Town of Tecumseh MRSPA SWM Environmental Study Report Addendum

December 2014 – Submitted for Public and Agency Review

April 2015 – FINAL REPORT

11-5366-7000

Corporation of the Town of Tecumseh

Submitted by

Dillon Consulting Limited

3200 Deziel Drive, Suite 608
Windsor, Ontario N8W 5K8
Telephone: (519) 948-5000
Facsimile: (519) 948-5054
E-mail: windsor@dillon.ca

Our File: 11-5366 (Corr.)

DILLON CONSULTING

3200
Deziel Drive
Suite 608
Windsor, Ontario
Canada
N8W 5K8
Telephone
(519) 948-5000
Fax
(519) 948-5054

April 9, 2015

Corporation of the
Town of Tecumseh
917 Lesperance Road
Tecumseh, ON
N8N 1W9

Attention: Mr. Phil Bartnik, P.Eng.,
Manager, Engineering Services

Finalized Addendum to Class Environmental Assessment
Manning Road Secondary Plan Area (MRSPA)
Stormwater Management Study

Dear Sir:

The MRSPA SWM Environmental Study Report Addendum (December 2014) has undergone a 30 day public and agency review period that ended on January 19, 2015. Several comments were received during this period, which have been included along with our responses in Appendix F of the attached report.

Furthermore, this Addendum Report has now been updated to reflect additional information arising from the comments that have been received. In particular, the Essex Region Conservation Authority's comments resulted in an expanded hydraulic analysis of the preferred solution, which has now been outlined in the revised Functional Servicing Modelling Memo included in Appendix A. This expanded hydraulic analysis did not identify the need for significant changes to the preferred solution and as a result, this report was not re-issued for public and agency review.

The requirements outlined in the attached Addendum Report will be incorporated into the Functional Servicing Report for the MRSPA to clarify the detailed design requirements associated with the implementation of this preferred solution.

This project is now considered to be approved under the Municipal Class Environmental Assessment process.

Yours sincerely,

DILLON CONSULTING LIMITED

Flavio R. Forest, P.Eng.
Project Manager

FRF:d
Encl.

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1.0 INTRODUCTION

This report is an Addendum to the Town of Tecumseh Manning Road Secondary Plan Area, Stormwater Management Class Environmental Assessment (EA) Environmental Study Report (ESR) (April 2010). The study identified the preferred stormwater management solution and design to accommodate future development in the Manning Road Secondary Plan Area (MRSPA). The study was completed as a Schedule C Class EA following the Municipal Engineers Association, Class Environmental Assessment (June 2000). The Study Area was bound by Essex County Road 22 to the north, Manning Road (Essex County Road 19) to the east, the Canadian Pacific Railway (CPR) to the south, and the west side of St. Anne Street and Lesperance Roads to the west. The existing storm drainage areas are shown in **Figure 1**, while the revisions to these storm drainage areas recommended in the April 2010 ESR are shown in **Figure 2**.

The preferred alternative involved a regional stormwater management (SWM) facility to address the development needs of the MRSPA (located at the southerly limits), whereas drainage for the balance of the Study Area would by-pass this new SWM facility and discharge directly to existing drainage outlets. The ESR was available for the required public review period, during which time no Part II Order requests ("bump-ups") were received and the project was confirmed as being approved under the *Environmental Assessment (EA) Act*.

The Baillargeon Drain drainage area formed part of the original Study Area, located to the west of the MRSPA, and serves existing residential uses. The Baillargeon Drain crosses through the MRSPA, conveying stormwater runoff in an easterly direction and discharging directly to the East Townline Drain on the west side of Manning Road. There are currently no measures, nor were there any proposed in the future, to control the quality and quantity of the stormwater runoff from the Baillargeon Drain, which affects the level of service and characteristics of the East Townline Drain.

Since the completion of the 2010 ESR, the Town of Tecumseh has been reviewing its stormwater servicing strategy in this area and identified the potential to redirect the Baillargeon Drain to the proposed MRSPA SWM facility. This would provide a means of optimizing the use of this facility to control the quality and quantity of stormwater runoff from a larger area, thereby

further improving the existing and future conditions of the East Townline Drain. The Municipal Class EA (October 2000, as amended in 2007 and 2011), requires that a project be reviewed if it cannot be carried out in the manner outlined in the ESR. Any "significant" modification to the project or change in the environmental setting for the project which occurs after the ESR requires a review of the ESR and the preparation of an Addendum document.

The proposed change in the drainage area served by the MRSPA stormwater management facility was considered a "significant" change to the preferred solution outlined in the 2010 ESR. Accordingly, this Addendum was prepared to document the planning and decision-making process that was followed to confirm the selection of the preferred alternative.

The Notice of Filing of Addendum was advertised on December 12 and 19, 2014, for a 30 day public and agency review period, a copy of which is included in **Appendix F**. Several comments were received during this period, the responses to which are included in **Appendix F**.

In addition, this April 2015 Addendum Report, has now been updated to reflect additional information arising from the comments that have been received. In particular, the Essex Region Conservation Authority's comments resulted in an expanded hydraulic analysis of the preferred solution, which has now been outlined in the revised Functional Servicing Modelling Memo included in **Appendix A**. This expanded hydraulic analysis did not identify the need for significant changes to the preferred solution and as a result, this report was not re-issued for public and agency review.

The requirements outlined in the attached Addendum Report will be incorporated into the Functional Servicing Report for the MRSPA to clarify the detailed design requirements associated with the implementation of this preferred solution.

Based on the noted resolution of the public and agency comments and in light of no Part II Order requests having been received, this project is now considered to be approved under the Environmental Assessment Act.

2.0 2010 ENVIRONMENTAL STUDY REPORT RECOMMENDATIONS

Six alternative solutions were developed and evaluated as part of the 2010 study, consisting of various configurations of a regional SWM facility at two alternative locations in the Study Area. Based on the evaluation that was completed, the preferred solution (Alternative 2), involved the implementation of a regional stormwater management facility at the southerly limits of the Study Area to serve the development needs of the MRSPA. A stormwater pump station would serve to discharge the runoff volume collected in this facility to the East Townline Drain at a controlled rate, while the Baillargeon Drain would continue to discharge separately and directly to the East Townline Drain. The preferred design option included:

- A modified wet pond/wetland design.
- Pump station outlet to the East Townline Drain.
- 20 m setbacks from existing and future residential lot lines.
- 5 m setback from the existing Canadian Pacific Railway right-of-way.
- Surface storage requirements throughout the MRSPA for major rainfall events, with drainage to the SWM facility provided through the minor storm sewer system.
- Integrated parks and trail systems connecting to the wet pond, including planting and habitat enhancements designed for both function and aesthetics.

3.0 PROJECT DESCRIPTION

Development of lands within the MRSPA portion of the Study Area has not taken place since the 2010 ESR was completed, including any of the associated infrastructure improvements. In order to facilitate this development in the MRSPA, the Town initiated the functional design of site services, including an area-specific development charges study. During the course of these efforts, the Town identified an opportunity to incorporate the Baillargeon Drain as part of the MRSPA storm sewer system and stormwater management facility to better utilize the capacity of the existing and proposed storm drainage infrastructure in the area.

The scope of this Addendum is limited to an evaluation of whether to incorporate the Baillargeon Drain as part of the design drainage area for the proposed MRSPA storm sewers and stormwater management facility. In order to evaluate this alternative against the preferred solution identified in the 2010 ESR, the following work was completed and documented as part of this report:

- Hydraulic and hydrologic modeling of this alternative to confirm the associated infrastructure requirements and hydraulic impacts; and
- An updated inventory of the environment.

4.0 CLASS EA REQUIREMENTS

The 2010 ESR was prepared in accordance with the Municipal Class Environmental Assessment (June 2000) as a Schedule C project. Since that time, the Municipal Class EA was amended by the Ministry of the Environment in 2011. One of the key amendments in the 2011 document is the allowable time lapse between filing of the ESR and project implementation, which has now been increased from five years to 10 years. The ten year period extends from the filing of the Notice of Completion (or resolution of a Part II Order request) to the proposed commencement of construction for the project.

Section A.4.3 of the 2011 Class EA identifies two reasons for completing an Addendum:

- *Significant modifications to the project.* Any significant modification which occurs after filing the Notice of Completion shall be documented in an Addendum. The Addendum must describe the circumstances necessitating the change, the environmental implications of the change and what, if anything can and will be done to mitigate any negative environmental impacts:
    - The addition of the Baillargeon Drain drainage area to the design drainage area for the MRSPA stormwater management facility is considered a significant modification to the project.

- *Lapse of time.* If the period of time between filing the Notice of Completion and project implementation exceeds the timing window identified in the Class EA, the proponent shall review the planning and design process and the current environmental setting to ensure that the project and the mitigation measures are still valid given the current planning context:
    - While the 2010 ESR is valid until April 2015, the opportunity to complete a review of any changes to the environment was identified as part of this Addendum since project implementation may not be initiated until after April 2015. This Addendum includes a review of the existing environment for the Study Area.

As required by the Class EA, this Addendum involved five major activities:

- Update existing and future conditions potentially affected by the project.
- Confirm the appropriate range of design options.
- Update the evaluation of alternative designs, considering all aspects of the environment.
- Update the impact assessment of the preferred alternative, including measures to avoid or mitigate adverse impacts.
- Public and agency consultation on the proposed changes.

5.0 PUBLIC AND AGENCY CONSULTATION

As part of this Class EA Addendum, a letter was sent to the Ministry of the Environment, Southwestern Region, Regional Environmental Planner on August 11, 2014, outlining the project and the need for an Addendum (included in **Appendix B**).

There have also been on-going discussions with the Essex Region Conservation Authority (ERCA) regarding drainage considerations in this Study Area. A meeting was held with ERCA on August 15, 2014, to review the proposed changes being considered in this Addendum.

The Town of Tecumseh met with several land owners in the MRSPA to inform them of the proposed expansion of the drainage area for the pond, including the anticipated schedule for completion of this Addendum and next steps related to site servicing and development.

This Addendum will be available to the public and review agencies for a 30-day review period. During the review period, there is an opportunity for any person who has significant concerns with the changes outlined in this report, which cannot be resolved with the Town, to request the Minister of the Environment to change the status of the project from a Schedule C Class EA to an individual EA by issuing a "Part II Order" under the *EA* Act. If there are no Part II Order requests, the project may proceed to construction. The Part II Order request is only for the changes documented in this report and does not apply to the 2010 ESR.

A copy of the Notice of Filing of Addendum will be published in two editions of the Tecumseh Shoreline and will be sent to the project contact list (**Appendix B**), including the ten First Nations identified by Indian and Northern Affairs Canada that have specific claims in the vicinity of the project.

The Notice of Filing of Addendum was advertised on December 12 and 19, 2014, for a 30 day public and agency review period, a copy of which is included in **Appendix F**. Several comments were received during this period, the responses to which are included in **Appendix F**.

6.0 EXISTING CONDITIONS

This section of the Addendum includes an update of the existing conditions in the Study Area.

6.1 Existing and Future Land Use

Lands within the Study Area include vacant lands that are currently used for agricultural purposes, existing residential land uses to the west, commercial uses to the northwest, and light industrial uses to the northeast.

As outlined on Schedule A-1 of the Sandwich South Official Plan (Consolidated June 2014), the vacant lands that form the Manning Road Secondary Plan Area (MRSPA) are designated "Low Density Residential", "Medium Density Residential", "General Commercial", "Neighbourhood Commercial", "Community Facility" and "Recreational".

6.2 Natural Environment

The natural environment within the Study Area is highly degraded and there is little natural habitat remaining. The 2010 ESR documents the existing natural environment within the MRSPA. As part of this Addendum, a background review and site reconnaissance was completed to assess any changes to the natural environment and document conditions along the Baillargeon Drain. The desktop review included an assessment of potential Species At Risk (SAR) and their habitat in the area (**Appendix C**).

Baillargeon Drain

The only area with some natural habitat in the study area is the Baillargeon Drain. It is a constructed drain with no DFO classification (Land Information Ontario, 2014). It flows in an easterly direction across the Manning Road Secondary Plan Area to Manning Road where it joins East Townline Drain and continues north for approximately 3 km until the outlet in Lake St. Clair. Request for information was submitted to both the Aylmer District Ministry of Natural Resources & Forestry (MNRF) as well as the Essex Region Conservation Authority. The MNRF does not have any fisheries information for the Baillargeon Drain and a response from ERCA is pending (Kate MacIntyre (Pers Comm Oct 2014) Biologist, MNRF, Aylmer District).

Fisheries and Oceans Canada (DFO) mapping for the Essex Region Conservation Authority area was consulted and no fish or mussel Species at Risk (SAR) are documented within the Baillargeon Drain. DFO mapping does indicate that there are known fish SAR in Lake St. Clair at the outlet of East Townline Drain.

Field Investigation

A fish community assessment and characterization of the existing fish habitat within the Baillargeon Drain was conducted by Dillon biologists on October 8, 2014. Weather conditions at the time of the assessment were sunny with an approximate temperature of 16°C and wind

speed of approximately 6 on the Beaufort Scale (Strong Breeze). The drain was assessed by documenting of physical features and taking photographic record for future reference. The fish community survey was conducted with a backpack electofisher (Halltech HT-2000B) with settings of 150 v and 60 Hz for 1,491 seconds (in the lower reach of the drain), as well as 250 v and 80 Hz for an additional 317 seconds (in the upper reach of the drain), resulting in a combined effort of 1808 electrofishing shocker seconds.

The Baillargeon Drain was observed to exhibit typical drain characteristics, such as a flat morphology and was relatively homogenous in form and function. Furthermore, channelization of the drain was evident. At the time of assessment, the drain had very little flow, with an average wetted width of approximately 1.2 m and an approximate average depth of 0.1 m. Substrates consisted primarily of silt, clay, muck and detritus. The channelized banks are steep, yet stable. Overhanging vegetation primarily in the form of Red Osier Dogwood (*Cornus sericea*) and other shrub species were present in the upper reaches of the drain providing shade and cover to fish species within the drain. Within the drain, cover instream was limited to organic debris (approximately 30% surface area) in the form of leaf litter and minor coarse woody debris. Instream vegetation is also present (approximately 15% surface area), and is predominantly represented by Common Cattail (*Typha latifolia*). The riparian area on either size of the drain was narrow with clearing occurring to within 1 m of the top of bank and comprised of ground cover vegetation and sparse trees and shrubs. The invasive Common Reed (*Phragmites australis*) was also observed on-site. Active agricultural fields are present to the north and south of the drain in the project area. Upstream of the project area, the drain is subsurface and flows through an approximate 1.25 m concrete culvert. Two additional corrugated steel pipes (CSPs) approximately 1.25 m in diameter are also present along the drain in the area of the project site believed to be installed for machinery field access.

During field investigations, one fish species, the Brook Stickleback (*Culaea inconstans*) was identified through capture by electrofishing effort as well as observation. Forty individuals were caught with an approximate twelve more observed. The Brook Stickleback is a native, common species in Ontario with a Provincial Rank of S5, indicating that it is "Very Common" in Ontario with a population that is widespread, abundant and demonstrably secure. Its ecological and economic importance is its role as a forage fish and incidental bait fish.

Species At Risk

The background review identified thirteen historical occurrence records for SAR within 1 km of the Baillargeon Drain. Given the historical nature of the occurrence records in the general area of the project and the open country habitat type as determined through air photo interpretation, it is unlikely these species currently occupy the Study Area given the level of local disturbance, quality of residual habitat and the lack of suitable habitats to fulfill one or more of their life processes. The SAR screening completed for the Baillargeon Drain was sent to the Ministry of Natural Resources and Forestry (MNRF) for review. MNRF confirmed by letter dated August 8, 2014, there are no known occurrences for the Baillargeon Drain (**Appendix C**). MNRF advised that Eastern Fox Snake is known to occur widely in the County of Essex; however, it has not been specifically noted in the Study Area.

Based on this assessment, there has been no significant change to the natural environment since the completion of the 2010 ESR.

In response to the Addendum Notice, the MNRF provided feedback on SAR potential in the wider study area, which is included in **Appendix F**. Based on input received, there is some potential for SAR in the area (beyond the Baillargeon Drain) which includes Eastern Fox Snake. Prior to construction, approval from MNRF is required, either through a Letter of Advice or an *Endangered Species Act* approval. Consultation with MNRF is required to determine if species-specific surveys are required.

6.3 Cultural Resources

A Stage 1 Archaeology Assessment was completed for the MRSPA portion of the Study Area by Fisher Archaeological Consulting (October 2014). As shown in Figure 7 of the Stage 1 Archaeological Assessment Report (**Appendix D**), the majority of the Study Area has low potential for the discovery of archaeological artifacts. Only areas identified as high potential require additional assessment prior to any construction activities.

Please refer to **Appendix F** for further clarification in response to comments received from the Ministry of Tourism, Culture and Sport (MTCS) following the Notice of Filing of Addendum for this study.

6.4 Socio-Economic Environment

The 2010 ESR documents existing economic activity within the Study Area. In general, there has been little change to the economic environment in the Study Area since 2010. Commercial and Light Industrial businesses dominate the surrounding landscape. Lands within the Study Area remain under agricultural production of cash crops.

6.5 Drainage System

The 2010 ESR documented the drainage system that serves the Study Area, including the East Townline Drain, the Cyr Drain, and the Baillargeon Drain, as shown in **Figure 1**.

The Baillargeon Drain is an open drain that crosses the MRSPA and serves as a drainage outlet from an enclosed storm sewer system that serves the existing residential lands to the west, and flows in an easterly direction to the East Townline Drain at Manning Road. As outlined in the 2010 ESR, the open portion of the Baillargeon Drain was proposed to be enclosed with a 1350 mm diameter concrete pipe to accommodate development within the MRSPA, but was not to be integrated as part of the proposed MRSPA storm drainage system. The revised drainage system associated with the recommended solution from the 2010 ESR is shown in **Figure 2**.

