Long Pond Weir – Environmental Assessment Registration Document

File Ref No. 200.20.2321

143063.01 ● Report ● February 6, 2015

Prepared for:

Department of Environment and Conservation

Prepared by:

CBCL LIMITED
Consulting Engineers

CBCL LIMITED
Consulting Engineers

February 6, 2015

Department of Environment and Conservation
PO Box 8700
St. John's, NL
A1B 4J6

Attention: Bas Cleary, Director of Environmental Assessment

RE: Long Pond Weir – Environmental Assessment Registration
File Ref No. 200.20.2321

187 Kenmount Road
St. John's, Newfoundland
Canada A1B 3P9

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Solving today's problems with tomorrow in mind

Dear Mr. Cleary:

Please find enclosed six copies of the Environmental Assessment Registration for the Long Pond Weir project, as well as a compact disk containing a pdf copy of the registration document.

A cheque for the registration fee of $226.00 was included with the documents sent on January 30.

Please contact me with any questions related to this submission.

Sincerely,

CBCL LIMITED
Consulting Engineers

Greg Sheppard, P.Eng.
Project Manager
Direct: 709-364-8623, Ext. 288
E-mail: gregs@cbcl.ca

CANADA'S BEST MANAGED COMPANIES

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Long Pond Weir

1.2 Proponent

1.2.1 Name of Corporate Body

City of St. John's

1.2.2 Address

City of St. John's
Department of Planning, Development and Engineering
P.O. Box 908
St. John's, NL
A1C 5M2

1.2.3 Contact Information

Name: Mr. Scott Winsor, P.Eng.
Official Title: Manager – Construction Engineering
Telephone No: (709) 576-8258

1.2.4 Principal Contact Person for purposes of Environmental Assessment

Name: Mr. Greg Sheppard, P.Eng.
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Telephone No: (709) 364-8623

1.3 The Undertaking

1.3.1 Name of the Undertaking

Long Pond Weir

1.3.2 Background

In November 2012, CBCL Limited was awarded the Rennies River Catchment Stormwater Management Plan study by the City of St. John's. The Rennies River catchment 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. Consequently, the City identified a need for an overall plan to address flooding issues in the Rennies River catchment. One of the key components of this plan is a prioritized list of flood protection infrastructure improvements.

The 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 is 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 this 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 this 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.

Floodplain maps illustrating the extent of flooding are included in APPENDIX A. The maps labeled 'Model Calibration Igor' show the extents of flooding during Hurricane Igor. Map 1 shows flooding

experienced downstream of Long Pond at Carnell Drive, the Fieldian Grounds soccer field and tennis courts, Portugal Cove Road, Pringle Place, Vaughan Place, and Prince Philip Drive. Map 2 illustrates the flooding that occurred between Long Pond and the Team Gushue Highway, and Map 3 shows the floodplain along Ken Brook (location 8 listed above) and Yellow Marsh Brook.

A second set of floodplain maps entitled 'Flood Control Measures 1:100 AEP Floodplain', also contained in APPENDIX A, demonstrate the expected floodplain with the recommended flood protection measures (described above) in place. As shown, there is a significant reduction in the floodplain extents, especially downstream of Long Pond, and between Clinch Crescent west and Clinch Crescent east.

The reader is referred to the *Rennies River Catchment Stormwater Management Plan – Final Report* (http://www.stjohns.ca/sites/default/files/files/publication/Rennies%20River%20Catchment%20Stormwater%20Management%20Plan_0.pdf) which describes the hydrologic and hydraulic analysis of the catchment, and gives greater details on the flood protection measures described above.

1.3.3 Purpose/Rationale/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 B

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 a floodplain mapping study of Rennies River, Virginia River and Quidi Vidi River, titled Quidi Vidi Lake Tributary Flood Plain Delineation. The study findings are summarized below.

Kendall Engineering Ltd. completed the Quidi Vidi Lake Tributary Flood Plain Delineation study in August 2006. The study used HEC-HMS to estimate flood flows along the rivers, then modelled river cross sections in HEC-RAS to determine the extent of flooding. The hydraulic model for Rennies River extended 1,300 m from the entrance to Quidi Vidi Lake and included 42 cross sections and five river crossings, namely: Carnell footbridge, Carnell Bridge, footbridge at Loblaws, Kings Bridge Road Bridge, and Portugal Cove Road Bridge.

The 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 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 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.

Catchments with the following features were assessed as potential locations for regional detention facilities:

- Sufficient drainage area to justify a regional facility;
- Sufficient land at the sub-catchment outlet to accommodate a regional detention facility; and
- Mildly sloped land at the sub-catchment outlet, to minimize excavation and/or damming during construction.

The analysis 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 Rennies River Stormwater Management Plan, and used for the Long Pond weir design, included the Yellow Marsh Brook detention facility.

The 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. A copy of this policy is included in APPENDIX C. 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.

The Rennies River Stormwater Management Plan 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 25% 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 (example Health Sciences Facility). This is illustrated on the maps provided in APPENDIX A. 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 are required to address the current flood problems. The berms at this location are needed without the weir in place, and their design (ie. height) is not affected by the weir.

1.4 Description of the Undertaking

1.4.1 Geographic 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. The project is located within Pippy Park. See attached location drawing in APPENDIX D.

1.4.2 Physical Features

The project will consist of a concrete weir, with a 4 m wide opening for flow conveyance and fish passage. The weir will be approximately 30 m long and 5 m wide, with a vertical upstream face and sloped downstream face. The crest elevation of the weir will be approximately 56.3 m. This leaves a freeboard of 0.6 m during the 1:100 AEP event (see Table 1 - Peak Water Levels in Long Pond below). The pond outlet has a rocky bottom with aquatic grass, and grassed banks. See attached conceptual drawings in APPENDIX E.

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 m and will increase to approximately 55.7 m during the design flood (1:100 AEP) with the weir in place. As mentioned above, 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 1 - Peak Water Levels in Long Pond, illustrates the expected peak water level in Long Pond during various events.

Table 1 - Peak Water Levels in Long Pond

Rain Event	Pond Elevation Without Weir (m)	Pond Elevation With Weir (m)
1:100 AEP	55.2	55.7
1:20 AEP	54.9	55.3
1:5 AEP	54.5	55.0
Hurricane Igor	55.4	N/A

1.4.2.1 Project's Effect on Fish And Wildlife

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 F. 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.

1.4.2.2 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 G. In general, the soils present at the site include clayey silt, gravelly clay or sand, sandy gravel till and bedrock.

1.4.3 Construction

Construction is expected to take place between June 1, 2015 and August 31, 2015 and will not be staged.

During construction, temporary cofferdams will be used to create a dry working area. Water will be transferred from the pond side of the weir location to 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 H.

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.

All construction work will be contracted out.

1.4.4 Operation

The project 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 concrete structure with no operable (ie. mechanical and/or electrical) parts; therefore, no operations personnel and/or procedures will be required. Regular maintenance of the weir will be required, and will be the responsibility of the City of St. John's. Expected maintenance activities will be 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.

1.4.5 Occupations

Approximately 20 employees will be required for the construction period of roughly 3 months. It is estimated that 2 employees will be required for maintenance for the life of the structure.

The City has policies in place to address employment equity. The contractor will be required to have policies in place to address employment equity.

The following occupations (as per National Occupational Classification, 2011) are anticipated for the project, with expected numbers of each following in brackets:

1241 (2) – Administrative Assistants
2131 (2) – Civil Engineers
2144 (1) – Geological Engineer
2231 (1) – Civil Engineering Technologist and Technician
2254 (1) – Land Survey Technologist and Technician
2264 (1) – Construction Inspector
7302 (2) – Contractors and supervisors, heavy equipment operator crews
7521 (5) – Heavy equipment operators (except crane)
7611 (5) – Construction Trades Helpers and Labourers

1.4.6 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. *Subdivision Design Manual.*
4. City of St. John's Department of Engineering. *Stormwater Detention Policy.*
5. Golder Associates Ltd. November 2014. *Report on Proposed Weir Structure – Long Pond St. John's, NL*. Prepared for CBCL Ltd.
6. H.T. Kendall and Associates Ltd. October 2002. *Ken Brook and Leary's Brook Floodplain Delineation Study.* Prepared for City of St. John's.
7. Kendall Engineering Ltd. August 2006. *Quidi Vidi Lake Tributary Flood plain Delineation.* Prepared for City of St. John's.
8. Thaumas Environmental Consultants Ltd. December 2014. *Report on Fish Passage at the Proposed Long Pond Weir, Rennies River.* Prepared for CBCL Ltd.

There are no known reports on environmental work related to the proposed undertaking already performed by, or for, the proponent.

1.5 Approval of the Undertaking

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).

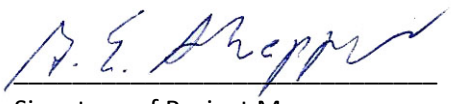
1.6 Schedule

The earliest and latest anticipated dates for start of construction are June 1, 2015 and July 6, 2015, respectively. These dates correspond to the 'project planning - timing window' as recommended by the Department of Fisheries and Oceans while maintaining a 12 week construction schedule.

1.7 Funding

Funding for this project is secured by the City of St. John's.

February 6, 2015
Date



Signature of Project Manager

APPENDIX A

Floodplain Mapping

ST. JOHN'S
NEWFOUNDLAND AND LABRADOR, CANADA

Model Calibration
Igor

Rennies River Catchment
Stormwater Management Study

Water Depth (m)
High : 9
Low : 0

Map 1

CBCL LIMITED
Consulting Engineers

Coordinate System:
NAD_1983_MTM_1
Units:Metre
Scale:1:10,000

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ST. JOHN'S
NEWFOUNDLAND AND LABRADOR, CANADA

Model Calibration
Igor

Rennies River Catchment
Stormwater Management Study

Water Depth (m)
High : 9
Low : 0

Map 2

CBCL LIMITED
Consulting Engineers

Coordinate System:
NAD_1983_MTM_1
Units:Metre
Scale:1:10,000

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ST. JOHN'S
NEWFOUNDLAND AND LABRADOR, CANADA

Model Calibration
Igor

Rennies River Catchment
Stormwater Management Study

Water Depth (m)
High : 9
Low : 0

Map 3

CBCL LIMITED
Consulting Engineers

Coordinate System:
NAD_1983_MTM_1
Units:Metre
Scale:1:10,000

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ST. JOHN'S
NEWFOUNDLAND AND LABRADOR, CANADA

Flood Control Measures
1:100 AEP Floodplain

Rennies River Catchment
Stormwater Management Study

Water Depth (m)

High : 9

Low : 0

Map 1

CBCL LIMITED
Consulting Engineers

Coordinate System:
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Units:Metre
Scale:1:10,000

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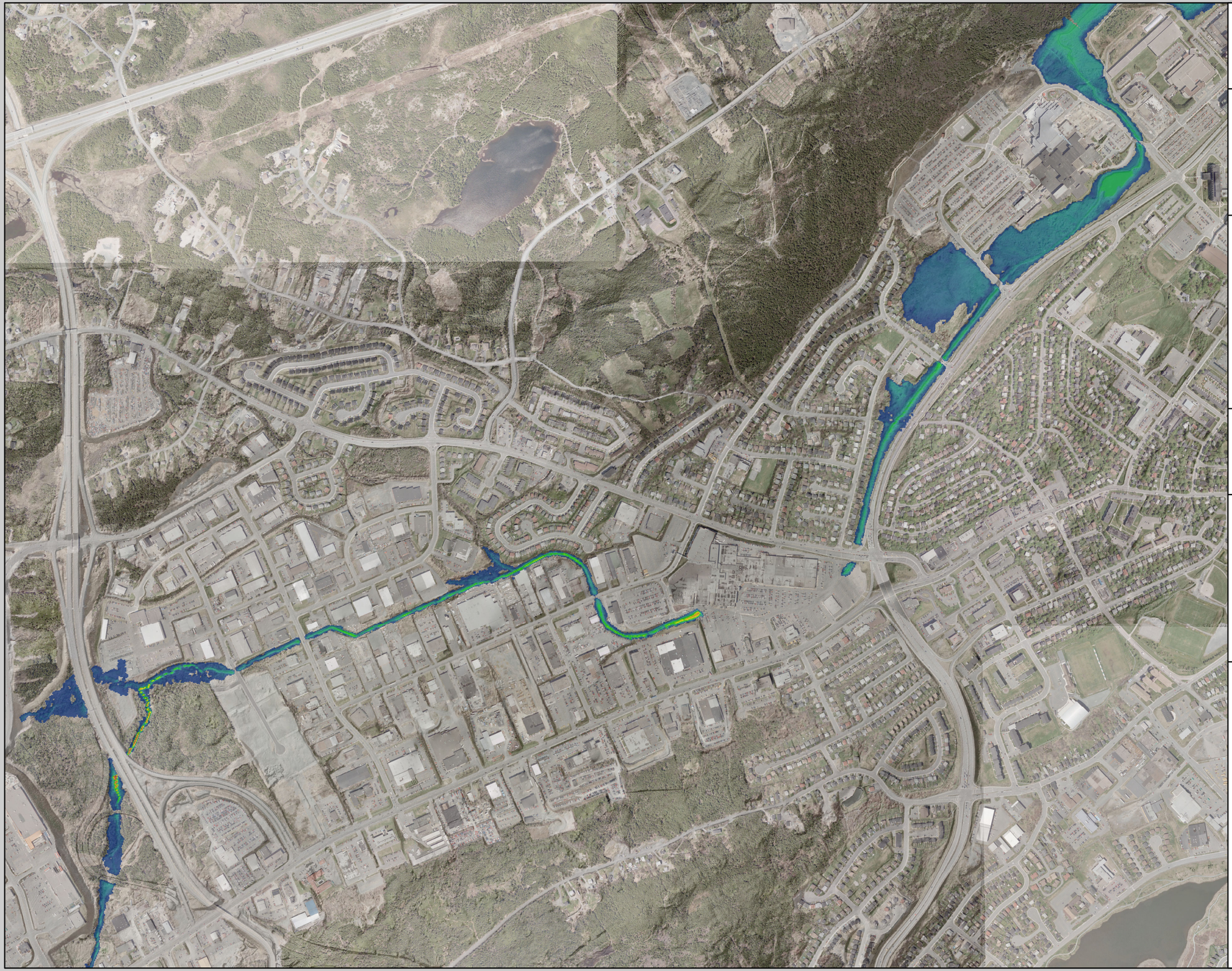

ST. JOHN'S
NEWFOUNDLAND AND LABRADOR, CANADA

Flood Control Measures
1:100 AEP Floodplain

Rennies River Catchment
Stormwater Management Study

Water Depth (m)
High : 9
Low : 0

Map 2

CBCL LIMITED
Consulting Engineers

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ST. JOHN'S
NEWFOUNDLAND AND LABRADOR, CANADA

Flood Control Measures
1:100 AEP Floodplain

Rennies River Catchment
Stormwater Management Study

Water Depth (m)

