Long Pond Weir
Environmental Preview Report

File #: 2.2321.0279

Reg #: 1783

143063.02 ● Report ● March 2016

Prepared for:
ST. JOHN'S
NEWFOUNDLAND AND LABRADOR, CANADA

Prepared by:
CBCL LIMITED
Consulting Engineers

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March 3, 2016

Minister
Environment and Conservation
P.O. Box 8700
St. John's NL A1B 4J6

Attn: Director of Environmental Assessment

Dear Sir/Madam:

RE: Long Pond Weir Project
File #: 2.2313.0279
Reg. #1783

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On behalf of our client, the City of St. John's, we are pleased to submit the enclosed Environmental Preview Report in response to the "Guidelines for an Environmental Preview Report for the Long Pond Weir" as issued on June 9, 2015.

We trust that the enclosed report provides a comprehensive overview of the project and meets the requirements of the above-noted guidelines.

Please contact the undersigned with any questions.

Yours very truly,

CBCL Limited

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Senior Civil Engineer
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Cc: Mr. Scott Winsor, P. Eng., City of St. John's

Project No: 143063.02

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CHAPTER 1 INTRODUCTION

1.1 Project Background

In November 2012, CBCL Limited was awarded the Rennies River Catchment Stormwater Management Plan (RRCSMP) Study by the City of St. John's (City). The Rennies River watershed has an area of approximately 32 km^2 and contains several major water courses, including Yellow Marsh Stream, Ken Brook, Leary's Brook and Rennies River. Runoff from this catchment ultimately discharges to Quidi Vidi Lake. During significant rainfall events, flooding has occurred at locations along Ken Brook, Leary's Brook and Rennies River. Flooding has, at a minimum, been inconvenient for the residents of the City of St. John's and, at other times, has resulted in major public and private property damage.

The RRCSMP Study included hydrologic modelling of the catchment to determine flood flows for existing and future land uses, considering up-to-date rainfall data as well as rainfall representative of climate change conditions. A hydraulic model was then created to examine the extent of the floodplain resulting from the flood flows. The flood selected for design of flood protection improvements was the 1:100 annual exceedance probability (AEP) flow associated with future land development and climate change conditions.

Several flood protection approaches were evaluated using the hydrologic and hydraulic models developed for the RRCSMP Study, and the most optimum flood protection measures recommended for the City's consideration. In terms of overall impact on the study area, the most significant recommended flood protection improvement is a weir located at the east end of Long Pond. The construction of the weir will result in reduced flooding downstream of Long Pond. The flood control improvements recommended for downstream of Long Pond (mainly berms) have been designed to function with the weir at Long Pond in place. Consequently, the weir at Long Pond must be constructed before the downstream improvements can be constructed.

In addition to the Long Pond weir, the study identified the need for flood protection improvements at several locations in the Rennies River watershed. These locations are summarized below:

1. Kings Bridge Road to Portugal Cove Road and upstream of Portugal Cove Road Bridge,
2. Upstream of Carpasian Road,
3. Clinch Crescent East to Clinch Crescent West,

4. Wicklow Street to Thorburn Road,
5. Upstream of the Avalon Mall Culverts,
6. O'Leary Avenue Bridge,
7. Downstream of Mews Place Culverts, and
8. Local culverts on Ken Brook where the brook runs parallel to Kenmount Road.

Earth berms and/or concrete walls were recommended as the flood protection measure at locations 1 to 7. It was also recommended that the O'Leary Avenue Bridge be replaced and the headwall at the Avalon Mall culvert be raised.

1.2 Name of the Undertaking

The undertaking has been assigned the name Long Pond Weir and will be referred to as such throughout this report.

1.3 Proponent

1.3.1 Name of Corporate Body

City of St. John's.

1.3.2 Address

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1.4 Need for the Undertaking

During significant rainfall events the City of St. John's has experienced flooding in the Rennies River Catchment. Some examples of past floods in the catchment are summarized below:

- April 11, 1986: Rainfall of 110 mm caused flooding along Leary's Brook and Rennies River. The Avalon Mall parking lot flooded, and there was an estimated 30 cm of water covering Prince Philip Drive between the entrance to the Health Sciences Centre and the CBC building. The water level in Rennies River reportedly rose 1.8 m above the normal water level, destroying approximately 100 m of walking trail and causing severe flooding at Pringle Place.
- September 19-20, 2001: Post-tropical storm Gabrielle deposited 175 mm of rain in the city of St. John's, much of which fell within 6 hours or less according to Environment Canada (EC). Flooding caused road closures on Kenmount Road, the Boulevard, Portugal Cove Road, Prince Philip Parkway and Clinch Crescent West. Carnell Drive was flooded, as was the Avalon Mall parking lot. In addition, forty-five stores located in the Avalon Mall sustained flood damage.
- November 16, 2004: Rainfall caused minor flooding in St. John's. For example, water built up on Prince Philip Drive near the west entrance to the Health Sciences Centre, at Clinch Crescent West.
- April 11-12, 2005: Rainfall of 70 mm caused flooding along Leary's Brook, both upstream and downstream of the Avalon Mall, the Clinch Crescent West entrance to the Health Sciences to be temporarily closed, and the normal water level of Long Pond to rise by between 1 and 2 m.
- November 29, 2008: This storm dropped 100 mm of rain on the Northeast Avalon, most of which fell in a 3 hour period, according to a CBC News report. The storm caused Rennies River to overtop its banks near the entrance to Quidi Vidi, flooding the King George V Soccer Pitch, causing an estimated $500,000 in damages to the artificial turf. Since the incident, a berm has been constructed between Rennies River and the field, near the shoreline of Quidi Vidi Lake.
- September 20-24, 2010: Rainfall associated with Hurricane Igor resulted in flooding at several locations along Rennies River and Leary's Brook, including Fieldian Grounds, Pringle Place, Vaughan Place and the Prince Phillip Parkway in the vicinity of the CBC Building. Appendix A contains photos comparing the water level of Rennies River, near 3 Pringle Place, under normal conditions and during Hurricane Igor.

A literature review of previous flood studies was conducted to assess the underlying mechanisms of flooding, as well as to identify any areas which experience frequent flooding. In 2006, Kendall Engineering Ltd. completed the Quidi Vidi Lake Tributary Flood Plain Delineation Study.

The Kendall Study found that two large areas are prone to flooding during the 1:100 AEP flood; Portugal Cove Road bridge and the floodplain immediately upstream and downstream, as well as the floodplain from Kings Bridge Road bridge to Quidi Vidi Lake. To mitigate flooding near the Portugal Cove Road bridge, the study recommended alterations to the bridge, which include removing sediment beneath the bridge, removing concrete obstructions in the downstream channel and raising the north bank of Rennies River for approximately 150 m upstream of the bridge. However, even with these modifications, a large portion of the soccer pitch at Fieldian Grounds and the Riverdale Tennis Club grounds would still be flooded. To minimize the extent of flooding between Kings Bridge Road bridge and Quidi Vidi Lake, the report suggests constructing berms or levees along the north bank of Rennies River from Kings Bridge Road bridge to Carnell bridge and raising the footbridge at Loblaws. However, these alterations will not prevent all the flooding problems; a large portion of the Loblaws parking lot as well as sections of Carnell Drive and Lake Avenue will still be within the flood limits.

The City of St. John's also examined the use of regional stormwater detention systems to reduce flooding in the Rennies River catchment. Regional stormwater detention involves the temporary storage of runoff for a large area. The runoff is then released at a lesser flow rate (usually the pre-development flow rate). By restricting stormwater runoff to pre-development conditions, existing hydraulic structures (like storm sewers and road culverts and bridges) that are downstream of the stormwater detention facility should not experience increased hydraulic loading during significant rainfall events. In February 2013, CBCL Limited completed the Regional Stormwater Detention Feasibility (RSDF) Study for the City of St. John's. The study's scope included identifying potential drainage areas for regional stormwater detention, selecting feasible locations for regional stormwater detention facilities, and developing preliminary designs and cost estimates. One of the areas examined in the study was the Southwest Development Area (SWDA), which drains to Learys Brook and Yellow Marsh Brook, both of which are part of the Rennies River catchment.

The RSDF Study revealed that only one location in the SWDA was suitable for a regional detention facility: on Yellow Marsh Brook, approximately 750 m upstream of the crossing at Team Gushue Highway. One of the recommendations of the study was to proceed with the construction of a detention facility at that location. Locations examined along Learys Brook were deemed inappropriate for regional detention due to insufficient depth and/or area. The model developed for the RRCSMP, and used for the Long Pond weir design, includes the Yellow Marsh Brook detention facility.

The RRCSMP identified the Long Pond weir as a significant flood control measure for Rennies River. Constructing the weir at the outlet of Long Pond will result in water being temporarily stored in Long Pond during a storm event and released at flow rate lower than the rate would be without the weir in place. Due to the increased storage capacity, the level of Long Pond would increase for a short period of time during a storm and return to its normal level a short time after the end of a storm.

Design calculations show that peak flows can be reduced by about 20% with the weir in place. Reduced flows downstream of Long Pond result in two major benefits. First, the costs to implement flood protection improvements are reduced. Second, reducing flows downstream of Long Pond during peak flow events will result in reducing erosion in the river.

Although the weir will temporarily increase the level in Long Pond during a storm, it will not cause a backwater effect, and will not exacerbate the flooding experienced at upstream locations, such as the Health Sciences Facility. This is illustrated on the maps provided in Appendix B. When the maps entitled 'Model Calibration Igor' Map 2 and 'Flood Control Measures 1:100 AEP Floodplain' Map 2 are compared, it can been seen that there is no discernible increase in the floodplain at, or downstream of, Clinch Crescent east. The flood control measures proposed between Clinch Crescent west and Clinch Crescent east in the RRCSMP are required to address the current flood problems. The berms at this location are needed with or without the weir in place, and their design (ie. height) is not affected by the weir.

The Long Pond weir design was completed in accordance with the City's Subdvision Design Manual as well as the City's Stormwater Detention Policy, which is frequently referred to as the Zero Net Increase in Runoff policy. The purpose of the policy is to restrict the release of stormwater from new developments to the pre-development rate. In essence, this policy means that any future development activities in the Rennies River Catchment will not result in an increase in flow above that used as the design flow for the Long Pond weir.

In addition to meeting the needs of the City, the project will also contribute to the objectives outlined in the Provincial Climate Change Action Plan 2011. The vision statement of the Action Plan is *"a province that effectively integrates progressive action on climate change into its policy, planning and programs in a way that supports future economic, social and environmental success."* The Action Plan lists four goals, the first being to "e*nhance Newfoundland and Labrador's resilience to the impacts of climate change."* By including the effects of climate change in the design storms, and hence the flood flows used in design, and reducing the impacts of flooding on downstream properties and infrastructure, the weir will achieve goal one of the provincial Action Plan.

This Environmental Preview Report (EPR) has been prepared in accordance with the *Guidelines for an Environmental Preview Report for the Long Pond Weir (June 9, 2015)*. In this document, these guidelines are referred to as the "Guidelines". The Guidelines and clarifications to the Guidelines provided by the Department of Environment and Conservation (ENVC) are contained in Appendix C.

CHAPTER 2 DESCRIPTION OF THE UNDERTAKING

2.1 Geographical Location

The proposed location of the weir is at the outlet of Long Pond, just upstream of the Allandale Road Bridge in St. John's, NL. The project is located in Pippy Park. See location drawing in Appendix D.

Long Pond was identified during the RRCSMP as the only location along the reach with sufficient area and depth to temporarily store stormwater for the purpose of reducing flood flow and flood water levels downstream.

2.2 Design Parameters

The following parameters were used in the design of the weir:

- *A 1:100 AEP Climate Change flow plus 30%*. The weir was originally designed to the 1:100 AEP Climate Change flow; however, as per the Guidelines the design flow was increased by 30%, which is ENVC's standard sensitivity range for flood risk studies.
- *A maximum water elevation in Long Pond of 55.7 m while passing the design flow*. This elevation was selected as the maximum water level in Long Pond as it maintains a 1.45 m difference between the HSC Utility Tunnel entrance (elevation of 57.15). The maximum water elevation also provides 0.6 m of freeboard on the weir (top elevation of 56.3 m: the road elevation of Allandale Road Bridge).

Analysis of the weir based on these design parameters is described in detail in Section 3.