Consideration is now being given to incorporating the Baillargeon Drain within the proposed storm sewer and stormwater management system that is required to serve the development of the MRSPA, as shown in **Figure 3**.

7.0 EVALUATION OF ALTERNATIVE SOLUTIONS

7.1 Alternative Solutions

The alternative to the preferred solution identified in the 2010 ESR involves expanding the design drainage area of the proposed MRSPA stormwater management facility to include the Baillargeon Drain drainage area. While the location of the proposed MRSPA stormwater management facility will remain the same, any required changes to the size, shape, discharge capacity and operational requirements of this facility will be confirmed and included as part of the evaluation of this alternative.

The results of the hydraulic and hydrologic analysis of the proposed MRSPA stormwater management facility are summarized in a report that has been included in **Appendix A**. This report has been updated based on comments received from the Essex Region Conservation Authority (ERCA) following the Notice of Filing of Addendum for this study. In addition to addressing the resulting changes in the operation of the MRSPA SWM pond, functional design details of the overland drainage and surface storage system were also developed to facilitate the detailed design of a fully integrated stormwater drainage solution for the MRSPA.

Based on the findings of this analysis, the resulting changes to the MRSPA stormwater management facility to accommodate the Baillargeon Drain are summarized as follows:

- The 1:100 year water level in the SWM pond would increase by 1.48 m (Preferred Scenario 3), reducing the freeboard to the lowest proposed surface elevation in the MRSPA from 3.61 m to 2.13 m (1.48 m freeboard reduction); and
- The time to drain down the pond facility would increase from approximately 2.25 days to 4.06 days during the 1:100 year storm event.

An evaluation of the alternatives was completed based on engineering, natural environment, cultural, socio-economic and cost considerations, as outlined in **Table 1.0.**

Table 1.0: Alternative Design Solutions Evaluation Matrix		
	Alternative Design Solution #2 A (2010) Regional CPR Pond Approved 2010 Concept	**Alternative Design Solution #2 B (2015) Regional CPR Pond Including the Baillargeon Drain**
Description / **Evaluation Criteria**	A regional SWM facility located adjacent to the CPR Tracks that serves the 100 Ha MRSPA.	A regional SWM facility located adjacent to the CPR Tracks that serves the 100 Ha MRSPA and the 96 Ha Baillargeon Drain drainage areas.
Engineering		
Degree of Stormwater Quality Control	The MRSPA SWM facility would control the MRSPA stormwater runoff to a level of treatment greater than "Normal". The quality of the existing runoff from the Baillargeon Drain drainage area is not controlled, and would continue to discharge directly to the East Townline Drain.	The MRSPA SWM facility would provide quality control for BOTH the MRSPA and Baillargeon Drain stormwater runoff to a "Normal" level of treatment.
Maximum Detention Time	The maximum runoff detention time for the 1:100 Year storm event is 54 hours based on a 500 L/s discharge rate.	The maximum runoff detention time for the 1:100 Year storm event would increase to 98 hours based on a 500 L/s discharge rate, resulting in the potential risk of increased overland flows if a storm event were to occur immediately following a 1:100 year storm. It was determined that on the basis of the storage volume available up to an extreme water surface elevation of 180.5m, there is a reasonable level of service to address this risk. Some additional risks are to vegetative plantings in the MRSPA pond as a result the increased duration of submergence.
Maximum High Water Level (HWL)	The maximum HWL elevation for the 1:100 year storm event is 177.14 metres, providing a 3.5 m freeboard to the lowest proposed surface grade in the MRSPA.	The maximum HWL elevation for the 1:100 year storm event is 178.62 metres, reducing the freeboard to the lowest proposed surface grade in the MRSPA to 2.13 m, and resulting in: Minor degree of additional surcharging at northerly limits of MRSPA that can readily be accommodated with surface controls. Impacts to additional vegetative plantings due to height of submergence. Increased public safety risks, reinforcing the need to adhere to 5:1 side slopes.
Drainage Infrastructure Efficiencies	Peak flow attenuation would be achieved for the MRSPA only, whereas the Baillargeon Drain would continue to discharge directly to the East Townline Drain, resulting in fewer benefits to future downstream infrastructure requirements. A separate enclosure of the Baillargeon Drain would be required, adding to the infrastructure costs for development of the MRSPA, without improving the outlet conditions in the interim.	Peak flow attenuation may be achieved for both the MRSPA and the Baillargeon Drain drainage area, without affecting the proposed pond and pump station outlet design, resulting in significantly improved benefits to downstream drainage infrastructure requirements. The enclosure of the Baillargeon Drain would be more cost-effectively incorporated as part of the proposed MRSPA storm sewer system, including an improved outlet condition for the upstream drainage area.
Constructability	Enclosure of the Baillargeon Drain would result in a deficient outlet at the existing East Townline Drain (ETLD) until such time that the ETLD is improved in the future as part of the Manning Road improvements.	Initial stages of development must account for integration of the added drainage contributions from the Baillargeon Drain as part of the storm sewer servicing and the staged construction of the MRSPA pond requirements.
Hydraulic Considerations/ MRSPA Surface Storage	All major overland flow can be contained on-site with acceptable surface storage requirements within the roadway.	Inflows from the Baillargeon Drain during the 1:100 year storm event causes an increase in the hydraulic gradeline through the MRSPA storm sewer system, which increases the amount of surface storage needed within the MRSPA. It has been confirmed that the major drainage system can function by increasing downstream storm sewer sizes and by allowing limited overland flow release to the Cyr Drain and East Townline Drain.
Engineering Summary		**Preferred:** **- Provides additional runoff quality control for the Baillargeon Drain** **- Impacts of increased runoff detention time, HGL increases and HWL in the MRSPA pond may be mitigated while maintaining an acceptable level of service.** **- Cost-effective infrastructure solution for MRSPA servicing and future downstream drainage improvements.**
Natural Environment		
Aquatic Environment	No loss of fish habitat or fish refuge resulting from works documented in the ESR, however Baillargeon Drain proposed to be enclosed and directed to the East Townline Drain as part of works completed outside of the EA. Enclosure would result in loss of fish habitat.	Loss of fish and fish refuge in the existing Baillargeon Drain. No significant aquatic environments are found in the Study Area.
Terrestrial Environment	Loss of common meadow-type vegetation and wildlife. No significant natural areas occur within the Study Area. Potential impacts to SAR habitat requires approval from MNRF prior to construction.	Same loss of common meadow-type vegetation and wildlife, compared to Alternative 2A. No significant natural areas occur within the Study Area. Potential impacts to SAR habitat requires approval from MNRF prior to construction.
Natural Environment Summary	**Equal**	**Equal**
Cultural Resources		
Archaeological Resources	Additional Stage 2 archaeological assessment required in identified high potential areas prior to construction.	Additional Stage 2 archaeological assessment required in identified high potential areas prior to construction.
Cultural Resources Summary	**Equal**	**Equal**
Socio-Economic Impacts		
Future Development	Pond accommodates all flows associated with development within the MRSPA with excess capacity.	Pond accommodates all flows associated with development within the MRSPA and Baillargeon Drain drainage areas.

	Alternative Design Solution #2 A (2010) Regional CPR Pond Approved 2010 Concept	**Alternative Design Solution #2 B (2015) Regional CPR Pond Including the Baillargeon Drain**
Future Development Outside of Study Area	Pond can accommodate some of the stormwater flows from the Tecumseh Hamlet development south of the CPR Tracks.	Pond cannot accommodate the stormwater flows from the Tecumseh Hamlet development south of the CPR Tracks.
Socio-Economic Summary	**Equal**	**Equal**
Cost		
Capital Cost of Trunk Sewers	Full enclosure of Baillargeon Drain is required.	Integrating flow into the established storm sewer network will reduce overall cost of construction within the MRSPA. Increased benefits to the cost of future downstream improvements to the ETLD.
Operational & Maintenance Cost of Pump Station(s)	One stormwater pumping station needs to be operated and maintained.	One stormwater pumping station needs to be operated and maintained.
Cost Summary		**Preferred due to improved cost effectiveness now and in the future.**
Evaluation Summary		**Recommended Design Solution**

7.2 Recommended Design Solution and Detailed Design Considerations

Alternative Design Solution #2 B (2015) Regional CPR Pond, Including the Baillargeon Drain has been identified as the recommended design solution based on the evaluation outlined in **Table 1.0**.

The detailed design of this facility must incorporate the recommendations outlined in the 2010 ESR, including consideration of the recommended refinements to the normal water level and the level of stormwater quality control. Furthermore, due to the increased runoff volume from the expanded design drainage area that would now be served by the MRSPA SWM facility, the following recommendations are highlighted for further consideration during the detailed design stages of this project:

- It is recommended that consideration be given to incorporating inlet controls throughout the MRSPA to promote an appropriate balance between minor system drainage (limiting inflows to the capacity of the storm sewer system) and major system drainage (incorporating sufficient surface storage to accommodate runoff from major storm events), including reinforcing the importance of overland drainage outlets to the Cyr Drain, the East Townline Drain and the MRSPA SWM facility.
- It is recommended that the proposed vegetative plantings for the embankments of the MRSPA SWM facility be limited to the selection of species that are more tolerant of extended periods of submergence, and that increased attention to maintenance of these plantings is considered.
- It is recommended that the 5:1 side slopes recommended in the 2010 ESR be strictly adhered to for public safety considerations, particularly with the increased depths and duration of water storage that would now arise with the expanded storm drainage area being served by the MRSPA SWM facility.
- It is recommended that the design of the pump station outlet from the MRSPA SWM facility include appropriate emergency back-up power supply provisions, and that stand-by pump capacity be available in case of pump failure.

8.0 COST

The total estimated cost of the proposed MRSPA stormwater management facility is not significantly affected by introducing the Baillargeon Drain drainage area. It is also more cost effective to incorporate the Baillargeon Drain as part of the MRSPA storm sewer system rather than separately enclosing this open drain through the MRSPA. Furthermore, there are expected to be significant benefits to future downstream drainage improvements for the East Townline Drain.

9.0 IMPACTS AND MITIGATION

Re-routing Baillargeon Drain to the MRSPA stormwater management facility will not have significant adverse environmental effects. Potential adverse impacts can be avoided or mitigated by implementing the proposed mitigation measures outlined in **Table 2.0**, including the detailed design considerations outlined in Section 7.2 of this report.

Baillargeon Drain

Based upon the information on the Baillargeon Drain known at this time and presented above, it is recommended that a Request for Review be submitted to DFO as the proposed works are not included in the DFO list of project activities where DFO review is not required. As this time, it is anticipated that with the implementation of DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat, a DFO Authorization will likely not be required. Recommended measures to avoid causing harm include the following, however shall be confirmed based on input from DFO prior to construction:

- Instream work take place outside of the Southern Region Spring Restricted Activity Timing Window - March 15th to July 15th [1].

1 This date may be further refined upon consultation with ERCA and DFO

- Erosion and Sediment Control Plan for the site is developed to minimize the risk of sedimentation to the downstream East Townline Drain and Lake St. Clair (where known SAR are present).
- Works are to be isolated and if necessary a fish salvage conducted to remove any trapped fish to be released unharmed downstream of the work area.

- Diverted water from any temporary flow diversion measures shall be discharged into energy dissipation devices downstream of work area.

- Water from any dewatering measures shall be discharged into a filter bag or sediment basin located in an area of undisturbed vegetation downstream of the work area.

Table 2.0: Potential Impacts and Mitigation Measures

Feature	Potential Issue/Concern/Impact	Mitigation Measures
Engineering Environment	Some additional risks of additional overland flows if a storm event were to occur immediately following a 1:100 year storm.	- Incorporate inlet controls to limit inflows to the storm sewer system, as identified herein. - Incorporate sufficient surface storage to accommodate specified runoff volumes, as identified herein. - Site grading for the major overland drainage system is to direct surface runoff in excess of the specified surface storage capacity to the existing Cyr Drain, East Townline Drain, and MRSPA SWM facility drainage systems.
	Some additional risks of impacts to some vegetative plantings in the MRSPA pond as a result the increased depth and duration of submergence.	- Selection of proposed planting materials that are more tolerant of submergence conditions, including additional maintenance, as required.
	Additional surcharging at northerly limits of MRSPA that can be accommodated through a combination of mitigating measures.	- Incorporate inlet controls to limit inflows to the storm sewer system, as identified herein. - Surface storage will be required to accommodate specified runoff volumes, as identified herein. - Site grading for the major overland drainage system is to direct surface runoff in excess of the specified surface storage capacity to the existing Cyr Drain, East Townline Drain and MRSPA SWM facility drainage systems.
Natural Environment	Potential for contamination of surface water through erosion/sedimentation spills or leaks.	- Use of erosion and sediment control measures such as erosion blanket, rip rap, straw bale, rock flow checks and vegetated buffers (as required) to mitigate high flow velocities and excessive erosion and sedimentation. - Temporary silt fencing installed around the construction site prior to commencement of any site preparation activities (clearing, grubbing, excavation, filling, grading) and maintained on a regular basis prior to and after run-off events. - Sediment and erosion control measures will be left in place until all construction activities are complete and disturbed areas have been stabilized and re-vegetated. - Minimize time of exposure for re-vegetated soils. - All materials and equipment used for construction activities will be operated and stored in a manner that prevents any deleterious substances from entering the water. - All disturbed areas will be re-vegetated as soon as conditions allow to prevent erosion and restore habitat. - Refueling or handling of potential hazardous substances are to be done away from the East Townline Drain and the Baillargeon Drain.
	Potential clearing of naturalized vegetation cover.	- Vegetation removal will be kept to a minimum and trees and shrubs to remain will be protected during construction. - Re-vegetation of pond slopes and natural areas will be completed using native seed mixes/native species where appropriate. - Re-vegetation of pond slopes and exposed areas will be completed as soon as possible to minimize soil exposure. - A monitoring/maintenance program will be developed until vegetation is established.
	Potential destruction of nests, eggs and young of migratory birds prior to and during construction.	- Vegetation removals should not be completed during the breeding bird season (May 1 – August 1). - The construction contractor shall not destroy active nests (nests with eggs or young birds), or wound or kill birds, or species protected under the Migratory Birds Protection Act, 1994 and or regulations under that act.
	Potential for the new stormwater management pond to attract unwanted waterfowl to the area which is in close proximity to the Windsor Airport.	- Incorporate shallows and wetland plants into the flow pattern to increase water retention time and contact time to minimize utilization of the pond by waterfowl. - Plant tall dense plants and woody plants near the water's edge to minimize intrusion by waterfowl.
	Potential for standing water within the pond to increase the risk of the spread of the West Nile Virus.	- Install bird and bat boxes to help consume nuisance species. - Stock fish upon completion of construction including Bass and Fathead Minnow to control nuisance species – mosquito larvae, biting midges, coarse fish, goldfish, carp etc.
	Potential for impacts to fish and fish habitat with the enclosure and re-routing of Baillargeon Drain.	Preliminary, recommended Measures to Avoid Causing Harm include (to be confirmed with DFO prior to construction): - Instream work take place outside of the Southern Region Spring Restricted Activity Timing Window; March 15th to July 15th. - Erosion and Sediment Control Plan for the site is developed to minimize the risk of sedimentation to the downstream East Townline Drain and Lake St. Clair (where known SAR are present). - Work are to be isolated and if necessary a fish salvage conducted to remove any trapped fish to be released unharmed downstream of the work area. - Diverted water from any temporary flow diversion measures shall be discharged into energy dissipation devices downstream of work area. - Water from any dewatering measures shall be discharged into a filter bag or sediment basin located in an area of undisturbed vegetation downstream of the work area.
	Potential impacts to SAR and SAR habitat	- Based on feedback received from MNRF, there is potential for SAR and SAR habitat within the general study area (beyond the Baillargeon Drain) which includes Eastern Fox Snake. - Prior to construction, approval from MNRF is required, either through a Letter of Advice or an *Endangered Species Act* permit. Consultation with MNRF is required to determine if species-specific surveys are required.
Cultural Environment	Potential destruction/disturbance of deeply buried archaeological artifacts or human remains.	- The Ontario Cemeteries Act applies to discovery of human remains. - If deeply buried cultural deposits are found the contractor will cease work and contact the Ministry of Tourism Culture and Sport and the Town of Tecumseh immediately.
Socio-Economic Environment	Potential dust and air quality impacts during construction.	- The contractor will prohibit equipment/truck idling when equipment is not in use. - Use well maintained equipment and machinery with properly functioning muffler and exhaust systems. - Comply with operating and maintenance specifications for heavy equipment and machinery. - Minimize vehicular traffic on exposed soils. - Cover or otherwise contain loose construction materials that potential to release airborne particulates during transport, installation or removal. - Restore disturbed areas as soon as practical to minimise the duration of soil exposure. - Measures should be in place to minimize the tracking of mud by construction vehicles and for the timely cleanup of mud and construction debris along public roads adjacent to the site.
	Potential for noise impacts during construction.	- Construction activities will be restricted to daytime hours. - The contractor must comply with the Town of Tecumseh Noise By-Law (#2002-07) at all times.
	Potential for public access to the edge of the stormwater management pond increasing the possibility for unintended slips or falls into the pond during summer and winter months.	- Edges of the pond will be constructed with **5:1 side slopes,** allowing for gentle egress to the pond edge preventing unintentional slipping into the water. - The area will be posted with "Thin Ice – No Skating" signs to discourage use of the pond during winter months. - Life ring stations will be positioned around the perimeter of the pond every 100 m.