High : 9

Low : 0

Map 3

CBCL LIMITED
Consulting Engineers

Coordinate System:
NAD_1983_MTM_1
Units:Metre
Scale:1:10,000

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APPENDIX B

Flood Photos During Hurricane Igor

Photo 1: View of Rennies River From Rear of Pringle Place Property

Photo 2: Same View as Photo 1 During Hurricane Igor

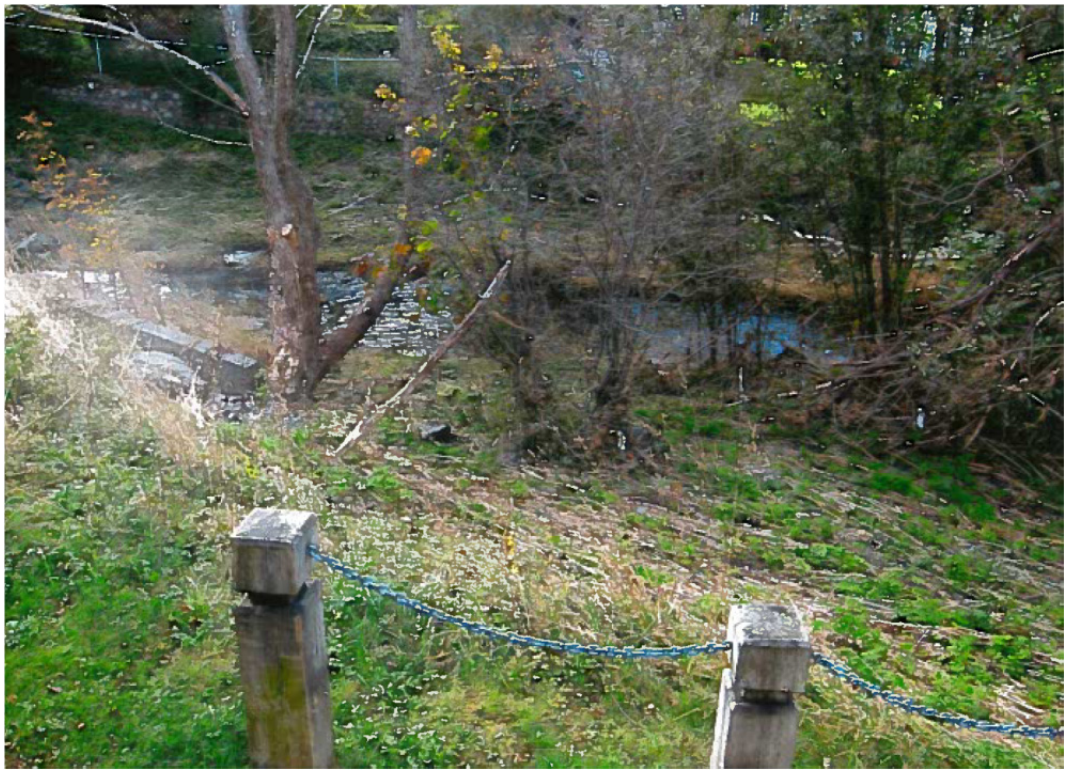


Photo 3: View across Rennies River Taken From Walking Trail

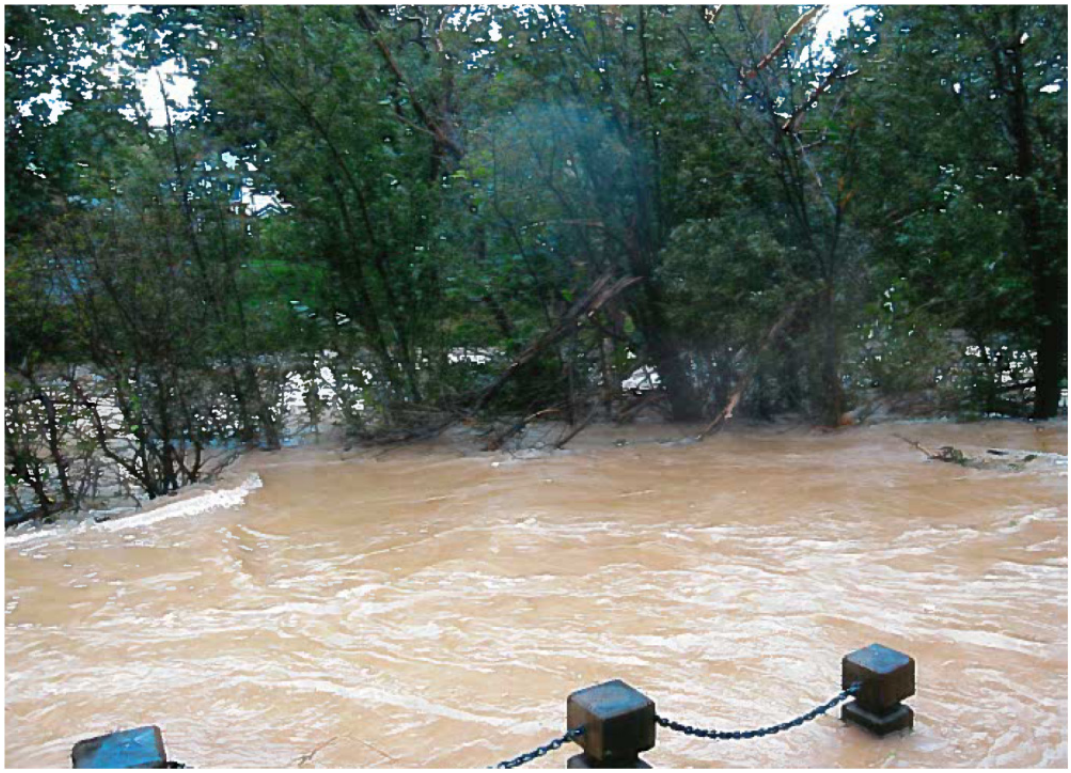


Photo 4: Same View as Photo 3 During Hurricane Igor
Note: Normal route of river is behind the treeline.

Photo 5: Trail Looking West
Note the location of the guy wires.

Photo 6: Same View as Photo 5 During Hurricane Igor

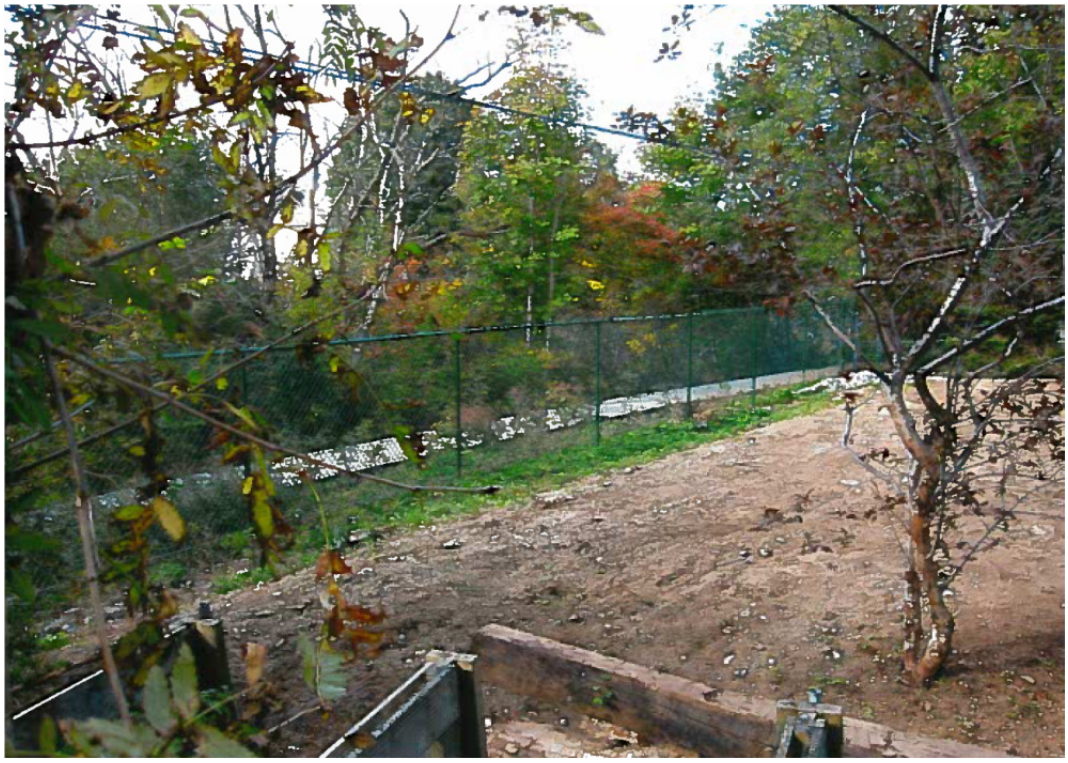


Photo 7: Rear of Property on Pringle Place
Note the location of the fence.

Photo 8: Same View as Photo 7 During Hurricane Igor

APPENDIX C

City of St. John's Stormwater Detention Policy

STORMWATER DETENTION POLICY

1. POLICY STATEMENT

The purpose of this document is to provide policy direction when stormwater detention systems are required for development where an increase in stormwater runoff may:

a) contribute to risk of flooding, and/or

b) exceed the capacity of City storm sewers, bridges/culverts, river channels, or ditches.

2. POLICY OBJECTIVE

The objectives of the Stormwater Detention Policy are to:

a) Temporarily store the difference in volume between the 100-year 24-hour post-development runoff and the 100-year 24-hour pre-development runoff while limiting the post-development runoff rate from a development to the pre-development runoff rate.

b) Prevent increases in downstream flooding and drainage problems that could increase flood losses, damage public assets, reduce property values, and require additional capital works expenditures for flood mitigation.

c) Encourage integration of the detention system into a sustainable overall stormwater management plan for the development, and

d) Promote the incorporation of detention systems into the engineering design and layout of the development so that adequate storage areas are included in the initial stages.

3. POLICY APPLICATION

The Policy applies to all developments within the City of St. John's which present an immediate or foreseeable risk of flooding, with the exception of:

a) Developments in areas, such as Downtown, where the storm sewer system discharges directly into the Atlantic Ocean - subject to City storm sewer infrastructure having sufficient capacity as determined by the Director of Engineering,

b) Developments comprising a land area of less than 0.5 hectares and where the increase in stormwater runoff is less than or equal to 25 liters per second,

c) New developments in subdivisions where a stormwater detention system has already been provided for the entire subdivision,

d) The grassed playing field and vegetated area of public sports and recreational facilities that are not part of a development,

e) Locations where such a system would, due to timing of outflows, have an adverse effect on downstream properties by increasing peak rates of runoff – as determined by the Director of Engineering,

f) Where there is a written agreement between the Developer and the City to provide stormwater infrastructure improvements that remedy the downstream flooding problems in lieu of constructing a stormwater detention system. The Developer would be required to provide the City with a certified cheque or an acceptable Irrevocable Letter of Credit for the value, as determined by the City, of the downstream flood remediation work,

g) Small size developments where it can be demonstrated to the satisfaction of the Director of Engineering that the stormwater detention system would have no beneficial effect to downstream properties, and

h) Other areas where the Director of Engineering determines, based on hydrologic/hydraulic analysis, that stormwater detention is not necessary, or may be permissible at a reduced level.

4. AREA OF THE DEVELOPMENT TO WHICH STORMWATER DETENTION APPLIES

Generally, stormwater detention applies to the entire development with the following exceptions:

a) On already-developed property, the stormwater detention system requirements only apply to the area of the new development – provided runoff from previously developed areas can be excluded from the detention storage,

b) In residential subdivisions where new public roads will be created, the stormwater detention requirements will apply to the entire development area – including streets and lots. However, any areas of a lot that remain in a natural undeveloped state may be excluded from the area to be controlled by the stormwater detention system provided that flows from

these areas can be diverted around the detention system. Approval from the Director of Engineering must be obtained before excluding any area from the detention requirements.

c) Where the proposed development is on previously developed vacant site or is a complete redevelopment of an already-developed property, the stormwater detention system requirement will be applicable to the entire property.

5. EFFECTIVE DATE OF POLICY

This Policy will come into effect on January 1, 2013. Development applications which have been received by the City prior to January 1, 2013, and where construction is substantially underway by September 1, 2013, as determined by the Director of Engineering, will be exempt from this Policy – unless the City has already advised that stormwater detention is required or there is a capacity issue in the receiving storm sewer system.

6. DEVELOPER'S RESPONSIBILITY

It is the responsibility of the Developer(s) to submit for City approval a stormwater management plan which meets the requirements of this Policy. The City reserves the right to accept or reject the stormwater management plan, or propose amendments to the plan. Where requested by the Developer, the City may provide guidance as to the type of stormwater detention which might be acceptable for a particular development. The City's Stormwater Detention Design Manual provides the design standards that the Developer must use to design and construct the stormwater detention system.

7. REGIONAL DETENTION

The City may, where it is considered more effective, direct Developers to cooperate in, and fund the cost of, a regional detention system as a condition to a development(s) proceeding. A regional detention system would establish large scale stormwater detention structure(s) to meet this Policy's requirements for several developments within a geographic region. Similarly, a Developer(s) may also propose a regional stormwater detention system to the City.

8. DETENTION INFRASTRUCTURE COSTS

Developers will fund all costs of stormwater infrastructure constructed within the borders of their property. In the case of a regional stormwater detention system, where the detention infrastructure serves more than one development, the regional detention infrastructure costs will be shared among developers in proportion to the amount of stormwater volume each development is expected to detain. Where the City must upgrade its infrastructure outside the borders of the development, the City may recover its costs, including interest and financial charges, through assessment charges/fees against developable properties served by, or to be served by, the regional stormwater detention system.

9. OWNERSHIP

Stormwater detention systems in residential developments may be accepted for ownership and maintenance by the City. Detention systems in Commerical, Industrial, or Institutional developments will not be accepted for ownership by the City.

The City of St. John's provides no maintenance of stormwater detention systems located on private property. Maintenance must be provided by the owner of the property upon which the detention system resides – unless there is an agreement between the owner and the City which supercedes the preceding.

10. ACCEPTANCE

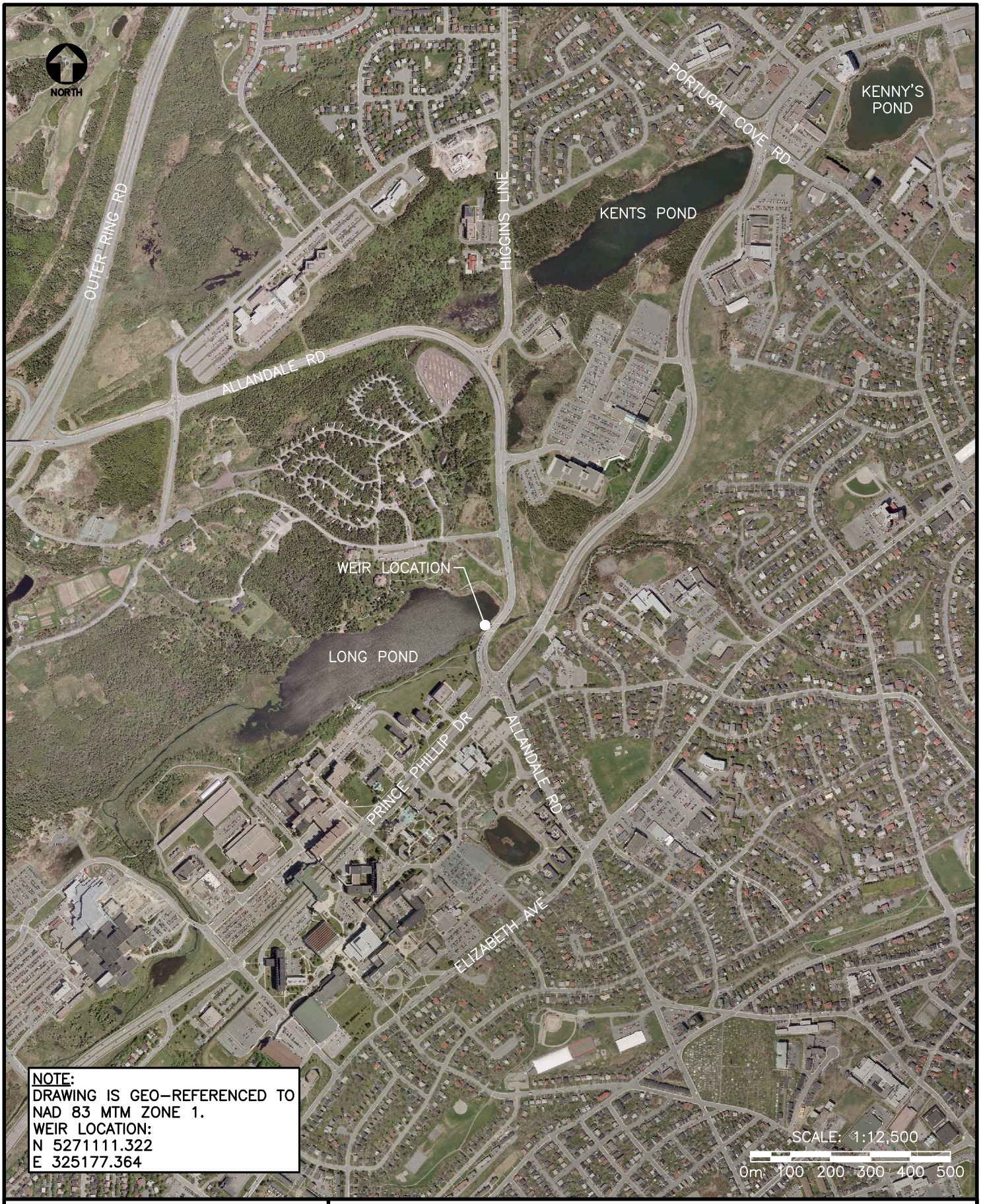
Acceptance of stormwater detention systems is subject to the following requirements:

a) A Developer owning property with an area greater than 0.5 hectares must construct a stormwater detention system in accordance with the approved engineering plans and must convey the system, and associated lands, at no cost to the City as a condition of Final Approval subject to the requirements of Section 9 of this Policy.

b) The City will not accept the detention system until (a) the system has been fully completed in accordance with the approved plans, (b) 80% of the proposed lots have been fully developed, and (c) adequate erosion control measures, as approved by the Director of Engineering, have been installed on the remaining 20% of the lots. The Developer must continue to own and maintain the detention system until accepted by the City.

