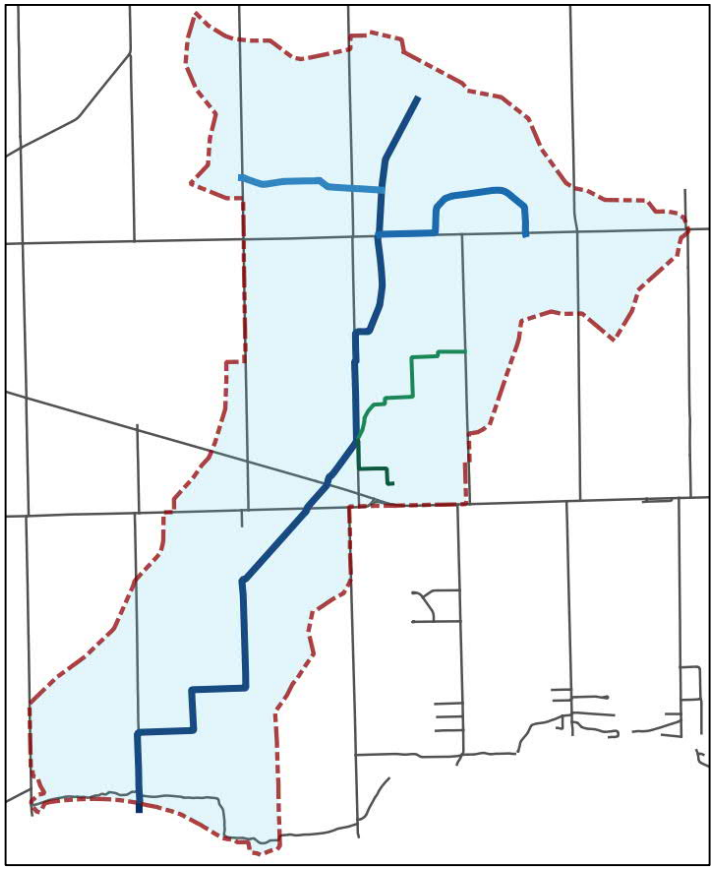
Beaver Dam Drain Stormwater Baseline Report



August 9, 2018

Project No: EWB-189999

EWA Engineering Inc.
84 Main Street, Unionville, Ontario
L3R 2E7
647.400.2824 www.ewaeng.com

Revision and Version Tracking

Title: Beaver Dam Drain Stormwater Baseline Report
Submission Date: August 9, 2019

Version #	Issued As:	Prepared by	QA/QC	Editor	Date:
100	Issued as Final	P.Marsh	A.VanderVeen	P.Marsh	August 9, 2019
95	95% Issued For Review	P.Marsh	A.VanderVeen	P.Marsh	June 24, 2019
070	70% Issued For Review	P.Marsh		P.Marsh	April 15, 2019
025	25% Outline IFR				

FileName: PC_Beaverdam_baseline_v100

Seal Page:
Prepared by:

Paul C. Marsh, P.Eng.
EWA Engineering Inc.
Principal Engineer

Table of Contents

1 Introduction 1

1.1 Drain History 2
1.2 Beaver Dam Drain Basics: 5
1.3 RFP Drainage Issue Identification 12

2 Study Approach 14

2.1 Methodology 16
2.1.1 Drainage Objectives: 16
2.1.2 Municipal Drains and Environmental Improvements 19
2.2 Document Record 24

3 Beaver Dam Drain 28

3.1 Condition Appraisal 30
3.1.1 Drain Grade 30
3.1.2 Condition of Outlet 32
3.1.3 Channel Condition 34
3.1.4 Beaver Dam Control Structure 35
3.1.5 Beaver Dam Drain Structures 37
3.2 Overall Drain Performance 41
3.2.1 Quantity Issues 42
3.2.2 Quality Issues 42
3.3 Environmental Appraisal 43
3.3.1 Ministry of Natural Resources 44
3.3.2 Federal Species at Risk (SAR) 46
3.3.3 Fisheries 46
3.3.4 Migratory Birds Convention Act 48
3.3.5 Ministry of Environment, Conservation and Parks 50
3.3.6 Conservation Authority 55
3.3.7 Cultural Heritage Resources 56
3.4 Stakeholders 56
3.4.1 Navigable Waters 56
3.4.2 Ministry of Transportation 56
3.4.3 Potential Utility Conflicts 58
3.5 Drainage Needs 59

4 Interim Drainage Works 61

4.1 Emergency works 61
4.2 Drain Channel Maintenance STA 4+000 to 5+500 61
4.3 Outlet Maintenance Works 62

5 Beaver Dam Drain Baseline Summary 63

Appendix A: Drain History & Consultation Record

Appendix B: Drain Drawings and Figures

Appendix C: Relevant Reports

Appendix D: Environmental Mapping

Figures

Figure 1 Municipal Drains - Beaver Dam Boundary 2
Figure 2 Beaver Dam Drain Upper Watershed 6
Figure 4 Beaver Dam Grade Above Second Concession Rd. 8
Figure 5 East Branch Extension looking West 9
Figure 3 West Branch Grade 10
Figure 6 NPCA supplied Regulated Flood limits and Areas 11
Figure 7 Drain Analysis and Report Methodology 16
Figure 8 Example of clear drain 17
Figure 9 Obstructed drain; Beaver Dam looking Southwest from White Rd. 17
Figure 10 Dead Ash trees within drain banks 18
Figure 11 Cross-section ditch view 21
Figure 12 Trapezoidal Ditching Under Construction 21
Figure 13 Naturalized Channel cross-section 22
Figure 14 Naturalized Channel with Pools and Riffles 22
Figure 15 Agricultural Property Zoning 29
Figure 16 Beaver Dam Drain Profile 31
Figure 17 Beaver Dam Outlet 32
Figure 18 Lake Erie Water Level GC Hydrographic Bulletin, June 2019 33
Figure 19 Cross-Section STA 1+415 34
Figure 20 Port Colborne Hydrographic Water Level 36
Figure 21 Beaver Dam Control Gate Structure, B-GS-01 37
Figure 22 Beaver Dam Bridge and Culvert Drain Structures 38
Figure 24 Environmental Influences on Beaver Dam Drain 44
Figure 25 DFO Fisheries at Risk inventory 47
Figure 26 Ontario Agricultural Information Atlas – DFO Drain Classification 48
Figure 27 Nesting Period for C1 applicable to Port Colborne 49
Figure 28 Permits to Take Water 51
Figure 29 MOECC Source Protection Atlas - default view 52
Figure 30 MOECC Source Protection Atlas - Watersheds 53
Figure 31 MOECC Source Protection Atlas - Highly Vulnerable Aquifers 53
Figure 32 MOECC Source Protection Atlas - Livestock Density 54
Figure 33 Water Well Records 55
Figure 34 MTO Grade line Option at HWY #3 58
Figure 35 Beaver Dam Maintenance STA 5+260 Upstream 61
Figure 36 Brushing Beaver Dam STA 4+160 Upstream 62
Figure 37 Beaver Dam Re-Alignment Options 64

Tables

Table 1 Beaver Dam Drain Culverts 39
Table 2 Beaver Dam ROW Culverts 40
Table 3 Species at Risk Designation for Port Colborne Area 45

1 Introduction

The City of Port Colborne retained Paul Marsh, P.Eng of EWA Engineers Inc. to prepare a Drainage Report under the Drainage Act R.S.O. 1990 for the Beaver Dam Drain. The Beaver Dam Drain Engineer's Report is prepared as follows:

- Baseline Drainage Report; provides an assessment of current drainage problems and identifies the extent of the drainage area to be serviced by the municipal drain.

- Drain Capacity Assessment Report; provides an assessment of existing capacity through the use of hydrologic and hydraulic modelling which identifies the options for resolving problems and recommends a preferred option to improve drainage.

The final Engineer's Report is composed of the two previous reports along with supporting documentation and final drainage cost estimates and assessment schedule or table.

This report is the Baseline Drainage Report and provides a summary assessment of the existing condition and drainage issues of the Beaver Dam Drain. The Baseline Drainage Report presents the current, as of 2019, baseline or reference condition from which all proposed improvements will be reviewed, planned and designed to address. In some cases, a drainage issue may be identified in the Baseline Report but deferred from a specific implementation in the specific Drain Engineer's report. The Baseline Report provides the total needs of the drain works but does not provide specific recommendations on implementation.

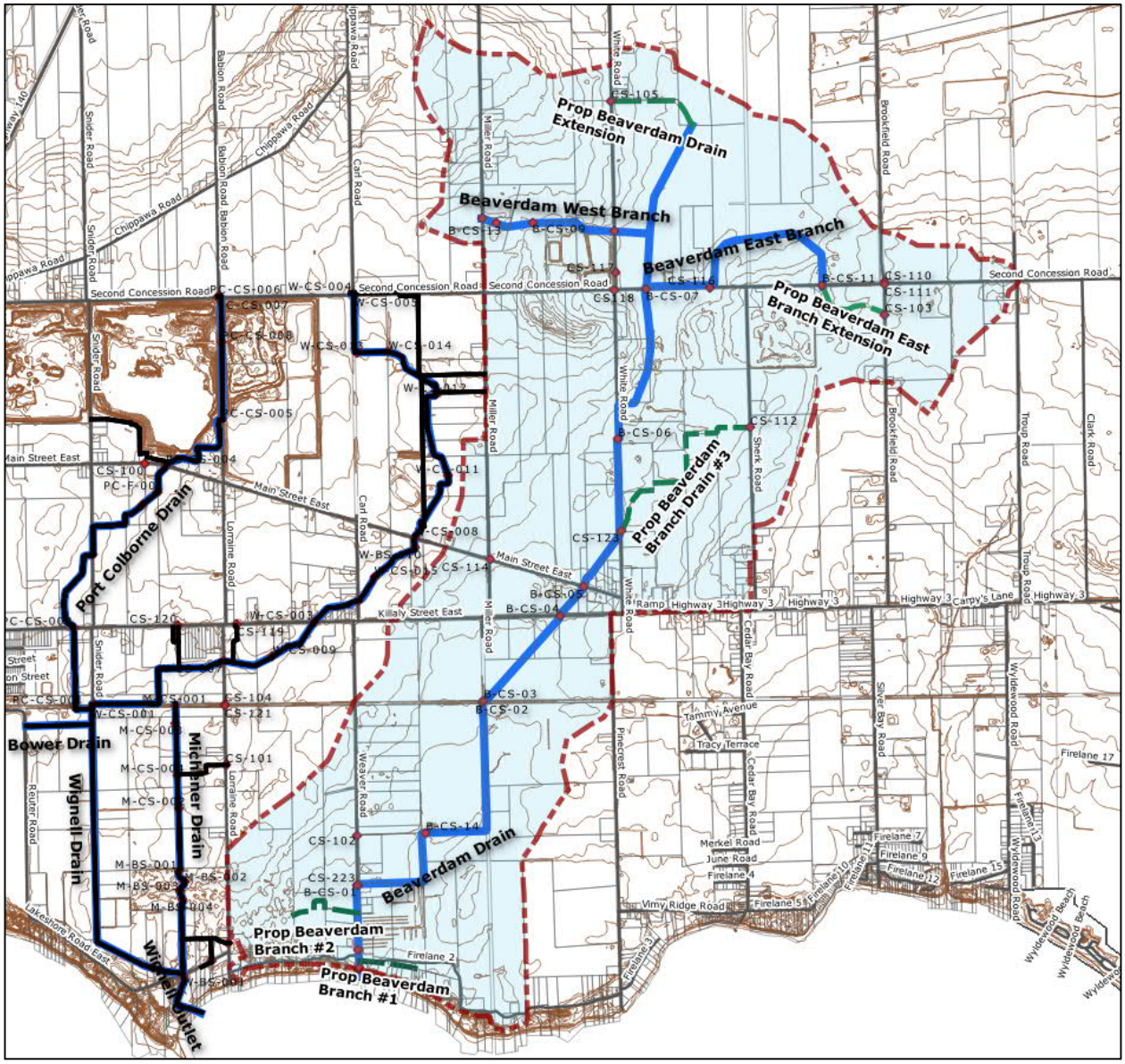


Figure 1 Municipal Drains - Beaver Dam Boundary

1.1 Drain History

The earliest record of the Beaver Dam Drain dates back to 1885 in the requisition by Samuel Knisley, Frederick Knoll & others and in the Geo. Ross award for the deepening and maintaining of the Beaver Dam Ditch. Later, the Geo. Ross petition of 1890 was awarded for the Deterling-Noxel extension of the Beaver Dam Ditch that later became the West Branch Drain. Several requisitions, dated from 1893 to 1902, were made to construct, deepen and widen a ditch under the Ditches and Watercourse Act along the Con 1 and 2 Humberstone lots.

In 1905 the James Craig Agreement Ditch, including two branches, was constructed starting at west limit of the Lot 14 Con 2 Humberstone Beaver Dam Ditch.

An Engineer's Report dated April 27, 1916 indicated the drain was laid out without a uniform grade causing flooding of the lower lands along the drain. The report recommended repairs to the northern part of the Drain and to the East Branch, along Concession 3 Road. Information of the time suggests no work was done on the western portion of the drain (West Branch); the northerly portion was referenced to as northerly extension in Con 3. The recent profiling conducted by the City of Port Colborne in 2009 (ref. City drawings 120-73 and 120-74) in preparation for maintenance, revealed that the original design grade of 1916 was never attained and never mentioned in subsequent reports.

A watershed map was prepared in the Engineer's Report of 1947 that showed a drainage area of approximately 2550 acres (1000 ha). It was noted that some the lands in the drainage areas were flooded constantly, however the specific areas were not identified. The report suggested the drain width was 0.9 m at the north and 2.4 m at Lake Erie.

In 1954, the first petition by Lawrence F. Townsend & others was made to install control gates in the existing concrete dam at the south end of Weaver Road. Later an Engineer's Report dated May 28, 1973 was prepared by C.J. Clarke regarding the flood control for the Beaver Dam Drain ARDA Grant. In 1982, maintenance works on the flood control gates was undertaken.

In 1995 and 1997, K. Smart Associates Ltd prepared a report for the repair and maintenance of the Beaver Dam Drain to address flooding of lands in the area of the flood gate structure near the outlet at Lake Erie. The cause of flooding was identified to be due to a shift of beach sand that frequently blocked the drain's outlet. It was recommended that:

- The existing flood gate should be replaced by a new lower flood gate control sill elevation that would allow for gravity drainage of the drain during low lake level periods.

- A new engineer's report be prepared, as the By-Law dating from 1947 did not include the channel along the west side of Weaver Road, as part of the Beaver Dam Drain.

Further, during an on-site meeting with adjacent landowners on November 1994, concerns were raised about process water from Port Colborne Poultry causing silting and algae blooms in Lorraine Bay.

To address the foregoing concerns, K. Smart Associates Ltd inspected the wastewater treatment system at Port Colborne Poultry. Based on the inspection, it was determined that the treatment system consisted of three lagoons, whereby wastewater from lagoon 3 was discharged into the West Branch at White Road, and the lagoon had a capacity of approximately 38 million litres.

The Ontario Ministry of Environment, at the time, issued a Certificate of Approval for the discharge to the drain from Port Colborne Poultry which limited the discharge period to two (2) weeks after the ice cover had gone from the lagoon, until May 1st, and in the fall, after September 1st till freeze up. The Certificate of Approval also required periodic monitoring of the water quality in the drain during discharge at downstream points including at the 2nd Concession Road crossing, near the lakeshore and at "intermediate points as may be necessary". Parameters to be monitored included pH, temperature and dissolved oxygen. The discharge was to be carried out over a minimum period of two weeks. Discharge flow rates in the order of 1650 litres/min to a maximum of 3800 litres/min were reported. The discharge was by gravity to an area where rip rap had been placed to prevent scour of the drain.

The report from the on-site visit by K. Smart Associates Ltd determined that Port Colborne Poultry also had a Certificate of Approval to spray irrigate the wastewater from lagoon 3 on agricultural lands to the north of the lagoon, usually during July and August, when discharge to the drain was not permitted. The area receiving the spray irrigation was reportedly bermed with swales so that runoff from the spray irrigation did not directly enter the West Branch of the Beaver Dam Drain. The report concluded that Port Colborne Poultry could not be adversely affecting the water quality in the Beaver Dam Drain, and that its discharge may actually help to maintain a favourable base flow in the drain.

While the preparation of the Engineer's report for the watershed was originally assigned to Amec Foster Wheeler but not completed.

From the RFP

> The Beaver Dam Municipal Drain dates back to 1885. A more complete history/chronology is contained in Appendix 'B'. The most current report was prepared in 1997 by John Kuntze of K. Smart & Associates, providing for improvements to the outlet structure and the provision of an up to date assessment schedule for the entire system. The 1997 report contains references to the 1947 R. Blake Erwin report for the design profile for the Main Drain & East Branch and the 1967 C. J. Clarke report for the design profile for the West branch. There was no investigation of the upper watershed to determine upstream constraints or watershed needs at that time.
>
> The Beaver Dam Municipal Drain consists of a watercourse length of approximately 9,527 metres and a watershed area of 1,223 hectares. The headwaters lie north of Second Concession Road to Lake Erie draining southerly, along White Road across Highway # 3 and the Friendship Trail to a flood control structure/pumping station into Lorraine Bay.

The Conservation Authority has completed the class authorization on the Municipal Drains in the City of Port Colborne and the classifications for the Beaver Dam Drain is - C & F

As well the NPCA, in concert with the MNR, have delineated a number of new wetland areas that may have an impact on potential options/solutions to be considered under the reports.

The Beaver Dam Municipal Drain headwater tributaries/watersheds outlet to Lorraine Bay and is a concern by waterfront property owners and users of the Lorraine Bay beach area.

Significant water quality documentation through sampling has been undertaken by the Lorraine Bay Water Quality Group, the NPCA, Niagara Region Health Unit, Region of Niagara water Quality Strategy and the City of Port Colborne which is referenced in Appendix 'E'.

APPENDIX 'E' WATER QUALITY DOCUMENTATION

- August 2001 AMEC Environmental Investigation Lorraine Bay Community Water Quality Concerns.
- NPCA Water Quality Monitoring Program for the Beaver Dam & Wignell/Michener Drains, for the years 2007, 2008, 2009 & 2010. http://www.npca.ca/water-management/source-water-protection/quality-water-monitoring.htm
- Water Smart Niagara Beaches Microbial Sources Tracking Study, data for the years 2010 & 2011.

Other related studies:
- January 2000 MOE Phytotoxicology Soil Investigation INCO Port Colborne 1998.
- July 2000 MOE Phytotoxicology Soil Investigation INCO Port Colborne 1999.
- 1999 Environmental Assessment of the Wignell/Michener Drains & Associated Watershed Thesis by Eric A. Azzopardi.
- July 2002 Jacques Whitford Environmental Ltd. soils analysis at stormwater management site for the Wignell/Michener Drain.
- Nov. 25, 2004 Jacques Whitford Engineering, Scientific Planning & Management Consultants comments to the NEDL sediment sampling reports.

1.2 Beaver Dam Drain Basics:

The Beaver Dam Drain serves an area of 1236 hectares based on the defined drain boundary. The main branch of the drain is 6,650m in length from the drain origin, which is defined as 1000m north of Second Concession Rd. to the outlet into Lake Erie.

The watershed boundary or high point is approximately 1,700m north of Second Concession Rd. to the West of Miller Rd. with a high point of 194m. The outlet

at the lake varies with the change in Lake Levels but the recorded average lake level is given as 174.15. The lake level fluctuates and for the month of June, 2019 has been at record levels 1.6 & 1.8 above chart datum, which is higher than historic high levels and influences the water surface profile upstream from the lake.

- Watershed average fall (slope) is given as 0.24% or 2.4m per 1000m
- Drain average fall (slope) is given as 0.062% or 0.62m per 1000m

This slope characterises the Beaver Dam drain as low slope or slow watershed.

The lower portion of the drain is highly influenced by Lake Erie's water elevation with a littoral sand beach influenced outlet.

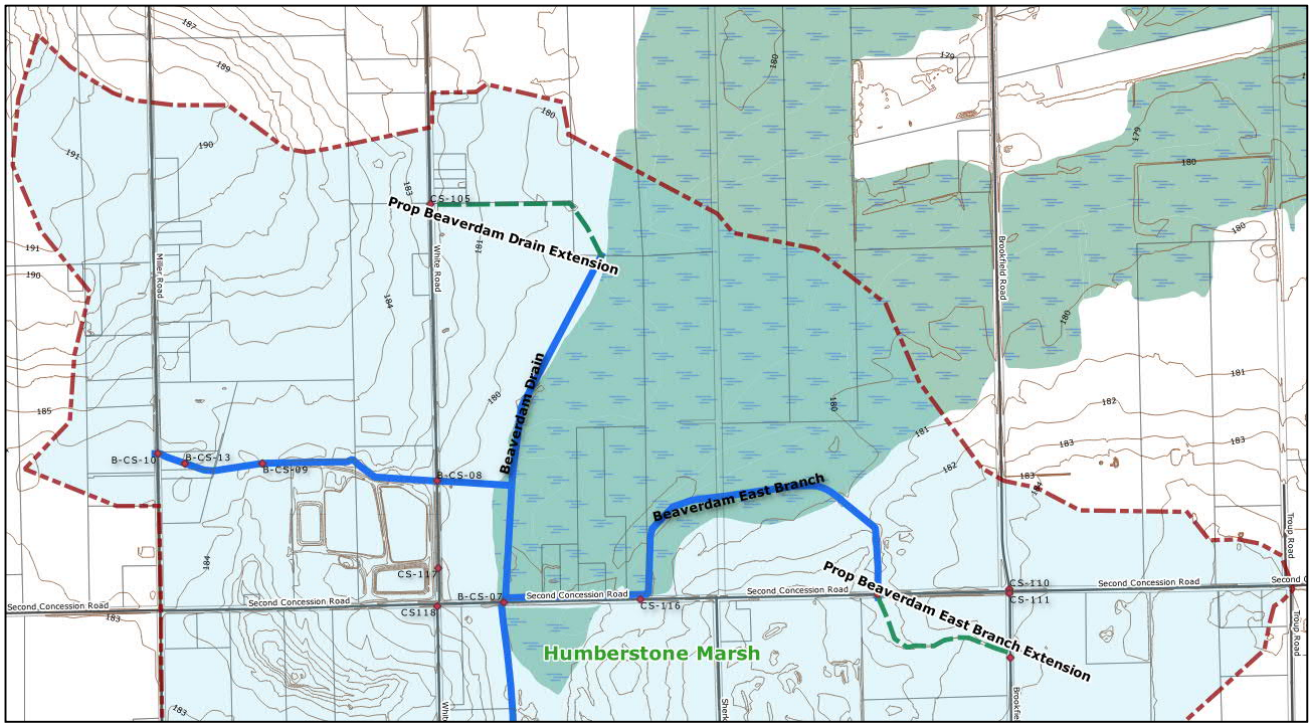


Figure 2 Beaver Dam Drain Upper Watershed

The Beaver Dam drain can be segregated into several distinct geographic areas as follows:

- Lower Lake Influenced Outlet with Control & Pumping
  2494m – STA -0-054 to STA 2+440 @ Miller Rd. Culvert B-CS-014
- Main Drain with Grade; Friendship Trail to Second Concession
  m – STA 2+440 to STA 5+500 @ Second Concession Rd.
- Upper Main Catchment; influenced by Humberstone Marsh
  1758m – STA 5+500 to culvert crossing @ White Rd.
  (based on proposed extension from existing at STA 6+485)

- East Branch; including proposed extension
  Existing 1557m
  (proposed extension of 488m of existing pipe)
- West Branch; to Miller Rd. – 1086m

These five zones are described in more detail as follows.

Lower Lake Influenced Outlet with Control & Pumping; The outlet to the lake is perpetually changing with beach material moving across the drain outlet through wave action, referred to as littoral drift. This area has very low slope, features permanent water levels and the outlet will always require maintenance in the form of mechanical removal by equipment.

A Gate Structure is used to control back flow from the lake during high lake levels such as during a seiche event. The pump is operated from a tractor PTO, which requires the tractor to be driven to the site, connected and operated as a stationary equipment.

There is a closed conduit connection draining from the East that is proposed to be made a branch drain, under Section 4.0 of the Act. However, the requesting authority is not clear unless it is the Road authority and the existing road at the end of the conduit is a private lane and not a municipal roadway. The existing conduit is a pre-cast vaulted concrete 360m long and providing maintenance or assessing it for defects is not currently possible as a private structure.

There are parts along the drain that feature irrigation, which are not part of the drain. The drain is used as a source for irrigation of adjacent farms.

Main Drain with Grade; Miller Rd. to Second Concession; The overall grade to the Second Concession Rd. has over 5500m of drain length (to GS) an average grade drop of 3.8m which is calculated to be 0.069%. which is a very low grade for a drain to be effective. Portions of the drain reaches approach. 0.2% which corresponds to really low grades in the lower reach, 0.04% and 0.08%. There are several drain crossings with significant roads above; Weaver, Killaly, Highway #3 and White Rd. The portion along White Rd. has been considered “too close to the road” for many years but options to address the encroachment haven’t progressed.

The central portion of this section of the drain contains the built up area formerly known as XXX and is functionally the intersection of Highway #3 and the end of the Killaly St. E at Hwy 3. There exists a local pipe storm sewer connection to the drain along Hwy 3, which is owned and maintained by MTO. North of Hwy 3 is the award drain of David Michener. This is a open channel draining to the West and then North crossing White Road to outlet to Beaverdam Drain at STA 3+840.

This portion also contains the existing James Craig Agreement Drain, which is to be made a Branch drain of the Beaver Dam Drain. This is a Section 4 request at the petition of the road authority for Sherk Rd.

Upper Main Catchment; influenced by Humberstone Marsh; the upper portion of the main drain proceeds northwards until it appears to lose grade. This section is the connecting portions for the East and West Branch Drains.

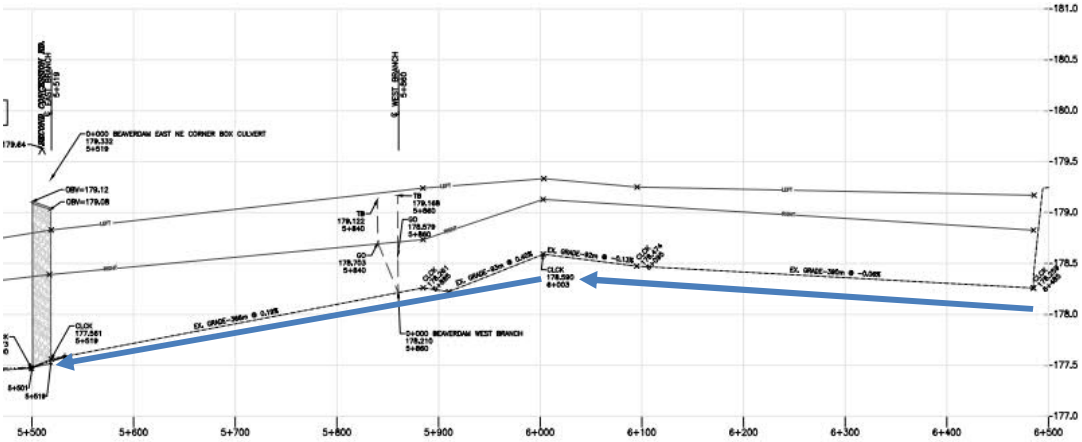


Figure 3 Beaver Dam Grade Above Second Concession Rd.

The upper reach begins with positive grade to the drain but reverses direction as it enters the Humberstone Marsh area.

East Branch, including proposed extension; Draining lands to the east along Second Concession Rd., the East Branch has a confluence for flows passing to the north crossing a culvert under Second Concession Rd. The City of Port Colborne has requested that the drain be extended to Brookfield Rd. to provide drainage for a newly installed culvert. The intent is to use an existing Tile Drain, PE 250mm as the drain, which outlets to the end of the existing drain culvert at Second Concession Rd.

Figure 4 East Branch Extension looking West

From the photo, it is clear that the existing inlet is not performing well and surface flows are re-establishing along the field.

West Branch; to Miller Rd.; serves lands to the West north of Second Concession Rd. The drain is very much along a West to East axis and flows behind the chicken processing lagoon facility and ends at Miller Rd. with culvert crossing B-CS-10.

The existing culvert crossing White Rd. has a channel with a very low grade before making an effective connection to the main drain.

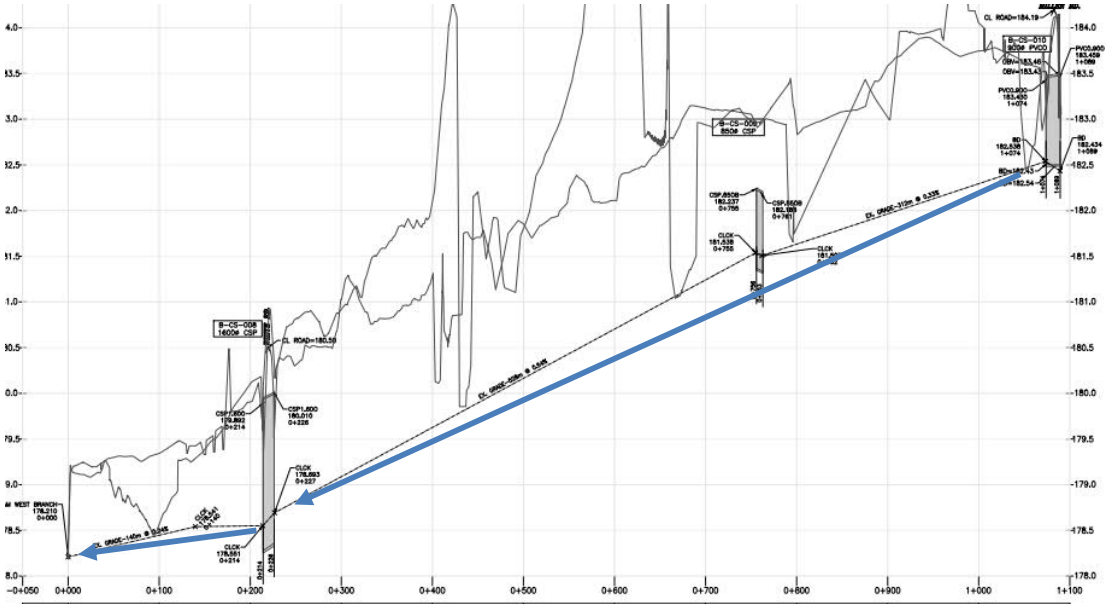


Figure 5 West Branch Grade

The two blue arrows in the figure show the difference in available grade. This exemplifies the East and West Branch Drains as having positive grade drain lines to the main branch but the main branch through the Humberstone Marsh area (North South) does not have a positive drain grade, see Figure 3 Beaver Dam Grade Above Second Concession Rd..

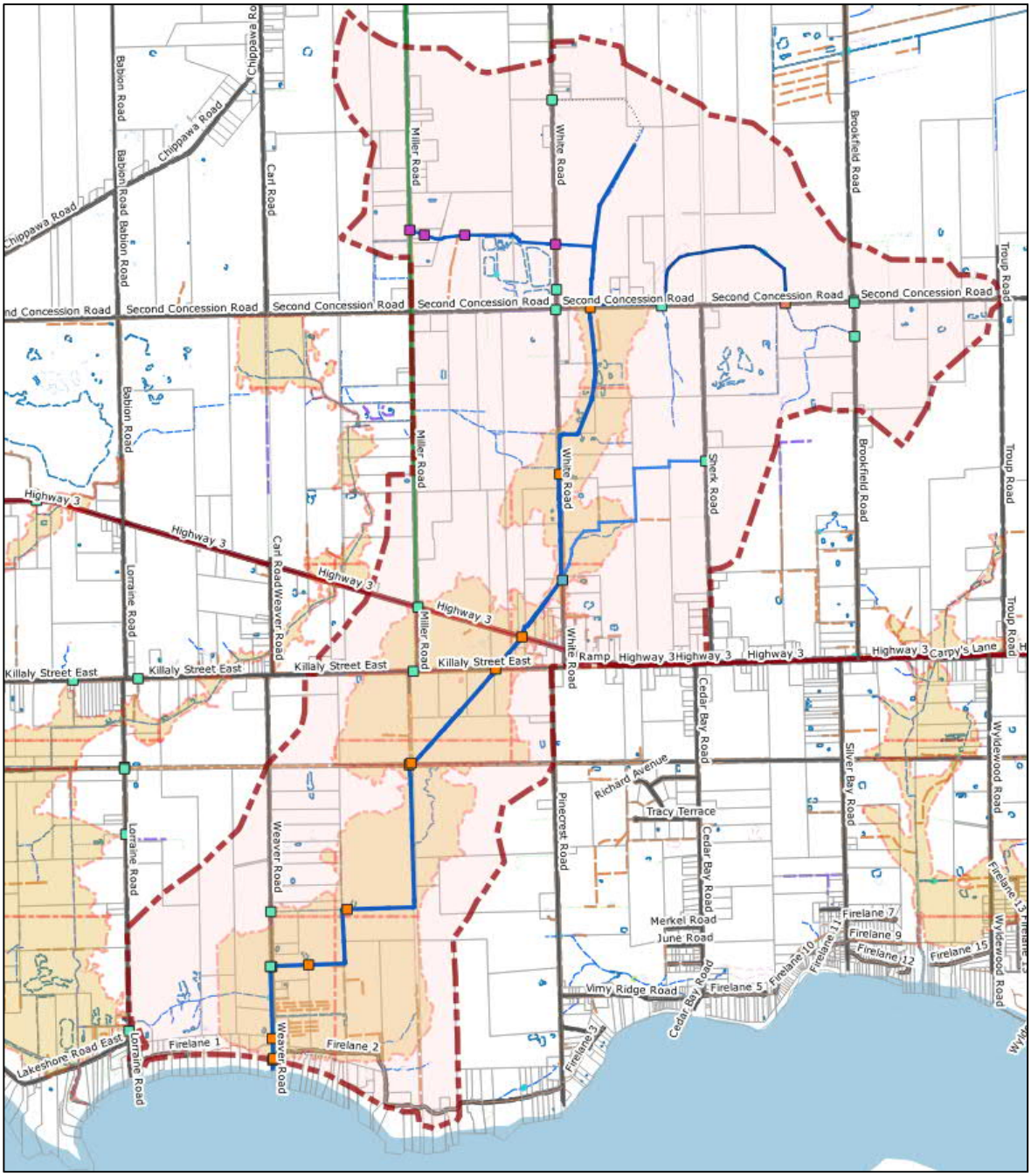


Figure 6 NPCA supplied Regulated Flood limits and Areas

This map shows that the outlet experiences significant flooding during the 100 year modelled flood event by NPCA but also the flooding extends along the drain all the way up to Second Concession Road. This suggests that the flood event is not within the banks of the established channel for the Beaver Dam Drain.

Comparing this to the Wignell Drain with reducee flooding outside the existing banks north of Killaly St. and Highway #3 but still showing major flooding below the Friendship trail where the slope is compromised.

The modelling shows extensive flooding north of the Friendship trail; however, one of the two culverts has been removed at present and with a restoration this flood zone could change. Also of note for the modelling shown by the NPCA, are the indicated spill zones to the East of the Friendship Trail and East / West spill zones north of the outlet.

1.3 RFP Drainage Issue Identification

The following items are referenced from the original RFP issued in 2010.

> Terms of reference for an RFP to facilitate a water quality feature (sediment basin), a project initiated by the Lorraine Bay Water Quality Group through the then drainage superintendent were in the works but not completed due to a number of issues related to MNR financing and components of a summary document related to water quality data and point source identification (See Appendix 'F'). Since that time a number of new developments such as the designation of the lower watershed as a provincially significant wetland, capacity constraints at White Rd & Friendship Trail, original grade design, flooding issues and potential upgrades have come to light, again necessitating a more comprehensive set of terms of reference.

APPENDIX 'F' BEAVER DAM DRAIN WATER QUALITY FEATURE

- June 2008 MNR Wetland Drain Restoration Project Feasibility Study for Beaver Dam Drain.

- January 2009 Beavers Dam Creek Wetland Complex (PSW) Evaluation.

- File containing related correspondence.

Other information related to Beaver Dam drain design grade:

- September 1998 City of Port Colborne drawings 50-415, 50-416 & 50-417 Beaver Dam Drain (at White Road) realignment/x-section improvement.

- April 1999 City of Port Colborne drawing Beaver Dam Drain (at White Road) cross sections.

- October 2000 City of Port Colborne drawing Beaver Dam Drain West Branch.

- August 2009 City of Port Colborne drawings 120-73 & 120-74 profile design for maintenance of Beaver Dam Drain from David Michener Award along White Road to Con. Rd. 2.

Note: At White Road the original design grade of 1916 which was utilized in all subsequent reports was never constructed due to bed rock outcropping.

APPENDIX 'H' SYNOPSIS OF BEAVER DAM INVESTIGATION

- determine coastal issues pertaining to the outlet as to frequency of maintenance, removal and placement of beach sand (siltation) from outlet and armour protection at control structure.

- investigate the integrity of the control structure & pump station, determine upgrades required (code), efficiencies, automation, power supply, safety, alternatives, provision of operating & maintenance manuals and the development of operating protocols.

- examine the ability of the Beaver Dam system to handle flood flows, determine overland flow route and water quantity/quality sites.

- assess water quality issues with view to the implementation of water quality features such as vegetated buffers, water quantity/quality sites, sediment ponds and wetland restoration/enhancement opportunities.

- examine existing alignment, design grade & capacity of existing channel and culvert crossings with particular attention to bedrock outcrops, x-section width, alternative solutions at the golf course, White Road realignment, Friendship Trail culvert improvements, potential drain extensions such as the East Branch to Brookfield Road and potential branch drains to Sherk Road and at the Friendship Trail.

- potential for water control structure upstream of Con. Rd. 2.

- watershed boundary issues.

- determine type & frequency of maintenance.

2 Study Approach

All drainage work is legislated by the Provincial Drainage Act.

A one-third agricultural grant is available to all eligible farmlands to help with the cost of drainage repairs and capital projects through the Agricultural Drainage Infrastructure Program (ADIP) managed by the Ontario Ministry of Agriculture Food and Rural Affairs (OMAFRA).

Work is done within the guidelines established by the Department of Fisheries and Oceans (DFO) and the Endangered Species Act as established by the Ministry of Natural Resources (MNR). Design is to be compliant with the requirements. Design work is prepared and submitted for review by the relevant Conservation Authority (NPCA) for compliance with Section 28 Regulations and in accordance with the 'Drainage Act and Conservation Authorities Act Protocol'.

Drainage Act and Conservation Authorities Act Protocol
Working as part of a multi-stakeholder Drainage Act & Section 28 Regulations Team (DART), co-chaired by the Ministry of Natural Resources and the Ministry of Agriculture, Food and Rural Affairs, Conservation Authorities, in partnership with representatives from the drainage sector, agricultural sector, and municipalities have completed a protocol for drain maintenance and repair activities.
The purpose of this provincially approved document is to improve communications, promote best practices, and streamline the permitting process under the Conservation Authorities Act for municipal drain maintenance and repair work performed under the Drainage Act.
Read the report ***Drainage Act and Conservation Authorities Act Protocol,*** online at:
https://conservationontario.ca/

The Municipal Drainage Act requires a specific process for establishing and making alterations to a Municipal Drain. The Act was prepared with a specific process to be followed. The process for a drainage project improvement under Section 78 of the Act is as follows:

- Under Section 78 of the Act, Council appoints an Engineer to initiate a study and to prepare a report.
- On Site Meeting; notice required by the clerk.
- Preparation of a Preliminary Report
    - Identification of the issues to be improved.
    - The preferred method for improvement.
    - An estimate of the costs for improvement, and
    - The principles for revising, changing or otherwise adjusting the drainage schedule of cost sharing.

- Field Survey
- Detailed Design
- Final Drainage Report Preparation
- Drainage Report Review and Consideration
- Contract Tendering
- Construction
- Post Construction Final Documentation of the Drainage Report

For this report, the following notes are provided for context within the previous work undertaken by Amec Foster Wheeler to establish the purpose and context of the Baseline Drainage Report.

The appointment of the engineer has been completed by Council following the revocation of the assignment to Amec Foster Wheeler, previously appointed to prepare a drainage report.

The onsite meeting has been conducted previously by Amec Foster Wheeler and consultation notes are included in Appendix A. In order to provide those affected by the proposed drainage works, a Public Information Centre (PIC) is planned to provide an update with the focus being on proposed and preferred alternative(s) to address the drainage issues.

The appointed Engineer has conducted a drainage wide site review, summarized in this baseline document.

