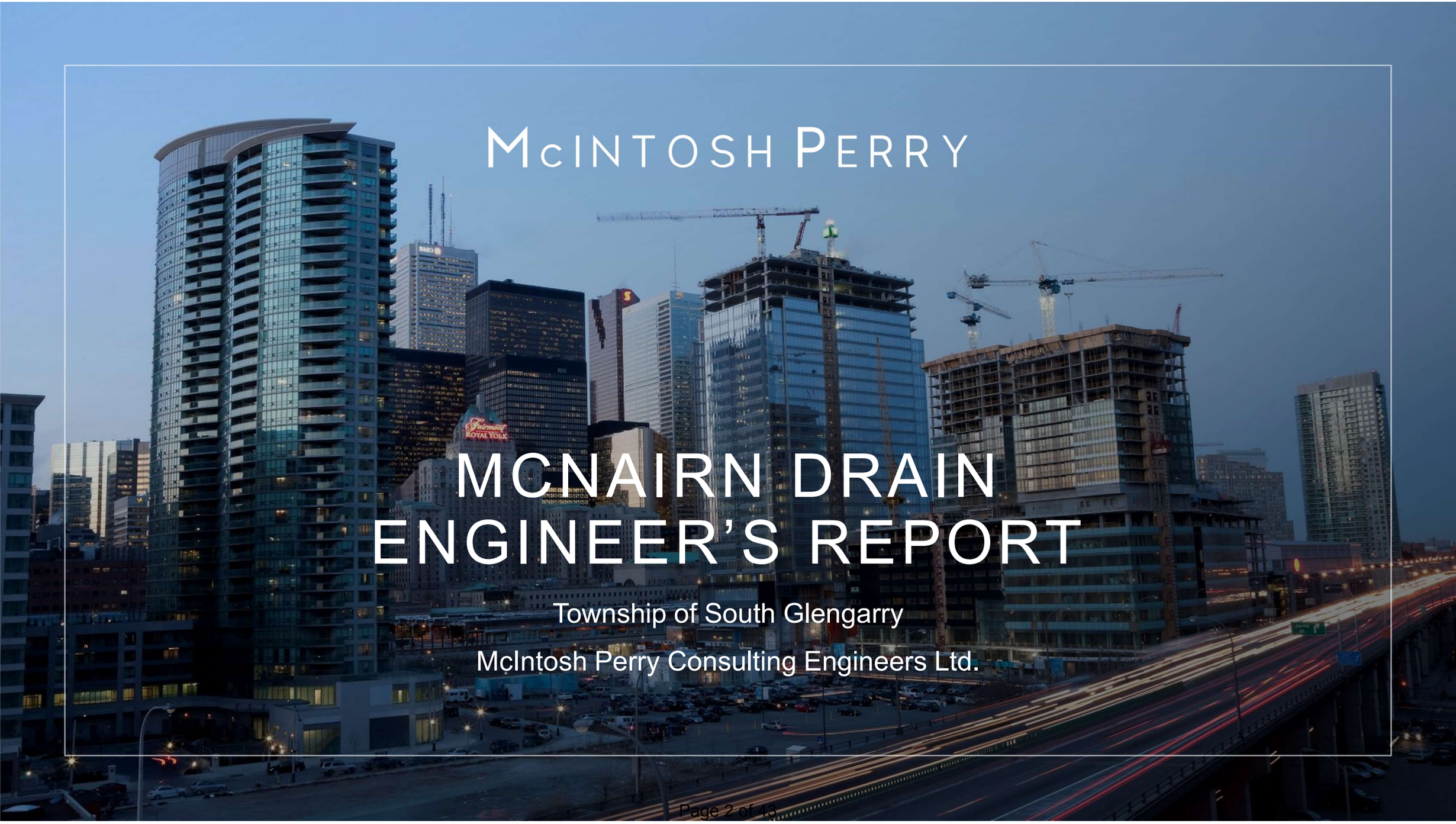
TOWNSHIP OF SOUTH GLENGARRY
SPECIAL MEETING OF COUNCIL
AGENDA

Monday, June 6, 2022, 6:00 PM
Tartan Hall - Char-Lan Recreation Centre
19740 John Street, Williamstown

Pages



McINTOSH PERRY

MCNAIRN DRAIN ENGINEER'S REPORT

Township of South Glengarry

McIntosh Perry Consulting Engineers Ltd.

LOCATION

McNairn Drain

- 1,342m open channel system
- Spanning from Lot 13, Concession 1 to the outlet at Grey's Creek
- Draining 52 hectares of mixed land uses

EXECUTIVE SUMMARY

Last completed in 1995, updates to the McNairn Engineer's Report have been requested due to a number of factors including: recent developments of multi-lot subdivision from former agricultural land, over excavation of the existing profile, and assessment of the hydrology of the drain and culverts. Costs of the updated report as well as future maintenance are to be assessed out to the contributing landowners as outlined in the included assessment schedules.

PURPOSE

- Update the existing McNairn Drain Engineer's Report, under Section 78 of the Drainage Act
- Update the assessment schedules, under Section 76 of the Drainage Act in order to fairly distribute future maintenance costs.
- Assess the over excavated design grade for adequate capacity.
- Revise the culvert schedules, under Section 78 of the Drainage Act.

SECTION 78 – DRAINAGE ACT REQUIREMENTS

Completed to Date

1. Township initiates the project
2. Council appoints an engineer [78(2)]
3. Upon completion of the Engineer's Report, the Engineer files it with the municipality [39(1)]
4. Clerk send notice of "Meeting to Consider" [41(1,2)]
5. Meeting to Consider for impacted parties to provide input on the new Engineer's Report [44]

To be Completed

6. Council may adopt the new report provisionally by two readings of a by-law [45(1)]
7. Notice sent of the sitting of the Court of Revisions [45(1)]
8. Appeal period to the Court of Revisions, Tribunal, and Referee for assessments, technical aspects, and legal aspects respectively [47(1), 48, 49, 50, 52(1), 54]
9. Council may give a third reading to the provisional by-law giving it legal priority [58(1)]

NEW ENGINEER'S REPORT

Includes

- Project overview and drain history;
- All relative calculations and analysis conducted by the Engineers;
- Full set of engineering drawing;
- Updated assessment schedules;
- Summary of works completed under the Drainage Act;
- Specifications for future maintenance.

CONCLUSION

- All Engineering costs and cost for future maintenance are to be assessed out as per the included assessment schedules;
- Standard maintenance procedure will continue as usual with the support of the new Engineer's report;
- The new Engineer's Report includes an update report, drawings, and assessment schedule;
- The new Engineer's Report addresses all of the previously mentioned purposes for updating the McNairn Drain;
- For maintenance related concerns, please contact:
  - Sean MacDonald, Drainage Superintendent.

THANK YOU!

Lucas Gibson
613-714-6143
l.gibson@mcintoshperry.com

STAFF REPORT S.R. No. 83-2022

PREPARED BY: Kelli Campeau, GM Corporate Services/Clerk

PREPARED FOR: Council of the Township of South Glengarry

COUNCIL DATE: June 6, 2022

SUBJECT: McNairn Drain Engineer's Report – Meeting to Consider

BACKGROUND:

1. In October 2018, Council appointed McIntosh Perry Consulting Engineer's Ltd. under Section 78 (1) of the *Drainage Act* ("the Act") to update the necessary engineer reports to legitimize all drainage works completed and required to be completed on the Place St. Laurent Subdivision located on Part of Lot 3, Registered Plan 101.

2. The filing of the Engineer's Report is required within one year of appointment, unless the appointment is extended by Council resolution.

3. On April 4, 2022, Council passed a resolution to extend the appointment, as the filing of the Engineer's Report was delayed due to:
    a. Allowing the various phases of the development to proceed and be incorporated into the assessment schedule of the report.
    b. Inability to hold public meetings as a result of the COVID-19 pandemic.

4. On May 16, 2022, Council received the Engineer's Report and passed a resolution to proceed on the report, with the next step being a Meeting to Consider the report.

ANALYSIS:

5. Following the May 16th Council Meeting, a notice was sent to all affected property owners and applicable agencies (RRCA, OMAFRA).

6. The Meeting to Consider (June 6th Special Council Meeting) will include:

    a. Presentation of the final report (Engineer)
    b. Opportunity for public comment
    c. Council decision to proceed or not.

7. If Council wishes to adopt the report and proceed, a provisional by-law to adopt the report shall be passed (first and second reading) and the process will continue.

8. If there appear to be errors in the report or for any other reason the report should be reconsidered, Council may refer the report back to the engineer. The engineer shall then reconsider the report and report back to Council, the new report will be subject to the same procedures as the original report.

9. If Council chooses to proceed and provisionally adopt the report, the next steps will include:

    a. Sending a copy of the by-law and appeal period notice to all affected property owners.

10. Appeals shall be heard by a Court of Revision, which shall be appointed by Council at an upcoming Regular Meeting.

IMPACT ON 2022 BUDGET:

N/A

ALIGNMENT WITH STRATEGIC PLAN:

Goal 2: Invest in infrastructure and its sustainability.

RECOMMENDATION:

BE IT RESOLVED THAT Staff Report 83-2022 be received and that By-law 41-2022, being a by-law to provide for amendments to the McNairn Drain be read a first and second time and provisionally adopted this 6th day of June 2022.

_____

Recommended to Council for Consideration by:
CAO – TIM MILLS

THE CORPORATION OF THE TOWNSHIP OF SOUTH GLENGARRY BY-LAW 41-2022 FOR THE YEAR 2022

BEING A BY-LAW TO PROVIDE FOR UPDATES TO THE MCNAIRN DRAIN PURSUANT TO SECTIONS 76 AND 78 OF THE DRAINAGE ACT, R.S.O. 1990, C.D.17.