2.3 Physical Components

The project will consist of a pre-cast concrete channel, with a 6 m wide opening for flow conveyance and fish passage. An earth berm will be constructed from each side of the concrete channel to the pond banks. The invert of the weir will be consistent with the existing bottom of Long Pond (approximate elevation of 52.0 m). Rip-rap will be placed along the bottom of the concrete weir to replicate the natural channel, and to aid the passage of fish. The berm will be approximately 60 m long and 20 m wide (in direction of flow), with sloped (2H:1V) upstream and downstream faces. The berm crest elevation will be approximately 56.3 m with a width of approximately 3.0 m. Two 2.0 m by 3.0 m stainless steel control gates will be installed on either side of the 6 m channel, with bottom elevations of approximately 52.0 m. The proposed control gates are Aquanox C Series open channel gates (an equivalent product may also be used). These gates are made of stainless steel and ultra-high-molecular-weight polyethylene (UHMWPE), ensuring the best corrosion resistance for a long life in tough environments. Appendix E contains preliminary drawings of the weir and product literature for the control gates.

The structure will also include a walking surface for inspections and maintenance activities and will include a guard rail and barriers at both ends to prevent pedestrian access.

There have been some changes to the weir design submitted in the February 2015 Environmental Assessment (EA) report. The changes are summarized in the table below.

Table 2.1: Summary of Design Changes

Parameter	Environmental Assessment	Environmental Preview Report	Reason for Design Change
Embankment Material	Concrete	Earthen Berm and Pre-Cast Concrete	The construction of an earth berm will result in reduced cost compared to a concrete structure. Also, construction duration is likely to be shorter; this is important from an environmental perspective as there is less chance of harmful substances entering the river system as a result of prolonged construction activities. In addition, it is less likely to exceed the timing window for working in a watercourse as set out by the Federal Department of Fisheries and Oceans (DFO).
Embankment Side Slopes	Upstream (Vertical) Downstream (2H:1V)	Upstream and Downstream (2H:1V)	A vertical upstream face is not possible for an earth embankment. Golder Associates have completed a slope stability analysis of the earth berm which is included in Section 4.
Weir Opening Width	4 m	6 m + Flow Control Gates	The design parameters used in the EA included passing the 1:100 AEP Climate Change flood while maintaining an elevation of 55.7 m in Long Pond. The Guidelines increased the design flow by 30%, but maintained a peak water level of 55.7. Changes were made to the weir opening to accommodate this increase in flow while still protecting downstream infrastructure.

The overall increase in the storage capacity of Long Pond with the weir in place is in the order of 160,000 m^3. The normal water level of Long Pond is approximately 53.2 m and will increase to approximately 55.7 m during the design flood (1:100 AEP Climate Change plus 30% flow) with the weir in place. Floods are naturally attenuated by Long Pond; for example, during Hurricane Igor the level in Long Pond was recorded to be 55.4 m. Table 2.2 illustrates the expected peak water level in Long Pond during various events.

Table 2.2: Peak Water Levels in Long Pond

Flood Event	Pond Elevation Without Weir (m)	Pond Elevation With Weir (m)
1:100 AEP CC + 30 %	55.4	55.7
1:100 AEP	55.2	**55.4**
1:50 AEP	55.0	55.1
1:20 AEP	54.7	54.8
1:5 AEP	54.2	54.3
Hurricane Igor	**55.4**	N/A

2.4 Existing Environment

The weir is designed with an invert the same as the natural channel and will have rip-rap placed throughout the entire width and length of the opening. Mimicking the natural channel will aid the passage of fish through the weir.

2.4.1 Flow Monitoring

Flow measurements during the first year of the weir operation are required to verify that fish passage is maintained, as per DFO's requirements outlined in the letter dated March 23, 2015 (Appendix F). Open channel flow rates are determined from measured water levels and a rating curve (plot of flow vs. water level) established for the location of the water level measuring device. The rating curve is created by surveying the cross section of the channel at the location of the device, and measuring velocities for a range of flows. The velocity and cross sectional flow area are used to develop a channel flow for the observed water level. Several of these measurements are taken, over a range of flows, to create the rating curve. All of the measured water levels can then be related to flow using the rating curve. Currently the City owns and operates a water level monitor on the upstream side of Allandale Road bridge, as shown in Figure 2.1. This monitor

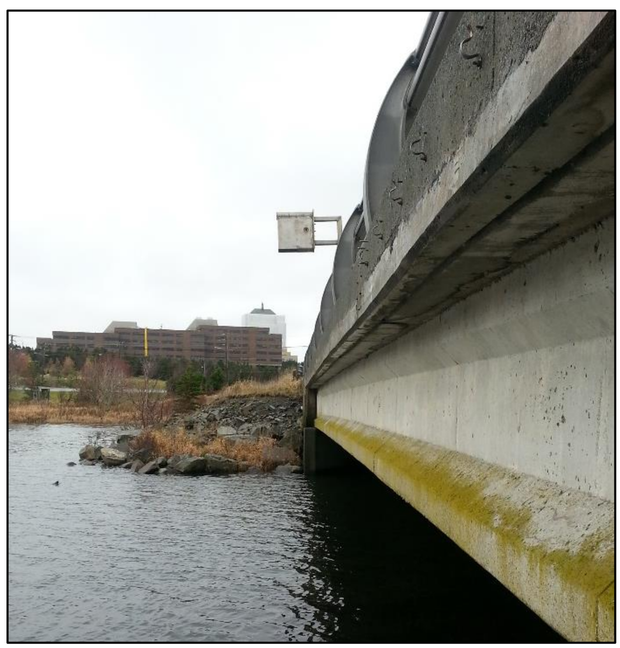

Figure 2.1: Water Level monitor on Allandale Road Bridge

has been in operation for several years; water levels recorded during Hurricane Igor, in September 2010, was used to calibrate the hydraulic model developed for the RRCSMP Study. This level will be used to monitor flow through the weir.

2.4.2 Project's Effect on Fish and Wildlife

As the weir is designed with an opening to the natural channel bottom, the normal water level in Long Pond will not be altered. Therefore, the current normal water level of approximately 53.2 m will remain at 53.2 m after the construction of the weir. Although the weir will cause the water level in Long Pond to increase during a flood event, this increase will be for a relatively short time period. The anticipated duration of stormwater retention in Long Pond with the weir in place is described further in Section 6.3. Therefore, the project is not expected to interfere with wildlife and has been designed to alleviate the project's effect on fish. As a part of the design, Thaumas Environmental Consultants Ltd. was engaged to study the effects that the weir may have on fish migration. The results of this study are included in Appendix G. The fish species present include the Brown Trout, Brook Trout, American Eel, Atlantic Salmon and forage fish such as the Three Spined Stickleback. The analysis concluded that each species present will be able to migrate through the weir.

2.4.3 Geotechnical Investigation

Field investigations were carried out by Golder Associates Ltd. on October 3 and 4, 2014 and included drilling 3 boreholes at the proposed project location. The results of this geotechnical investigation are included in Appendix H. In general, the soils present at the site include clayey silt, gravelly clay or sand, sandy gravel till and bedrock.

CHAPTER 3 HYDROTECHNICAL ANALYSIS

The Guidelines, in accordance with the Canadian Dam Association (CDA) Dam Safety Guidelines, require a detailed evaluation of the hydraulic response of the Rennies River system to the construction of the proposed weir at Long Pond. The hydrotechnical assessment, as outlined in the Guidelines, consists of the following components:

- Sizing of the hydraulic opening according to the design criteria indicated by the guidelines: a maximum water level of 55.7 m in Long Pond during the 1:100 AEP Climate Change flow plus 30%;
- Sensitivity analysis of the hydrologic and hydraulic model parameters;
- Identification of areas vulnerable to flooding before and after construction of the weir based on the results of the sensitivity analysis;
- Estimation of the duration of water retention in Long Pond after construction of the weir;
- Stage-discharge analysis;
- Weir breach assessment;
- Freeboard analysis;
- Structure classification;
- Identification of mitigation measures to protect adjacent land; and
- Identification of measures to implement a zero net runoff policy in the Rennies River watershed.

A computer model of Rennies River was used to conduct the hydrologic and hydraulic analysis. The following sections describe the modelling approach.

3.1 Rennies River Catachment Computer Modelling

The development of the RRCSMP included assembling a hydrologic and hydraulic computer model of the Rennies River catchment system. The model was built using XPSWMM, a modelling software developed by XP Solutions that uses standard hydrological methods to estimate runoff flows in a watershed and solves dynamic flow equations to calculate 1D flows through pipes, culverts, narrow channels, etc. The software also calculates 2D flows through floodplains, large bodies of water, wide bridges, etc.

The computer model developed for the RRCSMP was used as a base to conduct the initial hydraulic calculations associated with the Long Pond weir hydrotechnical analysis. However, the calculations associated with the objective of this analysis included the simulation of a set of complex scenarios that required the use of specific XPSWMM tools. The configuration and operation of these tools lead to a series of adjustments and improvements to the initial RRCSMP model.

A summary of the hydrologic and hydraulic modelling for the RRCSMP and for this study is presented in the following sub-sections. For a detailed description of the RRCSMP model, the reader is referred to the RRCSMP report, available at:
http://www.stjohns.ca/sites/default/files/files/publication/Rennies%20River%20Catchment%20Stormwater%20Management%20Plan_0.pdf

3.1.1 RRCSMP Hydrologic Modelling

The hydrologic module of the software was used to estimate the runoff flows within the Rennies River watersheds under a range of rainfall events. Hydrologic inputs for these calculations included: watershed areas, slopes, percentage of impervious land, surface roughness, infiltration parameters and rainfall hyetographs (precipitation time series). The physical characteristics of each sub-catchment were estimated using topographical survey data, 1 m contour mapping, LiDAR survey data, aerial photography, satellite images, onsite ground measurements and photos. Rainfall inputs included synthetic design storms derived from precipitation data recorded by the City's Windsor Lake rain gauge.

The hydrologic model was calibrated by comparing the flow hydrograph recorded at Environment Canada's (EC) Leary's Brook at Prince Philip Drive hydrometric station (02ZM020) with the hydrographs simulated at the same location, using the observed precipitation data during Hurricane Igor. Modelling parameters such as the roughness coefficients were adjusted until the simulated hydrograph was representative of the observed hydrograph.

3.1.2 RRCSMP Hydraulic Modelling

The hydraulic module of XPSWMM was used to estimate water levels and flow rates through the river channel and at the structures located along the river reach, and to produce floodplain maps. The input data for this module consists of river channel invert elevations, channel and floodplain roughness coefficients and hydraulic structure dimensions. This information was extracted from field surveys, LiDAR data and air photos. The domain of the model consists of a 5 m grid used to calculate the 2D flow of water within the river channel and the floodplain. The grid was connected to the model 1D elements used to calculate the flow through bridges, weirs and culverts.

Hurricane Igor was also used as the calibration event for the hydraulic model. Water levels observed at the City-owned Long Pond level gauge were compared to the water levels simulated by the hydraulic model. The calibrated model includes adjustments to the Manning's roughness coefficient and the river bed elevation.

3.1.3 Model Improvements

The hydrotechnical assessment of the weir included simulations of breaching scenarios under extreme flows such as the 1:1,000 AEP flow. This scenario required a model configuration able to generate stable results under high flow conditions. It also required a modelling feature able to simulate a time-controlled failure of the structure triggered by specific water levels at Long Pond. These requirements lead to modifications of the computer model developed for the RRCSMP.

One of the changes consisted of increasing the resolution of the model domain from a 5 m to a 3 m grid in the upstream proximity of Long Pond's outlet and the downstream proximity of Allandale Road bridge.

Another adjustment involved changing the 1D modelling approach for the Long Pond weir in the RRCSMP Study to a 2D approach. The flow constriction caused by the weir in the 2D domain was modelled as a filled area with a crest elevation of 56.3 m with a 6 m opening. This model approach allowed the calculation of the energy losses introduced by the abrupt change in the flow stream lines at the inlet and outlet of the proposed structure. The modification also allowed the application of XPSWMM modelling tools to simulate a breach in the weir by changing the crest elevation based on user-defined conditions, such as water levels at a specific location.

The modifications also included modelling the Allandale Road Bridge as a 2D feature. This approach maintained the characteristics of the 2D flow, calculated upstream at the weir, through the bridge and the downstream area.

The RRCSMP computer model extended from the headwater of Ken Brook to Quidi Vidi Lake. However, simulations performed with the hydraulic model indicated that after installing the weir, water levels at Wicklow Street do not vary from those simulated for existing conditions. This observation led modelling efforts to focus on the river section extending downstream of Wicklow Street.

Excluding the weir, the modified model was re-calibrated to the flow rates, water levels and flood extents observed during Hurricane Igor. Once the calibration was completed, the weir was re-entered to complete the dam breach analysis.