10.0 OTHER PERMITS/APPROVALS

Prior to construction, the following permits/approvals will be required:

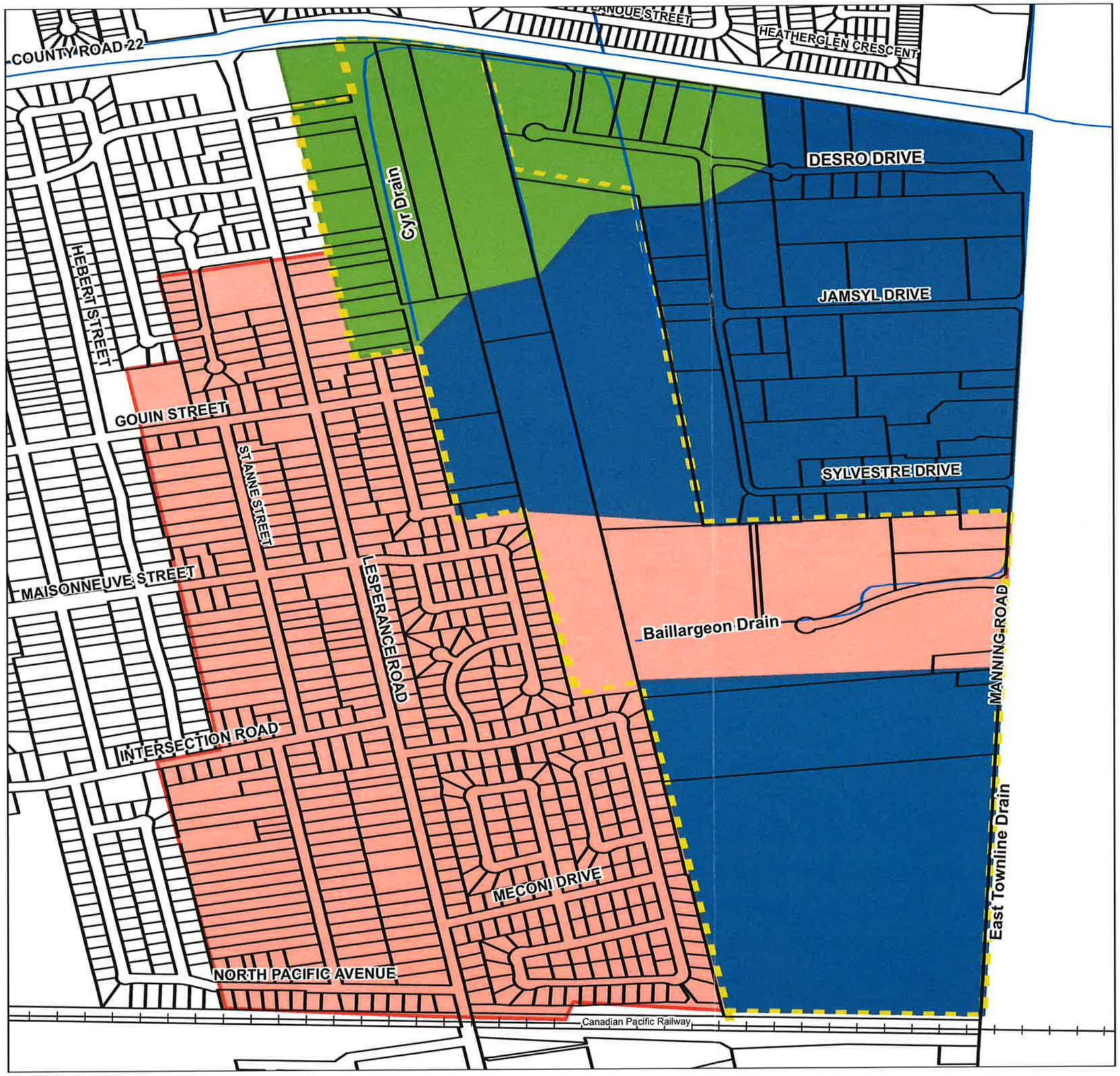
- Drainage Report for the Baillargeon Drain and approval of the enclosure under the Fisheries Act;
- Essex Region Conservation Authority Approval;
- Environmental Compliance Approval;
- Ministry of Natural Resources and Forestry Endangered Species Act Approval; and
- Town of Tecumseh Approval.

To comply with the Ontario Environmental Assessment Act, all of the mitigation measures identified in this Addendum must be incorporated into the design and/or construction of the infrastructure outlined in this Addendum.

Flavio R. Forest, P. Eng.,
Project Manager

Sabrina Stanlake, RPP,
Environmental Planner

FIGURES



Town of Tecumseh
Manning Road Secondary Plan Area
Class Environmental Assessment Addendum

Existing Drainage Areas
Figure 1

- Watercourse
- Railway
- Stormwater Management Facility
- Manning Road Secondary Plan Area
- Cyr Drain Drainage Area
- East Townline Drain Drainage Area
- Baillargeon Drain Drainage Area

0 105 210 420
Meters

N W E S

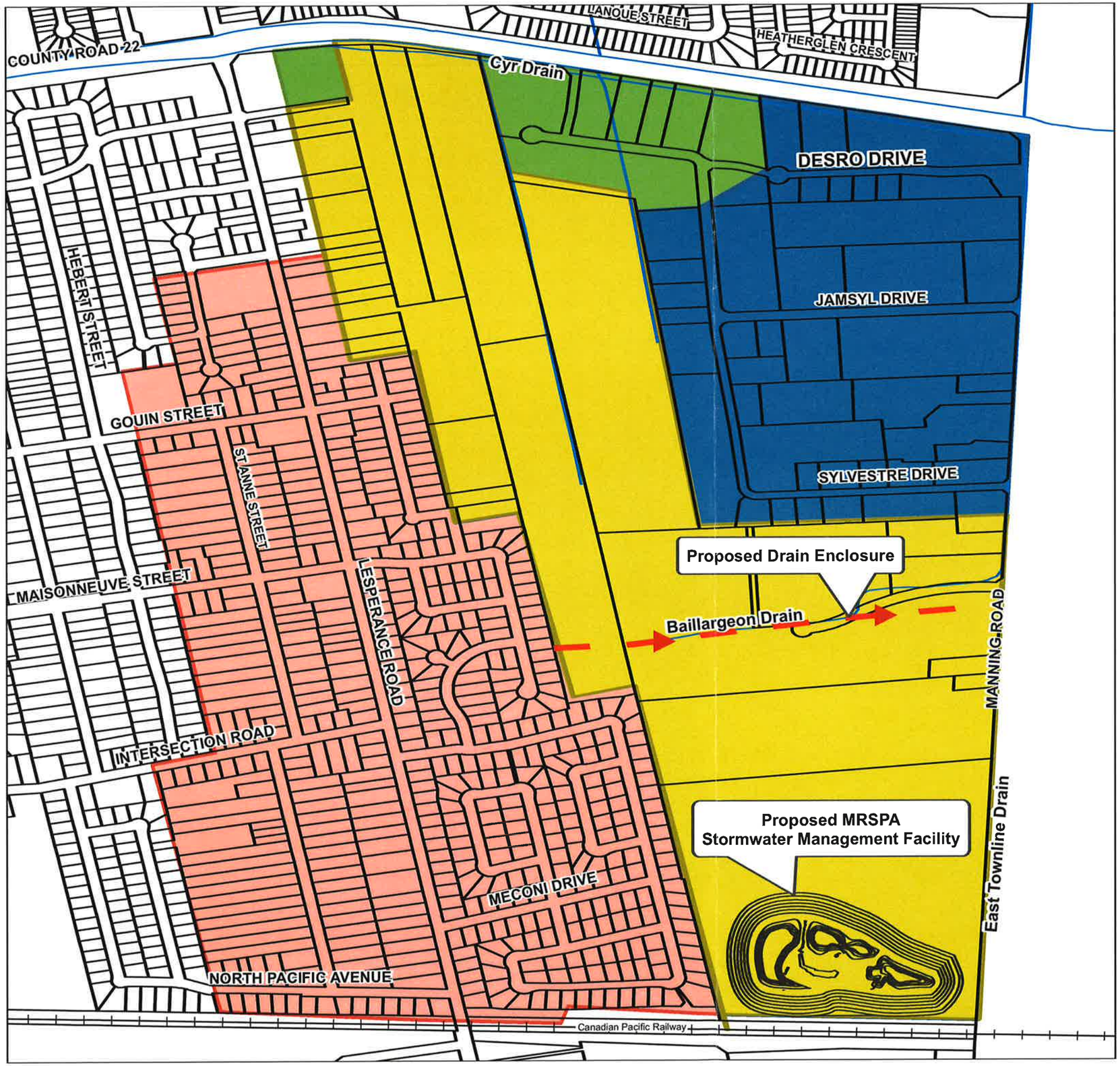
MAP DRAWING INFORMATION:
DATA PROVIDED BY MNR AND THE TOWN OF TECUMSEH

MAP CREATED BY: BJF
MAP CHECKED BY: FF
MAP PROJECTION: NAD 1983 UTM Zone 17N

FILE LOCATION: G:\GIS\115366 MRSPA\mxd

DILLON CONSULTING

PROJECT: 11-5366
STATUS: FINAL
DATE: 12/03/14



Town of Tecumseh
Manning Road Secondary Plan Area
Class Environmental Assessment Addendum

Drainage Areas Based on the 2010 ESR
Figure 2

- Watercourse
- Railway
- Stormwater Management Facility
- MRSPA SWM Drainage Area
- Cyr Drain Drainage Area
- East Townline Drain Drainage Area
- Baillargeon Drain Drainage Area

0 105 210 420
Meters

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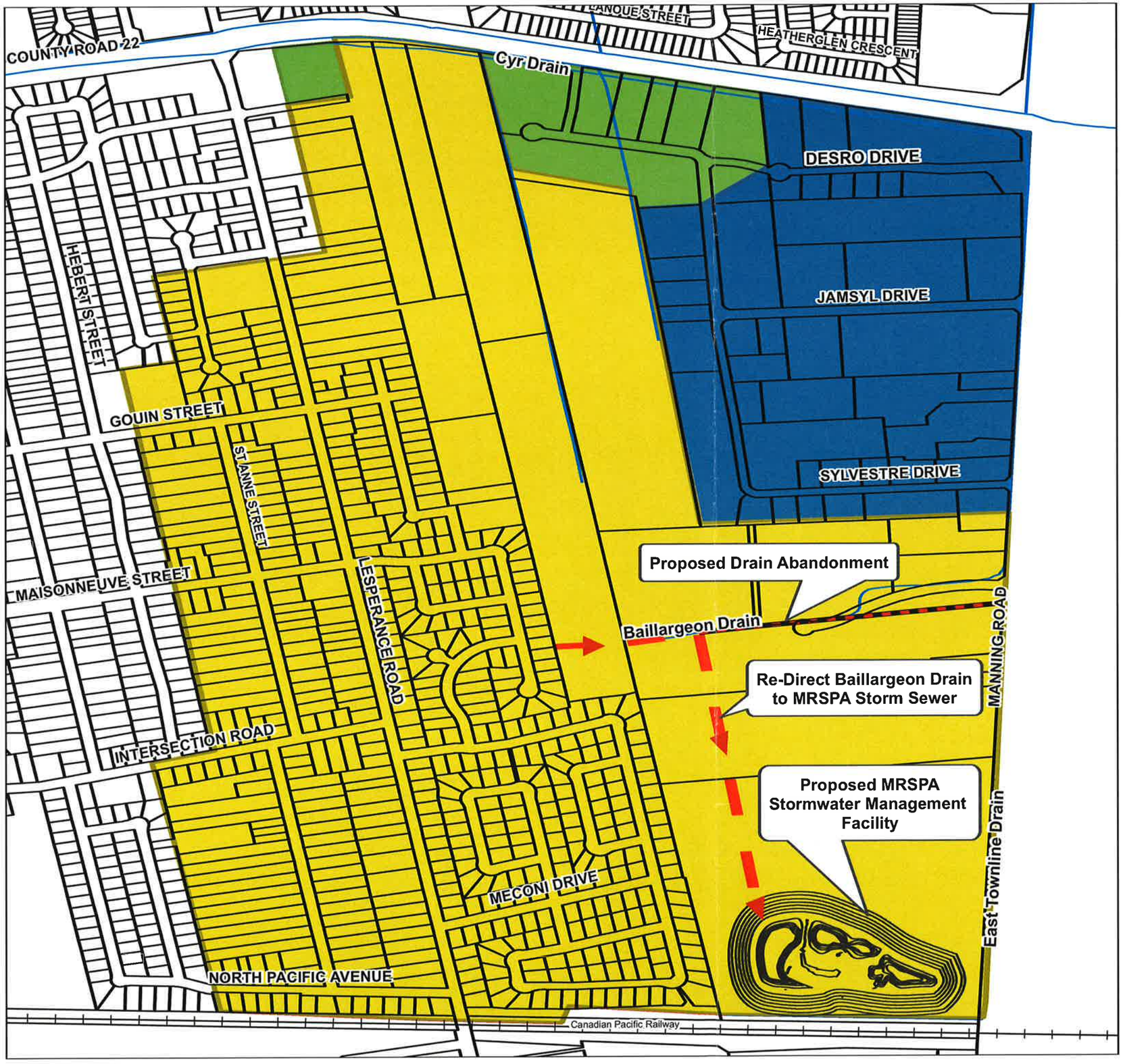

Town of Tecumseh
Manning Road Secondary Plan Area
Class Environmental Assessment Addendum

Drainage Areas Based on the 2014 ESR Addendum
Figure 3

- Watercourse
- Railway
- Stormwater Management Facility
- MRSPA SWM Drainage Area
- Cyr Drain Drainage Area
- East Townline Drain Drainage Area

0 105 210 420
Meters

N
W E
S

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APPENDIX A

FUNCTIONAL SERVICING MODELLING MEMO
MANNING ROAD SECONDARY PLAN AREA

Functional Servicing Modelling Memo Manning Road Secondary Plan Area Town of Tecumseh

April 2015

11-5366

Corporation of the Town of Tecumseh

Submitted by

Dillon Consulting Limited

3200 Deziel Drive, Suite 608
Windsor, Ontario N8W 5K8
Telephone: (519) 948-5000
Facsimile: (519) 948-5054
E-mail: windsor@dillon.ca

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1.0 INTRODUCTION

In April 2010, a Class Environmental Assessment study was completed to identify the preferred solution to address the stormwater management (SWM) requirements of the Manning Road Secondary Plan Area (MRSPA) in the Town of Tecumseh (Town). Since the completion of that study, the Town has been reviewing its stormwater servicing strategy in this area and identified the potential to expand the drainage area served by the proposed MRSPA SWM pond to include the Baillargeon Drain. An Addendum to the April 2010 Class EA was undertaken to confirm the feasibility of this alternative solution, which was finalized in March 2015. The existing drainage areas under consideration are illustrated within ***Figure 1***.

This report summarizes the results of the hydraulic and hydrologic modelling evaluation for the proposed alternative of incorporating the existing Baillargeon Drain area into the proposed MRSPA SWM pond in support of the Class EA Addendum. Furthermore, SWM functional design criteria for the related minor drainage system inlet controls, roadway surface storage and major overland drainage requirements for the MRSPA have now also been developed in response to comments received from the Essex Region Conservation Authority (ERCA) following the Notice of Filing of Addendum.

2.0 BACKGROUND

The stormwater management study for the MRSPA, titled the *Manning Road Secondary Plan Area - Stormwater Management Study Class EA Environmental Study Report - Final Report*, was completed in April 2010. The preferred solution resulting from this study consisted of a proposed stormwater management (SWM) pond located at the southerly limits of the study area to service the future MRSPA developments, discharging to the East Townline Drain (ETLD) along County Road 19 (CR 19) at a maximum pumping rate of 500 L/s. This solution also included the enclosure of the existing Baillargeon Drain, which discharges uncontrolled into the ETLD, south of Sylvestre Drive.

Following this study, the Town completed a draft Functional Servicing Report (FSR) for the MRSPA in October 2013, to serve as a guideline for the Town, regulatory agencies and landowners/developers to complete the orderly servicing of this area. This FSR will be updated by the Town to reflect the revised stormwater servicing requirements outlined herein. The layout of the current landowners/developers within the MRSPA is provided in ***Figure 2***.

Since the completion of the above noted reports, several studies and improvements have been completed along the ETLD. The opportunity to integrate and better utilize the capacity of the existing and proposed storm drainage infrastructure in the area by combining the existing Baillargeon Drain area as part of the proposed MRSPA stormwater management solution was subsequently identified during assessments of the ETLD. In addition to optimizing the storm drainage infrastructure, this alternative solution also presents an opportunity to improve the quality of stormwater runoff from the Baillargeon Drain.

This report summarizes the approach and methodology that was undertaken for the hydraulic and hydrologic modelling, including the comparative results and design considerations associated with the alternative storm drainage solution that is now being considered for this study area.

3.0 STORMWATER MANAGEMENT FACILITY CHARACTERISTICS - MRSPA

The proposed MRSPA SWM pond characteristics include the following:

- Approximately 200,600 m^3 of active storage volume in the pond for water quantity control.
- A minimum requirement of 5,400 m^3 of permanent pool volume is required for a "Normal level" of runoff water quality control as defined in the Stormwater Management Planning and Design Manual (MOE, 2003);
    - A total of 44,900 m^3 of permanent pool volume is provided in the functional design of this facility for a level of control beyond the "Normal level".
- 4,200 m^3 of extended detention volume for water quality control, pumped at a rate of 45 L/s; and providing in excess of 24 hours of drawdown time for the initial Chicago 25 mm - 4 hour storm event.
- Maximum pump rate of 500 L/s discharge into ETLD, which occurs once the extended detention volume has been exceeded.