WHEREAS, the *Municipal Act, 2001,* c.25 S 5 (1) provides that the powers of a municipal corporation are to be exercised by its council;

AND WHEREAS the *Municipal Act 2001*, c. 25 S. 5(3) provides that the powers of every council are to be exercised by by-law;

AND WHEREAS the *Drainage Act*, R.S.O. 1990, c.D.17 S. 76 provides that the council of any local municipality liable for contribution to a drainage works in connection with which conditions have changed or circumstances have arisen such as to justify a variation of the assessment for maintenance and repair of the drainage works may make procure a report of an engineer to vary the assessment;

AND WHEREAS the *Drainage Act*, R.S.O. 1990, c.D.17 S. 78 provides that if drainage works have been constructed under a by-law passed under the Act and the council considers it appropriate to undertake one or more of the major improvement projects listed in subsection 1.1 the municipality may undertake and complete the project in accordance with the report of an engineer appointed by it;

AND WHEREAS the Council of the Corporation of the Township of South Glengarry has directed, under sections 76 and 78 of the *Drainage Act*, that an Engineer's Report shall be prepared by McIntosh Perry Consulting Engineers for the drain known as the McNairn Drain;

AND WHEREAS the appointed engineer has prepared an Engineer's Report titled McNairn Drain: Engineers Report Section 76 & 78 of the Drainage Act, Project No.: PM-18-9531 dated May 9, 2022 and attached hereto as Schedule "A";

AND WHEREAS the Council of the Township of South Glengarry has considered the Engineer's Report in accordance with Section 42 of the *Drainage Act* and is desirous of adopting the report.

NOW THEREFORE THE COUNCIL OF THE CORPORATION OF THE TOWNSHIP OF SOUTH GLENGARRY ENACTS AS FOLLOWS:

1. **THAT** the Engineer's Report prepared under Sections 76 and 78 of the Drainage Act for the McNairn Drain, attached hereto as Schedule "A" is hereby adopted and the drainage works and assessment

schedule as therein indicated and set forth is hereby authorized and shall be completed accordingly.

2. **THAT** this by-law shall come into force and effect upon its final passing.

READ A FIRST, SECOND TIME AND PROVISIONALLY ADOPTED THIS 6TH DAY OF JUNE 2022

MAYOR:_____ CLERK:_____

MCNAIRN DRAIN: ENGINEER'S REPORT
SECTION 76 & 78 OF THE DRAINAGE ACT

Project No.: PM-18-9531

Prepared for:

Township of South Glengarry
6 Oak Street
Lancaster, ON
K0C 1N0

Prepared by:

McIntosh Perry Consulting Engineers Ltd.
3240 Drummond Concession 5A
Perth, ON
K7H 3C9

Date Submitted: May 9th, 2022

By-Law No.: _____

TABLE OF CONTENTS

1.0 INTRODUCTION

The McNairn Drain was originally constructed in the Township of Charlottenburgh to provide proper drainage outlet for roadside ditches that were to be constructed as part of the development of the McNairn Subdivision. Currently, a portion of these lands in the watershed are undergoing further development.

It should be noted for clarity that the Township of South Glengarry was incorporated in 1998 through the amalgamation of the former Geographic Townships of Charlottenburgh and Lancaster. Therefore, all references to the Township of Charlottenburgh, shall hence forth be known as the Township of South Glengarry. Since the drain's adoption under By-Law 606 in 1977, there has been subsequent development within the area. The early 1990's saw the addition of the Fairway Estates Subdivision directly north of the existing McNairn Subdivision and the last decade has welcomed the multiple phases of Place St-Laurent, a 5-phase development located west of the McNairn Subdivision.

With the final phases of Place St-Laurent nearing completion, the Township of South Glengarry has requested updates to the Engineer's Report for the McNairn Drain under Sections 76 & 78 of the Drainage Act R.S.O. 1990, c. D.17. Thereafter, McIntosh Perry Consulting Engineers Limited (McIntosh Perry) was formally appointed by the Township of South Glengarry on October 1, 2018 as the "Drainage Engineer" to undertake the updates to the McNairn Drain Assessment Schedule. Section 76(1) of the Drainage Act allows a municipality to obtain a new Assessment Schedule for an existing drain. The Township of South Glengarry has initiated a report under this section due to numerous subdivisions created without the preparation of individual Section 65(1) reports. The addition of these subdivisions has also altered the existing watershed boundary for the McNairn Drain. Section 78(1) of the Drainage Act allows for drain improvements intended to increase the effectiveness of the system. At this time, the Section 78 undertaking has been limited to revising the drain profile plans and updating the Culvert Schedule.

1.1 HISTORY

The McNairn Drain was initially established as a Petition Drain, under the Drainage Act, (commonly referred to as a "Municipal Drain") in 1977 within the former Township of Charlottenburgh to provide proper drainage outlet for the construction and development of the McNairn Subdivision. The Engineer's Report was prepared under Section 4 of the Drainage Act, R.S.O. 1975 by R. M. Kostuch Associates Ltd. and was adopted under by-law.

Following the initial construction of the drain, an Engineer's Report was prepared in 1991 by R. W. Connelly Associates Inc. to update the Assessment Schedule for the drainage system due to the additional lands developed for the Fairway Estates Subdivision. This Engineer's Report was prepared under Section 76 of the Drainage Act, R.S.O. 1975.

In 1995, Totten Sims Hubicki Associates Ltd. prepared a new Engineer's Report under Section 78 of the Drainage Act, 1980 for the relocation of the McNairn Drain through Lot 14, Concession 1. The drain was re-aligned to accommodate the construction of an artificial recreation lake in Lot 14 through a site plan agreement between

the municipality and the landowner. The portion of the McNairn Municipal Drain lying upstream of the easterly limit of Sutherland Ave was abandoned by ByLaw 27-11 on September 12, 2011.

2.0 PURPOSE OF THE DRAINAGE REPORT

As indicated above, this drainage report has been prepared at the direction of the Township of South Glengarry to update the McNairn Drain Engineer's Report under Section 76 & 78 of the Drainage Act, R.S.O. 1990, c. D.17.

An updated Assessment Schedule has been requested under Section 76, to fairly distribute future maintenance costs due to recent development of multi-lot subdivisions on former agricultural land within the watershed boundary of the drain. Due to a previously performed over-excavation of the drain during its relocation in 1995, the Township has also requested the design grade be assessed for adequate capacity and Culvert Schedules be revised accordingly under Section 78 of the Drainage Act, R.S.O. 1990, c. D.17.

3.0 EXISTING CONDITIONS

3.1 LOCATION OF THE DRAIN

The McNairn Drain is a 1,342 meter (4,403 foot) open channel drainage system. The McNairn Drain begins in Lot 13, Concession 1 and runs south-west of Sutherland Ave in the Fairway Estates Subdivision from station 1+342 to 1+290. The drain then descends south for 300 meters along the back of the properties located within the McNairn Subdivision, turns southwest to station 0+769 then northwest to station 0+510 which consists of the 1995 re-alignment to accommodate the artificial recreation lake on Lot 14 Concession 1. The drain then meanders in a south-westerly direction across Lots 15 to 18 for 510 meters, which then outlets into Grey's Creek at station 0+000.

3.2 DRAINAGE AREA LIMITS

The McNairn Drain watershed spans from Lot 12 to 18, Concession 1 within The Township of Charlottenburgh, encompassing 52 hectares (128 acres) of mixed land uses including: developed; cultivated; wetland and woodland areas. The watershed boundary was first assessed using the Ministry of Natural Resources and Forestry's (MNRF) Ontario Watershed Flow Assessment Tool (OFAT III) and was then confirmed through a review of Ontario Base Mapping.

3.3 AREA REQUIRING DRAINAGE

Since the area requiring drainage is only applicable to Section 4 under the Drainage Act, it has not been considered for the purposes of this report. The area requiring drainage remains unchanged from previous Engineer's Reports as only improvements and updates under Sections 76 & 78 respectively will be revised in this report.

4.0 CONSULTATION / ON-SITE MEETING

A notification letter was circulated on November 2, 2018 to all those within the McNairn Drain watershed (per the 1995 Engineer's Report), to notify them of the undertaking of the Section 76 and 78 report updates and to invite them to attend the on-site meeting. An on-site meeting was held at 6 PM on November 27, 2018 at the Glen Walter Fire Station as a public information session for landowners and to offer them the opportunity to ask questions or express concerns about the project. At the time of the filing of this report, no communication from affected landowners regarding this project has been received by McIntosh Perry or the municipality. Upon completion of this report, and in fitting with the requirements of the Drainage Act, an invitation to the Meeting to Consider will be circulated to all stakeholders within the watershed.

5.0 DESIGN CONSIDERATIONS

As the scope of this project was limited to updating the Engineer's Report of an existing drain, no construction or improvements were conducted on the McNairn Drain. All design considerations of the channel and crossings are based on the previously prepared Engineer's Reports and have not been considered for the purposes of this report. As such, the channel design of the drain provided with the 1995 Engineer's Report prepared by Totten Sims Hubicki Associates Ltd. continues to govern.

6.0 PLANS, PROFILES AND SPECIFICATIONS

The following engineering drawings, included in Appendix A, have been prepared and shall form part of the McNairn Drain Engineer's Report:

The General Layout Plan (Drawing 01) has been prepared to identify the overall watershed boundary; the McNairn Drain alignment; the Block Assessments for each development and the property boundaries. Municipal roads, watercourses, waterbodies, and the artificial recreation lake located within the watershed boundary have been displayed along with geographic lot and concession boundaries.

The Assessment Layout Plan (Drawing 02) includes distance factor offset limits at the 50 m, 150 m and 250 m intervals and three sub-sections factor limits (upstream, midstream and downstream). Further discussions regarding distance factors and sub-section factors can be found in Section 7.

The Drain Profile (Drawing 03) has been prepared for the McNairn Drain to identify the post-realignment existing conditions including invert of the ditch, culvert inverts and diameter. A Future Maintenance Profile has also been included to allow for the drain to be cleaned to the now current elevations.