3.2 Sizing of Weir Opening

3.2.1 Design Criteria

The Guidelines require that a minimum elevation difference of 1.45 m be maintained, during a 1:100 AEP Climate Change flow plus 30%, between the peak water levels at Long Pond and the entrance to the Health Science Centre (HSC) Utility Tunnel located near Clinch Crescent East. The elevation of the utility tunnel is 57.15 m; therefore, this requirement translates into maintaining a maximum water elevation of 55.7 m in Long Pond.

3.2.2 Design Event

During the RRCSMP Study the intensity-duration-frequency (IDF) curves for the St. John's International Airport climate station were updated to include precipitation up to 2012. The updated IDF curves include rainfall intensities for the 1:5, 1:10, 1:20, 1:50 and 1:100 AEP events for 5, 10, 15, and 30-minute and 1, 2, 6, 12 and 24-hour durations. In addition, precipitation amounts for each of these return periods and durations were estimated for the climate change scenario developed by Dr. Joel Finnis, Professor, Department of Geography, Memorial University of Newfoundland. Dr. Finnis' report describing the climate change projections is included in Appendix I. The projections developed for each return period listed for the 24 hour precipitation are presented in Table 3.1.

The alternating block method was used to synthesize the 1:5, 1:20, 1:50, 1:100 and 1:1,000 AEP 24-hour duration hyetographs for present climate conditions and the 1:100 AEP 24-hour duration hyetograph for climate change conditions. Figure 3.1 shows the resulting hyetographs.

Table 3.1: Return Period Values for 24-Hour Precipitation (mm)

AEP Event	24-hour Precipitation Amounts (mm)	Ratio to Updated IDF
1:5	98.3	1.15
1:10	116.3	1.14
1:20	133.5	1.12
1:50	155.9	1.09
1:100	172.7	1.07

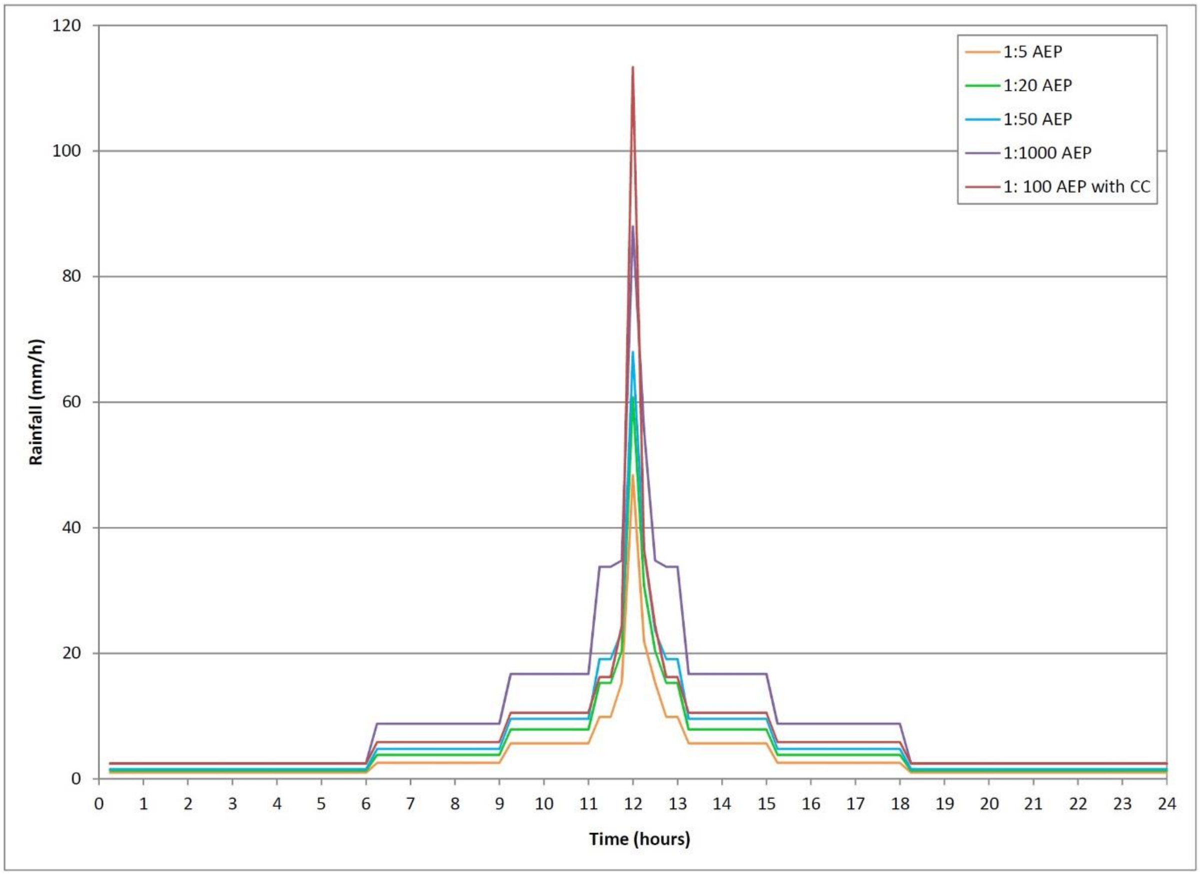

Figure 3.1: Synthetic Hyetographs Using the Alternating Block Method

3.2.3 Hydraulic Opening Design

The design of the hydraulic opening of the weir required the calculation of the peak water levels in Long Pond for the 1:100 AEP Climate Change flow and the 1:100 AEP Climate Change plus 30% flow. A range of opening widths were tested in order to identify a configuration that would meet the design criteria outlined in the guidelines while providing flood relief downstream of the weir. Table 3.2 summarizes the water levels and flows calculated for several opening sizes.

Table 3.2: Hydraulic Opening Analysis

Hydraulic Opening Width	Peak Water Level in Long Pond (m)		Peak Outflows (m^3/s)	
	1:100 AEP CC	1:100 AEP CC + 30%	1:100 AEP CC	1:100 AEP CC + 30%
4 m	55.9	56.6	42.5	55.5
6 m	55.5	55.9	45.9	61.4
10 m	55.3	55.7	47.5	64.8
23 m (equivalent to Allandale Road Bridge)	55.2	55.4	57.1	71.5

For the 1:100 AEP Climate Change plus 30% flow, a 4 m opening results in a water level in Long Pond above the maximum allowable level indicated in the guidelines. With a 6 m opening the

Long Pond water level is less than 55.7 m for the 1:100 AEP Climate Change flow, but rises slightly above the maximum allowed for a 30% increase in flow. A 10 m opening results in a water level in Long Pond that meets the Guideline requirement for both flow scenarios.

Figure 3.2 shows water level results at Long Pond for the 1:100 AEP Climate Change plus 30% flow with a variable weir width. The initial width of the opening is 6 m and increases to 10 m at an elevation of 55.5 m. These results indicate that installing a system designed to change the weir width in response to the water levels in Long Pond will reduce the 1:100 AEP Climate Change outflow from Long Pond while maintaining a peak water level of 55.7 m during the 1:100 AEP Climate Change plus 30% flow.

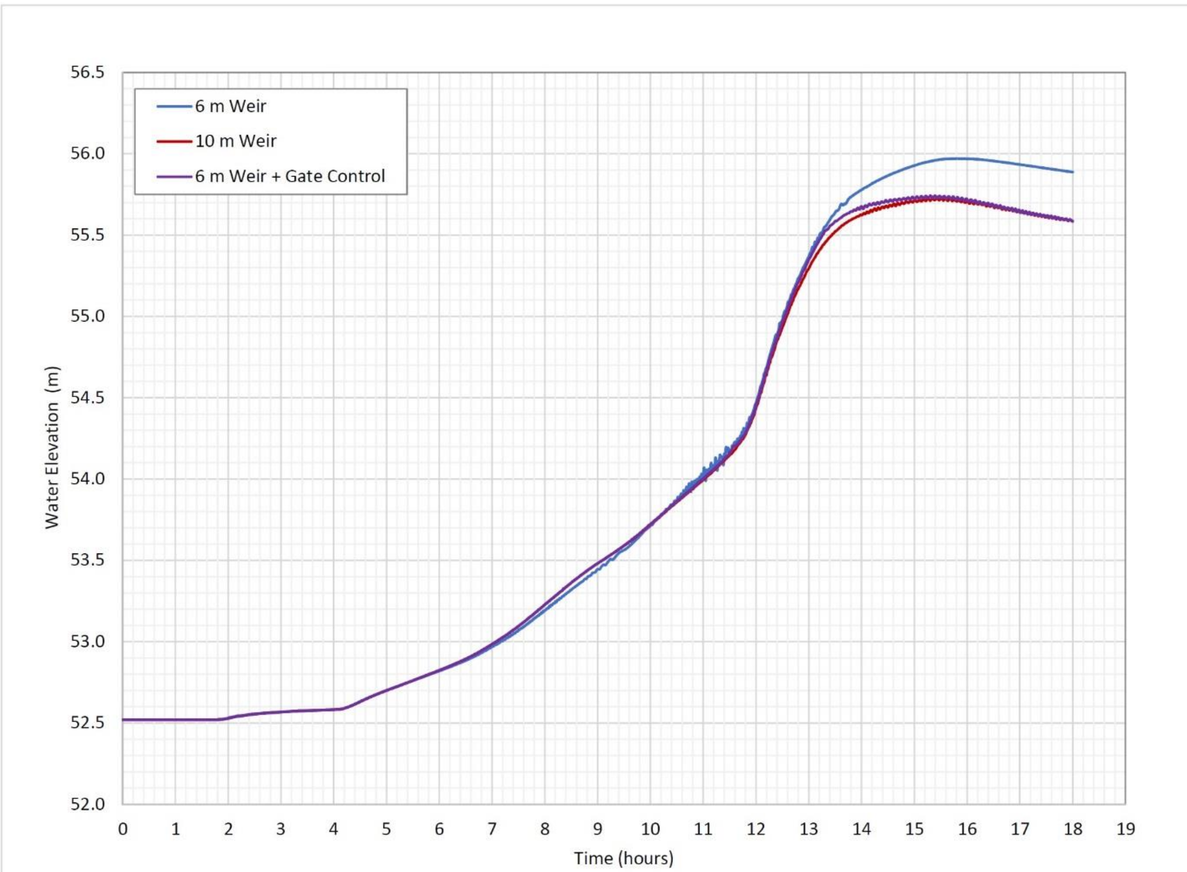

Figure 3.2: Water level Time Series for Variable Weir Width

3.3 Sensitivity Analysis

The sensitivity assessment consisted of evaluating the effect that changes in a set of hydrologic and hydraulic parameters cause to the peak flows and peak water levels at Long Pond. Sensitivity assessments allow one to estimate the effect that uncertainties in these parameters may cause in the values simulated by the computer models.

3.3.1 Hydrologic Model

The hydrologic parameters selected for the sensitivity analysis include the following:

- Average capillary suction,
- Initial moisture deficit,
- Saturated hydraulic conductivity,
- Subbasin width,
- Percent impervious area, and
- Manning's roughness values.

The 1:100 AEP Climate Change event for the existing development conditions was selected as a benchmark to evaluate the sensitivity of the flow to the variation of each parameter. Sensitivity analysis included changes of ± 10%, 20% and 30% of the parameter values used in the model calibration. Table 3.3 shows the percent variation of peak flow at Wicklow Street in response to the tested changes in the hydrologic parameters.

Table 3.3: Hydrologic Model Sensitivity Analysis

Parameter Variation	% Variation of Peak Flow at Wicklow Street					
	Average Capillary Suction	Initial Moisture Deficit	Saturated Hydraulic Conductivity	Subbasin Width	Percent Impervious Area	Manning's Roughness Values
30%	-0.06	-0.06	-0.06	12.04	14.30	-11.20
20%	-0.04	-0.04	-0.04	8.28	9.76	-7.88
10%	-0.04	-0.04	-0.04	4.31	5.61	-4.17
0%	0.00	0.00	0.00	0.00	0.00	0.00
-10%	0.04	0.04	0.04	-4.57	-5.73	4.74
-20%	0.04	0.04	0.05	-9.58	-10.86	10.19
-30%	0.07	0.07	0.07	-15.02	-16.80	16.56

The results indicate that the hydrologic model is most sensitive to changes in the percent impervious area, Manning's roughness values and subbasin width parameters. Decreasing the percent impervious by 30% decreases the peak flow by 16.8% (compared to the base case). A 30% reduction in Manning's roughness values increases the peak flow by 16.6%, and a 30% reduction in subbasin width decreases peak flow by 15%. Average capillary suction, initial moisture deficit and saturated hydraulic conductivity had the least effect on peak flow. A decrease in these parameters by 30% increased peak flow by only 0.7%.

