PETITCODIAC RIVER CAUSEWAY PROJECT
STAGE 2 FOLLOW-UP PROGRAM RESULTS

YEAR 6 EXECUTIVE SUMMARY

Submitted to:

New Brunswick Department of Transportation and Infrastructure
Fredericton, New Brunswick

Submitted by:

Amec Foster Wheeler Environment & Infrastructure,

a Division of Amec Foster Wheeler Americas Limited
Fredericton, New Brunswick

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1.0 INTRODUCTION

1.1 Purpose

This document is a summary of the results of Year 6 (April 1, 2015 – March 31, 2016) of the Stage 2 Follow-up Program (S2FUP) for the Petitcodiac Causeway Project (the "Project"). Year 6 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 Project Option 4B (the bridge); therefore 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 6 of Stage 2 are trending as compared to the EIA predictions and conclusions specific to Stage 3 and beyond. The document focuses on the findings and conclusions relevant to the six Valued Ecosystem Components (VECs, see Section 1.3).

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 6 (April 1, 2015 – March 31, 2016) 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 with regard 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.

Stage 2 was originally planned to extend for at least two full seasons before proceeding with Stage 3. Although an exact or maximum extent of the Stage 2 duration was never specified, it is implicit in the EIA that Stage 3 would directly follow after two years of Stage 2 assuming that the above-mentioned objectives had been satisfied. The implementation of Stage 3 has been delayed for reasons that are not related to the environmental effects that have occurred since April 2010. Due to the delay, the Stage 2 Follow-up program has been carried out an additional four years. Data collection continues to complement and support the results and conclusions of the first two years intended for the duration of Stage 2. Taking into consideration the limitations noted within the report, the EIA Project Option that is most similar to Stage 2 (gates open) of Project Option 4B (a new bridge), is Project Option 3 (gates and some piers removed). Therefore, if done with caution and prudence, it is possible in some cases to compare the Stage

2 Year 6 results with the EIA predictions for Project Option 3. Where this approach is appropriate, it has been attempted and is noted as such within the report.

1.3 Scope

The S2FUP focused 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.

1.4 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 (CoA4). The S2FUP is divided into stages 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.

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 in order to understand effects on width, depth, and other physical characteristics as compared to baseline conditions.

2.2 Results

2.2.1 Aerial Photography

Aerial photographs were collected twice during 2015 (May and December) during low tide in the Estuary. Photos show that by December 2015 the main channel was well developed and the tidal flats were well established with local drainage channels being formed on the tidal flats and adjacent to the causeway. Vegetation is now quite well developed on the tidal flats. Substantial erosion can be noted on the major bend below the bridge on the right (Riverview) side between November 2009 (pre-gate opening) and December 2015. The tidal flats on the upper east side of the channel have grown about 100 m laterally between September 18, 2011 and December

2015. The mid-channel bar located to the north of the outfall evident in 2009 has been greatly reduced and an ebb flood channel has developed after the gates were opened. In the most recent image of December 2015 small drainage channels have become established on the surface of the developing tidal flat. Approximately 10.5 km downstream of the causeway, the area has a well-developed ebb channel and flood channel with the ebb channel on the west and the flood channel on the east whereas in 2009 there was only a single channel. Here the flood channel is both enlarging and migrating upstream and, on the south bank downstream, a narrow tidal flat is developing.

2.2.2 Cross-sections

All references to “right” or “left” are taken as looking upstream. The most recent hydrographic survey was conducted 28 October, 2015 with the following observations:

2.2.2.1 Upstream of the Causeway

At Kilometre 1.1 (km 1.1): As of October 7, 2015 extensive mudflats have developed on both sides of the channel to elevation 6.7 metres (m)±, a rise of 3.9 to 5.2 m since May 21, 2009. The channel width at elevation 4.0 m has narrowed from approximately 440 m on May 21, 2009 to approximately 187 m in December 2015. The Light Detection and Ranging (LiDAR) survey in 2015 did not provide the bottom elevation below water level.