The preliminary Report and Engineer's Drain Report has been segregated into three sub-reports as follows:

1. Baseline Report, presents clear identification of the current drain with particular emphasis on current drain issues that are to be resolved through the improvement works. Also included in this report are environmental criteria and constraints that will or may impact the preferred solution(s).

2. Drain Hydrology and Hydraulics Assessment Report, establishes the current performance of the drain against selected standards.

3. Drain Report, proposed preferred solution including plan & profiles.

The Baseline and Hydrology and Hydraulics reports are planned for completion in 2019. The final report will follow those reports.

It is planned to have the detailed design and Final Drain Report prepared for consideration before the end of 2019 with tender and construction currently forecast for 2020.

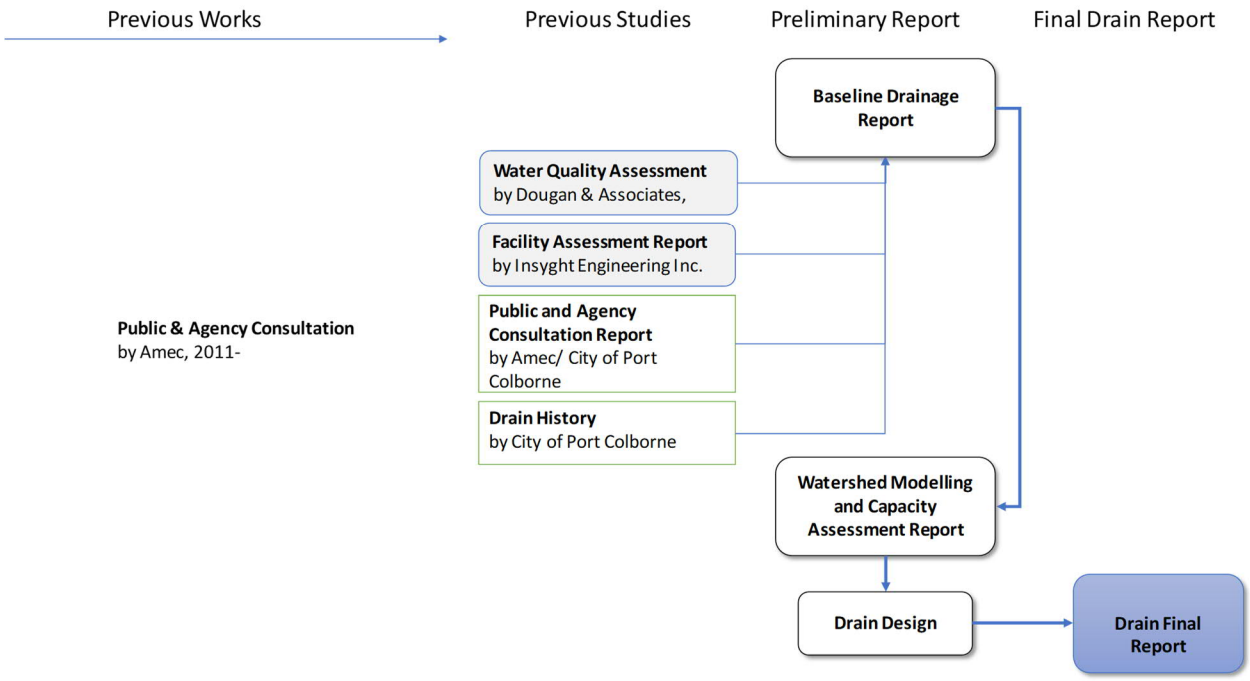


Figure 7 Drain Analysis and Report Methodology

2.1 Methodology

The baseline assessment is performed from site inspections and a technical review of the available data.

The culvert inventory and assessment are preliminary at this time. Depending on the findings, more detailed assessments may be performed.

The control gate has been assessed by others, Insyght Engineering, and a technical review of the assessment is provided herein. Refer to Appendix D for the assessment report.

2.1.1 Drainage Objectives:

The objective of a drain is to provide a clear unobstructed flow with depth to provide adequate private drain connection outlets. The following image exemplifies a traditional "good" drain profile and cross-section with contributary flows from a tile drain connected to the drain.

Figure 8 Example of clear drain

While the figure shows clear and unimpeded flow, the following image shows an obstructed flow.

Figure 9 Obstructed drain; Beaver Dam looking Southwest from White Rd.

This flow is obstructed by tree growth within the banks. Bull rushes provide evidence of standing water. The expected performance of the drain based on this approach is compromised and unlikely to perform as designed or expected.

Figure 10 Dead Ash trees within drain banks

The presence of ash trees allowed to grow within the drain banks previously, which are now dead or dying from the emerald ash borer will provide a source of wood debris that may potentially block the drain and cause backwater or other degradations in performance.

It's not desirable from an equipment and drain maintenance view point to have trees within the working allowance. The purpose of the allowance is for machine access to conduct future maintenance of the drain working from the preferred side of a drain. However, it is not environmentally sustainable or appropriate to remove all trees from the working allowance. Trees provide several benefits to the function of drains while also posing a risk to drain function depending on type of tree and placement. All trees growing within a constructed drain between the top of banks are to be avoided. Where a mature tree is already established and is an individual tree, it can be accommodated by having drainage machinery work around the tree.

New trees can be planted adjacent to a drain following two key criteria:

- The trees are planted back from the top of bank, (the exact distance is determined by tree type and local conditions).

- The trees are planted with adequate space to provide future maintenance. Grouping of planted trees is encouraged given that the spacing of the trees and the arrangement permits future maintenance. This is accomplished by providing an angled approach along the tree edge line to the drain and increasing the tree plant density only as the distance from the drain increases.

From Chatham Kent website, providing advice on tree placement within drain influences.

"Individual hardwood trees may be allowed every 100 feet. Trees of any type shall not be planted within 25' of an existing tile drain (solid tile, wrap joints) or 35' from existing open drain. In certain circumstances where an owner owns property on both sides of the open drain, upon consultation with the Drainage Superintendent, a windbreak may be permitted on one side. On existing drains where windbreaks exist, costs due to trucking material will be the direct responsibility of the owner and not the upstream ratepayers."

The presence of existing trees on an existing drain does not require a clear cut approach to improving the function of the drain. Trees can be selectively removed to achieve a drain benefit, such as the case with the lower reach of the Beaver Dam drain at Weaver Road.

Individual trees that are currently healthy and with a good expectation for continued good health should be preserved and protected during construction. Trees that group both side of the drain and create an obstruction to flow are to be removed.

Tree Benefits to Drains

While trees can impede flow and through dead limbs or other debris cause problems with backwater effects, there is an overall recognized benefit for trees on a municipal drain. The primary benefit is through soil stabilization by tree roots, although it is not uncommon for a drain under a meander influence to erode the soil from under the tree roots, depending on the species. There are trees, such as willows, whose roots will seek out water and these trees should be avoided along closed conduit drains, as the roots will potentially clog the drain.

There is a recognized benefit from trees to provide shade or canopy to protect the drain with standing water from having a detrimental effect on fish species. While many drains are more likely to be a habitat for warmwater species, there is a real benefit from trees providing shade. As such, there is a stated preferred side for trees based on this benefit, which is the south and west side of a drain.

2.1.2 Municipal Drains and Environmental Improvements

In the past, Municipal Drains have been created to convert functioning wetlands to functioning farmland. Examples of this can be seen at significant scales in

Ontario; Holland Marsh area, Thedford area (former Lake Smith) and throughout Chatham Kent area.

There is an unquestionable contradiction between removing the water to promote farming and retaining the water to support native flora and fauna. The engineering and drainage community have come to appreciate that a straight line to the lake with the highest grade possible to move the most water the fastest off the fields may not be in the best interest of all ratepayers. There is an expectation that drainage can be used to ensure that farming practices are achieved to a reasonable extent on designated lands. However, drainage does not have to negatively impact existing native flora and fauna for the benefit of the community as a whole.

The distinction is made in the pursuit of water management strategies within the Drainage Act and not to just focus on moving water away from farmland for the benefit of landowners. The issue is managing the water cycle through all stages:

- Spring Freshet: snow meltwater runoff potentially with spring rain.
- Summer Convective storm: high intensity sudden but short and not widespread thundershowers.
- Large Air mass precipitation event: longer duration lower intensity but high yield precipitation event.
- Drought: time between precipitation events.

Water management practices change as our understanding of the hydrologic cycle and land management practices improve through research. The following describes past stages of water management practices:

- Pre- 1940 introduction of farming to areas that require drainage to grow crops. From introduction of the drainage act, areas previously identified as bogs, swamps or lakes are drained to provide high quality soil for farming.
- 1950s to 60s sought to move water off the land as quickly as possible, leading to erosion and quality problems as well as environmental degradation.
- 1970s and 80s introduced urban areas to stormwater management ponds which decreased peak runoff but increased erosion and geomorphological forms. Ponds also increased temperature in the resulting runoff as well as changing stream chemistry.
- 1990s to 00s implemented geomorphological assessment of streams to enhance and to mimic natural systems including profile of cold water and warm water streams through modelling of baseflow contributions to runoff and baseflow management. SWM in urban areas with a treatment

train approach to water management to address both quantity and quality of runoff.

- 2010 to present features low impact development and soil conservation practices through buffer strips and low tillage practices. Low impact development practices use runoff control techniques to reduce runoff impacts through a watershed as well as controlling through end point practices such as SWM ponds.

The following figure illustrates features associated with a traditional approach to ditching or a typical view of a ditch.

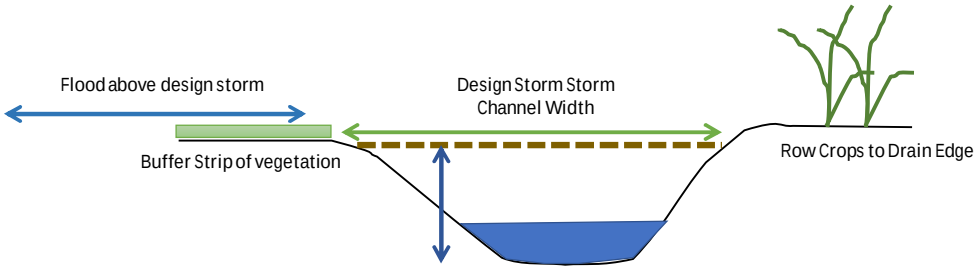


Figure 11 Cross-section ditch view

Figure 12 Trapezoidal Ditching Under Construction

The traditional ditch has the following features:

- A trapezoidal channel design with a bottom width, a depth and a top width that defines the capacity of the ditch.

- The illustration shows a farm use that occurs up to the ditch edge while the opposite bank illustrates a buffer strip of vegetation between the row crops and the ditch top of bank.

- Where the storm exceeds the ditch capacity, the flooding spills out to either side on to the ratepayer lands. The ditch requires an easement equal to the top width of the ditch, which determines the total capacity.

The following figure illustrates a naturalized channel design approach to a ditch or creek channel.

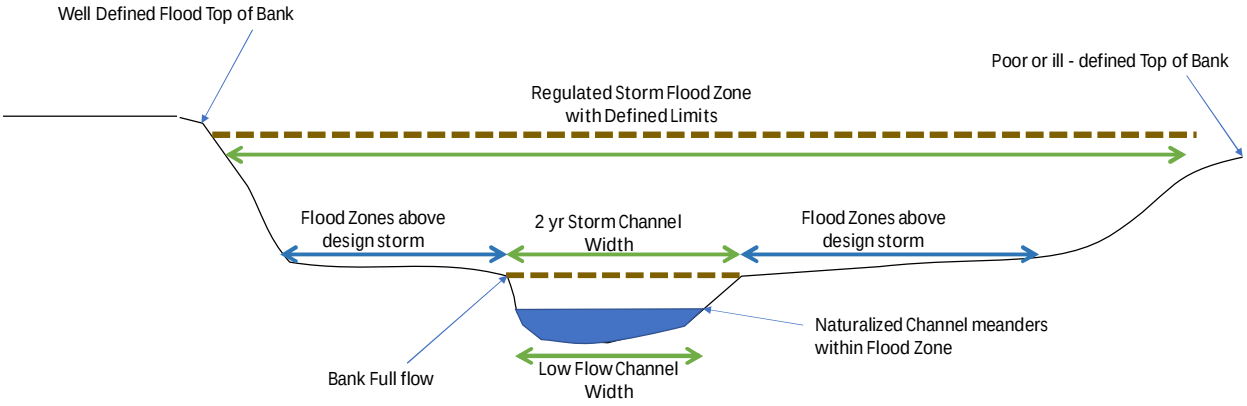


Figure 13 Naturalized Channel cross-section

Figure 14 Naturalized Channel with Pools and Riffles

A naturalized channel design has the following features:

- The natural channel has a pool and riffle design that alternates through a sinusoidal pattern defined by the size, type of watershed and geologic materials composing the watershed.

- The channel is designed to mimic a natural stream that would occur had the creek or stream occurred through geological processes.

- The area above the channel is a flood zone.

- The channel has a specific design capacity while the flood zone has a larger design capacity and the risk to flooding is defined by these capacities.

- Tree and vegetation plantings will grow into a mature canopy that provides shade at the planned locations within the flood zone.

These changes in practice and expectation have resulted in greater analysis requirements during drainage design to assess not only the basic drain performance but it's potential negative or positive impact on the environment. Negative or positive impacts are regulated under various legislation within Canada but the primary bodies that implement the regulations are:

- Government of Canada Fisheries and Oceans (DFO), specifically approvals on culverts to assess potential negative impacts on fish habitats and species. Important to recognize that habitat impacts can be assessed whether the fish species is present in the specific portion of the stream or not.

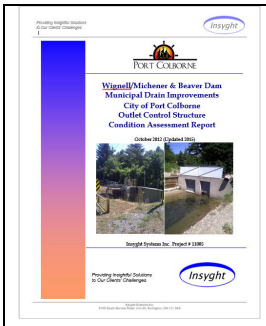
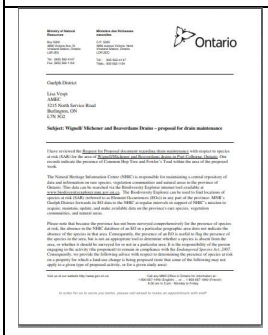
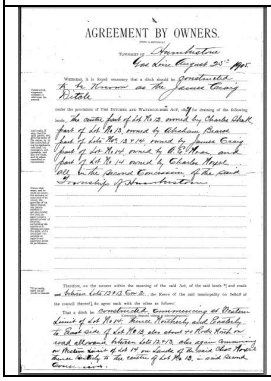
- Government of Ontario Ministry of Natural Resources (MNR) can assess habitat impacts of proposed projects that affect terrestrial or aquatic habitats.

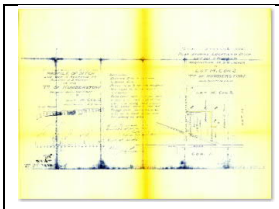
- Niagara Peninsula Conservation Authority, NPCA is responsible for regulated flood zones, lands within the designated areas.

- Lastly, the Government of Ontario Ministry of Agriculture, Food and Rural Affairs OMAFRA has responsible oversight under the Drainage Act of Ontario

2.2 Document Record

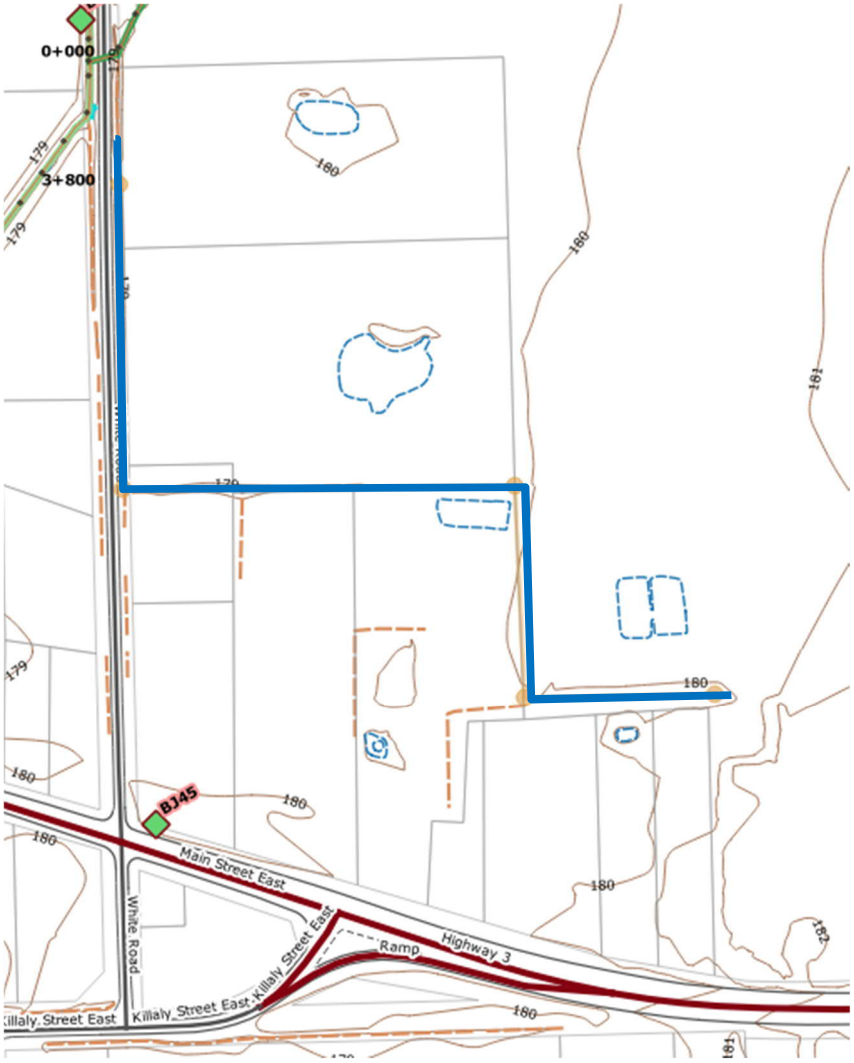
The following is a list of the documents that are relevant to the Beaver Dam Municipal Drain.

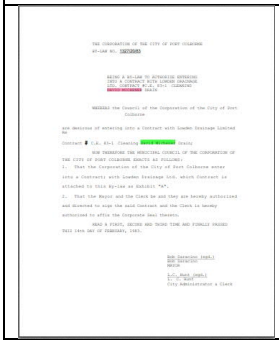
	Wignell/Michener & Beaver Dam Municipal Drain Improvements City of Port Colborne Outlet Control Structure Condition Assessment Report "The findings in this assessment indicate that the Beaver Dam Drain facility is well maintained and in reasonably good condition and, therefore, requires only minimal short term work much of which is optional. A summary of the general condition of each discipline area is as follows: 1. Structural: Good condition 2. Building Exterior: Good condition 3. Electrical Systems: Fair condition *3.2 Electrical Equipment & Systems* *The dam and structure has no connected loads and the main utility feeder from the nearby utility pole has been disconnected.* 4. Mechanical Systems: Good condition 5. Code Compliance: No major issues found"
	Correspondence MNR Guelph District Subject: Wignell/ Michener and Beaver Dams Drains – proposal for drain maintenance Katharine Yagi, M.Sc. Species at Risk Biologist Ministry of Natural Resources Niagara Area, Guelph District Letter regarding SAR within the identified drains. "Our records indicate the presence of Common Hop Tree and Fowler's Toad within the area of the proposed work."
	**James Craig Agreement Drain** Original document describing the lands agreement for a shared drain, not a municipal drain under the act but an Agreement Drain. The distinction is that the municipality can't act to provide maintenance as maintenance is part of the agreement. It's proposed to make this agreement drain a branch drain of the Beaver Dam Drain.



David Michener Award Drain

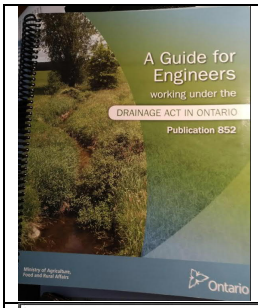
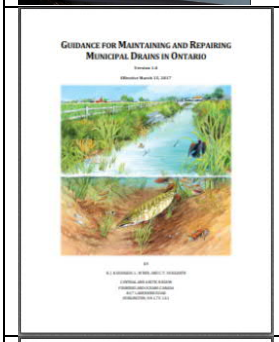
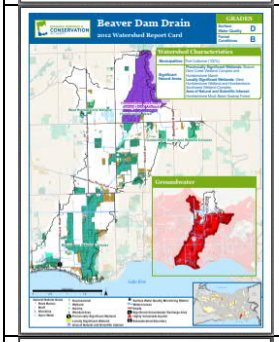
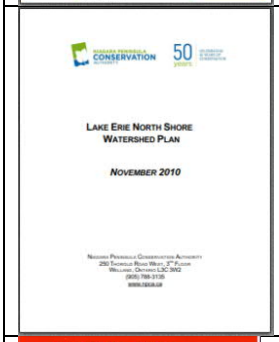
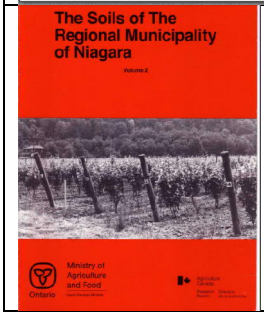
Engineering plans for construction dated 1895
Corresponds to the following path with grades typical for Port Colborne.





A bylaw to contract drain maintenance supplied by Lowden Drainage Ltd. on behalf of the City of Port Colborne.
Dated Feb 14, 1983

Other Reference Works:

	Drainage Engineers Guide OMAFRA Updated July 2018
	GUIDANCE FOR MAINTAINING AND REPAIRING MUNICIPAL DRAINS IN ONTARIO Version 1.0 Effective March 15, 2017 By R.J. KAVANAGH, L. WREN, AND C.T. HOGGARTH CENTRAL AND ARCTIC REGION FISHERIES AND OCEANS CANADA
	Lake Erie North Shore 2012 Watershed Report Card NIAGARA PENINSULA CONSERVATION AUTHORITY
	LAKE ERIE NORTH SHORE WATERSHED PLAN NOVEMBER 2010 NIAGARA PENINSULA CONSERVATION AUTHORITY
	THE SOILS OF THE REGIONAL MUNICIPALITY OF NIAGARA, Vol 2 OMAF 1989

	NPCA Stormwater Management Guidelines

For a complete correspondence record, please refer to Appendix A for a summary listing and reproduction of records.

3 Beaver Dam Drain

This section describes the original drain design. The Beaver Dam Drain Plan & Profile that is included in Appendix B includes the most recent survey conducted by Amec Foster Wheeler in 2013. The survey provides detailed information on the major road crossings and some sections with channel definition survey data are provided in key locations. The survey is supplemented using NPCA 1m DEM data, which provides a useful reference view of the generalized slopes and shapes but is not considered accurate enough to profile channel bed slope. The City of Port Colborne has supplemented the original survey data with RTK GPS survey of specific locations.

The drain provides service to predominately agriculture as shown in the following figure. The property categories are provided by GIS data from the property database.

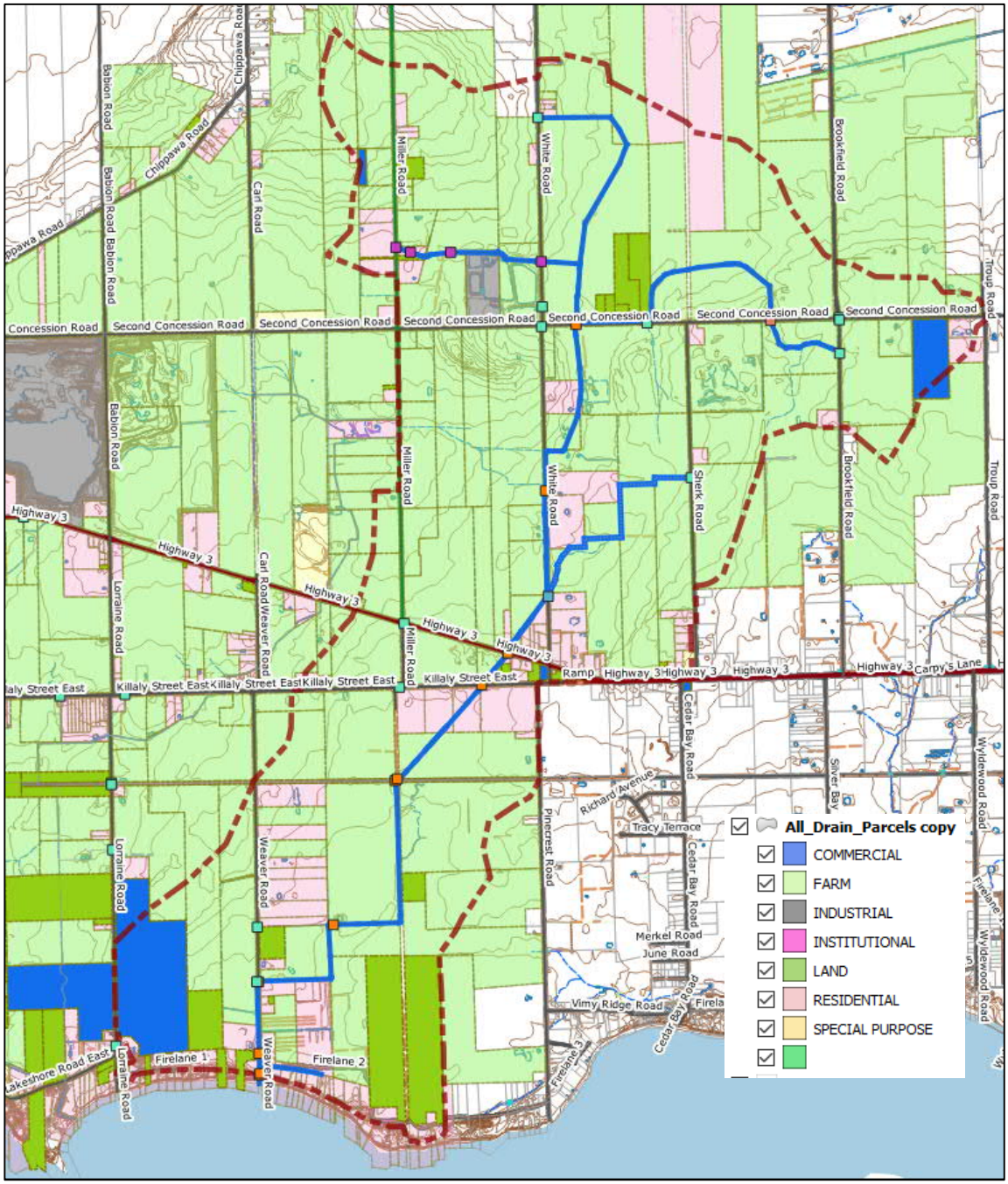


Figure 15 Agricultural Property Zoning

The figure is composed from the property zoning to identify agriculture properties; however, not all of the properties zoned for agriculture are currently under cultivation. The property coded data in the parcel map database is dated and not necessarily current to existing uses.

The proposed Drain Structure is for a main drain with branches. Branches can be one of four possible types of branches:

- Municipal Branch Drain connection; forms part of the regulated drain with schedule assessments reflecting area, connection adjacency, etc.
- ROW ditches that connect to the Drain but are not part of the regulated drain.
- Private drain connections that depend on the Municipal Drain but are not part of the Drain. Ideally, each of these will have an established and recognized connection elevation to suit the upstream grade.
- Municipal Drain Features that form part of the drain but are technically ancillary to the drain itself. Examples include:
    - Flood Gate Control structures, including flap gates,
    - Pumping stations,
    - Water Quality control features such as;
        - Stormwater Management Control Ponds,
        - Sediment Basins,
        - Drain related wetlands, and
        - Other runoff quality control measures.
    - Culverts and Bridges.

Generally, the drainage system has a well defined course throughout its length, consisting of natural open water courses, artificially made open ditches, roadside ditches, and roadway and private crossings. Typically, the channel cross-sections are well defined, trapezoidal in shape, with typically steep to almost vertical side slopes in variable depths and lengths.

3.1 Condition Appraisal

The following describes both the existing open channel condition through the drain but also the structures that are a key feature of the drain.

3.1.1 Drain Grade

The Beaver Dam Drain Grade is distinct for the extremely low grade at the outlet, 0.04% and a very low grade in the upper reach, 0.05%. Compared to the grade from Weaver Rd. to the Highway 3 crossing that has an average grade of

0.11% with some segments at 0.19%. The historical existence of rock outcrops within this graded section make achieving grade challenging. An actual survey of rock hasn't not been established; however, it is generally recognized that the drain segment below the Friendship Trail has the rock.

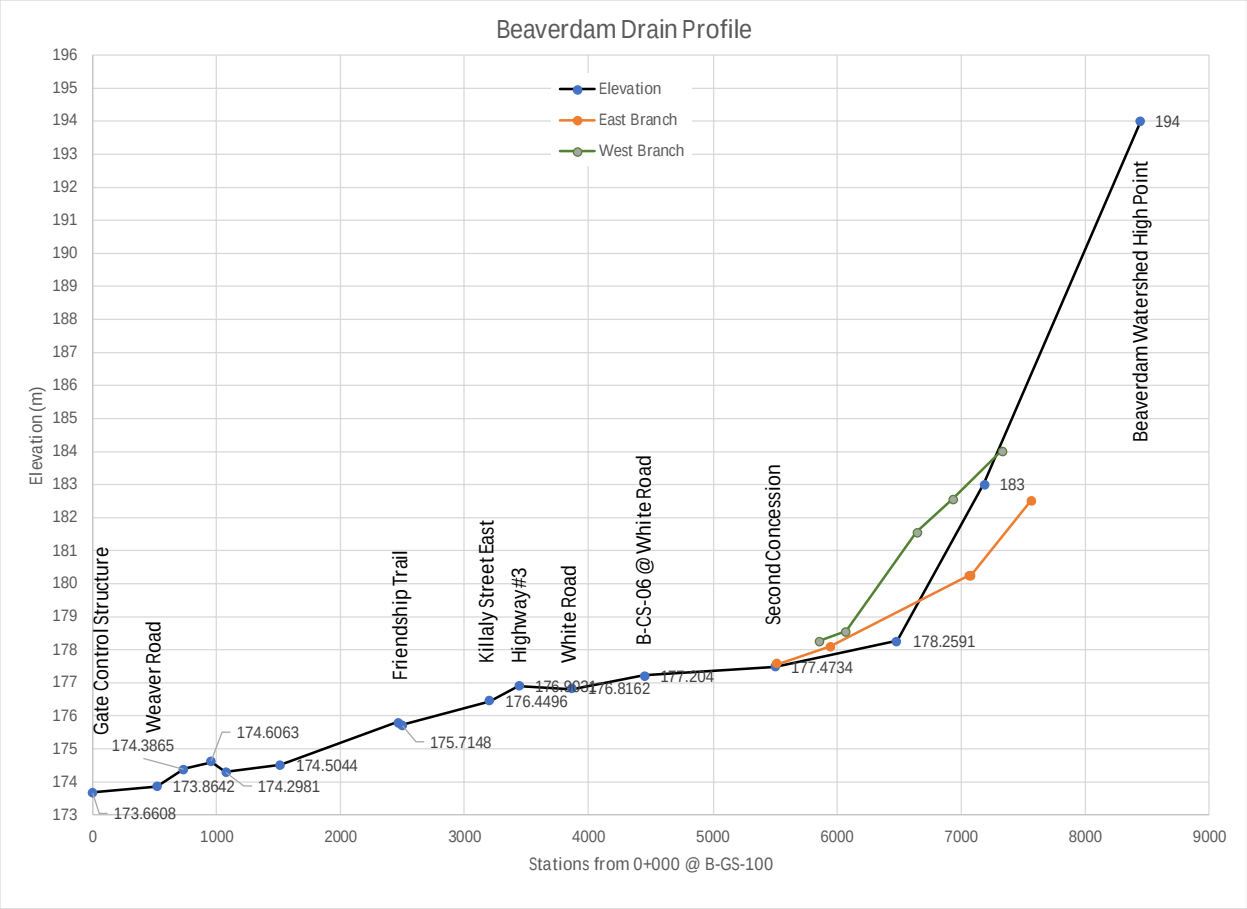


Figure 16 Beaver Dam Drain Profile

The other significant feature visible in the Drain profile is the grade present in the drain uplands or the source. These are the grades present with overland flow and not channel drain grade that are on average 0.8%. The result is relatively high overland runoff rates in portions of the watershed that once collected into the drain have very low grades to convey the flow. This geomorphologically is a condition for flooding.

The figure also shows the grades that are present in the East and West Branches. The grades are more significant than the corresponding grade to the North which is influenced by the Humberstone Marsh. The observation is that the grades for East and West Branches are able to drain effectively but once the flow is conveyed to the main drain, the low grades available in the Beaver Dam Drain make it prone for the banks to be exceeded.

3.1.2 Condition of Outlet

The Beaver Dam outlet is composed a pump discharge pipe, and a control gate structure, shown in following photo. This infrastructure provides a control against a seiche causing short term high lake levels impacting the relatively shallow lower reach.

Figure 17 Beaver Dam Outlet

During these seiche and storm events where the lake levels are pushed high over short duration periods (3 to 8 hours), the gates are closed and a tractor is driven to the location, connected by PTO and stormwater is pumped through the outlet to the lake.

Lake Erie Levels

In geologic time, Lake Erie levels have varied depending on glaciation and on the various flow sills that have existed into and out of the Great Lakes basin. These sills have changed in elevation as landforms rebounded from the effects of glaciation. In the modern period, Lake Erie levels are dominated by flows out of Lake Huron and out of Lake Erie into the Niagara River and Welland Canal system.

The following historic Lake levels are provided by the Government of Canada Fisheries & Oceans Hydrographic Service based on 100+ years of monitoring

data and statistics. The values are quoted in monthly mean water levels reference to IGLD 1985

Yearly Average	Minimum Monthly	Maximum Monthly
174.15	**173.18**	**175.04**

From the F&O Government of Canada Water Level bulletin for June 2019, the mean for month of June, 2019 was reported as 175.14 (174.89m last year). This is significantly higher than the Yearly average, 174.35.

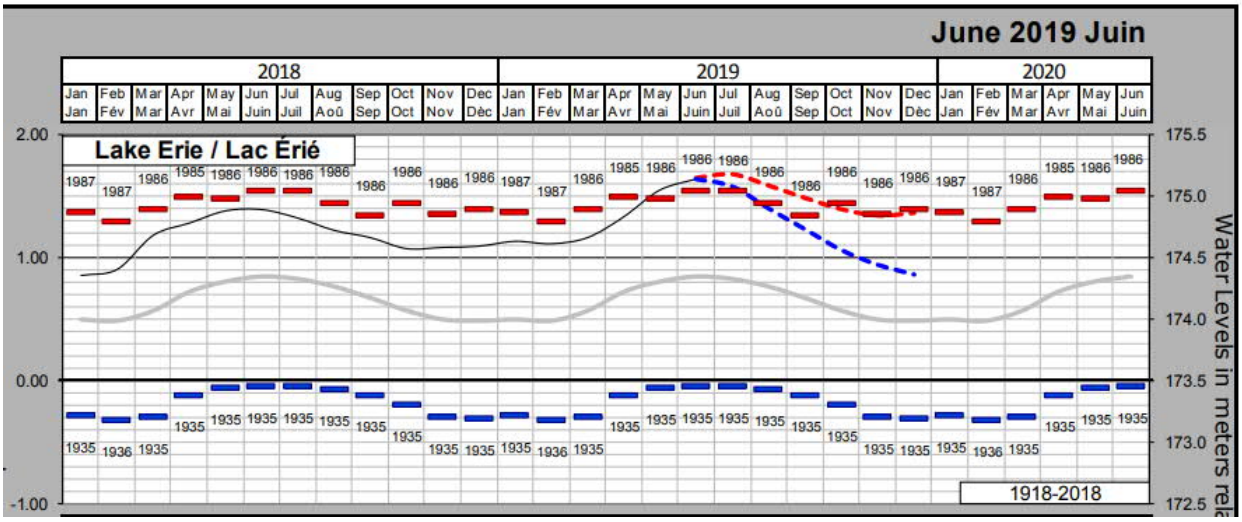


Figure 18 Lake Erie Water Level GC Hydrographic Bulletin, June 2019

The chart shows that for the past two years, water levels are 0.5m above average conditions. Adding wave set up to this further influences the lower reach of the Beaver Dam Drain.

Lorraine Bay

The water quality issues of Lorraine Bay were initiated in 2000 by the Lorraine Bay Community, now known as the Lorraine Bay Water Quality Group, who raised concerns that the Drains may be responsible for the observed degradation of the water quality in the Bay.

Lake Erie water quality effects and the potential cause (or causes) is too large and significant of a topic to be covered in this report. Lake Erie phosphorous levels, Algae blooms and hypoxic zones within the Lake are well documented but these are larger lake scale effects than the observed localized effects within Lorraine Bay; however, a relationship between all aspects of the Lake can't be excluded nor is it reasonable to just focus on the Municipal drains as a contributor to water quality concerns.

However, it is reasonable to expect that the municipal drain would be designed to not only enhance drainage for upstream ratepayers but also to enhance water quality or to mitigate through design the potential negative effects of runoff.

Contributory to these concerns would be changes in land use in upstream areas along with changes such as Climate Change that affect both precipitation events and also heating impacts between events.

3.1.3 Channel Condition

From the Amec Survey of the Drain, there were 12 cross-sectional surveys and surveys of 9 Culvert / Bridge crossings. Determining a gradeline from these 21 sample data set over the entire drain length of 6, 485m presents some challenges with interpretation. The chart of x-sections included in Appendix B shows the calculated flow achieved for each x-section. The hydraulic model was implemented using depth data and bottom-width data for each of the channel links in the model.

Capacity of the channel is influenced by the selection of the Manning's 'n' used in the formula. There's significant information available for selecting 'n' but the following shows the range of values for a 'natural' stream.

- Natural streams - clean and straight 0.030
- Natural streams - major rivers 0.035
- Natural streams - sluggish with deep pools 0.040
- Natural channels, very poor condition 0.060

From the MTO Drainage Manual the suggested value for n of an earth channel with grass and some weeds is 0.030 to 0.035. This compared to the following for a "not maintained" channel:

- Clean bottom, brush on sides 0.05 - 0.08
- Some weeds, heavy brush on banks 0.05 – 0.07
- For tree within channel with branches submerged add 0.01 to 0.02.

To illustrate the impact that the Manning's n has on design capacity, we'll examine the performance of one channel section located between B-CS-011 2450 CSP and the culvert crossing the Friendship Trail and with channel data provided by survey at Station 1+415. The cross-section from the survey is as shown in the following figure.

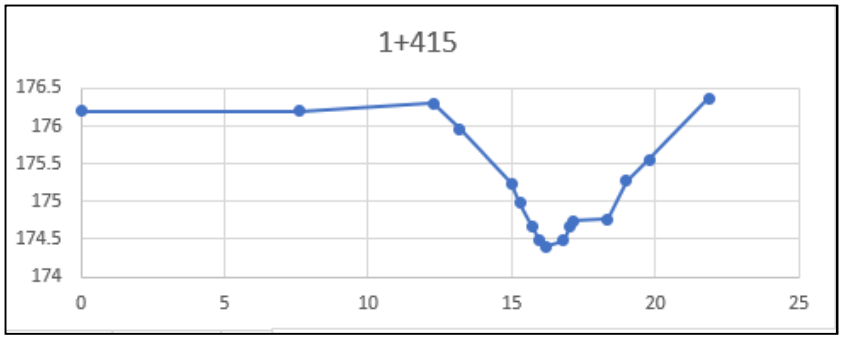


Figure 19 Cross-Section STA 1+415

If we assume the channel is clean and clear, then we can calculate the capacity of the channel using Manning's n of 0.035. For a channel that has trees growing

within the banks, specifically Ash Trees, then we can assess the channel capacity using a Manning's n of 0.048.

Clean n = 0.035	Capacity = 7.652 cms
Overgrown n = 0.065	Capacity = 3.348 cms

From the modelling prepared for the Beaver Dam Drain the design objective flow for this reach is 5 cms for the 1:5 year storm (68.9mm). This shows that for a clear clean drain, the channel meets the standard but for an overgrown drain, it fails to meet the required flow and will lead to localized flooding.

Emerald Ash Borer Impacts on Established Ash Trees

The invasive species of ash borer from Asia as decimated Ash trees in southern Ontario. There were significant and numerous opportunistic ash trees that established themselves along the Beaver Dam Drain. These trees are now standing dead with large upper limbs in various stages of decay.

While some trees are showing evidence of re-establishing themselves from the trunk there's no single leader and they are more likely to establish a bush that will eventually be subject to another ash borer infestation.