3.3.2 Hydraulic Model

The sensitivity assessment of the hydraulic model consisted of evaluating the variation of the peak water levels in Long Pond to changes of ± 10%, 20% and 30% in the 2D Manning's coefficient values used for calibration. The 1:100 AEP Climate Change plus 30% flow for existing development conditions was selected as the benchmark to evaluate the sensitivity of the water levels. Figure 3.3 and Table 3.4 indicate that increasing Manning's roughness coefficients by 30% results in an increase in water level in Long Pond of only 0.2%.

The results of the hydraulic sensitivity analysis indicate that isolated changes in roughness coefficients downstream of Wicklow Street have a very small impact on the water level in Long Pond.

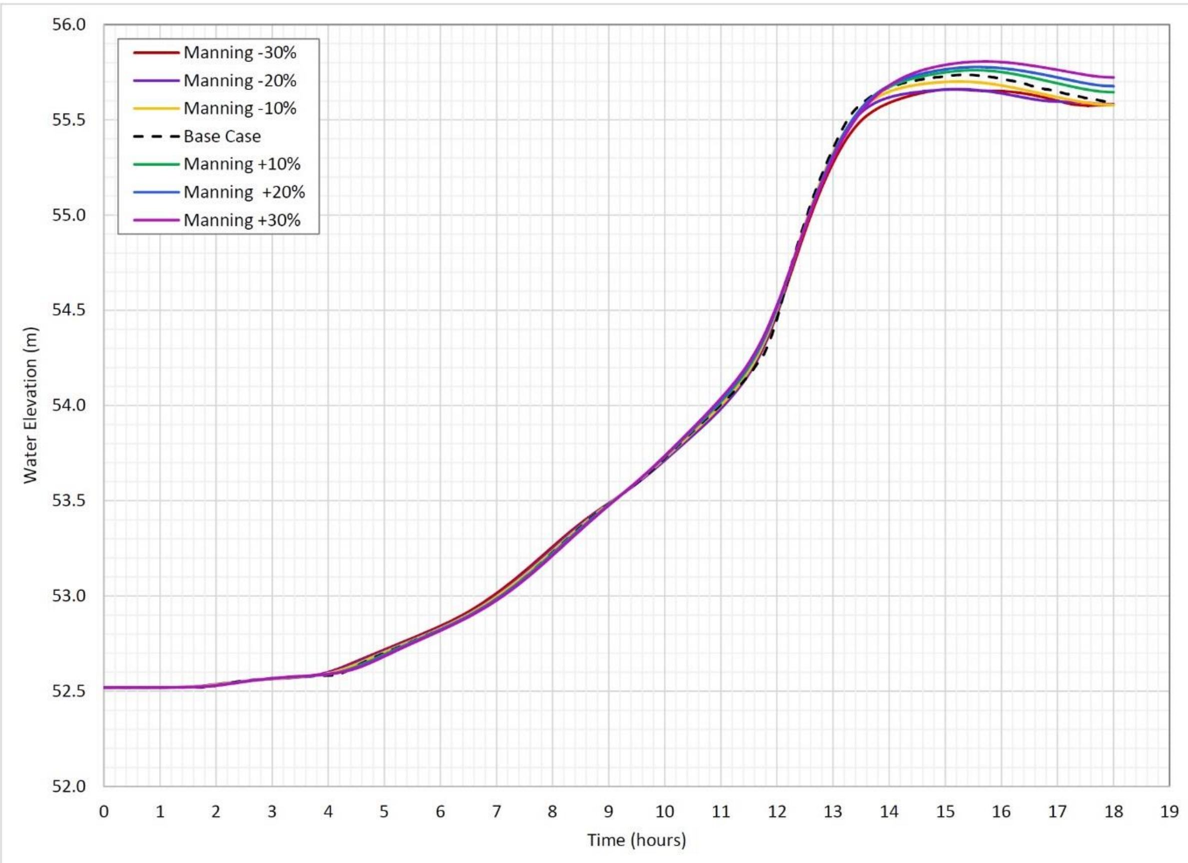

Figure 3.3: Peak Water level Time Series According to Variations in manning's Coefficient

Table 3.4: Hydraulic Model Sensitivity Analysis

2D Manning's Coefficient Variation	% Variation of Peak Water Levels at Long Pond
30%	0.19
20%	0.14
10%	0.11
0%	0.00
-10%	0.00
-20%	-0.07
-30%	-0.08

3.4 Stage-Discharge Analysis

Figure 3.4 illustrates the stage-discharge curve derived for the Long Pond weir using the XPSWMM model. For this calculation, a time series of linearly increasing flows was input in the model. Water levels in Long Pond at different time steps were extracted from the results and plotted against the peak flows calculated through the weir for the same time steps.

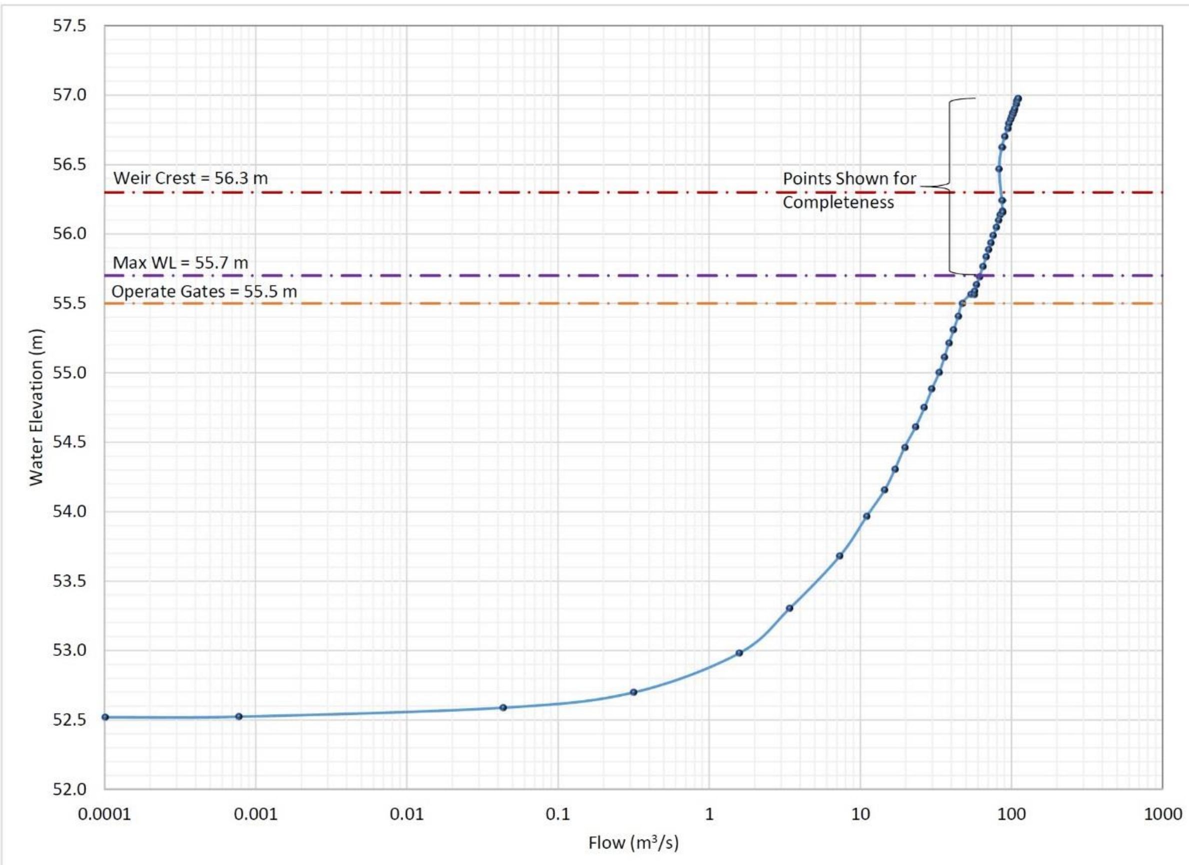

Figure 3.4: Estimated Stage-Discharge Curve for the Proposed Weir

The calculations indicate that when water levels in Long Pond reach an elevation of 55.7 m, the flow rate through the weir is approximately 64.8 m^3/s. The graph shows an inflection point when the flow control gates start opening as the water level reaches an elevation of 55.5 m. The curve also shows a second inflection point when water reaches an elevation of 56.3 m and overtops the weir. The points shown above elevation 55.7 m are included for completeness of the graph only; under design conditions the elevation in Long Pond does not exceed 55.7 m.

Changes associated with the random variation of watershed characteristics and weather conditions may influence the stage-discharge relation of the weir. Therefore, after construction of the proposed structure, the calculated stage-discharge relation will be validated through stage-discharge measurements. However, it is noted that the collection of field data during extreme events may be difficult and unsafe to perform. Therefore the application of graphical methods, correlation analysis, or numerical models may be necessary to extrapolate the stage-discharge relation during high flows.

3.5 Weir Breach Assessment

A fundamental component of the safety assessment of the proposed weir is the evaluation of the consequences of a failure of the structure. An estimation of the magnitude and severity of the consequences underlie the classification of the weir, according to the scheme presented in the CDA Dam Safety Guidelines. The classification system is used to define the design, and operation and maintenance standards of the dam. Table 3.5 present the design flood frequencies associated with each dam class. Calculations based on these design floods are used to estimate the forces and loads that the structure should be able to withstand to safely pass the design flows.

Table 3.5: Consequence Classes and Inflow Design Floods as per CDA Dam Safety Guidelines

Consequence Class	Inflow Design Flood
Low	1:100 AEP
Significant	Between 1:100 and 1:1,000 AEP
High	1/3 between 1:1,000 AEP and probable maximum flood
Very High	2/3 between 1:1,000 AEP and probable maximum flood
Extreme	Probable maximum flood

The CDA classification scheme is based on the estimation of the incremental consequences of failure. The guidelines define the consequences of failure as *"the total damage from an event with dam failure minus the damage that would have resulted from the same event had the dam not failed"*. Consequences of failure may include loss of life or injuries, damage to infrastructure and the environment, loss of economical assets and disruption of the lives of the population.

The characterization of the potential modes of failure of a weir (the hydrotechnical assessment of the flows and water levels and the associated inundation maps) provide extensive information about the type and magnitude of potential impacts and damages of a breach. The estimation of the incremental damages is based on a comparison of the hydraulic calculations and the inundation maps assuming a safe weir with those that result from a breach.

The following sections present the hydrotechnical assessment conducted to calculate the flows and the inundation maps that underlie the classification of the Long Pond weir.

3.5.1 Long Pond Weir Modes of Failure

The dam breach assessment as outlined in the CDA Dam Safety Guidelines (Section 2.5 and *Technical Bulletin: Inundation, Consequences and Classification for Dam Safety*), includes the evaluation of the following modes of failure:

- Sunny day failure: A dam failure during normal operations. Causes of this event include internal erosion, piping, earthquakes, mis-operation, etc. The intent of the sunny day failure is to address the consequences of a failure caused by piping when the water level reaches the maximum operational level, without overtopping. With the weir constructed, the maximum operational level (55.7 m) is caused by natural events resulting from heavy precipitation. For this reason, the mode of failure associated with the maximum operational level at Long Pond is henceforth referred to as *piping failure*.

- Flood induced failure: A dam failure caused by a natural flood greater than what the dam can safely pass. This failure mode is hereafter referred to as *overtopping failure*.

Each mode of failure is characterized by a set of breach parameters that include shape, width, depth, rate of formation and location within the structure. Golder Associates conducted the calculation of the breach parameters associated with piping and overtopping failures for the proposed Long Pond Weir. Table 3.6 summarizes breach parameters extracted from Golder Associates' report, found in Appendix J.

Table 3.6: Weir Breach Parameters Estimated by Golders Associates

Dam Breach Parameter	Piping Breach	Overtopping Breach
Average Width of Breach (BR) (m)	14.8	22.2
Bottom Width of Breach (BBD) (m)	11.1	18.5
Side Slope of Breach (ZBCH or S)	1.0	1.0
Time to Failure (TFH) (hour)	0.5	0.2
Elev. Breach Commences (HFDD) (m)	55.7	56.6
Bottom Invert (YBMIN) (m)	52.6	52.6

3.5.2 Piping Failure Simulation

The hydraulic model was edited to simulate a piping breach by changing the top elevation of the structure from 56.3 m to 52.6 m in a 30 minute period. The change in elevation was applied to a total breach width of 14.8 m, as per Table 3.6. The change in elevation was simulated using XPSWMM dynamic elevation tools. The tool triggered a breach when the water elevation at Long Pond reached 55.7 m.