APPENDIX D

Location Drawing



NOTE:
DRAWING IS GEO-REFERENCED TO NAD 83 MTM ZONE 1.
WEIR LOCATION:
N 5271111.322
E 325177.364

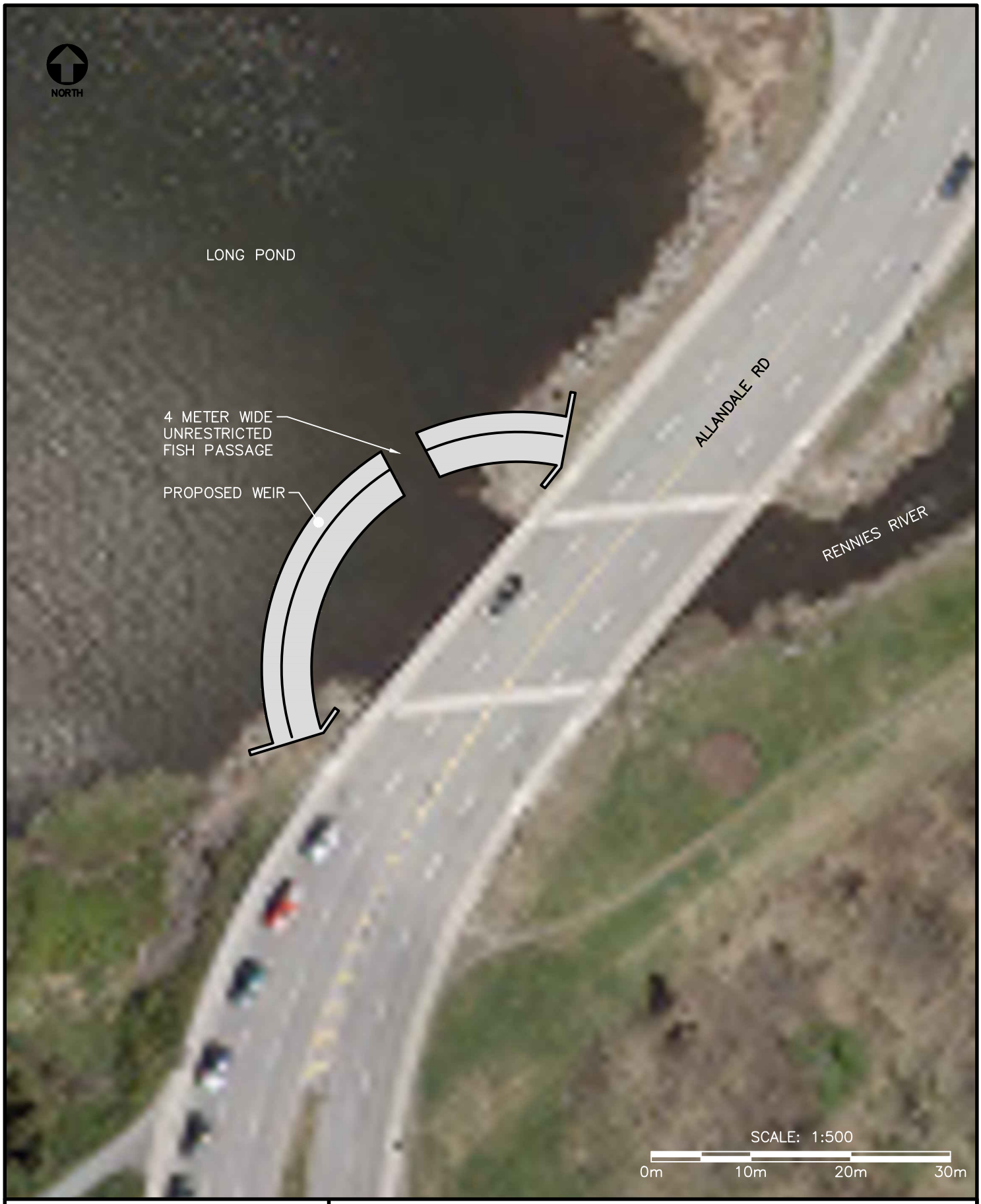
CBCL LIMITED
Consulting Engineers
187 KENMOUNT ROAD
ST. JOHN'S, NL, A1B 3P9
Phone: (709) 364-8623
Fax: (709) 364-8627

PROPOSED LONG POND WEIR

LOCATION PLAN

APPENDIX E

Conceptual Drawings



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ST. JOHN'S, NL, A1B 3P9
Phone: (709) 364-8623
Fax: (709) 364-8627

PROPOSED LONG POND WEIR

CONCEPTUAL DESIGN

Figure 1: Existing – Looking Southwest Toward Allandale Road Bridge

Figure 2: Same View as Figure 1 – Showing Proposed Weir

Figure 3: Same View as Figure 1 – Showing Proposed Weir Under Design Flood Conditions

Figure 4: Existing – Looking Northeast Along Allandale Road Bridge Toward Confederation Building

Figure 5: Same View as Figure 4 – Showing Proposed Weir

Figure 6: Same View as Figure 4 – Showing Proposed Weir Under Design Flood Conditions

Figure 7: Existing – Looking East Along Allandale Road Toward Health Sciences Centre

Figure 8: Same View as Figure 7 – Showing Proposed Weir

Figure 9: Same View as Figure 7 – Showing Proposed Weir Under Design Flood Conditions

APPENDIX F

Report on Fish Passage

Thaumas
ENVIRONMENTAL
CONSULTANTS Ltd.

www.THAUMAS.ca
(902)466-2095
BobRutherford@Accesswave.ca

December 6, 2014

Re: Report on fish passage at the proposed Long Pond weir, Rennies River, St John's, NL.

Thaumas Environmental Consultants Ltd has been contracted by CBCL Ltd. to review fish passage conditions for a proposed flood control weir to be located in Long Pond, which is on the Rennies River, St John's, NL. CBCL recommended the flood control weir in a 2104 study that was completed for the City of St John's. The findings outlined in this report are in support of the weir design.

The opening in the proposed weir is four meters wide and will extend to the bottom of the pond with concrete sides and rock rip rap bottom. It is suggested that the upstream corners of the weir opening be rounded with a radius of 1/3 the length of the weir for smoother flow pattern in the opening, this will improve the flow pattern for migrating fish. The velocities through the opening, under different flow conditions and the percent duration of these flows, was provided by CBCL and are in Appendix 1.

The fish species present at the site include Brown trout (*Salmo trutta*), Brook trout (*Salvelinus fontinalis*), American eel (*Anguilla rostrata*), Atlantic salmon (*Salmo salar*) and forage fish primarily three spined Stickleback (*Gasterosteus aculeatus*) (Piercey 2104).

Swimming speeds of fish are dependent on species, age class, body length, condition and health of the fish, and water quality particularly temperature. Also fish migration behaviour needs to be considered as they will migrate against strong velocities during spawning runs than normal foraging, they navigate natural barriers better than man-made structures, and have depths and velocities they prefer to swim at and against.

The velocities used are the mean velocity in the weir and there will be lower velocities at the bottom over rip rap and along the sides. These velocities will be used by the smaller fish for better passage outcomes than calculated below which are based on the mean velocity.

This makes a complete picture of the outcome of migration through a weir difficult to fully predict under all seasons and conditions. To deal with the uncertainty we have taken a conservative approach to the swimming speeds and looked at a range of age classes and body lengths for the three main swimming behaviours, sustained, prolonged (1800 sec) and burst speed (10 sec). Fish also have a burst escape speed which is much higher and of shorter duration than the burst speed used here, however, this behaviour is seldom used during migration so has not been included.

Swimming speeds used are from Katopodis (1992) and Peake (2002). The fish for which there was data suitable for modeling include Brook trout, Atlantic salmon, and American eel. Swimming ability of the Brown trout are between those of Brook trout and Atlantic salmon based on Peake (2002) and Stickleback and other forage fish that may be present are based on a general formula for minnow species.

Brook trout passage

Brook trout are native trout to Newfoundland. In the Rennies system, most are located in the upper areas of the watershed, in Three Pond Barrens, although they have been seen and caught in Long Pond. Like Brown trout, they are anadromous, and seasonally migratory. The spawning season for Brook trout is a little earlier than Brown trout, typically in early to mid-September, depending on water temperature (Piercey, R. 2014).

The velocities proposed by Peake (2008) for Brook trout passage through culverts up to 100m long in Newfoundland proposed that water velocities up to 30.0 and 50.0 cm/s or less should allow passage of most juvenile and adult Brook trout, respectively. This means if the passage at the weir was this long passage in October / November passage would be 3% and 20% of the time respectively, the October / April the passage would be 20% to 80% of the time respectively, the May to September 4% to 20% of the time respectively. In these cases the distance that the fish would have to traverse to get through a culvert is much greater than that of the proposed weir so they would have to use sustained or prolonged swimming to complete the passage and endurance would be a major issue. This is the case for all the species of fish in the river.

Using the swimming ability of Brook trout from Katopodis (1992) we can generate the percent of the time various sized trout will be able to pass through the weir of 5m in length (Fig 1). This approach is more realistic as the fish can approach the weir in low velocities and only encounter the highest velocities for very short period and use their higher burst swimming speeds. Endurance is not an important and issue here as it is in culverts. This approach provides more detail including the use of burst velocities for short distances.

It can be seen that in October /November flows that all sizes can pass using burst speeds from 37% to 100% of the depending on fish length. The October / April low flows provide passage 69% to 100% of the time with burst speeds. May / September high flows allow passage 34% to 84% of the time again with the larger fish passing a greater percent of the time.

Fig 1 Brook trout tables

Brook trout October / November flows										
age	Length cm	Sustained m/sec	Current passage % time	4m weir Passage % time	Prolonged for 1800 sec m/sec	Current passage % time	4m weir Passage % time	Burst 10 for sec m/sec	Current passage % time	4m weir Passage % time
0+	3.0	0.022	70	3	0.178	100	18	0.394	100	37
1	12.0	0.081	95	9	0.359	100	35	0.798	100	67
2	16.5	0.121	100	13	0.422	100	40	0.938	100	75
3	20.0	0.148	100	16	0.465	100	43	1.034	100	80
4	24.0	0.185	100	19	0.510	100	47	1.100	100	83
5	27.0	0.200	100	20	0.541	100	49	1.205	100	87
6	28.0	0.208	100	21	0.552	100	50	1.227	100	88
7	29.6	0.223	100	23	0.567	100	51	1.263	100	100

Brook trout October / April low flows										
age	Length cm	Sustained m/sec	Current passage % time	4m weir Passage % time	Prolonged for 1800 sec m/sec	Current passage % time	4m weir Passage % time	Burst 10 for sec m/sec	Current passage % time	4m weir Passage % time
0+	3.0	0.022	80	0	0.178	100	56	0.394	100	69
1	12.0	0.081	90	0	0.359	100	68	0.798	100	88
2	16.5	0.121	95	52	0.422	100	71	0.938	100	93
3	20.0	0.148	100	54	0.465	100	73	1.034	100	95
4	24.0	0.185	100	56	0.510	100	76	1.100	100	97
5	27.0	0.200	100	57	0.541	100	77	1.205	100	99
6	28.0	0.208	100	58	0.552	100	78	1.227	100	100
7	29.6	0.223	100	59	0.567	100	79	1.263	100	100

Brook trout May / September high flows										
age	Length cm	Sustained m/sec	Current passage % time	4m weir Passage % time	Prolonged for 1800 sec m/sec	Current passage % time	4m weir Passage % time	Burst 10 for sec m/sec	Current passage % time	4m weir Passage % time
0+	3.0	0.022	70	0	0.178	92	0	0.394	98	34
1	12.0	0.081	85	0	0.359	100	31	0.798	100	61.5
2	16.5	0.121	90	0	0.422	100	36	0.938	100	69
3	20.0	0.148	32	0	0.465	100	39	1.034	100	74
4	24.0	0.185	93	0	0.510	100	43	1.100	100	77
5	27.0	0.200	94	0	0.541	100	45	1.205	100	82
6	28.0	0.208	95	0	0.552	100	46	1.227	100	83
7	29.6	0.223	98	0	0.567	100	47	1.263	100	84

Brown trout passage

Brown trout are a non-native species, introduced to Newfoundland in the late 1880's. The Rennies system has the densest concentration, in terms of weight per cubic meter of water, of this particular species of any trout stream in North America. They are anadromous so are seasonally migratory, as they move out of ponds/lakes in early October, into the spawning beds located in adjoining rivers, and streams. Just below the eastern outflow of Long Pond there is a prime spawning area, located at the beginning of Rennies River (Piercey, R. 2014).

The Brown trout swimming ability formula is not available but based in the information provided in Peake (2008) the results would fall between Brook trout and the Atlantic salmon in swimming ability. Peake (2008) suggested culvert velocities are 35 cm/sec to 70 cm/sec higher than for Brook trout but lower than Atlantic salmon.

Atlantic salmon passage

Atlantic Salmon have not been found in this river system for over sixty years, and documented evidence of salmon as far in the river system as Long Pond in recent years doesn't exist. The Fluvarium has been releasing salmon fry into the tributaries around Long Pond for close to twenty years as part of our Fish Friends program. Adult salmon have not been seen, but Fluvarium staff have witnessed young salmon parr and smolt. The Salmon Association of Eastern Newfoundland (SAEN) are currently involved in a salmon reintroduction program in Rennies River, and are concerned about any development on Long Pond (Piercey, R. 2014).

Salmon passage at the weir under all scenarios is 100% for grilse and adults using their burst speeds. Parr passage during October /November flows, all sizes can pass using burst speeds from 44% to 78% of the time depending on fish length. The October / April low flows provide passage 73% to 95% of the time with burst speeds. May / September high flows allow passage 39% to 78% of the time again with the larger fish passing a greater percent of the time.