7.0 CROSSINGS

There are six (6) culverts located along the McNairn Drain listed below in Table 1. A 1200 mm diameter corrugated steel pipe (CSP) culvert located at chainage 0+720 on the drain alignment at the east end of Galleon Crescent is used as a private crossing within the East half of Lot 15, Concession 1 the artificial lake access road. Only pedestrian access was considered in the 1995 drain re-alignment for this culvert as such it was not included in the 1995 drain re-alignment report. Due to the culvert's current condition and adequate size, no replacement is deemed to be required at this time. The culvert located at the east end of Galleon Crescent (Roll: 010100601244265) shall henceforth be adopted as part of the McNairn Drain. The Township of South Glengarry shall be responsible for administering maintenance or replacement of the culvert crossing however, the cost of future maintenance work or culvert replacement is to be assessed fully and directly against the landowner(s) on whose property the culvert is located (Roll: 010100601244265). The following table summarizes the crossings considered part of the McNairn Drain:

Table 1: Schedule of Crossings – McNairn Drain

Culvert ID	Roll Number	Lot	Concession	Station	Description
C6	Sutherland Ave – Road Crossing Culvert	West Half of 13	1	1+335	1 @ 17.1 m x 900 mm Ø CSP
C5	010100601244265	East Half of 14	1	1+234	1 @ 12.0 m x 1200 mm Ø CSP
C4	010100601244265	South Part of 14	1	0+925	1 @ 30.5 m x 1200 mm Ø CSP
C3	010100601244265	East Half of 15	1	0+720	1 @ 9.2 m x 1200 mm Ø CSP
C2	Yacht Blvd. – Road Crossing Culvert	South Part of 15	1	0+425	1 @ 27.9 m x 1200 mm x 1200 mm Conc. Box
C1	010100601250000	East Half of 17	1	0+225	1 @ 6.3 m x 1200 mm Ø CSP

7.1 HYDROLOGIC REVIEW

It has been confirmed, through means of hydrologic modelling as shown in Appendix C, that the existing 1200 mm diameter CSP culvert west of Lot 17 at STA. 0+225 (Roll: 010100601250000) is of adequate size for the 5-year storm criteria. As per "A Guide for Engineers working under the Drainage Act in Ontario (Publication 852)", field crossings shall be sized for the 2 – 5 year storm criteria. Based on the pipe diameter and channel design of the drain, the culvert can convey approximately 1.6 m^3/s of flow at the obvert, whereas a 5-year storm in the region is only expected to convey flows of 1.1 m^3/s. Upon inspection of the existing culvert, it has been determined that the pipe is of relatively new construction and its replacement is not anticipated in the near future.

8.0 ASSESSMENTS

8.1 GENERAL

In accordance with Section 21 of the Drainage Act, "The engineer in the report shall assess for benefit, outlet liability and injuring liability, and shall insert in an Assessment Schedule, in separate columns, the sums assessed for each opposite each parcel of land and road liable therefore." In the case of this project, an Assessment Schedule for the entire works has been created, which displays a fair and reasonable distribution of estimated costs for future maintenance. As per the Drainage Act, the total estimated cost has been assessed against the affected parcels of land and roads under benefit (Section 22) and outlet liability (Section 23). The McNairn Municipal Drain does not require an assessment for injuring liability (Section 23), special benefit (Section 24) and special assessment (Section 26) because the drain has already been constructed.

The method of determining appropriate assessment values and the distribution between benefit and outlet assessments is the responsibility of the Drainage Engineer. The Drainage Engineer is to use best judgement to provide an Assessment Schedule that is fair to all concerned. In doing so, the engineer has utilized several basic principles:

1. You cannot assess a property for any part of the cost of work that is done upstream from it. Unless there is a special circumstance.
2. You cannot assess a property for benefit for work done some distance downstream, although you can assess it for outlet liability on this work.
3. You cannot assess for benefit lands that are not reasonably close to the drain. Usually those assessed for benefit are abutting the drain, or perhaps one farm removed.
4. You cannot assess those lands that are too low to make any use of the work, such as a gravel pit or quarry, unless they are directly connected by an outlet to the drain.
5. You must assess public utilities and road authorities (Drainage Act Section 26) for the increase in the actual cost of the proposed drainage works caused by the existence of the works of the public utilities or road authorities.
6. Care must be taken in assessing lands covered with bush and trees. If the situation is such that, once the drain is in place, the property owner will be able to clear the bush and cultivate the land, then the property should be assessed in the same way as land already under cultivation. Unless there is a legal restriction preventing the clearing and cultivation in such areas.

A technique used by Drainage Engineers to calculate individual assessments is to convert all lands within the watershed into factored areas. Benefit assessment uses the area of land within the watershed per property multiplied by a factor related to that property's land use. Outlet assessment uses the area of land within the watershed per property multiplied by a factor related to that property's land use, proximity of the property to the drain (distance factor) and the length of the drain that the particular property utilizes (sub-section factor). The summation of these factored areas allows the Drainage Engineer to compare an individual property circumstance to the total of the factored areas within the entire watershed. This method is known as the Factored Area Method and considers the different volumes and rate of flow of water. These parameters are

directly related to the various land uses, soil types, surface conditions, location to the drain and the length of the drain used on an individual property basis.

8.2 BENEFIT

As defined by the Drainage Act, benefit assessment is the "advantages to any lands, roads, buildings or other structures from the construction, improvement, repair or maintenance of a drainage works such that the assessed lands, roads or buildings will result in a higher market value, easier maintenance, increased crop production, improved appearance or better control of surface or subsurface water". In the case of this project, benefit assessment has been applied to all lands that are located immediately adjacent to the drain, or with a direct connection to the drain via road-side ditch. Benefit assessment is only charged against properties in the section where work is being completed. The benefit factored area is calculated by multiplying the area of a particular property within the watershed (or its assessed area) by the applicable land use factor.

8.3 OUTLET

As defined by the Drainage Act, outlet liability may be assessed for those "lands and roads that use a drainage works as an outlet, or for which, when the drainage works is constructed or improved, an improved outlet is provided either directly or indirectly through any drainage works of overland flow, a swale, ravine, creek or watercourse". In the case of this project, outlet liability has been applied to all properties within the watershed boundary of the drain whenever work is completed downstream of such property. Assessment for outlet is based on the location, area and rate of flow and as such the outlet factored area is calculated by multiplying the area of a particular property within the watershed (or its assessed area) by the applicable land use factor, its distance factor and the sub-section factor.

8.4 SPECIAL BENEFIT & SPECIAL ASSESSMENT

As defined by the Drainage Act, special benefit is "any additional work or feature included in the construction, repair or improvement of a drainage works that has no effect on the functioning of the drainage works". The special benefit or special assessment is assessed directly against any owner, utility, agency, authority or municipality for which the special design and/or maintenance consideration was required. In the case of this project, no construction or improvements were conducted on the McNairn Drain. As such, no special benefits or special assessments were awarded.

8.5 SUB-SECTION FACTOR

The McNairn Drain alignment is separated into equal one-thirds based on its length, called sub-sections. The upstream one-third portion of the section is assigned a sub-section factor of 1.00, the middle sub-section is assigned a factor of 0.67 and the downstream sub-section is assigned a factor of 0.33. Each individual property is assigned a particular sub-section factor corresponding with the general location of the drainage in relation to that particular property. Properties that are upstream of a particular maintenance section are assigned a sub-section factor value of 1.0. Sub-section factors are applied to properties when calculating outlet assessments based on the fact that only those lands that are upstream of construction or future maintenance works will be assessed for its costs. As an example, the sub-section factor provides an indication of whether a

property utilizes the entire length of a maintenance section or only the bottom one-third. Properties that utilize a longer length of the drain would therefore have a higher assessment factor.

8.6 LAND USE FACTOR

Land use factors are employed when determining assessments for a particular property. The land use factor provides a general factor to account for the volume of runoff from a particular property depending on that property's purpose or use. A land use factor value of 0.5 is applied to all wetland areas. A numeric value of 1.0 is applied to all agricultural lands. A value of 2.0 is used for small, residential (non-agricultural) areas that are 2 ha (5 acres) or less and a value of 4.0 is assigned to lands that are classified as institutional, commercial or as a municipal road.

Each property's area of land within the watershed boundary is multiplied by the land use factor to determine a factored area that is then used to calculate the final assessments for benefit and outlet. As an example, one hectare of agricultural land is assessed at twice the rate of one hectare of wetlands.

In almost all cases, properties will have multiple land uses. For example, a single property may have predominately agricultural lands, with a small residential area surrounding the homestead and possibly also encompass a section of wetlands. In these cases, each of the different land uses is determined and a composite land use factor is determined for each property.

8.7 DISTANCE FACTOR

Distance factors were also utilized when determining assessments for a particular property. The distance factor accounts for the proximity of land to the drain and the relative amount of water that will enter the drain. Distance factor markers provide an approximate marker at the 50 m, 150 m and 250 m intervals. A property that is included entirely within the 50 m marker is assigned a distance factor of 1.0. A property that is included entirely outside of the 50 m marker and within the 150 m marker is assigned a distance factor of 0.75. A property that is included entirely outside of the 150 m marker and within the 250 m marker is assigned a distance factor of 0.5. Properties that are beyond the 250 m marker are assigned a distance factor of 0.3.

Each property's area of land within the watershed boundary and the applicable distance factor markers is multiplied by the applicable distance factor in order to provide a factored area which is then used to calculate the final assessments for outlet. Properties that are closer to the drain would therefore have a higher distance factor than those farther away.

In almost all cases, properties will have areas of land that fall into more than one distance factor marker. For example, a single property may have lands within the 50 m marker, 150 m marker and then the remainder of the property within the 250 m marker. In these cases, the area of land within each individual distance marker is multiplied by its applicable distance factor. The summation of these factored areas then provides a combined or pro-rated factored area on an individual property basis.

8.8 ASSESSMENT SCHEDULE

The Assessment Schedule identifies the assessed costs to benefit and outlet for each property and also includes net HST, Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) grant (if applicable) and the net cost to be assessed to the landowner. At the time of this report, eligible farm tax class properties receive a one third grant on agricultural land from the OMAFRA. The grant for eligible properties has been applied in the Assessment Schedule but may be updated as deemed necessary.

Based on present practices, the recommended approach for determining the apportionment of an assessment to either benefit or outlet is such that the assessment percentage split is reflective of the relative use of the drain by immediate benefitting landowners and the size of the watershed. As a general rule, the portion of the assessment cost assigned to outlet increases with the size of the drain and the total area of the watershed. In other words, when the use of the drain by benefitting landowners is outweighed by the number of landowners using that particular section of the drain for outlet only, then the apportionment to outlet assessment is higher than the apportionment to benefit assessment.