Appendix K shows the floodplain, inundation and velocity maps prepared for the piping failure scenario. Maps are provided for both the breach and non-breach conditions. Golder Associates examined both conditions to determine the incremental damages of a piping failure to aid in assigning a classification to the Long Pond weir.

3.5.3 Overtopping Failure Simulation

The 1:1,000 AEP flood event was selected to simulate a breach in the Long Pond weir caused by overtopping failure. This breach was also modelled with XPSWMM, using the estimated breach parameters shown in Table 3.6. A water elevation of 56.6 m at Long Pond triggered a change in elevation of the structure from 56.3 m to 52.6 m over a period of 12 minutes. The change in elevation was applied to a total breach width of 22.0 m.

Appendix K also shows the floodplain, inundation and velocity maps prepared for the overtopping failure scenario. Floodlines are presented for the 1:1,000 AEP flow for breach and non-breach conditions. These results were used by Golder Associates to estimate the incremental damages resulting from an overtopping failure.

3.5.4 Dam Classification

The CDA Dam Safety Guidelines group dams into the following 5 classifications:

1. Low,
2. Significant,
3. High,
4. Very High, and
5. Extreme.

Each classification is based on 3 consequence categories; incremental losses associated with loss of life, losses of environmental and cultural values, and infrastructure and economic losses. The class of the dam is determined by the highest potential incremental loss resulting from the worst failure scenario (piping or overtopping failure).

Golder Associates, through review of the breach assessment, classified the Long Pond structure as ‘Significant’. Appendix L contains Golder Associates’ dam classification report.

3.6 Freeboard Analysis

According to the CDA Dam Safety Guidelines (Section 6.4 and *Technical Bulletin: Hydrotechnical Considerations for Dam Safety*), the distance between the crest of the weir and the still water level in Long Pond should prevent overtopping of large waves, such as caused by wind setup, wave runup and seiche. The total water level increase in Long Pond caused by a combination of each one of these processes was estimated following the procedures outlined in the CDA Dam Safety Guidelines and using hydrodynamic computer modelling.

3.6.1 Wind Wave Assessment

The Dam Safety Guidelines outline the following freeboard criteria for embankment dams:

- Normal freeboard: No overtopping by 95% of the waves caused by a 1:1,000 AEP wind when the water level in the reservoir is at maximum normal elevation;
- Minimum freeboard: No overtopping by 95% of the waves caused by a critical wind when the water level in the reservoir is at the maximum extreme level during the passage of the inflow design flood (IDF).

The critical wind and IDF for the minimum freeboard calculation are dependent on the consequence class of the dam. As discussed in Section 3.5.4, Golder Associates classified the Long Pond weir as ‘Significant’. As per the CDA Dam Safety Guidelines, the critical wind for a Significant class dam is the 1:10 AEP wind and the IDF is the 1:100 AEP Climate Change plus 30% flow.

Statistical assessments of wind records extracted from the MSC50 wave model hindcast, at different locations of Atlantic Canada, indicate that the 1:1,000 AEP wind speed in the region is approximately 27 m/s (97.2 km/h) and the 1:10 AEP wind speed is approximately 22 m/s (80 km/h). In Long Pond, the available fetch (i.e. the distance in the wind direction between the weir location and the opposite shore) is approximately 650 m. For this combination of factors, the Jonswap method of wave hindcasting computes a significant wave height (average of highest 1/3 of the waves in a wave train) of 0.34 m for a 1:1,000 AEP wind and 0.29 m for a 1:10 AEP wind. According to the Dam Safety Guidelines, the highest 5% of the waves is estimated as 1.37 times the significant wave height; resulting in 0.47 m and 0.40 m wave heights for the 1:1,000 AEP and 1:10 AEP winds respectively.

The stress exerted by the wind over a body of water causes water to build up on the opposite shore. This process is known as wind setup and results in an increase in the still water elevation. The equations given in the Dam Safety Guidelines results in a wind setup of 0.03 m in Long Pond for the estimated 1:1,000 AEP wind and 0.02 m for the estimated 1:10 AEP wind.
The maximum normal elevation in Long Pond is 55.5 m, achieved during a 1:100 AEP Climate Change flow. The combined action of wind setup and wave runup during maximum normal elevation results in a water level of 56.0 m. A maximum extreme level of 55.7 m during the passage of the 1:100 AEP Climate Change plus 30% flow, paired with the effect of a 1:10 AEP wind results in a water level of 56.1 m. Both criteria are below the proposed weir crest elevation (56.3 m), therefore, there is sufficient freeboard.

3.6.2 Seiche

The action of strong winds in closed bodies of water may result in water level oscillations known as seiches. The amplitude of these oscillations is also a consideration for establishing the freeboard of a dam. The potential water level fluctuations at Long Pond were investigated using the 2D computer model Mike 21. This software includes a hydrodynamic module that allows the calculation of the effect of wind forces over the surface of water. As shown in Figure 3.5, the model results indicate that water levels in the Long Pond tend to remain constant under the effect of a 27 m/s wind blowing for 6 hours. Therefore, overtopping by seiche fluctuations at Long Pond is not anticipated.

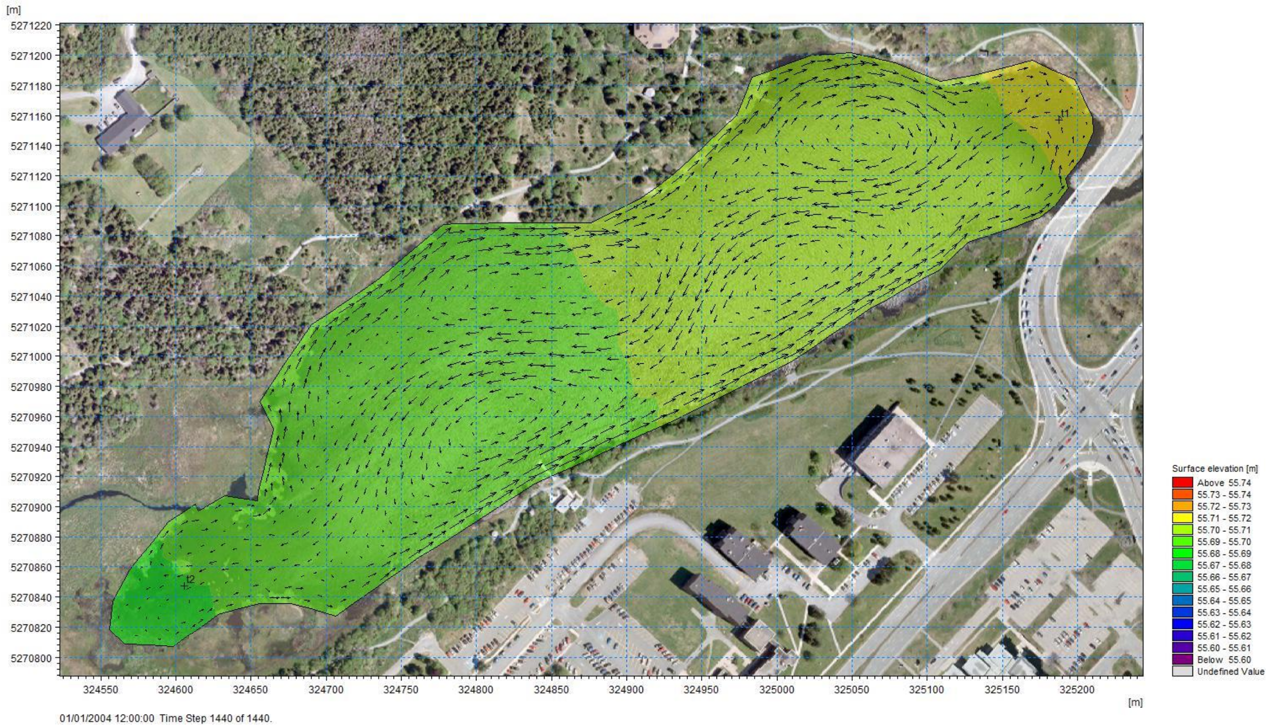

Figure 3.5: Hydrodynamic Model Results for a 27 m/s Wind for 6 Hours

CHAPTER 4 GEOTECHNICAL ASSESSMENT

4.1 Slope Stability Assessment

Golder Associates prepared the slope stability assessment, included in Appendix M.

4.2 Erosion Assessment

Golder Associates prepared the erosion assessment, included in Appendix M.

CHAPTER 5 CONSTRUCTION

5.1 Construction Schedule

Construction is expected to take place between June 1, 2016 and September 30, 2016. These dates correspond to the ‘project planning - timing window’ as recommended by the Department of Fisheries and Oceans while maintaining a 16 week construction schedule.

5.2 Construction Materials

The project will consist of a pre-cast concrete channel with a 6 m wide opening for flow conveyance and fish passage, two 2 m openings for high flow conveyance, and a rock fill berm. The invert of the channel will be consistent with the existing bottom of Long Pond (approximate elevation of 52.0 m). Rip-rap will be placed along the bottom of the concrete channel to replicate the natural channel, and to aid the passage of fish. The berm will be approximately 60 m long and 20 m wide (in direction of flow), with sloped (2H:1V) upstream and downstream faces. The berm crest elevation will be approximately 56.3 m, and have a width of approximately 3.0 m.

The berm will be constructed of rock fill, in accordance with Item 322 of the City’s Specification Book, installed in 500 mm lifts as per Item 321 of the City’s Specification Book. Items 321 and 322 are provided in Appendix N.

Two 2.0 m by 3.0 m stainless steel control gates will be installed in the 2 m openings with invert elevations of 52.3 m. The proposed control gates are Aquanox C Series open channel gates (an equivalent product may also be used). These gates are made of stainless steel and ultra-high-molecular-weight polyethylene (UHMWPE), ensuring the best corrosion resistance for a long life in tough environments. Appendix E contains more information on these gates.

A geosynthetic clay liner (GCL) will be used on the upstream side of the berm, under approximately 900 mm of cover. The proposed GCL is Terrafix Geosynthetics Inc.’s Bentofix Thermal Lock GCL (an equivalent product may also be used). The technical data and specification sheets for this GCL are provided in Appendix O. GCLs are often used as a hydraulic barrier, some of the benefits of GCLs include their successful use under high gradient conditions; relatively easy/quick installation; and ability to withstand stresses due to installation, elongation and settlement without significantly impacting hydraulic performance. GCLs are often used in dams, canals, ponds, rivers, lakes and landfill applications.

Rip-rap and a filter fabric will be placed on the upstream face of the berm to prevent erosion.

The pond outlet has a rocky bottom with aquatic grass, and grassed banks. Rip-rap protection will be placed downstream of the weir opening to provide erosion protection over the long term. The spaces between the large rocks used for rip-rap will also provide resting places for fish as they migrate through the weir opening.

5.3 Construction Details

During construction, temporary cofferdams will be used to create a dry working area. Water will be transferred from the construction site to a settling basin on the downstream side using pumps. The contractor will be required to develop a dewatering plan that includes environmental protection measures. The plan will give consideration to fish protection, and other special precautions regarding working around water bodies. As the work is being done for the City of St. John's, the contractor will have to adhere to Division 9, Environmental Requirements, of the City's Specifications Book. Division 9 is included in Appendix P.

The work area will be isolated using cofferdams. Settling basin(s) will be constructed downstream of Allandale Road bridge. Appendix E contains drawings showing a proposed dewatering scheme. The actual dewatering scheme used during construction may vary from that shown on the drawings. The water from the work area will be pumped to the settling basin before being released to Rennies River. Upon completion of construction the settling basin will be removed and the disturbed land reinstated.

All construction work will be contracted out.

5.4 Potential Resource Conflicts During Construction

Construction activities are expected to interfere with vehicular traffic along Allandale road for short durations throughout the construction period, and pedestrian traffic along Allandale Road, as well as short sections of the Long Pond walking trail. The contractor will be required to adhere to Division 7 of the City's Specification Book. Division 7 is included in Appendix Q.

The construction may also interfere with fish habitat and passage. As mentioned, the contractor is to adhere to the Environmental Requirements of the City's Specification Book, which also references the Fisheries Act.

Section 8 discusses potential sources of pollutants, environmental implications and mitigative measures to be considered during construction of the weir.

CHAPTER 6 OPERATION AND MAINTENANCE

6.1 Operation Of Weir

The weir will result in water being temporarily stored in Long Pond during a storm event and released at a flow rate lower than it would be without the weir in place.