Table 1 outlines the minimum MRSPA SWM pond volume and storage requirements the MRSPA area only.

Table 1: Minimum MRSPA Pond Volume Requirements

Drainage Area	103 ha
Permanent Pool (52 m^3/ha)	5,400 m^3
Extended Detention (40 m^3/ha)	4,200 m^3
Recommended Peak Storage Volume	72,100 m^3

The functional design of the pond has a total volume (including permanent pool, extended detention storage and available volume for all rainfall events) of approximately 245,500 m^3. Relative to the proposed contributing drainage area and the active storage volume provided, there appears to be excess volume available within the proposed pond to warrant further consideration of increasing the contributing drainage area to the pond, specifically through the addition of the Baillargeon Drain drainage area.

4.0 HYDRAULIC AND HYDROLOGIC MODELLING

The hydraulic and hydrologic analysis was completed using the Autodesk Storm and Sanitary Analysis (SSA) software, which allows for simulation of dynamic modelling conditions, including the response of the drainage system to rainfall events. The model software uses the EPA SWMM Hydrology Method and Hydrodynamic Link Routing method (i.e. Saint Venant Equations) to allow for an assessment of drainage system performance, including the downstream SWM pond, the routing of overland and storm sewer flows and consideration of surface storage requirements. The model was used to simulate the 2, 5, 10, 25, 50 and 100 year storm events for the proposed MRSPA drainage system with the inclusion of the Baillargeon Drain Area flows from the west.

The Autodesk SSA model has been developed to account for both minor and major system flows (dual drainage), including the routing of flows through the storm sewer network (minor system) and the overland drainage network (major system). The results of the analysis were used to:

- Calculate the required inlet restriction for each subcatchment for the 1:100 year event;
- Calculate the required surface ponding during a 1:100-year event;
- Calculate the storm sewer hydraulic grade line for the 1:100-year storm event;
- Evaluate overland flow and ponding volumes during the 100-year event;
- Determine the restricted major system runoff from the site to the overland flow outlets; and
- Assess the hydraulic impacts on the MRSPA SWM pond.

4.1 Design Storms

The hydrologic analysis was completed using the following synthetic design storms. The IDF parameters used to generate the design storms were taken from Windsor Airport Rainfall Data.

4 Hour Chicago Storms:
25 mm Chicago Storm
2-year Chicago storm
5-year Chicago storm
100-year Chicago storm

12 Hour Chicago Storms:
2-year Chicago storm
5-year Chicago storm
100-year Chicago storm

24 Hour Chicago Storms:
2-year Chicago storm
5-year Chicago storm
100-year Chicago storm

The 24-hour Chicago distribution generated the highest peak flows for both the minor and major systems during the 1:100 year storm event and was determined to be the critical storm distribution for the design of the drainage system and stormwater management facility for the MRSPA development. The 25 mm - 4 hour storm event was used as the water quality storm.

4.2 Drainage Areas

The delineation of drainage areas are outlined in ***Figure 1*** and described in further detail below.

4.2.1 Manning Road Secondary Planning Area (MRSPA)

The 103 hectare MRSPA area is currently undeveloped and is generally comprised of agricultural land uses. Future development of these lands will primarily result in residential uses, with some commercial and institutional development. The southern portion of these lands generally slopes east to the East Townline Drain, while the northern portion slopes north to the Cyr Drain.

Based on the proposed land uses, the following runoff coefficients have been used in the sewer design and modeling for this area:

- Parkland: C = 0.20
- Residential: C = 0.40
- Institutional: C = 0.70
- Commercial: C = 0.70

Based on the topography of the MRSPA site, the major overland drainage system is generally directed away from the proposed location of the MRSPA SWM facility at the southerly limits of these lands. Accordingly, runoff volumes for major rainfall events are proposed to be accommodated as follows:

- Temporary surface storage in roadways to a maximum depth of 300 mm, including inlet control devices within the catchbasins to provide an appropriate balance between runoff being conveyed by the storm sewer system and the temporary surface storage required within the roadways during larger storm events. Temporary surface storage will be discharged as follows:
    - To the proposed MRSPA SWM pond through the minor storm sewer system.
    - Runoff volumes in excess of the surface storage capacity of roadways will be conveyed through overland flow routes to the following drainage outlets, as shown in ***Figure 3***:
        - MRSPA SWM pond to the south;
        - East Townline Drain (ETLD) to the east; and
        - Cyr Drain to the north.

4.2.2 Baillargeon Drain Area

The existing Baillargeon Drain drainage area is approximately 96 ha in size and is primarily comprised of single family detached homes. These lands generally slope easterly, with the storm sewer system providing conveyance of storm runoff to an existing 1350 mm diameter storm sewer outlet pipe east of Candlewood Drive. The Baillargeon Drain conveys flow easterly and outlets to the East Townline Drain at CR 19, south of Sylvestre Drive.

The drainage characteristics of the Baillargeon Drain under major storm events were determined based on a review of the existing grades along its boundary with the MRSPA. It was observed that a previously designated emergency overland flood route to the MRSPA lands is identified within an easement that was established between existing homes on Charlene Lane. Based on further investigation, the existing grades within the overland flood easement appear to be at least 0.30 m higher than the existing roadway elevations. At this time, there are no alterations being proposed to the existing grades along this boundary that would result in an increase to overland flow contributions between the Baillargeon Drain area and the MRSPA.

This analysis was therefore based on surface runoff for major storm events up to the 1:100 year event being contained within the Baillargeon Drain drainage area boundaries, with drainage of surface storage taking place through the minor storm sewer system to the proposed MRSPA SWM pond.

In the case of more extreme events exceeding the 1:100 year storm condition, a new ditch inlet catchbasin is proposed to be incorporated at the downstream end of the overland flood easement, connecting to the MRSPA storm sewer system.

The existing surface elevations within the drainage area are illustrated in ***Figure 4.0 and 4.1***.

4.2.2.1 Model Calibration

Hydrodynamic modeling for the Baillargeon Drain area initially began by discretizing the watershed into a total of 19 subcatchments and incorporating the existing storm sewers exceeding 600 mm in diameter into the model. Each subcatchment area was assigned a percent impervious value based on the current land uses, with equivalent width values based on an estimate of existing flow lengths. Adjustments were made to the design parameters of four subcatchment areas to calibrate the model to the 1:2 year design storm capacity of the 1350 mm diameter storm outlet pipe from the upstream contributing area.

The storm sewer sizing for the future MRSPA network took into consideration the Autodesk SSA model results for time of concentration and peak inflows from the existing Baillargeon area during the Chicago 1:5 year 4 hour storm event. The representation of these variables for the Baillargeon Drain area within the MRSPA storm sewer design sheet combined the following two methodologies:

- Hydrodynamic Link Routing Method (i.e. Saint Venant Equations); and
- Rational Method Calculations.

The use of the Saint Venant equations within the model analysis enables the computation of backwater effects, flow reversal, surcharging and looped connections to name a few related to the future system. The flow can also be routed through a variety of different storage elements such as surface storage nodes and detention ponds.

It was determined that through analysis of the modelling results during the Chicago 1:5 year 4 hour storm event, a peak flow of 2600 L/s and the time of peak inflow occurrence of 101 minutes is to be used within the storm sewer design sheet and carried forward for the MRSPA development beginning at the confluence with the Baillargeon Drain storm sewer network at MH 77a. The storm sewer design sheet is provided within Appendix B of the Functional Servicing Report for the MRSPA.

5.0 HYDRODYNAMIC MODELLING APPROACH

The Autodesk SSA model has been developed to account for both minor and major system flows (dual drainage), including the routing of flows through the storm sewer network (minor system) and the overland drainage network (major system).

The hydrodynamic model for the MRSPA area was developed to represent the proposed drainage system as follows:

- Storm sewers were represented by "conveyance links" with the appropriate pipe size and inverts;
- Manholes were represented by "junctions" with the appropriate sump depths and grate elevations;
- Roadway surface storage was represented by "storage nodes" with a maximum storage depth of 300 mm; and
- Major system flow routes were interconnected between storage nodes with weirs to model overland flow conveyance to not exceed 300 mm in dynamic depth of surface storage during the 1:100 year event. The SSA model is capable of accounting for both static and dynamic storage within the storage nodes and can compute the overland flow between each subcatchment beyond the maximum ponding depths.

By using a hydrodynamic, dual drainage model, a more accurate representation of conveyance flows within the storm sewers and along the surface can be analyzed during the 1:100 year storm event. This allows for establishing stormwater management criteria that would be applicable during the detailed design stage of the MRSPA development, including:

- Restricted allowable release rates into the storm sewer system (L/s/ha);
- On-site surface storage requirements (m^3/ha); and
- Overland flow rates discharging to the existing downstream outlets (L/s/ha).

5.1 Modelling Scenarios

A series of modelling scenarios were chosen to assess the capacity of the proposed MRSPA stormwater management facility, including the impacts on the major and minor drainage systems, as described below:

Scenario 1: Preferred solution from the 2010 MRSPA SWM Class EA, with the design drainage area limited to the MRSPA, the SWM pond normal water level (NWL) at elevation 175.0 m, and a SWM pond discharge rate of 500 L/s.

Scenario 2: Same as Scenario 1, but with an expanded design drainage area to include the Baillargeon Drain, including corresponding upgrades to the storm sewer system to accommodate these additional flows.

Scenario 3: Same as Scenario 2, but with the SWM pond NWL lowered by 0.50m to an elevation of 174.5 m.

The modelling of Scenario 1 was updated from the VISUAL OTTHYMO Version 2.0 hydrologic model used in the 2010 SWM Class EA to the Autodesk SSA hydrologic model being used as part of this analysis, allowing for a more representative comparison to the proposed alternatives.

The hydraulic models for Scenarios 2 and 3 were further developed to account for both minor and major system flows *(dual drainage)*, allowing for an assessment of the related inlet control, surface storage, and overland drainage requirements for the MRSPA. The model was also used to assess the suitability of the resulting major system excess overland flow (beyond the surface storage capacity) that would be conveyed to both the East Townline Drain and Cyr Drain during the 1:100 year storm event.

5.2 Model Input Parameters

The detailed hydrologic input parameters for each scenario are provided within ***Appendix B***. This includes the drainage area, weighted Runoff CN values, Runoff Coefficients, subcatchment equivalent widths and average slopes. Model schematics identifying each subcatchment location in relation to the storm sewer layout is provided within ***Figures 5, 6, 7 and 8.***

The storm sewer information included in the SSA model is consistent with the storm sewer design sheet information included in the Functional Servicing Report for the MRSPA, and as-built information for the existing Baillargeon Drain storm sewer system.

5.3 Hydrodynamic Modelling

The hydrodynamic model was initially completed at a coarse level of detail to confirm the feasibility of the alternative stormwater drainage solution, followed by a more detailed model that was developed to confirm the functional design requirements of the proposed drainage infrastructure.

The detailed dual drainage model was developed utilizing an appropriate number, size and arrangement of subcatchment areas. The existing and proposed storm sewer system was modelled for pipe sizes that are generally larger than 600 mm in diameter. The surface storage requirements for major storm events were estimated with consideration for interconnection between each of the surface storage units.

6.0 MODELLING RESULTS

6.1 SWM Quantity Control

A comparison of the MRSPA pond storage requirements and associated drawdown times for each scenario are outlined in ***Table 2*** based on restricting the runoff from the 1:100 year storm event to a maximum discharge rate of 500 L/s. For both Scenarios 2 and 3, the increased HWL is lower than the lowest grade within the MRSPA area, as well as the top of bank elevation of the pond, providing a reasonable degree of freeboard.

Table 2: Pond Operating Characteristics (1:100 Year Event)

Scenario	Pond Inflow (m^3/s)	Normal Water Level (m)	1:100 Year Water Level (m)	Freeboard to Lowest Proposed MRSPA Surface Elevation of 180.70 m (m)	1:100 Year Active Storage Volume (excl. quality control) (m^3)	1:100 Year Drawdown Time (hrs)
1	6.6	175.00	177.14	3.56	72,058	54
2	10.15	175.00	178.88	1.80	120,874	84.8
3	10.15	174.50	178.62	2.08	122,462	97.5

The dynamic modelling of Scenario 2 and Scenario 3 is based on an inlet pipe invert to the pond of 175.00 m. The minor difference in active storage volumes and drawdown times reflect the change in the geometry of the pond arising from the varied normal water level elevation for each scenario.

Based on the results outlined in ***Table 2***, it is estimated that the addition of the Baillargeon Drain drainage area would result in approximately a 70 percent (50,404 m^3) increase in active storage within the MRSPA pond during a 1:100 year storm event. The impact of this increased runoff volume would result in the following:

- The 1:100 year water level in the SWM pond would increase from 177.14 to 178.62 (1.48 m increase - Scenario 3), reducing the freeboard to the lowest proposed surface elevation in the MRSPA from 3.56 m to 2.08 m (1.48 m freeboard reduction); and
- The time to drain down the pond facility beginning at the end of the 1:100 year storm event would increase from 2.25 days to 4.06 days for a 1:100 year storm event.

The results of the modelling for the preferred design (Scenario 3) is included within ***Appendix A through C***. This includes a detailed stage-storage table for the MRSPA SWM pond, hydraulic grade line profiles throughout the trunk storm sewer network, and SSA model output results.

Comments related to the noted changes to the MRSPA pond as a result of incorporating the Baillargeon Drain drainage area are described as follows:

6.1.1 Increased Baillargeon Drain Flows and MRSPA Water Level

The increased 1:100 year event water level resulting from incorporating the Baillargeon Drain drainage area can be accommodated in the proposed MRSPA storm sewer system and SWM pond without

negatively affecting the level of service in the contributing drainage areas. The revised conditions would result in the following:

- Drainage of minor storm events without surcharging above the existing and proposed ground surface elevations;
- Improved drainage of minor and major storm events in the Baillargeon Drain drainage area as a result of outlet conditions that are improved over those that exist in the ETLD; and
- Increased surface storage requirements in the MRSPA, which may be accommodated by implementing the following measures:
    - Provide a 2100 mm diameter storm sewer outlet to the proposed MRSPA pond downstream of the confluence with the 1350 mm diameter Baillargeon Drain outlet;
    - Incorporate inlet control restrictions in the roadway catchbasins to balance the runoff in the major and minor drainage systems; and
    - Allow overland flows exceeding the surface storage capacity of the roadways to be released to the existing Cyr Drain and East Townline Drain, subject to confirmation that these overland flows do not exceed the existing conveyance capacity of these drains.

The hydraulic grade line profiles in the storm sewer system are included in ***Appendix A*** of this report.

6.1.2 Increased Drawdown Time

A risk analysis was completed to assess the resiliency of the proposed MRSPA pond to accommodate a storm during the 97.5 hour drawdown period following a 1:100 event. The following ***Table 3*** summarizes the incremental storage available (up to an extreme high water surface elevation of 180.50 m) during the drawdown period following a 1:100 year 24 hour storm, and the corresponding storm event that could be accommodated at each interval of time:

Table 3: MRSPA Pond Drawdown Summary

Drawdown Time (hrs)	WSEL (m)	Active Storage Available (m^3)	Active Storage Needed for Storm Event (m^3)	Storm Event Capacity in MRSPA Pond @ Time
0	178.62	78,152	55,779	1:5 year
12	178.20	93,549	101,408	1:25 year
24	177.64	113,050	101,408	1:25 year
26	177.54	116,581	116,570	1:50 year
30	177.34	123,000	122,462	1:100 year
48	176.36	153,215	122,462	1:100 year

The proposed MRSPA SWM pond is able to provide a reasonable level of service to address the risk of storm events immediately following a major 1:100 year storm based on the results outlined above. The active storage accounted for under this condition reflects the additional active storage volume in the pond up to an extreme water surface elevation of 180.50 m, which is still below the lowest proposed grade at the northern limits of the MRSPA (180.70).

6.2 SWM Quality Control

The water quality sizing requirements for each of the drainage areas that will contribute to the proposed MRSPA SWM pond are summarized below in ***Table 4***. The impervious values have been revised accordingly and weighted with respect to the future proposed land uses.

Table 4: Water Quality Pond Characteristics

Drainage Areas	Area (ha)	% Impervious	Required Total Quality Control Storage (m^3/ha)	Required Extended Detention (m^3/ha)	Required Permanent Pool (m^3/ha)	Required Total Storage Volume (m^3)	Required Extended Detention Storage (m^3)	Required Permanent Pool Volume (m^3)
MRSPA Area	103	37	92	40	52	9,476	4,120	5,356
Baillargeon Drain Area	93	30	90	40	50	8,370	3,720	4,650
Total	***196***	***34***	***91***	***40***	***51***	***17,846***	***7,840***	***10,006***

The water quality requirements are based on Table 3.2 of the MOE Stormwater Management Planning and Design Manual (March 2003) for a "Normal" level of protection.

Incorporating the Baillargeon Drain into the proposed MRSPA SWM Facility provides an opportunity to improve runoff quality for the respective drainage areas that currently has no measures in place. The criteria used in the model included the Chicago 25 mm - 4 hour storm event, which resulted in the following:

- 25 mm water surface elevation within the MRSPA Facility = 174.92 (0.42 m active depth)
- Water quality drawdown time = 37 hours

6.2.1 Permanent Pool Volume

The available permanent pool detention volume in the proposed MRSPA SWM pond is 28,419 m^3 at a normal water level of 174.50, which exceeds the minimum required volume identified in ***Table 4***.