The Assessment Schedule has been provided in Appendix B.

9.0 COST ESTIMATE

The total estimated cost for the Section 76 & 78 updates to the McNairn Drain Engineer's report is $18,500.00. The estimated costs do not account for any additional efforts or expenses that may be incurred by the engineer during the appeals period whether through individual landowner meetings / consultation, The Ontario Drainage Tribunal, The Court of Revision or The Drainage Referee. Typically, the cost estimate includes construction and engineering prices however since no construction work was proposed for the scope of this project, construction costs will not be included.

10.0 FUTURE MAINTENANCE

Future maintenance of the McNairn Drain shall be the administrative responsibility of the Township of South Glengarry, although the individual landowners whose property is directly adjacent to the drain should periodically inspect the drain and report any problems to the municipality.

The cost of future maintenance is to be assessed in the proportions of the Assessment Schedule, as shown in Appendix B, against the upstream owners of lands and roads.

For future maintenance, the "Sub-Total Cost" column contained within the Assessment Schedule shall be used when determining a property's pro-rata ratio (percentage of cost). When determining the percentage of the cost of future maintenance to be assigned to individual properties, this shall be completed prior to any consideration of special benefit, Net HST (municipal tax rebates), farm tax class rate (OMAFRA one third grant) and allowances. Net HST and OMAFRA grant values shall be adjusted to the current values at the time of the maintenance.

All future replacement of culverts shall be installed complete with rip-rap and geotextile at the inlet and outlet and countersunk (embedded) 10 % of their diameter. In accordance with the Drainage Act all future maintenance costs are to be assessed against the lands adjacent to and upstream of the location of the maintenance works pro-rata with the assessments for benefit and outlet.

Future maintenance and the costs of such maintenance for private crossings, private tile outlets and fences shall be the responsibility of the adjacent landowner to whom the culvert, tile or fence belongs. Future maintenance and the costs of such maintenance and replacement for road crossings, such as the Sutherland Avenue road crossing (Sta. 1+335) and the Yacht Boulevard road crossing (Sta. 0+425), shall be the responsibility of the Municipality of South Glengarry. With respect to the newly adopted crossing at the east end of Galleon Crescent and at the West limit of Elm Street (Sta. 1+234) as well as the existing crossing at Sta. 0+225 and Sta. 0+925, it shall be the financial responsibility of the landowner on which the crossing is located to maintain and replace the crossing as required. All permitting and coordination of construction shall remain the administrative responsibility of the Township of South Glengarry, in fitting with standard maintenance practices under the Drainage Act. Costs specifically associated with repairs, maintenance or replacement of the crossing adopted by way of this report, shall be solely borne by the landowner on whose property the culvert is located. The landowner shall contact the Township of South Glengarry's Drainage Superintendent prior to undertaking any works on the crossing.

In addition, as per Section 26 of the Drainage Act R.S.O. 1990, any increased costs or costs of maintenance caused by the existence of municipal infrastructure or public utility, along the drainage system, shall be at the expense of the road authority or public utility. For the purpose of this report, locates on public utilities (such as gas, telecommunications, electricity, etc.) were not thoroughly investigated however any increased cost caused by a public utility is at their respective cost.

10.1 Working Area

The working area as required for the purpose of this drainage works, in accordance with Section 63 of the Drainage Act, shall be 15 metres as measured from the top ditch bank, with the exception of station 0+355 to 0+510 where the working area shall be 10 metres from the top of ditch bank. The working area is required for the purpose of all future maintenance. Additionally, trees, shrubs, landscaping, sheds, play structures or other obstructions to maintenance should not be placed within the working area. Any increase in the maintenance cost due to obstructions will be at the owner's expense.

Specific excavation locations and spreading directions are as follows:

Start Station	End Station	Location
0+000	0+355	Either side of the drain
0+355	0+510	North Side of the drain
0+510	0+770	East side of the drain
0+770	0+990	North side of the drain
0+990	1+295	West side of the drain

10.2 Disposal of Excavated Materials

The excavated earth material removed from the drain shall be disposed of by spreading it over the adjoining land. The depth of spreading is not to exceed 150mm which provision will also apply for future maintenance works. For purposes of future maintenance works, the excavated material may be spread with landowner(s) consent or hauled away. If the owner requests the material to be hauled away, the cost of removing the excavated material is to be levied directly against the landowner. This provision shall apply to all future maintenance works in spite of the wording under the future maintenance section.

11.0 CLOSING

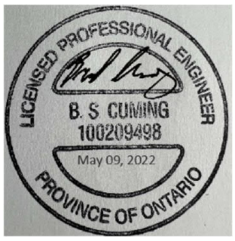
This report has been respectfully submitted to the Township of South Glengarry staff and council on behalf of McIntosh Perry Consulting Engineers Ltd. for updates to the McNairn Drain under Sections 76 & 78 of the Drainage Act, R.S.O 1990, c.D.17.

This report is respectfully submitted by,
McIntosh Perry Consulting Engineers Ltd.

Report Prepared By:

Lucas Gibson, C. Tech
Civil Engineering Technologist

Report Reviewed By:



Brent Cuming, P.Eng.
Project Engineer, Land Development

Mustafa Sasal, P.Eng.
Senior Water Resource Engineer

APPENDIX A:

Engineering Drawings

LOT 18 CON. 1
LOT 17 CON. 1
LOT 17 CON. 1
LOT 16 CON. 1
LOT 16 CON. 1
LOT 15 CON. 1
LOT 15 CON. 1
LOT 14 CON. 1
LOT 14 CON. 1
LOT 13 CON. 1
LOT 13 CON. 1
LOT 12 CON. 1

PROPOSED
PI STA: 0+000.00
EXISTING 1977 REPORT
PI STA: 32+30.00

GRAYS CREEK

PRIVATE DRAIN

CORNWALL

COUNTY RD No. 2

FARLINGER DR.

McNAIRN DRAIN

C1

C2

C3

C4

C5

C6

TBM#3
CUT-CROSS ON TOP OF CONCRETE CULVERT AT OUTLET END
ELEV=48.21m

TBM#1 (APPROXIMATE)
BOTTOM OF METAL PLATE EAST SIDE OF CONCRETE HYDRO POLE LOCATED 6m NORTH OF CULVERT OUTLET
ELEV=50.15m

TBM#2 (APPROXIMATE)
CUT-CROSS ON TOP OF CONCRETE HEAD WALL SUPPORTING OUTLET PIPE
ELEV=47.77m

PROPOSED
PI STA:0+509.99
EXISTING 1995 REPORT
PI STA:0+805.00

PROPOSED
PI STA:0+769.43
EXISTING 1995 REPORT
PI STA: 0+518.00

PROPOSED
PI STA:0+990.45
EXISTING 1995 REPORT
PI STA: 0+300.00

PROPOSED
PI STA:1+290.55
EXISTING 1995 REPORT
PI STA:0+000.00

PROPOSED
PI STA: 1+342.00

BLOCK ASSESSMENT 1
BLOCK ASSESSMENT 2
BLOCK ASSESSMENT 3
BLOCK ASSESSMENT 4
BLOCK ASSESSMENT 5
BLOCK ASSESSMENT 6
BLOCK ASSESSMENT 7
BLOCK ASSESSMENT 8

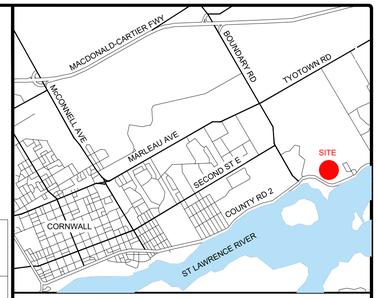
YACHT BLVD.
ST. LAURENT BLVD.
SUTHERLAND AVE.
GILMORE HILL RD.
ELM AVE.

FAIRWAY ESTATES SUBDIVISION
McNAIRN SUBDIVISION
CORNWALL GOLF AND COUNTRY CLUB LTD.
ARTIFICIAL RECREATION LAKE

LANCASTER

ST. LAWRENCE RIVER

CULVERT ID	STATION	DESCRIPTION
C1	0+225	1 @ 6.3m x 1200mm Ø CSP
C2	0+425	1 @ 27.9m x 1200mm x 1200mm CONCRETE BOX CULVERT
C3	0+720	1 @ 9.2m x 1200mm Ø CSP
C4	0+925	1 @ 30.5m x 1200mm Ø CSP
C5	1+234	1 @ 12.0m x 1200mm Ø CSP
C6	1+335	1 @ 17.1m x 900mm Ø CSP



LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- WATERSHED BOUNDARY
- BLOCK ASSESSMENT BOUNDARY
- LOT AND CONCESSION BOUNDARY
- WATERCOURSE / WATERBODY
- McNAIRN DRAIN ALIGNMENT
- APPROXIMATE ROAD ALIGNMENT
- (1) ASSESSMENT PROPERTY IDENTIFER

SCALE 1 : 2000
0 50 100 150 200 Metres

No.	Revision/Issue	Date
01	ISSUED FOR FINAL SUBMISSION	2022.05.09
00	ISSUED FOR REVIEW	2021.07.30

Check and verify all dimensions before proceeding with the work
Do not scale drawings

McINTOSH PERRY
3240 Drummond Cons 5A, R.R. #7, Perth, ON K7H 3C9
Tel: 613-267-6524 Fax: 613-267-7992
www.mcintoshperry.com

Stamp:
LICENSED PROFESSIONAL ENGINEER M. SASAL 100151510 PROVINCE OF ONTARIO May 09, 2022
LICENSED PROFESSIONAL ENGINEER B. S. CUMMING 100209498 PROVINCE OF ONTARIO May 09, 2022