- **It is necessary to perform a clean up of these standing dead ash trees that occur within the banks of a municipal drain along with the removal of trees that block or create the potential for flow area reductions.**

3.1.4 Beaver Dam Control Structure

The Beaver Dam Control Structure is designed to reduce seiche event water levels from driving back into the drain. The following is the Fisheries and Oceans Canada Water Level monitoring for February 2019 located at Port Colborne.

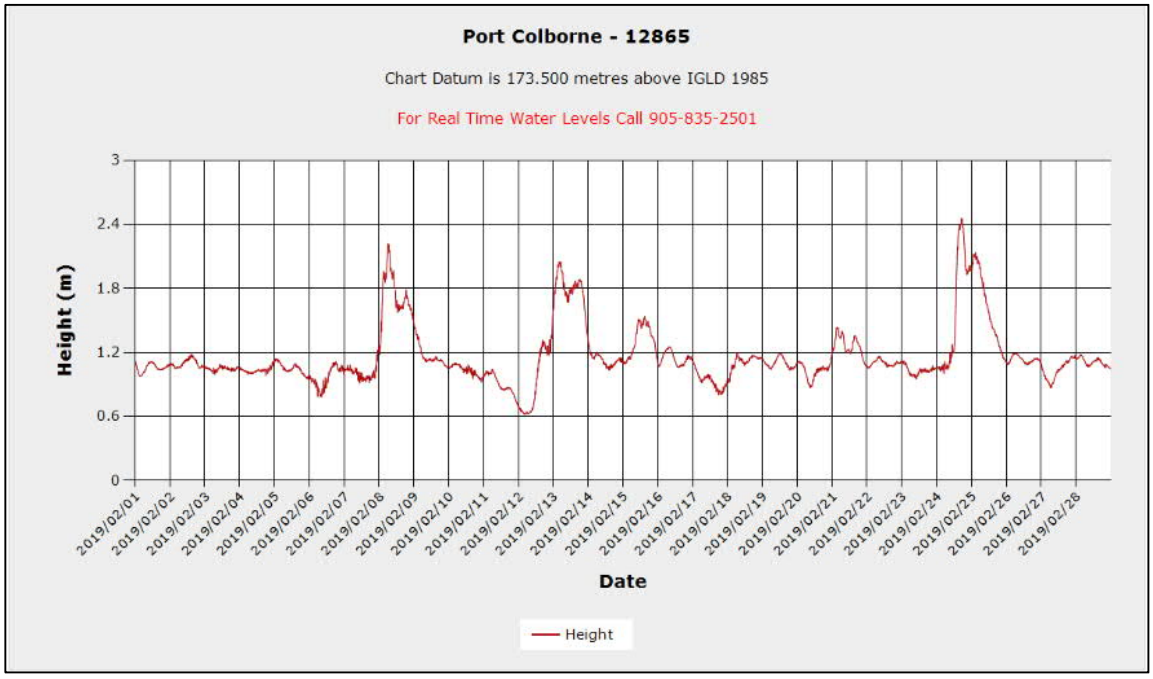


Figure 20 Port Colborne Hydrographic Water Level

The chart datum used for the hydrographic level is different than the drain survey elevations as a result of alternate earth referencing systems and this distinct varies from location to location; however, if we neglect this distinction and convert the chart datum for a peak elevation that would impact the control gate we have the following result.

Chart datum 173.5m + peak observed flow above datum 2.4m = 175.9m.

This is within 0.7m of the top of the opening for the gate structure shown in the following photo.

Figure 21 Beaver Dam Control Gate Structure, B-GS-01

From this it is clear that the existing function of the gate control structure is a required element of the drain.

3.1.5 Beaver Dam Drain Structures

There are 10 crossings on the main drain consisting of bridges, culverts or flow controls. The crossings are shown in the following figure and are listed in the following Table. A larger map showing crossings with labels for cross reference is included in Appendix B

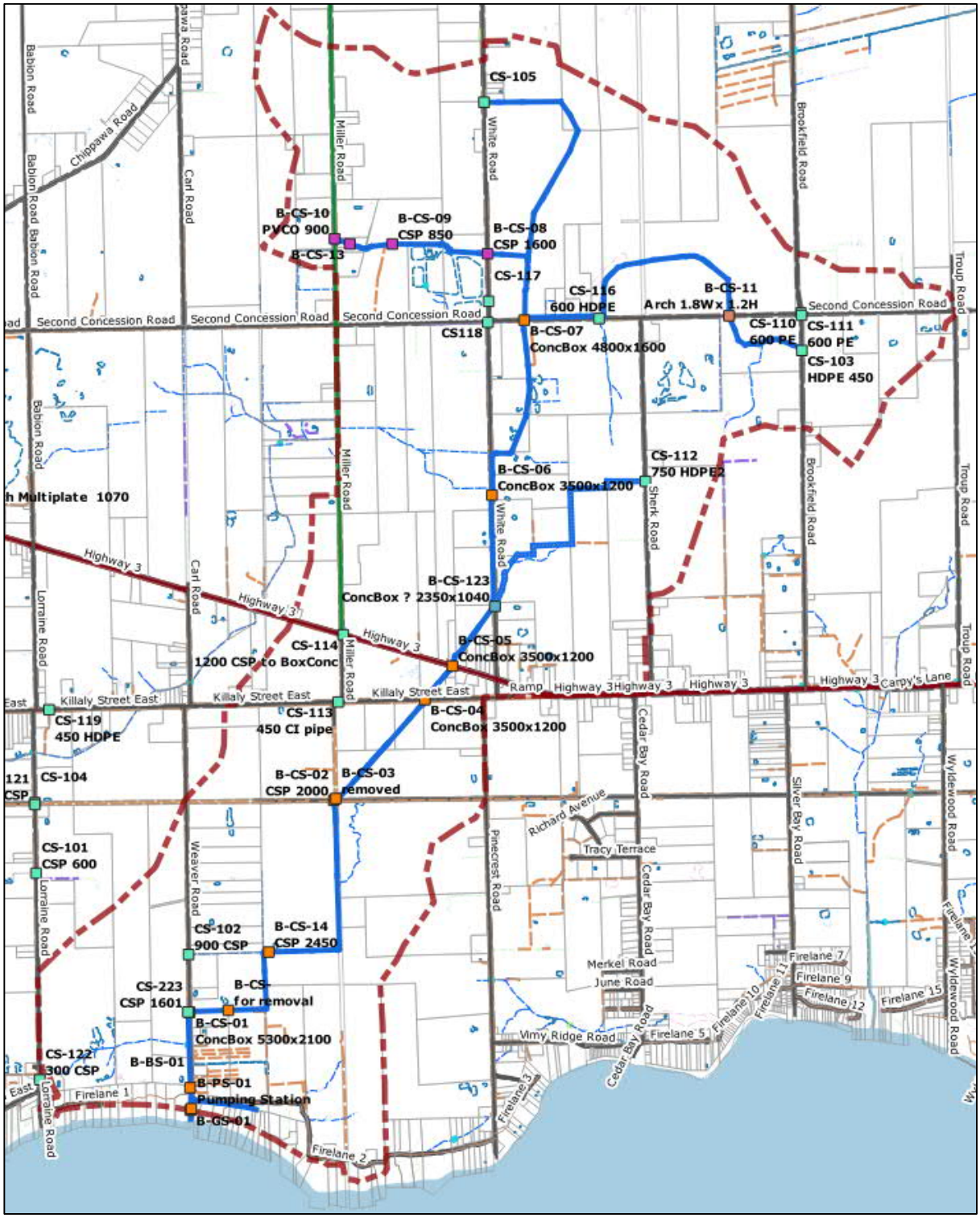


Figure 22 Beaver Dam Bridge and Culvert Drain Structures

Culverts are organized into two classes; those that are part of the drain and those that complementary to the drain but assigned to the Road Right of Way (ROW) for their functional purpose and assessment. ROW culverts are not assessed.

Table 1 Beaver Dam Drain Culverts

id	NameID	Crossing	Crossing Height	Drain	Culv desc	Num culv.	Station	Length
53	B-BS-01	Fire Lane 1		Beaver Dam Drain			0+119	4.2
52	B-CS-01	Weaver Road	176.734	Beaver Dam Drain	ConcBox 5300x2100		0+530	17
55	B-CS-02	Friendship Trail		Beaver Dam Drain	CSP 2000	1	2+464	11.5
56	B-CS-03	Miller Road (URA)		Beaver Dam Drain	removed		2+482	10
57	B-CS-04	Killaly Street East		Beaver Dam Drain	ConcBox 3500x1200	1	3+210	16
58	B-CS-05	Hwy 3		Beaver Dam Drain	ConcBox 3500x1200		3+447	15.2
59	B-CS-06	White Road	179.338	Beaver Dam Drain	ConcBox 3500x1200		4+450	7.5
60	B-CS-07	Second Concession Road	179.643	Beaver Dam Drain	ConcBox 4800x1600		5+510	19
84	B-CS-14	Private	175.3	Beaver Dam Drain	CSP 2450	1	1+275	7
50	B-GS-01	Weaver Road	176.8	Beaver Dam Drain			0+000	2.4
64	B-CS-11	Second Concession Road	181.894	Beaver Dam East Branch	Arch 1.8Wx 1.2H	1	1+556	14
61	B-CS-08	White Road	180.501	Beaver Dam West Branch	CSP 1600	1	0+598	12.2
62	B-CS-09	Private	182.714	Beaver Dam West Branch	CSP 850	1	1+100	4.5
63	B-CS-10	Miller Road	184.193	Beaver Dam West Branch	PVCO 900	1	1+428	15.6
33	B-CS-13	private access lane		Beaver Dam West Branch			1+335	8.6
88	B-CS-123	White Road		ROW – David Michener & James Craig	??			
73	B-CS-	Private		Beaver Dam	To be removed		0+700	4

At present there's no culvert through the Friendship trail as a result of emergency works to address a collapse in 2017. This is presented as an opportunity to make changes to improve the drain through this area. Downstream of the crossing, there's a known bedrock outcrop that is limiting grade in this area.

Owner of private crossing located at 0+700 has indicated they would like the crossing removed.

Table 2 Beaver Dam ROW Culverts

id	NameID	Crossing	Crossing Height	Drain	Culv desc	Num culv.	Station	Length
205	CS-102	Weaver Road	177.284	ROW	900 CSP			11
65	CS-103	Brookfield Road		ROW	HDPE 450	1		11
86	CS-104	Lorraine Road	179.35	ROW		1		17.3
87	CS-105	White Road	183.4	ROW				17.3
200	CS-110	Brookfield Road		ROW	600 PE	1		
201	CS-111	Brookfield Road		ROW	600 PE	1		
202	CS-112	Sherk Road		ROW	750 HDPE2	1		9
203	CS-113	Killaly Street East		ROW	450 CI pipe	1		
204	CS-114	Main Street East		ROW	1200 CSP to BoxConc	1		
206	CS-116	Second Concession Road		ROW	600 HDPE	1		
207	CS-117	White Road		ROW		1		
208	CS118	White Road		ROW				
223	CS-223	Private Entrance	176.275	ROW	CSP 1601	1		8

Culvert crossing Weaver Rd, CS-102 outlets South along the West side of Weaver Road to the Beaver Dam Drain by a ROW drainage swale. This was part of the original Drain but was moved to the South for the current alignment and abandoned in a report.

Culvert CS-103 on Brookfield was installed relatively recently (<3 years) and has the proposed East Beaver Dam extension as an existing tile through the field as it's outlet. The tile function is compromised by the poor inlet and outlet arrangement (obstructed flow) along with the undersize of the existing tile to meet design standards.

Culvert CS-105 crossing White Rd. and having the proposed extension of Beaver Dam Main Branch as its outlet does not have a known size at this time but is believed to be a CSP in the 450 to 600 range.

3.2 Overall Drain Performance

The following sections describe the existing Beaver Dam Drain and compliance with accepted design standards and practices.

- Compliance with design objectives; the drain is providing a service to all ratepayers within the watershed on a multi-objective basis that includes both quantity and quality objectives.
- Report on design storm criteria
    - Quantity criteria are considered to be acceptable risk factors:
        - 1 in 2 year flood for channels through agricultural lands.
        - 1 in 5 year flood for channels through residential fringe lands.
        - 1 in 5 year flood of private crossings.
        - 1 in 10 year flood for Port Colborne road crossings.
        - 1 in 25 year flood of Regional Road crossings.
        - MTO crossings are required to meet MTO guidelines for highway crossings, (refer to MTO Highway Drainage Design Standards, January 2008)
    - Quality Objectives include:
        - Suspended Solids and Sediment (often referred to as Total Suspended Solids or TSS) TSS is often related to types of agricultural practices and the presence or absence of drain buffers that reduce direct runoff contributions of TSS. Mitigations through effective design and practices are recommended for implementation in the Design Report.
        - Phosphorous and Nitrogen are nutrients and part of the natural cycle. They are applied to farm land as commercial fertilizers that may runoff and cause excess growth of aquatic plants that affect watershed and receiving water as an ecosystem. Reductions at source is the best practice but practices including the use of wetlands aid in treating excess contributions of these nutrients to the watershed and receiving waters.

3.2.1 Quantity Issues

Figure 6 NPCA supplied Regulated Flood limits and Areas shows the forecasted regulated flood limits and a map based figure of flood lines is included in Appendix D.

For more detail on the modelling of predicted flows refer to the Beaver Dam Hydrology and Hydraulics Report.

3.2.2 Quality Issues

Completed by Dougan & Associates (Dougan) and included in Appendix C, the study entailed the assessment of existing vegetation and land uses along the Drains, researching possible ecological restoration works to improve water quality in the Drains, assess the costs of the works, and describe opportunities and constraints for water quality improvement measures for each drain based on the field work and research findings.

The report identified the following within the watershed.

> "The field survey recorded a total of 34 reaches, 20 for the Wignell/Michener Drain and 14 for the Beaver Dam Drain. The lands adjacent to the drains were divided into 8 ELC vegetation community types: Agricultural, Anthropogenic, Coniferous Plantation, Cultural Meadow, Cultural Thicket, Cultural Woodland, Deciduous Forest, Deciduous Swamp and Meadow Marsh.
>
> It was observed that the dominant vegetation communities are agriculture and deciduous swamp, followed by rural residential properties. The drains are directly adjacent to roads in several locations and some parts run through a golf course **(at the time of the report)*. The topography was identified as typically very flat except for the remnant dunes along Lake Erie, which were large and rolling.
>
> In terms of natural heritage features, the Beaver Dam Drain watershed includes Humberstone Marsh and Beaver Dam Creek Wetland Complex PSW."

The report recommended the following:

> "In general, the specific restoration measures recommended by Dougan & Associates can be summarized into the following categories:
> - Buffer plantings;
> - Channel modifications;
> - Wetland creation; and
> - Using existing wetlands during high water events."
>
> The total cost of water quality improvement works proposed for the Wignell/ Michener and Beaver Dam Drains are estimated at $5,105,250. A breakdown

of the cost estimate for the restoration work on the Drains is included in Appendix 'E'.

The total cost of buffer planting works based on site preparation and planting of 10 m wide buffer strips along the channel at $100 per meter is $1,018,500. The cost of wetland creation works, including the purchase of an easement is $4,056,000 ($60 per sq.m)."

3.3 Environmental Appraisal

The improvement of the drain should be performed while minimizing or mitigating any negative environmental effects. The existing drain has been functioning in much the same way as it is now for more than 100 years and is proposed to continue to function.

The Port Colborne area has environmental issues historically that are well documented. The relevant issues for the Beaver Dam drain are:

- Water Quality in the receiving water of Lake Erie.

The drain passes along the North Boundary of the Humberstone Marsh as shown in the following figure.

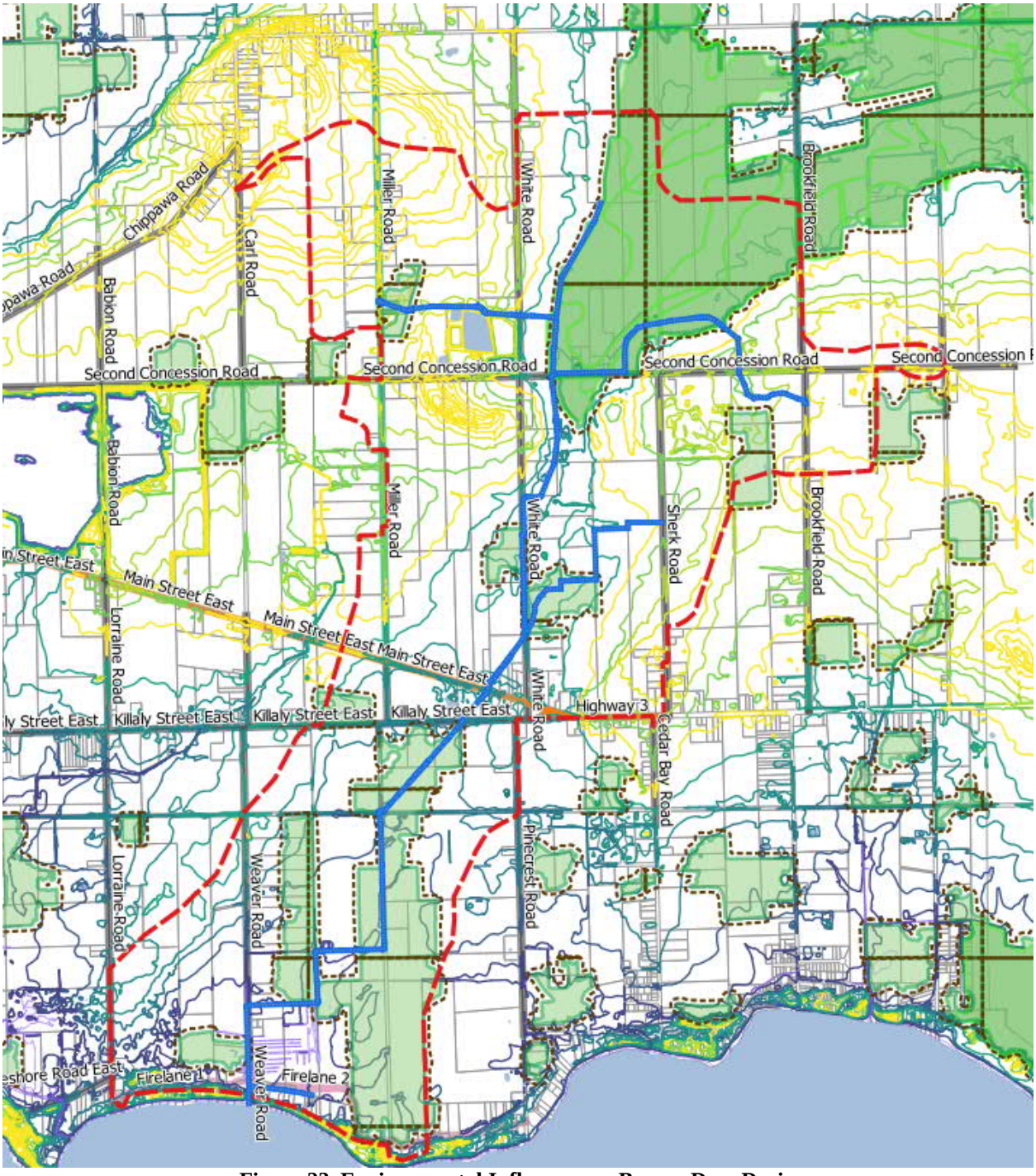


Figure 23 Environmental Influences on Beaver Dam Drain

3.3.1 Ministry of Natural Resources

The recommendation from MNR was to conduct the three activities of:

I. Habitat Inventory

II. Potential SAR on the property

III. SAR Surveys

An inventory of existing vegetation in the riparian zone was compiled by Dougan and Associates, the full report is available upon request. A shortened version, minus the Appendices is included in Appendix C.

3.3.1.1 Species At Risk (SARs)

The following is the information provided by MNR for designated species at risk within the project area.

Table 3 Species at Risk Designation for Port Colborne Area

Species At Risk Designations	
ENDANGERED	
THREATENED	
SPECIAL CONCERN	
EXTIRPATED	
AMPHIBIANS	
Fowler's Toad (*Anaxyrus fowleri*)	Known to Occur
BIRDS	
Barn Owl (*Tyto alba*)	Suspected to Occur
Black Tern (*Childonias niger*)	Known to Occur
Bobolink (*Dolichonyx oryzivorus*)	Suspected to Occur
Cerulean Warbler (*Dendoica cerulea*)	Known to Occur
Chimney Swift (*Chaetura pelagica*)	Suspected to Occur
Common Nighthawk (*Chordeiles minor*)	Suspected to Occur
Least Bittern (*Ixobrychus exilis*)	Known to Occur
Peregrine Falcon (*Falco peregrinus*)	Known to Occur
Short-eared Owl (*Asio flammeus*)	Known to Occur
FISH	
INSECTS	
Monarch Butterfly (*Danaus plexippus*)	Known to Occur

The drainage works, as considered from past works and general construction practices are not forecast to impact bird species in any direct way. There is a clear risk of work in and around the drainage system that could impact amphibians and reptiles and for this we will specify mitigating measures to be implemented during construction.

Those mitigation measures may include:

- Pre-construction survey to confirm that no species at risk are present and/or put at risk through construction. The pre-construction survey will be conducted within a specific time window relative the construction work being undertaken.

- Intervention during construction will occur if a reptile or amphibian is found within the construction site. A qualified person will assess the animal and determine if it is or is not a species at risk and a local re-location effort will occur.

3.3.2 Federal Species at Risk (SAR)

The SAR from the Federal web site listing for Ontario location is provided in Appendix C. Not all species will be likely to occur in the Port Colborne area, and not in the specific habitats of the Beaver Dam Drains. The contractor will be directed to this information with a requirement to ensure that no species at risk are adversely affected.

3.3.3 Fisheries

The long history of the drain confirms that the works being considered are unlikely to cause a change in environment that is distinctly different from what is currently in existence. Historically, fish have been seen and documented within the Beaver Dam Drain as far north as the Second Concession.

From the DFO website, the following figure does not list the Beaver Dam drain as having Fisheries species at risk. The map does show inventoried streams to the West and East of Port Colborne.

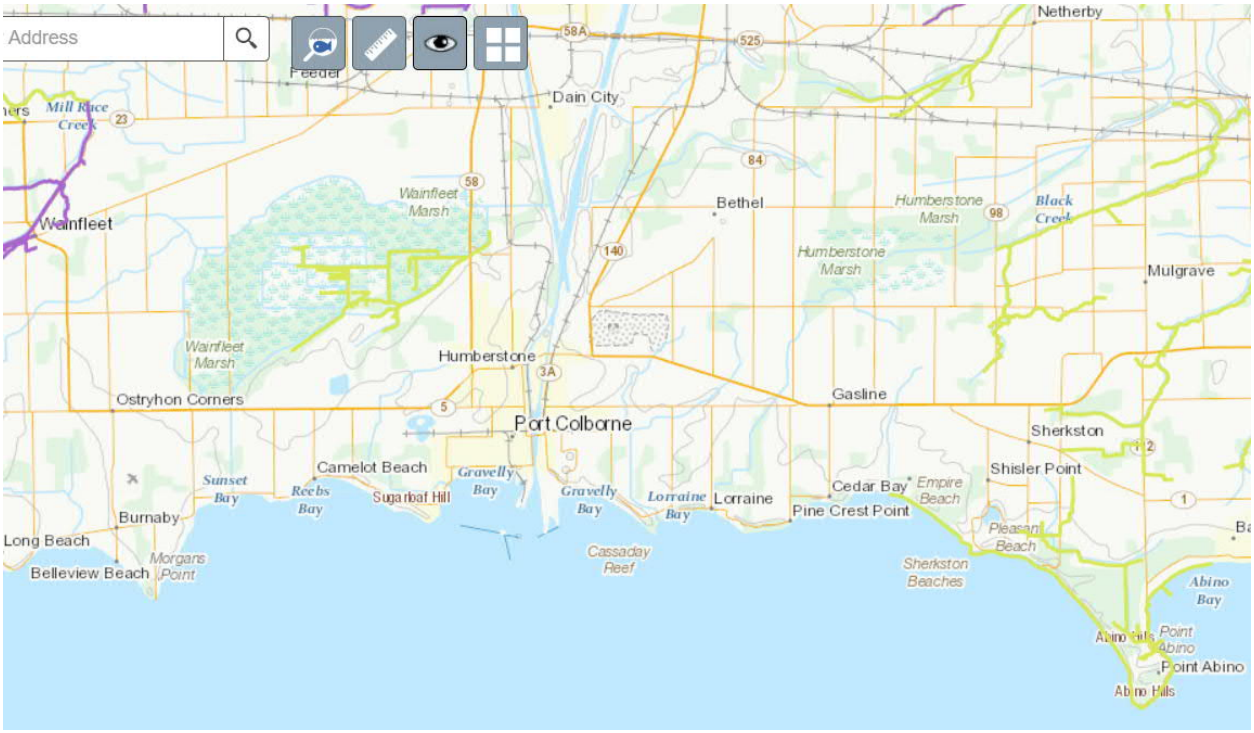


Figure 24 DFO Fisheries at Risk inventory

From this figure, there's no expectation of special measures or requirements to be addressed either by design or during construction for the protection of special significant species. However, suitable construction practices to protect fish in the drains will be implemented. This will focus on downstream sediment impacts as a result of construction to control sediment loading during excavation.

From the DFO and the Ontario Agricultural Information Atlas the Beaver Dam drain classification (see figure below) is as follows:

a. 0+000 to 0+250 and 0+500 to 1+650 are classified as "Class C" drains with permanent flow

b. 0+250 to 0+500 is classified as "Not Rated" requiring a DFO site specific review

c. 0+1650 through the rest of the drain is classified as "Class F" with intermittent flow

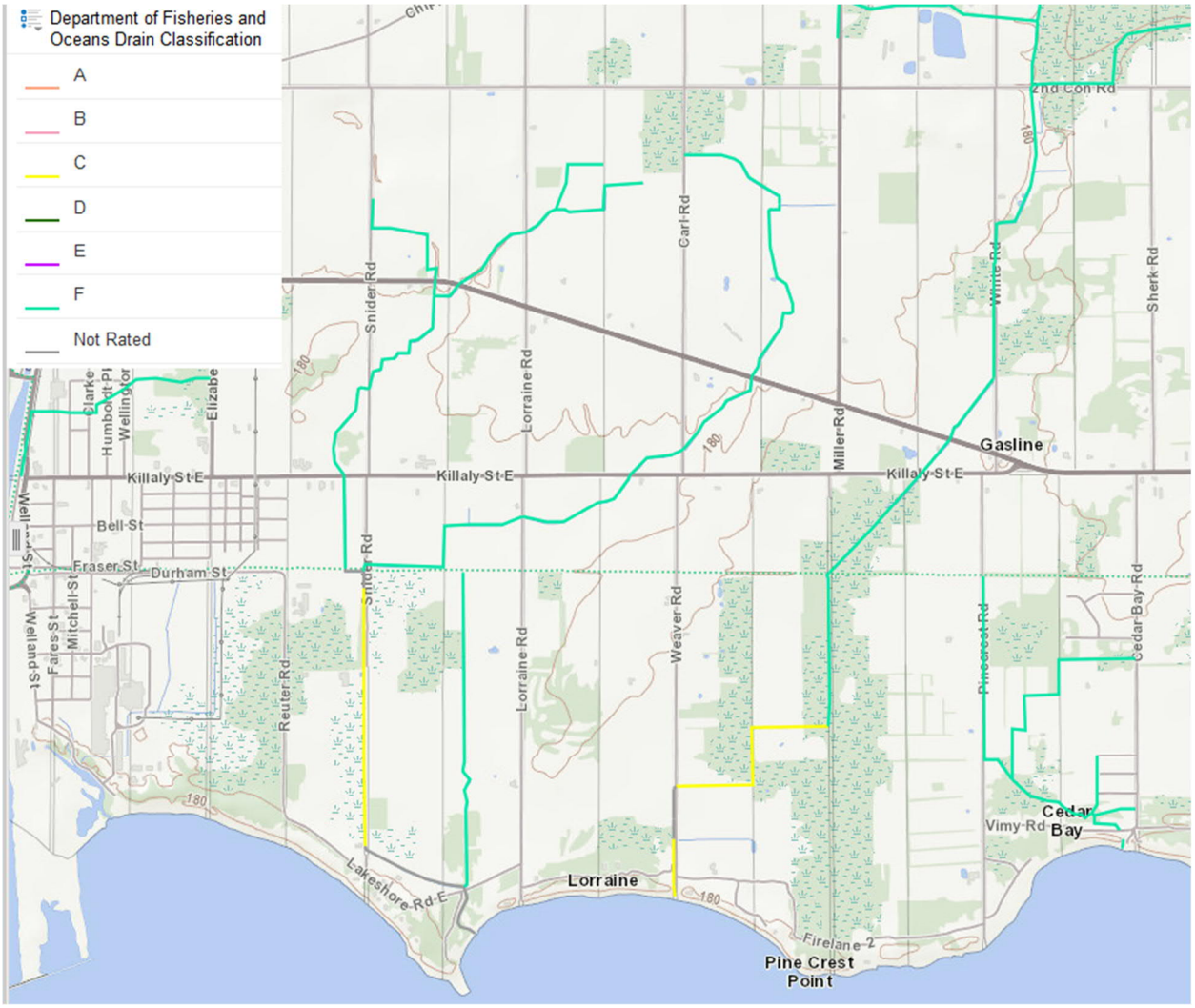


Figure 25 Ontario Agricultural Information Atlas – DFO Drain Classification

3.3.4 Migratory Birds Convention Act

The Migratory Birds Convention Act, 1994 (MBCA) provides protection to migratory birds, their eggs and nests. The Act is Federal and administered by Environment Canada and Climate Change Canada (ECCC).

From their website the following identifies two primary consideration for the drain improvement works considered for Beaver Dam.

- General Nesting period mid-March to late August (with regional variations.)
- Exceptions include:

- Species that may nest earlier, such as Great Blue Heron and American Woodcock in March, or those which may nest later such as Cedar Waxwing, Bohemian Waxwing, Pine Siskin, American Goldfinch, Common Murre and Great Blue Heron until the end of September, or Leach's Storm-Petrel, Fork-tailed Storm-Petrel and Northern Gannet in October;

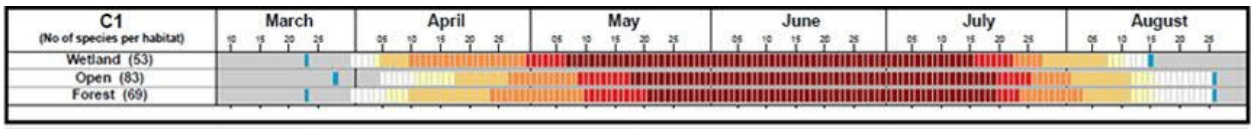
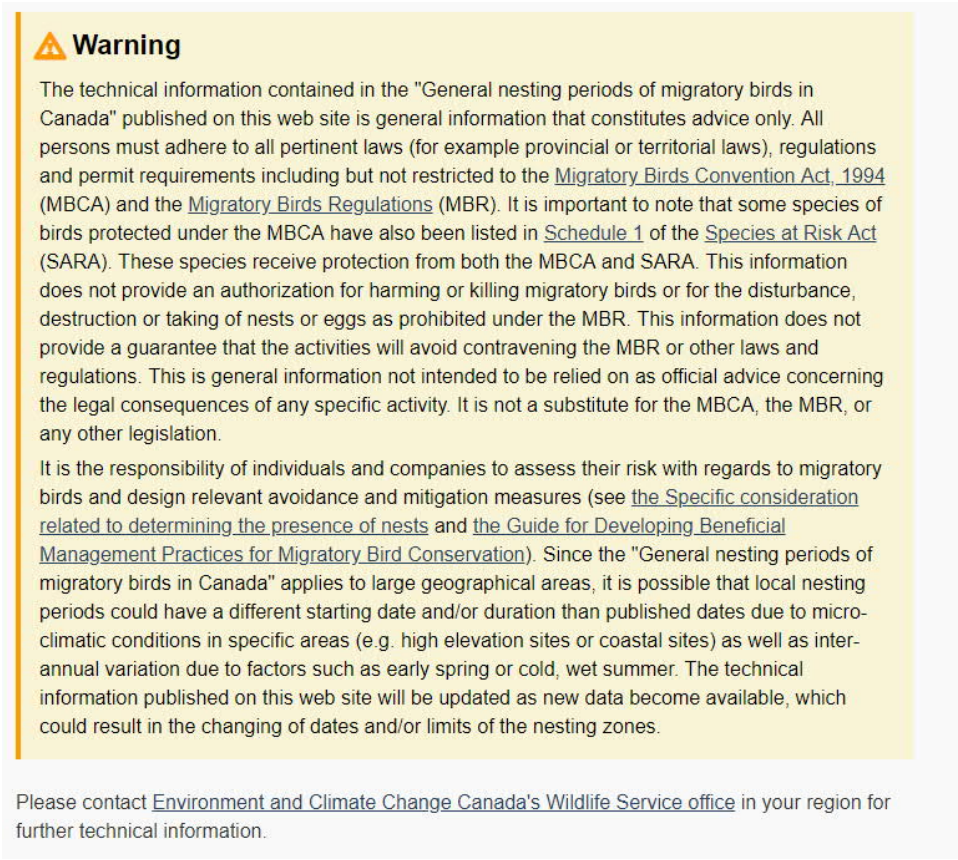


Figure 26 Nesting Period for C1 applicable to Port Colborne

The proposed work of reducing the dead ash within the drain could have a nesting impact if conducted within the general nesting period. Work to remove trees will be scheduled outside of the general nesting period and effort to ensure exceptions to the general nesting are not impacted will be made by a qualified person.

Topside vegetation removal; trunk, limbs, branches will occur prior to the general nesting period and preferably during frozen ground conditions. Some vegetation removal could be scheduled after the nesting period for the following construction year; however, preceding construction is preferred. Full removal of the stump will be scheduled with excavations associated with the drainage works.



Warning

The technical information contained in the "General nesting periods of migratory birds in Canada" published on this web site is general information that constitutes advice only. All persons must adhere to all pertinent laws (for example provincial or territorial laws), regulations and permit requirements including but not restricted to the Migratory Birds Convention Act, 1994 (MBCA) and the Migratory Birds Regulations (MBR). It is important to note that some species of birds protected under the MBCA have also been listed in Schedule 1 of the Species at Risk Act (SARA). These species receive protection from both the MBCA and SARA. This information does not provide an authorization for harming or killing migratory birds or for the disturbance, destruction or taking of nests or eggs as prohibited under the MBR. This information does not provide a guarantee that the activities will avoid contravening the MBR or other laws and regulations. This is general information not intended to be relied on as official advice concerning the legal consequences of any specific activity. It is not a substitute for the MBCA, the MBR, or any other legislation.

It is the responsibility of individuals and companies to assess their risk with regards to migratory birds and design relevant avoidance and mitigation measures (see the Specific consideration related to determining the presence of nests and the Guide for Developing Beneficial Management Practices for Migratory Bird Conservation). Since the "General nesting periods of migratory birds in Canada" applies to large geographical areas, it is possible that local nesting periods could have a different starting date and/or duration than published dates due to micro-climatic conditions in specific areas (e.g. high elevation sites or coastal sites) as well as inter-annual variation due to factors such as early spring or cold, wet summer. The technical information published on this web site will be updated as new data become available, which could result in the changing of dates and/or limits of the nesting zones.

Please contact Environment and Climate Change Canada's Wildlife Service office in your region for further technical information.

Ontario Region
Canadian Wildlife Service
Environment and Climate Change Canada
4905 Dufferin Street
Toronto ON
M3H 5T4

3.3.5 Ministry of Environment, Conservation and Parks

Works carried out under the Drainage Act are exempt from seeking an Environmental Compliance Approval (ECA formerly CofA) issued by the MOECP.

Under the Ontario Water Resources Act, 1990 consideration to Water Taking Permits will be reviewed during the design period. Note that there are none shown for the Beaver Dam at this time. Also the discharge of deleterious substances including excess sediment will be given consideration in the design and specifications for construction execution practices to minimize and/or mitigate construction impacts downstream.

Permits to Take Water

The following figure is from the MOE website providing map based review of approved Permits.

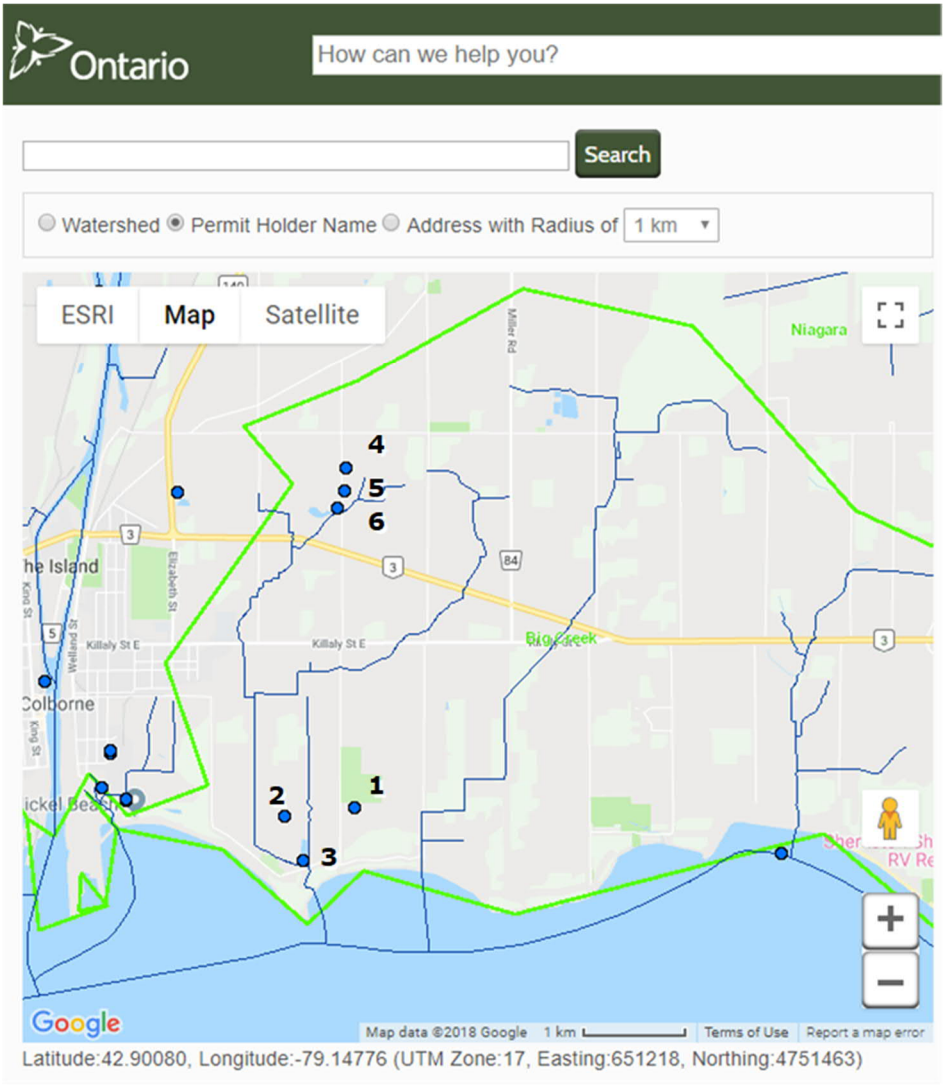


Figure 27 Permits to Take Water

Under the Nutrient Management Act, 2002 a farmer seeking to construct a permanent storage facility is required to identify all drainage tile and piped drains within 15m of perimeter of the permanent nutrient storage facility.

A review of nutrient management within the Watershed and the potential role that the drain may play will be considered in the Hydrologic and Hydraulic Watershed Study.

Regarding the Clean Water Act, 2006 information relevant to the drains is provided by the MOECC's Source Protection Information Atlas. The default view of the area is shown in the following figure.