Fig 2 Atlantic salmon tables

Atlantic salmon October / November flows										
age	Length cm	Sustained m/sec	Current passage % time	4m weir opening Passage % time	Prolonged for 1800 sec m/sec	Current passage % time	4m weir opening Passage % time	Burst 10 for sec m/sec	Current passage opening % time	4m weir opening Passage % time
0+	4.2	0.022	70	3	0.2389	100	24	0.468	100	44
1	5.6	0.081	95	9	0.2609	100	26	0.542	100	49
2	9.3	0.121	100	13	0.319	100	31	0.701	100	60
3	11.6	0.148	100	16	0.3551	100	34	0.784	100	66
4	17.4	0.185	100	19	0.4462	100	42	0.964	100	76
5	18.8	0.200	100	20	0.4682	100	44	1.003	100	78
grilse	52	0.449	100	42	0.989	100	77	2.080	100	100
1 syr adult	95	0.712	100	61	1.665	100	100	3.800	100	100

Atlantic salmon October / April low flows										
age	Length cm	Sustained m/sec	Current passage % time	4m weir opening Passage % time	Prolonged for 1800 sec m/sec	Current passage % time	4m weir opening Passage % time	Burst 10 for sec m/sec	Current passage % time	4m weir opening Passage % time
0+	4.2	0.022	80	0	0.2389	100	24	0.468	100	73
1	5.6	0.081	90	0	0.2609	100	26	0.542	100	77
2	9.3	0.121	95	52	0.319	100	31	0.701	100	85
3	11.6	0.148	100	54	0.3551	100	34	0.784	100	88
4	17.4	0.185	100	56	0.4462	100	42	0.964	100	94
5	18.8	0.200	100	57	0.4682	100	44	1.003	100	95
grilse	52	0.449	100	72	0.989	100	77	2.080	100	100
1 syr adult	95	0.712	100	100	1.665	100	100	3.800	100	100

Atlantic salmon May / September high flows										
age	Length cm	Sustained m/sec	Current passage % time	4m weir opening Passage % time	Prolonged for 1800 sec m/sec	Current passage % time	4m weir opening Passage % time	Burst 10 for sec m/sec	Current passage % time	4m weir opening Passage % time
0+	4.2	0.022	60	3	0.2389	95	24	0.468	99	39
1	5.6	0.081	58	8	0.2609	97	26	0.542	100	45
2	9.3	0.121	90	12	0.319	100	28	0.701	100	56
3	11.6	0.148	94	14	0.3551	100	31	0.784	100	61
4	17.4	0.185	95	17	0.4462	100	40	0.964	100	71
5	18.8	0.200	96	18	0.4682	100	58	1.003	100	78
grilse	52	0.449	99	38	0.989	100	72	2.080	100	100
1 syr adult	95	0.712	100	56	1.665	100	95	3.800	100	100

American eel passage

The American eel is a native fish species to Newfoundland, it is catadromous, meaning it is born in salt water, and moves into the fresh water systems to spend the majority of their lives. They often overwinter in deeper ponds and lakes, but will move into rivers and streams seasonally (Piercey, R. 2014).

Swimming ability has not been found but Peake (2008) suggests not exceeding 20 cm/sec for culvert passage of elvers returning from the sea to freshwater.

Katopodis (1992) does not provide formula for American eel but does provide information on swimming abilities of fish with the same body form as the eels. From this swimming ability formula for the 5m of maximum velocities through the weir for a 10cm elver would be 35 cm/sec using burst speed. For a 30cm resident eel the velocity would be 75 cm /sec.

Passage at the weir in October /November flows, Eels can pass using burst speeds from 60% of the time. The October / April low flows provide passage 80% for larger Eels and for elvers 20% of the time with burst speeds. May / September high flows allow passage for larger Eels 50% and for elvers 2% of the time again with the larger fish passing a greater percent of the time.

Elver migration is in the spring and passage would have to be mainly under low flows. Eels also use the bottom cover and turbulence provided by the rip rap and slower velocities along the face of the sides of the weirs so this is a very conservative estimate of passage it will be substantially higher.

Three spined Stickleback passage

The predominant forage fish is the three-spine Stickleback. These fish can be anadromous, although the ones found in the Rennies system are totally freshwater, and live out their entire lifespan in the river, and the joining streams and ponds. They are an important food source to the larger trout and eels. There have been reports of the Banded killifish in the waters of Long Pond. They are found in Burtons Pond on the MUN campus, which has no connection to this system (Piercey, R. 2014).

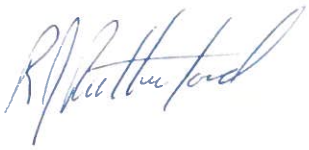
The swimming ability of stickleback for passage from Peake (2008) is through flows of 25cm/sec or less velocity. Using formula for minnows from Katopodis (1992) for a 2.5cm stickleback the velocity would be 22cm/sec or less for passage.

From this the ability to swim the 5m of maximum velocities through the weir for a 2.5cm minnow forage fish would be 22 cm/sec using burst speed. Passage at the weir for minnow species during October /November flows is 2% of the time. The October / April low flows provide passage 10% of the time with burst speeds. May / September high flows allow passage 4% of the time. These are small fish and will use the lower velocities along the bottom where there is turbulence and cover for passage so these numbers are conservative.

Conclusion

The weir will provide fish passage for all the species present over periods suitable for migration and distribution through the watershed. The smaller fish will be limited in the percent of the time they will be able to pass based on the mean flow through the weir but will be able to use the slower flows and cover form the flows along the rip rap bottom to move through the area more of the time than shown in the is analysis. Exactly what that percent time they will be able to pass cannot be calculated without knowing the velocities that will be found in this bottom layer.

The velocities through the weir under all flows will be lower than the river above Long Pond (see (Appendix 1). The fish do move up through the river which is a clear indication of the positive effect the bottom morphology has on the velocities and fish migration.



Bob Rutherford
President
Thaumas Environmental Consultants Ltd

References

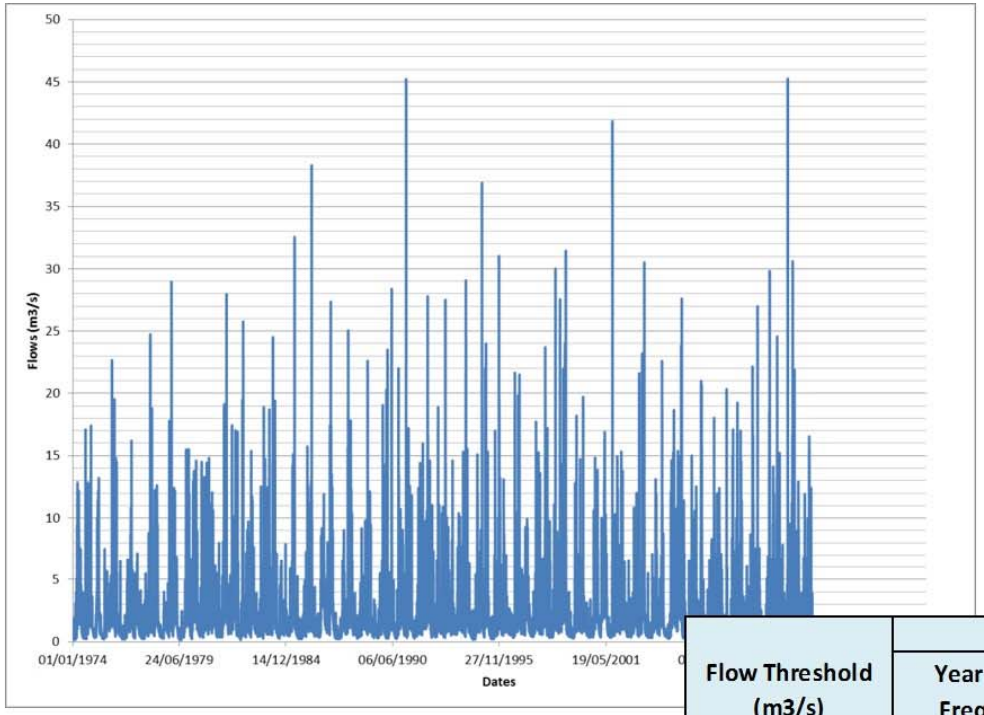
CBCL 2014, Rennies River Catchment Stormwater Management Plan, Final Report

Katopodis, C. 1992 Introduction to Fishway Design, Freshwater Institute Central and Arctic Region, Department of Fisheries and Oceans.

Peake, S.J. 2008. Swimming performance and behaviour of fish species endemic to Newfoundland and Labrador: A literature review for the purpose of establishing design and water velocity criteria for fishways and culverts. Can. Manuscr. Rep. Fish. Aquat. Sci. 2843: v + 52p.

Piercey, R. 2014 Education Manager, Suncor Energy Fluvarium, personal communication

Appendix 1



Flow input in XPSWMM to calculate velocities at weir

Flow Threshold (m3/s)	Non Exceedance Frequency (% Time)			
	Year Round Frequency	High Flow Season (May-Sept)	Low Flow Season (Oct-Apr)	October & November
0.2	0.00	0.00	0.00	0.00
0.5	4.52	1.20	9.12	0.91
1	23.89	9.91	43.27	10.48
2	52.37	36.60	74.25	41.16
2.5	61.31	47.44	80.55	52.72
5	84.00	77.30	93.29	81.19
10	94.58	91.93	98.26	94.22
20	98.77	98.15	99.62	98.49
45	99.95	99.95	99.95	100.00
66	100.00	100.00	100.00	100.00