6.2.2 Extended Detention Storage

The pump station outlet from the proposed MRSPA SWM pond is proposed to consist of low flow pumps to manage the extended detention outflow through the facility, as well as high flow pumps for all storms up to the 1:100 year event. The low flow pumps would operate up to an elevation of 0.34 m above the permanent pool level with a maximum flow rate of 0.045 m^3/s. The high flow pump arrangement would operate beginning from 0.19 m above the permanent pool level and have a maximum release rate of 0.5 m^3/s. The low flow and high flow pumps will work in conjunction from elevations 0.19 to 0.34 metres at a constant rate of 0.545 m^3/s. The water quality figure identified within ***Appendix B*** of the report show the results of the analysis for the water quality modelling during the 25 mm storm event.

During the 25 mm rainfall event, the drawdown from the MRSPA pond is between 24 – 48 hours, which meets the water quality requirements. Additionally, the extended detention total required storage volume for both the MRSPA as well as the Baillargeon area is 7,840 m^3, as outlined in ***Table 4.***

6.3 Baillargeon Drain Hydraulic Analysis

The hydraulic performance of the Baillargeon Drain will improve as a result of being redirected to the proposed MRSPA storm sewer system and SWM facility. The controlled outlet from the proposed MRSPA pond will provide considerable relief to the East Townline Drain.

The outlet conditions at the confluence of the 1350 mm diameter Baillargeon Drain outlet with the proposed MRSPA storm sewer will consist of a drop of approximately 1.8 m, while the northern portion of the Baillargeon Drain area will be separately accommodated by extending an existing 900 mm diameter storm sewer stub on Gouin Street to the MRSPA storm sewer. In addition, the tailwater conditions at the proposed MRSPA pond are considerably lower than the existing hydraulic conditions in the East Townline Drain under existing conditions.

A comparison of the hydraulic gradeline under existing and future conditions for MH EX4, located directly upstream of the Baillargeon Drain outlet along Candlewood Drive, is outlined below in ***Table 5***.

Table 5: Baillargeon Drain - Hydraulic Gradeline Comparison

Storm Event	Existing Conditions HGL @ U/S MH EX4 (m)	Future Conditions HGL @ U/S MH EX4 (m)
1:2 Year	181.51	181.24
1:5 Year	181.69	181.37
1:100 Year	181.82	181.68

7.0 MRSPA DEVELOPMENT STORMWATER MANAGEMENT CRITERIA

7.1 Minor System Flow Considerations

The SSA model analysis was completed using inlet control devices to restrict the amount of inflow and reduce the hydraulic elevations throughout the proposed storm sewer system. The detailed design for each phase of the MRSPA shall incorporate inlet control devices/orifice plates to limit flows into the storm sewer system. The restricted release rates into the storm sewer system during the 1:100 year event are identified in Section 8.0 and ***Figure 10*** of this report.

7.2 On-Site Surface Storage Consideration

The estimated maximum average surface storage capacity of the roadways in the MRSPA based on the proposed overland grades and a 300 mm dynamic ponding depth is approximately 90 m^3/ha. The maximum available surface storage value was determined based on a typical 8 m wide roadway with high points and catchbasins separated by 100m.

Storage nodes were established within the SSA model to estimate an appropriate balance between the required surface storage (roadway and parking lot) for each subcatchment in the MRSPA, the inlet control restrictions, and the allowable overland flow release rates to the Cyr Drain and East Townline Drain.

The surface storage volumes were analyzed and adjusted accordingly to ensure that during the 1:100 year event, overland flow to the proposed major system flow outlets were not exceeding the release rates under existing conditions and not adversely affecting the watercourses, as described in further detail below.

7.3 Major System Flow Considerations

Overland flows during the 1:100 year storm event exceeding the surface storage capacity of the roadways in the MRSPA are to be directed to the following drainage outlets (as identified in ***Figure 3*** of the report):

- MRSPA Stormwater Management Facility
- Cyr Drain
- East Townline Drain (ETLD)

The allowable major overland flows to the existing municipal drains were generally established as further described in Section 7.3.1 and 7.3.2 below.

Model analysis was completed for both the ELTD and Cyr Drain under both existing and future conditions to ensure that the major system overland flow from the MRSPA area during the 1:100 year storm event does not exceed the capacity of the downstream system. It was confirmed that the existing conditions within the Baillargeon Drain area and MRSPA lands were accounted for within the design of the East Townline Drain pump station outlet at Lake St. Clair. The major system overland flows during the 1:100 year event into the East Townline Drain will not have any negative effects on the downstream enclosure and pump station under future conditions.

7.3.1 Cyr Drain Analysis

Under existing conditions, the Cyr Drain consists of the following contributing areas, as shown in ***Figure 1***:

- CR 22 right-of-way from Lesperance Road to Manning Road (CR 19);
- Westlake Drive right-of-way east of Lesperance Road;
- Agriculture lands south of CR 22, between Lesperance Road and CR 19; and
- Industrial lands south of CR 22, at the southwest corner of CR 22 and CR 19.

Under future conditions, the MRSPA development will result in redirecting the majority of the existing agriculture lands (approximately 33.5 ha) to the proposed MRSPA SWM pond. This future condition will ultimately reduce the total drainage area to the Cyr Drain and East Townline Drain (as shown in this Environmental Study Report Addendum ***Figure 1*** and ***Figure 2***), and as outlined below in ***Table 6***:

Table 6: Cyr Drain – Drainage Area Comparison (Existing vs. Future)

Description	Existing Conditions	Future Conditions
Cyr Drain Drainage Area (ha)	45.3	11.8
MRSPA Major Overland Flow Drainage Area (ha)	-	*29.4
TOTAL (ha)	**45.3**	**41.2**

** The MRSPA contributing overland flow from the assigned area noted above under future conditions will spill over into the Cyr Drain once maximum surface storage is exceeded within the development lands along the northern boundary of the site.**

With the reduction of area within the Cyr Drain subwatershed as outlined above, it is proposed that the drain will act as a major system overland flow outlet from the northern portion of the MRSPA development. The major system overland flows will discharge into the Cyr Drain through a defined easement once the surface storage within the MRSPA has been exceeded during the 1:100 year event. The proposed overland flow routes are shown in ***Figure 3***.

To assess the impact that the MRSPA major system flows would have on the Cyr Drain, an Autodesk SSA hydrologic model was developed to evaluate the overall peak flow and water levels within the Cyr Drain under both existing and future developed conditions up to its confluence with the ETLD. The detailed model parameters for the Cyr Drain analysis are provided within ***Appendix B***. The MRSPA SSA model results are summarized below in ***Table 7*** and ***Table 8***, which outline the following:

- Existing Cyr Drain subcatchment flow that will be developed in the future with the MRSPA;
- Future development overland flow contribution from the MRSPA to the Cyr Drain;
- Existing flows from the Cyr Drain at the confluence to the ETLD; and
- Future flows from the Cyr Drain to the ETLD after development of the MRSPA.

Table 7: Existing and Future Peak Flows - Cyr Drain

Storm Event	Cyr Drain Peak Flows into East Townline Drain			Cyr Drain Inflows from MRSPA Lands		
	Existing (m^3/s)	Future (m^3/s)	Decrease (%)	*Existing Agriculture Land (m^3/s)	Future Major Overland Flow (m^3/s)	Decrease (%)
1:2 Year	0.53	0.18	66.0 %	0.47	0	100.0%
1:5 Year	0.83	0.28	66.3 %	0.74	0	100.0%
1:100 Year	1.77	1.61	9.0 %	1.42	1.41	0.70%

** Existing Agriculture Land peak flows represent the 33.5 ha currently contributing to the Cyr Drain, which will be developed and redirected in the future with development of the MRSPA.*

Based on the results outlined within ***Table 7***, future flows in the Cyr Drain during more frequent storm events are expected to be reduced by approximately 66% due to the reduction of contributing area from the MRSPA under future conditions.

While the frequent storm event runoff from the MRSPA would be redirected to the MRSPA pond in the future through the proposed storm sewer system, overland drainage cannot be redirected away from the Cyr Drain due to the natural topography of this area that slopes to the north. The major overland flow contribution from the MRSPA lands for the 1:100 year event will be reduced through on-site surface storage in the roadways (and directed to the proposed MRSPA pond through the storm sewer system), with the amount exceeding the required surface storage being allowed to overflow to the Cyr Drain to a level that does not exceed the existing contribution from the MRSPA.

The resulting water surface elevations within the Cyr Drain during the 1:100 year storm event under both existing and future conditions are summarized below in ***Table 8***. The flow from the MRSPA enters the Cyr Drain at Station 1+025 during both existing and future conditions.

Table 8: 1:100 Year Water Surface Elevation Comparison - Cyr Drain

STATION	*Existing Drain Characteristics		Existing Conditions		Future Conditions		WSEL Comparison
	Drain Bottom (m)	Edge of Gravel Shoulder (m)	Water Surface Elev. (m)	Flow Depth (m)	Water Surface Elev. (m)	Flow Depth (m)	Depth Decrease (exist. – fut) (m)
1+025	179.325	180.66	180.04	0.72	180.01	0.69	- 0.03
1+150	179.153	180.271	179.8	0.65	179.78	0.63	- 0.02
1+200	179.046	180.249	179.65	0.60	179.62	0.57	- 0.03
1+325	178.785	179.887	179.33	0.55	179.3	0.52	- 0.03
1+450	178.523	179.557	179.27	0.75	179.24	0.72	- 0.03
1+700	177.998	179.042	178.58	0.58	178.53	0.53	- 0.05

**Existing Drain Characteristics taken from the Cyr Municipal Drain Report (Bruce D. Crozier, February 1992)*

During the 1:100 year storm event, the water surface elevations within the Cyr Drain decrease from 0.02 m to 0.05m from the MRSPA major system overland flow location (1+025) to its confluence with the ETLD (1+700).

Based on the analysis completed for the Cyr Drain, the future flows within the system will have no adverse impact on the downstream watercourses. The model schematic is provided within ***Figure 9***.

7.3.2 East Townline Drain Analysis

Under development conditions, it is proposed that the Baillargeon Drain is directly connected to the MRSPA storm sewer system and conveyed into the proposed MRSPA SWM pond, which would have a release rate to the ETLD of 0.50 m^3/s. Under these development conditions, the ETLD would experience a significant reduction in flows.

Based on the degree to which the proposed MRSPA SWM pond would reduce the flows in the ETLD, it is proposed to allow a limited amount of overland flow to be directed to the ETLD, thereby reducing the required surface storage requirements in the MRSPA. It is proposed that major system overland flow routes to the ETLD be established at the following locations:

- At Street B; and
- At Jamsyl Drive.

A survey was completed along Jamsyl Drive confirming that the longitudinal grades of the roadway can accommodate overland drainage towards the ETLD. At the time of detailed design, it is proposed that the Jamsyl Drive/Sylvestre Drive intersection be reconstructed to accommodate the proposed road grades and that curb depressions. A conveyance swale must also be constructed at the Jamsyl Drive/Manning Road (CR 19) intersection to direct overland flows to the ETLD.

The model analysis results for the East Townline Drain under both existing and future conditions are summarized below in ***Table 9***. The proposed overland flow routes are shown in ***Figure 3***.

Table 9: Existing vs. Future Peak Flows – East Townline Municipal Drain

Storm Event	Existing Flows into ETLD			Future Flows into ETLD			
	*Baillargeon Drain (m^3/s)	MRSPA Lands (m^3/s)	Total (m^3/s)	MRSPA Pond (m^3/s)	Jamsyl Drive Outlet (m^3/s)	Street B Outlet (m^3/s)	Total (m^3/s)
1:2 Year	2.28	1.08	3.36	0.50	0	0	0.50
1:5 Year	2.69	1.56	4.28	0.50	0	0	0.50
1:100 Year	2.92	3.41	**6.10**	0.50	0.17	1.13	**1.80**

**Baillargeon Drain flows taken at Confluence to existing East Townline Drain*

Based on the results outlined above, the flows in the East Townline Drain flows from the 1:2 year to the 1:100 year events would be significantly reduced under future conditions, primarily due to the elimination of the direct connection with the Baillargeon Drain. Future flows will therefore have no negative impact on the existing East Townline Drain enclosure north of County Road 22.

8.0 STORMWATER MANAGEMENT CRITERIA

The detailed design of the storm drainage system for the MRSPA development is to incorporate the stormwater management criteria that have been outlined herein to achieve a fully integrated drainage solution for this area. The criteria has been developed based on the runoff coefficients outlined within ***Section 4.2.1*** for each proposed land use and the hydrodynamic dual drainage modelling completed and analyzed for the system. The stormwater management model was created to represent both minor and major system flows for the site as well as reasonable surface storage volumes that can be accommodated in both the roadway and parking lots for each subcatchment.

The stormwater management design criteria for each proposed land use is provided in ***Figure 10***, which includes the following:

- Inlet control restrictions into the storm sewer system (L/s/ha);
- Required on-site surface storage requirement (m^3/ha); and
- Restricted overland flow rate into the downstream flow outlets (L/s/ha).

9.0 CLIMATE CHANGE

While the Provincial Policy Statement references the need to consider the potential impacts of climate change while accommodating project needs, there is a lack of direction on the degree of increase/decrease and frequency of climate changes that should be used for assessment.

At this time, the concept of climate change is still an evolving term but needs to be addressed as it is expected to influence, directly and indirectly all elements of local development and watersheds. Climate change may cause potential impacts such as increase in phosphorus loading, increase in sediment and contaminants in flood transportation, reduction in ground water flows, and changes in precipitation, lake levels, erosion and ice cover. As such, potential impacts of climate change were considered on the effectiveness of the SWM works within the MRSPA development.

The drainage system and proposed MRSPA pond was evaluated by performing a sensitivity analysis on the system and applying a 20 percent increase to the 1:100 year, 24 hour Chicago design storm event. This methodology is taken from the City of Ottawa Sewer Design Guidelines, *(October 2012)*. The sensitivity of the system was analyzed and a summary of the pond results is as follows:

- High water surface elevation in the MRSPA pond increased from 178.62 m to 179.38 m (0.76 m increase);
- Freeboard from the lowest surface elevation within the MRSPA area to the high water level in the MRSPA pond decreased from 2.08 m to 1.32 m; and

- Freeboard from the top of the pond (180.50) decreased from 1.88 m to 1.12 m.

Based on this evaluation, the proposed MRSPA pond continues to provide sufficient freeboard during the 1:100 year (+20%) storm.

Inflow into the storm sewer system under climate change conditions will be affected by the increase of surface ponding and head along the roadway and parking lot areas throughout the MRSPA development as inlet control devices are to be installed within all catchbasins. The hydraulic gradeline within the system will change based on the slight increase in inflow as well as water level changes within the MRSPA Pond. The benefits of using inlet control devices for future climate change include:

- Reduction in the hydraulic gradeline elevations under more extreme events and climate change conditions; and
- Reduction of storm sewer backup into development properties.

Potential impacts under climate change within the MRSPA development through the use of inlet control devices include an increase of overland flow along the roadways and into the downstream outlets. These impacts include:

- Additional ponding within roadway and parking lot areas beyond 300 mm in depth; and
- Additional overland flow into the downstream outlets during larger storm events.

10.0 STAGING

10.1 MRSPA SWM Pond

It is expected that the Baillargeon Drain would be re-directed to the proposed MRSPA pond in the early stages of development in this area. In addition, approximately 15 ha of the MRSPA area are currently being considered as part of the early stages of development (Phase 1).

In order to satisfy the Phase 1 development requirements outlined above, we estimated the minimum required size for the first stage of the MRSPA pond, as follows:

- The water quality volume required for Stage 1 of the MRSPA development and Baillargeon Drain Area would be 9,720 m^3 *(Stage 1=1,350 m^3 + 8,370 m^3).*
- The quantity control requirement would be 73,726 m^3 up to and including the 100 year storm event at a maximum water elevation within the facility of 177.57 m.
- Thus, the total volume required to meet both the water quality and quantity for Stage 1 of the MRSPA Area and Baillargeon Drain Area would be 83,446 m^3.

In sizing the facility, a substantial portion of the pond would be required as the initial stage of the pond construction to meet the water quantity and quality requirements. Therefore, based on the modelling completed as part of this report, it has been confirmed that approximately 55 percent of the pond would be required to accommodate the Baillargeon Drain and the development of approximately 15 hectares of MRSPA.

While it may be possible to consider a staged approach to the construction of this facility, its full implementation at the outset may be considered a more practical solution. In any event, the proposed MRSPA pond should be implemented in no more than two stages.

10.2 Interim Storm Inlet Considerations

It is anticipated that the northern portion of the MRSPA may be developed in advance of the southern portions. While the northern portion of the MRSPA undergoes development in phases in advance of the southern portions, it has been confirmed that these lands may be allowed temporary removal of inlet controls to the storm sewer system until the major overland flow outlet to the Cyr Drain is available, as shown in ***Figure 11***.

11.0 CONCLUSIONS AND RECOMMENDATIONS

1. The proposed MRSPA pond is capable of accommodating the addition of the Baillargeon Drain area flows. Based on the recommendation that the Baillargeon Drain area be added into the proposed MRSPA pond (Scenario 3), the following pond design and model results have been identified:

    - Provided Permanent Pool Volume of 44,900 m^3 at a Normal Water Level of 174.50;
    - Provided Active Storage Volume of 200,600 m^3 at a bank height of 180.50; and
    - 1:100 Year Active Storage Volume of 122,462 at a Water Level of 178.62 m.

2. The MRSPA SWM pond discharge to the ETLD is to be established at 500 L/s.

3. The current water quality requirement is for a normal level of treatment based on the Ministry of the Environment guidelines. This analysis has shown that water quality can be maintained to the normal level with both the permanent pool and the extended detention available within the MRSPA SWM pond.

4. Stormwater Management Criteria has been determined and set out within ***Figure 10*** of the modelling memo for the following:

   - Restricted allowable release rate into the storm sewer system (L/s/ha);
   - Required on-site surface storage requirement (m^3/ha); and
   - Restricted overland flow rate into the downstream flow outlets (L/s/ha).