At km 6.1 (just downstream of Turtle Creek confluence): Tidal flats have formed on the left to an elevation of 6.65 m± increasing in height by approximately 3 m since May 2009. The River channel width at elevation 4.0 m has narrowed from approximately 230 m in May 2009 to 120 m in October 2015.

At km 15.2: LiDAR surveys from 2012 to 2015 show that narrow tidal flats have formed on the left bank to elevation 6.7 m± with a depth of deposition of approximately 2.5 to 3.0 m since the gates were opened. The main channel width at elevation 6.0 m has reduced from 138 m in 2008 to 96 m in 2013, widening to 120 m in 2015.

2.2.2.2 Downstream of the Causeway to Hopewell Cape

At km 0.9: The channel width, at an elevation of 2.0 m, has increased by approximately 29 m on the right bank up to 2015, remaining virtually unchanged since 2014.

At km 2.0 (Gunningsville Bridge): The lowest annual elevations are comparable at about -5 m; however, the seasonal variation of bed elevations have been significantly reduced at this section after the gates were opened. The typical bed elevation during the summer and fall are in the order of 5.0 m lower after the gates were opened compared to the condition before the gates were opened.

At km 5.1 (just downstream of Halls Creek confluence): The section has widened on the left bank by approximately 40 m between 2009 and 2015 at an elevation of 2.0 m.

At km 7.3 (Chartersville area): The left bank has widened by approximately 100 m at elevation of 2.0 m between 2009 and 2015, and 16.7 m since 2013. The channel bed has lowered slightly since 2014.

At km 10.5: This section has undergone the most extensive modification since the gates were opened, widening on the right (Dieppe) side by approximately 415 m at an elevation of 2.0 m between 2009 and 2015.

At km 19.5 (approximately 4 km upstream of Stoney Creek): Most of the changes at this section are restricted to the riverbed which has deepened by about 2.5 m on average. The left bank at an elevation of 2.0 m has widened by about 44 m between 2009 and 2015 whereas the right bank has not changed to any significant degree.

At km 35.9 (Hopewell Cape): The changes in this section are occurring in the estuary bed below low tide level. The various surveys show a sequence of deposition and erosion at this section which is probably a result of sediment being eroded from the banks upstream, moving downstream toward Shepody Bay on a seasonal basis. In 2015, there was some infilling in the deepest part of the channel, erosion in the centre and some infilling on the right.

2.2.2.3 Upper Bay of Fundy (downstream of the causeway)

At km 39.2 (Calhoun Flats): There has only been a marginal increase in silt accumulation since 2012. Most of the change is occurring on the left looking upstream where accumulations about 2 m thick are forming a pronounced high point

At km 42.8 (Grand Anse): The bed level in the central portion of the section (Middle Ground area) has risen approximately 0.5 to 2 m over a width of approximately 2500 m since 2010 with the peak in November 2013 being approximately 0.4 m higher than in November 2012. The peak elevation has lowered approximately 1.5 m by 2015, suggesting down-Bay movement. This rise in the bed level was attributed to the net erosion of sediment from the estuary upstream of Hopewell Cape, which is now being transported downstream, depositing in the upper part of Shepody Bay.

At km 48.8 (Daniels Flats): There has been additional deposition of approximately 4 m over a width of 1000 m in the deepest part of the Bay since 2010, with little change during 2015.

2.2.3 Channel Profiles along the Estuary

2.2.3.1 Thalweg

The thalweg profile represents the lowest elevations along the length of the Estuary and provides a means of assessing areas where water may pond during periods of low tide and low flow from the land. It varies substantially on a seasonal basis, rising in the summer and winter and lowering in the spring and usually the late fall as well.

- Estuary: In addition to the seasonal movement there is a net permanent downstream movement of silt generated by widening of the channel below the causeway as a result

of opening the gates in 2010. There was noticeably less fluctuation in the low point of river bed elevation in 2015, possibly due to the record high fresh water runoff in April 2014, resulting in the lowest elevation by about 1 m measured to date.