Figure 1 Frequency Analysis -Gauged Flows 1974-2011

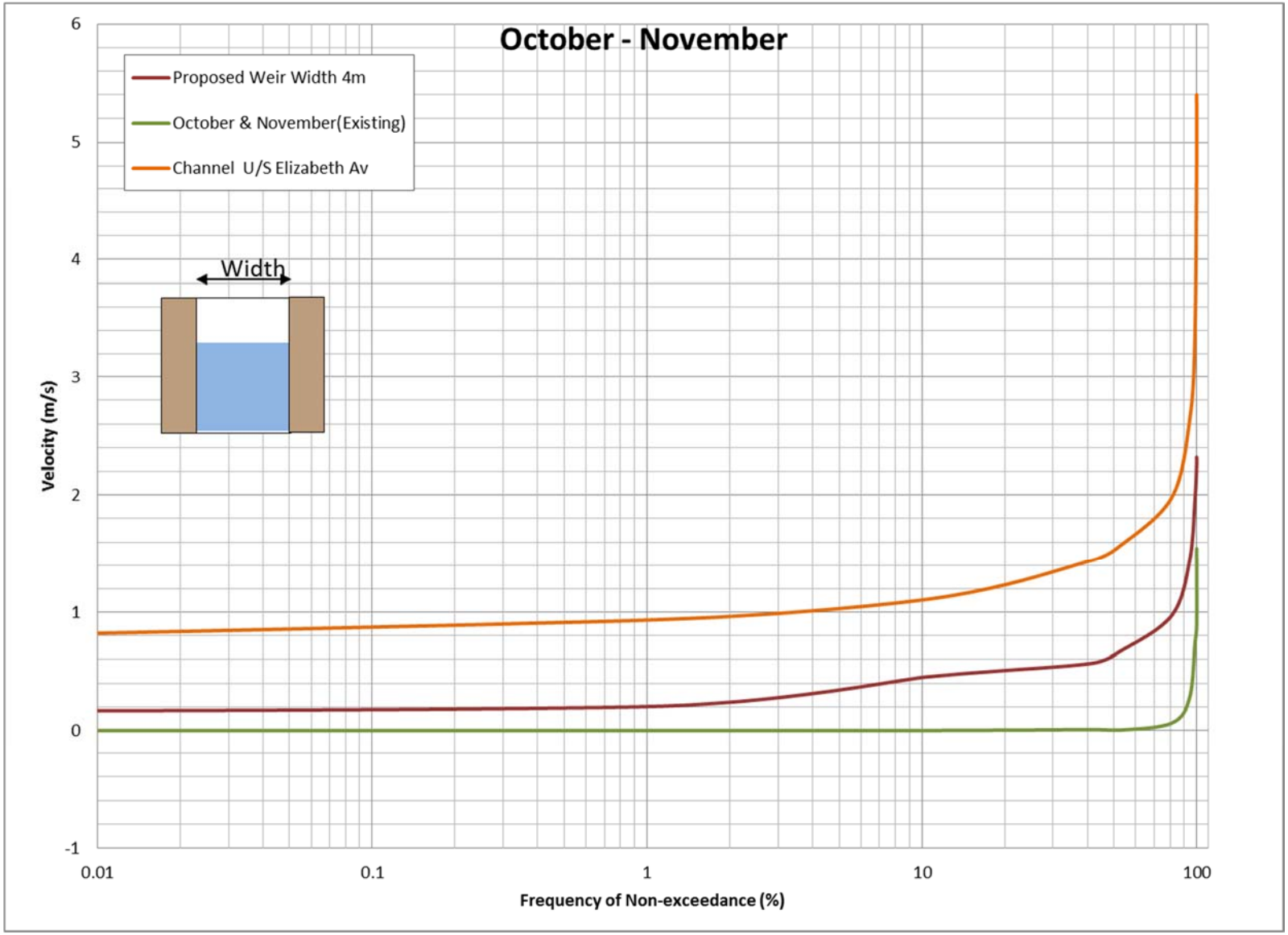


Figure 2 Calculated Velocities vs Non Exceedance Frequency- October and November

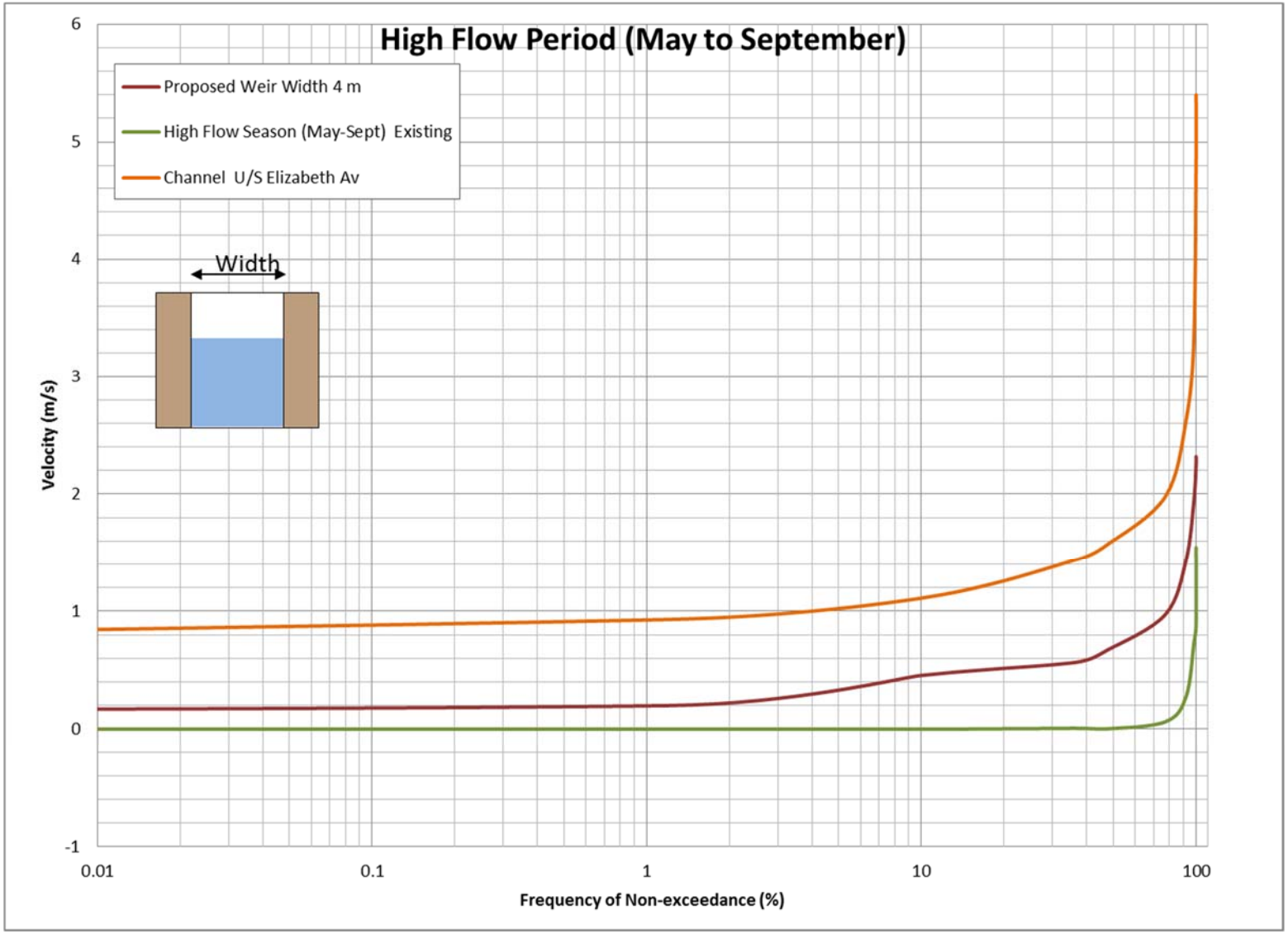


Figure 3 Calculated Velocities vs Non Exceedance Frequency- High Flow Season

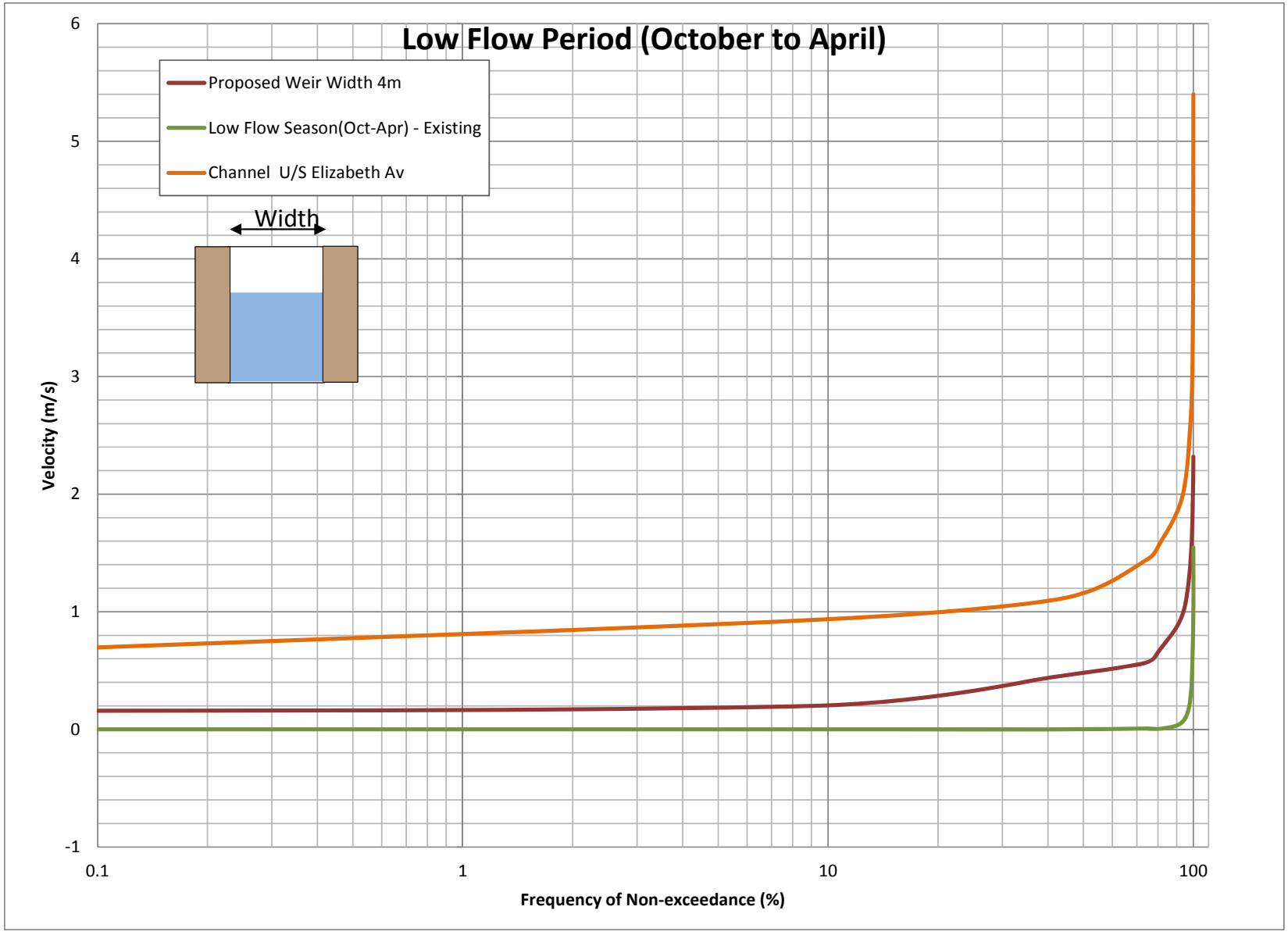


Figure 4 Calculated Velocities vs Non Exceedance Frequency- Low Flow Season

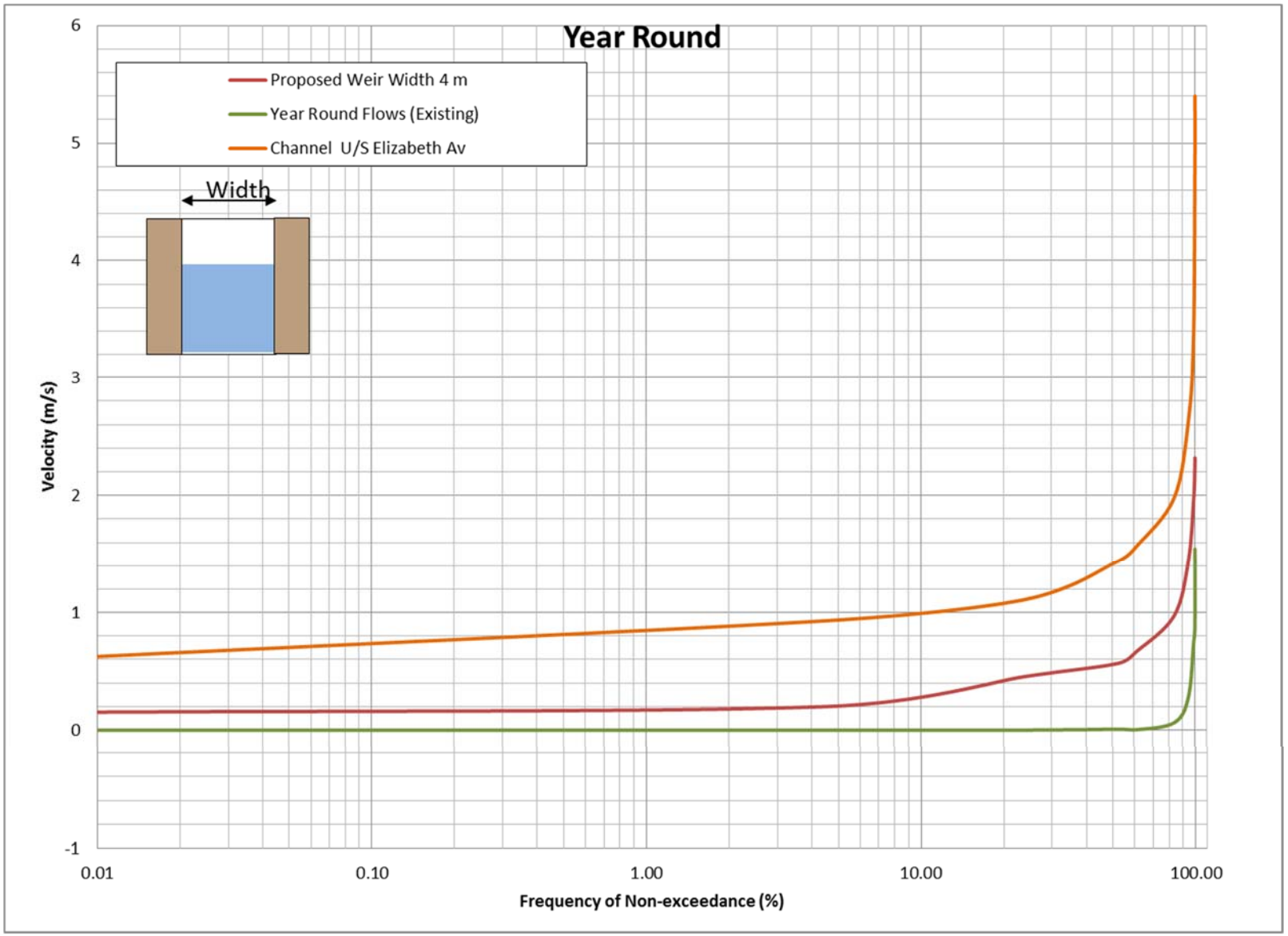


Figure 5 Calculated Velocities vs Non Exceedance Frequency- All Year Round

APPENDIX G

Geotechnical Report

November 2014

REPORT ON

Proposed Weir Structure
Long Pond
St. John's, NL

Submitted to:
Greg Sheppard
CBCL Limited
187 Kenmount Road
St. John's, NL
A1B 3P9

REPORT

Report Number: 1407587-0001-Rev1
Distribution:
1 e-copy - CBCL Limited
1 copy - Golder Associates Ltd.

Golder Associates

Table of Contents

1.0 INTRODUCTION

Golder Associates Ltd (Golder) has been engaged by CBCL Ltd. (CBCL) to undertake a geotechnical investigation at the site of the proposed weir structure at Long Pond adjacent to the Allandale Road Bridge crossing near the Memorial University Campus, St John's, NL. The work was authorised by CBCL with a sub-consultant agreement dated July 24, 2014 and signed on August 6, 2014.

This report presents the results of a geotechnical investigation carried out by Golder at the site of the proposed weir structure. The work was carried out in general conformance with our proposal P1407587 dated July 9, 2014.

The purpose of the geotechnical investigation was to assess the subsurface conditions at the site by means of a limited number of boreholes.

Based on an interpretation of the factual information available for this site, a general description of the subsurface conditions across the site is presented. These interpreted subsurface conditions and available project details were used to prepare engineering guidelines on the geotechnical design aspects of the project, including construction considerations which could influence design decisions.

The reader is referred to the "Important Information and Limitations of This Report" which follows the text and forms an integral part of this document.

2.0 SITE AND PROJECT DESCRIPTION

CBCL has been retained by the City of St. John's as the prime consultant to provide engineering support for a proposed weir structure located in Long Pond, just upstream from Rennies River in St. John's, Newfoundland (see Figure 1).

Based on drawings provided by CBCL dated August 11, 2014 (reference: 143063.00 SK-01 and SK-02), it is understood that the weir structure will be constructed on the western side of Allandale Road, between the north and south bridge abutments.

It is also understood that the proposed founding level of the weir structure is at an approximate elevation of 50.5 m (based on CBCL Drawing #SK-02, dated 11 August 2014, which was provided to Golder during the coarse of the investigation). Based on this drawing, the approximate maximum water level under future flood conditions following the construction of the weir structure is indicated to be at 55.8 m elevation.

The existing ground level on the western side of the north and south bridge embankments slopes down from Allandale Road into the pond. The slope surface currently comprises vegetation, small trees, cobbles and boulders. During the site investigation at the approximate location of the weir structure, vegetation and water grass were observed to be present within the pond between the bridge embankments.

3.0 FIELDWORK PROCEDURE

3.1 Permitting

Prior to carrying out the field investigation in Long Pond, Golder obtained a "*Permit to Alter a Body of Water*" from the Department of Environment and Conservation – Water Resources Management Division. The permit was issued on August 25, 2014 (permit No.: ALT7655-2014).

Golder has also undertaken a self-assessment for the proposed scope of work in order to meet the requirement introduced by the Department of Fisheries and Ocean (DFO). As a result of the self-assessment, it was determined that geotechnical drilling activities at Long Pond did not require a review from DFO.

Approvals from the City of St John's and the Pippy Park Commission were obtained by CBCL who provided confirmation to commence the field investigation in an email dated September 30, 2014.

The drilling of the boreholes at Long Pond followed the procedures, requirements and conditions as listed in the permits issued by the governing bodies.

3.2 Field Investigation

The field investigation was carried out on October 3 and 4, 2014. A total of three (3) boreholes (numbered BH1 to BH3) were drilled and the approximate locations of the boreholes are shown in Figure 1.

The drilling of the boreholes was undertaken on a barge with a CME 55 drill rig, supplied and operated by Logan Geotech Inc. The drilling equipment, barge and support boat were lifted into and out of Long Pond by utilising a 60t mobile crane, positioned on Allandale Road immediately to the north of the bridge crossing. Traffic management/control during the equipment mobilisation and demobilisation periods was provided by Safety First Ltd.

To minimise the disturbance to the pond, the boreholes were drilled utilising continuous split spoon sampling techniques which obtained soil samples from the major soil strata encountered in the boreholes. The equipment allowed performing standard penetration tests as per ASTM D 1586-11. This provided information on the compactness condition of soils through the measurement of N values. The soil samples collected were classified by visual and tactile examination. NW casing was also advanced following split spoon sampling to stabilise the borehole. NQ diamond coring technique was utilised in BH1 for rock coring. All soil and rock samples returned to the barge deck during the drilling process were collected, stored and disposed of offsite.

The field work was supervised by a member of our engineering staff who collected the soils and rock encountered and logged them. The field samples obtained during the field work were shipped to our St. John's office for further examination by the project engineer.

According to CBCL drawing SK-02, the top of the western sidewalk at Allandale Road is at elevation 56.3 m. This elevation was used by Golder as the reference level (i.e. job benchmark) during the site investigation to determine the approximate termination depth of the boreholes (to ± 15 cm) relevant to the founding level of the weir structure. The borehole locations were selected by Golder along the approximate alignment of the weir structure and were located in the field by Golder personnel using a handheld GPS with a ± 5 m accuracy.

4.0 SUBSURFACE CONDITIONS

4.1 General

The subsurface conditions encountered in the boreholes are shown on the Record of Boreholes presented in Appendix A. A summary of the subsurface conditions encountered in the boreholes are presented in Table 1.

In general, below the water in the pond, the soils present on site consist of clayey silt overlying gravelly clay or sand and sandy gravel till which overlies inferred bedrock. The following sections present a more detailed overview of the subsurface conditions encountered in the boreholes.

4.2 Water

The water surface level of the pond at the time of the field investigation was measured to be approximately 3.3 m below the level of the sidewalk on the western side of the Allandale Road Bridge. The approximate elevation of the water surface was at elevation 53.0 m during the field investigation. Depths within each borehole are referenced to the water surface level.

The depth of water encountered at the three borehole locations was 1.80 m at Borehole BH1, 1.45 m at Borehole BH2 and 0.85 m at Borehole BH3.

4.3 Lacustrine deposits

Cohesive, wet clayey silt was encountered immediately below the water in the three boreholes. The lacustrine deposit extends to depths of 3.8 m in Borehole BH1, 2.8 m in Borehole BH2 and 4.0 m in Borehole BH3. Organic material such as rootlets and wood fragments was observed in this material. The clayey silt is soft to firm with measured N values of 2 to 12 within the lower half of this deposit. The upper half may be very soft as N values could not be performed. Note that in each of the three boreholes the drill rods sank under their own weight through the pond-bottom sediments. For example, in borehole BH1, the rods sank 2.0 m, 0.75 m in BH2, and 1.15 m in BH3.

4.4 Till

Wet gravelly clay, gravelly sand and sandy gravel till were encountered below the lacustrine deposit. The till also comprised cobbles and boulders. Boreholes BH2 and BH3 were terminated in this material at a depth of 5.8 m and 6.9 m respectively. In Borehole BH1, the till was observed to be overlying the inferred bedrock at a depth of 8.15 m. The till is generally compact to very dense with measured N values of 24 to 52. The top surface of the till is generally compact and slopes down to the north-east.

4.5 Probable Bedrock

Probable siltstone bedrock was encountered in Borehole BH1 underlying the till at a depth of 8.15 m and was cored to a depth of 8.60 m. The rock is very poor quality with a measured RQD of 0.

4.6 Summary

The depth ranges and elevation of the subsurface materials encountered in Boreholes BH1 to BH3 are summarised in Table 1.

Table 1: Depth ranges of subsurface materials

Description	Depth ranges of subsurface materials (m)		
	BH1 (water surface elevation 53.0 m)*	**BH2 (water surface elevation 53.0 m)***	**BH3 (water surface elevation 53.0 m)***
Water	0.0 – 1.8	0.0 – 1.45	0.0 – 0.85
Lacustrine deposit	1.8 – 3.8	1.45 – 2.8	0.85 – 4.0
Till	3.8 – 8.15	2.8 – 5.8	4.0 – 6.9
Probably Bedrock	8.15 – 8.6	-	-
End of Borehole	8.6	5.8^	6.9^

**- the pond's water surface elevation is referenced to the elevation of the top of sidewalk on the western side of Allandale Road bridge, defined as elevation 56.3 m from CBCL's drawing SK-02.*

^- Borehole BH2 terminated due to encountering cobbles or boulders within the till, pushing the drilling rod from its vertical alignment. Borehole BH3 terminated in till as the borehole wall collapsed during drilling.

