4. Given that there is no significant contamination of the sediment, the filling of the channel and lagoon is not justified given that this area is a Provincially Significant Wetland (PSW).
5. Dredging the outlet of the channel to allow for a free flow from the lagoon to the Strait would require the outlet bottom elevation to be -0.4 m geodetic. This would require dredging in the Northumberland Strait approximately 600 m.
6. Due to the longshore drift rates, shallow trench, large sandbar, geography and use of this recreational area, the channel would need to be evaluated for re-dredging each year to maintain inlet flow.
7. Based on a delay in rising tides, we have found that there is a restriction at the inlet based on the delay in rising tide from the Northumberland Strait to the channel due to the narrowing and shallowness of the inlet.

Recommendations:

1. *Evaluate the feasibility of removing or moving back the existing rock structure at the mouth of the channel. It is recommended that NBDTHC obtain legal advice on the responsibilities for this given it was constructed by a private landowner.*

2. *At this time, we have found that the existing sediment should remain in place as there is no apparent advantage to dredging out this material.*

3. *Continue monitoring the water quality and the sediment for contamination on a quarterly basis (except winter) and revisit the recommendations after a 3-year data collection program. The monitoring program could be added to the already existing Parlee Beach Steering Committee or local watershed program for water quality monitoring, however, focus on the storm water discharging into the channel after precipitation events, particularly during the Spring/Summer months.*

6.2 Central Culvert

8. The existing culvert was constructed in 2009 and has the theoretical hydraulic capacity for a 1:50 year storm.
9. The existing culvert is 40% full of sediment and limits the natural flushing from the lagoon to the channel. A new structure with a larger opening would improve complete flushing.

Recommendations:

1. *Replace the existing culvert with a box culvert or concrete arch with an opening width of minimum 3.6 m.*
2. *We estimate this order of magnitude cost at $600,000 + HST.*

6.3 Input Sources to Lagoon

10. A total of seven (7) pipes were found to discharge storm water to the lagoon from the Parlee Beach parking lot or the Pointe-du-Chêne residential / cottage area.
11. In some cases, the flow from these pipes were found to contain E. coli. and/or enterococci exceeding the Guidelines.
12. There are no stormwater treatment devices on any of the pipes discharging to the lagoon.

Recommendations:

1. *Perform a detailed stormwater system study to identify sources of contamination in these lines with video inspection and smoke testing.*
2. *Install a stormwater treatment device on all pipes discharging to the PSW. Consider combining some lines where possible. This could also include a sedimentation basin and treatment before discharging to the environment.*
3. *Consider constructing small berms around the lagoon perimeter to reduce the amount of surface water flowing from the parking area directly into the lagoon. This would allow to have this water go through stormwater treatment prior to discharge.*
4. *We estimate the cost of the stormwater study at $25,000. This will permit to estimate the work required and the cost for proper stormwater management and treatment.*

6.4 Sanitary Sewer Services

13. Homes along the Channel were all confirmed to be serviced by the Greater Shediac Sewerage Commission.
14. There was no visual indication of sanitary services discharging to the watercourse.
15. All potable water wells along the watercourse were also sampled for E. coli levels and Coliform. Samples all indicated no E. coli and only small traces of coliform.

Recommendations:

1. *None*

6.5 Land Ownership

16. Records indicate no existing easement above the highwater mark across the dunes through private property parcels (PID 70464888, 70287461 and 01049980).

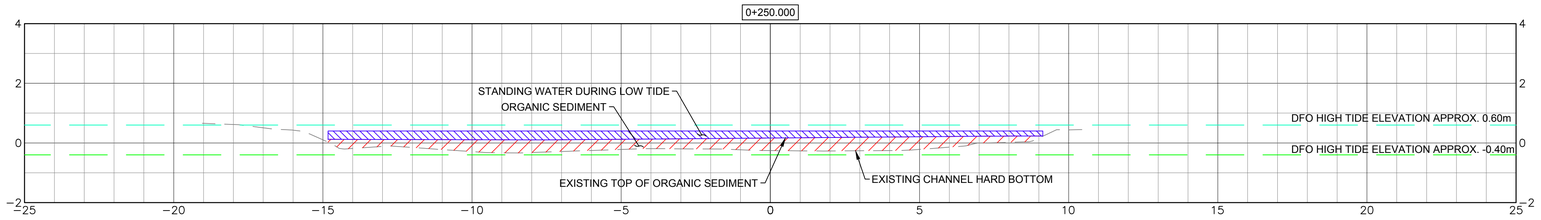
17. There are no records of any permits obtained for the rock wall at the mouth of the channel.