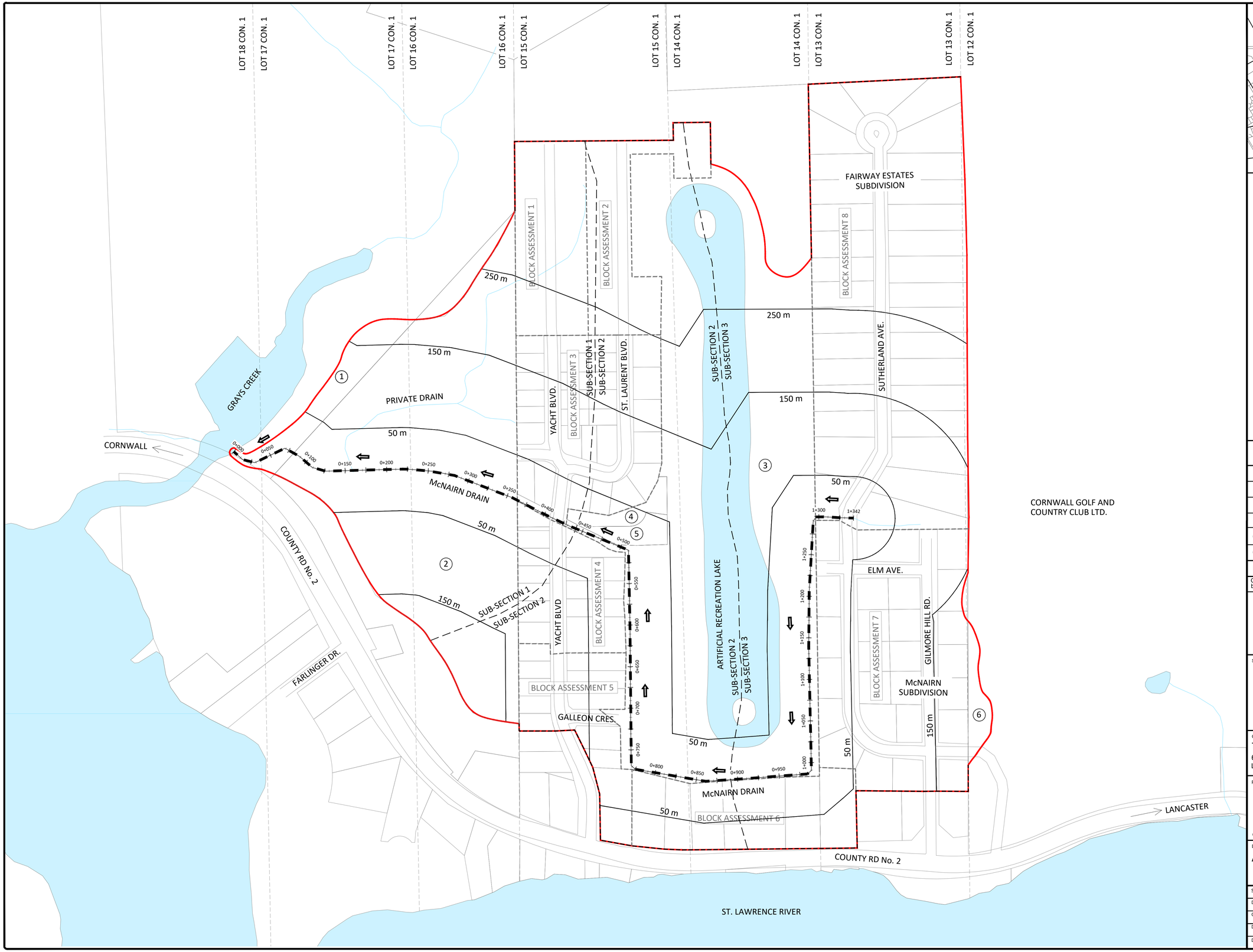
Client:
TOWNSHIP OF SOUTH GLENGARRY
6 OAK STREET, P.O. BOX 220
LANCASTER, ON, K0C 1N0

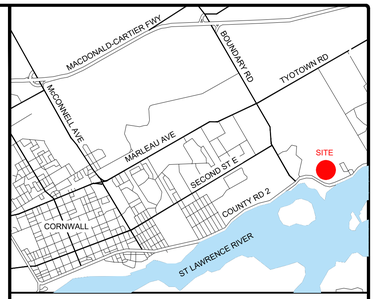
Project:
McNAIRN DRAIN
CORNWALL ONTARIO

Drawing Title:
GENERAL LAYOUT PLAN

Scale:	1:2000
Drawn by:	M.M.
Checked By:	B.C.
Designed By:	L.G.
Date:	2022.05.09

Project Number: 0PM-18-9531
Drawing Number: 01
SHEET 1 of 3





LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- WATERSHED BOUNDARY
- BLOCK ASSESSMENT BOUNDARY
- LOT AND CONCESSION BOUNDARY
- WATERCOURSE / WATERBODY
- McNAIRN DRAIN ALIGNMENT
- APPROXIMATE ROAD ALIGNMENT
- (1) ASSESSMENT PROPERTY IDENTIFER
- ASSESSMENT BANDS
- ALIGNMENT SUB-SECTIONS

SCALE 1 : 2000

0 50 100 150 200 Metres

No.	Revision/Issue	Date
01	ISSUED FOR FINAL SUBMISSION	2022.05.09
00	ISSUED FOR REVIEW	2021.07.30

Check and verify all dimensions before proceeding with the work

Do not scale drawings

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LICENSED PROFESSIONAL ENGINEER B. S CUMING 100209498 May 09, 2022 PROVINCE OF ONTARIO

Client:
TOWNSHIP OF SOUTH GLENGARRY
6 OAK STREET, P.O. BOX 220
LANCASTER, ON, K0C 1N0

Project:
McNAIRN DRAIN
CORNWALL ONTARIO

Drawing Title:
ASSESSMENT LAYOUT PLAN

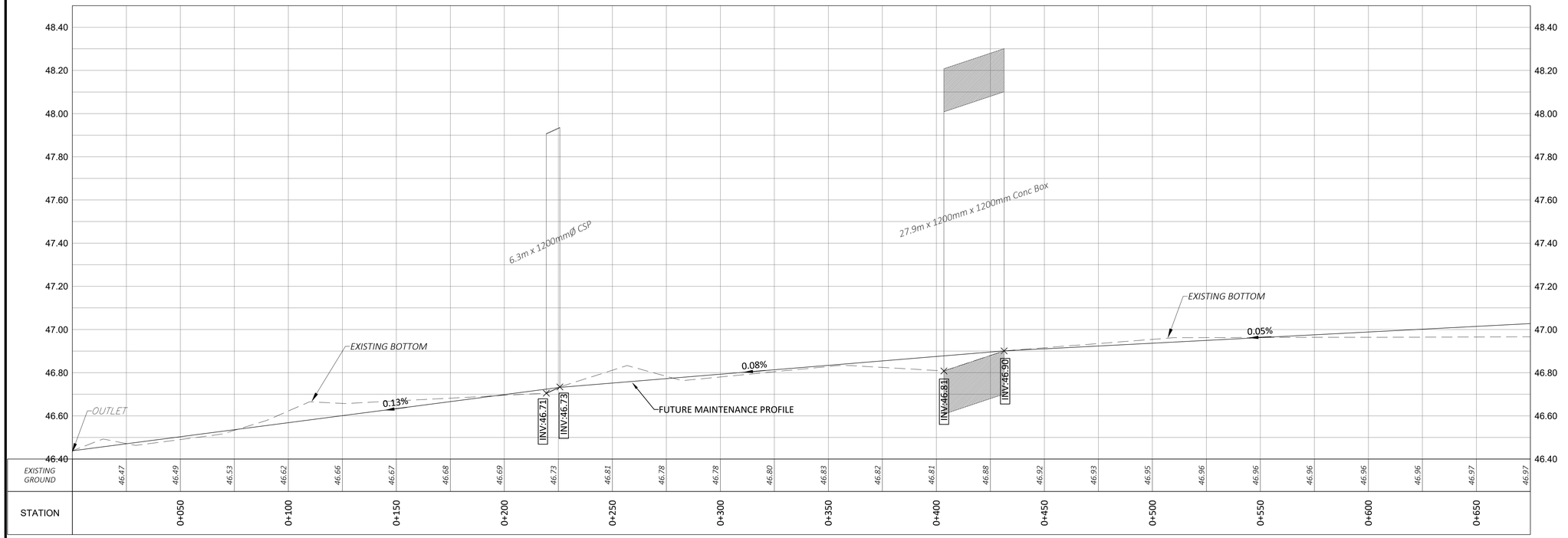
Scale:	1:2000
Drawn by:	M.M.
Checked By:	B.C.
Designed By:	L.G.
Date:	2022.05.09

