PETITCODIAC RIVER CAUSEWAY PROJECT
STAGE 2 FOLLOW-UP PROGRAM RESULTS

YEAR 11 EXECUTIVE SUMMARY

Submitted to:

New Brunswick Department of Transportation and Infrastructure
Fredericton, New Brunswick

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TABLE OF CONTENTS

PAGE

1.0 INTRODUCTION

1.1 Purpose

This document is a summary of the results of Year 11 (April 1, 2020 – March 31, 2021) of the Stage 2 Follow-up Program (S2FUP) for the Petitcodiac Causeway Project (the "Project"). Year 11 results are compared to baseline conditions established during the Stage 1 Follow-up Program with respect to predictions and conclusions contained in the Environmental Impact Assessment (EIA) and provide a measure of the effectiveness of mitigation measures undertaken in Stage 1. The predictions and conclusions contained in the EIA are generally focused on conditions that will be present following completion of Stage 3. Thus, it is not possible to verify these during Stage 2 of this three stage Project. This document focuses on how the environmental effects observed during Year 11 of Stage 2 are trending as compared to the EIA predictions and conclusions specific to Stage 3 and beyond. The document presents the findings and conclusions relevant to the six Valued Ecosystem Components (VECs, see Section 1.4).

For a comprehensive description of background, methodology, references, program modifications and a more detailed presentation of the results the reader is encouraged to refer to the main report, Stage 2 Follow-up Program Results for the Petitcodiac River Causeway Project Year 11 (April 1, 2020 – March 31, 2021) which is available from the New Brunswick Department of Transportation and Infrastructure (NBDTI) by contacting the Communications Director.

1.2 Follow-up Program Objectives

The S2FUP objectives are to:

- examine trends in environmental conditions for selected VECs to determine how environmental conditions are trending compared to the environmental effects predictions in the EIA;
- verify the effectiveness of mitigation measures to protect physical works installed during Stage 1;
- provide an early indication of any unexpected change in environmental conditions; and
- improve understanding of environmental cause and effect relationships.

1.3 Transitioning from Stage 2 to Stage 3 Follow-up Program

Stage 2 was originally planned for at least two full seasons before proceeding with Stage 3. Although the exact Stage 2 duration was never specified, it is implicit in the EIA that Stage 3 would be initiated after two years of Stage 2, assuming the above-mentioned objectives had been satisfied. The implementation of Stage 3 had been delayed for reasons that are not related to the environmental effects that have occurred since the opening of the gates on April 2010. Thus, the S2FUP program data collection continues to complement and support the results and conclusions of the first two years intended for the duration of Stage 2.

On December 16, 2016, the provincial government announced funding for Stage 3 of the Project, which includes the construction of a new bridge. Bridge construction began in May 2017 and is scheduled to be complete in 2022.

1.4 Scope

The S2FUP focuses on six VECs:

- Physical Characteristics of the Petitcodiac River and Estuary;
- Commercial Fisheries;
- Archaeology;
- Public Health and Safety – Surface Water;
- Fish Passage; and
- Engineered Environmental Protection Works.

1.5 Regulatory Context

The EIA required a Follow-up Program that would satisfy the objectives presented above. The S2FUP is a key component of the Environmental Management Plan (EMP) and is required as per Condition of EIA Approval #4 (CoA4). The S2FUP is divided into phases that correspond with the Implementation Plan, as per CoA5 and has been, and will continue to be, submitted to the New Brunswick Department of Environment and Local Government (NBDELG) for review and approval when required. The S2FUP is also required under the Canadian Environmental Assessment Act (CEAA) as a condition of the CEAA Screening undertaken by Fisheries and Oceans Canada (DFO). A Technical Review Committee (TRC), comprised of federal and provincial agency and department representatives, presided over the EIA process. The TRC was co-chaired by NBDELG, with DFO acting as the Federal Lead Responsible Authority. A similar TRC, chaired solely by NBDELG with input from DFO, was assembled to preside over the implementation of the Project.

1.6 Year 11 Activities Completed

A summary of activities completed in Year 11 is provided in Table 1.1.