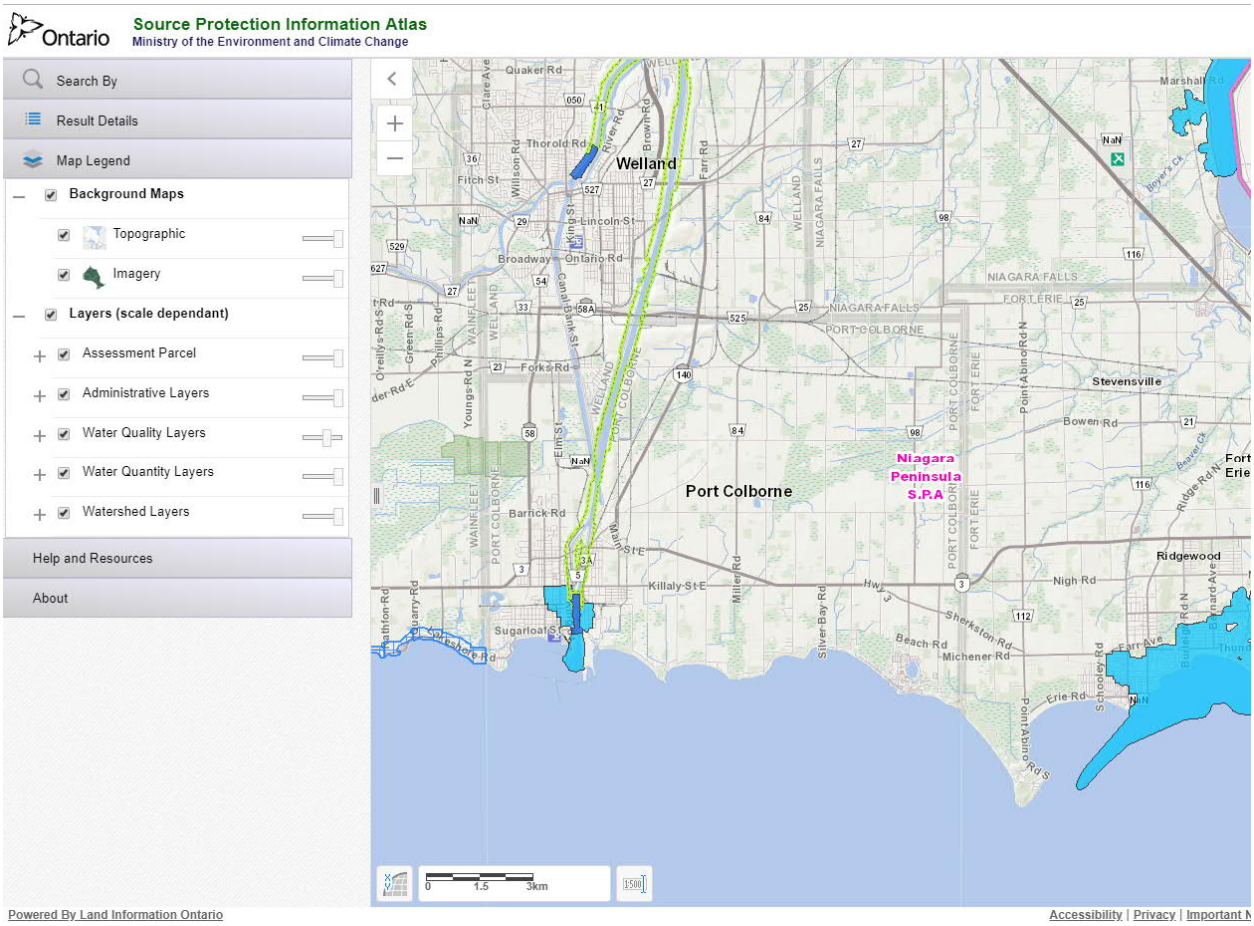


Figure 28 MOECC Source Protection Atlas - default view

The predominate features are the water intakes operated by the RMON.

The following figure shows the Watershed layers to the quaternary level.

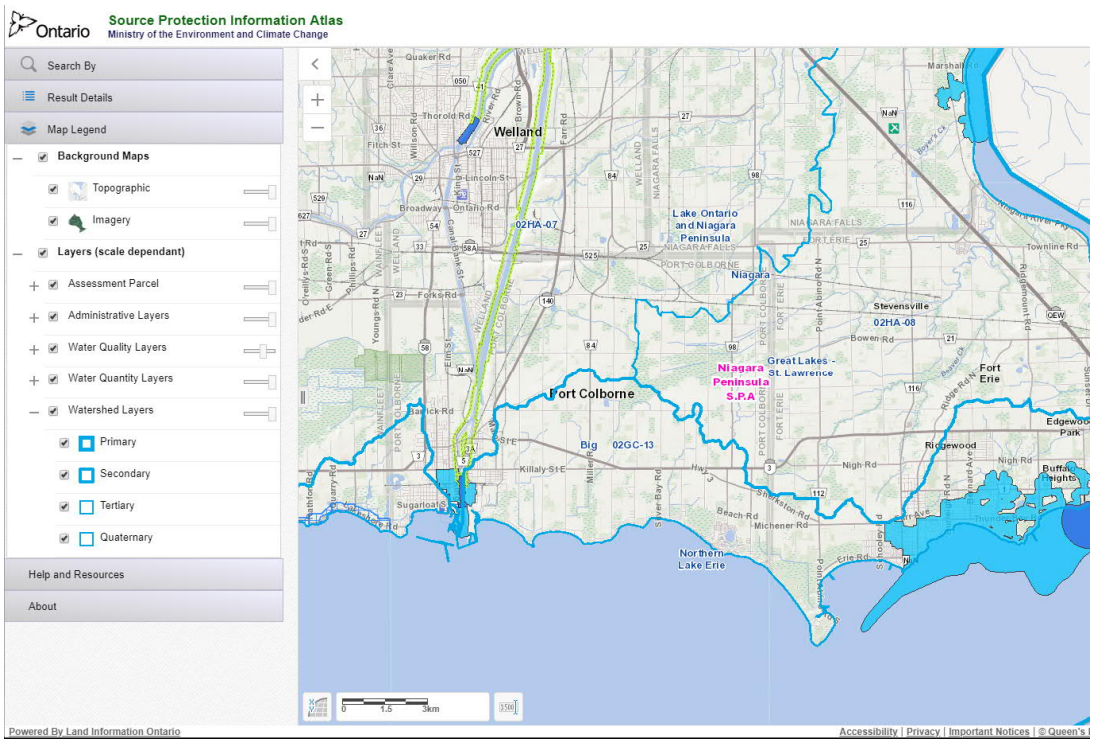


Figure 29 MOECC Source Protection Atlas - Watersheds

The following figure shows highly vulnerable aquifers.

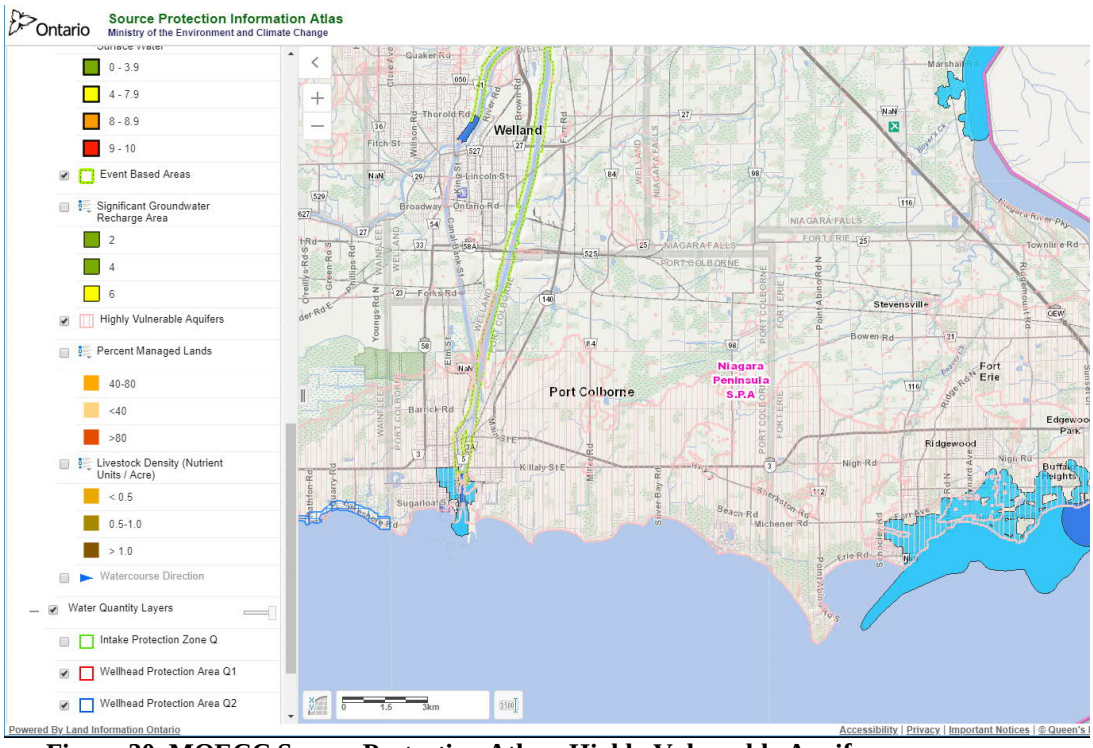


Figure 30 MOECC Source Protection Atlas - Highly Vulnerable Aquifers

The following figure shows the livestock density (Nutrient Units/ Acre)

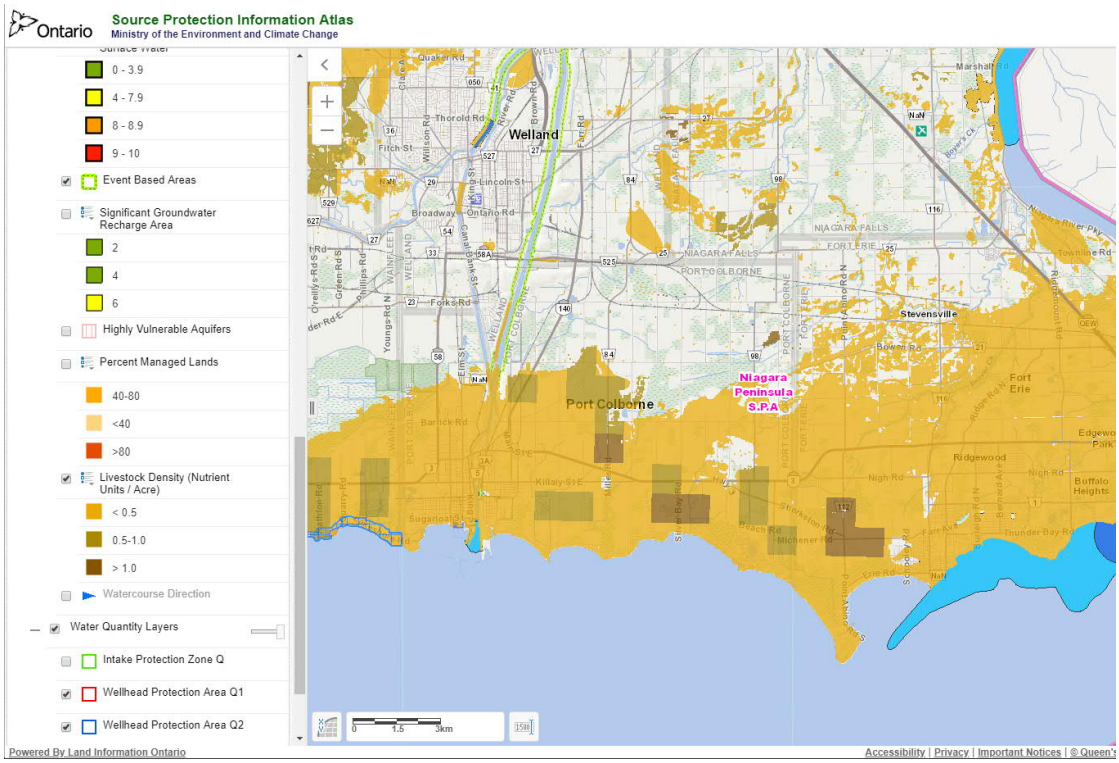
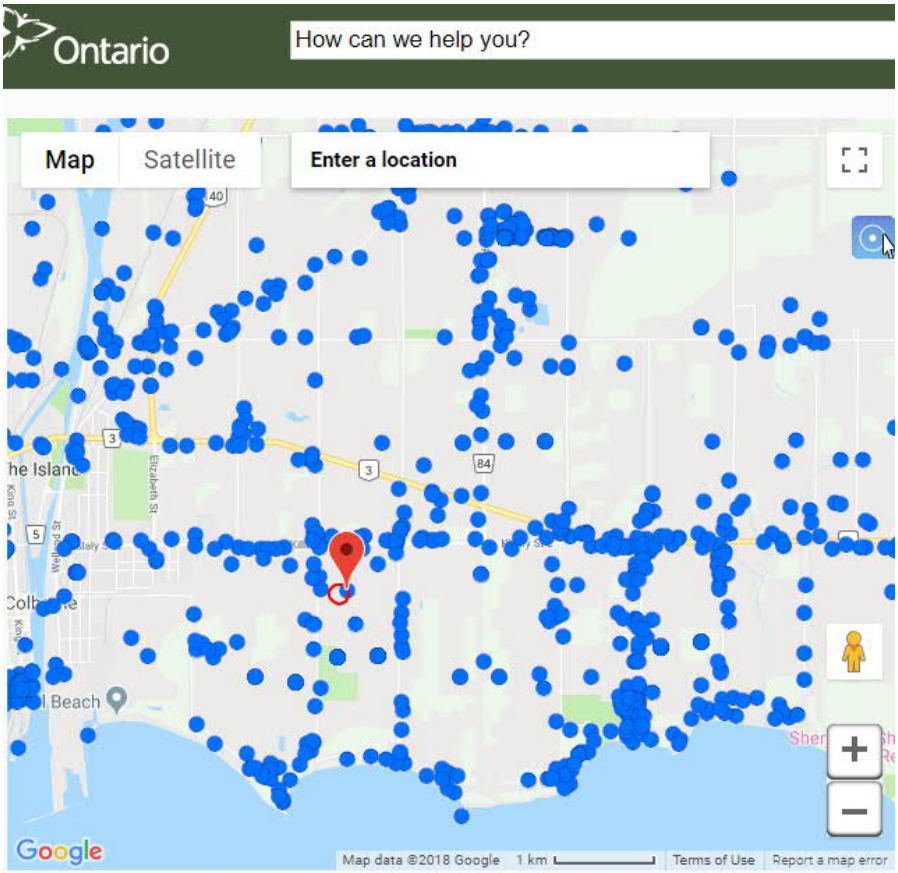


Figure 31 MOECC Source Protection Atlas - Livestock Density

From this information and from previously expressed issues around conveyance of nutrients to the Lorraine Bay by the municipal drains, there is a potential concern that should be considered during the design period of the drain improvement. The drain can be engineered to reduce or mitigate the potential negative influences that can occur within the watershed through a variety of hydrologic and hydraulic techniques; however, the best technique is to address at the source.

There are new regulations around the use of excess soil and at risk considerations for use of soils that may be contaminated. Review of the requirements and incorporation of measures into specifications for implementation by the contractor will be addressed in the Engineer's report.

The following figure shows the placement of water well records within the area of drains.



Latitude:42.87811, Longitude:-79.15212 (UTM Zone:17, Easting:650917, Northing:4748935)

Show 100 entries Search:

Well ID	Well Record Information	Well Tag # (since 2003)	Audit #	Contractor Lic#	Well Depth (m)	Date of Completion (MM/DD/YYYY)
6604018	PDF|HTML	N/A	108562	4795	9.8	08/13/1991

Figure 32 Water Well Records

A more detailed analysis of water well records will be conducted during the Hydrologic and Hydraulic analysis; however, the presence of the overlying limestone series Onondaga, that is above a rock series that is very low permeability along with the parent soil material of predominately clay suggests that interactions with local municipal drains are unlikely to be a consideration for negative groundwater effects.

3.3.6 Conservation Authority

Niagara Peninsula Conservation Authority provides control through regulated authority on a variety of environmental areas including the following;

- Wetlands; designated or not.
- Watercourses; including shorelines of the Great Lakes and inland lakes.
- Regulated areas adjacent to wetlands and watercourses.
- Hazardous lands, and
- Other areas that could interfere with the hydrologic function of the wetland.

3.3.7 Cultural Heritage Resources

The drains already exist and cultural heritage impacts may have already been affected by past construction activities. Where a drain is to be moved on to a new path, then a pre-construction investigation will be conducted prior to the start of construction.

During construction in the event that specific artifacts are uncovered by excavation or other works, then a qualified person will be contacted, attend the site and make a determination of the potential significance along with recommending specific measures to continue construction.

3.4 Stakeholders

All ratepayers within the watershed are stakeholders. Additional interests as potential stakeholders as discussed in the following sections.

3.4.1 Navigable Waters

Under the revised legislation, Navigation Protection Act, 1985 (2012 amendments).

The Beaver Dam drain is not listed and specific approval for the works is not considered required with the exception of the outlets to the Lake Erie. Works in and around the Beaver Dam outlet may require application for approval under the Minor Works Order. As regular mechanical maintenance is required to keep the outlet free flowing a standing Minor Work Order should already be in place and a review of this requirement will be referenced under the maintenance section of the Engineer's Report.

3.4.2 Ministry of Transportation

Where drainage works are within an MTO right of way, then an Encroachment permit will be sought.

All work conducted in and around rights of way is to follow the MTO's Book 7 Ontario Traffic Manual – Temporary Conditions to ensure the safety of right of way users during construction.

Received correspondence from Nader Mikhail, P.Eng. of AIA Engineers
April 29, 2019

> RE: GWP 2374-15-00: Rehab/Replacement of Structures on Hwy 3, 58 and 140 - City of Port Colborne Works
> Good morning Alana,
> Yes, it is in MTO scope to replace the culvert at Site 10-331/C with similar size culvert or larger.
> The plan to replace this culvert in summer 2021.

Further correspondence indicated a replacement size.

> We got an update from our structural engineer, the new size is precast 5x1.650 m.
> Thanks.

And,

> The inside opening of the culvert is 5m x 1.65m.
> The proposed culvert is to be embedded by 0.3m.
> No internal culvert channel shaping has been considered.

An email was sent to Mr. Mikhail suggesting that the grade could be lowered through the Highway #3 culvert with a net benefit in overall grade from a South Limit of Friendship Trail and a north limit of the Second Concession. The following figure shows the identified improved grade change.

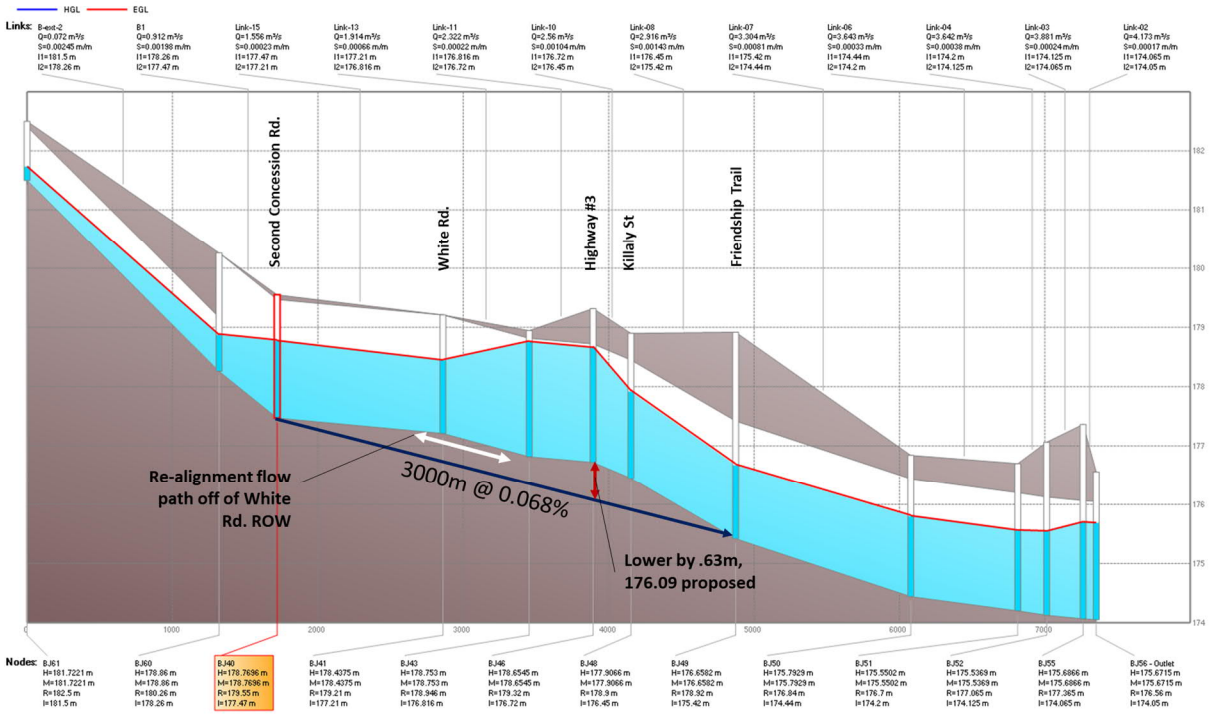


Figure 33 MTO Grade line Option at HWY #3

To date, there's not been a response from the MTO.

As of August 6, 2019 an email and phone exchange with the MTO consultants hired to design the replacement culvert has occurred. MTO is planning to replace the culvert in 2020.

3.4.3 Potential Utility Conflicts

Utility companies operating in the area were contacted by Amec Foster Wheeler and provided with two maps showing the extent of the works likely to occur with Wignell, Port Colborne and Michener Drains and with the Beaver Dam Drain. They responded with Markup plans indicating where potential conflicts may exist. This information will be carried forward and shown on the design drawings. It will be the contractor's responsibility to obtain locates of existing buried infrastructure and to ensure that all required measures to ensure existing infrastructure is protected and not disturbed or disrupted during construction.

3.5 Drainage Needs

Maintenance Activities Performed Under an Existing Engineer's Report may include:

- Brushing of banks
- Bottom cleanout of sediment
- Culvert repairs
- Erosion control
- Catch basin repairs
- Tile flushing

Construction Activities Requiring an Engineer's Report may include:

- Construction of new tile drains
- Construction of new culverts
- Realignment of open ditches
- Wetland restoration projects
- Excavation and brushing of open ditches

The opportunity to add water quality control features as part of the drain should be investigated and assessed where ever the opportunity is identified. Where such features may require future maintenance, such as sedimentation basins, the Engineer's report is to be explicit on frequency and trigger points for maintenance activities.

The following are descriptions of specific needs to resolve for the Beaver Dam Drain:

1. Repair or reconfiguration of the former culvert crossing the Miller Road allowance. This should be combined with a possible re-grading of the channel to lower the rock outcrop to improve overall slope in the middle section of the drain.

2. Recognize the former James Craig Agreement Drain as a Branch Drain of the Beaver Dam Drain. This is referred to as former as the original drain does not appear to have a functioning conveyance in evidence nor are any of the original agreement signatories present. This will also require a clearing of brush and re-grade to design gradeline.

3. Recognize the existing David Michener Award Drain as a Branch Drain of the Beaver Dam Drain. This requires signed petitions from half of the landowners and recognising 60% of the catchmet.

4. Re-Align Beaver Dam Drain along White's Road south of Second Concession Rd. to gain space between the road edge and the drain. This may involve re-alignment of the drain to the East.

5. Extend the East Branch Drain to Brookfield Rd. to provide an outlet for Culvert CS-103. This will require a Section 4 Drain Report based on a petition from the road authority in this case City of Port Colborne.

6. Extend the Beaver Dam Main Drain North and West to provide outlet for the White Road Culvert CS-105. This will require a Section 4 Drain Report based on a petition from the relevant road authority in this case City of Port Colborne.

7. The addition of a water quality improvement feature located south of the Second Concession Rd. crossing B-CS-07 is to be considered in the Drain Report and a design provided.

8. Additional Sediment basins to be considered for implementation where appropriate.

9. The existing Cast in Place arch concrete structure proposed as Branch Drain #1 is not yet determined as to how to petition it as a branch drain. It should be flushed with a flusher truck and a CCTV inspection conducted to evaluate the condition of the drain structure prior to inclusion as a Branch Drain and assessed to upstream owners.

10. Other Branch Drains to be assessed where a petition is provided.

11. The pumping arrangement for the Beaver Dam drain is to be assessed and an Operation and Maintenance program implemented in the drain report for adoption by the City of Port Colborne. This is to include operating procedures and policies for both pumping and operation of the gate structure. As assessment of the max flow through the gate structure is required.

4 Interim Drainage Works

The following improvements were undertaken by the City of Port Colborne and are to be recognized by the Beaver Dam Drain Engineer's report.

4.1 Emergency works

The City engaged in emergency works to remove culvert collapse on Beaver Dam Drain at Friendship / Miller Road ROW crossing. At present the removed culvert remains as an open channel with no functional crossing as the ROW is not a constructed road through the Road Allowance.

4.2 Drain Channel Maintenance STA 4+000 to 5+500

Channel was brushed and had basic bottom grading work done as evidenced in the following images. The first image shows a spoil pile adjacent to the drain from the removed material (no trucking)

Figure 34 Beaver Dam Maintenance STA 5+260 Upstream

Figure 35 Brushing Beaver Dam STA 4+160 Upstream

The works were completed as evidenced by the photos in 2009.

4.3 Outlet Maintenance Works

The outlet is subject to lake littoral drift and requires maintenance to remove the sediment from forming a sand bar obstructing the flow to the lake.

This has occurred in the past and is to be allocated as a cost using the appropriate schedule.

5 Beaver Dam Drain Baseline Summary

The Beaver Dam Drain continues to function and provide service to the residents and businesses within the watershed; however, these services are currently compromised or performing below desired service levels.

1. A ditch grade line survey of the existing drain is recommended in the following sections identified in the Map attached to Appendix B. The survey is to establish drain cross-sections from minus 5m to Top of Bank through the ditch and to +5m past the top of bank on a 25m interval minimum.
    a. James Craig Agreement Drain
    b. Existing and Proposed areas of Beaver Dam Drain along White Rd.
    c. Area south of Second Concession proposed for water quality feature.
    d. Area of the Friendship Trail
    e. Area of the East Branch Drain extension.
    f. Drain extension out of the Humberstone marsh to the West for culvert on White Road

2. It is recommended that the drain capacity be modelled and assessed for adequate capacity and to model specific aspects of water quality. The model should include aspects of stage discharge relationships for all storage elements within the watershed such as ponds but also for culverts across roads that restrict flows and create impoundments of water behind them.

3. The following are Section 4 improvements identified through petition by the relevant road authority.

    a. Extending East Branch Drain to the new culvert installed crossing Brookfield Rd.

    b. Extending Beaver Dam Drain to the North and West to serve a culvert crossing White Road. This requires the drain to cross a farm field, which appears to occur now as a surface runoff feature that is not well defined.

    c. The James Craig agreement drain is to be converted to a branch drain by Section 4 improvement request by the Road Authority for the culvert located on Sherk Rd.

4. The following are Section 4 improvements that will require 50% of property owners to sign a petition for drainage improvements and conversion of existing channels to branch drains of the Beaver Dam Drain.

    a. Beaver Dam Branch Drain #1
    services Firelane #2, which is identified as a private road. This may be a challenge to the Section 4 improvement request by the City of Port Colborne.

b. An existing channel flows from the West north of Firelane #1 but there's no petition to establish it as a branch drain and the Lorraine Road culvert is considered to flow to the Michener. To be discussed and potential petition for improvement with local landowners.

c. The existing David Michener Award Drain is recommended to be converted to a branch drain for conducting maintenance. A separate option to be discussed to convert the existing open channel drain to a closed conduit branch drain.

5. Other existing channels can be converted to branch drains on an as requested and with the required petition minimum threshold requirements under the Act.

6. A Technical Memo, fulfilling the requirements for a Pre-liminary Design Report assessing the options for the Miller Road Drain re-location is to be prepared and presented to the local ratepayers after review and approval by the City of Port Colborne.

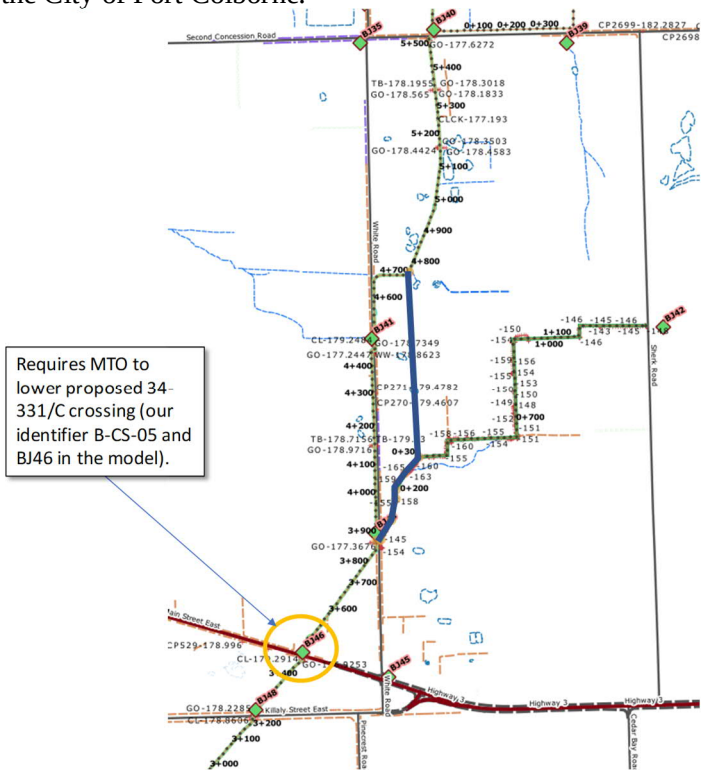


Figure 36 Beaver Dam Re-Alignment Options

7. The identified preferred alternative, based on the baseline review of available documentation, is a drain improvement project by Section 78; Improving, upon examination and report of engineer for the Beaver Dam Drain.

8. It is recommended the Baseline Report including the Preliminary Plan & Profile drawings be circulated for comment to the relevant authorities;

    a. DFO, Drain Class A – C, E authorization for maintenance and repair

    b. MNR, Species At Risk review

    c. NPCA, Habitat assessment and stream quality improvement recommendations, section 28 of CAA. Regulated Areas review.

    d. MTO, proposed crossing of Highway 3 for replacement by precast culvert in 2020.

        i. This culvert is currently limiting the grade line on elevations to the north as far as the Second Concession Rd. It is recommended that any new culvert be installed as deep as possible to allow for future lowering options that improve the grade line upstream be considered.
        (see Figure 33 MTO Grade line Option at HWY #3)

9. Replacement of original two culverts at Friendship Trail be considered for one culvert crossing using a pre-cast culvert.

    a. A technical memo to study the use of this culvert in concert with gates or other means of flow control to optimize flow through this culvert with storage in upstream areas is recommended.

10. Conduct a review of Water Quality potential impacts from upstream land uses and identify potential areas for quality improvement projects to be considered in the Hydrology and Hydraulics report of the Beaver Dam watershed

11. Existing Gate Structure and pumping arrangement is functioning, and improvements were not identified in the Assessment report. It's recommended to develop a long term maintenance plan for inclusion in the Assessment portion of the Drain report.

    a. The continued use of a tractor as the power source for the pump is recommended for investigation and consider options to replace the tractor as a source of power. This investigation should conclude with a technical memo to provide a preferred option.
    The TM should look at the options for stationary power vs. continued use a tractor as power along with environmental costs, social costs and costs to the drain.

Appendix B:

Beaverdam Drain Drawings and Figures

City of Port Colborne
Beaverdam Drain ~~Dam~~ Pump Station Photos

Beaverdam Drain ~~Dam~~ Pump Station

Inspected Area	Photo	Comments & Recommendations
STRUCTURAL		
1. Dam Grating - North Side		Good condition.
2. Dam Grating - South Side		Dam structure appears to be in good condition.

Inspected Area	Photo	Comments & Recommendations
3. Channel wall structure - North side		Wall structure appears to be in good condition
ELECTRICAL		
1. Hydro power transformer		Hydro pole and transformer are in reasonably good condition. Hydro feeds the structure lighting only.
MECHANICAL		

Inspected Area	Photo	Comments & Recommendations
1. Mechanical pump structure		The structure is in good condition. Mechanical pump is functional and in reasonably good condition.
2. Well pump discharge piping & walkway		The discharge piping appears to be generally functional and in good condition. The steps structure and walkway are mounted on an angle that could potentially carry a trip hazard. We recommend further investigation to determine if repairs are ~~is~~ required.

Inspected Area	Photo	Comments & Recommendations
3. Dam gate mechanism		The gates and hoist mechanism ~~is~~ are in reasonably good condition.

BEAVERDAM DRAIN

NOTES:

1. DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED
2. CATCHMENT BOUNDARIES ARE BASED ON THE NPCA DIGITAL ELEVATION MODEL (DEM) 2010
3. SPECIFIC POINTS IN THE SURFACE ARE BASED ON THE FOLLOWING SURVEYS:
   - DRAIN CROSSINGS & SPOT CHANNELS AMEC SURVEY, 2013
   - SUPPLEMENTARY SURVEY BY CofPC, 2018
   - WEIBE ENGINEERING SURVEY, 2008

BENCHMARK INFORMATION:

- 0+000 BEAVERDAM

PLAN VIEW LEGEND:

- DRAINAGE AREA BOUNDARY
- DRAIN CENTERLINE
- PROPOSED DRAIN CENTERLINE
- 0+000 DRAIN CHAINAGE
- X.SD-02 SITE SPECIFIC DETAIL I.D.
- BOUNDARY OF AREA CAPTURED IN SITE DETAIL
- DRAINAGE WORK PROPOSED
- *DRAINAGE WORK COMPLETED – TO BE ASSESSED*

NO.	REVISION DESCRIPTION	DATE
1	ISSUED FOR BASELINE REPORT	MAY 2019

BEAVERDAM DRAIN PLAN

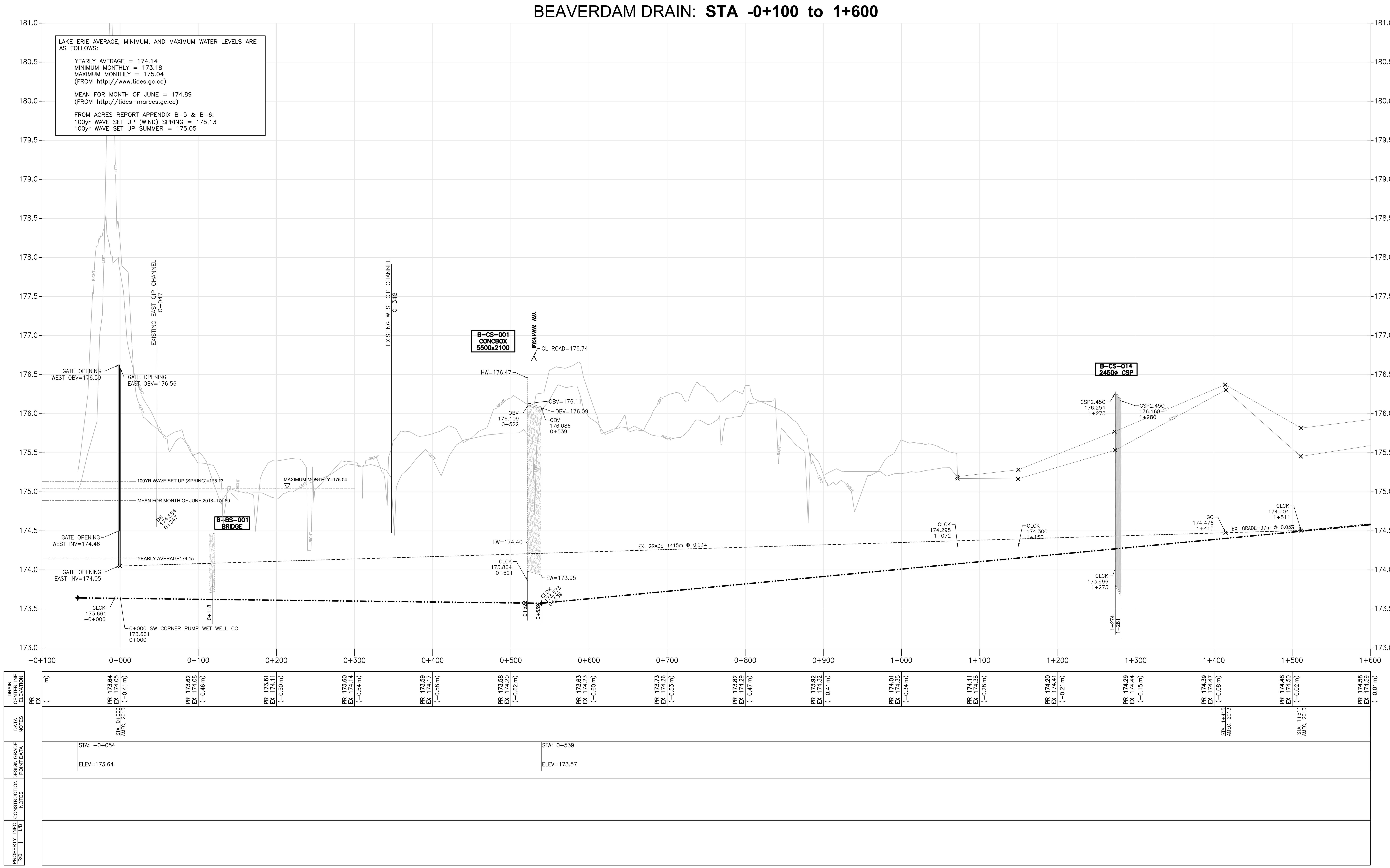
Paul C. Marsh, P.Eng. Principal Engineer
EWA Engineering Inc.
84 Main Street, Unionville, Ontario
L3R 2E7
647.400.2824 **www.ewaeng.com**

Automated Engineering Technologies Ltd.
91A Duke Street , Guelph, Ontario N1E 5L1 (519)821-8644
397 Romeo Street S., Stratford, ON, N5A 4V1 (519)273-9318 WEB: www.autoengtech.on.ca

City of Port Colborne

Beaverdam Municipal Drain

DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
DAC	PCM	183927	B.PLAN
DESIGNED BY :	DATE :	SCALE :	
PCM	31–May–19	F.T.P.	



NOTES:

1. DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED
2. CATCHMENT BOUNDARIES ARE BASED ON THE NPCA DIGITAL ELEVATION MODEL (DEM) 2010
3. SPECIFIC POINTS IN THE SURFACE ARE BASED ON THE FOLLOWING SURVEYS:
   - DRAIN CROSSINGS & SPOT CHANNELS AMEC SURVEY, 2013
   - AS CONSTRUCTED SURVEY BY CofPC, 2016 STATION 0+000-1+940
   - SUPPLEMENTARY SURVEY BY CofPC, 2018
   - WEIBE ENGINEERING SURVEY, 2008

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.

BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR ANY DAMAGE DONE TO THEM.