- "Mud Plug" (elevated bottom area upstream of the causeway): There is a mound of material over the old watermain followed by a secondary scour hole approximately 1.5 m deep with another mound approximately 50 m further upstream. The former waterline located approximately 160 m upstream of the control structure is now a hydraulic control point in the channel and has caused an additional scour hole and mound further upstream in response to flows during the flood tide.

  The obstruction caused by the old watermain limits the outflow from the lower upstream reach for several kilometres and is directing flow toward the Riverview bank with subsequent erosion on the bank so that the old watermain is now exposed. In winter, during low tides large blocks of ice have grounded on this area.

- Scour Hole (just upstream of control structure): Upstream, conditions have stabilized since the gate opening in 2010 and any additional scour in the future at this site should be relatively small. The peak tidal inflows are not likely to increase over time. The deepest part of the scour hole is located approximately 36 m upstream of the upstream extent of the concrete slab associated with the bridge crossing at the control structure. The slope of the hole is in the order of 1V:6H and should not negatively impact the control structure. Downstream, the deepest part of the scour hole has stabilized and the concrete lip is intact.

2.2.3.2 Tidal Flats Upstream

The amount of suspended sediment that is transported from the land is extremely low compared to the suspended sediment transported by tidal action in the Estuary. Some of the sediment that is transported upstream of the control structure is deposited on the channel bed and, when the tidal elevation exceeds the top of the developing tidal flat, some of the sediment is deposited there. The suspended sediment that deposits on the tidal flats is more or less locked in place and is not entrained in the flow during the ebb tide. When the tidal flat is below mean high tide elevation, a deposit of approximately 3 millimetres (mm) occurs during each tidal cycle.

It is estimated that the tidal flats upstream of the causeway will continue to increase in elevation from 6.7 to 6.8 m±, observed in 2015, to approximately 7.1 m within the next decade or so.

Tidal flats have become extensively colonized by vegetation by 2015 and, based on historic observations, it is anticipated that the tidal flats upstream of the causeway will become fully colonized by vegetation by approximately 2018.

In the long term, the planform of the channel could change in the area between the causeway and Turtle Creek if ebb flow and flood flow channels begin to diverge. The enlarged ebb flow-flood flow channel could move laterally into the newly deposited sediments that form the tidal

flats upstream of the causeway. This process, if it occurred, would increase the tidal storage upstream of the control structure.

2.2.3.3 Channel Width Relationships

Upstream of the Control Structure: The 2015 surveys showed that most of the nine sections surveyed have widened 5 to 15 m since 2013. This reach of the River is more influenced by fresh water flows. The narrowing in 2013 is attributed to low freshwater flows, and the widening in 2014 and 2015 is attributed to the record spring runoff in April 2014.

Downstream of the Control Structure: This section has not shown much change since 2012 and the rate of widening has slowed significantly.

2.2.4 Ground-level Observations

Ground-level observations have been conducted on both banks of the River from Salisbury to Hopewell Cape seasonally from 2010 to 2015. As a general observation, and as noted in the photographic records, no discernible changes in the shoreline at the lower portions of the Estuary have been noted. Furthermore, flow from the land in the small creeks flowing into the River appear unaffected by the 2010 opening of the gates, and the silt buildup in the mouths of Halls Creek and Jonathan Creek immediately downstream of the causeway was less than was observed seasonally prior to opening of the gates, due to the deepening of the River bottom in these areas. No appreciable silt build-up has been observed on the Hopewell Cape beach.

At Bore Park, erosion of the unprotected riverbank has exposed old timber structures, likely remnants of wharves. The pile-supported pedestrian viewing platforms in the Steadman Street area became seriously undermined by bank erosion, and in the fall of 2014 these structures were temporarily closed while deeper piles were driven to support the viewing platforms. Widening of the River at the new Gunningsville Bridge also exposed several temporary pipe piles which were driven during construction of the bridge. These piles were removed by NBDTI in the fall of 2014.