The weir will be a permanent, 6 m wide, concrete channel, with two 2.0 m by 3.0 m stainless steel control gates. Under normal conditions, the gates will remain closed and flow will be limited to the 6 m wide channel. If/when the water elevation in Long Pond reaches 55.5 m, the control gates will be opened. Operating the gates in this manner will ensure the water elevation in Long Pond does not exceed 55.7 m during a flood as large as the 1:100 AEP Climate Change plus 30% event. The gates, described in Section 5, are operated manually.

Regular maintenance of the weir will be required, and will be the responsibility of the City of St. John's. Expected maintenance activities are similar to those for other hydraulic structures (culverts and bridges) within the City, most importantly ensuring the opening is cleared of debris, particularly when heavy rainfall has been forecasted.

The weir is not expected to produce any pollutants during normal operation.

An Operation, Maintenance and Surveillance (OSM) manual for the weir has been prepared by Golder Associates and is presented in Section 8.

6.2 Water Level Monitoring

An automated real-time water level monitor will be set up on Long Pond, at a location agreed upon by the City and the Department of Environment and Conservation's (DOEC) Water Resources Management Division (WRMD). The automated real-time monitoring program is a joint partnership between EC and DOEC. EC will install, calibrate and maintain the station. The real-time water level data will be used to the signal the need to open the flow control gates. The data will also be used to trigger the need to issue an alert to downstream residents as well as the Health Sciences Centre (HSC), Memorial University of Newfoundland (MUN), the Elaine Dobbin Centre and the Pippy Park Commission in the event of a high water level.

6.3 Duration of Water Retention After Weir Construction

Retention time is considered to be the amount of time that the water level in Long Pond is above the normal pond elevation of 53.2 m. The hydraulic model, discussed in Section 3, was used to generate a time series of water levels in Long Pond for the 1:5, 1:20, 1:50, 1:100 and 1:100 AEP Climate Change plus 30% flood events with the weir in place. The expected retention time for each return period was estimated as the time the water level in Long Pond is above the normal water level. Figure 6.1 illustrates the time series water levels, and Table 6.1 summarizes the estimated retention time for each design storm.

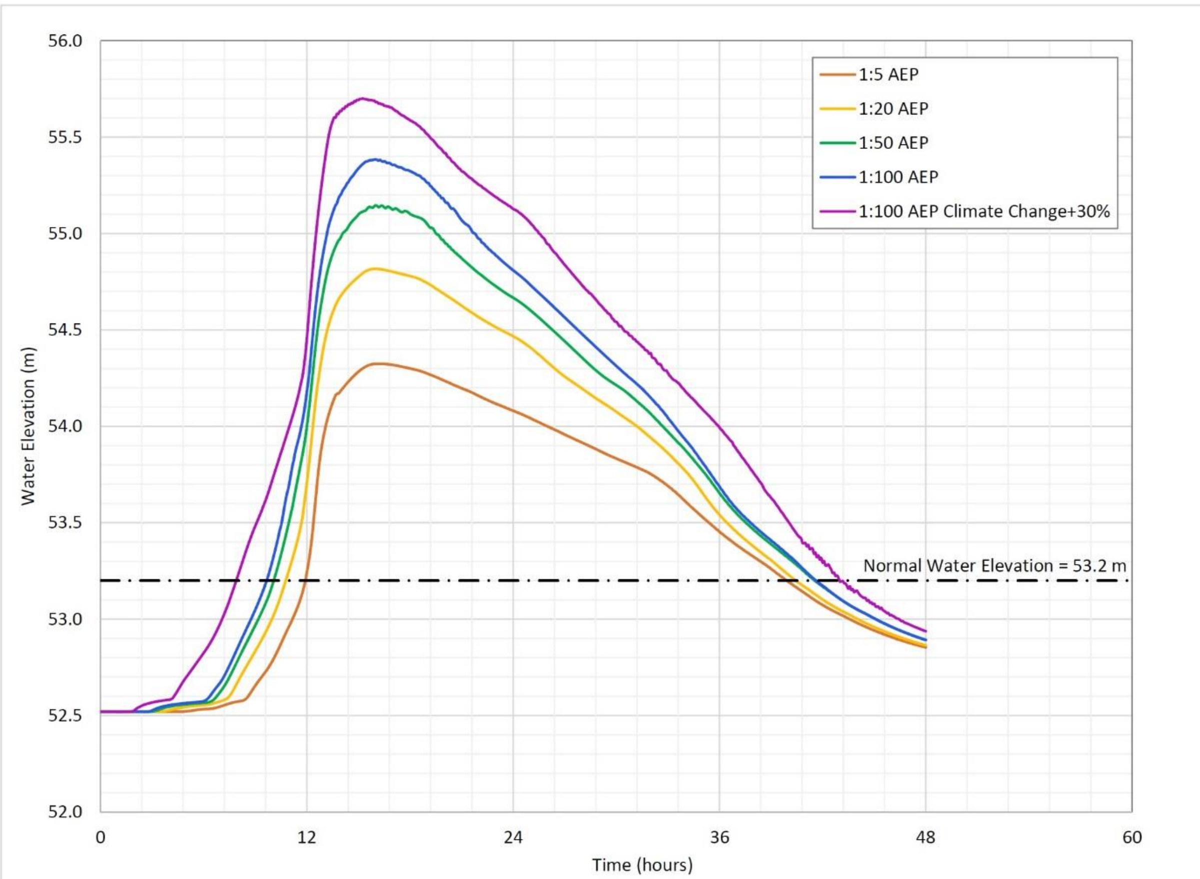

Figure 6.1: Water Elevation at Long Pond Time Series

Table 6.1: Retention Time in Long Pond for Extreme Events

Return Period	Retention Time (Hours)
1:5	28
1:20	30
1:50	31
1:100	32
1:100 AEP Climate Change + 30%	35

Table 6.1 shows that the 24 hour design rainfall used for these simulations result in a water elevation increase above 53.20 m for more than 24 hours. The retention time increases with the size of the storm.

6.4 Potential Effects on Adjacent Property

Floodplain maps have been prepared using the 1:5, 1:20, 1:50, 1:100 and 1:100 AEP Climate Change floods increased by 30%, for both pre- and post-construction of the weir. These maps are presented in Appendix R and help to illustrate the areas of flooding as a result of the weir. These maps were prepared assuming the flood control recommendations for the HSC, identified in the RRCSMP, have **not** been implemented. The maps show that the 1:5, 1:20, 1:50, and 1:100 AEP flows increased by 30% result in flooding of the walking trails around Long Pond and the wharf of the Splash Facilities prior to the weir construction. The maps show the construction of the weir causes a small increase in the inundated area around Long Pond under these flow scenarios. The 1:100 AEP plus 30% flow also causes flooding of Prince Philip Drive. However, there is no increase in inundated area upstream of Clinch Crescent east as a result of the weir construction for each of the flood events examined, as demonstrated by the coincident pre- and post-construction floodlines upstream of Clinch Crescent east. The floodplain map for the 1:100 AEP Climate Change plus 30% flow for existing conditions also shows flooding of the walking trails and wharf as well as flooding of Clinch Crescent west, Clinch Crescent east, Prince Philip Drive and Artic Avenue. As illustrated on this map, the construction of the weir increases the flooding around Long Pond slightly. As with the smaller flood events, the inundated area upstream of Clinch Crescent east does not increase as a result of the weir construction, as illustrated by the coincident floodlines in that area. To further illustrate the impacts of the weir on flooding, a profile was created extending from Allandale Road bridge to the duck pond between Clinch Crescent west and Clinch Crescent east, and is shown in Figure 6.2.

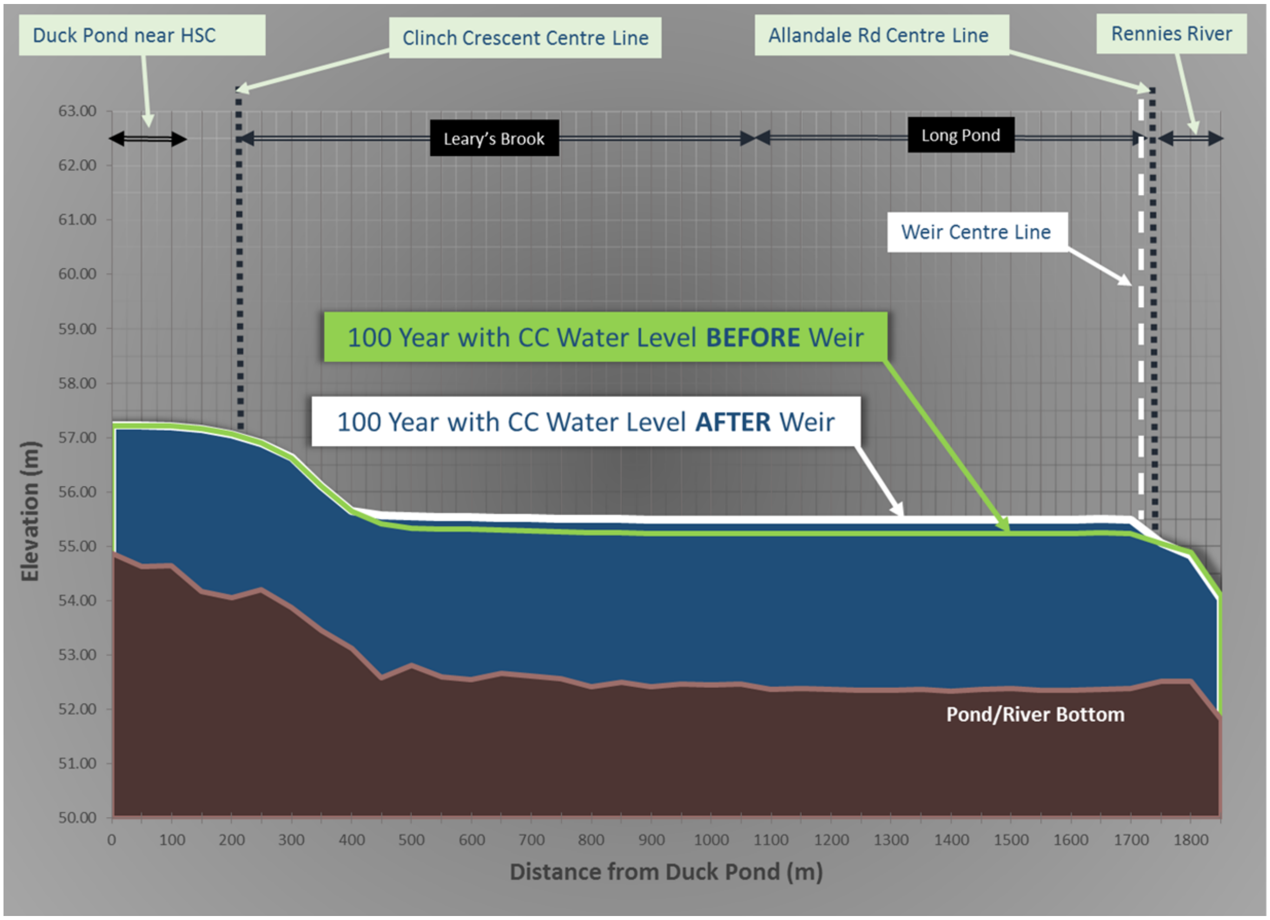

Figure 6.2: Elevation Profile

6.4.1 Wetlands

There are areas of wetland fringing Long Pond along much of its southern perimeter, and a large area of wetland surrounding the pond inlet at its western extremity. Based upon the vegetation and hydrological conditions observed at the site, the wetland areas in question are classified as marsh. Marshes, by their definition in the Canadian Wetland Classification System (National Wetlands Working Group, 1997), are shallow water wetlands whose water levels usually fluctuate daily, seasonally or annually in response to tides, flooding, evapotranspiration, groundwater recharge or seepage losses. In the case of the marsh at Long Pond, the hydrological fluctuations are predominantly attributed to stormwater inputs; these may be sourced both from overland flow directly into Long Pond, and from points upstream delivered via Learys Brook.

Figure 6.3: Typical Wetland Fringe Conditions on South Shore of Long Pond - Looking West

Tree cover in marshes is non-existent, and shrub cover is generally sparse, where it exists. The most common shrub species encountered in marshes within the Province include speckled alder and sweet gale. Vegetation is typically dominated by emergent herbaceous species such as grasses, sedges and cat-tails (Typha spp.); while one species is most commonly dominant, these sites may be quite species rich, owing to their nutrient laden waters. Bluejoint (Calamagrostis canadensis), bottle-brush (Sanguisorba canadensis), blue-flag iris (Iris versicolor), sensitive fern (Onoclea sensiblis) and tall meadow rue (Thalictrum pubescens) are all relatively common marsh components in Newfoundland and Labrador. In areas where there is shallow open water not dominated by other vegetation, emergent and floating-leaved vegetation may occur, such as pond lily (Nuphar variegata), pondweeds (Potamageton spp.) and bur-reed (Sparganium spp.).