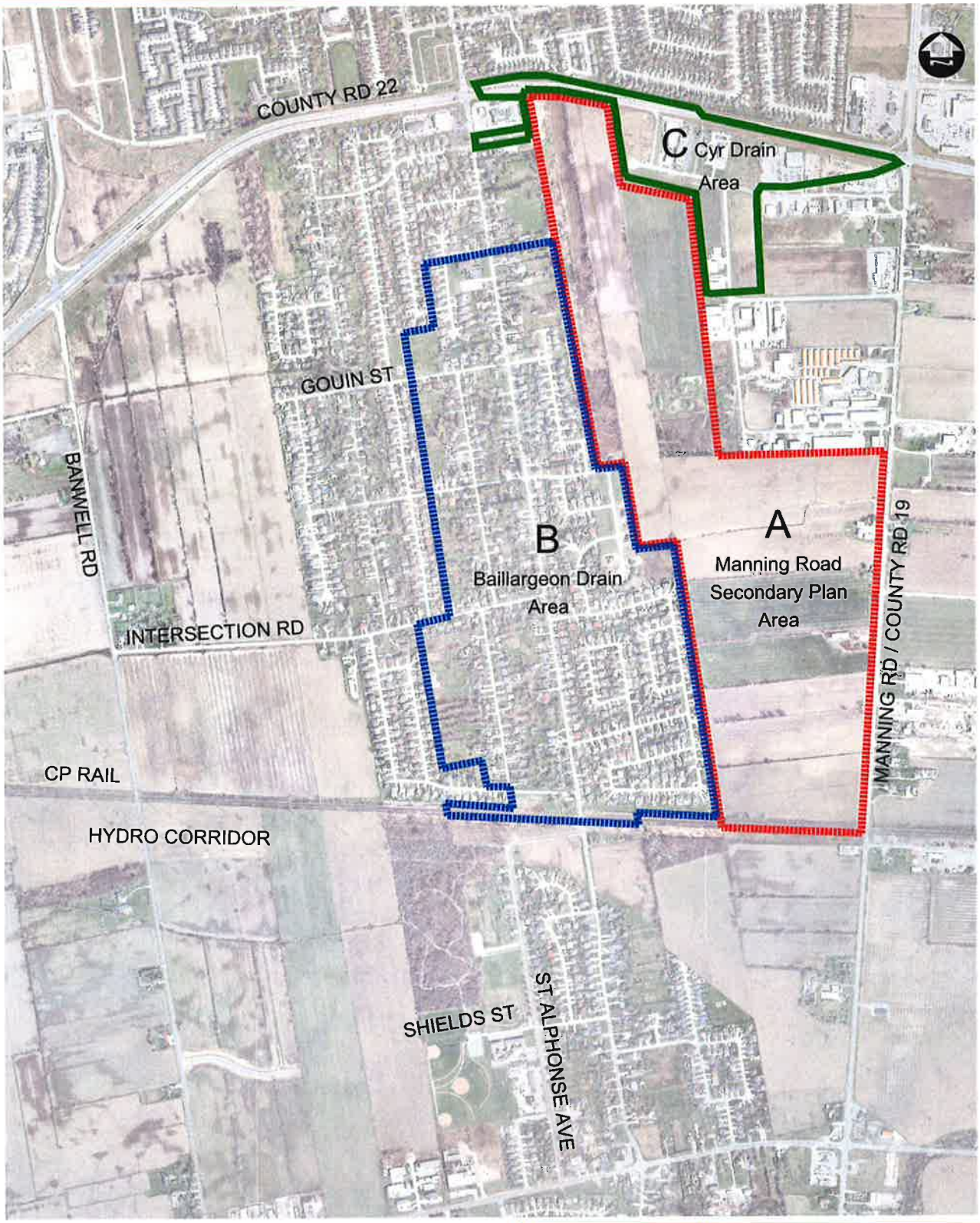
   It is up to the individual developers to meet the stormwater management criteria requirements based on the proposed land use and major system outlet location.

5. Overland flow routes are to be directed to the following Drains:

   - MRSPA Stormwater Management Facility;
   - Cyr Drain;
     - Overland flow from the MRSPA during the 1:100 year storm event will have no adverse impact on the downstream watercourses.
   - East Townline Drain (ETLD);
     - Major system overland flow during the 1:100 year event will not have any negative effects on the downstream enclosure and pump station under future conditions.

6. It is recommended that the proposed trunk sewers are increased in size from MH 101 to the MRSPA SWM pond to accommodate the contributions of the Baillargeon Drain. This is included in both Scenario 2 and Scenario 3 and provided in the storm sewer profiles within ***Appendix A.***

FIGURES



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TECUMSEH

March 2015

Project No. 11-5366-6000

Manning Road Secondary Plan Area

in the Town of Tecumseh

FIGURE 1.0
OVERALL FUTURE DRAINAGE AREAS

COUNTY ROAD 19 (MANNING ROAD)

COUNTY ROAD 22

DESRO DRIVE

JAMSYL DRIVE

SYLVESTRE DRIVE

CANADIAN PACIFIC RAILWAY

FUNARO CRES.

CHARLENE LANE

EUGENI STREET

SECOND DRIVE

ROXANNE CRESCENT

ST. MARTIN CRES

CANDLEWOOD DRIVE

VICKERY LANE

VERDANT COURT

ST. AGNES DRIVE

LESPERANCE ROAD

DESLIPPE DRIVE

GOULD STREET

WESTLAKE

FALSETTA CRT.

LEGEND

- ST. LOUIS LANDS (2.4 ha)
- DEMARSE LANDS (2.7 ha)
- ZOHIL LANDS (2.7 ha)
- BOLIVAR LANDS (0.2 ha)
- DRAGECEVIC/LESPERANCE LANDS (6.7 ha)
- KAURIC LANDS (1.6 ha)
- LECCE LANDS (0.3 ha)
- VARIOUS LAND OWNERS (5.3 ha)
- VALENTE LANDS (43.0 ha)
- SYLVESTRE LANDS (33.3 ha)
- STUDY AREA

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Functional Servicing Report
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FIGURE 2.0
PROPERTY OWNERS

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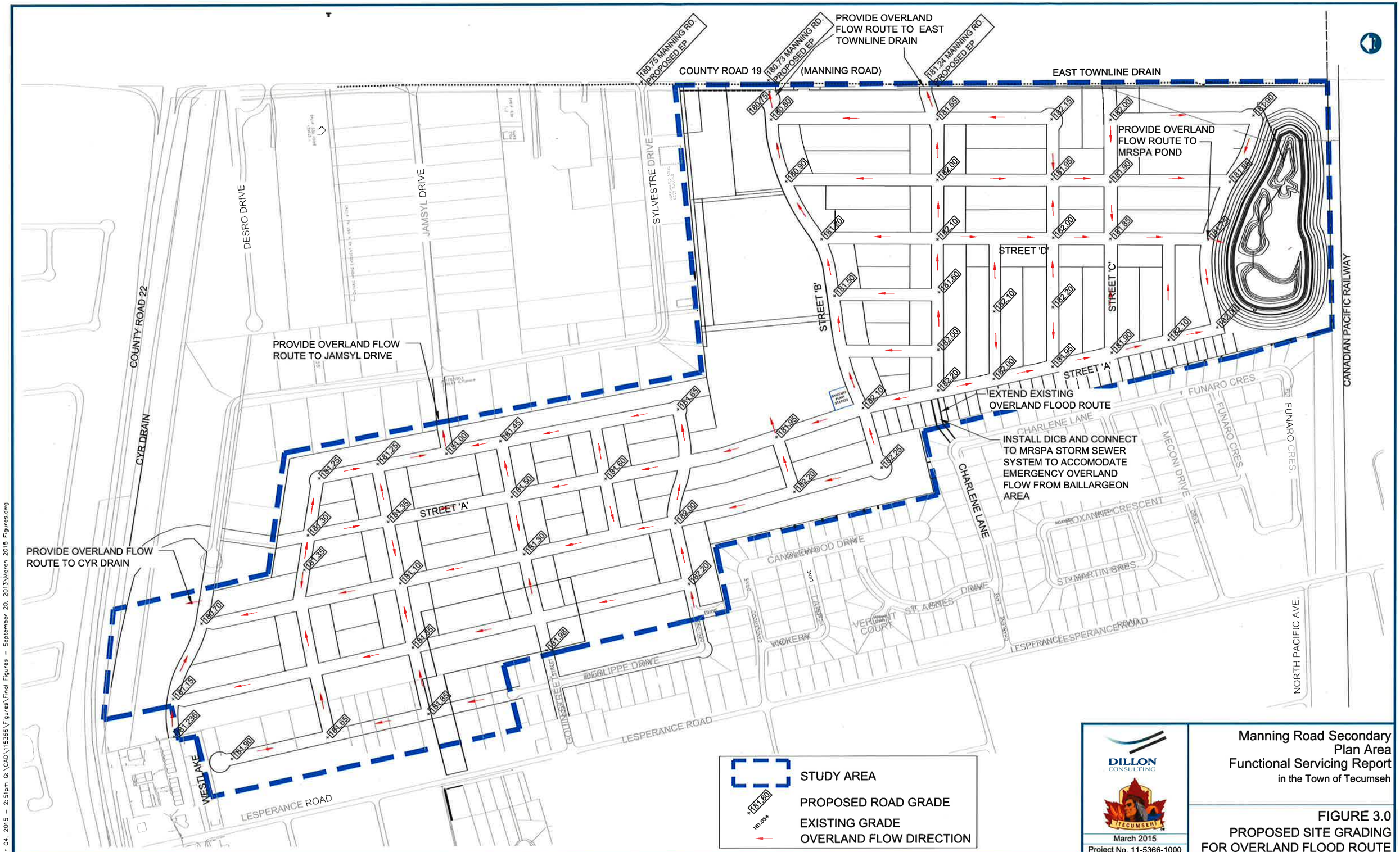

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COUNTY ROAD 19 (MANNING ROAD)

EAST TOWNLINE DRAIN

COUNTY ROAD 22

CYR DRAIN

DESRO DRIVE

JAMSYL DRIVE

SYLVESTRE DRIVE

BAILARGEON DRAIN

CANADIAN PACIFIC RAILWAY

FUNARO CRES.

CHARLENE LANE

EUGENI STREET

MECONI DRIVE

ROXANNE CRESCENT

ST. MARTIN CRES.

CANDLEWOOD DRIVE

VICKERY LANE

VERDANT COURT

ST. AGNES DRIVE

DESLIPPE DRIVE

GODIN STREET

LESPERANCE ROAD

WEST LAKE

FALSETTA CRT.

NORTH PACIFIC AVE.

ST. ANNE STREET

STUDY AREA

EXISTING GRADE

EXISTING OVERLAND FLOW PATH

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Functional Servicing Report
in the Town of Tecumseh

FIGURE 4.0
EXISTING LAND TOPOGRAPHY

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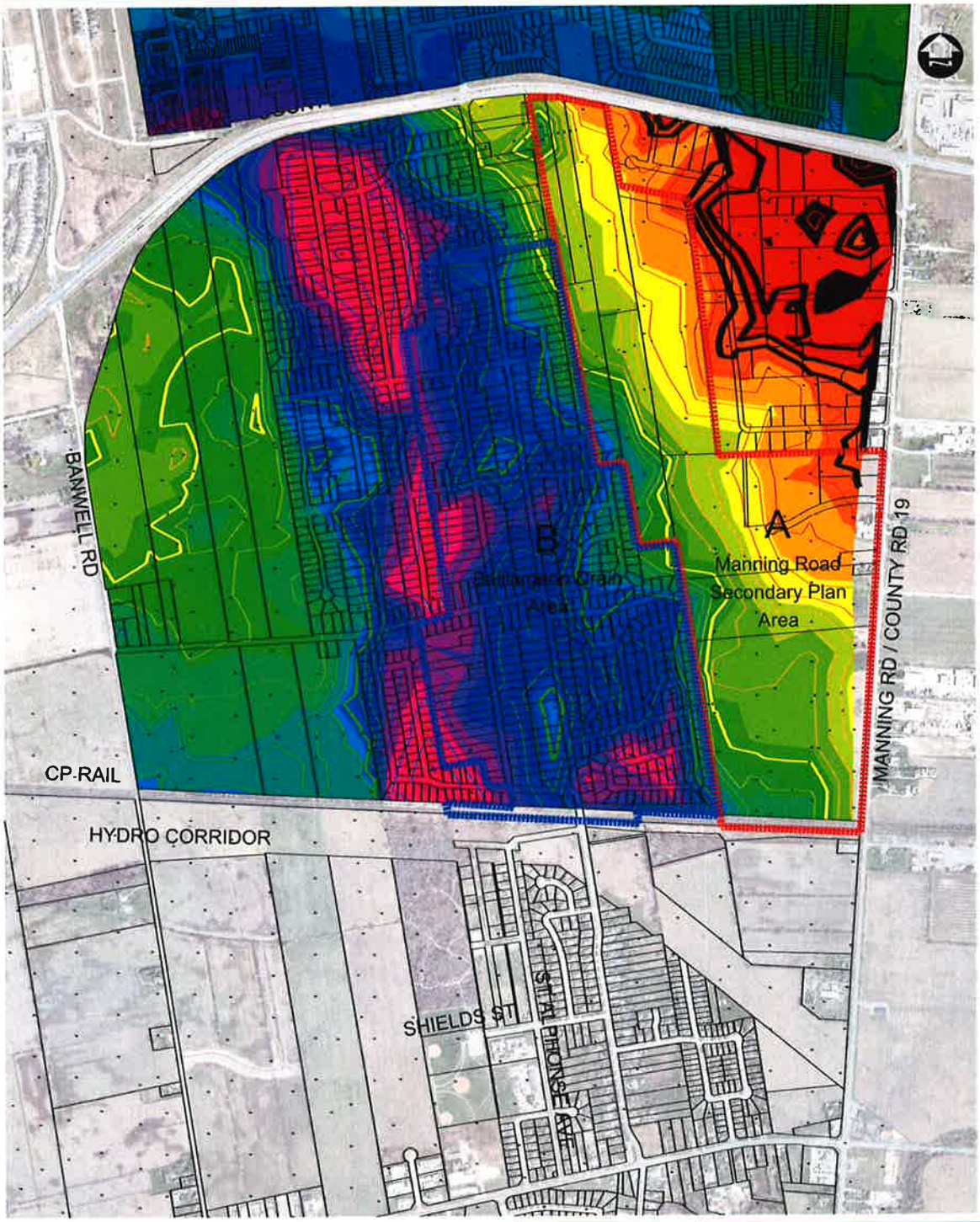