Upstream of the gates rapid siltation has occurred; the elevation of the mudflats has increased from an average 3.5 m at the time the gates were opened to an estimated 6.7 m by the fall of 2015. As a result lower high tides no longer cover the mudflats. The rate of silt deposition on the mudflats had decreased by the fall of 2015 as a result of the less frequent flooding. The vegetation of the mudflats along the shorelines upstream of the causeway, particularly on the Riverview shoreline in the vicinity of the former Tri-Community Marina, has continued in 2015 as a result of the less frequent flooding and large areas there are now covered.

The colder temperatures during the winters of 2014 and 2015 have resulted in more ice build-up in the River and narrowing of the tributaries. Large deposits of stranded ice cakes were present on the mudflats both upstream and downstream of the control structure, however ice passage did not cause any significant problems. NBDTI monitors the situation and conducts periodic de-icing of the gates during the winter months as a precautionary measure.

2.2.5 Water Level Observations

2.2.5.1 Water Levels

Water level data continues to be a good indicator of the behavior of the Estuary between Gunningsville Bridge and the railway bridge located 21.4 km upstream near Salisbury. The spring freshet of April 16, 2014 was a record at the Water Survey of Canada (WSC) Petitcodiac gauge 01BU002; approximately 38% higher than anything recorded back to 1962 when the gauge was installed. The water level reached 11 m±, at the Salisbury railway bridge, 7.1 m± at Turtle Creek, and 7.1± m at the causeway (approximately 0.5 m below the level recorded in the previous highest flow in September 1999) under closed-gate operation.

2.2.5.2 Effect on Tide Levels

Infilling of the former reservoir on the tide levels, applicable to ice-free conditions with low flow from the land, to 2015 has increased the high-tide elevation between Gunningsville Bridge and Turtle Creek due to the constriction at the control structure. The difference in high-tide elevations is decreasing at a lower rate for any high tide elevation at the Gunningsville Bridge. In 2010 the typical difference in elevation was 0.45 m, which lowered to approximately 0.2 m in 2012, and has since stabilized. The implication is that substantial sedimentation has occurred to reduce the total storage available in the area upstream of the causeway during a tide. This process has been verified by the cross-section data which indicates a net infilling of 7 x 10^6 cubic metres (m^3) or approximately 39% of the initial volume between April 14, 2010 and October 7, 2014.

2.2.6 Sediment Deposition, Erosion and Net Accumulation during Year 6

The following estimates are provided for changes in volume during the monitoring period:

- Upstream of the Causeway - Between April 2010 and October 2015, approximately 7 million m^3 of silt accumulated in the former reservoir mainly in the form of mudflats which in 2015 have now reached an elevation of 6.7 – 6.8 m±. In addition to the “permanent” infilling, approximately 2.0 to 2.5 million m^3 of sediment moves into the upstream area in the summer and is eroded out in the subsequent fall or spring.
- Causeway to Hopewell Cape - Between April 2010 and October 2015 a net erosion of approximately 46 million m^3 has occurred in this reach. There has actually been a slight reduction in volume of about 0.6 million m^3 indicating that the changes are now of the order of magnitude that they may be masked by seasonal siltation and accuracy of the computations due to the wide spacing of the cross sections. The most active widening of the River continues to occur between Dieppe and Upper Dover. .
- Shepody Bay - The volume changes in Shepody Bay over the period April 2010 to December 2015 indicate that there is a reasonable agreement between the computed and measured volume of material deposited in Shepody Bay.

The general limits of deposition in Shepody Bay over the period 2009 to January 2015 indicate that the major portion of the deposition is occurring in an area shown as the “Middle Ground” on the hydrographic charts. This area, which was dry at low water in 1965 but subsequently

disappeared after the causeway was completed in 1968, is now rebuilding since the gates were opened in 2010.