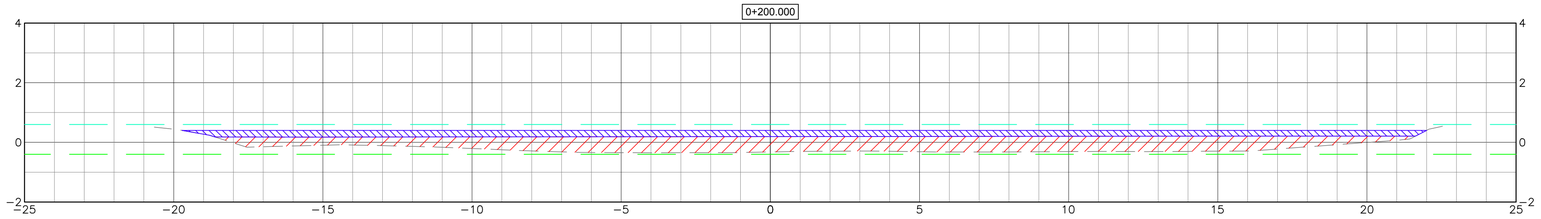
Recommendations:

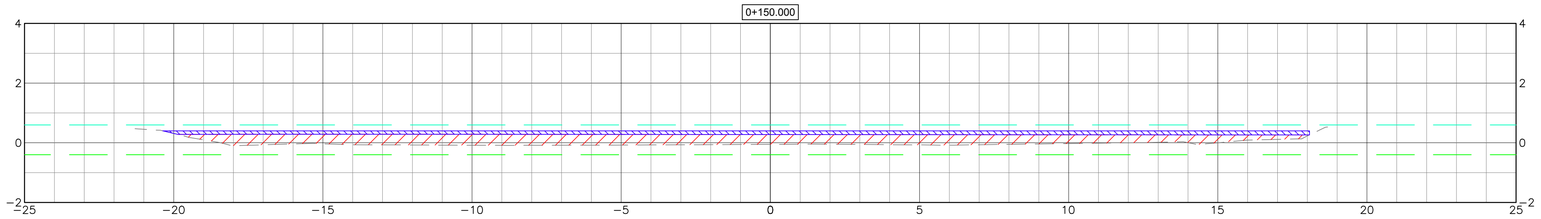
1. *Consider obtaining an easement through the private properties.*
2. *A License of Occupation should be registered so that all channel maintenance activities can be performed below the high-water mark.*

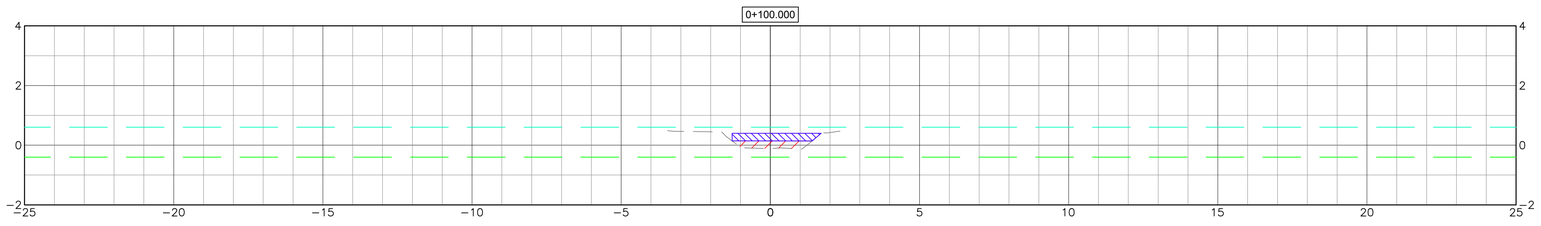
Appendix A:

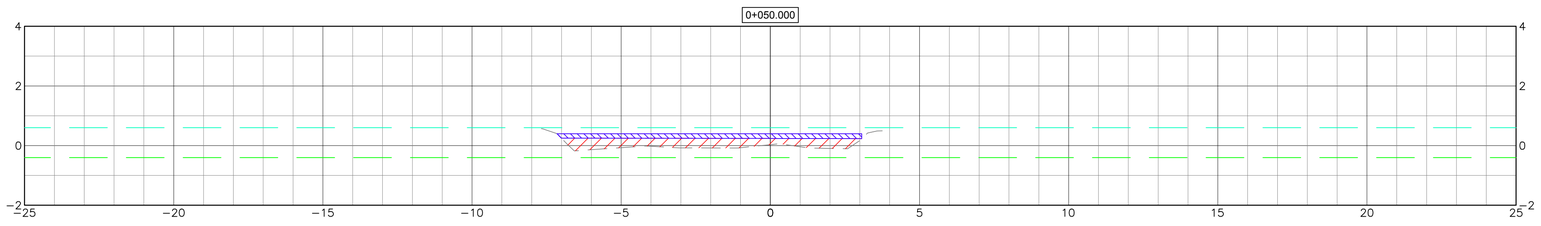
Drawings 18292-00P-C08 to C11 (Cross Sections)











SECTION LEGEND

- EXISTING HARD BOTTOM
- EXISTING TOP OF SLUDGE
- DFO HIGH TIDE (APPROX. 0.60m)
- DFO LOW TIDE (APPROX. -0.40m)

NOTES

NO.	DATE	REVISIONS	BY	APPR.
A.1	FEB 11/19	ISSUED FOR FINAL REPORT	JMB	CJG
A.0	DEC 21/18	ISSUED FOR DRAFT REPORT	JMB	CJG

New Nouveau Brunswick CANADA

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DATE PLOTTED: Feb 11, 2019
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PROJECT TITLE

PARLEE BEACH TIDAL
CHANNEL ASSESSMENT STUDY

SHEDIAC N.B.

DRAWING TITLE

CHANNEL CROSS SECTIONS
STA. 0+050 TO STA. 0+250

Scale	Drawn By	Design By
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	Checked By	Cadd Check
	CJG	TWA
	Sheet 8 of 11	

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Drawing No.
18292-00P-C08

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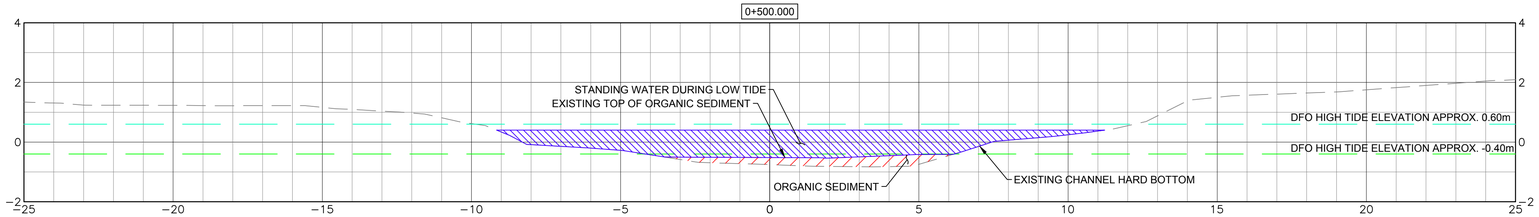