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in the Town of Tecumseh

FIGURE 4.1

EXISTING SURROUNDING LAND CONTOURS

SCENARIO 1: DRAINAGE AREA SCHEMATIC TO SPA POND - MRSPA AREA

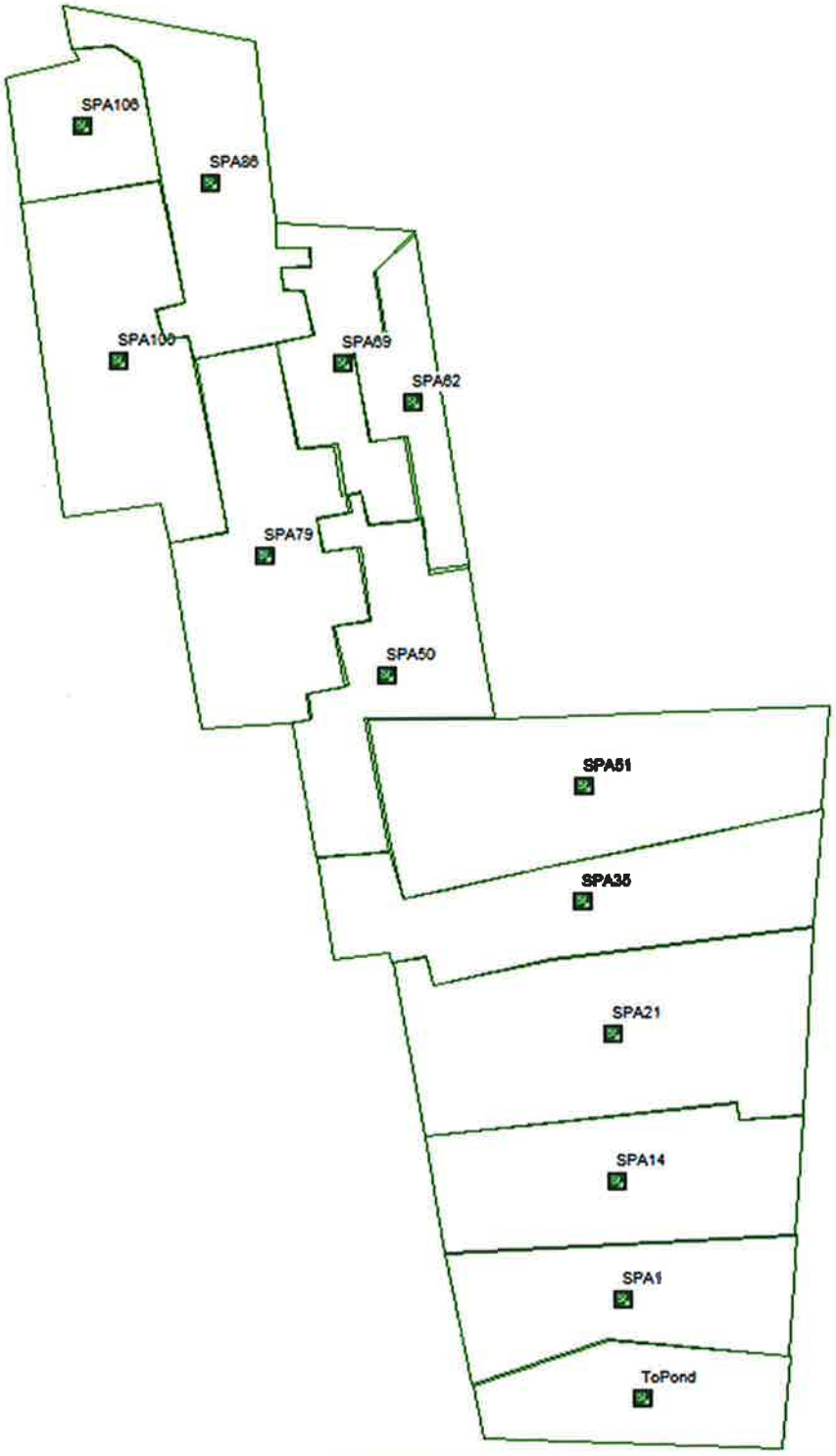


FIGURE 5.0

SCENARIO 1: STORM SEWER SCHEMATIC TO SPA POND - MRSPA AREA

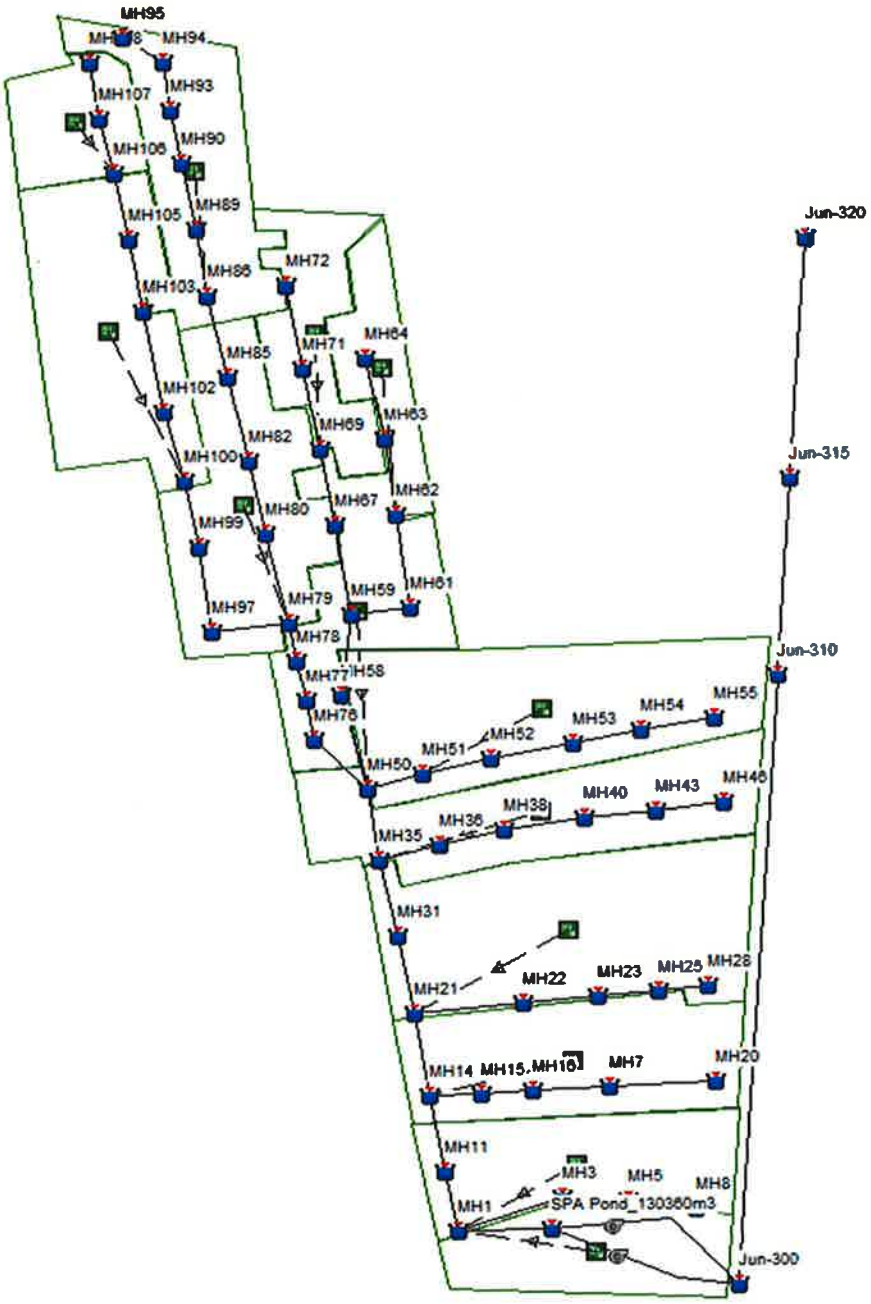
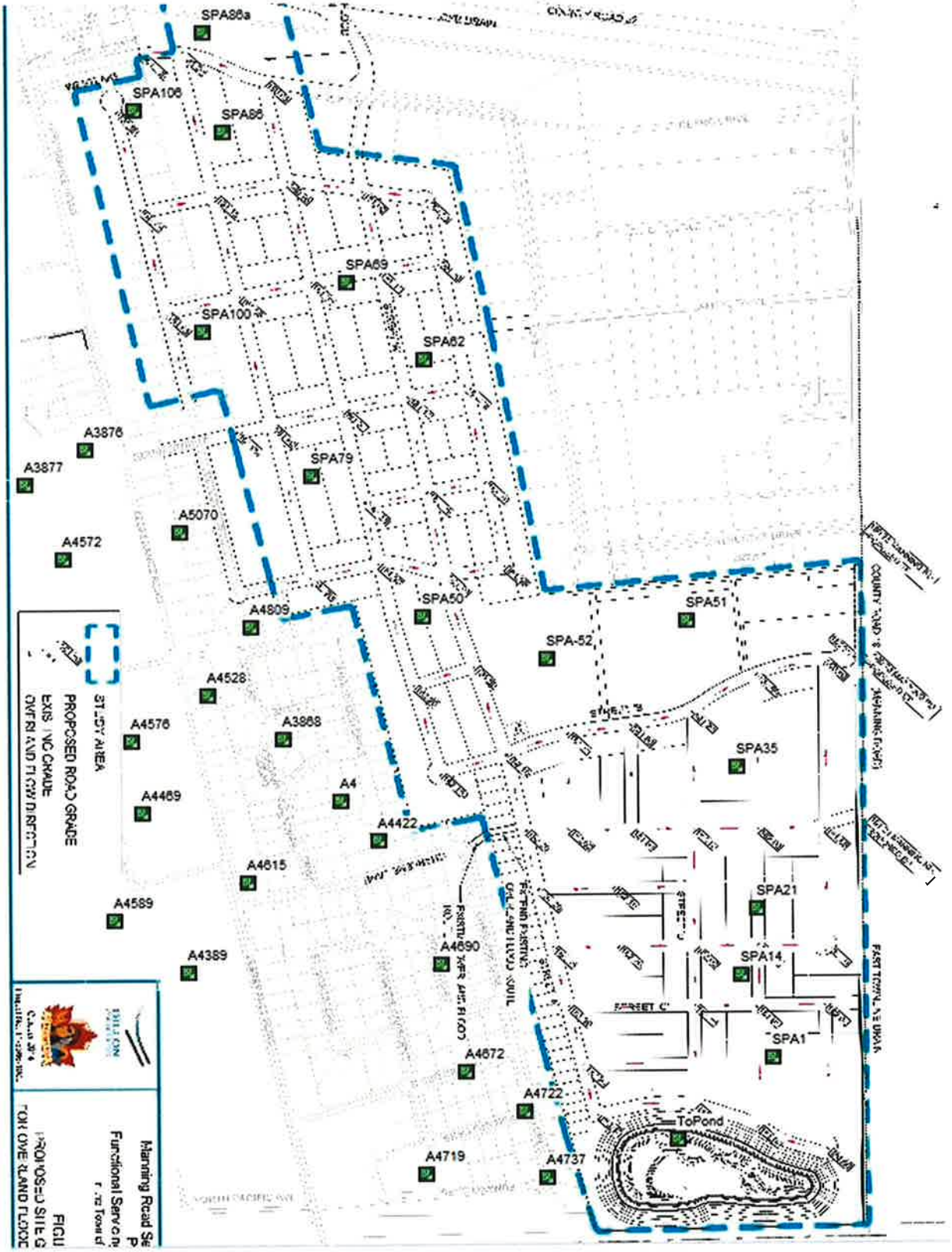


FIGURE 6.0

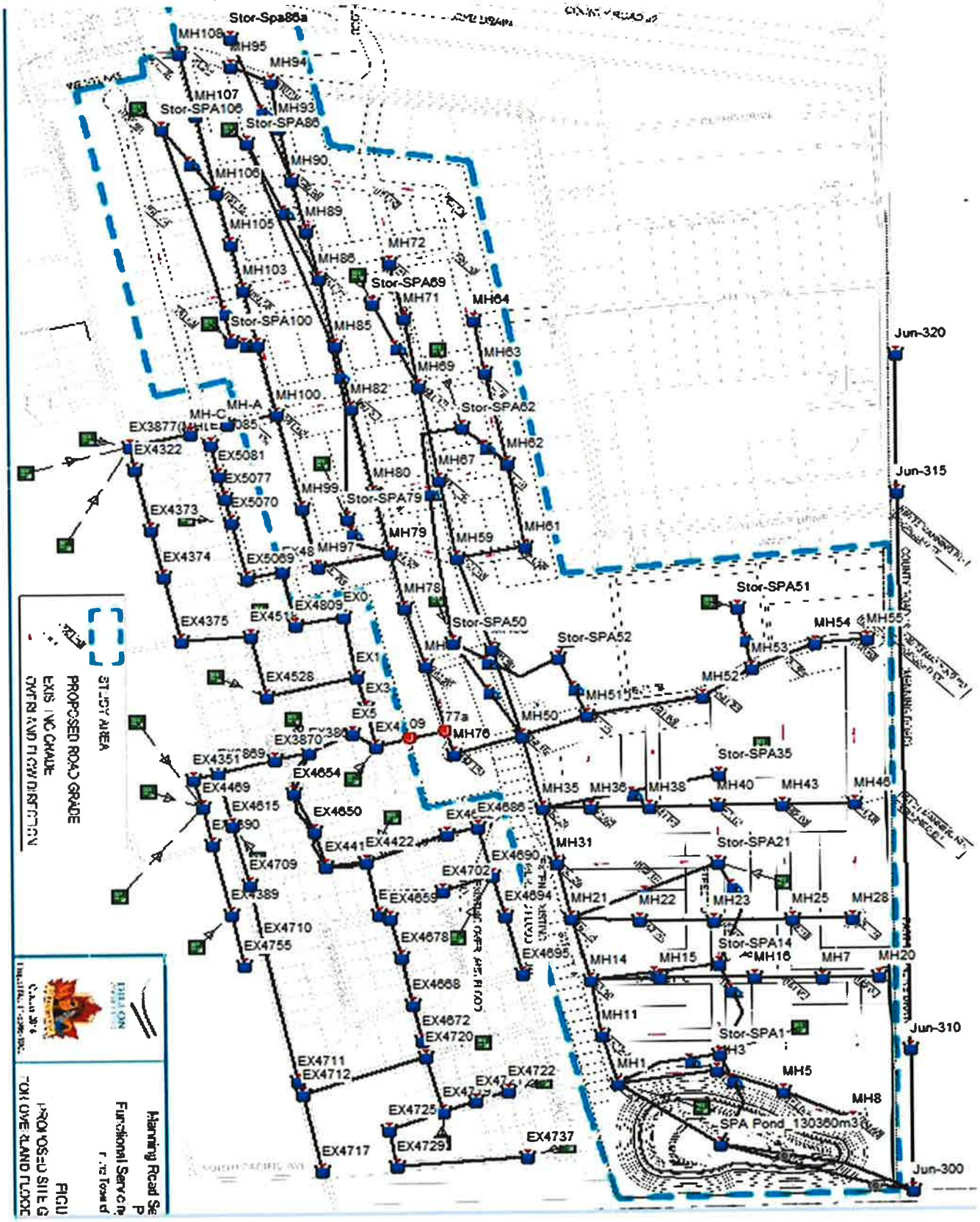
SCENARIO 2-3: DRAINAGE AREA SCHEMATIC TO SPA POND - MRSPA AREA + BAILLARGEON DRAIN



The model background image is used for road layout purposes only. The grades identified do not reflect the final grades within Figure 3.0

FIGURE 7.0

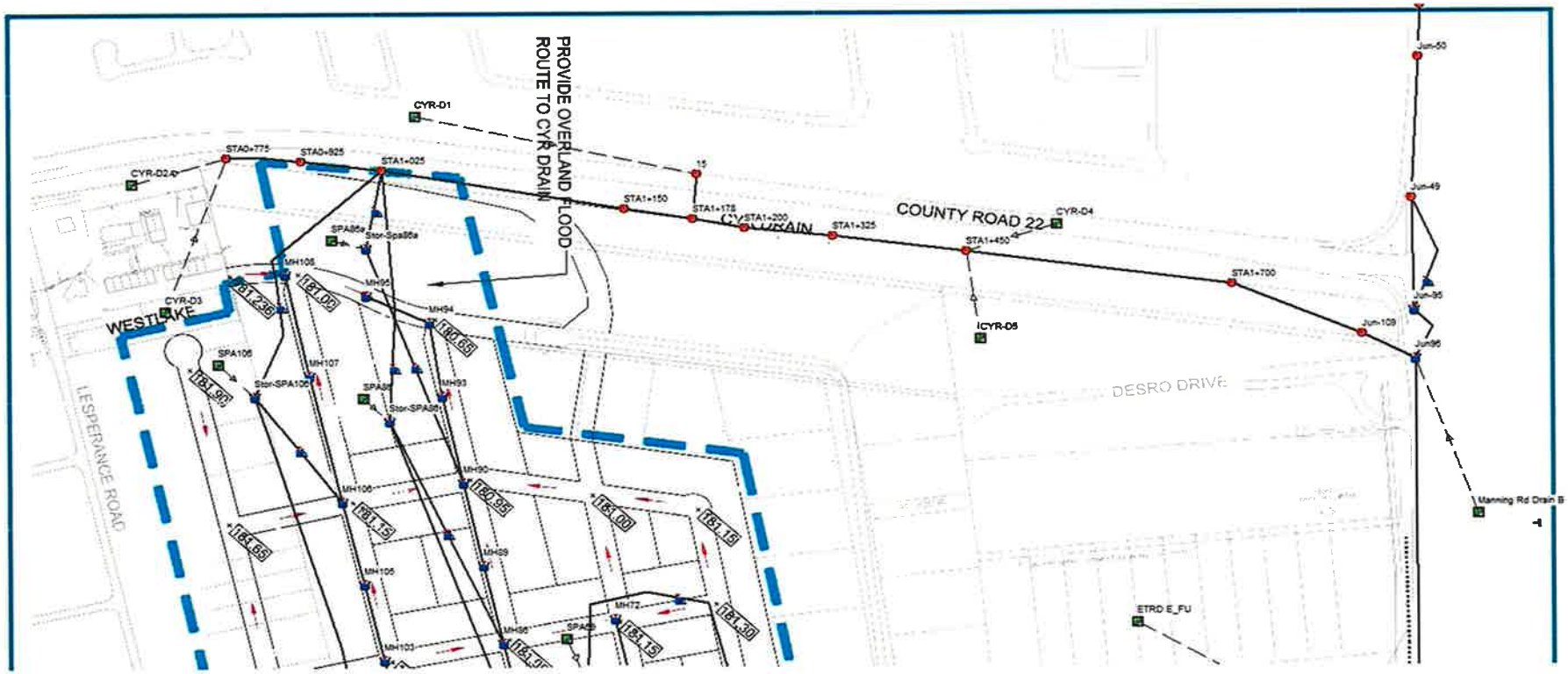
SCENARIO 2-3: STORM SEWER SCHEMATIC TO SPA POND - MRSPA AREA + BAILLARGEON DRAIN



The model background image is used for road layout purposes only. The grades identified do not reflect the final grades within Figure 3.0

FIGURE 8.0

CYR DRAIN ANALYSIS SCHEMATIC TO ETLD



The model background image is used for road layout purposes only. The grades identified do not reflect the final grades within Figure 3.0

FIGURE 9.0

STORMWATER MANAGEMENT CRITERIA				
CATCHMENT	REQUIRED ON-SITE STORAGE	MAX ALLOW. RELEASE RATE TO SEWERS	MAX ALLOW. OVERLAND FLOW TO OUTLET	OVERLAND FLOW OUTLET
RESIDENTIAL	31 m³/ha	81 L/s/ha	NO RESTRICTION	MRSPA POND
RESIDENTIAL	49 m³/ha	62 L/s/ha	5 L/s/ha	ETL DRAIN
INSTITUTIONAL	72 m³/ha	112 L/s/ha	78 L/s/ha	ETL DRAIN
PARKLAND	57 m³/ha	24 L/s/ha	76 L/s/ha	ETL DRAIN
RESIDENTIAL	73 m³/ha	65 L/s/ha	10 L/s/ha	PARKLAND
RESIDENTIAL	73 m³/ha	65 L/s/ha	10 L/s/ha	JAMSYL DRIVE
RESIDENTIAL	73 m³/ha	76 L/s/ha	48 L/s/ha	CYR DRAIN
COMMERCIAL	94 m³/ha	181 L/s/ha	35 L/s/ha	CYR DRAIN

NOTE 1: ALLOWABLE RELEASE RATES INTO STORM SEWERS BASED ON 1:100 YEAR FLOW THROUGH ORIFICE CONTROLS WITH MAXIMUM SURFACE PONDING HEAD OF 300mm.
NOTE 2: REQUIRED ON-SITE STORAGE BASED ON DYNAMIC OVERLAND FLOW CONDITIONS DURING 1:100 YEAR EVENT.