2.2.7 Estuary Volume and Tidal Prism

The most recent cross sections upstream of the causeway were based on the October 2015 LiDAR survey. This survey indicates that the mudflats have reached elevations up to 6.7 – 6.8 m ±. From the date the causeway was built in 1968 to the year 2002, a total of approximately 160 x 10^6 m^3 of sediment had infilled the channel downstream of the causeway, believed to originate from the "middle ground" in Shepody Bay.

When the gates were opened on April 14, 2010 the tidal prism increased by approximately 20.4 x 10^6 m^3 or approximately an 8% increase from the 2002 value due to the increased tidal volume in the former headpond. By October 2014, this has since decreased to approximately 13.5 x 10^6 m^3 as a result of channel narrowing and tidal flat build-up upstream of the causeway. Note that the actual tidal prism for large tides is approximately 2 x 10^6 m^3 less than the nominal tidal prism computed for the reference elevations since the upstream levels are currently approximately 0.5 m lower due to the hydraulic restrictions at the causeway control structure.

Over the same period, the tidal prism volume downstream of the causeway has increased by an estimated 25.4 x 10^6 m^3 and the total volume has increased by approximately 45.3 x 10^6 m^3. Thus the increase on the total tidal prism in the Estuary between 2002 and 2015 is approximately 39 x 10^6 m^3; 15% greater than in 2002 or approximately 18% greater than the tidal prism of 250 x 10^6 m^3 when the gates were opened in 2010.

3.0 COMMERCIAL FISHERIES

3.1 Objectives

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

3.2 Results

3.2.1 Lobster

Overall the catch per unit effort (CPUE) of legal lobsters in commercial traps during Stage 2 have shown increases from spring 2008 - 2015. Results suggest that the opening of the Petitcodiac River causeway gates has not influenced legal lobster catch rates in the UBoF. However, differences in CPUE between the control and exposure areas were observed for some years in spring. These differences may simply reflect natural fluctuations in catch rates or effects from environmental conditions, such as water temperature. The differences also highlight the importance of relying on a longer time-series to account for inter-annual variability, and to monitor a potential impact of the opening of the causeway gates on recruitment processes.

3.2.2 Scallop

The 2014 results indicated no apparent difference among the growth factors of scallops in the Control and Exposure Zones. These results, combined with the absence of sediment migration from the Estuary into Chignecto Bay, led to the conclusion that there has been no Project-related effect on UBoF scallop conditions and the program was thus suspended in 2015.

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 the causeway gates were opened.

4.2 Results

The Stage 2 Follow-up Program, endorsed by the provincial regulator, Archaeological Services New Brunswick (ASNB), required field surveys annually for five years (2010-2014) followed by two biennial surveys conducted in 2016 and 2018. Therefore, a visual survey was neither required nor conducted in 2015. In addition, no investigative archaeological site mitigation activities were recommended or conducted during the 2015 field season. Archaeological fieldwork will resume in 2016 after the one year hiatus.

5.0 PUBLIC HEALTH AND SAFETY: SURFACE WATER QUALITY

5.1 Objectives

The objective of sampling during Stage 2 (including Year 6) is to continue to obtain interim surface water quality data following the opening of the causeway gates in order to provide an indication of how the environment is trending toward the predictions and conclusions contained in the EIA.

5.2 Conclusions

The results of the surface water quality sampling events indicate that there are many factors that contribute to water quality, including Fecal Indicator Bacteria (FIB) concentrations in the Estuary. The 12-hr sampling events conducted at the Gunningsville Bridge and Salisbury Railway Bridge indicate that *E. coli* concentrations vary greatly throughout a tidal cycle. The nature of the Project is such that environmental conditions have significantly changed between Stages, particularly upstream of the causeway. Attempting to determine which factors are responsible for water quality conditions is problematic given the complexity of the system, limitations of the available data, and knowledge of how bacteria behave in suspended sediment-rich systems. However, despite these challenges, there continues to be sufficient evidence that peak *E. coli* concentrations have decreased (compared to Stage 1) at the Gunningsville Bridge, and continue to decrease at a rate of approximately 9% per year.