Project Number: 0PM-18-9531

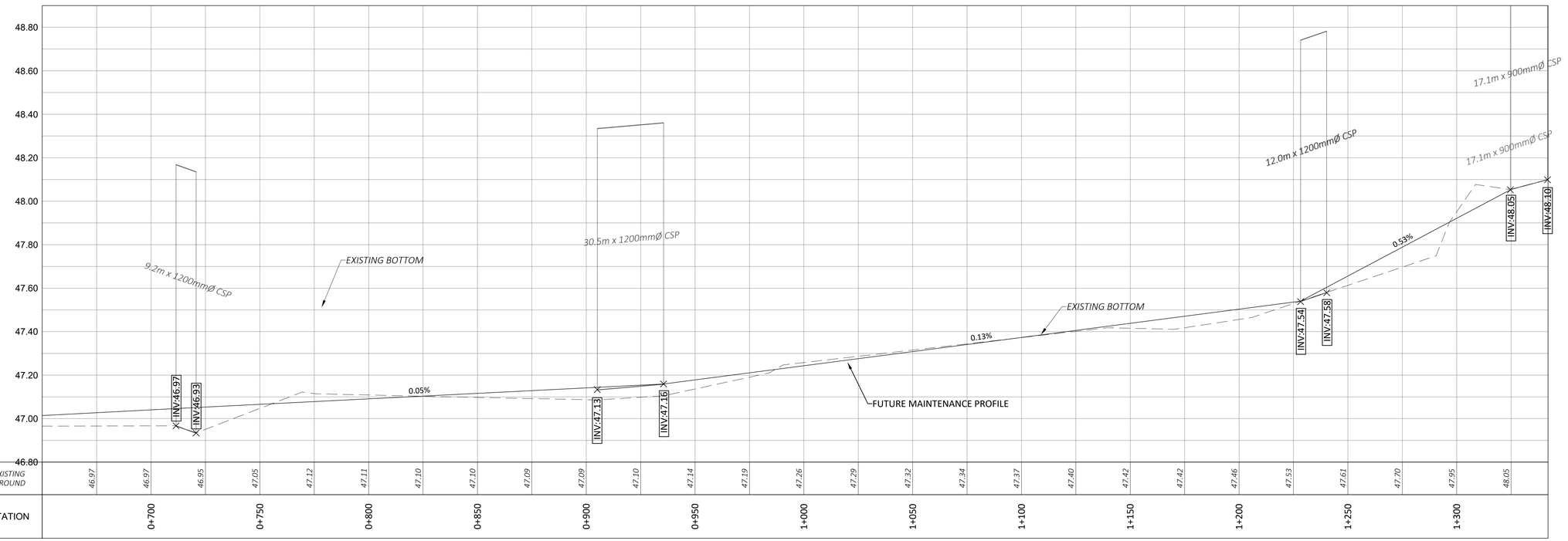
Drawing Number: 02

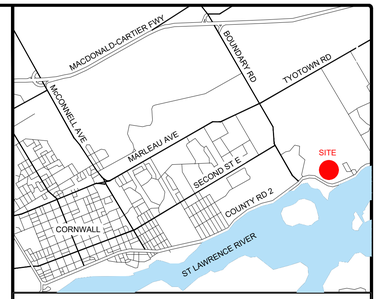
SHEET 2 of 3

Profile - McNairn Drain
STA. 0+000 TO STA. 0+675
Vert Exaggeration - 100.00



Profile - McNairn Drain
STA. 0+650 TO STA. 1+342
Vert Exaggeration - 100.00





LEGEND

- EXISTING BOTTOM OF DRAIN
- FUTURE MAINTENANCE PROFILE

SCALE 1 : 1000
0 25 50 75 100 Metres

No.	Revision/Issue	Date
01	ISSUED FOR FINAL SUBMISSION	2022.05.09
00	ISSUED FOR REVIEW	2021.07.30

Check and verify all dimensions before proceeding with the work
Do not scale drawings

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LICENSED PROFESSIONAL ENGINEER B. S CUMMING 100209498 May 09, 2022 PROVINCE OF ONTARIO

Client:
TOWNSHIP OF SOUTH GLENGARRY
6 OAK STREET, P.O. BOX 220
LANCASTER, ON, K0C 1N0

Project:
McNAIRN DRAIN
CORNWALL ONTARIO

Drawing Title:
DRAIN PROFILE

Scale:	1:1500H, 1:100V
Drawn by:	M.M.
Checked By:	B.C.
Designed By:	L.G.
Date:	2022.05.09

Project Number: 0PM-18-9531
Drawing Number: 03
SHEET 3 of 3

APPENDIX B:

Assessment Schedule

	McNairn Drain Total Cost	$ 18,500.00	
Section 1	Total Cost	$ 18,500.00	
	Benefit Costs	$ 12,950.00	70%
	Outlet Costs	$ 5,550.00	30%

Property Information		Area (Ha)	Land Use Factor	Factored Area	Direct Access to Drain	Benefit Factored Area	Benefit Cost	Distance Factor	Sub-Section Factor	Outlet Factored Area	Outlet Cost	Special Benefit / Specieal Assessment	Allowance	Sub-Total Cost	Farm Class Tax Rate	Net HST	OMAFRA Grant Reduction	Total Net Cost (After Tax & Grant)
Roll Number	Property ID																	
010100602671000	1	0.80	1.00	0.80	Y	0.80	$ 132.95	0.79	0.33	0.21	$ 27.50	$ -	$ -	$ 160.44		$ 2.82	$ -	$ 163.27
010100601250000	2	8.93	1.04	9.32	Y	9.32	$ 1,554.33	0.76	0.37	2.63	$ 345.71	$ -	$ -	$ 1,900.03	Y	$ 33.44	$ 633.34	$ 1,300.13
010100601244265	3	14.52	0.77	11.16	Y	11.16	$ 1,860.69	0.70	0.83	6.50	$ 853.42	$ -	$ -	$ 2,714.11		$ 47.77	$ -	$ 2,761.87
010100601244348	4	0.25	2.00	0.50	Y	0.50	$ 84.04	0.91	0.64	0.29	$ 38.12	$ -	$ -	$ 122.16		$ 2.15	$ -	$ 124.31
010100601244351	5	0.23	2.00	0.46	Y	0.46	$ 77.37	0.99	0.67	0.31	$ 40.16	$ -	$ -	$ 117.54		$ 2.07	$ -	$ 119.61
010100601199000	6	0.29	2.00	0.58	Y	0.58	$ 96.38	0.50	1.00	0.29	$ 37.95	$ -	$ -	$ 134.33		$ 2.36	$ -	$ 136.70
-	BLOCK ASSESSMENT 1	1.51	2.46	3.73	N	0.00	$ -	0.38	0.33	0.48	$ 62.55	$ -	$ -	$ 62.55		$ 1.10	$ -	$ 63.65
-	BLOCK ASSESSMENT 2	1.47	2.58	3.80	N	0.00	$ -	0.35	0.64	0.84	$ 110.05	$ -	$ -	$ 110.05		$ 1.94	$ -	$ 111.99
-	BLOCK ASSESSMENT 3	3.64	2.33	8.46	Y	8.46	$ 1,411.27	0.68	0.50	2.87	$ 377.17	$ -	$ -	$ 1,788.44		$ 31.48	$ -	$ 1,819.91
-	BLOCK ASSESSMENT 4	1.87	2.35	4.40	Y	4.40	$ 734.08	0.88	0.58	2.26	$ 297.27	$ -	$ -	$ 1,031.35		$ 18.15	$ -	$ 1,049.50
-	BLOCK ASSESSMENT 5	1.36	2.37	3.22	Y	3.22	$ 537.70	0.86	0.67	1.85	$ 243.09	$ -	$ -	$ 780.79		$ 13.74	$ -	$ 794.53
	BLOCK ASSESSMENT 6	1.41	2.00	2.83	Y	2.83	$ 471.39	0.96	0.83	2.26	$ 296.17	$ -	$ -	$ 767.56		$ 13.51	$ -	$ 781.07
-	BLOCK ASSESSMENT 7	5.33	2.59	13.81	Y	13.81	$ 2,302.22	0.77	1.00	10.67	$ 1,401.41	$ -	$ -	$ 3,703.63		$ 65.18	$ -	$ 3,768.81
-	BLOCK ASSESSMENT 8	9.96	2.22	22.11	Y	22.11	$ 3,687.59	0.49	1.00	10.81	$ 1,419.44	$ -	$ -	$ 5,107.03		$ 89.88	$ -	$ 5,196.91
		51.58				77.66	$ 12,950.00			42.26	$ 5,550.00	$ -	$ -	$ 18,500.00		$ 325.60	$ 633.34	$ 18,192.26

APPENDIX C:

Hydrologic Modelling Calculations

Project Title	McNairn Drain
MPCE Project Number	PM-18-9531

Watershed Area	A=	0.52	km^2
Lake and Wetland Area	A=	0.04	km^2

Step 1: Determine Appropriate Methodology

Peak Flow Calculation Methodologies for Small to Large Watershed

Methodology	Drainage Area Limits (km^2)			
	0 to 1	1 to 25	25 to 100	100 to 10000
Rational Method	☑	-	-	-
Hydrologic Model	☑	-	-	-
MNR Index Flood	-	☑	☑	☑
MNR Dimensionless	-	☑	-	-
MTO Watershed Classification	-	-	☑	☑
Station-Frequency	-	-	-	☑
Unified Ontario Flood Method	-	-	☑	☑
MTO Modified Index Flood Method	-	☑	☑	☑

Project Title	**McNairn Drain**
MPCE Project Number	**PM-18-9531**
Methodology	**Rational Method**

				Lake and Wetland Percentage (%)
Watershed Area	A=	0.52	km^2	
Lake and Wetland Area	A=	0.04	km^2	8.7

Runoff Coefficient

Land Use	Runoff Coefficient	Area (km^2)	Balanced Runoff Coefficient
Impervious	0.90	0.046	0.56
Wetland	0.05	0.045	
Agricultural	0.55	0.194	
Residential	0.60	0.231	

*Values Based on: MTO Drainage Management Manual - Design Chart 1.07: Runoff Coefficients

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Sheet Flow Distance (m)	Sheet Flow Tc (min)
455	0.22	30	16

Shallow Concentrated Flow Distance (m)	Shallow Concentrated Flow Velocity (m/s)	Shallow Concentrated Tc (min)
425	0.0719	99

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
125	0.65	0.37	6

Total Tc (min)
120

Intensity

Return Period	Results (mm/hr)
2-Year	13
5-Year	18
10-Year	20
25-Year	24
50-Year	26
100-Year	29

*Equation Based on MTO IDF Curve Lookup Results for 45.03916758568, -74.65679116009 - Year 2050

Peak Flow

Return Period	Results (L/s)
2-Year	1080
5-Year	1420
10-Year	1640
25-Year	1917
50-Year	2114
100-Year	2317

MTO Drainage Management Manual - Design Chart 1.06: Peak Discharge Reduction Factor to Allow for Storage

Watershed Area	0.52 km^2
Storage Area from Lakes & Swamps	0.04 km^2
Storage Percent	8.7%

Curve B: Significant portion of flow passes through detention areas distributed throughout basin or in the middle r

Ks (Peak Discharge Reduction Factor) = 0.788

Summary Flow Statistics

Return Period	Return Period Flow
	L/s
2-Year	851
5-Year	1119
10-Year	1292
25-Year	1511
50-Year	1666
100-Year	1826

Project Title	**McNairn Drain**
MPCE Project Number	**PM-18-9531**
Methodology	**Hydrologic Model - Visual OTTHYMO**

Watershed Area	A=	0.52	km^2
Lake and Wetland Area	A=	0.04	km^2

Curve Number

Land Use	Curve Number	Area (km^2)	Composite Curve Number
Impervious	98	0.046	84
Wetlands	50	0.045	
Agricultural	86	0.194	
Residential	86	0.231	

*Values Based on: MTO Drainage Management Manual - Design Chart 1.09: Soil Conservation Service Curve Numbers