Given that the hydrological regime of marshes consists, by definition, of a fluctuating water table, it is anticipated that the changes in hydrology brought about by the Long Pond weir will not result in major functional changes to the wetland areas surrounding Long Pond. The wetland will continue to deliver a variety of services to the watershed as it does presently, including stormwater retention, water quality maintenance, biodiversity, as well as scenic and recreational values.

It is not anticipated that the weir will result in a net decrease in wetland area, whether in terms of direct construction impacts, or operational impacts. Rather, it is plausible that a minor net increase in wetland may occur. The increased elevations of peak flood events may result in additional areas which are presently non-wetland becoming periodically inundated, and arguably such areas are a functional extension of the wetland; whether or not such areas are inundated for a sufficient duration to achieve permanent wetland characteristics (particularly hydric soils, and in turn a dominance of wet-tolerant vegetation) remains unknown.

Industry best-practices should be implemented during the construction of the weir, in order to mitigate against any undue damage to wetlands and their contained species. These will include the implementation of a sediment and erosion control plan, which will dictate the deployment of appropriate sediment control measures on-site, and ensure ongoing monitoring and maintenance of these through to construction completion and commissioning.

6.5 Stormwater Detention Policy

In January 2013 the City implemented its stormwater detention policy; frequently referred to as the zero net increase in runoff policy. The objectives of the policy are to reduce increases in downstream flooding, resulting from land development, by temporarily storing the increased runoff volume and releasing it at the pre-development runoff rate. Appendix S contains a copy of the Stormwater Detention Policy.

The policy discusses both on-site and regional stormwater detention facilities. Regional facilities service larger land areas with multiple land uses, such as neighboring residential and commercial areas. In contrast, on-site facilities are utilized on a smaller scale, such as subdivisions or even individual properties, and tend to ignore the characteristics of the overall watershed.

In 2012, CBCL carried out the Regional Stormwater Detention Feasibility Study for the City of St. John's. The scope of the study included identifying suitable catchment areas for regional detention, determining the volume of runoff to be stored and appropriate outlet control structures, and preparing preliminary designs. The study identified three potential locations for regional detention facilities, one in the Rennies River catchment, on Yellow Marsh Brook, approximately 750 m upstream of the crossing at Team Gushue Highway. One of the recommendations of the study was to proceed with the construction of a detention facility at that location.

The model developed for the RRCSMP, and used for the Long Pond weir design, considered the implications of the City's stormwater detention policy. The City has enforced the stormwater detention policy since January of 2013.

CHAPTER 7 ALTERNATIVES

Table 7.1 describes alternative methods that are technically and economically feasible to reduce flooding in Rennies River. The reasons these alternatives were rejected in favor of the Long Pond weir project are also discussed in the table.

Table 7.1: Alternative Flood Control Methods

Alternative	Location	Reasons for Rejection
Conveyance capacity upgrades: 1. Culvert/bridge upgrades;	1. Culvert/bridge improvements were recommended at several locations along the river, as described in Section 7.2.	1. Increasing the size of culverts and bridges is not practical at all locations due to space limitations (examples include developed adjacent property, and existing infrastructure). In addition, at some locations the flooding is a result of water level exceeding the river banks, and is not affected by the bridge size (for example between Clinch Crescent west and east).
2. Berms;	2. Berms are proposed for several locations along the river as described in Section 7.2.	2. The use of berms is not practical at all locations due to space restrictions.
3. Channel widening and deepening.	3. Near the intersection of Portugal Cove Road and Rennies Mill Road.	3. Channel widening/deepening was rejected as these activities are not accepted/permitted by DFO.
Storage to reduce flows: 1. Increase storage in existing water bodies;	1. Water bodies within the Rennies River drainage area (other than Long Pond).	1. No other existing water bodies (besides Long Pond) within the Rennies River catchment capture a significant drainage area/flow to make storing runoff feasible.
2. Regional storm water detention facilities.	2. Headwaters (i.e. west of Team Gushue Highway).	2. As noted in the *Regional Stormwater Detention Feasibility Study,* 4 of the 5 sites identified for regional detention were rejected due to insufficient storage as a result of existing infrastructure.

7.1 Selected Construction Materials

The main advantage of using earthen materials over concrete to construct the berm is the reduced cost. Also, construction duration is likely to be shorter; this is important from an environmental perspective as there is less chance of harmful substance entering the river as a result of prolonged construction activities. In addition, it is less likely to exceed the timing window for working in a watercourse as set out by DFO.

7.2 Importance Of Weir

The RRCSMP Study identified the following channel improvements:

- **Priority 1 - Outlet of Long Pond:** The most significant flood protection improvement is the weir located at the east end of Long Pond. The major benefit of the weir is that the peak flows and flood levels downstream of Long Pond will be reduced. The reduction in flood levels downstream allow for the berms and/or walls proposed at downstream locations to be achievable heights. Therefore, in order to realize these benefits, the weir must be constructed before the other downstream improvements.
- **Priority 2 - Kings Bridge Road to Portugal Cove Road & Upstream of Portugal Cove Road Bridge:** Three options for flood control are presented for the river section between Kings Bridge Road and Portugal Cove Road and immediately upstream from the Portugal Cove Road Bridge. The final decision regarding which of the options to implement will be made by the Department of Planning, Development and Engineering’s senior management in consultation with Council.
  For the river section above Portugal Cove Road, the existing trail on the north side of the river will have to be raised in order to accommodate the flood protection wall; otherwise, property at the rear of the yards along Pringle Place would be required to allow for the construction of a wider earth berm.
- **Priority 3 - Upstream of Capasian Road:** An earth berm is recommended for the north side of the river section above Carpasian Road.
- **Priority 4 - Clinch Crescent East to Clinch Crescent West:** Earth berms and a concrete wall are recommended for the river section from Clinch Crescent East to Clinch Crescent West.
- **Priority 5 - Wicklow Street to Thorburn Road:** Earth berms and a concrete wall are recommended for the river section from Wicklow Street to Thorburn Road. The preliminary design for this location requires that the height of the headwall and wing walls of the existing bridge be increased by approximately 0.8 m.
- **Priority 6 - Upstream from Avalon Mall Culverts:** It is recommended that the concrete headwall be raised. The total length is approximately 100 m.
- **Priority 7 - O’Leary Avenue Bridge:** It is recommended that the O’Leary Avenue Bridge be replaced to accommodate future flood flows. The preliminary design for this replacement includes pre-cast structural culvert sections similar to those used for the Pippy Place Culvert replacement. In addition, an earth berm is required for the left bank of the downstream side of the bridge.
- **Priority 8 - Downstream of Mews Place Culvert:** An earth berm is recommended for the right bank of the downstream side of the Mews Place Culvert.

Without the weir on Long Pond the recommended downstream improvements (priorities 2 and 3) do not work. The walls and berms at those locations would have to be so large/high that they become impractical. Since there is limited space in the downstream reach to construct flood control structures, it is necessary to reduce the peak flow by the use of the weir. Therefore, the weir must be constructed prior to the downstream improvements being implemented.

The remaining channel improvements (priorities 4 to 8) are recommended in the downstream to upstream sequence. The RRCSMP Study showed that there is significant flooding downstream of Long Pond during a less severe flood (i.e. 1:20 AEP event), whereas the flow in the upstream reach is mostly contained in the channel. This is illustrated in Appendix T. Therefore, the recommendations were prioritized from downstream to upstream.

7.3 Upstream Flood Control Structures

The RRCSMP recommended two flood protection improvements be implemented in the vicinity of the HSC; a flood control weir at the bottom of Long Pond, and berms located along the south and north banks of Leary's Brook just upstream of the Clinch Crescent East Bridge.

In March of 2015, Eastern Health engaged CBCL Limited to review potential flooding issues around the HSC in more detail. The analysis completed as part of the RRSCMP formed the basis for this assignment.

The original scope of work for the assignment included the following:

- Determine the effect that the existing Clinch Crescent East Bridge has on the upstream water level during the 1:100 AEP flood event. The XPSWMM model prepared for the City of St. John's was used to ascertain the increase in water level.
- If required, recommend upgrades that could be implemented at the bridge to reduce upstream water levels during peak flow events.
- Determine the effect that the 1:100 AEP flood event has on existing sanitary and storm sewers in the vicinity of the section of Leary's Brook that runs adjacent to the Health Sciences Centre.
- If required, recommend upgrades that could be implemented to reduce the effect that flooding has on the existing sewers.
- Investigate the potential effect of flooding on the utility tunnel located downstream from the Clinch Crescent East Bridge.
- If required, recommend upgrades for the tunnel.

In addition, the effect that the proposed flood control weir at the bottom of Long Pond would have on water levels in the immediate vicinity of the HSC was also reviewed. A copy of the report is included in Appendix U.

The analysis showed that increasing the opening of the Clinch Crescent east bridge does not significantly reduce the flood level in the vicinity of the HSC.

It was also observed that water levels remain the same along the river section from Clinch Crescent East to Clinch Crescent West with or without the weir at the outlet of Long Pond. This is illustrated in profiles of Figures 2A and 2B of the *Leary's Brook Investigation* report (Appendix U). In the 1:100 AEP design event, berms are able to successfully contain water throughout the river.

7.4 Operation And Maintenance

The original design of the weir was a 4 m a wide concrete channel with no mechanical or electrical parts. This design was capable of passing the 1:100 AEP Climate Change flow, while maintaining a water level of 55.7 m in Long Pond. The Guidelines have increased the flow requirement by 30% while still maintaining a maximum water level of 55.7 m. The design of the weir has therefore changed to accommodate this increase in flow. The current design is a 6 m wide channel, with two (2.0 m x 3.0 m) gates with sill elevation of 52.0 m. The gates will normally be in the closed position, but will be opened when the water level in Long Pond reaches an elevation of 55.5 m. This operation will ensure the water level in Long Pond does not exceed elevation of 55.7 m during a flood event as large as the 1:100 AEP Climate Change plus 30%.

CHAPTER 8 POTENTIAL ENVIRONMENTAL EFFECTS AND MITIGATION

8.1 During Construction

Potential sources of pollutants during construction include soil erosion, sedimentation, siltation and fuels from machinery entering the watercourse.

As mentioned previously, the work is being done for the City of St. John's, therefore the contractor will have to adhere to Division 9, Environmental Requirements, of the City's Specifications Book. This specification gives instruction regarding the following:

- Provincial and federal legislative requirements to be followed.
- Protection of watercourses and waterbodies, including clearing and grubbing adjacent to watercourses, installing watercourse crossings, pouring concrete in or adjacent to a watercourse, control and treatment of silted water, and fill placement in waterbodies.
- Storage and handling of fuels and other hazardous, toxic or dangerous materials. This specification section includes information regarding spill reporting and cleanup procedures, fuel storage and handling procedures, equipment servicing procedures, and the use of hazardous, toxic and/or dangerous material.
- Waste management, including solid waste disposal and sanitary facilities and sewage disposal.
- Dust control.
- Equipment operation and prevention of erosion and siltation, including stormwater management, temporary travel routes, erosion and silt control measures, and limitation of operation.
- Protection of vegetation and wetlands, including instructions regarding maintaining natural drainage patterns, protecting trees and shrubs, equipment travel off right-of-way, and bogs and wetlands.
- Revegetation, such as revegetation for surface stabilization, planting trees and shrubs as well as planting methods and maintenance.
- Protection of historic resources.

Prior to commencing construction, erosion and sediment control measures will be put in place. For instance, a settling basin(s) will be constructed which will receive the water being pumped/diverted from the site such that sediment is filtered out prior to the water entering Rennies River. The construction of the settling basin will be in accordance with City Specification 915.05, 915.07 and 945.03. The contractor is also required to ensure water discharged from the settling basin meets the water quality standards of the provincial Environmental Control Water and Sewage Regulations, as per Specification 915.02. The proposed location of the settling basin(s) is downstream of Allandale Road bridge. Appendix E illustrates the proposed location.

As per Specification 915.05 the contractor is responsible for continuous monitoring of the sedimentation basin(s) to ensure proper functioning, and perform maintenance as required. Upon completion of the project, the site of the sedimentation basin(s) shall be returned to its original condition, by pumping it dry, then backfilling with the original excavated material and compacted. Where required hand seeding, hydroseeding, and/or sodding of disturbed areas shall be carried out to return the sediment basin site to its original condition.