At the Salisbury railway bridge, additional 12-hour sampling events would be required to confirm potential trends among water velocity, water level, TSS, salinity and the concentration of

bacteria. A general increasing trend in *E. coli* concentrations was observed at the Salisbury railway bridge, though this is not statistically significant. An additional factor that could be influencing the concentration of bacteria at the Salisbury railway bridge station is the sewage lagoon that operates in Salisbury. The operation of this lagoon in terms of effluent discharge volumes and timing to the River is not known and therefore has not been accounted for when interpreting the bacteria data at this location.

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 as a result of the delay in implementing Stage 3.

6.2 Results

The habitat quality at the eight sites that were electrofished is generally good. However, most of the sites are situated in the middle or lower reaches of the two drainages. As such, they are probably thermally more suited to juvenile salmon than brook trout production. Without a continuing juvenile salmon augmentation program, either through direct introduction or pre-spawning adult stocking, and/or a suddenly renewed wild UBoF salmon spawning run, salmonid standing crops would probably again fall to extinction levels at all sites.

The poor juvenile densities generated from the adult releases on the Pollett River in 2013, and particularly from the larger releases in 2014, coupled with the very successful results from the fry releases particularly that of 2011, may indicate that the latter strategy is the better of the two. On the other hand, the 2015 fry introduction on the upper Pollett River did not appear to be particularly successful.

The 2015 brook trout results indicate that it would be better to delay electrofishing until after the rivers begin to cool from their summer maxima. It is recommended that, in future years, no electrofishing occur until after the first week of September.

The S2Y6 results of the Fish Passage monitoring program may be summarized as follows:

- Since 2010 **gaspereau** have decreased from 96% of the total catch in the trap to 36%. One reason for this decline is the set-up of the fish trap being delayed in 2014 and 2015. Therefore, it could be expected that more gaspereau would have been captured in the early sampling years.
- **American shad** were not captured at all in 2015. Due to River conditions, the trap did not begin fishing until May 28, so it is possible that some spawners passed undetected. American shad rapidly became extirpated from the upland reaches of the River after construction of the causeway. 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 quite some time to be recolonized by strays.

- The 1,661 **striped bass** captured in 2015 was bettered only by the 2,813 striped bass, captured in 2014, a number that was nearly four times the next highest number caught at the trap prior to 2015, although still their first meaningful year-to-year decline since they were first detected at the trap in 2011. It is strongly suspected that the Stewiacke River, where spawning was not successful in 2015, is the spawning site for the bass that are currently using the Estuary as a nursery area.
- **American eel** capture numbers in 2015 were much greater than during any other year that the gates were opened. This increased observation of activity is quite encouraging considering the widespread declines in populations of this species across its range. Blocked or reduced passage in rivers has been identified as one of the factors contributing to these declines.
- **White sucker** catch numbers in 2015 increased over the previous year for the second straight year, 1,298 in 2015 as compared to 795 in 2014.
- **White perch** numbers fell to 167 from 353 in 2014. This was particularly low compared to the record high for the monitoring period of 600 in 2013. It has been speculated that the slight, non-statistically significant decline in white perch catch rates may be a result of predation in the vicinity of the traps by striped bass and American eels.
- There were 21 **Atlantic salmon** captured in the trap during the 2015 season, 18 introduced adults and three smolts. The species is considered to be extirpated from the River system, except for those introduced in stocking programs. While for the 6th year straight, no adults returning from sea were caught at the trap, 2015 is noteworthy for perhaps four additional salmon that have been detected in the River in recent years that were not stocked.
- **Atlantic tomcod** captures decreased in 2015, from 2,518 fish in 2014 to 1,344. Regardless, while 2015 was not a strong year for tomcod capture, they were caught in large numbers, distributed across many days.
- **Brook trout** catch numbers decreased in 2015 to 7 which is less than half of 2014, but ties the next best year, 2013. The observed difference between the first 3 years and the last 3 years probably has more to do with the equipment being used than the status of the River's trout population. There is also the possibility that most trout movement upstream occurs prior to installation of the trap in the spring.
- The **chain pickerel** was encountered for the first time at the fish trap in 2015. There were 10 caught, most of which were in the 40 cm length range. It is unclear why they have not been caught previously at the fish trap since they were present in the headpond, and are reportedly encountered with some frequency by anglers further upstream near the mouth of the Pollett River. The apparent increase in chain pickerel numbers as evidenced by their sudden appearance in trap captures is of concern considering the threat they pose to a *Species At Risk Act* (SARA)-listed species, the Inner Bay of Fundy Atlantic salmon.