SPATIAL DATA:

DTM DATA FROM NIAGARA PENINSULA CONSERVATION AUTHORITY

- HORIZONTAL DATUM: UTM NAD83-CSRS ZONE 17N
- VERTICAL DATUM: CGVD28-1978
- ACCURACY: ABSOLUTE HORIZONTAL AND VERTICAL POSITIONAL ACCURACIES OF ±0.5m

LEGEND

- EXISTING DITCH BOTTOM (NPCA DEM DATA)
- EXISTING DITCH BOTTOM (SURVEYED)
- HISTORICAL GRADELINE
- PROPOSED DRAIN GRADELINE-EWA, 2018
- LEFT BANK
- RIGHT BANK
- EXISTING DRAIN SECTION
- EXISTING STRUCTURE DETAILS
- ASSUMED EXISTING STRUCTURE DETAILS
- OBV=175.00 — EXISTING DRAIN ELEVATION
- 175.00 PR. — PROPOSED DRAIN CENTERLINE ELEVATION
- 175.00 EX. — PORPOSED DRAIN ELEVATION (WHERE MATCHES EXISTING ELEVATION)
- DATA POINT FROM HISTORICAL DESIGN GRADELINE RVA, 1979

NO.	REVISION DESCRIPTION	DATE
1	ISSUED FOR BASELINE REPORT	MAY 2019

BEAVERDAM MUNICIPAL DRAIN PROFILE

CITY OF PORT COLBORNE

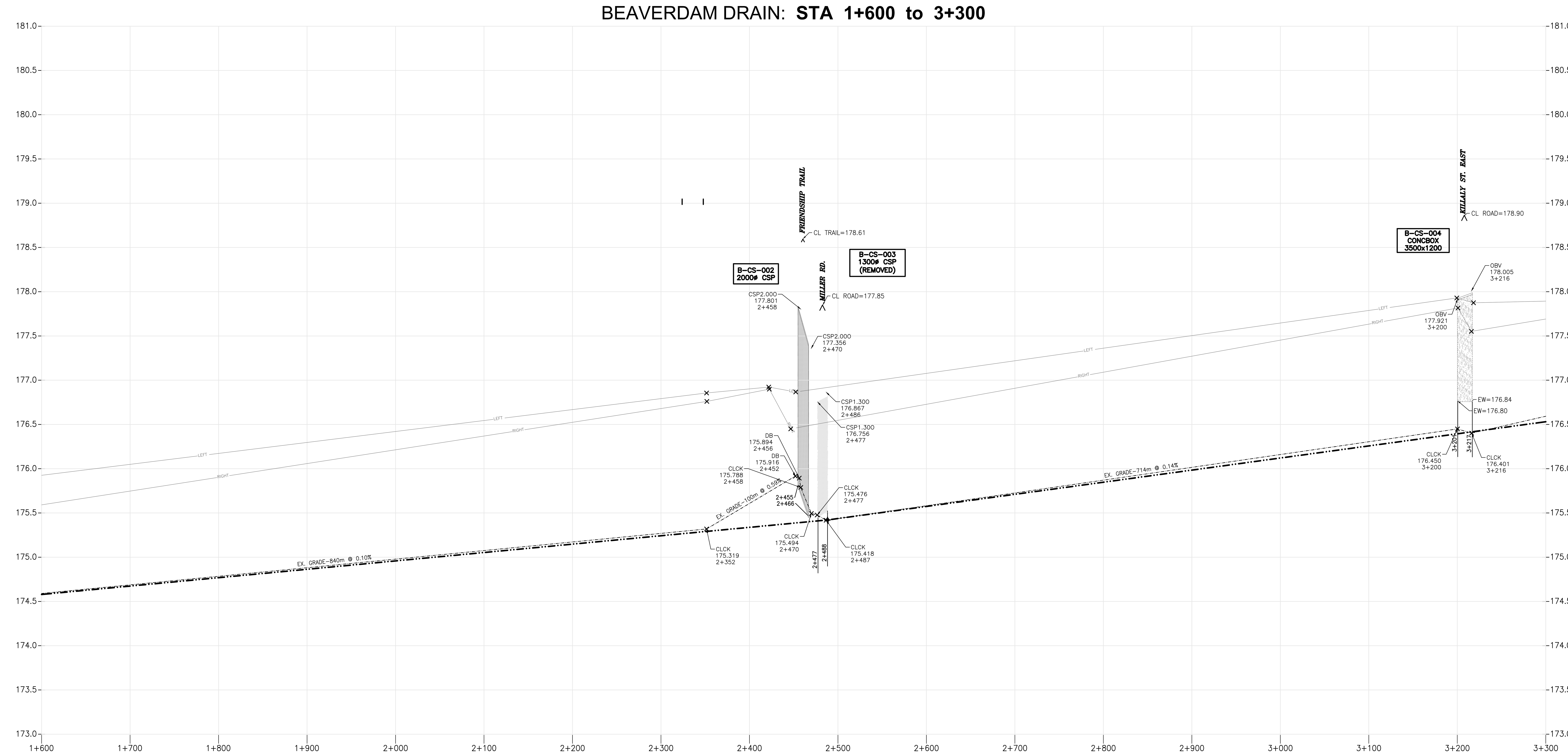
PORT COLBORNE

Paul C. Marsh, P.Eng. Principal Engineer
EWA Engineering Inc.
84 Main Street, Unionville, Ontario
L3R 2E7
647.400.2824
www.ewaeng.com

Automated Engineering Technologies Ltd.
91A Duke Street, Guelph, Ontario N1E 5L1 (519)821-8644
397 Romeo Street S., Stratford, ON, N5A 4V1 (519)273-9318 WEB: www.autoengtech.on.ca

DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
DAC	PCM	-	B.P1
DESIGNED BY :	DATE :	SCALE :	
PCM	3-Jun-19	H=1:2500 V=1:25	

BEAVERDAM DRAIN: STA 1+600 to 3+300



	1+600	1+700	1+800	1+900	2+000	2+100	2+200	2+300	2+400	2+500	2+600	2+700	2+800	2+900	3+000	3+100	3+200	3+300
DRAIN CENTERLINE ELEVATION	PR 174.58 EX 174.59 (−0.01 m)	PR 174.67 EX 174.69 (−0.01 m)	PR 174.77 EX 174.78 (−0.02 m)	PR 174.86 EX 174.88 (−0.02 m)	PR 174.96 EX 174.98 (−0.02 m)	PR 175.05 EX 175.08 (−0.02 m)	PR 175.15 EX 175.17 (−0.02 m)	PR 175.24 EX 175.27 (−0.03 m)	PR 175.34 EX 175.61 (−0.27 m)	PR 175.44 EX 175.44 (0.00 m)	PR 175.57 EX 175.58 (−0.01 m)	PR 175.71 EX 175.73 (−0.02 m)	PR 175.85 EX 175.87 (−0.02 m)	PR 175.98 EX 176.02 (−0.03 m)	PR 176.12 EX 176.16 (−0.04 m)	PR 176.26 EX 176.30 (−0.05 m)	PR 176.39 EX 176.45 (−0.06 m)	PR 176.53 EX 176.59 (−0.06 m)
DATA NOTES								STA. 2+352 AMEC, 2013	STA. 2+452 AMEC, 2013; STA. 2+487 AMEC, 2013								STA. 3+200 AMEC, 2013; STA. 3+216 AMEC, 2013	
DESIGN GRADE POINT DATA										STA: 2+488 ELEV=175.42								
CONSTRUCTION NOTES																		
PROPERTY INFO. L/B R/B																		

NOTES:

1. DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED
2. CATCHMENT BOUNDARIES ARE BASED ON THE NPCA DIGITAL ELEVATION MODEL (DEM) 2010
3. SPECIFIC POINTS IN THE SURFACE ARE BASED ON THE FOLLOWING SURVEYS:
   - DRAIN CROSSINGS & SPOT CHANNELS AMEC SURVEY, 2013
   - AS CONSTRUCTED SURVEY BY CofPC, 2016 STATION 0+000–1+940
   - SUPPLEMENTARY SURVEY BY CofPC, 2018
   - WEIBE ENGINEERING SURVEY, 2008

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.

BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR ANY DAMAGE DONE TO THEM.

SPATIAL DATA:

DTM DATA FROM NIAGARA PENINSULA CONSERVATION AUTHORITY

- HORIZONTAL DATUM: UTM NAD83–CSRS ZONE 17N
- VERTICAL DATUM: CGVD28–1978
- ACCURACY: ABSOLUTE HORIZONTAL AND VERTICAL POSITIONAL ACCURACIES OF ±0.5m

LEGEND

- EXISTING DITCH BOTTOM (NPCA DEM DATA)
- EXISTING DITCH BOTTOM (SURVEYED)
- HISTORICAL GRADELINE
- PROPOSED DRAIN GRADELINE–EWA, 2018
- LEFT BANK
- RIGHT BANK
- EXISTING DRAIN SECTION
- EXISTING STRUCTURE DETAILS
- ASSUMED EXISTING STRUCTURE DETAILS
- OBV=175.00 — EXISTING DRAIN ELEVATION
- 175.00 PR. — PROPOSED DRAIN CENTERLINE ELEVATION
- 175.00 EX. — PORPOSED DRAIN ELEVATION (WHERE MATCHES EXISTING ELEVATION)
- DATA POINT FROM HISTORICAL DESIGN GRADELINE RVA, 1979

NO.	REVISION DESCRIPTION	DATE
1	ISSUED FOR BASELINE REPORT	MAY 2019

BEAVERDAM MUNICIPAL DRAIN PROFILE

CITY OF PORT COLBORNE

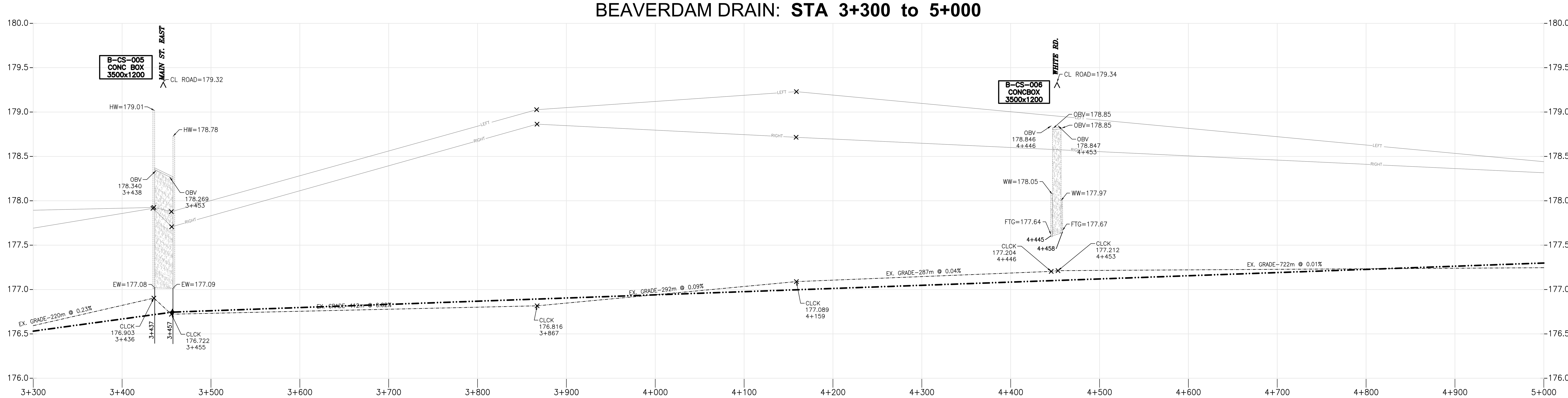
PORT COLBORNE

Paul C. Marsh, P.Eng. Principal Engineer
EWA Engineering Inc.
84 Main Street, Unionville, Ontario
L3R 2E7
647.400.2824 www.ewaeng.com

Automated Engineering Technologies Ltd.
91A Duke Street, Guelph, Ontario N1E 5L1 (519)821-8644
397 Romeo Street S., Stratford, ON, N5A 4V1 (519)273-9318 WEB: www.autoengtech.on.ca

DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
DAC	PCM	–	B.P2
DESIGNED BY :	DATE :	SCALE :	
PCM	31–May–19	H=1:2500 V=1:25	

BEAVERDAM DRAIN: **STA 3+300 to 5+000**



Station	Drain Centerline Elevation PR	EX	Difference
3+300	176.53	176.59	(-0.06 m)
3+400	176.67	176.82	(-0.15 m)
3+500	176.76	176.73	(0.03 m)
3+600	176.80	176.75	(0.04 m)
3+700	176.83	176.78	(0.05 m)
3+800	176.87	176.80	(0.07 m)
3+900	176.90	176.85	(0.06 m)
4+000	176.94	176.94	(0.00 m)
4+100	176.98	177.03	(-0.06 m)
4+200	177.01	177.11	(-0.09 m)
4+300	177.05	177.15	(-0.10 m)
4+400	177.08	177.19	(-0.10 m)
4+500	177.12	177.22	(-0.10 m)
4+600	177.15	177.22	(-0.07 m)
4+700	177.19	177.23	(-0.04 m)
4+800	177.23	177.23	(-0.01 m)
4+900	177.26	177.24	(0.02 m)
5+000	177.30	177.25	(0.05 m)

DATA NOTES: STA. 3+436 AMEC, 2013; STA. 3+455 AMEC, 2013; STA. 3+867 AMEC, 2013; STA. 4+159 AMEC, 2013; STA. 4+446 AMEC, 2013; STA. 4+453 AMEC, 2013

DESIGN GRADE POINT DATA: STA: 3+457 ELEV=176.75

CONSTRUCTION NOTES

PROPERTY INFO. R/B | L/B

NOTES:

1. DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED
2. CATCHMENT BOUNDARIES ARE BASED ON THE NPCA DIGITAL ELEVATION MODEL (DEM) 2010
3. SPECIFIC POINTS IN THE SURFACE ARE BASED ON THE FOLLOWING SURVEYS:
   - DRAIN CROSSINGS & SPOT CHANNELS AMEC SURVEY, 2013
   - AS CONSTRUCTED SURVEY BY CofPC, 2016 STATION 0+000-1+940
   - SUPPLEMENTARY SURVEY BY CofPC, 2018
   - WEIBE ENGINEERING SURVEY, 2008

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.

BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR ANY DAMAGE DONE TO THEM.

SPATIAL DATA:

DTM DATA FROM NIAGARA PENINSULA CONSERVATION AUTHORITY

- HORIZONTAL DATUM: UTM NAD83-CSRS ZONE 17N
- VERTICAL DATUM: CGVD28-1978
- ACCURACY: ABSOLUTE HORIZONTAL AND VERTICAL POSITIONAL ACCURACIES OF ±0.5m

LEGEND

Symbol	Description
	EXISTING DITCH BOTTOM (NPCA DEM DATA)
	EXISTING DITCH BOTTOM (SURVEYED)
	HISTORICAL GRADELINE
	PROPOSED DRAIN GRADELINE-EWA, 2018
LEFT	LEFT BANK
RIGHT	RIGHT BANK
	EXISTING DRAIN SECTION
	EXISTING STRUCTURE DETAILS
	ASSUMED EXISTING STRUCTURE DETAILS
OBV=175.00	EXISTING DRAIN ELEVATION
175.00 PR.	PROPOSED DRAIN CENTERLINE ELEVATION
175.00 EX.	PORPOSED DRAIN ELEVATION (WHERE MATCHES EXISTING ELEVATION)
	DATA POINT FROM HISTORICAL DESIGN GRADELINE RVA, 1979

NO.	REVISION DESCRIPTION	DATE
1	ISSUED FOR BASELINE REPORT	MAY 2019

BEAVERDAM MUNICIPAL DRAIN PROFILE

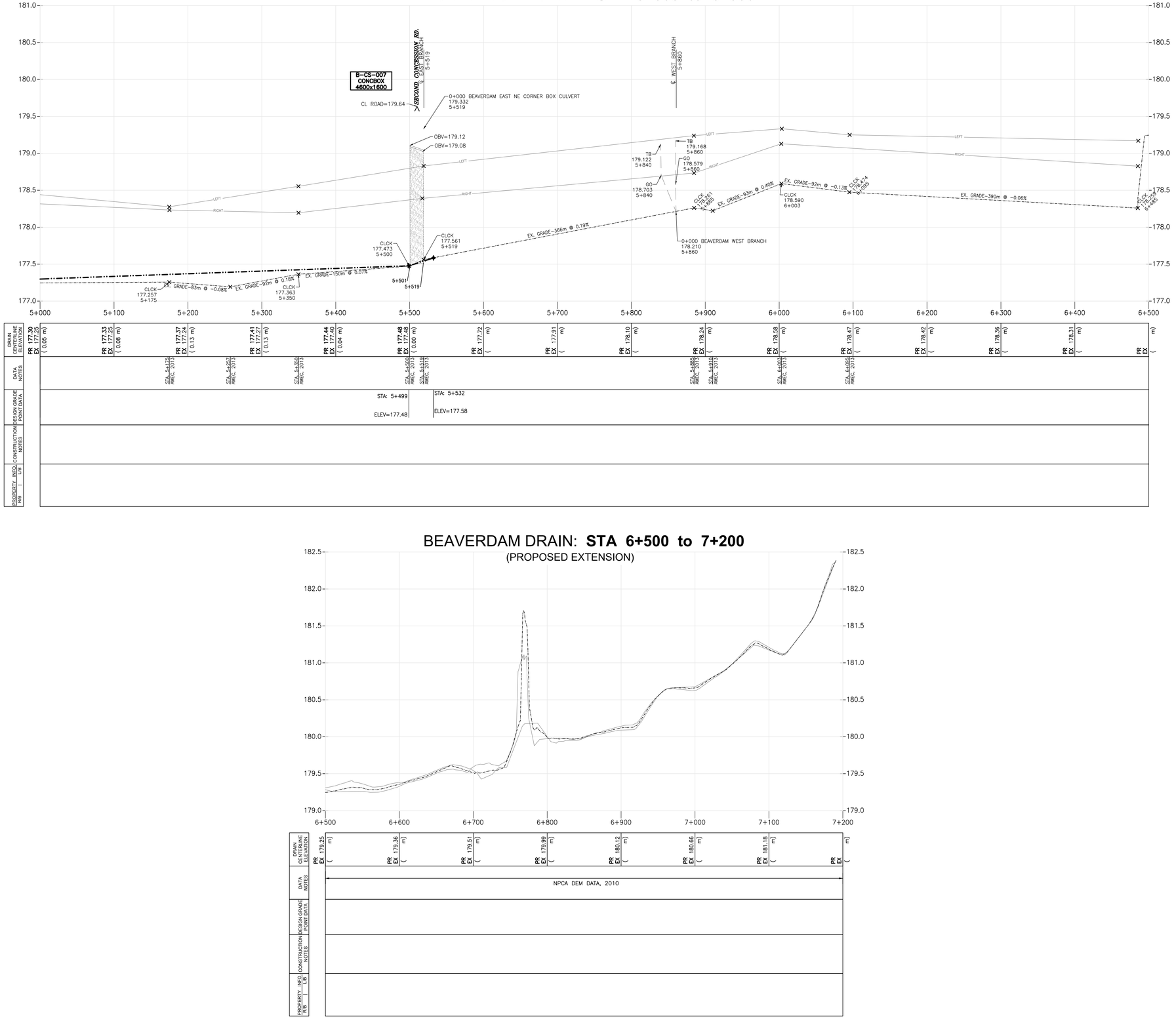
CITY OF PORT COLBORNE

Paul C. Marsh, P.Eng. Principal Engineer
EWA Engineering Inc.
84 Main Street, Unionville, Ontario
L3R 2E7
647.400.2824 **www.ewaeng.com**

Automated Engineering Technologies Ltd.
91A Duke Street , Guelph, Ontario N1E 5L1 (519)821-8644
397 Romeo Street S., Stratford, ON, N5A 4V1 (519)273-9318 WEB: www.autoengtech.on.ca

DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
DAC	PCM	-	B.P3
DESIGNED BY :	DATE :	SCALE :	
PCM	31-May-19	H=1:2500 V=1:25	

BEAVERDAM DRAIN: **STA 5+000 to 6+500**



BEAVERDAM DRAIN: **STA 6+500 to 7+200**

(PROPOSED EXTENSION)

NOTES:

1. DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED
2. CATCHMENT BOUNDARIES ARE BASED ON THE NPCA DIGITAL ELEVATION MODEL (DEM) 2010
3. SPECIFIC POINTS IN THE SURFACE ARE BASED ON THE FOLLOWING SURVEYS:
   - DRAIN CROSSINGS & SPOT CHANNELS AMEC SURVEY, 2013
   - AS CONSTRUCTED SURVEY BY CofPC, 2016 STATION 0+000-1+940
   - SUPPLEMENTARY SURVEY BY CofPC, 2018
   - WEIBE ENGINEERING SURVEY, 2008

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.

BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR ANY DAMAGE DONE TO THEM.

SPATIAL DATA:

DTM DATA FROM NIAGARA PENINSULA CONSERVATION AUTHORITY

- HORIZONTAL DATUM: UTM NAD83-CSRS ZONE 17N
- VERTICAL DATUM: CGVD28-1978
- ACCURACY: ABSOLUTE HORIZONTAL AND VERTICAL POSITIONAL ACCURACIES OF ±0.5m

LEGEND

	EXISTING DITCH BOTTOM (NPCA DEM DATA)
	EXISTING DITCH BOTTOM (SURVEYED)
	HISTORICAL GRADELINE
	PROPOSED DRAIN GRADELINE-EWA, 2018
LEFT	LEFT BANK
RIGHT	RIGHT BANK
	EXISTING DRAIN SECTION
	EXISTING STRUCTURE DETAILS
	ASSUMED EXISTING STRUCTURE DETAILS
OBV=175.00	EXISTING DRAIN ELEVATION
175.00 PR.	PROPOSED DRAIN CENTERLINE ELEVATION
175.00 EX.	PORPOSED DRAIN ELEVATION (WHERE MATCHES EXISTING ELEVATION)
	DATA POINT FROM HISTORICAL DESIGN GRADELINE RVA, 1979

NO.	REVISION DESCRIPTION	DATE
1	ISSUED FOR BASELINE REPORT	MAY 2019

BEAVERDAM MUNICIPAL DRAIN PROFILE

CITY OF PORT COLBORNE

PORT COLBORNE

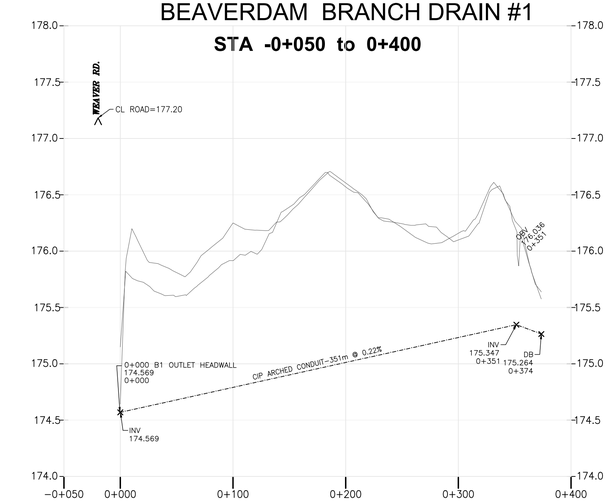
Paul C. Marsh, P.Eng. Principal Engineer
EWA Engineering Inc.
84 Main Street, Unionville, Ontario
L3R 2E7
647.400.2824 **www.ewaeng.com**

Automated Engineering Technologies Ltd.
91A Duke Street , Guelph, Ontario N1E 5L1 (519)821-8644
397 Romeo Street S., Stratford, ON, N5A 4V1 (519)273-9318 WEB: www.autoengtech.on.ca

DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
DAC	PCM	–	B.P4
DESIGNED BY :	DATE :	SCALE :	
PCM	31-May-19	H=1:2500 V=1:25	

BEAVERDAM BRANCH DRAIN #1

STA -0+050 to 0+400



DRAIN CENTRELINE ELEVATION	m)	PR EX (	PR 174.57 EX 174.57 (0.00 m)	PR 174.79 EX 174.79 (0.00 m)	PR 175.01 EX 175.01 (0.00 m)	PR 175.23 EX 175.23 (0.00 m)	PR EX (m)
DATA NOTES			STA -0+000 CofPC, 2018			STA 0+351 CofPC, 2018	STA 0+374 CofPC, 2018
DESIGN GRADE POINT DATA							
CONSTRUCTION NOTES							
PROPERTY INFO. RIB | LIB							

NOTES:

1. DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED
2. CATCHMENT BOUNDARIES ARE BASED ON THE NPCA DIGITAL ELEVATION MODEL (DEM) 2010
3. SPECIFIC POINTS IN THE SURFACE ARE BASED ON THE FOLLOWING SURVEYS:
   - DRAIN CROSSINGS & SPOT CHANNELS AMEC SURVEY, 2013
   - AS CONSTRUCTED SURVEY BY CofPC, 2016 STATION 0+000-1+940
   - SUPPLEMENTARY SURVEY BY CofPC, 2018
   - WEIBE ENGINEERING SURVEY, 2008

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.

BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR ANY DAMAGE DONE TO THEM.

SPATIAL DATA:

DTM DATA FROM NIAGARA PENINSULA CONSERVATION AUTHORITY

- HORIZONTAL DATUM: UTM NAD83-CSRS ZONE 17N
- VERTICAL DATUM: CGVD28-1978
- ACCURACY: ABSOLUTE HORIZONTAL AND VERTICAL POSITIONAL ACCURACIES OF ±0.5m

LEGEND

	EXISTING DITCH BOTTOM (NPCA DEM DATA)
	EXISTING DITCH BOTTOM (SURVEYED)
	HISTORICAL GRADELINE
	PROPOSED DRAIN GRADELINE-EWA, 2018
LEFT	LEFT BANK
RIGHT	RIGHT BANK
	EXISTING DRAIN SECTION
	EXISTING STRUCTURE DETAILS
	ASSUMED EXISTING STRUCTURE DETAILS
OBV=175.00	EXISTING DRAIN ELEVATION
175.00 PR.	PROPOSED DRAIN CENTERLINE ELEVATION
175.00 EX.	PORPOSED DRAIN ELEVATION (WHERE MATCHES EXISTING ELEVATION)
	DATA POINT FROM HISTORICAL DESIGN GRADELINE RVA, 1979

NO.	REVISION DESCRIPTION	DATE
1	ISSUED FOR BASELINE REPORT	MAY 2019

BEAVERDAM MUNICIPAL DRAIN PROFILE

PORT COLBORNE

CITY OF PORT COLBORNE

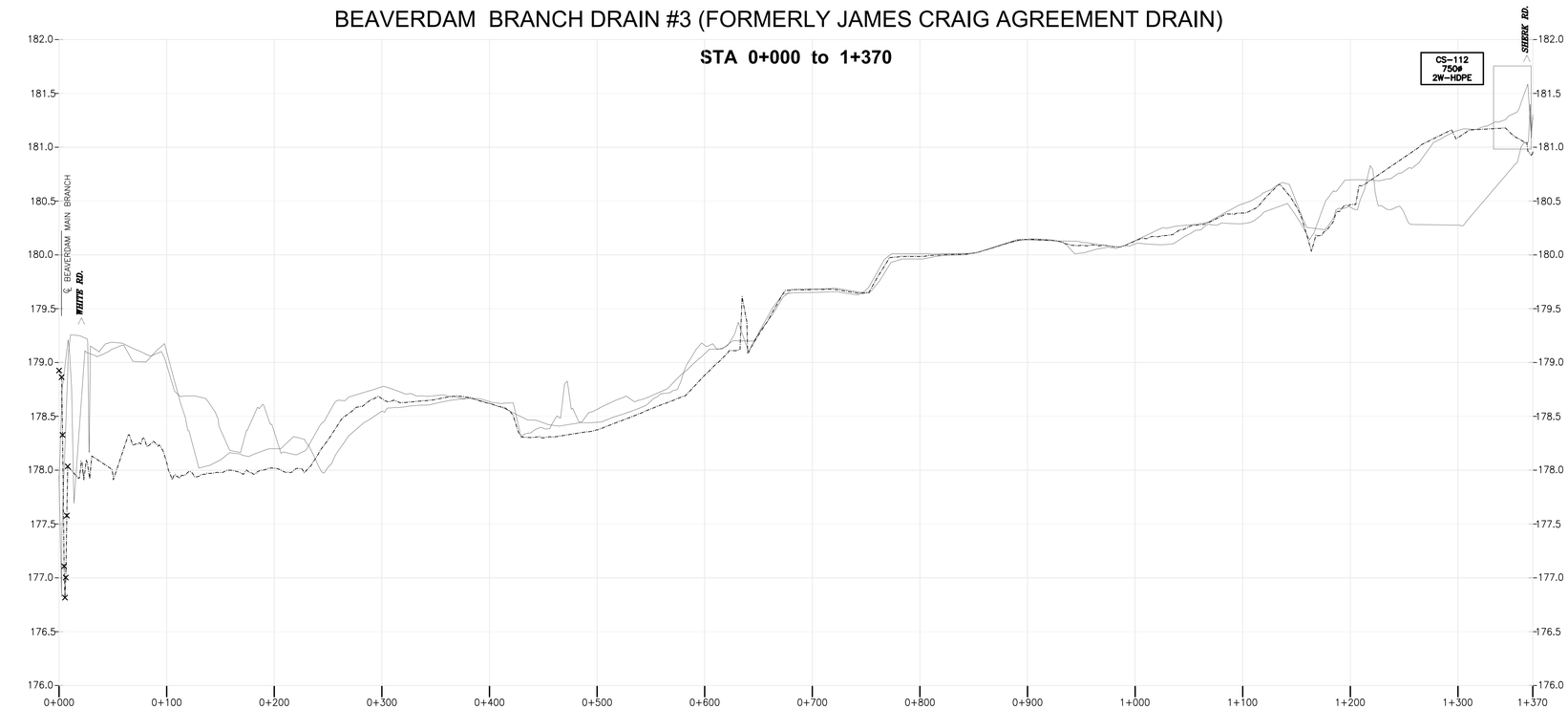
Paul C. Marsh, P.Eng. Principal Engineer
EWA Engineering Inc.
84 Main Street, Unionville, Ontario
L3R 2E7
647.400.2824 **www.ewaeng.com**

Automated Engineering Technologies Ltd.
91A Duke Street , Guelph, Ontario N1E 5L1 (519)821-8644
397 Romeo Street S., Stratford, ON, N5A 4V1 (519)273-9318 WEB: www.autoengtech.on.ca

DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
DAC	PCM	–	B.P5
DESIGNED BY :	DATE :	SCALE :	
PCM	31-May-19	H=1:2500 V=1:25	

BEAVERDAM BRANCH DRAIN #3 (FORMERLY JAMES CRAIG AGREEMENT DRAIN)

STA 0+000 to 1+370



		0+000	0+100	0+200	0+300	0+400	0+500	0+600	0+700	0+800	0+900	1+000	1+100	1+200	1+300	1+370
DRAIN CENTERLINE ELEVATION	PR		178.07	178.02	178.66	178.62	178.37	178.88	179.68	179.99	180.14	180.13	180.39	180.47	181.09	180.96
	EX.	(m)	178.07	178.02	178.66	178.62	178.37	178.88	179.68	179.99	180.14	180.13	180.39	180.47	181.03	180.96
			(0.00 m)	(0.00 m)	(0.00 m)	(0.00 m)	(0.00 m)	(0.00 m)	(0.00 m)	(0.00 m)	(0.00 m)	(0.00 m)	(0.00 m)	(0.00 m)	(0.00 m)	(0.00 m)
DATA NOTES		NPCA DEM DATA, 2010														
DESIGN GRADE POINT DATA																
CONSTRUCTION NOTES																
PROPERTY INFO. L&B R&B																

NOTES:

1. DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED
2. CATCHMENT BOUNDARIES ARE BASED ON THE NPCA DIGITAL ELEVATION MODEL (DEM) 2010
3. SPECIFIC POINTS IN THE SURFACE ARE BASED ON THE FOLLOWING SURVEYS:
   - DRAIN CROSSINGS & SPOT CHANNELS AMEC SURVEY, 2013
   - AS CONSTRUCTED SURVEY BY CofPC, 2016 STATION 0+000-1+940
   - SUPPLEMENTARY SURVEY BY CofPC, 2018
   - WEIBE ENGINEERING SURVEY, 2008

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.

BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR ANY DAMAGE DONE TO THEM.

SPATIAL DATA:

DTM DATA FROM NIAGARA PENINSULA CONSERVATION AUTHORITY

- HORIZONTAL DATUM: UTM NAD83-CSRS ZONE 17N
- VERTICAL DATUM: CGVD28-1978
- ACCURACY: ABSOLUTE HORIZONTAL AND VERTICAL POSITIONAL ACCURACIES OF ±0.5m

LEGEND

	EXISTING DITCH BOTTOM (NPCA DEM DATA)
	EXISTING DITCH BOTTOM (SURVEYED)
	HISTORICAL GRADELINE
	PROPOSED DRAIN GRADELINE-EWA, 2018
LEFT	LEFT BANK
RIGHT	RIGHT BANK
	EXISTING DRAIN SECTION
	EXISTING STRUCTURE DETAILS
	ASSUMED EXISTING STRUCTURE DETAILS
OBV=175.00	EXISTING DRAIN ELEVATION
175.00 PR.	PROPOSED DRAIN CENTERLINE ELEVATION
175.00 EX.	PORPOSED DRAIN ELEVATION (WHERE MATCHES EXISTING ELEVATION)
	DATA POINT FROM HISTORICAL DESIGN GRADELINE RVA, 1979

NO.	REVISION DESCRIPTION	DATE
1	ISSUED FOR BASELINE REPORT	MAY 2019

BEAVERDAM MUNICIPAL DRAIN PROFILE

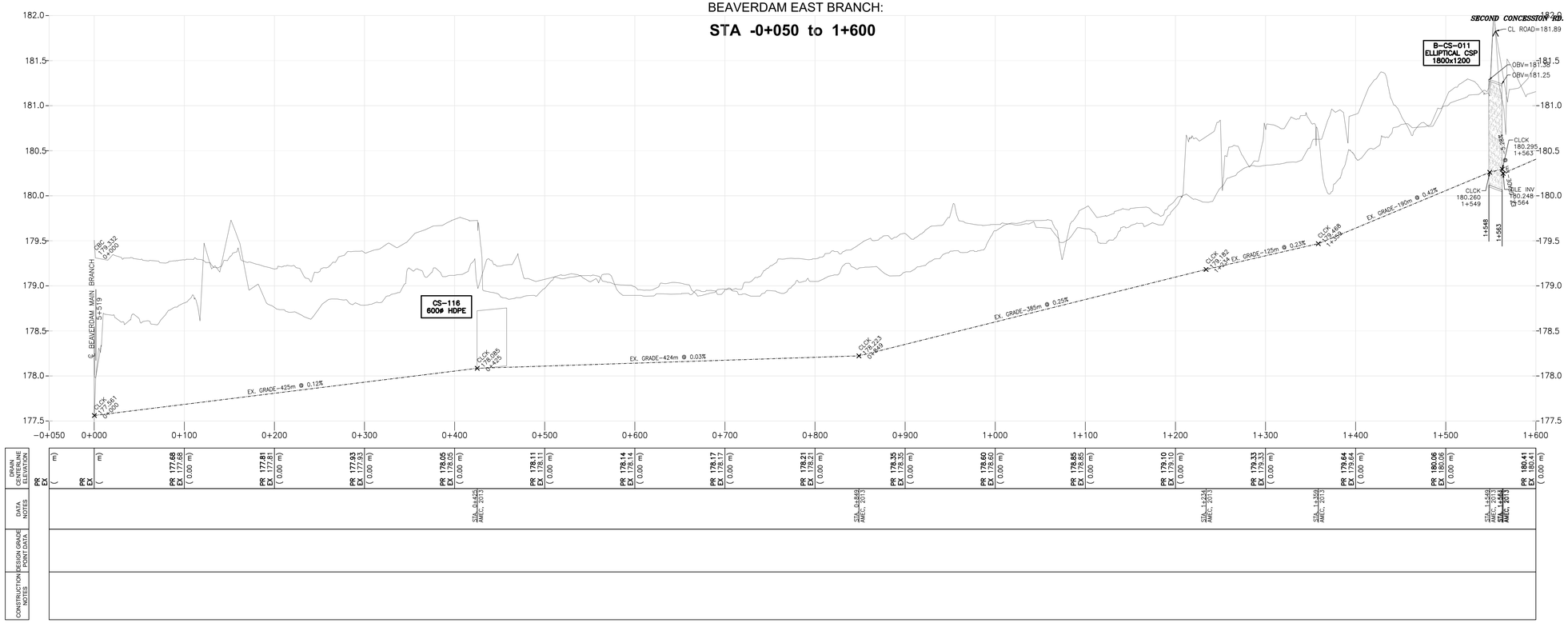
CITY OF PORT COLBORNE

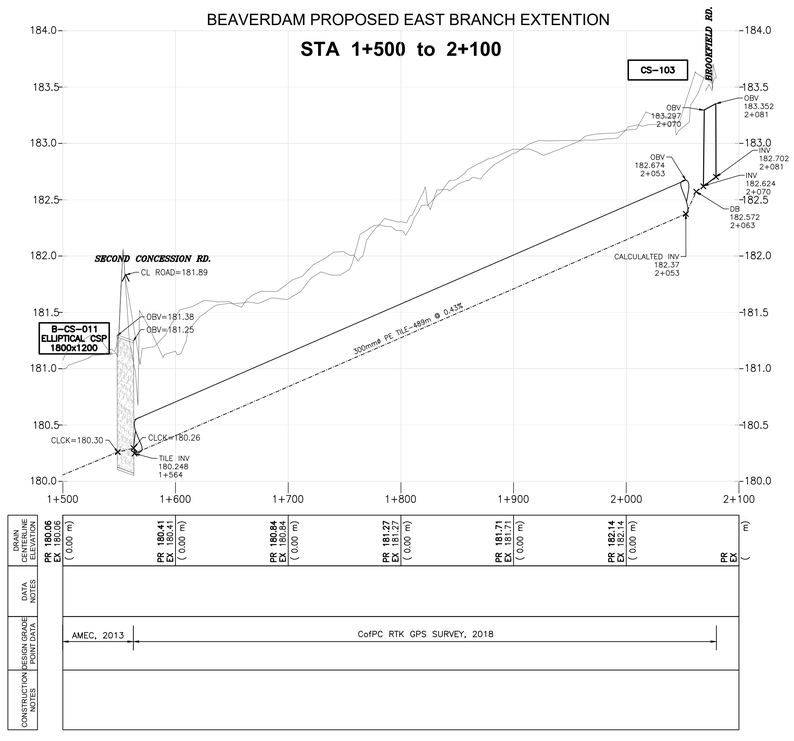
PORT COLBORNE

Paul C. Marsh, P.Eng. Principal Engineer
EWA Engineering Inc.
84 Main Street, Unionville, Ontario
L3R 2E7
647.400.2824 **www.ewaeng.com**

Automated Engineering Technologies Ltd.
91A Duke Street , Guelph, Ontario N1E 5L1 (519)821-8644
397 Romeo Street S., Stratford, ON, N5A 4V1 (519)273-9318 WEB: www.autoengtech.on.ca

DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
DAC	PCM	–	B.P6
DESIGNED BY :	DATE :	SCALE :	
PCM	31-May-19	H=1:2500 V=1:25	





NOTES:

1. DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED
2. CATCHMENT BOUNDARIES ARE BASED ON THE NPCA DIGITAL ELEVATION MODEL (DEM) 2010
3. SPECIFIC POINTS IN THE SURFACE ARE BASED ON THE FOLLOWING SURVEYS:
   - DRAIN CROSSINGS & SPOT CHANNELS AMEC SURVEY, 2013
   - AS CONSTRUCTED SURVEY BY CofPC, 2016 STATION 0+000-1+940
   - SUPPLEMENTARY SURVEY BY CofPC, 2018
   - WEIBE ENGINEERING SURVEY, 2008

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.

BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR ANY DAMAGE DONE TO THEM.