Table 1.1 Summary of Stage 2 Follow-up Program Activities Completed in Year 11

Program Component	Activities
Physical Characteristics of the Estuary Follow-up Program	• Vertical-stereo aerial photos. • Cross-sections (hydrographic surveys downstream and in Shepody Bay supplemented with LiDar upstream and downstream to Line 19). • Periodic fixed wing flyovers (ice monitoring, spring break-up, weather events). • Monthly cross-sections at Gunningsville Bridge. • Visual reconnaissance as required (max. ice accumulation, max. flows from land in spring and fall, max. sediment accumulation). • Monitoring of water level meters (3) and web cameras (3).
Engineered Land Protection Works Follow-up Program	• Regular inspections of traffic circle/starter dyke and related outfalls. • Inspection of shoreline protection.
Fish Passage and Fish Habitat Follow-up Program	• Picket trap operation. • Smolt wheel operation. • Electrofishing. • Redd survey. • Smelt survey.
Follow-up Program Reporting	• Annual Reporting to TRC.

2.0 PHYSICAL CHARACTERISTICS

2.1 Objectives

The objective of this component is to monitor and measure changes to the Petitcodiac River (“the River”), the Petitcodiac Estuary (“the Estuary”), and the Upper Bay of Fundy (“the UBoF”) after gate opening to understand effects on width, depth, and other physical characteristics as compared to baseline conditions.

2.2 Results

2.2.1 Aerial Photographs

Aerial photographs were obtained in the Fall of 2020. A summary of the observed changes to the estuary are:

- Near the control structure: The detour and work area for the new bridge construction are apparent.
- The area immediately upstream of the causeway is being developed as a disposal area for material excavated from the new channel under the bridge.

- The reach downstream of the new Gunningsville Bridge: the River is shifting slightly to the east in the vicinity of the large tidal flat at Outhouse Point. The bank has approached the area where water was ponding on the tidal flat and has drained this pond since 2015.
- in the area of the GMSC outfall, since 2015, the bar forming in the River upstream of the outfall has enlarged, moving downriver past the outfall and there has been some erosion of the newly formed tidal flat on the east side of the River.
- Immediately downstream of the GMSC outfall, the large mid-channel bar and the ebb and flood channels are less pronounced in 2020, the bar having shifted more to the south side of the channel.

2.2.2 Cross-sections

All references to "right" or "left" are taken as looking upstream.

A full set of hydrographic surveys were carried out downstream of the causeway in 2020. The next scheduled hydrographic survey is Fall 2021 to accommodate the bridge construction schedule. LiDAR surveys downriver to line 19 were also carried out in 2020.

As during Stage 1 and the subsequent Stage 2 program, cross sections were surveyed approximately once a month in 2020 at the Gunningsville Bridge.

2.2.2.1 Upper Bay of Fundy (downstream of the causeway)

Surveys were carried out in 2020 and the next field work is scheduled for the Fall of 2021 to complement the new bridge construction schedule .

2.2.2.2 Thalweg

The fluctuation in bed elevation in 2020 was similar to 2019, at about 1 – 2 m with perhaps slightly more erosion on the left Moncton side of the channel. The bed was about a metre higher in 2020 possibly as a result of extremely low river flows in 2020.

2.2.2.3 Development of the Scour Hole

Upstream of the control structure: Since there has been little change in the sections for several years, surveys were discontinued in 2019.

Downstream of the control structure: Data from the surveys indicate that this scour hole is stabilizing. The daily peak outflow at the site is related to the tidal volume upstream of the control structure. The repeated hydrographic surveys upstream of the control structure show that the tidal volume is decreasing over time due to sediment deposition in the developing tidal flats upstream. Based on these observations, it is expected that the peak tidal outflows will decrease over time, and thus the depth of the scour hole downstream of the control structure should not increase to any significant degree over time.

2.2.2.4 Tidal Flats Upstream of the Causeway

The data indicate that the rate of increase in the surface elevation of the developing tidal flats is decreasing with time. The upstream tidal flats are still rising at a rate of approximately 100 mm/year but the downstream rate of rise has slowed.

2.2.2.5 Channel Width Relationships

Upstream of the Control Structure: No hydrographic surveys were carried out in this section in 2019. Measurements from the 2020 LiDAR surveys from Line 19 upstream to Line S were obtained in 2020. The channel width at elevation +4 m up to Line J has reached a relatively stable position. The width at Line A has been increasing. Above Line B there has been some channel narrowing since 2015, probably due to accumulation of seasonal silt on the banks, which had not been removed due to low river flows in 2020. The widths are variable but consistently narrowing above Line D. Above Line J there has been substantial narrowing of the channel up to Line S, at the railway bridge at Salisbury. The 2020 survey is the narrowest. The widths have narrowed consistently between 2018 and 2020.