The Petitcodiac Fish Recovery Coalition (PFRC) also operate a rotary screw trap (smolt wheel) on the Pollett River, to capture juvenile salmon (smolts) during their migration to their rearing habitat in the Bay of Fundy and the Gulf of Maine. These smolts would have all been produced from the introduction of young-of-the-year salmon (fry) to the Pollett River in 2012 (3 year old

smolts in 2015) or from mature adult salmon introductions to the Little River in 2012 (2 year old smolts in 2015).

Redd surveys were conducted for virtually the entirety of the Little River including the lower portion of a major tributary, Prosser Brook, resulting in the discovery of 76 Atlantic salmon nests at 48 release sites. One hundred, sixty-three (163) adult female salmon were introduced on this river. There were ten nests discovered at seven sites on the Pollett River over its entire length including a reach upstream of Gordon Falls. One hundred, twenty-two (122) adult female salmon were stocked on the Pollett River. This indicates that the salmon released more than two weeks earlier and in one case over three weeks earlier had, at a minimum, started to spawn, and probably were very close to completing the activity. There were salmon noted in the vicinity of the redd sites, but none of the observers noted fish actively excavating redds.

Although the redd/nest counts on the Little River were substantially greater than on the Pollett River, at 1.5 nests per redd there should have been almost 250 nests counted. There should have been approximately 180 nests deposited on the Pollett River. The reason for the overall low nest-counts may be related to a premature search, or the missing of nests by the relatively inexperienced crews, although low levels and clear water helped with visibility during the searches.

The reason for the particularly low spawning-density relative to the Little River that was noted on the Pollett River is unknown, though poaching may be a factor. Alternatively, or in addition, the fish on the Pollett River may have backed down river since they were not imprinted to it, and perhaps spawned in the extreme lower reach of the Pollett, or perhaps in the main stem of the Petitcodiac River. The main stem Petitcodiac River has spawning habitat of acceptable quality, but the nursery habitat quality is fair-to-poor.

The numbers of young-of-the-year salmon in the electrofishing results in 2016 will act as a check on the veracity of the redd counts. Recommendations for 2016 are that the redd search be repeated in 2016 but, to ensure that spawning activities have ended, it should be conducted one week later, during the last week of November, weather pending. The reach of the main stem Petitcodiac River from the mouth of the Pollett River to the head-of-tide should be surveyed for the existence of redds.

Given the potential for the poaching of released fish, members of the PFRC should monitor the rivers between the time of fish release and the redd surveys. NB Public Safety and Fisheries and Oceans Canada (DFO) should be made cognizant of the potential for poaching.

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 (formerly Greater Moncton Sewerage Commission) outfall, along the Riverview riverfront, along the Moncton riverfront near Westmorland Street, and along the Chateau Moncton shoreline.
- Agricultural dykes and aboiteaux upstream of the causeway.
- 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 armoured (rock riprap) areas have been observed to function as was anticipated, providing adequate protection. In Year 6, no significant changes to existing erosion protection were noted at any of the locations.