SPATIAL DATA:

DTM DATA FROM NIAGARA PENINSULA CONSERVATION AUTHORITY

- HORIZONTAL DATUM: UTM NAD83-CSRS ZONE 17N
- VERTICAL DATUM: CGVD28-1978
- ACCURACY: ABSOLUTE HORIZONTAL AND VERTICAL POSITIONAL ACCURACIES OF ±0.5m

LEGEND

	EXISTING DITCH BOTTOM (NPCA DEM DATA)
	EXISTING DITCH BOTTOM (SURVEYED)
	HISTORICAL GRADELINE
	PROPOSED DRAIN GRADELINE-EWA, 2018
LEFT	LEFT BANK
RIGHT	RIGHT BANK
	EXISTING DRAIN SECTION
	EXISTING STRUCTURE DETAILS
	ASSUMED EXISTING STRUCTURE DETAILS
OBV=175.00	EXISTING DRAIN ELEVATION
175.00 PR.	PROPOSED DRAIN CENTERLINE ELEVATION
175.00 EX.	PORPOSED DRAIN ELEVATION (WHERE MATCHES EXISTING ELEVATION)
	DATA POINT FROM HISTORICAL DESIGN GRADELINE RVA, 1979

NO.	REVISION DESCRIPTION	DATE
1	ISSUED FOR BASELINE REPORT	MAY 2019

BEAVERDAM MUNICIPAL DRAIN PROFILE

CITY OF PORT COLBORNE

PORT COLBORNE

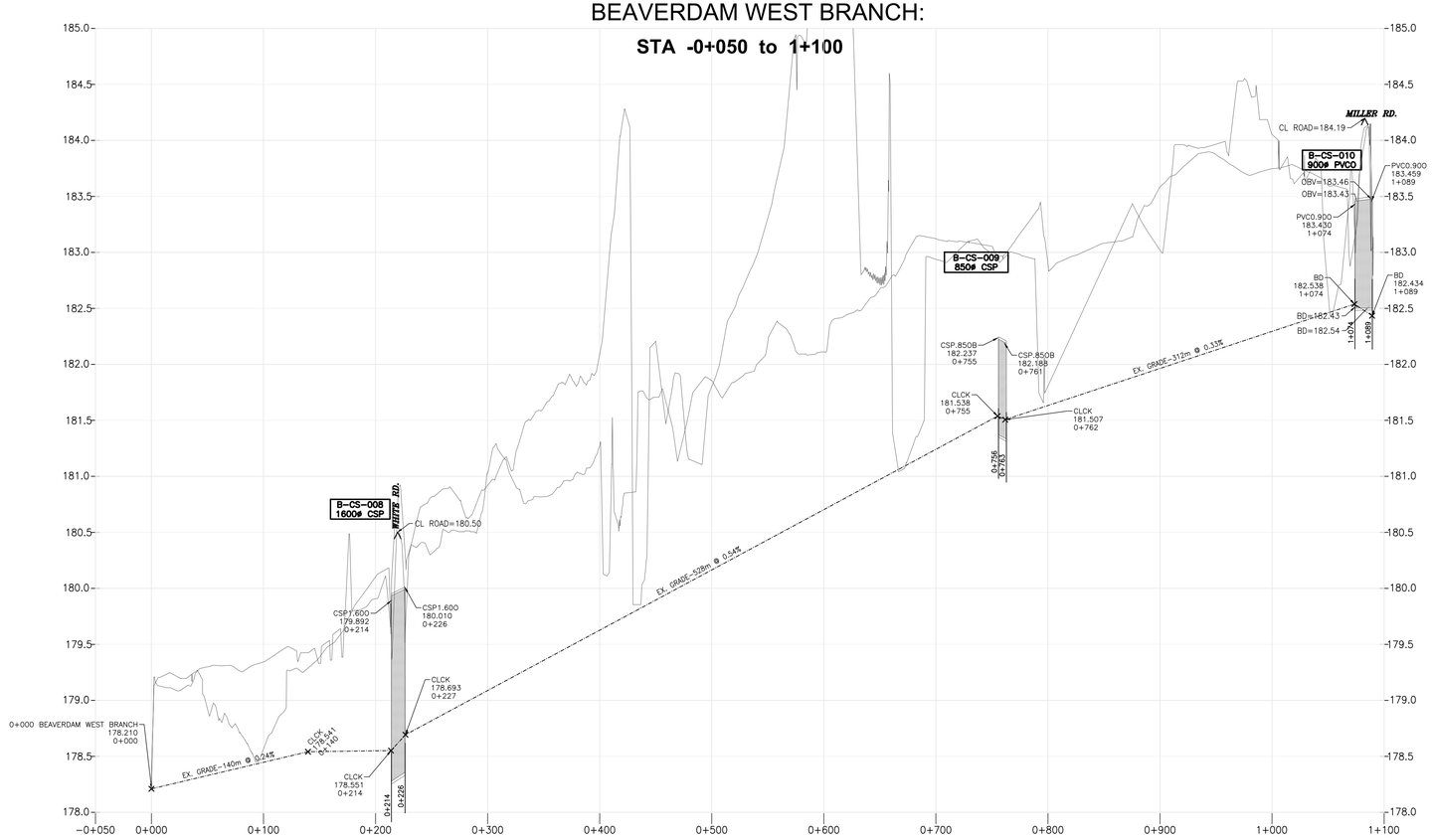
Paul C. Marsh, P.Eng. Principal Engineer
EWA Engineering Inc.
84 Main Street, Unionville, Ontario
L3R 2E7
647.400.2824
www.ewaeng.com

Automated Engineering Technologies Ltd.
91A Duke Street , Guelph, Ontario N1E 5L1 (519)821-8644
397 Romeo Street S., Stratford, ON, N5A 4V1 (519)273-9318 WEB: www.autoengtech.on.ca

DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
DAC	PCM	–	B.P7
DESIGNED BY :	DATE :	SCALE :	
PCM	3-Jun-19	H=1:2500 V=1:25	

BEAVERDAM WEST BRANCH:

STA -0+050 to 1+100



	DRAIN CENTRELINE ELEVATION	DATA NOTES	DESIGN GRADE POINT DATA	CONSTRUCTION NOTES	PROPERTY INFO. LIB / RIB
PR / EX	m)				
PR / EX	178.21 / 178.21 (0.00 m)				
PR / EX	178.45 / 178.45 (0.00 m)				
PR / EX	178.55 / 178.55 (0.00 m)				
PR / EX	179.09 / 179.09 (0.00 m)				
PR / EX	179.63 / 179.63 (0.00 m)				
PR / EX	180.16 / 180.16 (0.00 m)				
PR / EX	180.70 / 180.70 (0.00 m)				
PR / EX	181.24 / 181.24 (0.00 m)				
PR / EX	181.63 / 181.63 (0.00 m)				
PR / EX	181.96 / 181.96 (0.00 m)				
PR / EX	182.29 / 182.29 (0.00 m)				
PR / EX	m)				

NOTES:

1. DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED
2. CATCHMENT BOUNDARIES ARE BASED ON THE NPCA DIGITAL ELEVATION MODEL (DEM) 2010
3. SPECIFIC POINTS IN THE SURFACE ARE BASED ON THE FOLLOWING SURVEYS:
   - DRAIN CROSSINGS & SPOT CHANNELS AMEC SURVEY, 2013
   - AS CONSTRUCTED SURVEY BY CofPC, 2016 STATION 0+000–1+940
   - SUPPLEMENTARY SURVEY BY CofPC, 2018
   - WEIBE ENGINEERING SURVEY, 2008

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.

BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR ANY DAMAGE DONE TO THEM.

SPATIAL DATA:

DTM DATA FROM NIAGARA PENINSULA CONSERVATION AUTHORITY

- HORIZONTAL DATUM: UTM NAD83–CSRS ZONE 17N
- VERTICAL DATUM: CGVD28–1978
- ACCURACY: ABSOLUTE HORIZONTAL AND VERTICAL POSITIONAL ACCURACIES OF ±0.5m

LEGEND

	EXISTING DITCH BOTTOM (NPCA DEM DATA)
	EXISTING DITCH BOTTOM (SURVEYED)
	HISTORICAL GRADELINE
	PROPOSED DRAIN GRADELINE–EWA, 2018
LEFT	LEFT BANK
RIGHT	RIGHT BANK
	EXISTING DRAIN SECTION
	EXISTING STRUCTURE DETAILS
	ASSUMED EXISTING STRUCTURE DETAILS
OBV=175.00	EXISTING DRAIN ELEVATION
175.00 PR.	PROPOSED DRAIN CENTERLINE ELEVATION
175.00 EX.	PORPOSED DRAIN ELEVATION (WHERE MATCHES EXISTING ELEVATION)
	DATA POINT FROM HISTORICAL DESIGN GRADELINE RVA, 1979

NO.	REVISION DESCRIPTION	DATE
1	ISSUED FOR BASELINE REPORT	MAY 2019

BEAVERDAM MUNICIPAL DRAIN PROFILE

CITY OF PORT COLBORNE

PORT COLBORNE

Paul C. Marsh, P.Eng. Principal Engineer
EWA Engineering Inc.
84 Main Street, Unionville, Ontario
L3R 2E7
647.400.2824
www.ewaeng.com

Automated Engineering Technologies Ltd.
91A Duke Street , Guelph, Ontario N1E 5L1 (519)821-8644
397 Romeo Street S., Stratford, ON, N5A 4V1 (519)273-9318 WEB: www.autoengtech.on.ca

DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
DAC	PCM	–	B.P8
DESIGNED BY :	DATE :	SCALE :	
PCM	31–May–19	H=1:2500 V=1:25	

Appendix C:

Relevant Reports

Riparian Buffer Restoration Project
Beaverdam Drain Watershed

1. **Overview Map – Subwatershed Analysis/Statistics**
    - Lorraine Bay Water Quality Committee has raised concerns about poor water quality in the bay
    - How Much Habitat is Enough – Environment Canada
    - Beaverdam Drain Watershed Targets – Summary Statistics
    - Potential WDRP sites

2. **Restoration Map – Priority Site Identification**
    - GIS to identify sites where buffer needs to be improved
    - Each number corresponds to one project parcel/landowner
    - Landowner spreadsheet – information needed from City of Port Colborne

3. **Landowner Maps – Prioritized Sites**
    - Letter size maps to take to landowner meetings
    - Shows acreage of buffer increase if they chose 5m

4. **Roadside Photos – Field Ground Truthing**
    - NPCA – would you have time to conduct field ground truthing?

5. **Initial Landowner Contact**
    - We have several options to conduct the initial landowner contact:
        a) Landowner Liaison – local community member within watershed or Stewardship Council who can conduct initial extension to landowners; call landowner to give brief background on project and set up initial meeting
        b) NPCA can send out a mailing to landowners identified on the spreadsheet
        c) Municipality can hold landowner meeting for drain watershed
    - *Discussion:* which option would be best for this project?

6. **Landowner Meetings – set target dates…**
    - 1st Meetings: Landowner Liaison and Project Coordinator (project background)
    - 2nd Meetings: Project Coordinator and Delivery Agent (NPCA – site specifics)

7. **Incentives and Long Term Protection**
    a) Payment for Ecological Goods and Services
        - *Discussion:* use incentives? Duration? Amount?
    b) Drainage Act – Engineer's Report
        - *Discussion:* incorporate buffers into report?
    c) Monitoring
        - *Discussion*: water quality monitoring pre and post implementation?

WETLAND DRAIN RESTORATION PROJECT
Feasibility Study for

Beaverdam Drain

Regional Municipality of Niagara
City of Port Colborne

Ministry of Natural Resources
June 2008

Feasibility Study for Beaverdam Drain

SITE LOCATION:

Wetland Drain Site Identification Code	Niagara: Port Colborne: Beaverdam Drain
Site Source	Lorraine Bay Water Quality Committee, Port Colborne Drainage Superintendent, NPCA Staff
Site Ranking	Not Ranked
Common Wetland Name	Beaverdam Creek Port Colborne Wetland Complex
PSW: (Name/Score/High score section)/ Unevaluated	Final Wetland Evaluation pending – this wetland has the potential to be Provincially Significant, however has not yet been designated as such
Site Location: (Lot/Conc/Twp/County)	Regional Municipality of Niagara: City of Port Colborne: Lot 17, 18 Concession 1
Nearest Intersection	Weaver Road and Killally Street
Nearest Urban Centre	Port Colborne
Physiographic Region	Clay Plain, Sand Plain; Limestone Plain to the east
Associated Soils	Poorly Drained, Organic Soils
Associated Topography	Flat
Conservation Authority	Niagara Peninsula Conservation Authority
Field work completed on	July 18, 2007; September 7, 2007
Field work completed by	Alison Thomson, Rene Landry, Kate MacIntyre

Appendix A: SITE LOCATION MAP

DRAINAGE INFORMATION:

Drain Name	Beaverdam Drain
Drain Classification	Main Channel (Class C, F); West Branch (Class F); East Branch (Class F)
Date of Construction and Details	Date of original construction was 1885 for reach along the Miller Rd road allowance and across property (2711 040 003 101); and 1916 for the portion running south along the west side of the above property and west along the south side of property (2711 040 003 110) and south along Weaver Road
Date of Last Dredging Maintenance	Last Engineer Report in February 1997: reconstruct pump stations and flood gate, some cleaning downstream
Extent of Drainage Watershed	Approx. 1 252 ha
Drain Gradient	Approx. 0.025%
Channel Width	Along Miller Rd is 2.13 m (7 ft)
Bank Height	Generally 1.2 m (4 ft)
Spoil location	Spoils would be hauled away or spread upon the clay road surface
Soil composition within drain	Organic silt

Appendix B: WATERSHED PLAN AND DRAIN PROFILE

DRAIN HYDROLOGY:

Direction of Flow	Drain flows south into Lorraine Bay, Lake Erie
Drainage Ditch Flow (permanent/ intermittent)	Permanent
Water level	Approx. 0.5m at time of site visit
Receiving body	Lake Erie
Historic Status	The Historical Atlas of the Counties of Lincoln and Welland by H.R. Page (1876) indicates there was a natural watercourse that entered Lake Erie in the project area
Seeps	None noted by NPCA staff
General Water Quality	NPCA staff noted water in drain has a 'tea-coloured appearance consistent with peaty/organic soil conditions; where there is turbidity, it appears pinkish-brown, and is even visible in April aerial photos'
Air Temperature	~25°C at time of site visit
Water Temperatures (and time)	Not noted
# of Barriers/Dams Downstream	There is one water control structure at the very bottom of the drain at the beach, designed to

	prevent storm surges from deluging the drain
Distance to Closest Barrier	Approx. 950m from project site to existing water control structure
Distance to start of natural Watercourse	Approx 1030m from project site to Lake Erie
Steam Order/Stream Magnitude	2nd order drain (west and east branches would be 1st order)

Appendix C: HISTORIC ATLAS MAP

WETLAND HABITAT CHARACTERISTICS:

Wetland Evaluated?	Wetland evaluated at headwater of drain; wetland evaluation at project site location is pending
Wetland File location	MNR, Guelph District, Vineland Office
Location of Drain relative to habitat	Drain borders evaluated wetland habitat at headwaters; drain bisects downstream wetland habitat
Surficial soils	Organic
Headwater/ receiving body	Headwater wetland is within Humberstone Muck Basin Swamp Forest ANSI; receiving body is Lake Erie
Wetland Size	Headwater wetland approx. 131ha; downstream wetland approx. 75ha
Is Wetland Complexed?	Yes
Site Type	Palustrine
Dominant Species (Vegetation Communities):	NPCA Staff and Guelph District Wetland Evaluator noted the dominant species as Freeman's Maple (Red/Silver hybrid)
Other Species (Vegetation Communities)	NPCA Staff noted the following: Yellow Birch, Spicebush, Common Elderberry, Nannyberry, Great Ragweed, Water Hemlock, Jewelweed, Tall Nettle, Jack-in-the-Pulpit, Arrowhead, Smartweed spp. Reed Canary Grass, Common Rush, Sedge spp.
Wetland Significance/ functions	Headwater wetland = groundwater recharge and discharge, flood attenuation, wildlife habitat; Downstream wetland = water quality improvement, wildlife habitat
Evidence of vernal pooling/swales	Yes
Drainage impacts on wetland	Drain is most likely lowering water table in downstream wetland
Other/ previous impacts by drainage	Several private drains enter the municipal

works	drain across the onion fields that may contribute to nutrient loading
Other impacts on wetland	None noted
Fish Habitat	**NPCA**: last surveyed June 2002: found warm water fish community, tolerant of higher water temperatures and poor water quality **MNR Guelph**: no recent spring survey conducted; would support restoration within channel via letter of support from DFO if needed
Evidence of Wildlife	NPCA Staff noted Chimney crayfish during field visit in July 2007

SURROUNDING LAND USE:

Land use designations	Zoned Agricultural
Surrounding land uses	Onion farming and cattle pasture are the prominent land uses adjacent to the downstream drain
Existing tile outlets	Systematic tiling outlets into open private drains throughout the onion fields
Areas for mitigation or concern	Surrounding wetland has the potential to be designated as PSW
Elevation of arable lands in relation to the drain and wetland	Elevation of adjacent onion fields is very low in relation to drain and wetland
Influence of restoration options on arable lands	Arable land would have high potential for flooding if water table was raised

PROPERTY OWNER INPUT:

Landowner	2711-040-003-10100
Views/Comments	Not interested in original wetland project proposal, but gave permission to walk through the property
Mitigation measures	
Landowner	2711-040-003-07900
Views/Comments	September 7, 2007: met with landowner; member of Lorraine Bay Water Quality Committee; is interested in any restoration effort that would improve water quality within Lorraine Bay
Mitigation measures	

Appendix D: LOCALIZED SITE MAP showing PARCEL NUMBERS & Proposed Sediment Basin Locations

Appendix E: PHOTOS and ADDITIONAL INFORMATION

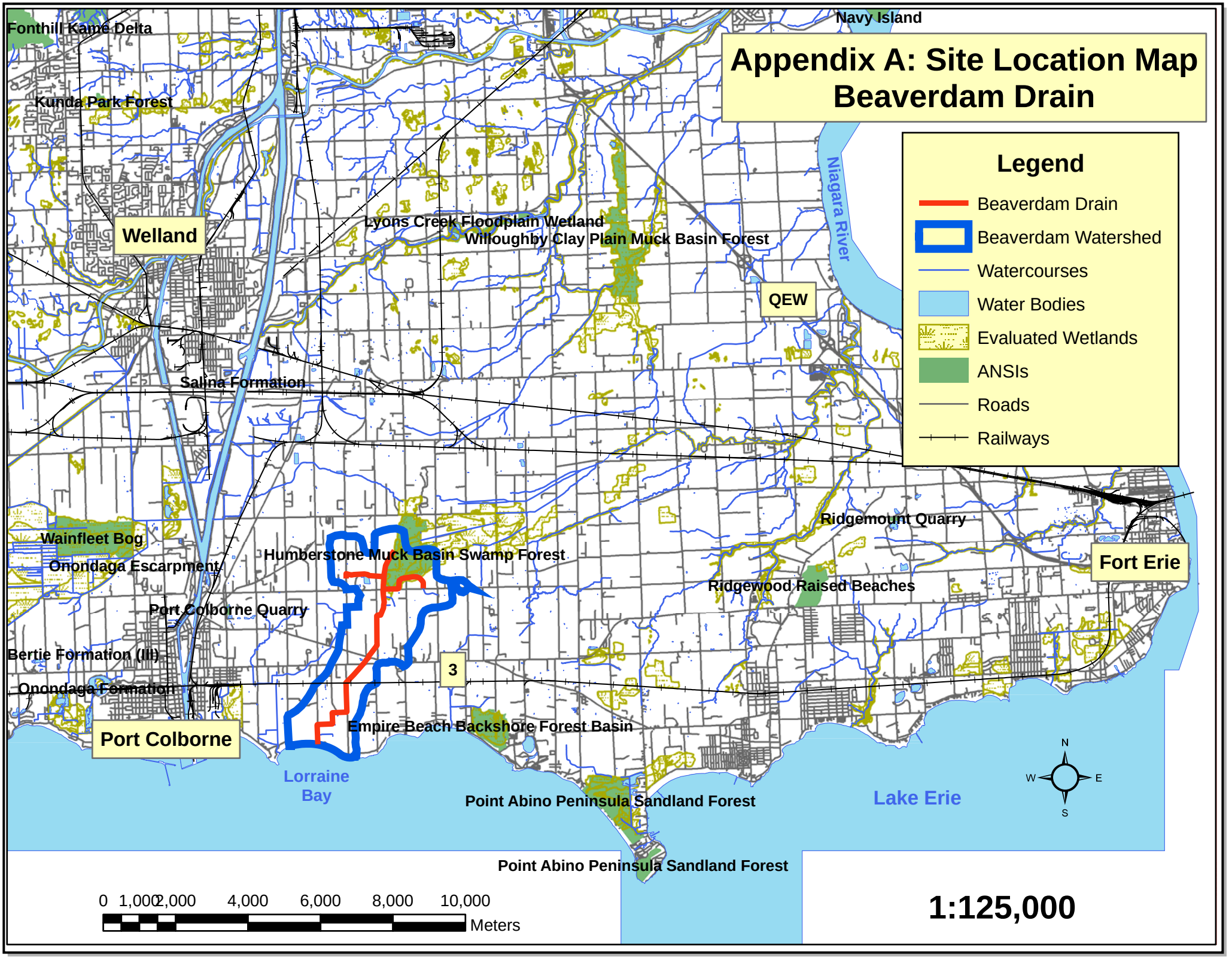
CONCLUSIONS AND RECOMMENDATIONS:

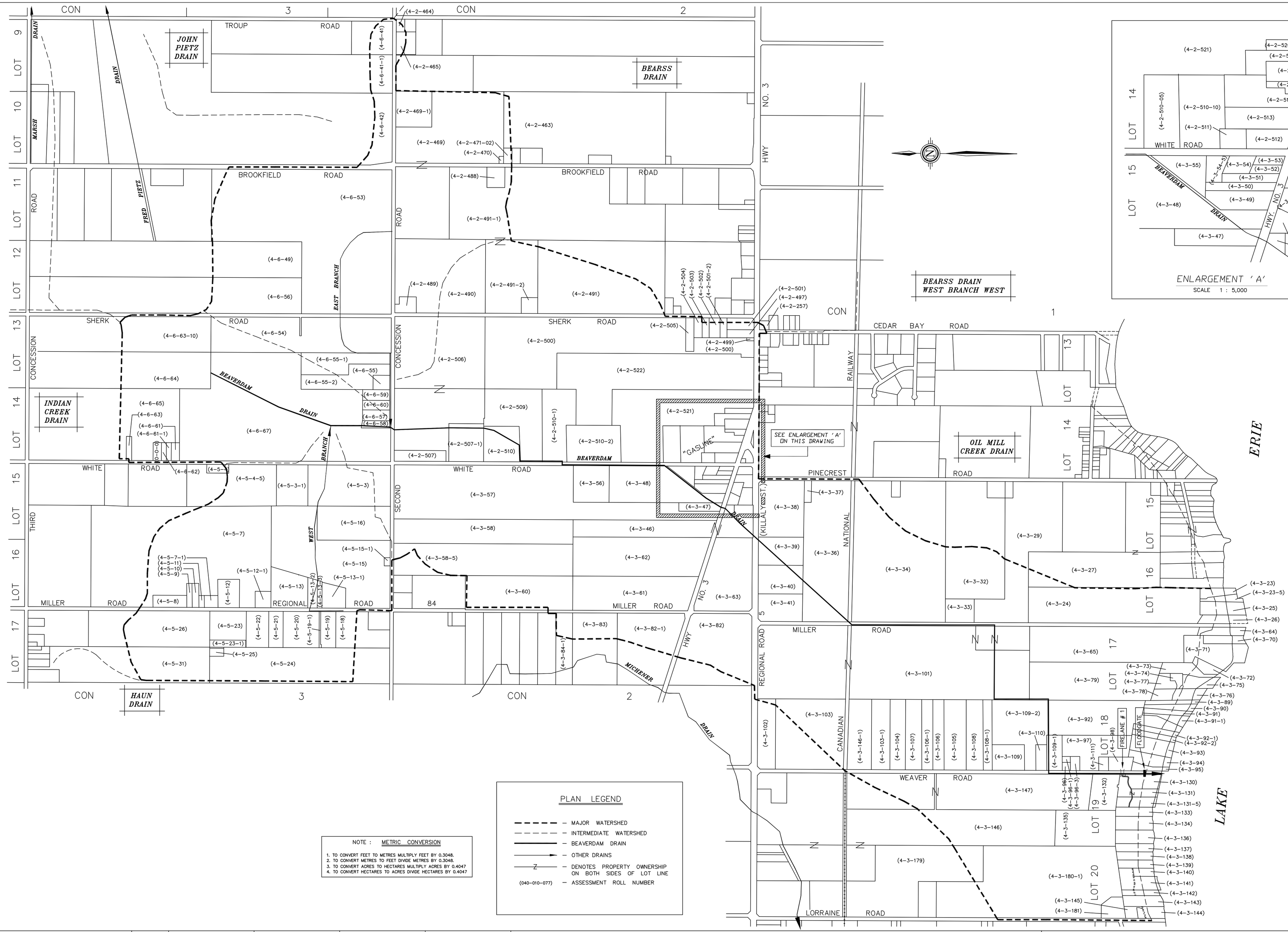
Conclusions & Recommendations	The following recommendations are based on comments from adjacent landowners, and suggestions / comments from all project partners: 1. **Wetland Drain Restoration Project** (WDRP): it was originally suggested to re-direct the drain through the wooded swamp, so that the wetland could act as a filtering system and help improve water quality for Lorraine Bay; however, project partners and landowners are not in agreement of this proposal; although the local wetland evaluation has not been finalized, it has the potential of having Provincial Significance; most partners agree that redirecting the drain through the wetland would do more harm than good; therefore the WDRP concludes that wetland creation and/or water level restoration is not recommended for this project 2. **Watershed Buffer Restoration Project** (WBRP): the goal of the WBRP is to improve downstream water quality, primarily by implementation of upstream buffer restoration, and occasionally support for installation of sediment basins; the WBRP recommends to proceed with the methodology outlined in the 'WBRP Summary' document sent to project partners on March 5, 2008; the WBRP also recommends to install one or more sediment basin(s) that would be deepened sections of the current drain channel to collect sediments from upstream erosion/runoff; the location of the sediment basins would be at the recommendation of the Engineer and the Drainage Superintendent; the Drainage Superintendent has proposed that the locations be along the road allowance to allow for easy access for future maintenance; see Appendix D for potential locations; 3. **Water Quality Monitoring:** a significant amount of water quality data has been collected by most project partners; this data should be shared by all project partners, and monitoring should be continued after restoration implementation to determine if any water quality improvement has been made

	4. **Point Source:** using the data collected to date, the Lorraine Bay Committee should submit to an agency that can determine the most probable source of these elevated pollutants; buffers and sediment traps will help reduce sediment and associated pollutant deposition into the Bay, however point sources should be determined and contended with

Drainage Superintendent Contact:

Drainage Superintendent	Rene Landry
Township/County	City of Port Colborne
Address	City Hall 66 Charlotte Street Port Colborne, ON L3K 3C8
Phone	905-835-2901-213


Appendix A: Site Location Map
Beaverdam Drain
Legend
Beaverdam Drain
Beaverdam Watershed
Watercourses
Water Bodies
Evaluated Wetlands
ANSIs
Roads
Railways
Fonthill Kame Delta
Navy Island
Kunda Park Forest
Welland
Lyons Creek Floodplain Wetland
Willoughby Clay Plain Muck Basin Forest
Niagara River
QEW
Salina Formation
Wainfleet Bog
Onondaga Escarpment
Humberstone Muck Basin Swamp Forest
Ridgemount Quarry
Fort Erie
Ridgewood Raised Beaches
Port Colborne Quarry
Bertie Formation (III)
Onondaga Formation
3
Port Colborne
Empire Beach Backshore Forest Basin
Lorraine Bay
Point Abino Peninsula Sandland Forest
Lake Erie
Point Abino Peninsula Sandland Forest
N
W
E
S
0 1,000 2,000 4,000 6,000 8,000 10,000
Meters
1:125,000



NOTE : METRIC CONVERSION

1. TO CONVERT FEET TO METRES MULTIPLY FEET BY 0.3048.
2. TO CONVERT METRES TO FEET DIVIDE METRES BY 0.3048.
3. TO CONVERT ACRES TO HECTARES MULTIPLY ACRES BY 0.4047
4. TO CONVERT HECTARES TO ACRES DIVIDE HECTARES BY 0.4047

PLAN LEGEND

- MAJOR WATERSHED
- INTERMEDIATE WATERSHED
- BEAVERDAM DRAIN
- OTHER DRAINS
- Z — DENOTES PROPERTY OWNERSHIP ON BOTH SIDES OF LOT LINE
- (040-010-077) — ASSESSMENT ROLL NUMBER

No.	REVISION	DATE

DESIGNED BY: J.K.
CHECKED BY: J.K.
DRAWN BY: J.R.M.
CHECKED BY: J.K.
FIELD BOOK:

SCALE
PLAN
200m 0 200m
(1:10,000)

LICENSED PROFESSIONAL ENGINEER
J. W. KUNTZE
PROVINCE OF ONTARIO

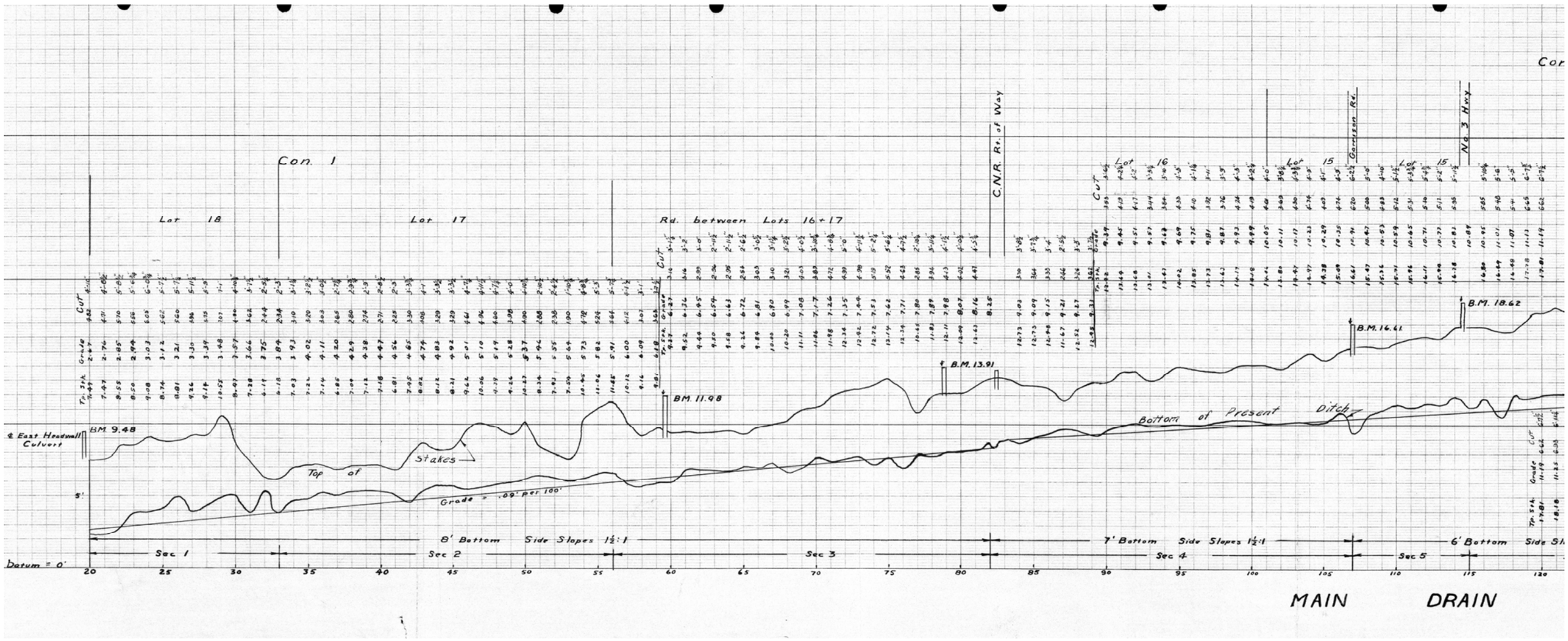
BEAVERDAM DRAIN

REGIONAL MUNICIPALITY OF NIAGARA — CITY OF PORT COLBORNE

WATERSHED PLAN

K. SMART ASSOCIATES LIMITED
CONSULTING ENGINEERS AND PLANNERS
85 McINTYRE DRIVE
KITCHENER, ONTARIO N2R 1G2

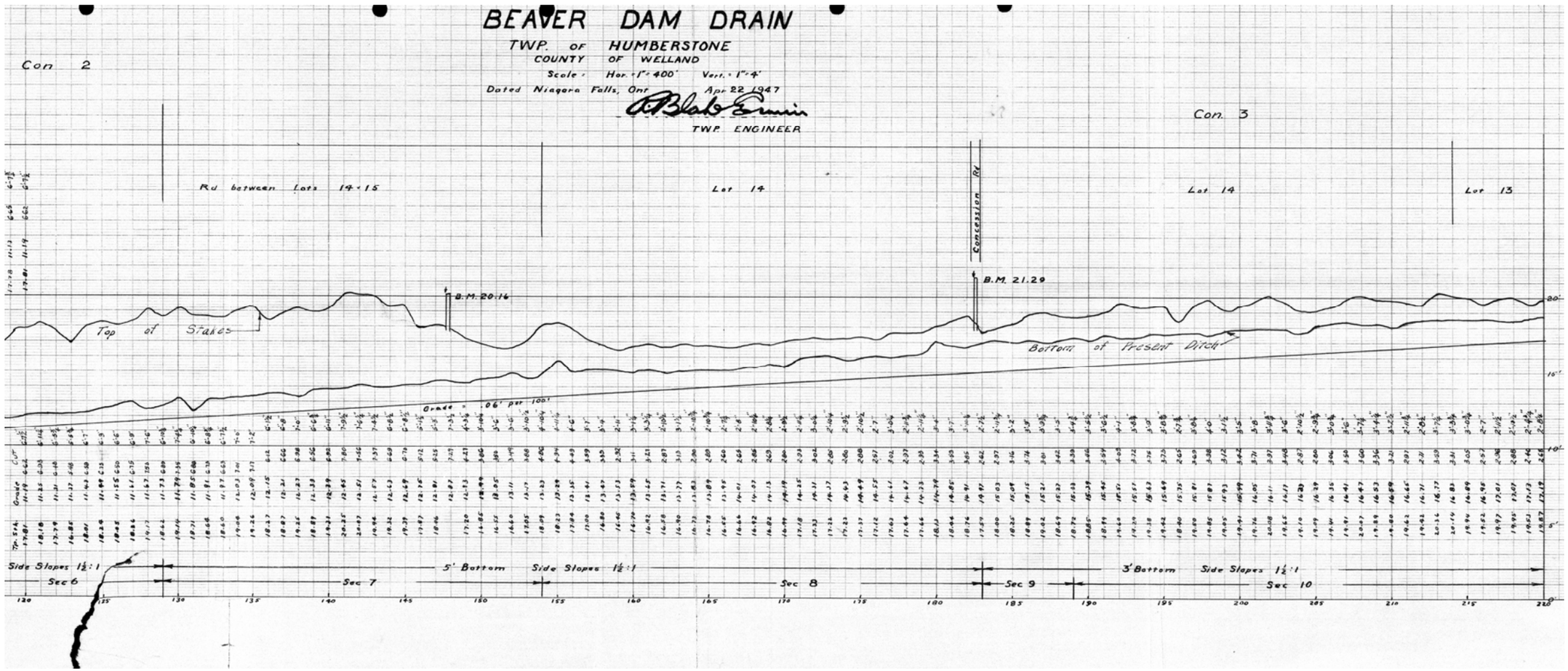
JOB NUMBER 94038
DATE FEB. 10, 1997
DRAWING NUMBER 1 OF 5


Con. 1
Lot 18
Lot 17
Rd. between Lots 16 + 17
C.N.R. R.of Way
Lot 16
Lot 15
Garrison Rd.
Lot 15
No. 3 Hwy
Lot 15
B.M. 18.62
B.M. 16.41
B.M. 13.91
B.M. 11.98
BM 9.48
& East Headwall Culvert
Top of Stakes
Grade = .09' per 100'
Bottom of Present Ditch
8' Bottom Side Slopes 1½:1
7' Bottom Side Slopes 1½:1
6' Bottom Side Sl
Sec 1
Sec 2
Sec 3
Sec 4
Sec 5
Datum = 0'
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
MAIN DRAIN

BEAVER DAM DRAIN

TWP. OF HUMBERSTONE
COUNTY OF WELLAND
Scale: Hor. 1" = 400' Vert. 1" = 4'
Dated Niagara Falls, Ont. Apr. 22 1947

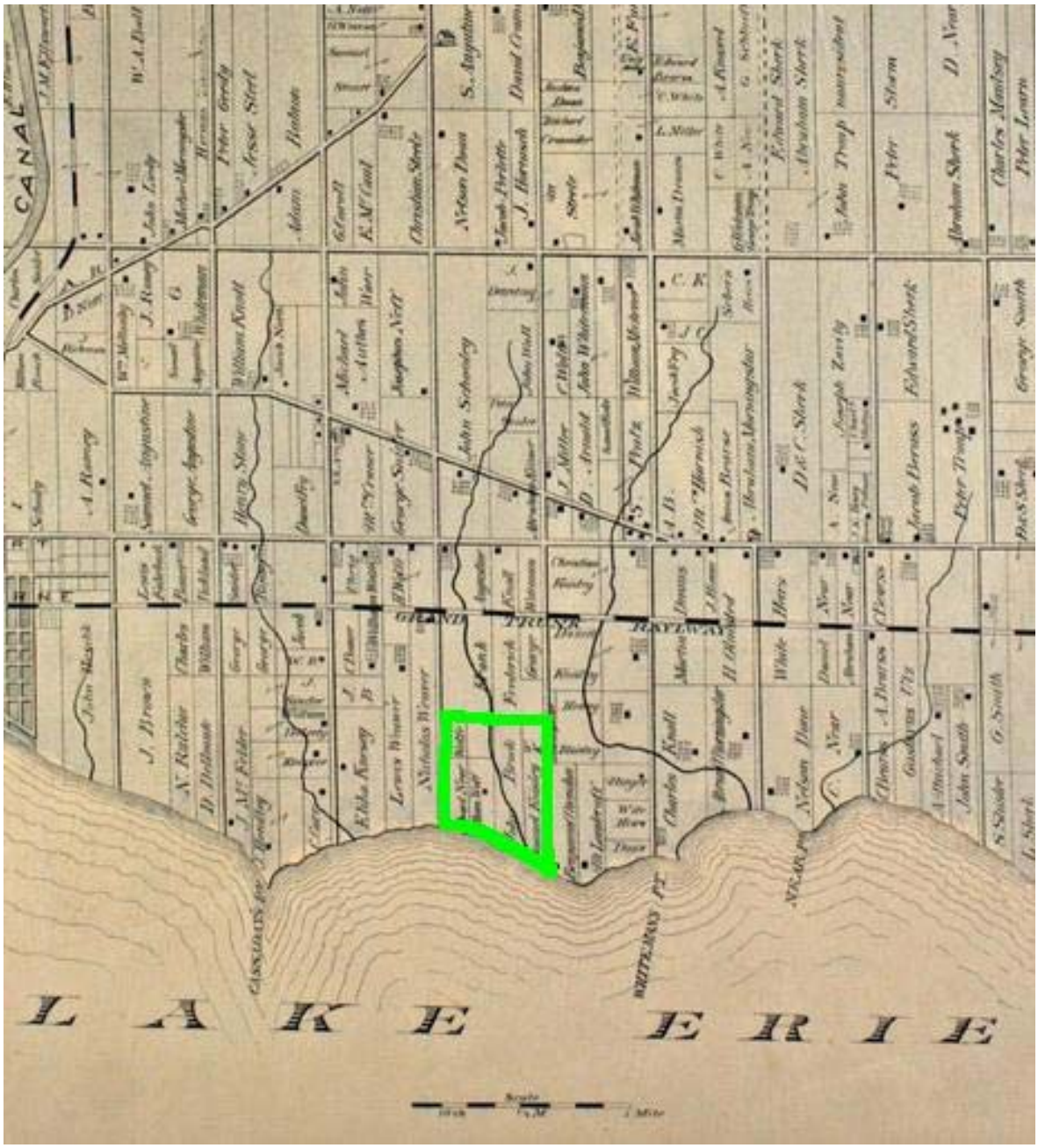
A. Blake Ermin
TWP. ENGINEER

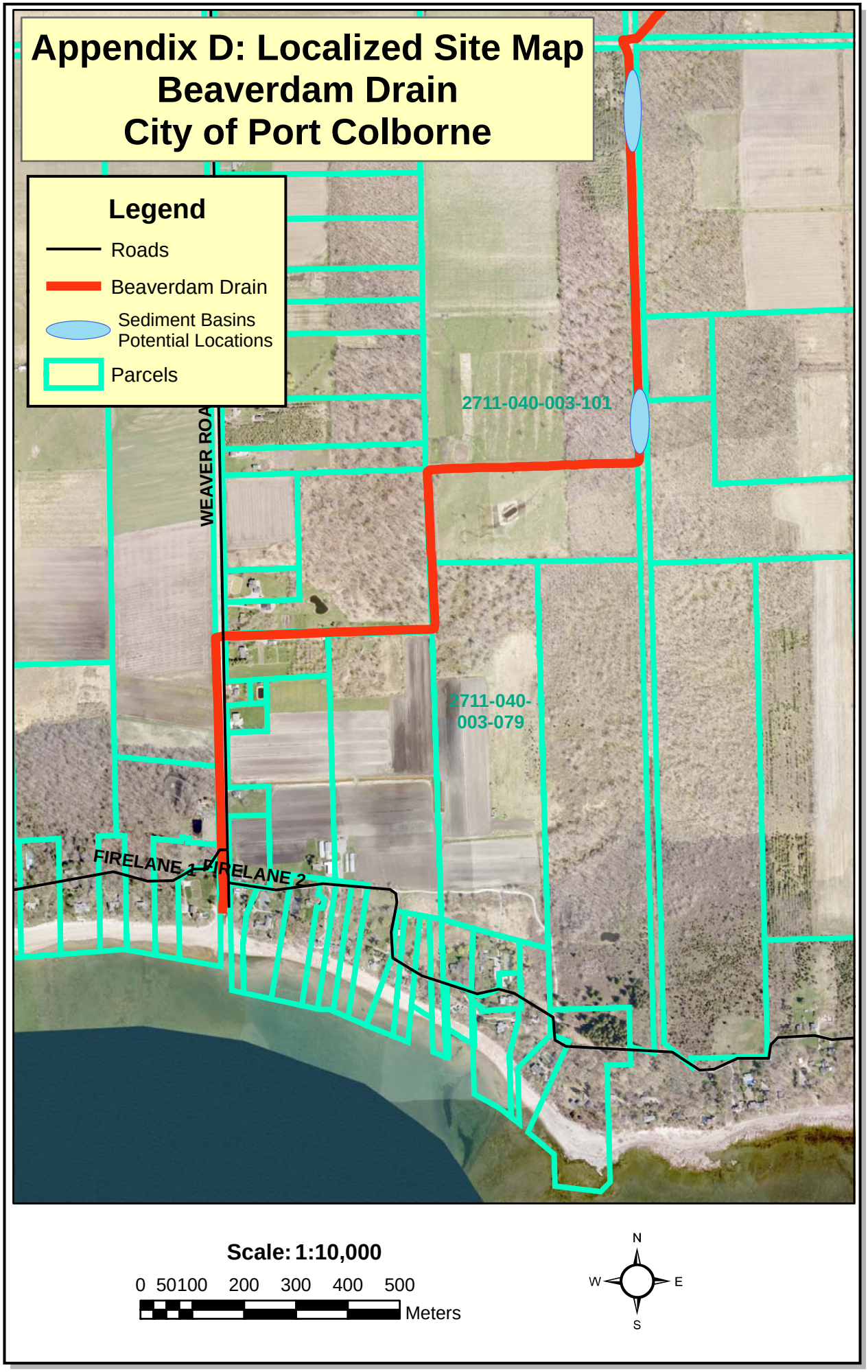


Appendix C: Historic Atlas Map

From the Historical Atlas of the Counties of Lincoln and Welland by H.R. Page, 1876.