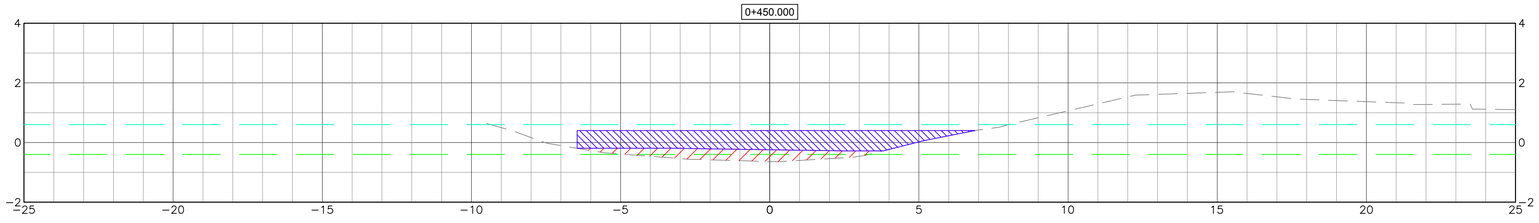

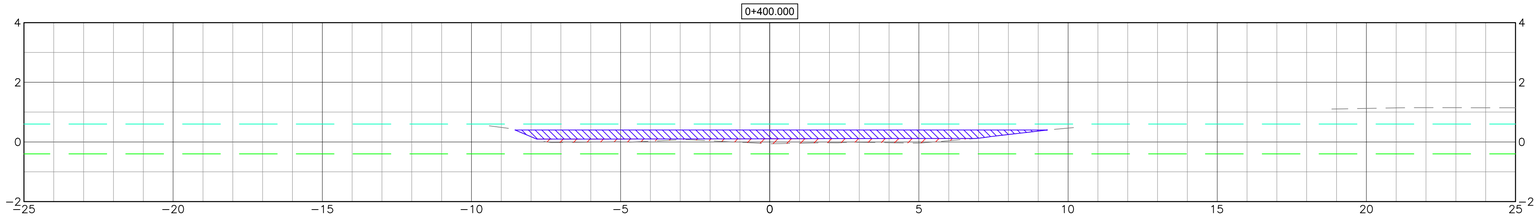

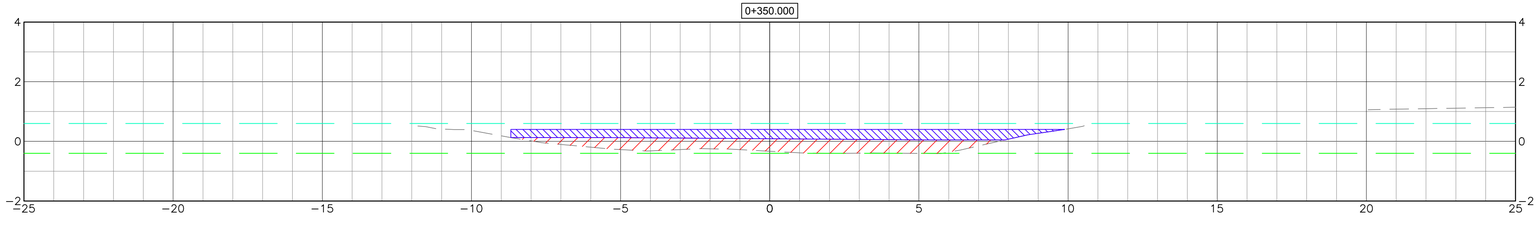

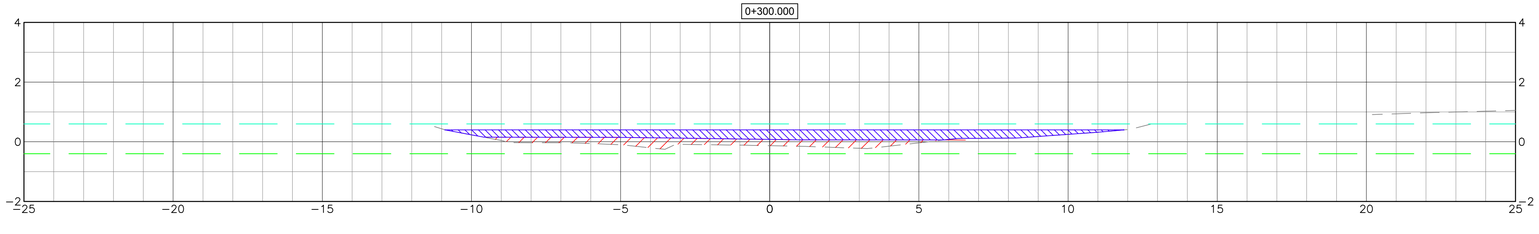

SECTION LEGEND

EXISTING HARD BOTTOM

EXISTING TOP OF SLUDGE

DFO HIGH TIDE (APPROX. 0.60m)

DFO LOW TIDE (APPROX. -0.40m)

NOTES

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A.1	FEB 11/19	ISSUED FOR FINAL REPORT	JMB	CJG
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PROJECT TITLE

PARLEE BEACH TIDAL CHANNEL ASSESSMENT STUDY

SHEDIAC N.B.