Initial Abstraction

Land Use	Initial Abstraction (Ia)	Area (km^2)	Composite Initial Abstraction
Impervious	2.0	0.046	6
Swamp	10.0	0.045	
Cultivated	7.0	0.194	
Residential	5.0	0.231	

*Table 7.5: Initial Abstraction/Depression Storage – Adapted from UNESCO, Manual on Drainage in Urbanized Areas, 1987

Time of Concentration (Refer to Rational Method Sheets for Breakdown)

Time of Concentration (min)	Time to Peak (hours)
120	1.34

Visual OTTHYMO Inputs

Area (ha)	Curve Number	Initial Abstraction (Ia)	Time to Peak (hours)
51.58	84	6	1.34

Peak Flow

Return Period	4-hr Chicago	12-hr SCS Type II	24-hr SCS Type II
	Results (m^3/s)		
2-Year	0.40	0.69	0.89
5-Year	0.68	1.12	1.36
10-Year	0.89	1.43	1.72
25-Year	1.17	1.79	2.15
50-Year	1.37	2.09	2.45
100-Year	1.59	2.38	2.75

MTO Drainage Management Manual - Design Chart 1.06: Peak Discharge Reduction Factor to Allow for Storage

Watershed Area	0.52	km^2
Storage Area from Lakes & Swamps	0.04	km^2
Storage Percent	8.7%	

Curve A: Significant portion of flow passes through detention areas in upper reaches, or elsewhere in basin not in pat

Ks (Peak Discharge Reduction Factor) = 0.788

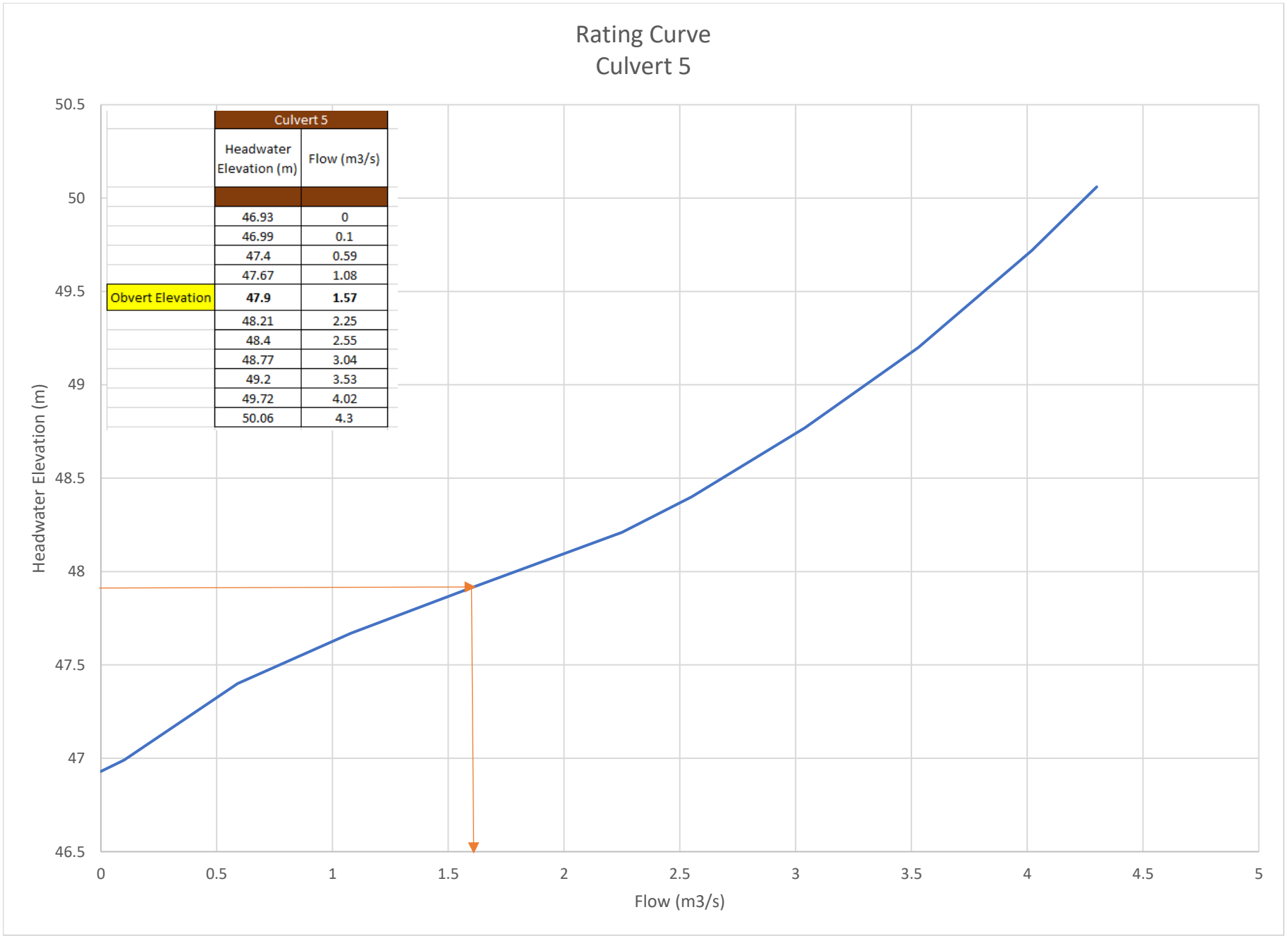
Summary Flow Statistics

Return Period	Peak Flow
	(m^3/s)
2-Year	0.70
5-Year	1.07
10-Year	1.35
25-Year	1.70
50-Year	1.93
100-Year	2.17

Project Title	**McNairn Drain**
MPCE Project Number	**PM-18-9531**
Page Title	**Summary of Results**

Watershed Area	A=	0.52	km^2
Lake and Wetland Area	A=	0.04	km^2

	Rational Method	Visual OTTHYMO	Maximum Results
Return Period	(m^3/s)		
2-Year	0.85	0.70	**0.85**
5-Year	1.12	1.07	**1.12**
10-Year	1.29	1.35	**1.35**
25-Year	1.51	1.70	**1.70**
50-Year	1.67	1.93	**1.93**
100-Year	1.83	2.17	**2.17**


Rating Curve
Culvert 5
Culvert 5
Headwater Elevation (m)
Flow (m3/s)
46.93 0
46.99 0.1
47.4 0.59
47.67 1.08
Obvert Elevation 47.9 1.57
48.21 2.25
48.4 2.55
48.77 3.04
49.2 3.53
49.72 4.02
50.06 4.3
Headwater Elevation (m)
50.5
50
49.5
49
48.5
48
47.5
47
46.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Flow (m3/s)

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0.10 cms

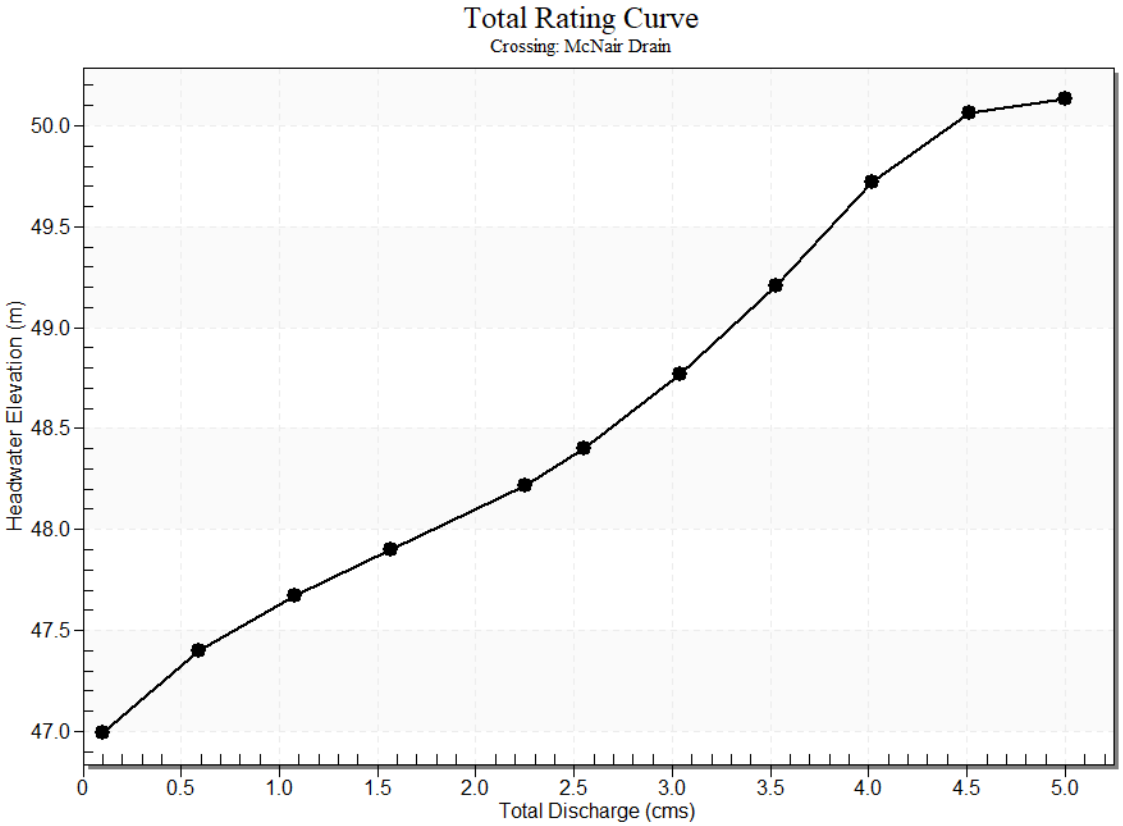
Design Flow: 2.25 cms

Maximum Flow: 5.00 cms

Table 1 - Summary of Culvert Flows at Crossing: McNair Drain

Headwater Elevation (m)	Total Discharge (cms)	Culvert 5 Discharge (cms)	Roadway Discharge (cms)	Iterations
46.99	0.10	0.10	0.00	1
47.40	0.59	0.59	0.00	1
47.67	1.08	1.08	0.00	1
47.90	1.57	1.57	0.00	1
48.21	2.25	2.25	0.00	1
48.40	2.55	2.55	0.00	1
48.77	3.04	3.04	0.00	1
49.20	3.53	3.53	0.00	1
49.72	4.02	4.02	0.00	1
50.06	4.51	4.30	0.20	7
50.13	5.00	4.36	0.64	5
50.00	4.25	4.25	0.00	Overtopping