5.0 DISCUSSION

5.1 General

This section of the report provides engineering guidelines on the geotechnical design aspects of the proposed weir structure at Long Pond based on our interpretation of the borehole information and project requirements. The information in this portion of the report is provided for the guidance of the designers and is intended for this project only. Contractors bidding on or undertaking the works should examine the factual results of the investigation, satisfy themselves as to the adequacy of the factual information for construction, and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, safety, and equipment capabilities.

5.2 Project Description

It is understood that the proposed weir is comprised of a semi-circular concrete structure with a fish passage opening towards the centre. The weir structure reaches an elevation of 54.8 m on the upstream side and 52.8 m on the downstream side, with riprap protection on both the upstream and downstream sides. The weir structural foundations will consist of spread footings founded on the till material.

According to CBCL, the maximum water level under future flood conditions following the construction of the weir structure is at an approximate elevation of 55.8 m.

The existing ground level on the western side of the north and south bridge embankments slopes down from Allandale Road into the pond. The slope surface currently comprises vegetation, small trees, cobbles and boulders.

In general, the subsurface conditions at the location of the proposed weir structure consist of very soft to firm clayey silt overlying either: a) very stiff gravelly clay or b) compact to dense gravelly sand glacial till or sandy gravel till. The glacial till rests on probable siltstone bedrock, which was penetrated 0.45 m by diamond drill rock coring. The glacial till directly underlying the clayey silt deposit was encountered at elevations 49.0 m and 50.2 m in boreholes BH3 and BH2, respectively.

5.3 Spread Footing

The very soft to firm lacustrine deposit (clayey silt) is not suitable for support of foundations. The weir structure foundations should be supported on native glacial till or on the very stiff gravelly clay. This will result in excavations that extend deeper than CBCL's proposed design level.

Foundations supported on the glacial till or on very stiff gravelly clay may be designed using a geotechnical resistance at Serviceability Limit States (SLS) of 150 kPa and a factored geotechnical resistance at Ultimate Limit States (ULS) of 200 kPa. The above resistances/reactions assume a minimum strip footing width of 400 mm.

The post-construction total and differential settlements of footings sized using the above SLS net bearing reaction should be less than about 25 and 15 millimetres, respectively, provided that the soil at or below founding level is not disturbed during construction.

The three boreholes performed indicate that the surface of the till slopes down in the north-east direction. The actual position of the till at the north-east abutment of the weir (i.e. north-east of BH3) is not known and may be deeper than 4.0 m.

The use of a structural backfill foundation may be used in the deeper portion of the excavation in order to limit the amount of concrete necessary for the proposed structure. In this case, the structural backfill should rest directly on intact glacial till or very stiff gravelly clay and be placed in individually compacted thin lifts.

The degree of compaction to be attained on each lift is a minimum of 95% of the Modified Proctor value of the material. The thickness of each lift will depend on the actual compaction equipment used on site and should be established based on the results of a trial pad or relevant experience. The structural backfill should be placed in horizontal lifts and should extend to the upstream and downstream edges of the excavation into the clayey silt. The material to be used for the structural backfill should consist of a well graded till with a minimum of 20% fines. The use of rockfill or other permeable material is not recommended since it may lead to excessive seepage beneath the proposed structure.

Prior to pouring the concrete for the footings, the foundation excavations should be inspected by a qualified geotechnical professional to confirm that the footings are located on undisturbed material, which has been cleaned of ponded water and loosened/softened material. If construction is carried out in the winter, special precautions will be required to avoid frost penetration and heave within foundation areas during construction, which may cause excessive settlements when thawed.

During the construction of the foundations, sufficient pumping capacity should be provided at the footing level to control water infiltration and keep founding surfaces free of water.

5.4 Site preparation and Foundation Excavation

It is understood that the water flow path from Long Pond into Rennies River is not likely to be diverted during the construction of the weir structure. The site preparation and excavation to the founding level for the footing would likely require constructing a cofferdam or similar system. Due to site constraints and environmental controls, it is understood that access of equipment into the working area may be limited and, at this stage, the type of cofferdam to construct the weir structure is not yet defined.

If an earthfill cofferdam is used, consideration should be given to select a low permeability material such as a well graded till to limit the amount of seepage within the working area, Upstream protection against wave action and siltation will be required. Such protection could be provided by a geotextile and surficial rockfill.

At least two possibilities could be envisioned for the construction of an earthfill cofferdam:

- A future stability analysis will be required to determine if both the upper and lower parts of the lacustrine deposit are appropriate to support the weight of the cofferdam while maintaining an appropriate factor of safety along the excavation slope of the working area. This analysis will have to take into account the expected flood level conditions of Long Pond. If the results of such an analysis are positive, the cofferdam could then be built either directly onto the clayey silt deposit or following partial excavation of the softer upper portion of this deposit. This option may also consider pushing back the cofferdam further into Long Pond in order to limit the influence of the weight of the cofferdam onto the adjacent excavation slope required for the construction of the weir.
- If the results of the stability analysis prove to be negative, the cofferdam will then have to be founded directly onto the till following progressive removal of the clayey silt under most of the cofferdam width. This will result in the need for an additional temporary floating curtain in Long Pond in order to control siltation during the excavation process.

If sheet piling is used in order to form a cofferdam, the type of sheet pile should be selected as to provide tight joints and minimum leakage into the working area. The restraint offered by sheet piles will depend on the length of embedment into the soils and the proximity of the excavation zone. If sheet piles are to be placed at close proximity to the temporary excavation, it is recommended that the passive force to be developed within the soft clayey silt be neglected. The following parameters can be used for the design of sheet piles:

- Unit weight of the clayey silt: 16.5 kN/m^3;
- Unit weight of the till: 19 kN/m^3;
- Friction angle of the till: 35 degrees.

Sand bags could also be considered for the cofferdam. Sand bags are however likely to settle into the soft clayey silt under their own weight and to tilt downstream as a result of the applied water (lake) pressure. Sand bags will also allow larger water seepage into the open excavation compared to an earthfill cofferdam. The crest of sand bags will probably not be high enough to match the design flood elevation which will increase the risk of flooding of the working area for the contractor.

All excavations will need to conform to the Newfoundland and Labrador Occupational Health and Safety Regulations, 2009. Additional information on the properties of the upper portion of the clayey silt deposit will be required to determine safe excavation slopes within this material, especially around BH3 where the excavation will be in the order of 3.2 m deep.

Excavation for the installation of site footings will be through the lacustrine deposit and till. Conventional hydraulic excavating equipment would be suitable to excavate the lacustrine deposit and the till material within a confined water-controlled area.

5.5 Frost Protection

All foundation elements should be provided with a minimum of 1.2 m of earth cover for frost protection purposes.

6.0 ADDITIONAL CONSIDERATIONS

The provision of continuous water pumping from Long Pond into Rennies River will likely be required in order to limit the environmental impact of the cofferdam onto the fish habitat further downstream in Rennies River. The sizing of the pumping system should be performed in conjunction with the selection of the cofferdam crest elevation as to take into account possible flood events while the cofferdam is in place. This may require performing a hydrological analysis.

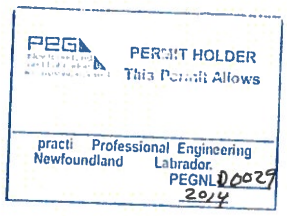
At the time of the writing of this report, only limited conceptual details for the proposed structure were available. Golder Associates should be retained to review the final drawings and specifications for this project prior to tendering to ensure that the guidelines in this report have been adequately interpreted.

Report Signature Page

GOLDER ASSOCIATES LTD.

Michel Wawrzkow
Senior Geotechnical Engineer

Michel Lemieux
Associate



MW/ML/kl

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LEGEND

APPROXIMATE BOREHOLE LOCATIONS

KEY MAP

0 5 10 20

1:500 METRES

NOTE(S)

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT NO. 1407587.

REFERENCE(S)

1. BING IMAGERY SUPPLIED BY ESRI AND MICROSOFT © 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS, IMAGE DATE: 2014-06.
2. SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, DELORME, USGS, INTERMAP, INCREMENT P CORP., NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI (THAILAND), TOMTOM, MAPMYINDIA, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 22 VERTICAL DATUM: CGVD28

CLIENT
CBCL LIMITED

PROJECT
LONG POND WEIR

TITLE
APPROXIMATE BOREHOLE LOCATIONS

CONSULTANT
Golder Associates

YYYY-MM-DD	2014-10-16
DESIGNED	---
PREPARED	BR
REVIEWED	BW
APPROVED	CR

PROJECT NO	PHASE	REV	FIGURE
1407587	4	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM 20cm

APPENDIX A

Record of Boreholes

Golder Associates

PROJECT: 1407587

RECORD OF BOREHOLE: BH1

SHEET 1 OF 2

LOCATION: See Site Plan

BORING DATE: October 3-4, 2014

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

DRILL RIG: CME 55

DRILLING CONTRACTOR: Logan Geotech

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	REC. LENGTH (mm) / SA. LENGTH (mm)	BLOWS/0.15m	N VALUE	REMARKS, ADDITIONAL LAB. TESTING & GRAIN SIZE DISTRIBUTION (%)	PIEZOMETER OR STANDPIPE INSTALLATION
		WATER SURFACE		53.00						GR SA SI CL	
0	Continuous Split Spoon, 90 mm Diam. Casing	WATER		0.00							
				51.20							
2		(ML) CLAYEY SILT; dark grey brown, with organics; w>PL, cohesive, very soft		1.80							
				49.20							
4		(Cl) gravelly CLAY, fine to coarse gravel; pale grey; w<PL, very stiff		3.80	1	SS	305/610	0 7 23 19	30		
				48.50							
		(GP) sandy GRAVEL, fine to coarse, subangular; pale grey to greenish grey, with low plasticity fines, cobbles and boulders (GLACIAL TILL); compact to dense		4.50	3	SS	356/610	13 13 12 32	25		
5					4	SS	305/610	18 27 22 22	49		
6	Rotary Drill, NQ Core				5	SS	203/534	33 16 21 50/0.08	37		
					6	SC	—				
7					7	SC	—				
8				44.85							
		Borehole continued on RECORD OF DRILLHOLE BH1 Note: 1. Drill string sank under it's own weight from 1.8 m to 3.8 m.		8.15							
9											
10											
11											
12											
13											
14											
15											

STANDARD PENETRATION RESISTANCE, N VALUE: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp — W — Wl (20 40 60 80)

DEPTH SCALE

1 : 75

LOGGED: BW

CHECKED: ML

Golder Associates

MIS-BHS 012 1407587 TEMP.GPJ GAL-MIS.GDT 11/04/14 JM

PROJECT: 1407587

RECORD OF DRILLHOLE: BH1

SHEET 2 OF 2

LOCATION: See Site Plan

BORING DATE: October 3-4, 2014

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Logan Geotech

JN - Joint, FLT - Fault, SH - Shear, VN - Vein, CJ - Conjugate
BD - Bedding, FO - Foliation, CO - Contact, OR - Orthogonal, CL -
PL - Planar, CU - Curved, UN - Undulating, ST - Stepped, IR - Irregular
PO - Polished, K - Slickensided, SM - Smooth, RO - Rough, MB - Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

Point Load Index Legend:
● Diametral Test on Intact Sample
○ Diametral Test on Microdefect/Foliation
■ Axial Test on Intact Sample
□ Axial Test on Microdefect/Foliation

UCS Legend:
▲ Intact Rock
△ Partial Failure

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jcon	Jr	Ja	UCS (MPa) / Point Load Index (MPa)	WEATHERING INDEX	NOTES
		BEDROCK SURFACE		44.85														
	Rotary Drill / NQ Core	Fresh, thinly bedded, red grey SILTSTONE, very poor quality		8.15 / 44.40	1	100												
		End of Drillhole		8.60														

DEPTH SCALE
1 : 75

LOGGED: BW
CHECKED: ML

MIS-RCK 020 1407587 TEMP.GPJ GAL-MISS.GDT 11/04/14 JM

PROJECT: 1407587

RECORD OF BOREHOLE: BH2

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: October 4, 2014

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

DRILL RIG: CME 55

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DRILLING CONTRACTOR: Logan Geotech

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	REC. LENGTH (mm) / SA. LENGTH (mm)	BLOWS/0.15m	N VALUE	STANDARD PENETRATION RESISTANCE, N VALUE / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT (Wp, W, Wl)	REMARKS, ADDITIONAL LAB. TESTING & GRAIN SIZE DISTRIBUTION (%)	PIEZOMETER OR STANDPIPE INSTALLATION
		WATER SURFACE		53.00								GR SA SI CL	
0	Continuous Split Spoon, 90 mm Diam. Casing	WATER		0.00									
1				51.55									
2		(ML) CLAYEY SILT; brown to dark grey, with organics; w>PL, cohesive, very soft to firm		1.45	1	SS	178/610	3 3 4	7	7			
				50.20				4					
3		(SP) gravelly SAND, medium to coarse, subangular; pale grey to greenish grey, with low plasticity fines, cobbles and boulders (GLACIAL TILL); compact to very dense		2.80	2	SS	229/610	5 12 29 35	41	41			
4					3	SS	229/610	29 15 11 10	26	26			
					4	SS	432/610	2 15 11 10	26	26			
5					5	SS	330/610	11 31 21 14	52	52			
				47.20									
6		End of Borehole		5.80									
		Note:											
		1. Borehole terminated at 5.8 m depth due to encountered cobbles or boulders within the fill, which caused the drill string to move out of vertical alignment.											
		2. Drill rods sank by own weight from 1.45 m to 2.2 m.											
7													
8													
9													
10													
11													
12													
13													
14													
15													

DEPTH SCALE
1 : 75

LOGGED: BW
CHECKED: ML

Golder Associates

MIS-BHS 012 1407587 TEMP.GPJ GAL-MIS.GDT 11/04/14 JM

PROJECT: 1407587

RECORD OF BOREHOLE: BH3

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: October 4, 2014

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

DRILL RIG: CME 55

DRILLING CONTRACTOR: Logan Geotech

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	REC. LENGTH (mm) / SA. LENGTH (mm)	BLOWS/0.15m	N VALUE	REMARKS, ADDITIONAL LAB. TESTING & GRAIN SIZE DISTRIBUTION (%)	PIEZOMETER OR STANDPIPE INSTALLATION
		WATER SURFACE		53.00						GR SA SI CL	
0	Continuous Spiit Spoon 90 mm Diam. Casing	WATER		0.00							
				52.15							
1		(ML) CLAYEY SILT, some gravel and wooden fragments; dark brown, with organics; w>PL, cohesive, very soft to firm		0.85							
2					1	SS	152/610	1 1 1 2	2		
3					2	SS	127/610	4 9 3 5	12		
					3	SS	127/585	1 2 1 50/0.13	3		
				49.00							
4		(GP) sandy GRAVEL, fine to coarse, subangular, some fines; greenish grey, pale brown and red (GLACIAL TILL); compact to dense		4.00							
					4	SS	305/610	8 17 21 26	38		
5					5	SS	305/610	21 20 29 7	49		
6					6	SS	483/610	15 16 15 21	31		
					7	SS	381/610	17 12 12 13	24		
				46.10							
7		End of Borehole		6.90							
		Note:									
		1. Borehole terminated in fill as the borehole wall collapsed during drilling.									
		2. Drill rods sank by own weight from 0.85 m to 2.0 m.									
8											
9											
10											
11											
12											
13											
14											
15											

STANDARD PENETRATION RESISTANCE, N VALUE: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp W Wl (20 40 60 80)

DEPTH SCALE 1 : 75

LOGGED: BW

CHECKED: ML

Golder Associates

MIS-BHS 012 1407587 TEMP.GPJ GAL-MIS.GDT 11/04/14 JM

APPENDIX B

Important information regarding this report

Golder Associates

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

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Golder Associates

APPENDIX H

City's Specification – Division 9

DIVISION 9

ENVIRONMENTAL REQUIREMENTS

INDEX

ITEM 901

OWNER'S POLICY

901.1 OWNER'S POLICY

It is Owner's policy to protect the environment of the area where the project is located. To ensure protection of the environment, the work at all times shall be subject to inspection by the staff of relevant municipal, provincial and federal agencies. Normally, all inspections other than by the Engineer will be arranged in advance through the Engineer. Any specific matters relating to environmental protection will be dealt with between Contractor and Engineer.