7.2.2 Dykes and Aboiteaux

Due to the large spatial area where these protection works are located, only aerial surveys were completed in Year 6. The objective of these surveys is to assess drainage patterns and verify that water is flowing properly through the aboiteaux, and that the dykes are appropriately vegetated and maintained. These structures are intended to prevent estuarine water from flowing into the adjacent farmland, while allowing surface water accumulating behind the dykes to drain into the Estuary. Aerial surveys in Year 6 were completed on 6 June and 17 November, 2015.

The dykes and aboiteaux appear to be functioning as planned. During both aerial surveys, some siltation was observed upstream and downstream of the aboiteaux. It was noted that the aboiteaux on Marsh Body (MB) 33B was functioning with limited flow, and potential erosion was observed on the downstream side of the aboiteaux on MB 4C. It was also noted during both surveys that the area behind the dyke in MB 33B was flooded. All dykes appeared to be intact and well-vegetated in the November survey, although areas of missing vegetation were noted on MB 28 and MB 4A dykes, and the need for vegetation maintenance was noted for the MB 33A and MB 43A dykes.

Maintenance activities on the dykes, aboiteaux and marshes are conducted by the NB Department of Transportation and Infrastructure (NBDTI). Throughout Year 5, NBDTI conducted various maintenance and site improvement activities such as clearing inlet and outlets of aboiteaux, ditching and land forming, and access road upgrades and fencing. All of these aspects of dyke and aboiteaux maintenance continue to be monitored and work is undertaken as required.

7.2.3 Traffic Circle Drainage Improvement and Starter Dyke

Visual inspections in January 2015 indicate that the flap gate continues to show signs of leakage despite the replacement. No immediate action is required; however this gate may need to be replaced in the near future should conditions worsen.

7.2.4 Watermain

No issues were noted during Year 6 inspections. Overall, the watermain and associated infrastructure is functioning as planned and no issues are anticipated.

7.2.5 Additional Observed Erosional Areas

Several erosional areas adjacent to existing infrastructure have been identified during visual inspections in Stage 2. As such, the following areas of shoreline were inspected bi-weekly or monthly as part of the on-going Year 6 inspections:

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

The results of monitoring undertaken since Year 1 at the TransAqua outfall observed a decreased rate of erosion. Overall, no significant change was observed in Year 6. At the causeway intake channel, some increased erosion (scour) was observed in the channel immediately upstream of the causeway and along the southern shoreline of the intake since Year 1. Some rip-rap exists along the southern shoreline that was installed prior to Stage 1, but no further protection was installed as part of the Project because Stage 2 was intended to be short in duration. Visual site inspections and hydrographic surveys have since been used to verify that the channel and section of shoreline remain stable and do not result in any risk to surrounding infrastructure. The results of monitoring and assessment activities completed through Stage 2 have observed the slumping to have stabilized as the base of the channel consists of competent bedrock. This observation was supported by the hydrographic surveys that indicate scour within the intake channel has stabilized. No significant changes to the shoreline were identified in this area during Year 6 and, at this time, there appears to be no risk to infrastructure from erosion in this area.

Erosion protection installed along shoreline between the Chateau Moncton and the Rogers building was inspected in Year 6. During these inspections it was revealed that an old wharf structure in this section of shoreline has become increasingly visible. The installation of additional erosion protection was recommended along this 310 m long stretch of shoreline in Year 3, but was not completed at the request of the City of Moncton, which has decided to continue monitoring this section of shoreline. Installation of erosion protection in this area may be completed at a later date by the City.

Erosion has been observed to have exposed the supporting cribwork beneath the Moncton riverfront boardwalk, upstream of Chateau Moncton. In Year 2, a 45-m long section of shoreline adjacent to the boardwalk and lookout building was protected with rip-rap. Monitoring undertaken in Year 6 observed that the erosion protection in this location continues to function as expected.