DRAWING TITLE

CHANNEL CROSS SECTIONS STA. 0+300 TO STA. 0+500

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	Checked By: CJG	Cadd Check: TWA
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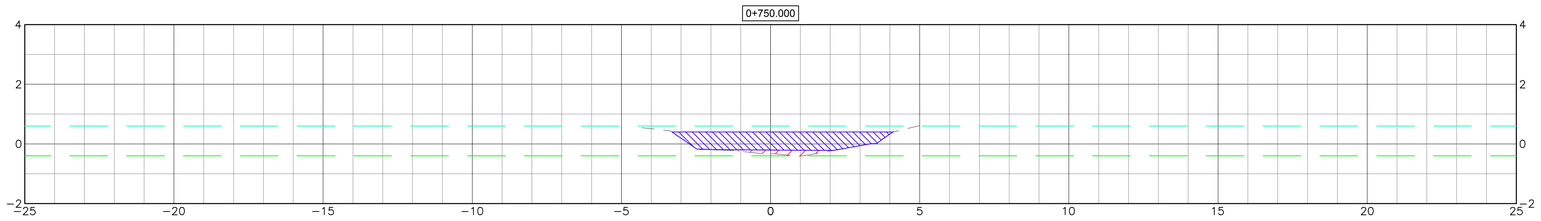