Downstream of the Control Structure: Hydrographic surveys were carried out in this section in 2020. The rate of widening has stabilized at about 2-3 m/year. Only minimal ice formed on the banks in 2020. The widening has exposed an old masonry pier of the former Gunningsville Bridge on the north bank (Moncton side).

2.2.3 Ground-level Observations

Ground-level observations have been conducted on both banks of the River from Salisbury to Hopewell Cape seasonally from 2010 to 2020.

Winter conditions generally result in narrowing of the River along the City of Moncton and Town of Riverview shorelines, and even more prevalent upriver of the causeway. No problems with ice jamming were observed at the control structure, and the shore-fast ice built up downriver of the control structure continued to protect the shoreline and any infrastructure adjacent to the River, such as trails and viewing platforms, during the winter months. The build-up of shore-fast ice and the narrowing of the River and its tributaries was less than that of past years in January. No large deposits of stranded ice were observed on the mudflats, beaches, shorelines, and tributaries in January 2020. The River had narrowed considerably in the Moncton area and upriver to Turtle Creek as a result of shore-fast ice. Tributaries were narrowed by both shore-fast ice and deposits of tidally-placed large chunks of ice in February and March 2020.

Erosion continues to expose the old wharf structure at Steadman Street, and continues to further deteriorate the wharf face of the city of Moncton's boardwalk near the Running Room. Widening of the River at the Gunningsville Bridge on the Moncton side of the River continues as well. Widening of the River appears to be occurring on the west bank near Stoney Creek and continues to occur on both sides of the River in the Moncton and Riverview area, downstream from the control structure in sections of the River that have not been stabilized with riprap, or where old wharf structures are present. There is still a section of unprotected shoreline of approximately 220 m between the Bore Park viewing platform and the Chateau Moncton wharf area. Shorelines previously protected by rip rap remain stable and unchanged. Widening continues downriver from the control structure on the Moncton shoreline adjacent to the old landfill and at the Gunningsville Bridge. Above the control structure no areas of increased erosion were observed in the spring. Past areas of erosion are still present. Creeks and streams that flow into the River continue to show signs of erosion in places, but no adjacent developed property or infrastructure appears to be at immediate risk.

Widening of the River due to erosion continues immediately downriver from the control structure in areas not protected on both sides of the River. Erosion and widening of the River continue at the unprotected shoreline between the boardwalk and the Bore Park viewing platform to the point where the adjacent walking trail is threatened in places. No infrastructure is at risk in these locations. Widening continues on the Moncton shoreline. An old bridge pier that is part of the Gunningsville Bridge is now nearly completely exposed. Shoreline areas stabilized with riprap show no signs of erosion or significant loss of cover material.

Upriver of the control structure change is less evident, as the mudflats have now established vegetation, and are only flooded on the highest tides. No increased signs of erosion were observed upriver of the control structure and the exposed berm of the Salisbury sewage treatment facility appears unchanged.

2.2.4 Water Level Observations

2.2.4.1 Effect on Tide Levels

Measured high tides at Saint John and Gunningsville for the typical month of December over the period 2010-2020 indicates that for each year the tides at Moncton show an increase when

compared to Saint John. This means that the total initial decrease in tide levels at Moncton, after opening the gates, is likely not permanent. However, the tide heights appear to be stabilizing about midway between the 2010 levels and those that had been recorded with the gates closed. Substantial sedimentation in the new tidal flats has taken place to reduce the total storage available in the upstream area during a tide.

2.2.5 Sediment Deposition, Erosion and Net Accumulation

No data are available for 2019 due to the change-over in water level recorders. The erosion/deposition is now occurring at a relatively constant rate. Based on the surveys to 2020, the tidal prism has remained relatively constant, downstream erosion balanced to some extent by upstream deposition.

3.0 COMMERCIAL FISHERIES

3.1 Objectives

The objective of this component is to determine how the Project affects commercial fisheries landings; lobster and scallop in the UBoF.

3.2 Results

In March 2015, due to the prolongation of Stage 2 and in recognition of the extensive information collected to date, a temporary suspension of the Lobster and Scallop monitoring program was approved in May 2015. This monitoring program will be resumed in Stage 3.

4.0 ARCHAEOLOGICAL AND HERITAGE RESOURCES

4.1 Objectives

The objectives of this component are to ensure all areas of potential archaeological interest are identified and, where necessary, to mitigate risk to archaeological and heritage resources due to changes in flow patterns and erosion after gate opening.