Any violations of environmental permits or authorizations or any environmental related incidents which are observed by inspectors representing regulatory agencies are to be reported by them prior to leaving the site to the Engineer. Except in emergency situations, environmental protection measures required by other agencies must be approved by the Engineer prior to implementation by the Contractor.

ITEM 915

PROTECTION OF WATERCOURSES AND WATERBODIES

915.01 SCOPE

This specification covers the environmental requirements for work being carried out at watercourses and waterbodies. It includes references to Federal and Provincial Legislation and prescribed methods and procedures to employ when carrying out such work as culvert or bridge installations, stream diversions, fording, fill placements at waterbodies, and any other work which may alter or impact any watercourse or waterbody, or the quality of the water therein.

915.02 LEGISLATIVE REQUIREMENTS

The Contractor shall be aware of all Federal and Provincial Legislation governing the protection of watercourses and waterbodies and all revisions and amendments to this legislation.

.01 PROTECTION OF INLAND FISHERIES ENVIRONMENT

All permanent or temporary works or undertakings which are proposed for watercourses or waterbodies constituting fish habitat require authorization from the Fish Habitat Management Branch of the Federal Department of Fisheries and Oceans at least two (2) weeks prior to the commencement of any work. The Contractor is required to obtain such approval and provide the Engineer with a copy prior to any work

Application forms for authorization for works or undertakings affecting fish habitat are available at all Department of Fisheries and Oceans located at St. John's, Grand Bank, Grand Falls, Goose Bay and Corner Brook.

Contractors are referred to the Department of Fisheries and Oceans publication entitled "Resource Road Construction - Environmental Guidelines and Design Criteria", latest edition, (and to other technical information). The DFO "Factsheets" contain recommended guidelines for culvert installations, road and bridge construction, and other works. They include mitigative measures and procedures intended to assist Contractors in minimizing impacts on fish and fish habitat.

Contractors are advised that Environmental and Fisheries regulations require that any work done in or near a watercourse, deemed to be viable fish habitat, must be restricted to the minimum of disturbance. The establishment of temporary and permanent buffer zones are required. Great care must be taken during construction not to harmfully alter, disrupt, or destroy fish habitat or to deposit any substance which may be harmful to fish habitat in or near any watercourse where it may enter the watecourse. Culvert pipes must be constructed, according to the requirements of the applicable permits, to allow free movement of fish.

Contractors are advised to refer to the Fisheries Act with particular attention to:

- Section 35 - Outlines required authorization for work or undertaking which may affect fish habitat.
- Section 36 - Prohibits the deposit of a harmful substance of any type into water frequented by fish.
- Section 37 - Powers of the Minister for the provision of information such as plans, specifications, studies, etc., and to require any modifications to such plans and/or related information.
- Section 38 - Powers of a Ministerial Inspection.
- Section 40-42 - Enforcement and Penalties.

.02 THE ENVIRONMENTAL CONTROL (WATER AND SEWAGE) REGULATIONS

Contractors shall maintain compliance with the Environmental Control (Water and Sewage) Regulations.

.03 THE WATER RESOURCES ACT, DEPARTMENT OF ENVIRONMEN

Where the Contractor must carry out any alteration of a body of water **which is not required specifically as part of the contractual work,** the Contractor must obtain a Certificate of Approval from the Department of Environment and Conservation before carrying out the work. Alterations to watercourses and waterbodies such as culvert installations, bridges, stream diversions, rock fill placement in waterbodies, etc., which are typically required as part of the contractual work are authorized and administered by DT&W and do not require separate approval from the Department of Environment and Conservation. All such alternations to bodies of water must be carried out according to established procedures of the regulatory agencies so as to prevent pollution or damage to the environment.

The Contractor is referred to the following **Environmental Guidelines** of the Department of Environment and Conservation, Water Resources Division, regarding construction procedures at watercourses:-

CHAPTER	TITLE	CHAPTER	TITLE
3	Watercourse Crossings	7	Diversions, New Channels & Major Alterations
4	Bridges	9	Pipe Crossings
5	Culverts	13	General Construction Practices
6	Fording	7	Diversions, New Channels & Major Alterations

915.03 FORDING OF WATERCOURSES

The use of equipment or machinery in a watercourse or waterbody is generally not permitted. Should it be necessary for equipment to ford a watercourse, then the approval of the Engineer is required for the specified equipment only and at a designated location. The same crossing point shall be used each time that a fording is required. When extensive or frequent crossing of a watercourse is necessary, temporary culvert or bridge installation may be required instead of fording. The Contractor is referred to the Environmental Guidelines Chapter 6, "Fording" of the Department of Environment and Conservation, regarding the selection, site preparation, and use of fording sites. The Contractor shall discuss all proposed fording sites with DT&W a minimum of five (5) working days before any fording activity. Site selection require the written approval of the Engineer.

915.04 CLEARING & GRUBBING ADJACENT TO WATERCOURSES

The Engineer shall mark limits for clearing and grubbing adjacent to watercourses. Buffer zones of undisturbed vegetation shall be maintained at watercourse crossings as marked in the field. A permanent buffer zone shall be maintained both sides of the construction zone at watercourse crossings, wherein, no disturbance or cutting of vegetation is to take place. A temporary ungrubbed buffer zone shall be maintained on both sides of the watercourse, unless otherwise directed by the Engineer, within the construction zone at watercourse crossings until such time as the installation of the crossing is to be carried out. The Contractor shall use appropriate mitigative measures such as the use of silt fencing, sedimentation basins and take-off ditches to control sediment laiden runoff from entering watercourses.

915.05 GENERAL PROCEDURES FOR INSTALLING WATERCOURSE CROSSINGS

The Contractor shall present to the Engineer for approval, a plan for the construction of unwatering systems including diversion systems, pumping systems, settling and/or filtration systems, a minimum of **three (3) working days** prior to the start of any work at the site for the approval of the Engineer.

A pre-construction meeting shall be convened on-site between the Contractor and the Engineer to review environmental protection measures and associated contract details pertaining to the watercourse crossing, prior to any work being carried out at the proposed crossing site.

All work carried out at watercourses shall be performed in the dry and with due care and caution so as to prevent unnecessary disturbance or impact on adjacent land or downstream areas. Where watercourses are deemed fish habitat, work within the

channel is generally prohibited between September 15 and June 1, on the island portion of the province, and between September 1 and June 30 for Labrador, unless otherwise approved by DFO and the Engineer. The Contractor shall carry out all work in and around watercourses in accordance with all Federal and Provincial permits and requirements, the relevant sections of this Specification Book, and the contract drawings.

The Contractor shall give **three (3) working days** notice prior to any instream or near stream grubbing or excavation.

Buffer zones shall be established and maintained as described in section 915.04.

An approved cofferdam shall be installed at the low end of the construction zone to collect all site water which is to be disposed of in an approved manner. (See Section 915.07 Treatment of Silted Water).

The operation of heavy equipment shall be confined to dry stable areas in order to prevent the generation of mud and silted water. All flow shall be diverted or pumped around or through the work area by means acceptable to the Engineer so as to maintain flow in the watercourse immediately below the site, prevent erosion, and maintain acceptable water quality.

The flow diversion system shall have sufficient freeboard to be capable of accommodating rain events or provision shall be made to safely discharge elevated flows without causing washouts of constructed works, erosion, or siltation in downstream areas. The discharge location of the pumping or diversion system shall be stabilized to prevent erosion. All unwatering operations shall be constantly monitored by the Contractor.

Work should be carried out from the downstream section of the work area and progress to the upstream.

The Contractor shall ensure that fish are not left stranded in the work area at the time the diversion system is made operational. All stranded fish shall be removed by appropriate means and quickly returned to the watercourse below the construction area to prevent mortalities.

An impermeable cofferdam of non-erodable material, such as sandbags and sheet plastic, shall be constructed at the outlet area of the construction zone to prevent any silted water from entering downstream areas and to assist in unwatering operations.

The location, size, construction, and operation of sedimentation basins shall be carried out according to City specifications or as directed by the Engineer and so as to achieve adequate settling parameters within the basins and ensure that discharged water from the basins, which is entering any watercourse, meets the water quality standards set forth in the Environmental Control (Water and Sewage) Regulations, (See Section 915.02.02).

Operation of the sedimentation basins shall be continuously monitored by the Contractor to ensure proper functioning and maintenance.

Excavation material shall be carried out to the limits marked in the field by the Engineer. All excavations shall be carried out using a tracked excavator which will operate within the limits of the work area or as directed by the Engineer.

Excavated material shall be removed from the site and stockpiled at an approved location where it will not enter any watercourse.

When corrugated steel pipes are installed, impervious material shall be placed under the invert of the pipe and around the haunches of the pipe at the inlet area so as to ensure that all flow is confined within the pipe, particularly during low flow conditions, and not lost into the porous fill zones outside the pipe.

All sections of newly constructed channel shall be adequately stabilized so as to prevent destabilization, erosion, or scouring of the channel and fill embankments. Rip-rap on road slopes shall be placed concurrently with backfilling operations on the pipe so that inlet and outlet areas are protected by the Resident Engineer.

Any disturbed areas or exposed soils within the high water zone of the watercourse shall be stabilized by such means as placing rip-rap or well staked sodding within 48 hours of completion of backfilling operations. Other adjacent disturbed areas shall be rehabilitated by sodding or seeding, or as directed by the Engineer.

Where baffles are required as part of a culvert installation all activities associated with the baffle pipe installation including the diversion of all water flow from the natural watercourse into the baffled pipe, abandonment of any temporary stream diversion system and rehabilitation of the surrounding disturbed area shall be carried out efficiently with out delay so as to not interfere with fish migration.

Upon completion of the work, flow shall be introduced slowly into the new channel or watercourse crossing. Any silted water generated as a result shall be prevented from entering downstream areas of the watercourse, and pumped or treated as required.

All construction related waste material shall be removed from the work site(s).

Sedimentation basins shall be pumped dry and backfilled with the original excavated material and compacted. Hand seeding, hydroseeding, and/or sodding of disturbed areas shall be carried out as directed by the Engineer. Additional rehabilitation may be required by the Engineer.

915.06 USE OF FRESH CONCRETE IN OR NEAR BODIES OF WATER

When concrete is poured in or adjacent to a watercourse or waterbody, all necessary precautions shall be taken to prevent the concrete from adversely affecting water quality. Whenever possible, fresh concrete should not come in contact directly with the waters of a watercourse. Standing water zones should be drawn down prior to placing fresh concrete. All formwork shall be well secured and made tight to prevent leakage of fresh concrete into any adjacent waters. Where tremmie concrete is required, the work shall be carried out under the specific directions of the Engineer. The washing of concrete delivery trucks or chutes is not permitted within 100 metres of any watercourse or waterbody. All necessary precautions shall be taken when handling related substances such as form coatings and concrete admixtures to prevent any spill or leakage of these substances.

915.07 CONTROL AND TREATMENT OF SILTED WATER

Silted or muddy water is not permitted to be released into any watercourse or waterbody or into any ditch or area that leads directly to a watercourse or waterbody. Runoff from adjacent areas shall be channeled, piped, diverted, or confined to prevent the water from entering construction zones and becoming polluted. Where due to rain events, runoff from construction zones and areas of exposed soils contains mud or silt, appropriate measures shall be taken by the Contractor to confine, settle, or channel such water so that adjacent watercourses or waterbodies are not adversely affected. Such measures may include the provision of mud basins, settling basins, ditch blocks, silt fencing, temporary ditching, or other means necessary to prevent pollution. Silted runoff water or water released or pumped from construction zones may be discharged to an approved vegetated area where ground absorption will occur or to an approved settling area or to a settling basin constructed in accordance with contract drawings or as directed by the Engineer.

915.08 FILL PLACEMENT AT WATERBODIES

Fill material placed in or at waterbodies shall be clean blasted rock. Where in the opinion of the Engineer, significant silty bottom sediments will disperse with potential of creating water quality problems, the fill zone shall be isolated from the remainder of the waterbody by such means as a silt curtain as approved by the Engineer. Rock shall be placed into the water zone so as to create the least amount of disturbance of bottom sediments. Rock shall be placed along the outer edge of the fill zone to close off and isolate the fill zone from the rest of the waterbody. Fill placement shall proceed with runs of rock along the inside of the first outer run of fill. Successive runs of rock fill shall be placed in this manner until the zone if filled back to the inner fill limits. Height of the placed rock fill shall be maintained a minimum of 300 mm above water level during fill operations. Equipment shall not operate in standing water zones. Removal of displaced sediments and/or bog shall be carried out as directed by the Owner. Pumping of water from the fill zone to a designated area may be required by the Owner to reduce water levels in the fill zone and prevent movement of silted water through the rock fill back into the waterbody.

ITEM 920

STORAGE AND HANDLING OF FUELS AND OTHER HAZARDOUS, TOXIC, OR DANGEROUS MATERIAL

920.01 STORAGE TANK REGISTRATION, INSPECTION, AND REMOVAL

All storage tank systems must be registered under and in compliance with Newfoundland Regulation 58/03, The Storage and Handling of Gasoline and Associated Products Regulations 2003 before commencing operation. Registration does not apply to storage tank systems of a capacity less than 2500 litres that are connected to a heating appliance. Contractors shall supply verification of storage tank registration to the Engineer prior to the Commencement of work.

Storage tank systems shall be inspected on a regular basis as per Section 18 of Newfoundland Regulation 58/03 Storage and Handling of Gasoline and Associated Products. This involves, but is not limited to, gauging or dipping, reconciliation of the records, and the proper maintenance of reconciliation records for a period of two (2) years. Records shall be maintained for inspection by the Engineer, ESO and/or Government Service Centre Inspectors.

The owner of a storage tank system shall, within thirty (30) days of known abandonment, empty the system of all products, remove the tank and associated piping from the ground, remove any contaminated soil, clean the area and restore the site to the satisfaction of the Engineer and in accordance with the criteria of the Government Services Centre.

920.02 SPILL REPORTING & CLEANUP PROCEDURES

The Contractor, Subcontractors, and their personnel shall take all necessary precautions to prevent the spillage, misplacement, or loss of fuels and other hazardous material. Contractor and Subcontractors shall abide by the following measure in the event of the detection of a fuel or hazardous material spill of **70** litres or metre:-

i) make every effort to stop leakage and contain contaminant flow;

ii) **immediately** upon detection, report spill location and size to the Canadian Coast Guard spill report number **772-2083** Pesticides Control Section 729-3395 and to the Owner; follow up with a full written report containing information on the cause of the spill, remedial action taken, damage or contamination estimate, and any further action to be taken;

iii) remove contaminant from spill site by absorbent, pumping, burning, or whatever method is appropriate and acceptable to Owner. Clean-up the affected area in accordance with the requirements of the Government Services Centre and then dispose of contaminated debris at an approved waste disposal site.

iv) take all necessary action to ensure the incident does not recur.

Contractor shall apply the following criteria in reaching decisions on contaminant and clean-up procedures:

i) minimize danger to persons;
ii) minimize pollution to watercourses and wetlands;
iii) minimize the size of the area affected by a spill; and
iv) minimize the degree of disturbance to the area and watercourses during clean-up.

Any spillage of hydrocarbons less than 70 litres shall be immediately cleaned up by the Contractor and reported promptly to the Engineer.

The Contractor shall dispose of any soil contaminated by small leaks of oil or lubricating fluids from equipment in a manner approved by the Engineer and in accordance with the criteria of the Government Services Centre.

The Contractor shall have on site a suitable quantity of absorbent material such as "Oclansorb" or similar product which can be accessed quickly and effectively in the event of any hydrocarbon spill. The Contractor shall advise fuel handling staff of its location and application.