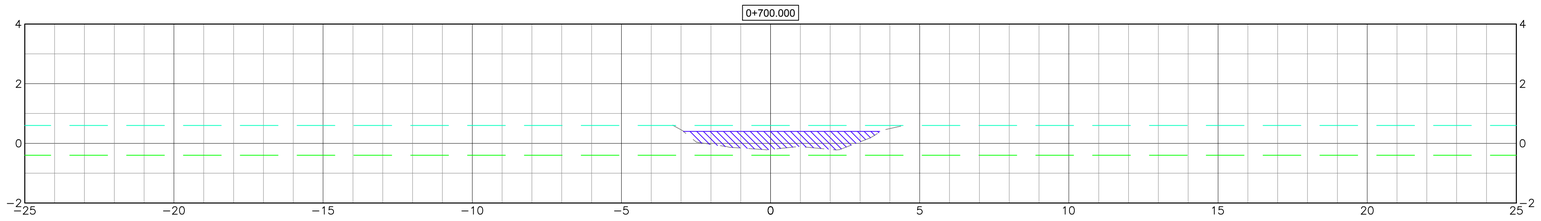

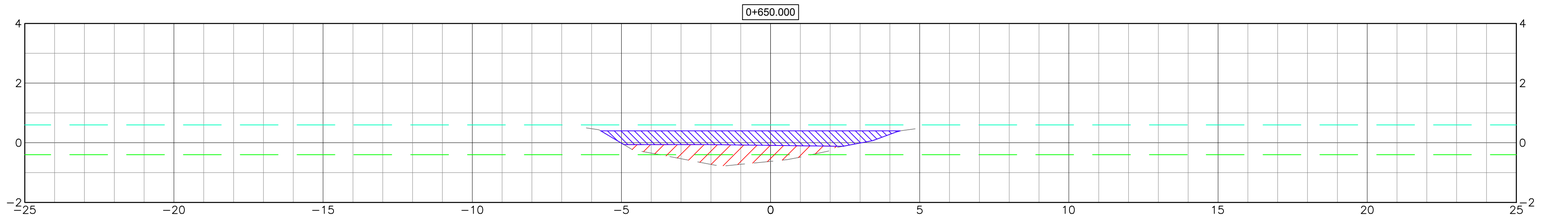

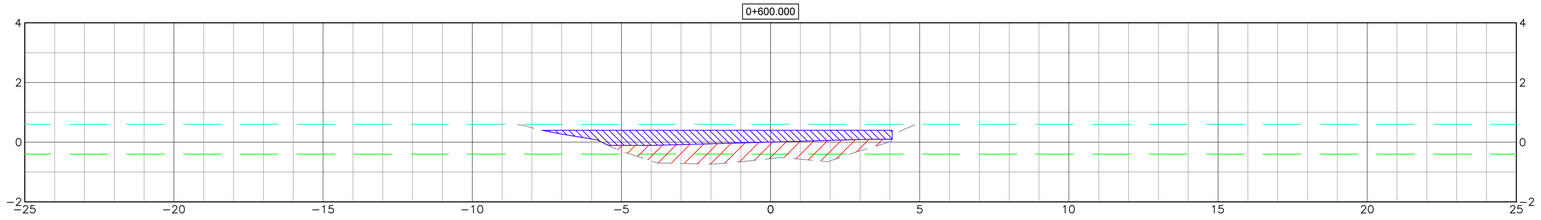

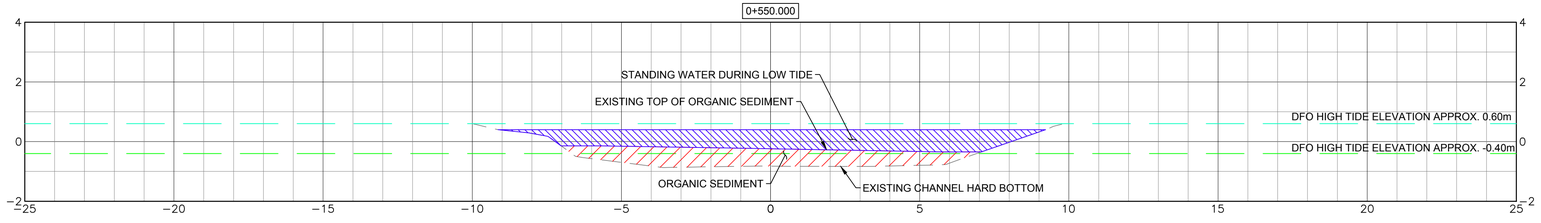

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DFO LOW TIDE (APPROX. -0.40m)	

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CHANNEL ASSESSMENT STUDY

SHEDIAC N.B.

DRAWING TITLE

CHANNEL CROSS SECTIONS
STA. 0+550 TO STA. 0+750

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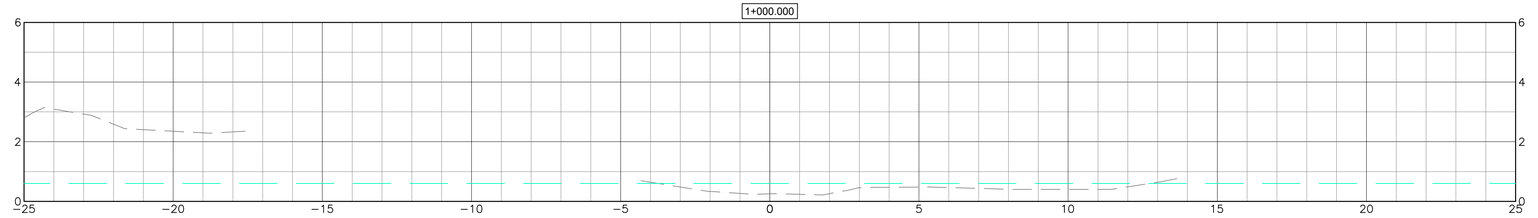