4.2 Results

It was recommended to the Archaeological Services Branch of New Brunswick that field surveys be removed from the Stage 2 program. This recommendation was accepted. However, while there are no more scheduled Stage 2 archaeological field surveys, it is still recommended that, should additional excavations be conducted on the historic marshlands associated with the Project, these activities should be monitored by a permitted Archaeologist. These future activities might include dyke “shaping” or expansion where additional indigenous soils may be impacted. In addition, it is still recommended that if erosion has negatively affected an archaeological site or cultural feature, the provincial regulator be notified and possible mitigation measures be considered.

5.0 PUBLIC HEALTH AND SAFETY: SURFACE WATER QUALITY

5.1 Objectives

The objective of sampling during Stage 2 is to continue the collection of interim surface water quality data following the gate opening in order to provide an indication of how the environment is trending toward the predictions and conclusions contained in the EIA.

5.2 Conclusions

Given the general stability of surface water results, supplemental monitoring was suspended for the remainder of Stage 2 and no sampling events were conducted in 2020. Further data are not required to further understand how the surface water bacteria concentrations are trending in the River. The Stage 3 FUP proposes that the next surface water sampling event be resumed in Stage 3, in the first year following channel opening.

6.0 FISH PASSAGE

6.1 Objectives

The objective of this component is to measure the passage of the nine fish species that require access to the Estuary for life cycle purposes. Fish passage monitoring that was originally proposed for Stage 3 was moved forward to Stage 2 due to the delay in implementing Stage 3.

6.2 Results

6.2.1 Presence of fish species

The S2Y11 results of the Fish Passage monitoring program using a picket trap may be summarized as follows:

- **Gaspereau:** 2020 gaspereau numbers were the lowest seen during any year of the monitoring program and were noticeably lower for both adults caught during the spawning run and Young-of-the-Year (YoY) caught after the spawning run. The low number of adult spawners in 2020 may be attributed to the small cohort of YoY that headed to sea in 2015. Tidal amplitude offers another possible explanation. Tides during the spawning run in 2019 were weaker than those noted in 2018. While the decline of gaspereau as a proportion of total catch was beyond anything seen previously, catches of almost everything in 2020 were so low that the low proportion of gaspereau does not appear more extreme. The low numbers of spawning gaspereau encountered in both 2020 and 2019 compared to 2018 suggest that there were in fact fewer gaspereau in the River those years than in 2018.

- **American shad:** Occasional captures of adult shad such as occurred in 2018 are not enough to contradict the conclusion from the 2010 monitoring, that shad remain effectively extirpated from the Petitcodiac River system. Shad show a high fidelity (97%) to their natal streams, so it is to be expected that a river lacking a resident population would require an extended period to be recolonized by strays.

- **Striped bass:** Striped bass numbers in 2020 were comparable to those in 2019 with 43 individuals. Aside from 2019, this was the lowest catch since 2011, when 158 were caught. Although numbers of striped bass caught have varied over the years, there has been an overall upward trend. The decline in 2018, 2019 and 2020 is probably attributable to the 2018 relocation of the trap. Most striped bass seen every year tend to be YoY striped bass, however 2019 was an exception. The two-year age class dominated the total numbers of YoY. In 2020 YOY and 1-year old striped bass accounted for the majority of the total number caught..

- **American eel:** American eel numbers were comparable to the total numbers caught in 2019 (15 eels) with 11 individuals caught in 2020. The 2019 and 2020 investigations saw the fewest number of eels detected at the head-of-tide since monitoring began after gate opening in 2010. This stands in stark contrast to the upward trend in numbers captured at the former site between 2010 and 2017.

- **White sucker:** White suckers accounted for 45% of the entire catch at the trap, the highest portion ever of the total catch. The number of suckers captured in 2020 (430) was much more aligned with those of previous years at the former trap (except 2010), than was captured at the relocated trap in 2018. The number of suckers caught in 2020 was not abnormally high, but the number of other species, particularly gaspereau, captured in 2020 were lower. Theories on the lower numbers of white suckers caught in 2020 are varied but inconclusive.

- **White perch:** Capture numbers (7) were almost identical to 2019 (8) though lower than 2018 (32). Captures at the former site in 2015 – 2017 ranged from 167 to 231. Consistently low capture rates suggest that by 2017 a plateau in white perch population density had been established. White perch tolerates estuarine level salinities and moved through the fishway prior to gate opening. Stage 2 monitoring results indicate that perch captures were strongly correlated with incoming tides; therefore, the low capture total may be attributable to the relocation of the trap upstream in 2018.