Proposed project site is outlined in green:




Appendix D: Localized Site Map
Beaverdam Drain
City of Port Colborne
Legend
Roads
Beaverdam Drain
Sediment Basins Potential Locations
Parcels
WEAVER ROA
2711-040-003-101
2711-040-003-079
FIRELANE 1
FIRELANE 2
Scale: 1:10,000
0 50100 200 300 400 500
Meters
N
W
E
S

Appendix E: Photos and Additional Information

BEAVERDAM DRAIN

Quick Summary prepared by Alison Thomson, NPCA

REASON FOR PROJECT:

- Local residents/cottagers concerned about poor water quality at beach
- A few of the landowners would like to naturalize their properties. They are considering land trust options. In general they have a feeling of wanting to protect the landscape and offer low-impact recreational opportunities in perpetuity to the community, if possible.

CONCERNS:

-Project design will need to address affects of raising water-table on the adjacent onion farming operations. It may be possible to offer irrigation advantages.

VEGETATION:

Bush vegetation is consistent with swamp (forested wetland) in this region; though logging appears to have reduced oaks (remaining Maples are mostly multi-stemmed or otherwise unfavourable for timber.) Note this summer has been extremely dry, so the whole area was walk-able. The cleared areas without crops, and shallow ditches, show natural regeneration of species consistent with abandoned wetlands.

Below is brief list of wetland indicator species noticed July 18, 2007:

Woodland areas:
Spicebush
Common Elderberry
Freeman's Maple (Red/Silver hybrid)
Yellow Birch
Great Ragweed
Water Hemlock
Jewelweed
Tall Nettle
Jack-in-the-Pulpit
Numerous sedge species

Cleared areas:
Common Elderberry
Nannyberry
Jewelweed
Arrowhead
Smartweed spp.
Reed Canary Grass
Common Rush
Sedge spp.

OTHER OBSERVATIONS:

- Patches of dark organic soil remaining unvegetated in high summer – indicating too wet most of the year for forest floor herbaceous plants. Also present in pasture. Organic soil predominates in the Onion farming area.
- Buttressed roots and water marks on trees, indicating periods of standing water in forest, despite intense drainage.
- Chimney crayfish "chimneys" indicating presence of high water table throughout area observed where bare soil allowed them to be visible.
- Water in the drain has a "tea" coloured appearance consistent with peaty/organic soil conditions. Where there is turbidity, it appears pinkish-brown, and this is even visible in April airphotos.

ADDITIONAL DATA:

I am awaiting the return of one of the Natural Areas Inventory staff to have a look at recently collected data from this area (still in raw form so not accessible yet.) This may help define goals for the project, especially if significant/rare species were recorded.

DRAIN CHARACTERISTICS:

The engineer's report shows gradients in the lower reaches of the drain average 0.025% Soil mapping indicates Poorly Drained soils for most of area.

PHOTOS:

Beaverdam Drain looking South:

Beaverdam Drain looking West:

Beaverdam Drain looking North:

Freeman's Maple with buttressed roots:

Shallow ditches on the Onion Farm, with bush to North:

Looking south at existing Water Control Structure from upstream side:

From same position as previous but looking north, upstream:

Looking south to lake, showing beach effect:

MEMORANDUM

Date: June 25, 2008

To: Landowners Adjacent to the Beaverdam Drain

From: The City of Port Colborne

Subject: Hiring an engineer to make alterations to the Beaverdam Drain

---

In 2007, the Ministry of Natural Resources, Niagara Peninsula Conservation Authority, the City of Port Colborne and the Lorraine Bay Water Quality Committee completed an investigation into the potential for water quality restoration in the Beaverdam Drain. The main purpose of this study was to determine if the municipal drain could serve a dual purpose: to provide drainage to the surrounding areas when required and to help improve water quality within and downstream of the drain at the same time.

The investigators believe these results can be achieved in the Beaverdam Drain with the construction of 1 or more "sediment ponds" within the drain channel. Nutrient laden sediment would be collected in the sediment ponds in the drain, and would reduce nutrient and sediment deposition in Lorraine Bay.

At this point in time the City of Port Colborne is seeking landowner support in the decision to recommend to the Council that an engineer be hired under Section 78(1) of the Drainage Act to make alterations to the Beaverdam Drain. These proposed alterations must take place under a new engineer's report and may consist of the construction of 1 or more sediment trap(s) within the drain at location(s) to be determined pending the engineer's survey.

Alternative funding sources have been utilized in order to complete investigations thus far so there are no costs to the landowners. In regard to how the balance of the project will be paid for, the landowners can rest assured that the Project Coordinators with the Ministry of Natural Resources are confident they can obtain enough funding to support the cost of the entire project. In the event they cannot obtain enough funding to cover the total project costs, some monies may be assessed to the landowners. However before costs are assessed to any landowners they will be notified as to what their assessed costs would be and whether or not they would like to proceed with the project at that expense.

This is a worthwhile project as it will help to improve water quality, both within the drain and in Lorraine Bay. Similar projects have been undertaken elsewhere in Southwestern Ontario and have proven to be successful.

Yours truly,

Rene Landry
Drainage Superintendent
City of Port Colborne

c.c. Dave Richards
A/Planning and Information Management Supervisor
Ministry of Natural Resources, Aylmer District

As a landowner within the watershed of the Beaverdam Drain, by signing below I am stating that I agree with the decision of the City of Port Colborne to proceed with hiring an engineer under Section 78(1) of the Drainage Act to make alterations to the existing Beaverdam Drain. I also understand that the Project Coordinators with the Ministry of Natural Resources are confident they can obtain enough funding to support the entire project costs. If enough funding cannot be obtained to cover the entire project costs I will expect to be notified as to my proposed assessed costs to continue with the project, and then have the availability to decide whether or not I would like to proceed at that expense.

_____	_____
Ed Walsh	Date
_____	_____
Chester Dann	Date
_____	_____
Doug Frame	Date

Beavers Dam Creek Pt. Col. WC

Wetland Evaluation Edition	3rd

January 8, 2009

Comments

The following evaluation was completed using polygon information derived from a "Geographic Information Layer" provided by the Guelph Ministry of Natural Resources . The wetland polygon's were identified from2002 GTA & 2006 RofNiagara Colour Ortho aerial photography.

Additional Information

Include relevant information that can not be entered in the wetland data record(Ex. Sections that have not been completed.)

This wetland is a complex. It is located behind Lake Erie Sand Dunes and is in part a backshore organic basin. The wetland units meet the OWES distance criteria < 750m, presence of a connecting watercourse "Beaver Dam Creek" which is the smallest scaled functional aquatic linkage for the wetland, presence and uniformity of hydric soils (Clay loam and silty clay loam), swamp communities and species communities (flora and fauna). Several terrestrial linkages are also present such as hedgerows, abandoned agricultural fields and meadows. Other important linkages are Lake Erie to the south and Humberstone Marsh to the North.

A. Yagi Nov. 07

This wetland scores more than 200points in Special Features and over 600 points overall and is therefore it is provincially significant.

Official Name:	Beavers Dam Creek Pt. Col. WC				
Evaluation Edition:	3rd	Class:		Wetland ID.:	
Wetland Significance	Year/Month Last Evaluated			January 8, 2009	
PSW	Year/Month Last Updated				
Special Planning Considerations:				**Scores**	
				Biological:	106
Dentention Area:	89.1			Social:	117
Catchment Area:	1072.24			Hydrological:	206
OMNR Source	Niagara Area Biologist A.Yagi 07			Special Features:	217
Information Source	Field Inspection R.Drabick/A.Yagi 07			Overall:	646
Submitted by:	Ron Drabick				
Date:					

INVESTIGATORS	AFFILIATION
Ron Drabick	OMNR 2006/2007
Anne Yagi	OMNR 2006/2007

DATES WETLAND VISITED

August 2007(Ron), November 16,21 (Ron/Anne)

DATE THIS EVALUATION COMPLETED: **January 8, 2009**

ESTIMATED TIME DEVOTED TO COMPLETING THE FIELD SURVEY IN "PERSON HOURS"

7.8 person hrs

WEATHER CONDITIONS

i) at time of field work Clear and Sunny-20dC, Cloudy and Rain-5dC

(Continue in the space below if necessary)

ii) summer conditions in general

OTHER POTENTIALLY USEFUL INFORMATION:

Office hours includes researching background information, GIS applications, air photo interpretation discussion with Area Biologist and evaluation completion est 44 person hours

CHECKLIST OF PLANT AND ANIMAL SPECIES RECORDED IN THE WETLAND:

Attach a list of all flora and fauna observed in the wetland.

*Indicate if voucher specimens or photos have been obtained, where located, etc.

Wetland Manual

WETLAND DATA AND SCORING RECORD

i) **WETLAND NAME:** **Beavers Dam Creek Pt. Col. WC**

ii) **MNR ADMINISTRATIVE REGION:** **Central** **DISTRICT:** **Guelph**

AREA OFFICE (if different from District): **Vineland**

iii) **CONSERVATION AUTHORITY JURISDICTION:** **Niagara Penisula C.A.**

(If not within a designated CA, check here: _____

iv) **COUNTY OR REGIONAL MUNICIPALITY:** **R.M. of Niagara**

v) **TOWNSHIP:** **Town of Port Colborne (Humberstone)**

vi) **LOTS & CONCESSIONS:** **Lots 14,17 Conc.2; Lots 15-19, Conc.1**

(attach separate sheet if necessary)

vii) **MAP AND AIR PHOTO REFERENCES**

a) Latitude: **42-52-46** Longitude: **79-11-37**

b) UTM grid reference: Zone: **17** Block: _____
Grid:E _____ Grid:N _____

c) National Topographic Series:

map name(s) **Buffalo**

map number(s) **030L14** edition **7**

scale **1: 50,000**

d) Aerial photographs: Date photo taken: **2002/2006** Scale: **Varible**

Flight & plate numbers: **2002 Colour GTA Ortho-Aerial Photography**
2006 Colour RofNiagara Ortho-Aerial Photography

(attach separate sheet if necessary)

e) Ontario Base Map numbers & scale **1 : 10,000**

10-17-6450-47500; 10-17-6450-47450

(attach separate sheets if necessary)

Data Summery Form

Code:

Wetland Name:

WETLAND UNIT #	DOMINATE FORM	WETLAND TYPE	COMMUNITY CODE	COMMUNITY SUB_CODE	AREA (ha)	SITE TYPE	SOIL	FORMS	# OF FORMS	% OPEN WATER	ha OPEN WATER	FISH HABITAT (LM / HM)	Dominate Species	Additional Species	COMMENTS
1	h	Swamp	1		5.68	Palustrine	humic/mesic	h,ts	2		-				
2	h	Swamp	1		15.11	Palustrine	clay/loam	h,ts	2		-				
2	h	Swamp	7		3.76	Palustrine	clay/loam	h,ts,gc,ne	4		-				
3	h	Swamp	3		1.79	Palustrine	clay/loam	h,ts, gc	3		-				
3	h	Swamp	4		73.47	Palustrine	clay/loam	h,ts,ne	3		-				
3	ts	Swamp	5		6.25	Palustrine	clay/loam	ts,gc,h	3		-				
3	ne	Swamp	6		1.50	Palustrine	clay/loam	ne	1		-				
3	ts	Swamp	8		11.13	Palustrine	humic/mesic	h,c,ts,gc,ne,re	6		-				
4	h	Swamp	1		4.42	Palustrine	clay/loam	h,ts	2		-				
5	h	Swamp	2		9.22	Palustrine	clay/loam	h,ts,gc	3		-				
6	h	Swamp	2		4.35	Palustrine	clay/loam	h,ts,gc	3		-				
											-				
											-				
					136.68						-				

viii) WETLAND SIZE AND BOUNDARIES

a) Single contiguous wetland area: _____ hectares

b) Wetland complex comprised of 6 individual wetlands:

Wetland Unit Number (for reference)		Size of each wetland unit
		Ha
Wetland Unit No.	1	5.68
Wetland Unit No.	2	18.87
Wetland Unit No.	3	94.14
Wetland Unit No.	4	4.42
Wetland Unit No.	5	9.22
Wetland Unit No.	6	4.35
Wetland Unit No.	7	0.00
Wetland Unit No.	8	0.00
Wetland Unit No.	9	0.00
Wetland Unit No.	10	0.00
Wetland Unit No.	11	0.00
Wetland Unit No.	12	0.00
Wetland Unit No.	13	0.00
Wetland Unit No.	14	0.00
Wetland Unit No.	15	0.00
Wetland Unit No.	16	0.00
Wetland Unit No.	17	0.00
Wetland Unit No.	18	0.00
Wetland Unit No.	19	0.00
Wetland Unit Totals:		136.68

(Attach additional sheets if necessary)

TOTAL WETLAND SIZE 136.68

c) Brief documentation of reasons for including any areas less than 0.5 ha in size:

(Attach separate sheets if necessary .)

1.0 BIOLOGICAL COMPONENT

1.1 PRODUCTIVITY

1.1.1 GROWING DEGREE-DAYS/SOILS

GROWING DEGREE DAYS (check one)		MAP
1)		<2800
2)		2800 -3200
3)		3200 -3600
4)	X	3600 -4000
5)		>4000

SOILS Estimated Fractional Area	
0.88	clay/loam
0.00	silt/marl
0.00	limestone
0.00	sand
0.12	humic/mesic
0.00	fibric
0.00	granite

Determine the soil type from the appropriate OMAF soils maps

SCORING:

Growing Degree-Days	Clay-Loam	Silt-Marl	Lime-stone	Sand	Humic-Mesic	Fibric	Granite
<2800	15	13	11	9	8	7	5
2800-3200	18	15	13	11	9	8	7
3200-3600	22	18	15	13	11	9	7
3600-4000	**26**	21	18	15	**13**	10	8
>4000	30	25	20	18	15	12	8

(maximum score 30; if wetland contains more than one soil type, evaluate based on the fractional area)

Steps required for evaluation: (maximum score 30 points)

1. Select GDD line in evaluation table applicable to your wetland;
2. Determine fractional area of the wetland for each soil type;
3. Multiply fractional area of each soil type by score;
4. Sum individual soil type scores (round to nearest whole number).

In wetland complexes the evaluator should aim at determining the percentage of area occupied by the categories for the complex as a whole.

Score		
26	clay/loam	22.80
	silt/marl	0.00
	limestone	0.00
	sand	0.00
13	humic/mesic	1.60
	fibric	0.00
	granite	0.00

Final Score Growing Degree-Days/Soils (maximum 30 points) 24

1.1.2 WETLAND TYPE (Fractional Area = area of wetland type/total wetland area)

Estimate the Wetland Type from air photos or default to "swamp" (8)

	Fractional Area		Score
Bog	0.00	x 3	0.0
Fen	0.00	x 6	0.0
Swamp	1.00	x 8	8.0
Marsh	0.00	x 15	0.0
		Subtotal:	8.0

Wetland type score (maximum 15 points) 8

1.1.3 SITE TYPE (Fractional Area = area of site type/total wetland area)

Estimate from air photos

	Fractional Area		Score
Isolated	0.00	x 1 =	0.00
Palustrine (permanent or intermittent flow)	1.00	x 2 =	2.00
Riverine	0.00	x 4 =	0.00
Riverine (at rivermouth)	0.00	x 5 =	0.00
Lacustrine (at rivermouth	0.00	x 5 =	0.00
Lacustrine (on enclosed bay, with barrier beach)	0.00	x 3 =	0.00
Lacustrine (exposed to lake)	0.00	x 2 =	0.00
		Sub Total:	2.00

Site Type Score (maximum 5 points) 2

1.2 BIODIVERSITY

1.2.1 NUMBER OF WETLAND TYPES

(Check only one)			Score
1)	9	one	9 points
2)		two	13
3)		three	20
4)		four	30

Number of Wetland Types Score (maximum 30 points) 9

1.2.2 VEGETATION COMMUNITIES Veg Ref

Attach a separate sheet listing community (map) codes,vegetation forms and dominant species.
Use the form on the following page to record percent area by dominant vegetation form. This information will be used in other parts of the evaluation.

Communities should be grouped by number of forms. For example, 2 form communities might appear as follows:

2 forms

Code	Forms		Dominant Species				
M6	re,	ff	re,	*Typha latifolia;*	ff,	*Lemna minor,*	*Wolffia*
S1	ts,	gc	ts,	*Salix discolor;*	gc,	*lmpatiens capensis,*	*Thelypteris palustris*

Note that the dominant species for each form are separated by a semicolon. The dominant species (maximum of 2) within a form are separated by commas.

Scoring:

Total # of communities with 1-3 forms	Total # of communities with 4 -5 forms	Total # of communities with 6 or more forms
1 = 1.5 points	1 = 2 points	1 = 3 points
2 = 2.5	2 = 3.5	2 = 5
3 = 3.5	3 = 5	3 = 7
4 = 4.5	4 = 6.5	4 = 9
5 = 5	5 = 7.5	5 = 10.5
6 = 5.5	6 = 8.5	6 = 12
7 = 6	7 = 9.5	7 = 13.5
8 = 6.5	8 = 10.5	8 = 15
9 = 7	9 = 11.5	9 = 16.5
10 = 7.5	10 = 12.5	10 = 18
11 = 8	11 = 13	11 = 19
+.5 each additional community = 4.5	+.5 each additional community = 2.0	+ 1 each additional community = 3.0

e.g., a wetland with 3 one form communities 4 two form communities 12 four form communities and 8 six form communities would score:

6 + 13.5 + 15 = 34.5 = 35 points SubTotal: 10

Vegetation Communities Score (maximum 45 points) 10

Wetland Name: Beavers Dam Creek Pt. Col. WC

Wetland Size (ha): 136.68

Vegetation Form	% area in which form is dominant
h	86.19
c	0.00
dh	0.00
dc	0.00
ts	12.72
ls	0.00
ds	0.00
gc	0.00
m	0.00
ne	1.10
be	0.00
re	0.00
ff	0.00
f	0.00
su	0.00
u (unvegetated)	0.00
Total = 100%	100.00

1.2.3 DIVERSITY OF SURROUNDING HABITAT

(Check all appropriate items(1))

Determine from air photos

1	row crop
1	pasture
1	abandoned agricultural land
1	deciduous forest
1	coniferous forest
	mixed forest (at least 25% conifer and 75% deciduous or vice versa)
1	abandoned pits and quarries
1	open lake or deep river
1	fence rows with cover, or shelterbelts
	terrain appreciably undulating,hilly,or with ravines
	creek flood plain
8	Subtotal

Diversity of Surrounding Habitat Score (1 for each, maximum 7 points) 7

1.2.4 PROXIMITY TO OTHER WETLANDS

(Check first appropriate category only) Scoring

Determine from air photos and other wetlands evaluations in the vicinity

1)	8	Hydrologically connected by surface water to other wetlands (different dominant wetlaI1d type) or to open lake or deep river within 1.5 km — 8 points
2)		Hydrologically connected by surface water to other wetlands (same dominant wetland type) within 0.5 km — 8
3)		Hydrologica11y connected by surface water to other wetlands (different dominant wetland type),or to open lake or deep river from 1.5 to 4 km away — 5
4)		Hydrologically connected by surface water to other wetlands (same dominant wetland type) from 0.5 to 1.5 km away — 5
5)		Within 0.75 km of other wetlands (different dominant wetland type) or open water body, but not hydrologically connected by surface water — 5
6)		Within 1 km of other wetlands,but not hydrologically connected by surface water — 2
7)		No wetland within 1 km — 0

Proximity to other Wetlands Score (Choose one only, maximum 8 points) 8

Hydrologically connected to Lake Erie.

1.2.5 INTERSPERSION

Optional: Complete as time permits or as scoring dictates.

	Number of Intersections (Check one)		Score
1)	26 or less		3
2)	27 to 40		6
3)	41 to 60		9
4)	61 to 80		12
5)	81 to l00	15	15
6)	101 to 125		18
7)	126 to 150		21
8)	151 to 175		24
9)	176 to 200		27
10)	>200		30

Interspersion Score (Choose one only maximum 30 points) 15

1.2.6 OPEN WATER TYPES Ref

Determine from aerial photos.

	Permanently flooded: (Check one)		Score
1)	8	type 1	8
2)		type 2	8
3)		type 3	14
4)		type 4	20
5)		type 5	30
6)		type 6	8
7)		type 7	14
8)		type 8	3
9)		no open water	0

Open Water Type Score (Choose one only maximum 30 points) 8

1.3 SIZE

Score may be lower than actual if "Vegetation Community and Interspersion" have not been calculated.

136.7 hectares 57 Subtotal for Biodiversity

Size Score (Biological Component) (maximum 5O points) 15

Evaluation Table Size Score (Biological component)

Wetland size (ha)	Total Score for Biodiversity Subcomponent									
	<37	37-48	49-60	61-72	73-84	85-96	97-108	109-120	121-132	>132
<21 ha	1	5	7	8	9	17	25	34	43	50
21-40	5	7	8	9	10	19	28	37	46	50
41-60	6	8	9	10	11	21	31	40	49	50
61-80	7	9	10	11	13	23	34	43	50	50
81-100	8	10	11	13	15	25	37	46	50	50
101-120	9	11	13	15	18	28	40	49	50	50
121-140	10	13	**15**	17	21	31	43	50	50	50
141-160	11	15	17	19	23	34	46	50	50	50
161-180	13	17	19	21	25	37	49	50	50	50
181-200	15	19	21	23	28	40	50	50	50	50
201-400	17	21	23	25	31	43	50	50	50	50
401-600	19	23	25	28	34	46	50	50	50	50
601-800	21	25	28	31	37	49	50	50	50	50
801-1000	23	28	31	34	40	50	50	50	50	50
1001-1200	25	31	34	37	43	50	50	50	50	50
1201-1400	28	34	37	40	46	50	50	50	50	50
1401-1600	31	37	40	43	49	50	50	50	50	50
1601-1800	34	40	43	46	50	50	50	50	50	50
1801-2000	37	43	47	49	50	50	50	50	50	50
>2000	40	46	50	50	50	50	50	50	50	50

2.0 SOCIAL COMPONENT

2.1 ECONOMICALLY VALUABLE PRODUCTS

2.1.1 WOOD PRODUCTS

Determine the percentage of the wetland area dominated by "h" or "c" by using aerial photograph.

Area of wetland forested (ha), i.e. dominant form is h or c. Note that this is not wetland size. (Check one only)

h:	117.80	c:	0.00

			Score
1)		<5 ha	0
2)		5 -25 ha	3
3)		26 -50 ha	6
4)		51- l00 ha	9
5)	12	101 -200 ha	12
6)		>200 ha	18

Source of information: Field Inspection R.Drabick/A.Yagi 07
2006 Colour Ortho Photograph's

Wood Products Score (Score one only, maximum 18 points) 12

2.1.2 WILD RICE

(Check one)			Score (Choose one)
Present (minimum size 0.5 ha)	1)		6 points
Absent	2)	0	0

Source of information: Field Inspection R.Drabick/A.Yagi 07

Wild Rice Score (maximum 6 points) 0

2.1.3 COMMERCIAL FISH (BAIT FISH AND/OR COARSE FISH

(Check one)			Score (Choose one)
Present	1)	12	12 points
Habitat not suitable for fish	2)		0

Source of infolmation: Niagara Area Biologist A.Yagi 07

If any part of the wetland is riverine or the District fisheries files indicate presence of fish score"present"

Commercial Fish Score (maximum 12 points) 12

2.1.4 BULLFROGS

(Check one)			Score (Choose one)
Present	1)		1 points
Absent	2)	0	0

Source of information: Field Inspection R.Drabick/A.Yagi 07

Bullfrog Score (maximum 1 point) 0

Wetlands Manual

2.1.5 SNAPPING TURTLES

(Check one)			Score (Choose one)
Present	1)		1 point
Absent	2)	0	0

Source of information: Field Inspection R.Drabick/A.Yagi 07

Snapping Turtle Score (maximum 1 point) 0

2.1.6 FURBEARERS Fur Ref

(Consult Appendix 9)

	Name of furbearer		Source of information
1)	Raccoon	3	Field Inspection R.Drabick/A.Yagi 07
2)	Coyote	3	Field Inspection R.Drabick/A.Yagi 07
3)			
4)			
5)			
	SubTotal	6	

Scoring: 3 points for each species. maximum 12

Furbearer Score (maximum 12 points) 6

2.2 RECREATIONAL ACTIVITIES

Type of Wetland-Associated Use							
Intensity of Use	Hunting		Nature Enjoyment/ Ecosystem Study		Fishing		
High	40 points		40 points		40 points		
Moderate	20		20	20	20		
Low	8	8	8		8		
Not possible/NotKnown	0		0		0	0	
Totals		8		20		0	28

(score one level for each of the three wetland uses; scores are cumulative; maximum score 80 points)

Sources of information:

Hunting: Field Inspection R.Drabick/A.Yagi 07

Nature: Field Inspection R.Drabick/A.Yagi 07
Trail, unopened road allowance adjacent to wetland

Fishing: Field Inspection R.Drabick/A.Yagi 07

Recreational Activities Score (maximum 80 points) 28

2.3 LANDSCAPE AESTHETICS

Score using ortho-aerial photography

2.3.1 DISTINCTNESS

(Check one)			Score (Choose one)
Clearly distinct	1)	3	3 points
Indistinct	2)		0

Landscape Distinctness Score (maximum 3 points) 3

2.3.2 ABSENCE OF HUMAN DISTURBANCE

(Check one)			Score (Choose one)
Human disturbances absent or nearly so	1)		7 points
One or several localized disturbances	2)		4
Moderate disturbance; localized water pollution	3)		2
Wetland intact but impairment of ecosystem quality intense in some areas	4)	1	1
Extreme ecological degradation, or water pollution severe and widespread	5)		0

Source of information: Field Inspection R.Drabick/A.Yagi 07
localized debri present in stream and in wetlands

Absence of Human Disturbance Score (maximum 7 points) 1

2.4 EDUCATION AND PUBLIC AWARENESS

Optional: complete as time and scoring dictates.

2.4.1 EDUCATIONAL USES

(Check one)			Score (Choose one)
Frequent	1)		20 points
Infrequent	2)		12
No visits	3)	0	0

Source of information: Field Inspection R.Drabick/A.Yagi 07

Requires contact with Local Boards of Education.

Educational Uses Score (maximum 20 points) 0

2.4.2 FACILITIES AND PROGRAMS

(check one)			Score (Choose one)
Staffed interpretation centre	1)		8 points
No interpretation centre or staff but a system of self-guiding trails or brochures available	2)		4
Facilities such as maintained paths (e.g., woodchips) boardwalks, boat launches or observation towers but no brochures or other interpretation	3)	2	2
No facilities or programs	4)		0

Source of information: Field Inspection R.Drabick/A.Yagi 07
Friendship Trail

Facilities and Programs Score (maximum 8 points) 2

2.4.3 RESEARCH AND STUDIES

(check appropriate spaces)		Score
Long term research has been done		12 points
Research papers published in refereed scientific journal or as a thesis		10
One or more (non-research) reports have been written on some aspect of the wetland ' s flora fauna hydrology etc.	5	5
No research or reports		0
Subtotal:	5	

Attach list of known reports by above categories

Refer to ESPA, EPA and ANSI reports.

Research and Studies Score (Score is cumulative, maximum 12 points) 5

2.5 PROXIMITY TO AREAS OF HUMAN SETTLEMENT

Circle the highest applicable score

Distance of wetland from settlement	1) population> 10,000		2) population 2,500 -10,000		3) population <2,500 or cottage community	
1) Within or adjoining settlement	40 points		26		16	
2) 0.5 to 10 km from settlement	26	26	16		10	
3) 10 to 60 km from settlement	12		8		4	
4) >60 km from settlement	5		2		0	
		26		0		0

Name of settlement: 2.4 km east of the City of Port Colborne

Proximity to Human Settlement Score (maximum 40 points) 26

2.6 OWNERSHIP (FA= fraction Area) Score

Select a default value of "4" if no other information exists.

FA of wetland in public or private ownership held under contract or in trust for wetland protection		x	10	=	0.00
FA of wetland area in public ownership,not as above		x	8	=	0.00
FA of wetland area in private ownership,not as above	1.00	x	4	=	4.00

Source of information: OMNR GIS Assessment/Teranet Layer 2006

Ownership Score (maximum 10 points) 4

Additional Reports
1.Weaver Rd Woodlot: R.M. of Niagara, Environmentally Sensitive Areas Report: #PC-05
2. Beaver Dam Drain Engineers report 1997
3. Region of Niagara Natural Area Inventory 2006 to 2008

2.7 SIZE

The score may be lower than actual since economic and recreational values have not been completed.

136.7 hectares 84 Subtotal for Social

Evaluation Table for Size Score (Social Component)

Wetland Size (ha)	Total for Size Dependent Score									
	<31	31-45	46-60	61-75	76-90	91-105	106-120	121-135	136-150	>150
<2 ha	1	2	4	8	10	12	14	14	14	15
2 - 4ha	1	2	4	8	12	13	14	14	15	16
5 - 8ha	2	2	5	9	13	14	15	15	16	16
9 - 12ha	3	3	6	10	14	15	15	16	17	17
13-17	3	4	7	10	14	15	16	16	17	17
18-28	4	5	8	11	15	16	16	17	17	18
29-37	5	7	10	13	16	17	18	18	19	19
38-49	5	7	10	13	16	17	18	18	19	20
50-62	5	8	11	14	17	17	18	19	20	20
63-81	5	8	11	15	17	18	19	20	20	20
82-105	6	9	11	15	18	18	19	20	20	20
106-137	6	9	12	16	**18**	19	20	20	20	20
138-178	6	9	13	16	18	19	20	20	20	20
179-233	6	9	13	16	18	20	20	20	20	20
234-302	7	9	13	16	18	20	20	20	20	20
303-393	7	9	14	17	18	20	20	20	20	20
394-511	7	10	14	17	18	20	20	20	20	20
512-665	7	10	14	17	18	20	20	20	20	20
666-863	7	10	14	17	19	20	20	20	20	20
864-1123	8	12	15	17	19	20	20	20	20	20
1124-1460	8	12	15	17	19	20	20	20	20	20
1461-1898	8	13	15	18	19	20	20	20	20	20
1899-2467	8	14	16	18	20	20	20	20	20	20
>2467	8	14	16	18	20	20	20	20	20	20

Total Size Score (Social Component) 18.0

2.8 ABORIGINAL AND CULTURAL HERITAGE VALUES

Either or both Aboriginal or Cultural Values may be scored. However, the maximum score permitted for 2.8 is 30 points. Attach documentation.

2.8.1 ABORIGINAL VALUES

Full documentation of sources must be attached to the data record.

1)	Significant		=	30 points
2)	Not Significant		=	0
3)	Unknown	0.0	=	0
	Total:	0		

2.8.2 CULTURAL HERITAGE

1)	Significant		=	30 points
2)	Not Significant		=	0
3)	Unknown	0.0	=	0
	Total:	0		

Aboriginal Values/Cultural Heritage Score (maximum 30 points) 0.0

3.0 HYDROLOGICAL COMPONENT

3.1 FLOOD ATTENUATION

Estimated&Calculated values can be obtained from G.I.S. data layers.

If the wetland is a complex including isolated wetlands, apportion the l00 points according to area. For example if 10 ha of a l00 ha complex is isolated, the isolated portion receives the maximum proportional score of 10. The remainder of the wetland is then evaluated out of 90.

Step 1: Detennination of Maximum Score

	Wetland is located on one of the defined 5 large lakes or 5 major rivers (Go to Step 4)
	Wetland is entirely isolated (i.e. not part of a complex) (Go to Step 4)
X	All other wetland types (Go through Steps 2,3 and 4B)

Step 2: Determination of Upstream Detention Factor (DF)

(a)	Wetland area (ha)		136.68	
(b)	Total area (ha) of upstream detention areas (include the wetland itself)		225.78	***estimate***
(c)	Ratio of (a):(b)		0.61	
(d)	Upstream detention factor: (c) x 2 = (maximum allowable factor = 1)	1.2	1.00	

Step 3: Determination of Wetland Attenuation Factor (AF)

(a)	Wetland area (ha)		136.68	
(b)	Size of catchment basin (ha) upstream of wetland (include wetland itself in catchment area)		1072.24	***calculate***
(c)	Ratio of (a):(b)		0.13	
(d)	Wetland attenuation factor: (c) x 10 = (maximum allowable factor = 1)	1.3	1.00	

Step 4: Calculation of final score

(a)	Wetlands on large lakes or major rivers		0	
(b)	Wetland entirely isolated		l00	
(b)	All other wetlands --calculate as follows:			
(c	* Complex Formula - Isolated portion	100.00		
	Initial Score		100 *	
	Upstream detention factor (DF) (Step 2)		1.00	
	Wetland attenuation factor (AF) (Step 3)		1.00	
	Final score: [(DF + AF)/2] x Initial score =		100.00	
(c	* Final score:=	100		

*Unless wetland is a complex with isolated portions (see above).

Flood Attenuation Score (maximum l00 points) 100.0

3.2 WATER QUALITY IMPROVEMENT

3.2.1 SHORT TERM WATER QUALITY IMPROVEMENT

Step 1: **Determination of maximum initial score**

	Wetland on one of the 5 defined large lakes or 5 major rivers (Go to Step 5a)
X	All other wetlands (Go through Steps 2, 3, 4, and 5b)

Step 2: **Determination of watershed improvement factor (WIF)**

Calculation of WIF is based on the fractional area (FA) of each site type that makes up the total area of the wetland.

(FA= area of site type/total area of wetland)	Fractional Area				
FA of isolated wetland	0.00	x	0.5	=	0.00
FA of riverine wetland	0.00	x	1	=	0.00
FA of palustrine wetland with no inflow		x	0.7	=	0.00
FA of palustrine wetland with inflows	1.00	x	1	=	1.00
FA of lacustrine on lake shoreline	0.00	x	0.2	=	0.00
FA of lacustrine at lake inflow or outflow		x	1	=	0.00
			Sub Total:		1.00
			Sum (WIF cannot exceed 1.0)		1.00

Step 3: Determination of catchment land use factor (LUF)

(Choose the first category that fits upstream landuse in the catchment.)

1)	1.0	Over 50% agricultural and/or urban	1.0
2)		Between 30 and 50% agricultural and/or urban	0.8
3)		Over 50% forested or other natural vegetation	0.6

LUF (maximum 1.0) 1.00

Step 4: Determination of pollutant uptake factor (PUT)

Calculation of PUT is based on the fractional area (FA) of each vegetation type that makes up the total area of the wetland. Base assessment on the dominant vegetation form for each community except where dead trees or shrubs dominate. In that case base assessment on the domininant live vegetation. (FA = area of vegetation type/total area of wetland)

	Fractional Area				
FA of wetland with live trees, shrubs, herbs or mosses (c,h,ts,ls,gc,m)	0.99	x	0.75	=	0.74
FA of wetland with emergent, submergent or floating vegetation (re,be,ne,su,f,ff)	0.01	x	1	=	0.01
FA of wetland with little or no vegetation (u)	0.00	x	0.5	=	0.00
			Subtotal:		0.75
Estimate FA from air photos or use default factor of "0.75"			**Sum (PUT cannot exceed 1.0)**		0.75

Step 5: **Calculation of final score**

(a)	Wetland on large lakes or major rivers	0
(b)	All other wetlands -calculate as follows	
	Initial score	60
	Water quality improvement factor (WQF)	1.00
	Land use factor (LUF)	1.00
	Pollutant uptake factor (PUT)	0.75
	Final score: 60 x WQF x LUF x PUT =	45.16

Short Term Water Quality Improvement Score (maximum 60 points) 45

3.2.2 LONG TERM NUTRIENT TRAP

Determine wetland type from aerial photos and soil type from OMAF soils maps.

Step 1:

	Wetland on large lakes or 5 major rivers	0 points
X	All other wetlands (proceed to Step 2)	

Step 2: Choose only one of the following settings that best describes the wetland being evaluated

1)		Wetland located in a river mouth	10 points
2)		Wetland is a bog, fen or swamp with more than 50% of the wetland being covered with organic soil	10
3)	3	Wetland is a bog, fen or swamp with less than 50% of the wetland being covered with organic soil	3
4)		Wetland is a marsh with more than 50% of the wetland covered with organic soil	3
5)		None of the above	0

Long Term Nutrient Trap Score (maximum 10 points) 3

3.2.3 GROUNDWATER DISCHARGE

The final score will be underestimated since some of the wetland characteristics cannot be scored

(Circle the characteristics that best describe the wetland being evaluated and then sum the scores. If the sum exceeds 30 points assign the maximum score of 30.)

Wetland Characteristics	Potential for Discharge					
	None to Little		Some		High	
Wetland type	1) Bog = 0		2) Swamp/Marsh = 2	2	3) Fen = 5	
Topography	1) Flat/rolling = 0		2) Hilly = 2	2	3) Steep = 5	
Wetland Area: Upslope Catchment Area	Large (>50%) = 0		Moderate (5-50%) = 2		Small <(5%) = 5	
Lagg Development	1) None found = 0	0	2) Minor = 2		3) Extensive = 5	
Seeps	1) None = 0	0	2) = or < 3 seeps = 2		3) > 3 seeps = 5	
Surface marl deposits	1) None = 0	0	2) = or < 3 sites = 2		3) > 3 sites = 5	
Iron precipitates	1) None = 0	0	2) = or < 3 sites = 2		3) > 3 sites = 5	
Located within 1 km of a major aquifer	N/A = 0	0	N/A = 0		Yes = 10	
Totals		0		4		0

(Scores are cumulative maximum score 30 points)

Groundwater Discharge Score (maximum 30 points) 4

3.3 CARBON SINK

Choose only one of the following

1)	Bog, fen or swamp with more than 50% coverage by organic soil		5 points
2)	Bog, fen or swamp with between 10 to 49% coverage by organic soil		2
3)	Marsh with more than 50% coverage by organic soil		3
4)	Wetlands not in one of the above categories	0	0

Carbon Sink Score (maximum 5 points) 0

Wetlands Manual

3.4 SHORELINE EROSION CONTROL

Step 1: ***Determine from ortho-aerial photography*** Score

0	Wetland entirely isolated or palustrine	0
	Any part of the Wetland riverine or lacustrine (proceed to Step 2)	

Step 2:

Choose the **one** characteristic that best describes the shoreline vegetation (see text for a definition of shoreline)

			Score
1)		Trees and shrubs	15
2)		Emergent vegetation	8
3)		Submergent vegetation	6
4)		Other shoreline vegetation	3
5)		No vegetation	0

Shoreline Erosion Control Score (maximum 15 points) 0

3.5 GROUND WATER RECHARGE

3.5.1 WETLAND SITE TYPE

Score

(a) Wetland > 50% lacustrine (by area) or located on one of the five major rivers — 0

(b) Wetland not as above. Calculate final score as follows:
(FA= area of site type/total area of wetland)

	Fractional Area			
FA of isolated or palustrine wetland	1.00	x 50	=	50.0
FA of riverine wetland	0.00	x 20	=	0.0
FA of lacustrine wetland (wetland <50% lacustrine)	0.00	x 0	=	0.0
		Subtotal:		50.0

Ground Water Recharge Wetland Site Type Component Score (maximum 50 points) 50

3.5.2 WETLAND SOIL RECHARGE POTENTIAL

Determine from OMAF soils maps.