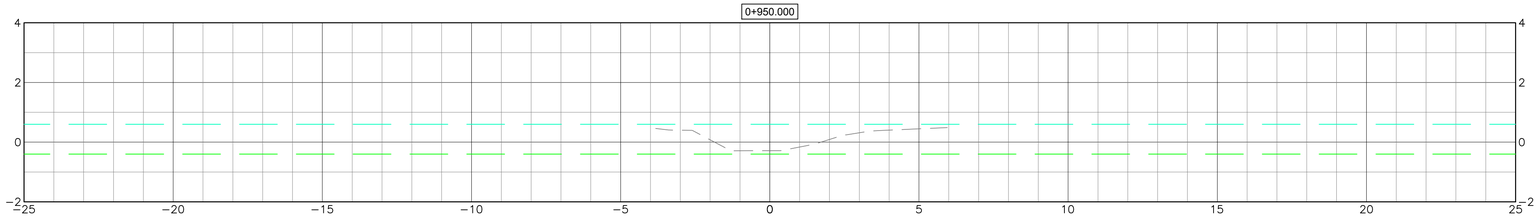

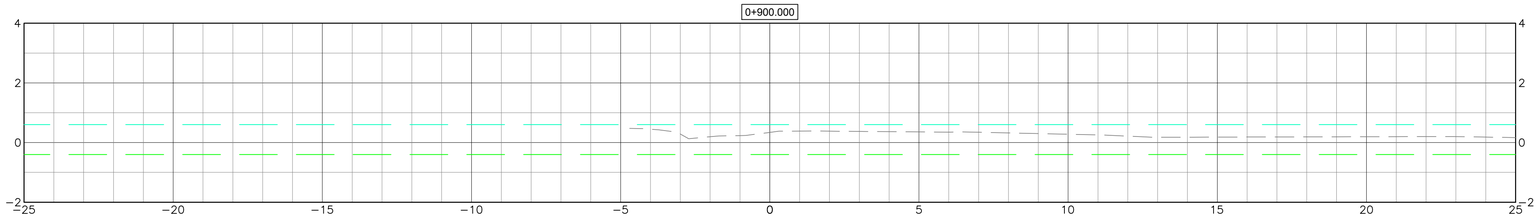

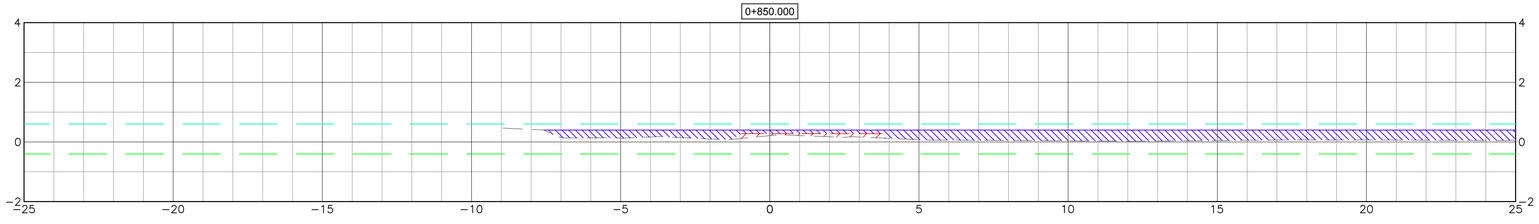

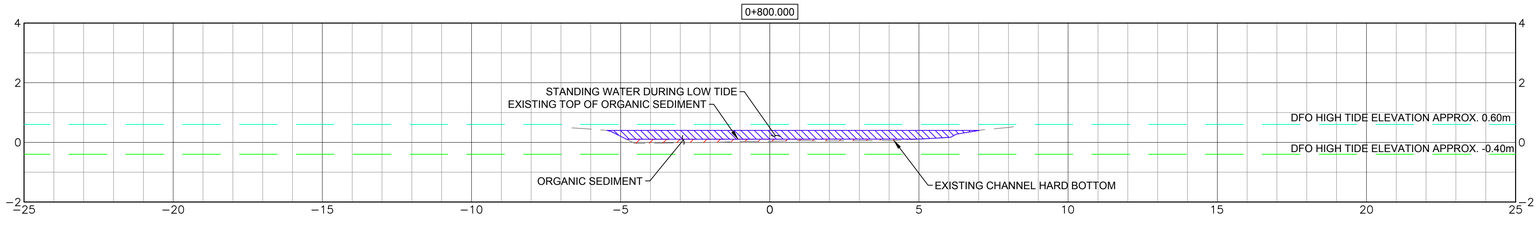

SECTION LEGEND
EXISTING HARD BOTTOM
EXISTING TOP OF SLUDGE
DFO HIGH TIDE (APPROX. 0.60m)
DFO LOW TIDE (APPROX. -0.40m)

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CHANNEL ASSESSMENT STUDY

SHEDIAC N.B.

DRAWING TITLE

CHANNEL CROSS SECTIONS
STA. 0+800 TO STA. 0+1000

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Appendix B:

Aerial Photos


1953


1963


1976


1982


2001


2012


2017