  Atlantic salmon: There were 21 Atlantic salmon captured during the 2020 season. All were tagged adults released as mature adults under the Fundy Salmon Recovery program.

- **Atlantic tomcod:** Tomcod captures in the trap remained low in 2020, with only 8 being caught. This was consistent with 2019 which saw five captures, but down from 24 in 2018. Captures fell to 5 in 2019, down from the 26 at the new trap site in 2018 and far less than the 1,609 captured in 2017, and the peak of 3,544 in 2016 at the former trap site. This is likely attributable to the trap relocation in 2018 and equipment change in 2019. Captures at the new site in 2019 were within a narrower window. Monitoring throughout the Follow Up Program has indicated that tomcod arrive in strong peaks, which may explain year-to-year variation due to the lack of constant trapping effort

- **Brook trout:** More than half the trout in 2020 were caught during May. Throughout S2FUP monitoring there has been a consistent result of very few trout being caught, in contrast to numbers seen by anglers, during electrofishing, and during snorkel surveys. Brook trout may simply be skilled at evading the traps or are most active at the head-of-tide monitoring site outside of the trap season.

- **Smallmouth Bass:** No smallmouth bass were captured at the trap in 2020 which is consistent with the absence of smallmouth bass at the head of tide in 2019. Capture rates declined between 2010 and 2013. The species then re-appeared in small numbers between 2015 and 2017. The results indicate there is a small but persistent smallmouth bass population still inhabiting the Petitcodiac River system.

7.0 ENGINEERED ENVIRONMENTAL PROTECTION WORKS

7.1 Objectives

The objective of this component is to ensure that the physical works completed during Stage 1, prior to gate opening, are working as intended, and to identify potential maintenance requirements. These works include:

- Armoured areas for tidal surge and erosion protection at the former Moncton landfill, the TransAqua outfall, along the Riverview riverfront, along the Moncton riverfront near Westmorland Street, and along the Chateau Moncton shoreline.
- Drainage improvements at the traffic circle and starter dyke.
- Re-alignment of the underground 750 mm watermain crossing the Petitcodiac River.

7.2 Results

7.2.1 Armoured Areas

Generally, the erosion protection has been observed to function as was anticipated, providing adequate protection to areas of concern. In Year 11, no significant changes to existing erosion protection was required at any of the locations.

7.2.2 Traffic Circle Drainage Improvement and Starter Dyke

During Year 11 inspections, water within the drainage channel was found to continue to flow correctly, despite some silt build-up in the channel immediately downstream of the traffic circle flap gate. Visual inspections in past years indicated that the flap gate on the drainage outfall to the former headpond was intermittently not operational due to silt and mud deposits. No immediate action is required; however, monitoring will continue in this area and repairs will be recommended if required. The starter dyke flap gate structure at the drainage channel, which was repaired in 2012 and replaced in 2014, continued to show signs of leakage during visual inspections in Year 11. No immediate action is required. The gate will be replaced with a permanent structure as part of Stage 3 construction. General drainage and function of the

drainage improvements and associated works will continue to be monitored on a quarterly basis as part of the on-going visual inspections.

7.2.3 Watermain

No issues were noted during Year 11 inspections. Overall, the watermain and associated infrastructure is functioning as planned and no issues are anticipated.

7.2.4 Additional Observed Erosional Areas

The following areas of shoreline were included in Year 11 inspections:

- downstream from existing riprap at the TransAqua outfall;
- southern shoreline immediately upstream of the causeway;
- between Chateau Moncton and the Rogers Building; and
- upstream of Chateau Moncton adjacent to, and underneath, the boardwalk.

TransAqua outfall: Overall, no significant change was observed in Year 11. As such, no additional erosion protection has been installed and no additional erosion protection is necessary.

Southern shoreline: No significant changes to the shoreline were identified in this area during Year 11. At this time, there appears to be no risk to infrastructure from erosion in this area, and therefore no mitigation has been recommended.

Between Chateau Moncton and the Rogers building: In Year 11, as in previous years, it was revealed that an old wharf structure is becoming increasingly visible. Although no infrastructure has been identified as being at risk, the installation of additional erosion protection was recommended along this 310 m stretch of shoreline in Year 3 but has not been implemented at the request of the City of Moncton.

Upstream of Chateau Moncton: Monitoring undertaken in Year 11 indicates that the erosion protection in this location continues to function as expected.