(Circle only **one** choice that best describes the hydrologic soil class of the area surrounding the wetland being evaluated.)

Dominant Wetland Type	1) Sand, loam, gravel, till		2) Clay or bedrock	
1) Lacustrine or on a major river	0		0	
2) Isolated	10		5	
3) Palustrine	7		4	4
4) Riverine (not a major river)	5		2	
Totals		0		4

Ground Water Recharge Wetland Soil Recharge Potential Score (maximum 10 points) 4

4.0 SPECIAL FEATURES COMPONENT

4.1 RARITY

4.1.1 WETLANDS Ref Map

Site District 7E-5
Presence of wetland type (check one or more)

	Bog
	Fen
X	Swamp
	Marsh

Score for rarity within the landscape and rarity of the wetland type. Score for rarity of wetland type is cumulative (maximum 80 points) based on presence or absence.

Slte District	Score for Rarity within the Landscape	Score for Rarity of Wetland Type			
		Marsh	Swamp	Fen	Bog
6-1	60	40	0	80	80
6-2	60	40	0	80	80
6-3	40	10	0	40	80
6-4	60	40	0	80	80
6-5	20	40	0	80	80
6-6	40	20	0	80	80
6-7	60	10	0	80	80
6-8	20	20	0	80	80
6-9	0	20	0	80	80
6-10	20	0	20	80	80
6-11	0	30	0	80	80
6-12	0	30	0	60	80
6-13	60	10	0	80	80
6-14	40	20	0	40	80
6-15	40	0	0	80	80
7-1	60	0	60	80	80
7-2	60	0	0	80	80
7-3	60	0	0	80	80
7-4	80	0	0	80	80
7-5	**60**	20	**0**	80	80
7-6	80	30	0	80	80

Rarity within the Landscape Score (maximum 80 points) 60
Rarity of Wetland Type Score (maximum 80 points) 0

The updated scores for rarity in Site Region 7-5 are in the stages of review and still require official confirmation.(June 8, 2004)

4.1.2 SPECIES Spp Ref

4.1.2.1 BREEDING HABITAT FOR AN ENDANGERED OR THREATENED SPECIES

	Name of species		Source of information
1)			
2)			
3)			
4)			
5)			
	Total:	0	

Attach documentation.

Scoring:

For each species 250 points

(score is cumulative, no maximum score)

Breeding Habitat for Endangered or Threatened Species Score (no maximum) 0

4.1.2.2 TRADITIONAL MIGRATION OR FEEDING HABITAT FOR AN ENDANGERED OR THREATENED SPECIES

	Name of species		Source of information
1)			
2)			
3)			
4)			
5)			
	Total:	0	

Attach documentation.
Scoring:

For one species 150 points
For each additional species 75

(score is cumulative, no maximum score)

Traditional Habitat for Endangered Species Score (no maximum) 0

4.1.2.3 PROVINCIALLY SIGNIFICANT ANIMAL SPECIES Prov Ref

	Name of species	Source of information
1)	Fowlers toad (*Bufo fowler* i)	NHIC database and MNR field records 2007-2008
2)		
3)		
4)		
5)		
6)		
7)		
8)		
9)		
10)		
11)		
12)		
13)		
14)		
15)		

Attach separate list if necessary; Attach documentation

Scoring:

Number of provincially significant animal species in the wetland:

1	species = 50 points		14 species	=	154
2	species = 80		15 species	=	156
3	species = 95		16 species	=	158
4	species = 105		17 species	=	160
5	species = 115		18 species	=	162
6	species = 125		19 species	=	164
7	species = 130		20 species	=	166
8	species = 135		21 species	=	168
9	species = 140		22 species	=	170
10	species = 143		23 species	=	172
11	species = 146		24 species	=	174
12	species = 149		25 species	=	176
13	species = 152				

Add one point for every species past 25 (for example, 26 species = 177 points, 27 species = 178 points etc.)

(no maximum score)

Provincially Significant Animal Species Score (no maximum) 50

4.1.2.4 PROVINCIALLY SIGNIFICANT PLANT SPECIES

(Scientific names must be recorded)

	Common Name	Scientific Name	Source of information
1)	Pin Oak	Quercus palustris	Weaver Rd Wdlt:
2)			R.M. of Niagara,
3)			E. S. A. Report: #PC-05
4)			
5)			
6)			
7)			
8)			
9)			
10)			
11)			
12)			
13)			
14)			
15)			

Attach separate list if necessary; Attach documentation

Scoring:

Number of provincially significant plant species in the wetland:

1 species	=	50 points	14 species	=	154
2 species	=	80	15 species	=	156
3 species	=	95	16 species	=	158
4 species	=	105	17 species	=	160
5 species	=	115	18 species	=	162
6 species	=	125	19 species	=	164
7 species	=	130	20 species	=	166
8 species	=	135	21 species	=	168
9 species	=	140	22 species	=	170
10 species	=	143	23 species	=	172
11 species	=	146	24 species	=	174
12 species	=	149	25 species	=	176
13 species	=	152			

Add one point for every species past 25 (for example, 26 species = 177 points, 27 species = 178 points etc.)

Provincially Significant Plant Species Score (no maximum) 50

4.1.2.5 REGIONALLY SIGNIFICANT SPECIES (SITE REGION) Spp Ref

Scientific names must be recorded for plant species. **Lists of significant species must be approved by MNR.**

SIGNIFICANT IN SITE REGION:

.

	Common Name	Scientific Name	Source of information
1)			
2)			
3)			
4)			
5)			
6)			
7)			
8)			
9)			
10)			
11)			
12)			
13)			
14)			
15)			

Attach separate list if necessary .Attach documentation.

Scoring:

No. of species significant in Site Region

1 species	=	20	6 species	=	55
2 species	=	30	7 species	=	58
3 species	=	40	8 species	=	61
4 species	=	45	9 species	=	64
5 species	=	50	10 species	=	67

Add one point for every species past 10. (no maximum score)

Regionally Significant Species Score (Site Region)(no maximum)

Additional Species							
Scienctific Name	Common Name	S Rank	G Rank	Wet CoE	Tracked	Poly. Loc	Comments
Plants							
Trees							
Acer saccharum ssp. Saccharum	Hard Maple	S5	G5	3	X		
Acer rubrum	Red Maple	S5	G5	0	X		
Acer saccharinum	Silver Maple	S5	G5	-3	X		
Carya ovata	Shagbark Hickory	S5	G5	3	X		
Fagus grandifolia	American Beech	S5	G5	3	X		
Fraxinus americana	White Ash	S5	G5	3	X		
Fraxinus pennsylvanica	Green/Red Ash	S5	G5	-3	X		
Juniperus virginiana	Eastern Red Cedar	S5	G5	3	X		
Picea glauca	White Spruce	S5	G5	3	X		
Acer saccharum ssp. nigrum	Black Maple	S4	G5Q	3	X		
Juglans nigra	Black Walnut	S4	G5	3	X		
Populus tremuloides	Trembling Aspen	S5	G5	0	X		
Ostrya virginiana	Hop Hornbeam	S5	G5	4	X		
Quercus alba	White Oak	S5	G5	3	X		
Quercus bicolor	Swamp White Oak	S4	G5	-4	X		
Quercus macrocarpa	Bur Oak	S5	G5	1	X		
Quercus palustris	Pin Oak	S3	G5	-3	X		Prov signif.
Quercus rubra	Red Oak	S5	G5	3	X		
Tilia americana	Basswood	S5	G5	3	X		
Ulmus americana	White Elm	S5	G5?	-2	X		
Ulmus rubra	Slippery Elm	S5	G5	0	X		
Shrubs							
Cornus sp	Dogwood spp						
Viburnum sp	Arrow-wood spp						
Ribes triste	Red current	S5	G5	-5			
Zanthoxylum americanum	Prickly ash	S5	G5	5			
Salix discolor	Pussy willow	S5	G5	-3			
Sweet Cherry							
Lindera benzoin	Spicebush	S5	G5	-2	X		
Rhus radicans ssp. rydbergii	Western Poison-ivy	S5	G5	0	X		
Rubus idaeus ssp. melanolasius	Wild Red Raspberry	S5	G5	-2	X		
Ferns							
Sedge							
Rush							
Vine							
Woody Vines							
Graminoid							
Herb							
Amphibians							
Bufo fowleri	Fowler's toad	THR				Prov	MNR records confirmation breeding at mouth of drain in beach area
Pseudacris triseriata triseriata	Western Chorus Frog						
Pseudacris crucifer	Spring Peeper						
Rana clamitans	Green frog						
Rana pipiens	Leopard Frog						
Mammals							
Procyon lotor	Raccoon						
Odocoileus virginianus	White tailed Deer						
Sciurus carolinensis	Grey squirrel						
Canis lantrans	Coyote						
Birds							
	Red-tailed Hawk						
Reptiles							
Chrysemys picta marginata	Painted turtle						
Thamnophis sirtalis sirtalis	Eastern Gartersnake						
Fish							
Lepomis gibbosus	Pumpkinseed						NPCA 2008
Umbra limi	Central Mudminnow						MNR Lake Erie Drains Study 1976; NPCA 2008
Notemigonus crysoleucas	Golden Shiner						"
Pimephales notatus	Bluntnose Minnow						NPCA 2008
Catostomus commersoni	Common White Shiner						NPCA 2008
Perca flavescens	Yellow Perch						NPCA 2008
Fundulus diaphanus	Banded Killifish						NPCA 2008
Notropis atherinoides	Emerald Shiner						NPCA 2008

4.2.1.6 LOCALLY SIGNIFICANT SPECIES (SITE DISTRICT)

Scientific names must be recorded for plant species. **Lists of significant species must be approved by MNR.**

	Common Name	Scientific Name	Source of information
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			

Attach separate list if necessary .Attach documentation.

Scoring:

No. of species significant in Site District

1 species	=	10	6 species	=	41
2 species	=	17	7 species	=	43
3 species	=	24	8 species	=	45
4 species	=	31	9 species	=	47
5 species	=	38	10 species	=	49

For each significant species over 10 in the wetland, add 1 point.

Locally Significant Species Score (Site District) (no maximum)

4.2 SIGNIFICANT FEATURES AND/OR FISH & WILDLIFE HABITAT

4.2.1 NESTING OF COLONIAL WATERBIRDS

Status	Name of species	Source of Information	Score	
1) Currently nesting			50	
2) Known to have nested within past 5 years			25	
3) Active feeding area (Do not include feeding by great blue herons)			15	
4) None known			0	

Consult the Ontario Heronry database at Bird Studies Canada. Subtotal: 0

Attach documentation (nest locations etc., if known)

Score highest applicable category only; maximum score 50 points.

Score for Nesting Colonial Waterbirds (maximum 50 points) 0

4.2.2. WINTER COVER FOR WILDLIFE

Score "locally significant" if trees & shrubs are present, also consult District deer yard data.

		(Check only highest level of significance) **(one only)**	Score
1)		Provincially significant	l00
2)		Significant in Site Region	50
3)		Significant in Site District	25
3)	10	Locally significant	10
4)		Little or poor winter cover present	0

Source of information: Niagara Area Biologist A.Yagi 07

Winter Cover for Wildlife Score (maximum l00 points) 10

4.2.3 WATERFOWL STAGING AND/OR MOULTING

(Check only highest level of significance for both staging and moulting; score is cumulative across columns, maximum score 15(

		Staging	Score (one only)	Moulting	Score (one only)
1)	Nationally significant		150		150
2)	Provincially significant		100		l00
3)	Regionally significant		50		50
4)	Known to occur		10		10
5)	Not possible		0		0
6)	Unknown	0	0	0	0
	Total:	0		0	
	Subtotal:		0		

Source of information: Niagara Area Biologist A.Yagi 07

Waterfowl Moulting and Staging Score (maximum 150 points) 0

4.2.4 WATERFOWL BREEDING

		(Check only highest level of significance)	Score
1)		Provincially significant	l00
2)		Regionally significant	50
3)	10	Habitat suitable	10
4)		Habitat not suitable	0

Source of information: Niagara Area Biologist A.Yagi 07

Waterfowl Breeding Score (maximum lOO points) 10

4.2.5 MIGRATOR PASSERINE, SHOREBIRD OR RAPTOR STOPOVER AREA

(check highest applicable category)

1)		Provincially significant	l00
2)		Significant in Site Region	50
3)		Significant in Site District	10
4)	0	Not significant	0

Source of information: Niagara Area Biologist A.Yagi 07

Passerine, Shorebird or Raptor Stopover Score (maximum 100 points) 0

4.2.6 FISH HABITAT

Consult District Fisheries files. If fish are present in the wetland, score 15 or 25 points depending on the size of the fish habitat present.

4.2.6. Spawning and Nursery Habitat

Table 5. Area Factors for Low Marsh, High Marsh, and Swamp Communities.

No. of ha of Fish Habitat	Area Factor
< 0.5 ha	0.1
0.5- 4.9	0.2
5.0- 9.9	0.4
10.0- 14.9	0.6
15.0 -19.9	0.8
20.0+ ha	1.0

Step 1:

_____ Fish habitat is not present within the wetland (Score = 0)

X Fish habitat is present within the wetland (Go to Step 2)

Step 2: Choose only one option

1) _____ Significance of the spawning and nursery habitat within the wetland is known (Go to Step 3)

2) X Significance of the spawning and nursery habitat within the wetland is not known (Go through Steps 4, 5, 6 and 7)

Step 3: Select the highest appropriate category below attach documentation:

1)	_____	Significant in Site Region	l00 points
2)	_____	Significant in Site District	50
3)	_____	Locally Significant Habitat (5.0+ ha)	25
4)	_____	Locally Significant Habitat (<5.0 ha)	15

Score for Spawning and Nursery Habitat (maximum score 100 points) 0

Step 4: **Proceed to Steps 4 to 7 only if Step 3 was not answered.**

(**Low Marsh**: marsh area from the existing water line out to the outer boundary of the wetland)

X Low marsh not present (Continue to Step 5)
_____ Low marsh present (Score as follows)

Scoring for Presence of Key Vegetation Groups

Scoring is based on the one most clearly dominant plant species of the dominant form in each Low Marsh vegetation community. Check the appropriate Vegetation Group (see Appendix 16 Table 16-2) for each Low Marsh community. Sum the areas of the communities assigned to each Vegetation Group and multiply by the appropriate size factor from Table 5.

Vegetation Group Number	Vegetation Group Name	Present as a Dominant Form (check)	Total Area (ha)	Area Factor (see Table 5)	Score	Final Score (area factor x score)
1	Tallgrass				6 pts	0.0
2	Shortgrass-Sedge				11	0.0
3	Cattail-Bulrush-Burreed				5	0.0
4	Arrowhead-Pickerelweed				5	0.0
5	Duckweed				2	0.0
6	Smartweed-Waterwillow				6	0.0
7	Waterlily-Lotus				11	0.0
8	Waterweed-Watercress				9	0.0
9	Ribbongrass				10	0.0
10	Coontail-Naiad-Watermilfoil				13	0.0
11	Narrowleaf Pondweed				5	0.0
12	Broadleaf Pondweed				8	0.0
Sub Total Score (maximum 75 points)						0.0
Total Score (maximum 75 points)						0.0

Step 5: (**High Marsh**: area from the water line to the inland boundary of marsh wetland type. This is essentially what is commonly referred to as a wet meadow, in that there is insufficient standing water to provide fisheries habitat except during flood or high water conditions.)

X High marsh not present (Continue to Step 6)
_____ High marsh present (Score as follows)

Scoring for Presence of Key Vegetation Groups

Scoring is based on the one most clearly dominant plant species of the dominant form in each High 1Marsh vegetation community. Check the appropriate Vegetation Group (see Appendix 16 Table 16-2) for each High Marsh community. Sum the areas of the communities assigned to each Vegetation Group and multiply by the appropriate size factor from Table 5.

Vegetation Group Number	Vegetation Group Name	Present as a Dominant Form (check)	Total Area (ha)	Area Factor (see Table 5)	Score	Final Score (area factor x score)
1	Tallgrass				6 pts	0.0
2	Shortgrass-Sedge				11	0.0
3	Cattail-Bulrush-Burreed				5	0.0
4	Arrowhead-Pickerelweed				5	0.0
Sub Total Score (maximum 25 points)						0.0
Total Score (maximum 25 points)						0.0

Step 6: (**Swamp**: Swamp communities containing fish habitat,either seasonally or permanently. Determine the total area of seasonally flooded swamps and permanently flooded swamps containing fish habitat.)

	Swamp containing fish habitat not present (Continue to Step 7)
X	Swamp containing fish habitat present (Score as follows)

Swamp containing fish Habitat	Present (check)	Total area (ha)	Area Factor (see Table 5)	Score	TOTAL SCORE (factor x score)
Seasonally flooded	X	1.5	0.2	10	2.0
Permanently flooded	X	1.5	0.2	10	2.0
Sub SCORE (maximum 20 points)					4.0
SCORE (maximum 20 points)					4.0

Step 7: Calculation of final score

Score for Spawning and Nursery Habitat (Low Marsh) (maximum 75)	=	0.0
Score for Spawning and Nursery Habitat (High Marsh) (maximum 25)	=	0.0
Score for Swamp Containing Fish Habitat (maximum 20)	=	4.0
	Subtotal:	4.0
Sum (maximum score 100 points) =		4.0

4.2.6.2 Migration and Staging Habitat

Score only if information on fish migration and staging exists, e.g. migration of northern pike through a wetland to access spawning areas.

Step 1:

1) ____ Staging or Migration Habitat is not present in the wetland (Score = 0)

2) X Staging or Migration Habitat is present in the wetland significance of the habitat is known (Go to Step 2)

3) ____ Staging or Migration Habitat is present in the wetland significance of the habitat is not known (Go to Step 3)

NOTE: Only one of Step 2 or Step 3 is to be scored.

Step 2: Select the highest appropriate category below, attach documentation:

		Score
1)	Significant in Site Region	25 points
2)	Significant in Site District	15
3)	Locally Significant	10
4) X	Fish staging and/or migration habitat present,but not as above	5

Score for Fish Migration and Staging Habitat (maximum score 25 points) 5

Step 3: Select the highest appropriate category below based on presence of the designated site type (does not have to be dominant). See Section 1.1.3. Note name of river for 2) and 3).

		Score
1)	Wetland is riverine at rivermouth or lacustrine at rivermouth	25 points
2)	Wetland is riverine,within 0.75 km of rivermouth	15
3)	Wetland is lacustrine,within 0.75 km of rivermouth	10
4)	Fish staging and/or migration habitat present, but not as above	5

Score for Staging and Migration Habitat (maximum score 25 points) 0

4.3 ECOSYSTEM AGE

(Fractional Area = area of wetland/total wetland area)

	Fractional Area			Scoring
Bog	0.00	x	25 =	0.0
Fen, treed to open on deep soils floating mats or marl		x	20 =	0.0
Fen, on limestone rock		x	5 =	0.0
Swamp	1.00	x	3 =	3.0
Marsh	0.00	x	0 =	0.0
		Sub Total:		3.0

Ecosystem Age Score (maximum 25 points) 3.0

4.4 GREAT LAKES COASTAL WETLANDS

Score for coastal (see text for definition) wetlands only

Choose one only

	wetland < 10 ha	=	0 points
25	wetland 10- 50 ha	=	25
	wetland 51 -lOO ha	=	50
	wetland > 100 ha	=	75

Great Lakes Coastal Wetlands Score (maximum 75 points) 25

5.0 EXTRA INFORMATION

5.1 PURPLE LOOSESTRIFE

____ Absent/Not seen

X Present

(a) One location in wetland ____
Two to many locations X

Abundance code
(b) (1 < 20 stems X
(2 20-99 stems ____
(3 100-999 stems ____
(4 >1000 stems ____

5.2 SEASONALLY FLOODED AREAS

Check one or more

Ephemeral	(less than 2 weeks)	X
Temporal	(2 weeks to 1 month)	X
Seasonal	(1 to 3 months)	X
Semi-permanent	(>3 months)	X
No seasonal flooding		____

5.3 SPECIES OF SPECIAL SIGNIFICANCE

5.3.1 Osprey

Present and nesting	____
Known to have nested in last 5 yr	____
Feeding area for osprey	____
Not as above	X

5.3.2 Common Loon

Nesting in wetland	____
Feeding at edge of wetland	____
Observed or heard on lake or river adjoining the wetland	____
Not as above	X

WETLAND EVALUATION SCORING RECORD

WETLAND NAME AND/OR NUMBER: Beavers Dam Creek Pt. Col. WC

1.0 BIOLOGICAL COMPONENT

1.1 PRODUCTIVITY

1.1.1	Growing Degree-Days/Soils	24.4	
1.1.2	Wetland Type	8.0	
1.1.3	Site Type	2.0	
	Total for Productivity		34

1.2 BIODIVERSITY

1.2.1	Number of Wetland Types	9.0	
1.2.2	Vegetation Communities (maxixmum 45)	9.5	
1.2.3	Diversity of Surrounding Habitat (maximum 7)	7.0	
1.2.4	Proximinty to Other Wetlands	8.0	
1.2.5	Interspersion	15.0	
1.2.6	Open Water Type	8.0	
	Total for Biodiversity		57
	Sub Total for Biodiversity	57	
1.3	SIZE (Biological Component)		15
	Sub Total:		106
	TOTAL FOR BIOLOGICAL COMPONENT (not to exceed 250)		106

2.0 SOCIAL COMPONENT

2.1 ECONOMICALLY VALUABLE PRODUCTS

2.1.1	Wood Products	12
2.1.2	Wild Rice	0
2.1.3	Commercial Fish	12
2.1.4	Bullfrogs	0
2.1.5	Snapping Turtles	0
2.1.6	Furbearers	6

Total for Economically Valuable Products: 30

2.2 RECREATIONAl ACTIVITIES (maximum 80): 28

2.3 LANDSCAPE AESTHETICS

2.3.1	Distinctness	3
2.3.2	Absence of Human Disturbance	1

Total for Landscape Aesthetics: 4

2.4 EDUCATION AND PUBLIC AWARENESS

2.4.1	Educational Uses	0
2.4.2	Facilities and Programs	2
2.4.3	Research and Studies	5

Total for Education and Public Awareness: 7

2.5 PROXIMITY TO AREAS OF HUMAN SETTLEMENT: 26

2.6 OWNERSH1P: 4

Subtotal for Social Component: 84.0

2.7 SIZE (Social Component): 18

2.8 ABORIGINAL AND CULTURAL VALUES: 0

Sub Total: 117

TOTAL FOR SOCIAL COMPONENT (not to exceed 250): 117

3.0 HYDROLOGICAL COMPONENT

3.1	FLOOD ATTENUATION		100
3.2	WATER QUALITY IMPROVEMENT		
3.2.1	Short Term Improvement	45.2	
3.2.2	Long Term Improvement	3.0	
3.2.3	Groundwater Discharge (maximum 30)	4.0	
	Total for Water Quality Improvement		52
3.3	CARBON SINK		0
3.4	SHORELINE EROSION CONTROL		0
3.5	GROUNDWATER RECHARGE		
3.5.1	Site Type	50.00	
3.5.2	Soils	4.0	
	Total for Groundwater Recharge		54
	Sub Total:		206
	TOTAL FOR HYDROLOGICAL COMPONENT (not to exceed 250)		206

4.0 SPECIAL FEATURES

4.1 RARITY

4.1.1 Wetlands		
4.1.1.1 Rarity within the Landscape	60.0	
4.1.1.2 Rarirty of Wetland Type (maximum 80)	0.0	
Total for Wetland Rarity		60
4.1.2 Species		
4.1.2.1 Endangered or Threatened Species Breeding	0.0	
4.1.2.2 Traditional Use by Endangered or Threatened Species	0.0	
4.1.2.3 Provincially Significant Animals	50.0	
4.1.2.4 Provincially Significant Plants	50.0	
4.1.2.5 Regionally Significant Species	0.0	
4.1.2.6 Locally Significant Species	0.0	
Total for Species Rarity		100

4.2 SIGNIFICANT FEATURES OR HABITAT

4.2.1 Colonial Waterbirds	0.0	
4.2.2 Winter Cover for Wildlife	10.0	
4.2.3 Waterfowl Staging and Moulting	0.0	
4.2.4 Waterfowl Breeding	10.0	
4.2.5 Migratory Passerine, Shorebird or Raptor Stopover	0.0	
4.2.6 Fish Habitat	9.0	
Total for Significant Features and Habitat		29

4.3 ECOSYSTEM AGE	3
4.4 GREAT LAKES COASTAL WETLANDS	25
Sub Total:	217
TOTAL FOR SPECIAL FEATURES (maximum 250)	217

Southern Ontario Wetland Evaluation, Score Summary — March 1993

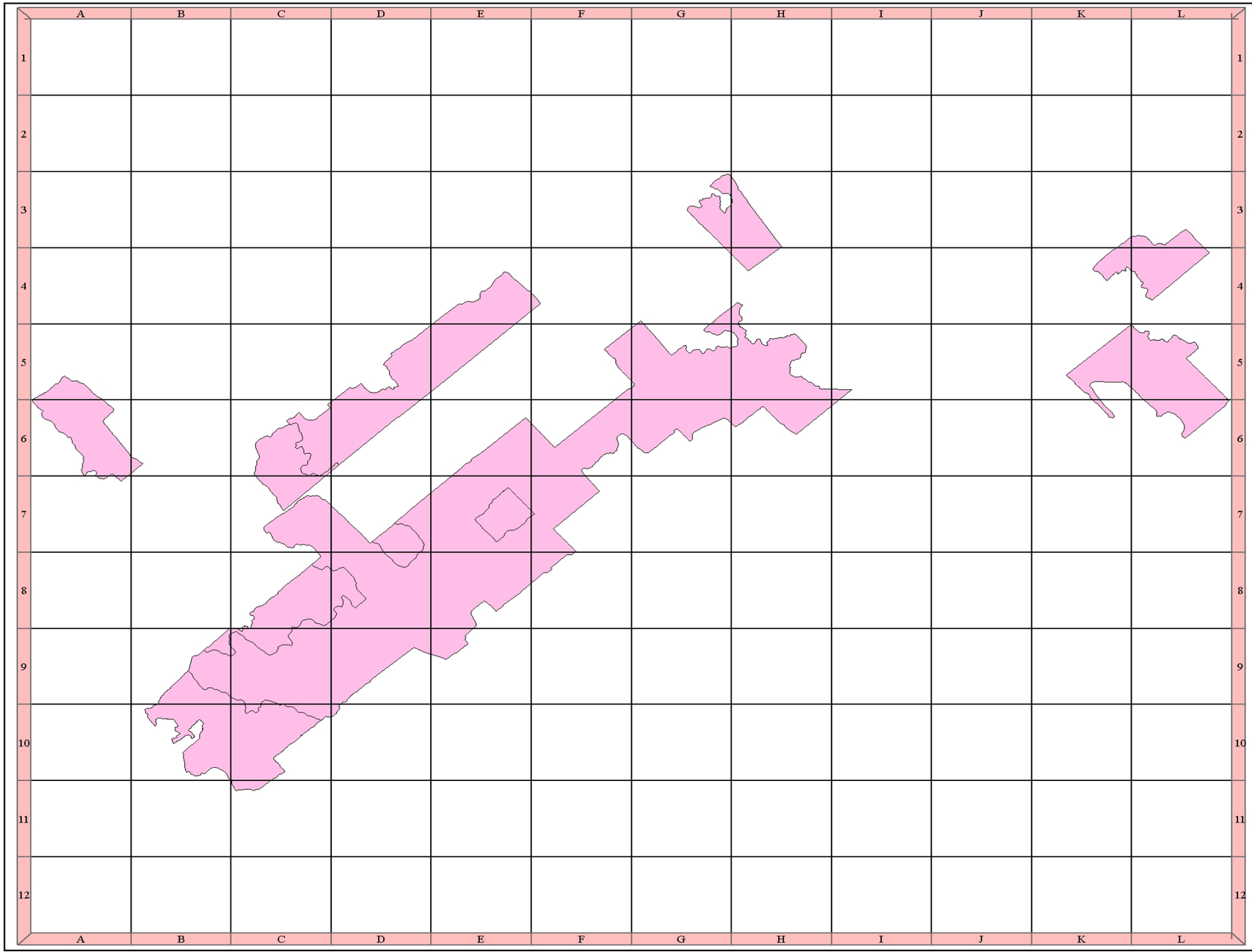
Wetlands Manual

SUMMARY OF EVALUATION RESULT

Wetland	Beavers Dam Creek Pt. Col. WC
TOTAL FOR 1.0 BIOLOGICAL COMPONENT	106
TOTAL FOR 2.0 SOCIAL COMPONENT	117
TOTAL FOR 3.0 HYDROLOGICAL COMPONENT	206
TOTAL FOR 4.0 SPECIAL FEATURES COMPONENT	217
WETLAND TOTAL	646

INVESTIGATORS	AFFILIATION
Ron Drabick	OMNR 2006/2007
Anne Yagi	OMNR 2006/2007
0	0
0	0
0	0

DATE: January 8, 2009



Ministry of Natural Resources
Guelph District
Vineland Office

Beavers Dam Creek
Wetland Complex

Interspersion

July 23, 2008

Guelph District/Vineland Office
Beavers Dam Creek
Wetland Complex

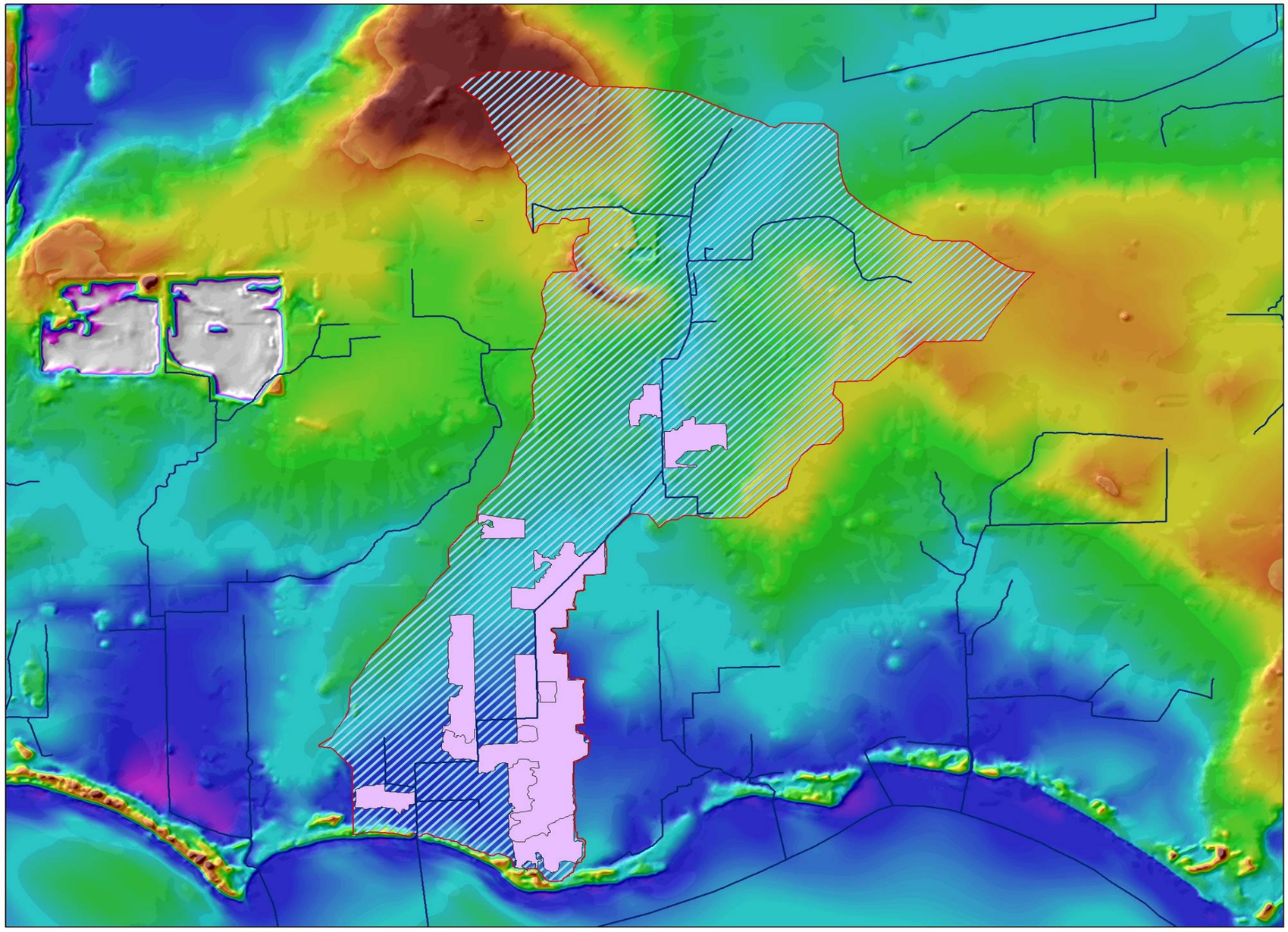
Beavers_Dam_Creek_08

1:12,000

Published August 10, 2005 by the Guelph District GIS Unit, Ministry of Natural Resources.
This map is for illustrative purposes only. Do not rely on it as being a precise indicator of routes, locations of features, nor as a guide to navigation. This map may contain errors and/or omissions.
This map is not for duplication.
Map Projection/Datum: UTM Zone 17, NAD 83

Ontario

Horizontal	4	5	10	10	4	5	5	2				45
Vertical:	1	2	6	8	4	6	4	9	2	4	1	47
												92



Ministry of Natural Resources
Guelph District
Vineland Area

Beavers Dam Creek
Wetland Complex

Catchment: 1072.24 ha

July 23, 2008

Beavers Dam Creek
Wetland Complex

Waterflow

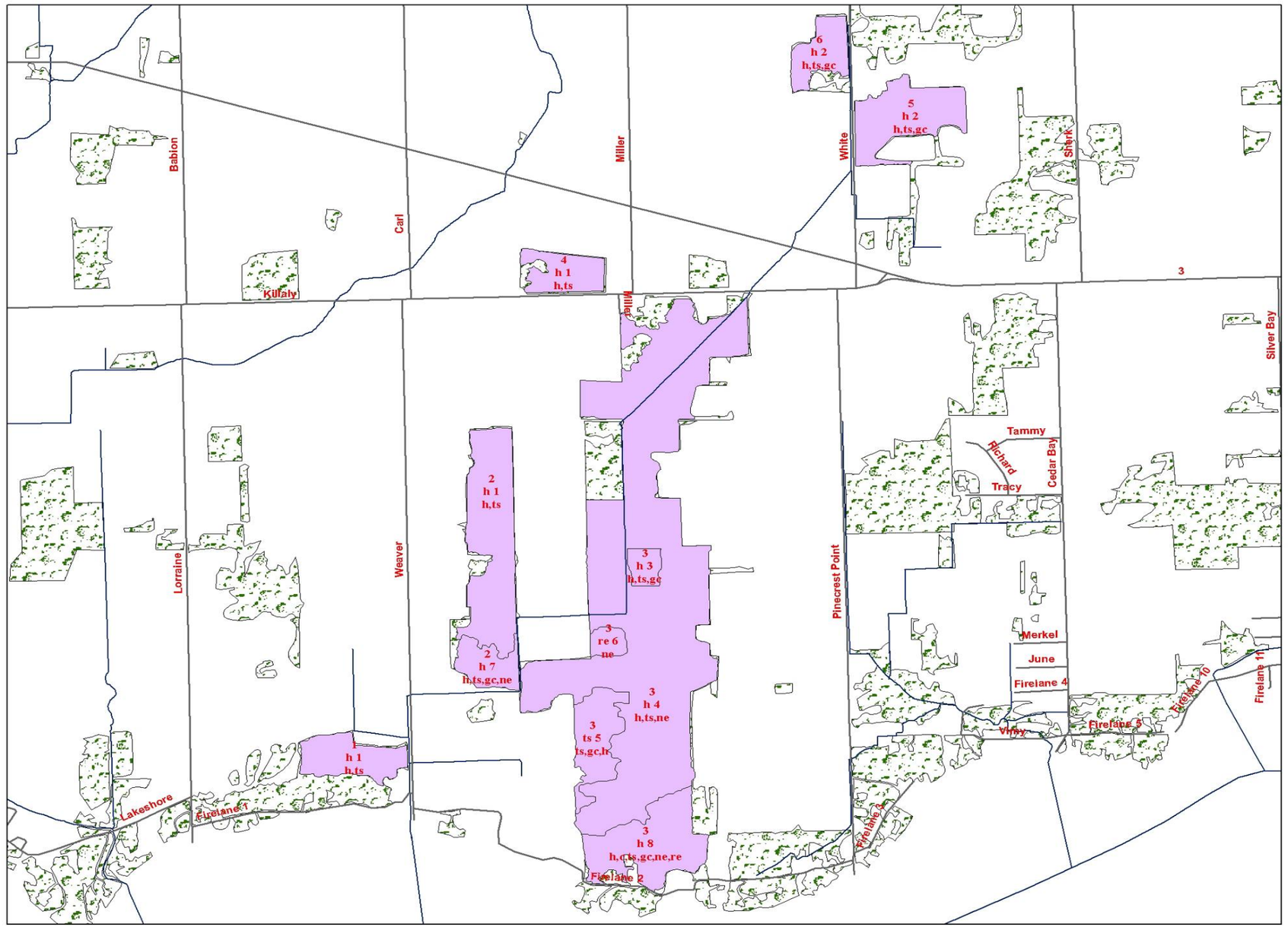
Beavers_Dam_Creek_Nov07

Beaver Dams Pt Col Catchment 28_11_06

1:26,323

N
W E
S

Ontario



Ministry of Natural Resources
Guelph District
Vineland Area

Beavers Dam Creek
Wetland Complex

Polygon Identification

July 23, 2008

Beavers Dam Creek
Wetland Complex

- Waterflow
- Niagara_Woodlots
- Beavers_Dam_Creek_Nov07

1:14,645

N
W E
S

Ontario

Ministry of Natural Resources
Guelph District
Vineland Area

Beavers Dam Creek Wetland Complex

Polygon Identification

July 23, 2008

Beavers Dam Creek Wetland Complex

Beavers_Dam_Creek_Nov07

1:14,645

N
W E
S

Published May 14, 2008 by the Guelph District GIS Unit, Ministry of Natural Resources.
This map is for illustrative purposes only. Do not rely on it as being a precise indicator of routes, locations of features, nor as a guide to navigation. This map may contain errors and/or omissions.
This map is not for duplication.
Map Projection/Datum: UTM Zone 17, NAD 83

Ontario

Data Summery Form

Code:

Wetland Name:

WETLAND UNIT #	DOMINATE FORM	WETLAND TYPE	COMMUNITY CODE	COMMUNITY SUB_CODE	AREA (ha)	SITE TYPE	SOIL	FORMS	# OF FORMS	% OPEN WATER	ha OPEN WATER	FISH HABITAT (LM / HM)	Dominate Species	Additional Species	COMMENTS	Soil Texture	Depth to Mottles	Depth to Gleying	Moisture Regime	Drainage	Field Map Code
1	h	Swamp	1		5.68	Palustrine	humic/mesic	h,ts	2		-										
2	h	Swamp	1		15.11	Palustrine	clay/loam	h,ts	2		-										
2	h	Swamp	7		3.76	Palustrine	clay/loam	h,ts,gc,ne	4		-										
3	h	Swamp	3		1.79	Palustrine	clay/loam	h,ts, gc	3		-		h: silver maple	ts: silver maple, american elderberry; gc: goldenrod & aster sp.	goldenrod & aster sp present						95
3	h	Swamp	4		73.47	Palustrine	clay/loam	h,ts,ne	3		-		h: silver maple	h: green ash, swamp white oak, red maple, black ash, white elm; ts: silve maple, green ash; ne: sedge sp.							94
3	ts	Swamp	5		6.25	Palustrine	clay/loam	ts,gc,h	3		-										
3	ne	Swamp	6		1.50	Palustrine	clay/loam	ne	1		-										
3	ts	Swamp	8		11.13	Palustrine	humic/mesic	h,c,ts,gc,ne,re	6		-		h; silver maple	h: green ash, red oak; c: white cedar, norway spruce; ts: bebbs willow, honeysuckle sp. gc: ;ne: grass/sedge sp; re: phragmities							91
4	h	Swamp	1		4.42	Palustrine	clay/loam	h,ts	2		-										
5	h	Swamp	2		9.22	Palustrine	clay/loam	h,ts,gc	3		-										
6	h	Swamp	2		4.35	Palustrine	clay/loam	h,ts,gc	3		-										
											-										
					136.68																

-

Appendix D:

Environmental Mapping