920.03 FUEL STORAGE & HANDLING PROCEDURES

Contractor shall ensure that fuels and hazardous materials are handled only by personnel who are trained and qualified in handling these materials in accordance with manufacturers' instructions and government regulations. The Contractor will be required to verify personnel qualifications as they pertain to this item and provide written confirmation of same to the Engineer. The Contractor shall supply a copy of the product safety data sheet to the Engineer of all hazardous, toxic or dangerous materials or substances which will be used during the course of the contract. Refueling operations shall be supervised at all times. Under no circumstances shall any refueling procedure be left unattended by the operator.
Handling and fueling procedures shall be carried out to prevent the contamination of soil or water. Smoking shall be prohibited within **10 metres** of a fuel storage area or during refueling operations. Fueling or servicing of mobile equipment shall not be allowed within **100 metres** of a watercourse, waterbody, or designated wetlands, Oils, greases, gasoline, diesel, hydraulic and transmission fluids or other fuels shall be stored at least **100 metres** (horizontal distance) from any water course, water body, or designated wetland unless otherwise approved by the Engineer.

Any above ground fuel containers, with the exception of those exempted under Newfoundland Regulation 58/03, shall be self dyked units that are in compliance with the terms and conditions of the approval of the Government Services Centre. Fuel storage areas and non-portable transfer lines shall be clearly marked or barricaded to ensure that they are not damaged by moving vehicles. The markers shall be visible under all weather conditions. The storage, handling and disposal of **used oils** shall be in accordance with the Used Oil Control Regulation (82-02) under the NL Environmental Protection Act..

920.04 EQUIPMENT SERVICING PROCEDURES

All heavy equipment maintenance shall be carried out by using suitable fluid collection equipment and in a manner which ensures all waste material is collected and suitably disposed of. The Contractor shall ensure that all equipment is mechanically sound to avoid leaks of grease, oil, diesel, gasoline, and hydraulic and transmission fluids. The Contractor shall ensure that no servicing or washing of heavy equipment occurs adjacent to watercourses and designated wetlands. Fueling, servicing or washing of equipment shall not be allowed within **100 metres** of a watercourse except within a refueling site approved by the Engineer where conditions allow for containment of accidentally spilled fuels. The Contractor shall remove from the work area and properly dispose of all waste oil, filters, containers of other such debris at an approved waste disposal site.

920.05 USE OF HAZARDOUS, TOXIC OR DANGEROUS MATERIAL

Toxic construction material e.g., creosote treated timber, shall be stored at least **100 metres** away from all areas where drainage is directed into any watercourse or wetlands.

Toxic or dangerous substances such as form release agents, fuels, concrete additives (including superplasticisers), and other substances, shall be transported, stored and handled with all necessary precautions so as to prevent any spillage from occurring. Drip pans shall be used at locations where such liquids are being drawn off in order to contain any minor spills, and as a safety measure for containment of a significant spillage.

ITEM 925

WASTE MANAGEMENT

925.01 SOLID WASTE DISPOSAL

Contractor shall collect and dispose of all waste produced by its employees and those of its Subcontractors in a manner approved by the Engineer, and in accordance with the Waste Material Disposal Act. Through the placement of suitable containers at the site, the Contractor shall collect and dispose of rubbish and domestic garbage generated by employees. During the progress of the work, the Contractor shall keep the areas occupied by it and access to such areas in a neat, clean, and safe condition, and free from the accumulation of all waste materials including crating materials, rubbish, drink containers, cigarette cartons, and all other waste. All solid waste shall be removed from the job site and recycled or disposed of at an Approved Waste Disposal Site, with the permission of the City. No waste material shall be deposited in any watercourse or wetland.

Upon completion of the work the Contractor shall, at its own expense, and to the satisfaction of the Engineer, dispose of or remove from the jobsite all construction plant, rubbish, unused material, including concrete forms, filter fabric material, sediment fencing, sand bags, and other equipment and material belonging to it or used under its direction during the performance of the work. The site shall be left in a neat and clean condition.

In the event of the Contractor's failure to comply with any of the foregoing, the same may be accomplished by the owner within **thirty (30) days** of the completion of the work and the cost of same may be deducted from any money due or owing to the Contractor whether under this or any other contract.

925.02 SANITARY FACILITIES / SEWAGE DISPOSAL

The Contractor shall maintain portable latrines on site or systems approved by the Government Services Centre. The sanitary facilities shall be used by all Contractor employees and those of subcontractors. The Contractor shall transport the waste from these units, using a collection company (whenever possible) licensed by Government Services Centre. Otherwise, transportation and disposal shall be by a means and at a facility or location as approved by the Government Services Centre.

ITEM 940

DUST CONTROL

940.01 DUST CONTROL

The Contractor shall ensure that dust does not become a problem for adjacent property owners or construction site personnel or a hazard to vehicular traffic. When required, or as directed by the Engineer, water or an acceptable dust suppressant such as calcium chloride shall be used by the Contractor on haul routes or other locations on the project to control dust.

All costs associated with dust control shall be borne by the Contractor.

ITEM 945

EQUIPMENT OPERATION & PREVENTION OF EROSION & SILTATION

945.01 STORMWATER MANAGEMENT

The Contractor is responsible for stormwater and drainage management during the period of the contract. This includes the collection, channeling, containment, settling, discharge and any other operation to effectively control storm runoff and prevent problems of erosion or siltation of adjacent or downstream areas. (See Section 915.07 Control and Treatment of Silted Water).

945.02 TEMPORARY TRAVEL ROUTES

Linear travel along the right of way by vehicles and equipment shall be restricted to one (1) track or travel route, particularly during the early stages of opening access along the route, unless otherwise approved by the Engineer. The route shall be maintained by the Contractor free of standing water. Surface drainage will not be permitted to run along the route which can generate extensive mud and silt, and adversely affect material to be excavated such as grubbing, unsuitable material, and overburden. Surface drainage shall be vented off the route at frequent intervals. Where drainage courses are encountered, and frequent crossings are required, temporary pipes (CSP or iron) shall be installed to permit passage of equipment and vehicles in the dry, without causing erosion and siltation. At certain locations fording may be permitted by the Engineer. (See Section 915.03 Fording of Watercourses).

945.03 EROSION & SILT CONTROL MEASURES

945.03.01 GENERAL PROTECTION MEASURES

The Contractor shall minimize terrain disturbance and erosion resulting from its activities. The Contractor shall, as part of its work, implement erosion and silt control measures where its activities result in a blockage of natural drainage, the diversion of natural drainage, or the exposure of soil or subsoil to potential erosion. Particular measures which may be required include:

i) using an erosion control blanket;
ii) using an appropriate hydraulic mulch;
iii) spreading hay over exposed soils;
iv) spreading a thin layer of brush or slash over disturbed areas;
v) the installation of baffles or sediment traps at appropriate intervals within the area of disturbance;
vi) the installation of drainage collectors across the disturbed area to channel drainage into vegetated areas;
vii) the re-routing of disturbed drainage courses back into the natural course;
viii) the stabilization of exposed soils at drainage locations with appropriate rip-rap;
ix) where so directed by the Engineer, to construct check dams to confine mud or slurry at such locations as unsodded ditchlines, catch-basins and culvert inlets.
x) the pumping of silted water to settling or designated vegetated areas;
xi) the installation of mud basins of adequate size at run-off locations from exposed areas to contain heavy silt and mud as directed by the Engineer.

945.04 LIMITATION OF OPERATION

During periods of heavy rain, where in the opinion of the Engineer, the movement of excavated material and equipment may give rise to extensive mud conditions, or the potential to seriously impact watercourses, or adjacent land, the Contractor may be required to suspend operations until such time as site conditions allow operations to resume. The Contractor shall not be paid for such downtime.

ITEM 950

PROTECTION OF VEGETATION AND WETLANDS

950.01 MAINTAIN NATURAL DRAINAGE PATTERN

Drainage is to be maintained in its natural state wherever possible, with provision being made for spring flooding. Where existing drainage patterns cannot be maintained, alternate drainage will be installed to approximate normal conditions with the approval of the Engineer.

950.02 PROTECTION OF TREES & SHRUBS

Some trees, shrubs and plants within the clearing limits may be required for use by the Owner or other groups. Where necessary, and as directed by the Engineer, such trees, shrubs and plants shall be flagged for removal. Also see Section 955.02 (Planting of Trees and Shrubs).

Where branches of trees are to be removed as a result of damage or where roots **2.5 cm** in diameter or larger are exposed as a result of contractors excavation work, the stumps shall be cut cleanly using a saw or lopping tool. The roots shall be cut back level to the surface of the cut slope within 24 hours following their exposure.

The Contractor shall adhere to the following protection measures:

i) No unnecessary cutting of trees is to be conducted. Care will be taken during construction to prevent damage to trees and shrubs adjacent to the flagged clearing limits which are to remain after construction.

ii) Care shall be taken when sloping embankments not to expose roots of trees, or put the soil at the base of such trees in danger of future erosion or extensive downslope drainage.

iii) The Contractor shall not use living trees as survey marks and shall not cut blazes or otherwise mark live trees except with removable surveyor's tape and/or tags.

iv) Where cutting is necessitated, the Contractor shall stockpile and remove all merchantable timber not required by the Owner. Other wood waste and slash remaining near the uncut zone shall be disposed of by chipping, burning, or removal, as acceptable to the Engineer.

950.03 OFF RIGHT OF WAY TRAVEL

The Contractor shall limit equipment travel to the surveyed right-of-way and existing municipal and provincial roads. Use of equipment of any type is not permitted outside the clearing limits of the right of way without prior approval. To obtain approval for additional or new travel routes, the Contractor shall notify the Engineer a minimum of five working days in advance of such requirements and not commence work until written approval is given by the Engineer.

950.04 BOGS AND WETLANDS

Bogs and wetlands are considered sensitive terrain because of their high disturbance potential . Travel by machinery across bogs and wetlands shall be avoided whenever possible. When such travel is necessary it shall be carried out as directed by the Engineer. Bog excavation shall conform with good construction practices and be carried out in accordance with other relevant sections of these specifications.

ITEM 955

REVEGETATION

955.01 REVEGATATION FOR SURFACE STABILIZATION

Immediately following and during some construction activities, the Engineer will identify areas requiring seeding/sodding or stabilization by a method to prevent erosion. These will include:

(i) Extensive cuts in overburden material. These areas shall be hydro seeded with **three (3)** calendar days of a cut being prepared and work shall be carried out as directed by the Engineer.
(ii) Stream crossing sites. Topsail placement, sodding, and shrub or tree plantings may be required as directed by the Engineer.
(iii) All remaining disturbed areas, designated, will be hydro seeded or sodded as soon as possible.

Where the potential for erosion exists, as on steep slopes, long slopes, or soft erodible type material, an appropriate erosion control material shall be applied to the surface. This can be in the form of an erosion control fabric or a sprayed on erosion control product which is approved by the Engineer and which will be in addition to hydroseeding as indicated in the contract documents or as directed by the Engineer. Also see Section 945.03 (Erosion and Silt Control Measures).

The Engineer will inspect all revegetated areas periodically to ensure that adequate results have been achieved. During adverse dry conditions watering of revegetated areas shall be carried out as directed by the Engineer. Additional REVEGETATION work will be undertaken upon direction from the Engineer if the desired results are not achieved.

955.02 PLANTING OF TREES & SHRUBS

955.02.01 GENERAL INSTRUCTION

The planting of trees will be carried out in those areas identified in the contract documents. The types of species, quantity, size, and exact location will be specified in the contract document or otherwise the Contractor will be advised by the Engineer. **Nursery stock**, (purchased trees and shrubs in pots), or **site stock**, (trees and shrubs removed from a site and held over or planted out directly), may be used as specified in the contract documents or as directed by the Engineer.

Native species of trees and shrubs are generally preferred, however, non-native species may be specified where, for example, a faster growing species or a disease resistant species or variety is needed.

The following species of trees are recommended:

SCIENTIFIC NAME	COMMON NAME	SCIENTIFIC NAME	COMMON NAME
Picea	Spruce	Acer Spicatum	Mountain Maple
Abies Balsamea	Fir	Acer Rubrum	Red Maple
Betula Papyrifera	Birch	Acer Platanoides	Norwegian Maple
Sorbus	Dog Berry	Salix Discolor	Willow
Larix Laricina	Larch, Juniper	Salix Bebbiana	Willow
Larix Kaempferi	Japanese Larch	Populus Tremuloides	Trembling Aspen, Poplar, Aps
Prunus Pensylvanica	Pin Cherry	Populus Balsamea	Cotton wood, Balsam Poplar

The following species of large shrubs are recommended:

SCIENTIFIC NAME	COMMON NAME	SCIENTIFIC NAME	COMMON NAME
Amelanchier	Chuckley Pear	Corylus Cornuta	Hazelnut
Viburnum Cassinoides	Northern Wild Raison	Aronia Melanocarpa	Eastern Chokeberry, Chokeberry
Alnus Crispa	Alder	Aronia Prunifolia	Eastern Chokeberry, Chokeberry
Cornus Stolonifera	Red Osier Dogwood		

The following species of small shrubs are recommended:

SCIENTIFIC NAME	COMMON NAME	SCIENTIFIC NAME	COMMON NAME
Myrica Gale	Sweet Gale, Bog Myrtle	Sambucus Patens	Red Elderberry
Rhododendron Canadense	Rodora	Rosa Nitida	Wild Rose
Nemopanthus Mucronata	Mountain Holly	Rosa Virginiana	Wild Rose
Vibernum Edule	Squashberry	Rubus Idaeus	Red Raspberry
Chamaedaphne Caliculata	Leatherleaf	Spiraea Latifolia	Meadowsweet

955.02.02 PLANTING METHODS & MAINTENANCE

The Contractor is referred to the **Manual for Native Plant Material Recovery**, available from the Department of Transportation and Works, for general information and recommended practices for the removal of trees and shrubs for either planting out directly or holding over for subsequent planting, and other aspects of care and maintenance.

All trees and shrubs do best when planted in early spring prior to the buds opening, but may also be successfully planted in late fall during their dormancy period. While it is possible to plant trees and shrubs at any time of the year, a regular watering program prepared by the Contractor and approved by the Engineer to reduce or prevent mortalities is required during the active growing period. A watering program is required for all planted stock (nursery stock or site stock) in the first year. This should commence as soon as active growth begins, and as determined by the prevailing weather conditions and dryness of the soil throughout the growth season. Watering and other necessary maintenance such as the provision of staking or supports, pruning, mulching, etc. is responsibility of the Contractor and not extra compensation will be paid for these items.

955.02.03 PAYMENT & WARRANTY

Measurement for payment shall be by the number of individual trees of the specified species and size planted. The Contractor is responsible for preventing mortalities in planted stock. Trees and shrubs which die within eighteen (18) months of being planted shall be replaced by the Contractor at not additional cost to the Owner.

ITEM 960

PROTECTION OF HISTORIC RESOURCES

960.01 PROTECTION OF HISTORIC RESOURCES

The Contractor shall be aware that the Historic Resources Act (1985) requires the protection of archaeological sites and artifacts, and sets forth procedures to be followed in the event that either are found. The Contractor shall be aware of the following sections of the Act:-

Section 10 (1) A person who discovers an archaeological object in, on, or forming part of the land within the province shall report the discovery forthwith to the Minister stating the nature of the object, the location where it was discovered and the date of the discovery.

Section 10 (2) No person, other than the one to whom a permit has been issued under this Act, who discovers an archaeological object shall move, destroy, damage, deface or obliterate, alter, add to, mark or in any other way interfere with, remove or cause to be removed from the province that object.

Section 11(1) The property in all archaeological objects found in, on or taken from the land within the province, whether or not these objects are in the possession of Her Majesty is vested in Her Majesty.

Should any archaeological remains be encountered, such as stone, bone or iron tools, concentrations of bone, fireplaces, house pits and/or foundations, work in the area of the find should cease immediately. The Contractor shall immediately notify the Owner through the Engineer, or the Senior Environmental Planner, or the ESO immediately upon discovery of any historic resources. The Owner shall immediately notify the Historic Resources Divisions.