Rating Curve Plot for Crossing: McNair Drain



Culvert Data: Culvert 5

Table 2 - Culvert Summary Table: Culvert 5

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.10 cms	0.10 cms	46.99	0.24	0.264	3-M2t	0.21	0.17	0.19	0.19	0.89	0.51
0.59 cms	0.59 cms	47.40	0.61	0.669	3-M2t	0.53	0.41	0.48	0.48	1.41	0.84
1.08 cms	1.08 cms	47.67	0.87	0.938	3-M2t	0.77	0.56	0.64	0.64	1.76	0.98
1.57 cms	1.57 cms	47.90	1.11	1.173	3-M2t	1.20	0.69	0.76	0.76	2.07	1.08
2.25 cms	2.25 cms	48.21	1.48	1.484	3-M2t	1.20	0.83	0.90	0.90	2.47	1.18
2.55 cms	2.55 cms	48.40	1.67	1.628	3-M2t	1.20	0.88	0.96	0.96	2.64	1.22
3.04 cms	3.04 cms	48.77	2.04	1.890	3-M2t	1.20	0.96	1.03	1.03	2.93	1.27
3.53 cms	3.53 cms	49.20	2.47	2.224	7-M2t	1.20	1.02	1.10	1.10	3.24	1.32
4.02	4.02	49.72	2.99	2.598	7-	1.20	1.07	1.17	1.17	3.58	1.37

cms	cms				M2t						
4.51 cms	4.30 cms	50.06	3.33	2.862	4-FFf	1.20	1.10	1.20	1.23	3.80	1.41
5.00 cms	4.36 cms	50.13	3.40	2.962	4-FFf	1.20	1.10	1.20	1.29	3.85	1.44

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

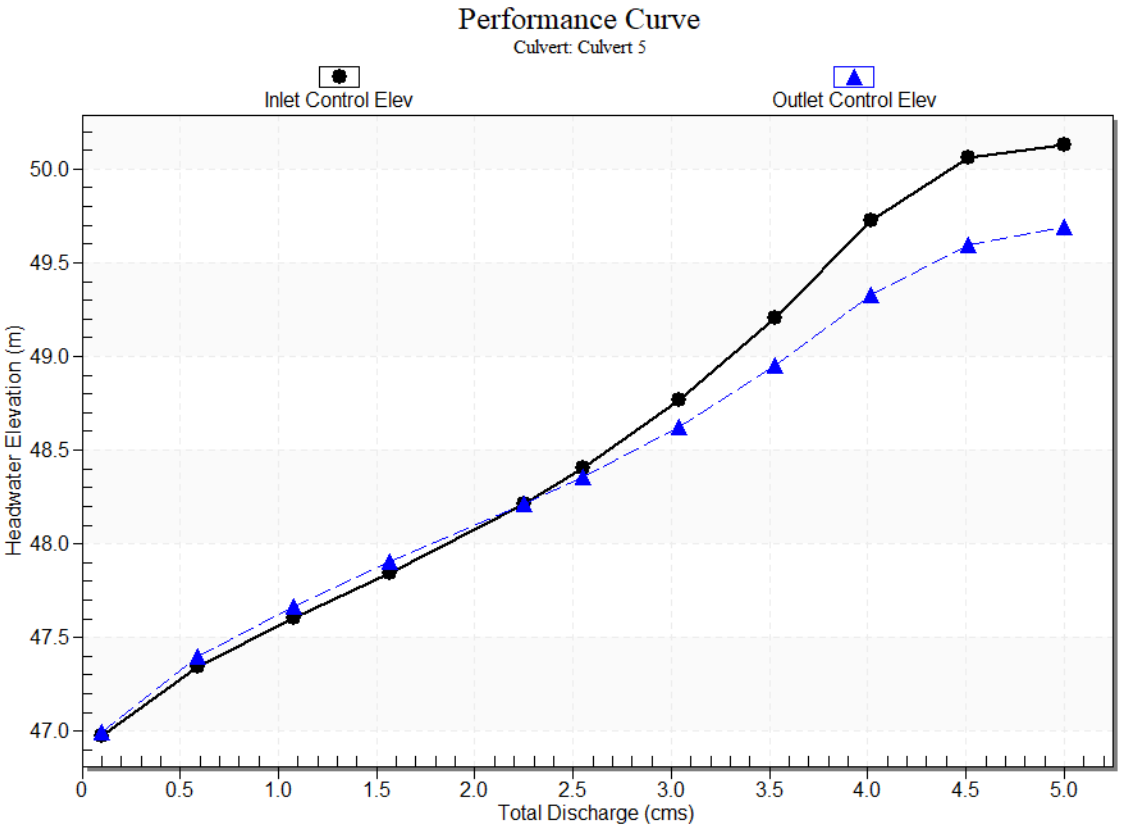
Inlet Elevation (invert): 46.73 m,

Outlet Elevation (invert): 46.70 m

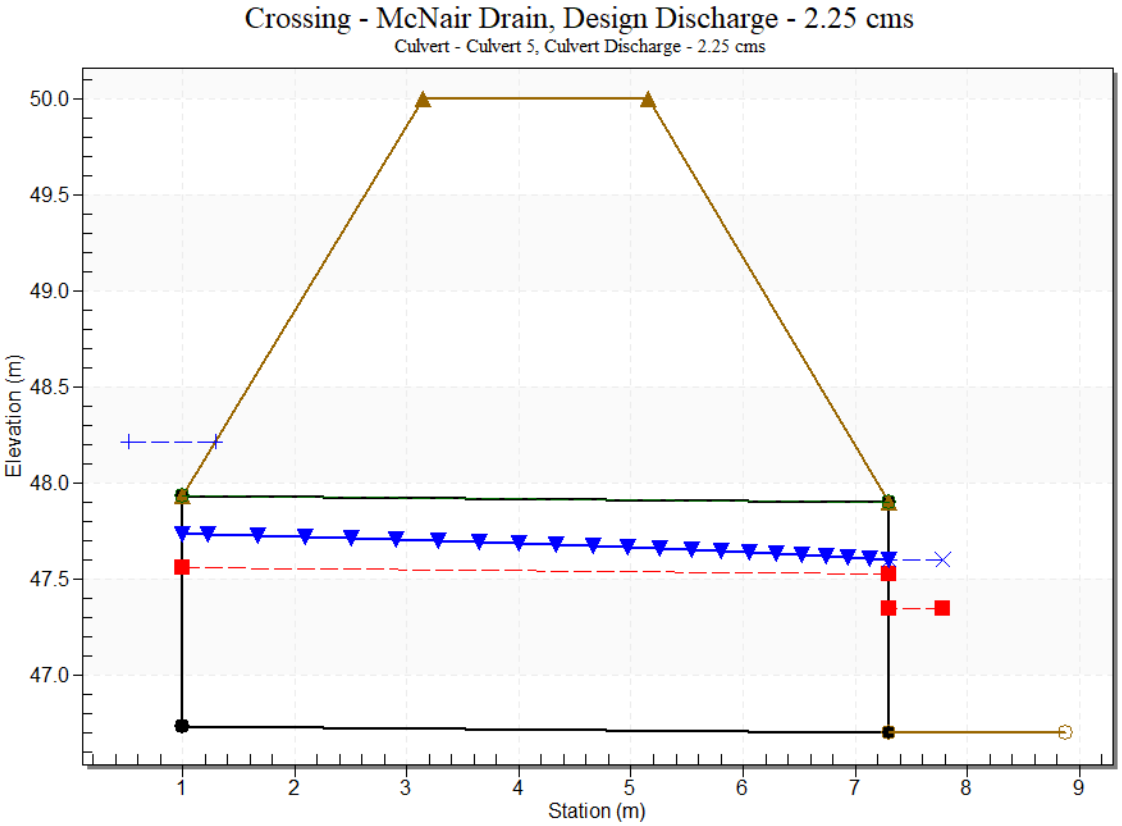
Culvert Length: 6.30 m,

Culvert Slope: 0.0048

Culvert Performance Curve Plot: Culvert 5



Water Surface Profile Plot for Culvert: Culvert 5



Site Data - Culvert 5

Site Data Option: Culvert Invert Data

Inlet Station: 1.00 m

Inlet Elevation: 46.73 m

Outlet Station: 7.30 m

Outlet Elevation: 46.70 m

Number of Barrels: 1

Culvert Data Summary - Culvert 5

Barrel Shape: Circular

Barrel Diameter: 1200.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting (Ke=0.9)

Inlet Depression: None

Tailwater Data for Crossing: McNair Drain

Table 3 - Downstream Channel Rating Curve (Crossing: McNair Drain)

Flow (cms)	Water Surface Elev (m)	Velocity (m/s)	Depth (m)	Shear (Pa)	Froude Number
0.10	46.89	0.19	0.51	8.45	0.43
0.59	47.18	0.48	0.84	21.52	0.47
1.08	47.34	0.64	0.98	28.89	0.49
1.57	47.46	0.76	1.08	34.47	0.50
2.25	47.60	0.90	1.18	40.68	0.51
2.55	47.66	0.96	1.22	43.06	0.51
3.04	47.73	1.03	1.27	46.61	0.52
3.53	47.80	1.10	1.32	49.82	0.52
4.02	47.87	1.17	1.37	52.78	0.52
4.51	47.93	1.23	1.41	55.52	0.53
5.00	47.99	1.29	1.44	58.08	0.53

Tailwater Channel Data - McNair Drain

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 0.76 m

Side Slope (H:V): 1.50 (_:1)

Channel Slope: 0.0046

Channel Manning's n: 0.0350

Channel Invert Elevation: 46.70 m

Roadway Data for Crossing: McNair Drain

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 9.00 m

Crest Elevation: 50.00 m

Roadway Surface: Paved

Roadway Top Width: 2.00 m