The 6 m wide channel and frames for the two 2 m wide flow control gates will be constructed of pre-cast concrete. The structure will be produced offsite by casting and curing the concrete in a controlled environment. It will then be transported to the site and lifted into place. As no fresh concrete will be poured in or near Long Pond or Rennies River, the potential environmental impacts resulting from such lime-containing construction material entering the aquatic environment is minimized.

During non-working hours (weekends, etc.), the contractor will ensure that equipment is checked regularly and performing properly.

Sub-section 920.03 and 920.04 of the City's Specification book discuss the procedures for fuel storage and handling and equipment servicing, respectively. Under sub-section 920.03, fueling or servicing of mobile equipment is prohibited within 100 m of a waterbody, or wetlands. Similarly, the storage of any oils, greases, gasoline, diesel, hydraulic and transmission fluids or other fuels is to be a minimum of 100 m from a waterbody or wetland. Activities related to the storage, handling and disposal of used oils are to follow the Used Oil Control Regulation of the NL Environmental Protection Act. It is the contractor's responsibility to ensure all equipment is mechanically sound to avoid the potential of leaks. Fueling, servicing or washing of equipment is prohibited within 100 m of a waterbody. It is the contractor's responsibility to remove and properly dispose all waste oil, filters, containers or other such waste from the work site.

The contractor is to adhere to sub-section 920.02 of the City's Specification book with regard to spill reporting and cleanup procedures. As per this sub-section, the contractor shall take ensure precautions are taken to reduce the likelihood of fuel, or other hazardous material, spills. In the event of a spill of 70 liters or more the contractor is to attempt to stop the leak and contain the material, immediately report the spill to the Canadian Coast Guard spill report number (772-2083) pesticides control section (729-3395) and the owner (City), remove the spilled material by absorbent, pumping, burning or other approved method, clean up the area to Government Services Center standards, and dispose of the contaminated material at an approved disposal site. After cleaning up the spill, the contractor is to prepare a written report detailing the cause of the spill, action taken, estimate of contamination, and any further action required and provide it to the City.

For spills less than 70 liters the contractor is responsible to dispose of the contaminated soil in accordance with the directions given by the Government Services Centre.

In addition a suitable quantity of absorbent material (Oclansorb or equivalent product) is to be kept on site, and contractor's staff is to be made aware of its location and application.

The contractor will minimize their fuel usage because using less fuel will save them money.

As demonstrated in Section 6.4, the weir does not cause increased instances of flooding at the HSC, the Elaine Dobbin Centre or MUN. The weir will cause increased flooding of the Long Pond walking trail during storm events. However, temporary flooding of the trail is currently experienced during storm events. The floodplain maps provided in Appendix R illustrate the incremental increase in trail flooding.

8.1.1 DFO Requirements

DFO provided the City with a list of items to be included in the construction and operations plans to minimize the effects of the project on fish. DFO's letter is included in Appendix F. Table 8.1 summarizes the requirements set out by DFO and the measures that will be taken during the weir construction and operation to address these requirements.

Table 8.1: DFO Requirements and Proposed Mitigation Measures

DFO Requirement	Proposed Mitigation Measure
Carry out all in-stream work between Jun 1 and Sep 30 and during low flow periods	Limit construction season to dates given. Changing the berm material from concrete to earth is also expected to reduce the construction schedule.
Avoid or reduce release of suspended sediment	The work area will be isolated using cofferdams. Settling basin(s) will be constructed downstream of Allandale Road bridge (as indicated in Appendix E). The water from the work area will be pumped to the settling basin before being released to Rennies River. Upon completion of construction the settling basin will be removed and the disturbed land reinstated.
Relocate fish trapped in the dewatered work area to Long Pond or Rennies River	Fish will be moved from work areas to pond using proper handling techniques, such as nets.
Maintain natural flows downstream of construction site at all times	It is proposed to construct the south portion of the weir and berm first, leaving the north section open for flow. The cofferdam will then be constructed for the north side, and the south side cofferdam removed. During construction of the north portion of the berm, flow will be released downstream through the weir. This construction sequence will allow natural flow downstream at all times.

DFO Requirement	Proposed Mitigation Measure
Flow specifications to meet those set out in the report by Thaumas Engineering	The weir has been designed to meet the flow specifications set out in the *'Report on Fish Passage at the Proposed Long Pond Weir, Rennies River, St. John's, NL'.*
Place rip-rap in the weir and downstream	Rip-rap will be placed along the bottom of the 6 m wide concrete channel, as well as in the natural channel downstream of the weir to aid the passage of fish.
Verify fish passage is maintained during first year of operation.	Flow rates through the weir are to be measured for the first year of operation. This flow monitoring program is described in Section 2.4.1. The City will provide the results of the program to DFO within 3 months of the end of the first year of the weir's operation. The report will be used to verify that fish passage is maintained.

8.2 Dam Risk Management Measures

The CDA Dam Safety Guidelines, and associated Technical Bulletins, provide *"guidelines that outline processes and criteria for management of dam safety"*. The following dam risk management measures have been prepared for the Long Pond weir project by Golder Associates:

- Emergency Preparedness Plan (EPP);
- Emergency Response Plan (ERP);
- Dam Operation, Maintenance and Surveillance Manual (OMS Manual);
- Hazard Identification and Risk Assessment (HIRA); and
- Self-assessment tool for the City of St. John's.

Appendices V through Z contain these reports as prepared by Golder Associates. Other related items outlined in the Guidelines include an inspection program and dam safety review schedule which are incorporated in the OMS Manual, as well as a testing schedule for the EPP which is included in the EPP report.

CHAPTER 9 PROJECT RELATED DOCUMENTS

The following reports have been prepared for, or referenced during, the design of the project:

1. CBCL Limited. April 2014. *Rennies River Catchment Stormwater Management Plan – Final Report.* Prepared for City of St. John’s.
2. CBCL Limited. February 2013. *Regional Stormwater Detention Feasibility Study – Final Report.* Prepared for City of St. John’s.
3. City of St. John’s Department of Engineering. *Specifications Book.*
4. City of St. John’s Department of Engineering. *Subdivision Design Manual.*
5. City of St. John’s Department of Engineering. *Stormwater Detention Policy.*
6. Golder Associates Ltd. February 2016. *Long Pond Weir – Emergency Preparedness Plan.* Prepared for CBCL Limited.
7. Golder Associates Ltd. February 2016. *Long Pond Weir – Emergency Response Plan.* Prepared for CBCL Limited.
8. Golder Associates Ltd. February 25, 2016. *Long Pond Weir – Hazard Identification and Risk Assessment.* Prepared for CBCL Limited.
9. Golder Associates Ltd. February 2016. *Long Pond Weir – Operation, Maintenance and Surveillance Manual.* Prepared for CBCL Limited.
10. Golder Associates Ltd. February 25, 2016. *Long Pond Weir – Self-Assessment Tool.* Prepared for CBCL Limited.
11. Golder Associates Ltd. December 2015. *Report on Long Pond Weir – Classification Canadian Dam Association.* Prepared for CBCL Limited.
12. Golder Associates Ltd. November 2014. *Report on Proposed Weir Structure – Long Pond St. John’s, NL*. Prepared for CBCL Limited.
13. Golder Associates Ltd. March 2016. *Slope Stability and Internal Erosion Assessment – Long Pond Weir, St. John’s, NL*. Prepared for CBCL Limited.
14. H.T. Kendall and Associates Ltd. October 2002. *Ken Brook and Leary’s Brook Floodplain Delineation Study.* Prepared for City of St. John’s.
15. Kendall Engineering Ltd. August 2006. *Quidi Vidi Lake Tributary Flood plain Delineation.* Prepared for City of St. John’s.
16. Thaumas Environmental Consultants Ltd. December 2014. *Report on Fish Passage at the Proposed Long Pond Weir, Rennies River.* Prepared for CBCL Limited.

CHAPTER 10 REQUIRED APPROVALS

The following items have been submitted for approval:

1. Fisheries Protection Program Request for Review (Fisheries and Oceans Canada).
2. Permit to Alter a Body of Water and corresponding Schedules A and H (Department of Environment and Conservation).

The construction of the weir is also dependent on the approval of the Pippy Park Commission, and the decision of the Minister of the Department of Environment and Conservation.

CHAPTER 11 PUBLIC INFORMATION MEETING

A Public Information Session was held on Wednesday, November 18, 2015 at 7:00 p.m. in the Foran/Greene Room, 4th Floor City Hall.

In Attendance:

- Deputy Mayor Ron Ellsworth
- Councillor Sandy Hickman
- Councillor Danny Breen
- Scott Winsor, Manager of Construction Engineering
- Dave Wadden, Manager of Development Engineering
- Consultants from CBCL Limited: Greg Sheppard and Jennifer Bursey
- Karen Chafe, Supervisor of Legislative Services
- Kenessa Cutler, Legislative Assistant

Also present were approximately 18 people from the general public.

The purpose of the session was to discuss the proposed Long Pond Weir Project. The consultants conducted a thirty five minute power point presentation, a copy of which is attached in Appendix AA. This was followed by a question and answer session during which the following points were made:

- Mrs. Judy Gibson raised concerns about the weir's impact on the walking trail. If the trail floods as a result of the weir will the City maintain it? She also voiced environmental concerns stating that with the rise and fall of the water, fish may be unable to spawn. The consultant advised that when flooding occurs, parts of the trail will indeed flood, but only for a short period of time. He also advised that several scientists have reviewed the proposed structure and it was designed in accordance with preserving the fish. Also, the construction of the structure will not impact the fish species in the pond.

- One resident asked if there were any alternative locations in which to place the detention facilities. The consultant stated the Long Pond is the only option.

- How far back does the backwater go? Will it flood the hospital as a result? The consultant stated that due to the location of the hospital, it may flood, but it will not be a result of backwater from Long Pond or the proposed weir.

- Will there be increased pressure on the water table resulting in water coming up through the foundation of the hospital causing flooding? The consultant indicated that that was not looked at but could be investigated during detailed design.

- With respect to flood control measures downstream of Long pond, some felt that the aesthetics of the weir and berms were unattractive, particularly along the walking trail and it was suggested that consideration be given to building a sloping structure instead. The consultant noted that there is not enough room for the width required of a sloping structure and that there are various decorative options that can be considered to hide the concrete face. The consultant also noted that a sloping structure would encroach upon private property.

- Mrs. Judy Gibson questioned the reliability of earth levees, saying that if they failed during Hurricane Katrina in New Orleans, they will fail here too. She further commented that she is disappointed that the City is putting too much emphasis on engineering and money and not enough on the environment. The consultant stated that temporarily storing the water from extreme rainfall events is quite environmentally friendly and reduces the risk of erosion. He also stated that if properly engineered, earth levees or dams do work.

- One resident expressed support of the proposed project stating that he appreciated that the City is trying to fix ongoing flooding issues that have resulted from upstream development.

- The consultant was asked to clarify the 30% value mentioned during the presentation. He stated that the 30% value represents rainfall amounts over and above expected 100 year flows which already account for climate change predictions. The 30% increase functions as a buffer and is recommended by the Department of Environment and Conservation. The consultant added that the analysis with the 30% increases has not yet been done but would be completed as part of this process.

- A question was raised as to how the Southlands development will affect the Rennie's River system. Dave Wadden, Development Manager, stated that the Southlands development drains into the Waterford River Basin not Rennie's River, and as the new Southlands Development adheres to the City's Net Zero Runoff Policy, the Waterford River Basin will be unaffected. Likewise, it was also stated that new development on Kenmount Road, specifically Kenmount Terrace, which is upstream of Long Pond would also adhere to the City's stormwater detention policy.

- Councillor Hickman inquired whether the weir depended on the downstream berms and as a result would they have to be constructed concurrently. The consultant replied that no, they would not have to be constructed at the same time. The weir would be constructed first followed by the berms downstream.

- One resident asked if the consultant felt the report was ready and if it met the Provincial guidelines. The consultant further explained the process: once the Province receives the report it will be posted for public comment. The Minister will then make a decision; the City may be allowed to proceed with the project, the Province may request revisions to the report, or the report could be elevated to an environmental impact study. The consultant stated that they have met every requirement in the EPR.

- When will the report be submitted? Early in the New Year.

- A resident who lives downstream wondered how the City will control the groundwater coming down from the hill in the Rennie's Mill Road area as the storm sewer system is insufficient. A catch basin would need to be installed in Rennies Mill Road which would be piped to the downstream side of the Portugal Cove Road bridge.

The meeting adjourned at 8:19 p.m.

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