PROVIDE OVERLAND FLOW ROUTE TO EAST TOWNLINE DRAIN
1,130 L/s
COUNTY ROAD 19 (MANNING ROAD)
EAST TOWNLINE DRAIN
SYLVESTRE DRIVE
STREET 'B'
STREET 'D'
STREET 'C'
PARKLAND
PROVIDE OVERLAND FLOW ROUTE TO PARKLAND
STREET 'A'
EXTEND EXISTING OVERLAND FLOOD ROUTE
CHARLENE LANE
INSTALL DICB AND CONNECT TO MRSPA STORM SEWER SYSTEM TO ACCOMODATE EMERGENCY OVERLAND FLOW FROM BAILLARGEON AREA
FUNARO CRES
MECONI DRIVE
CANADIAN PACIFIC RAILWAY
PROVIDE OVERLAND FLOW ROUTE TO JAMSYL DRIVE
170 L/s
COUNTY ROAD 22
CYR DRAIN
1,413 L/s
STREET 'A'
ROXANNE CRESCENT
CANDLEWOOD DRIVE
ST. MARTIN CRES
VERDANT COURT
ST. AGNES DRIVE
VICKERY LANE
DESLIPPE DRIVE
GOLLIN STREET
LESPERANCE ROAD
NORTH PACIFIC AVE
WEST LAKE
PROVIDE OVERLAND FLOW ROUTE TO CYR DRAIN

STUDY AREA

MAJOR SYSTEM OUTLET DIRECTION

DILLON CONSULTING

TECUMSEH

March 2015

Project No. 11-5366-1000

Manning Road Secondary Plan Area
in the Town of Tecumseh

FIGURE 10
DEVELOPMENT STORMWATER MANAGEMENT CRITERIA

Apr 08, 2015 – 9:57am G:\CAD\11-5366\Figures\Final Figures – September 20, 2013\March 2015 Figures.dwg

COUNTY ROAD 19 (MANNING ROAD)

PROPOSED STORM WATER PUMP STATION

PROPOSED REGIONAL STORMWATER MANAGEMENT FACILTY

CANADIAN PACIFIC RAILWAY

COUNTY ROAD 22

DESRO DRIVE

JAMSYL DRIVE

SYLVESTRE DRIVE

STREET 'A'

STREET 'B'

STREET 'C'

STREET 'D'

FUNARO CRES.

CHARLENE LANE

EUGENI STREET

MECONI DRIVE

ROXANNE CRESCENT

ST. MARTIN CRES.

CANDLEWOOD DRIVE

BAILLARGEON DRAIN

VICKERY LANE

VERDANT COURT

ST. AGNES DRIVE

LESPERANCE ROAD

DESLIPPE DRIVE

QUINN STREET

ST. ANNE STREET

NORTH PACIFIC AVE.

WESTLAKE

FALSETTA CRT.

DICB-1

EXISTING 900mm DIA. STORM SEWER STUB

STUDY AREA

ALLOWABLE DEVELOPMENT WITH NO INLET RESTRICTION UNDER INTERIM CONDITIONS

DILLON CONSULTING

TECUMSEH

March 2015

Project No. 11-5366-1000

Manning Road Secondary Plan Area
Functional Servicing Report
in the Town of Tecumseh

FIGURE 11.0
INTERIM
STORM CONDITIONS

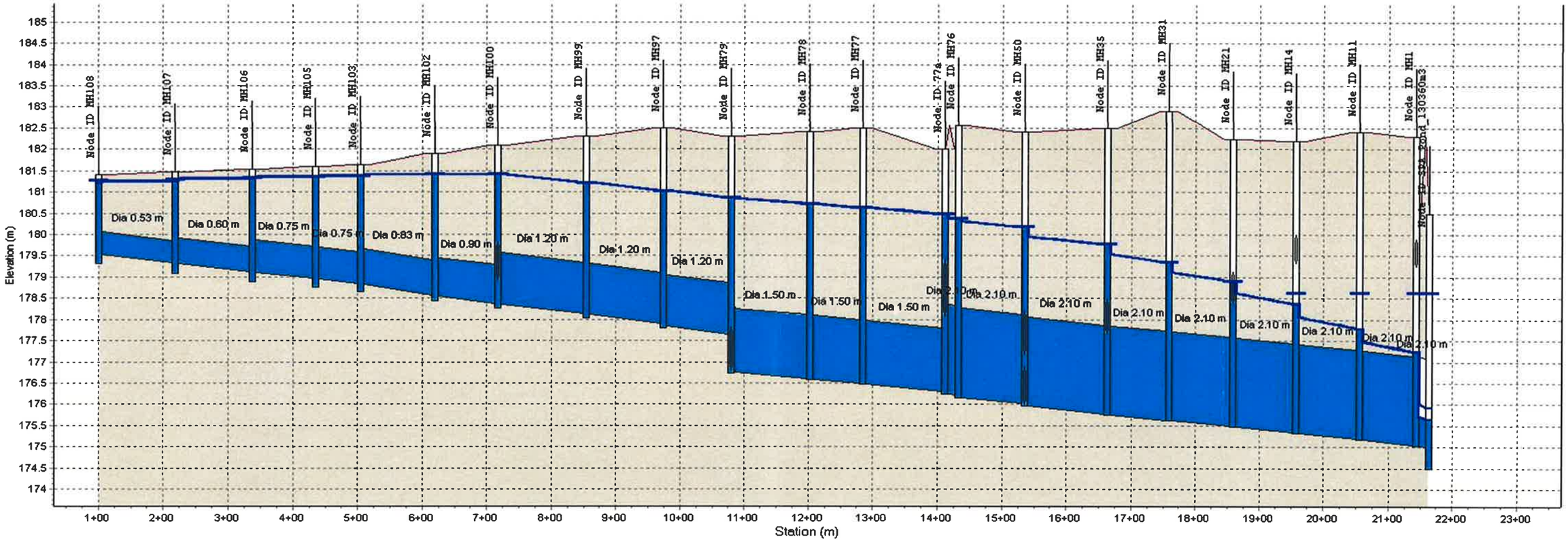
Apr 06, 2015 - 7:52am G:\CAD\11536\Figures\Final Figures - September 20, 2013\March 2015 Figures.dwg

APPENDIX A

TRUNK SEWER PROFILE PLOTS (1:100 YEAR EVENT)
PREFERRED SCENARIO 3

MRSPA Profile Plot - Preferred Scenario 3 -1:100 Year Storm

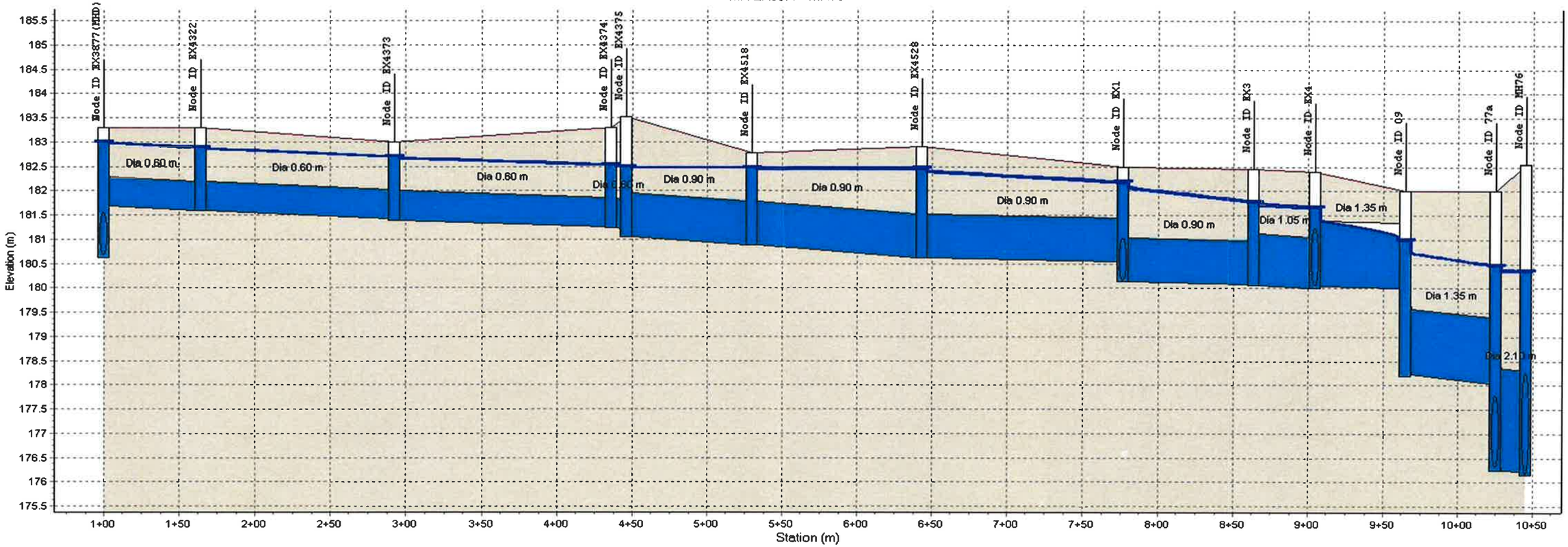
MH 108-SPA POND



Note: Surface Elevations identified reflect the maximum ponding depths throughout the MRSPA system. Grade elevations are 300mm below ground elevations shown.

MRSPA Profile Plot - Preferred Scenario 3 -1:100 Year Storm

MH EX3877 - MH76



Note: Surface Elevations identified reflect the maximum ponding depths throughout the MRSPA system. Grade elevations are 300mm below ground elevations shown.

APPENDIX B

MODELLING INPUT/SUMMARY FILES

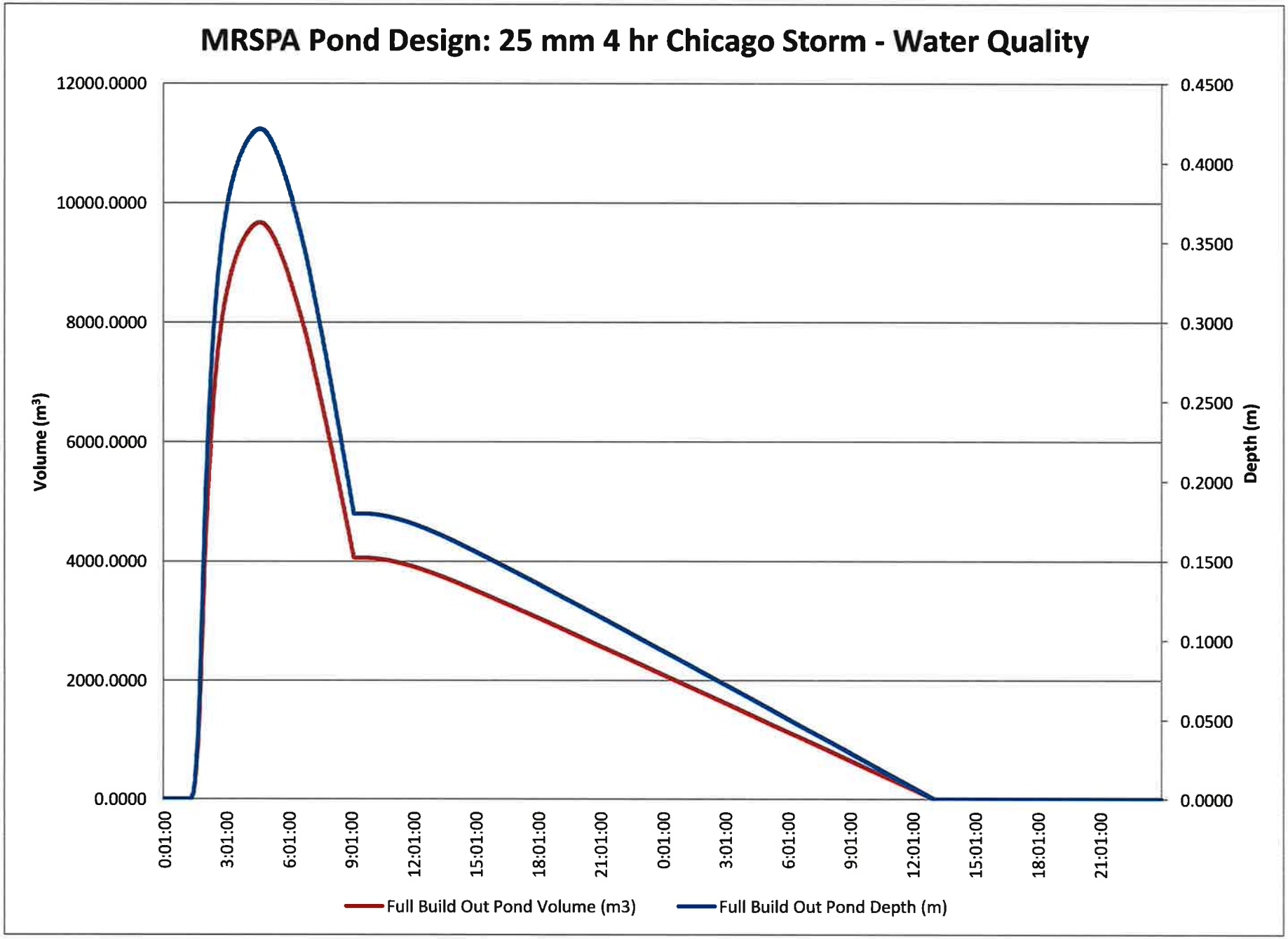
Area ID	Catchment Area (ha)	Weighted CN	Runoff Coefficient	Percent Impervious (%)	Equivalent Width (m)	Average Slope (%)
Existing Baillargeon Drain Subcatchments						
A3868	6.82	90.00	0.48	40.0%	309.90	0.15
A3876	8.44	90.00	0.38	25.0%	272.40	0.15
A3877	2.77	90.00	0.38	25.0%	256.60	0.15
A4	5.92	90.00	0.48	40.0%	316.70	0.15
A4389	4.75	90.00	0.34	20.0%	135.80	0.15
A4422	6.73	90.00	0.48	40.0%	224.20	0.15
A4469	1.62	90.00	0.34	20.0%	204.90	0.15
A4528	5.80	90.00	0.38	25.0%	130.40	0.15
A4572	6.76	90.00	0.34	20.0%	204.90	0.15
A4576	6.46	90.00	0.34	20.0%	208.40	0.15
A4589	13.74	90.00	0.31	15.0%	330.90	0.15
A4615	2.88	90.00	0.48	40.0%	575.80	0.15
A4672	2.93	90.00	0.48	40.0%	188.90	0.15
A4690	4.21	90.00	0.48	40.0%	165.00	0.15
A4719	4.92	90.00	0.48	40.0%	185.70	0.15
A4722	1.30	90.00	0.48	40.0%	92.50	0.15
A4737	2.05	90.00	0.48	40.0%	222.30	0.15
A4809	1.74	90.00	0.45	35.0%	128.50	0.15
A5070	3.21	90.00	0.45	35.0%	133.90	0.15
MRSPA Subcatchments						
SPA1	7.70	90.00	0.40	28.0%	513.30	0.15
SPA100	7.40	90.00	0.40	28.0%	203.90	0.15
SPA106	5.90	90.00	0.40	28.0%	224.30	0.15
SPA14	6.20	90.00	0.40	28.0%	137.80	0.15
SPA21	9.30	90.00	0.40	28.0%	195.80	0.15
SPA35	12.00	90.00	0.40	28.0%	233.00	0.15
SPA50	10.20	90.00	0.40	28.0%	174.10	0.15
SPA51	11.30	94.10	0.69	70.0%	299.70	0.15
SPA52	2.50	94.10	0.22	3.0%	112.60	0.15
SPA62	2.60	90.00	0.40	28.0%	54.40	0.15
SPA69	4.00	90.00	0.40	28.0%	105.30	0.15
SPA79	8.70	90.00	0.40	28.0%	204.20	0.15
SPA86	5.46	90.00	0.40	28.0%	152.60	0.15
SPA86a	1.94	90.00	0.70	71.4%	150.93	0.15
ToPond	6.60	95.00	0.89	99.0%	167.90	0.15

Existing Cyr Drain Catchments					
Area ID	Catchment Area (ha)	Weighted CN	Percent Impervious (%)	Equivalent Width (m)	Average Slope (%)
CYR-1	1.89	90	33.2%	314.1	0.15
CYR-2	1.89	90	21.4%	86.6	0.15
CYR-3	0.23	90	76.8%	742.5	0.15
CYR-4	2.10	90	42.6%	12.5	0.15
CYR-5	5.72	90	28.9%	26.4	0.15
CYR-EXIST	*33.46*	*90*	-	*100.5*	*0.15*

MRSPA Preferred Scenario 3
SWM FACILITY STAGE-STORAGE TABLE

DILLON CONSULTING

Stage	Active Depth (m)	Pond Elevation (m)	Area (m^2)	Volume		Outflow			Side Slopes (H:V)
				Incremental (m^3)	Total Active (m^3)	Low Flow Pump (L/s)	High Flow Pump (L/s)	Total (L/s)	
Normal Water Level	*0.00*	*174.50*	*22,233*	-	*0*	-	-	-	5 to 1
	0.25	174.75	23,083	5,665	5,665	45	500	545	5 to 1
	0.50	175.00	23,943	5,878	11,543	0	500	500	5 to 1
	0.75	175.25	24,888	6,104	17,647	0	500	500	5 to 1
	1.00	175.50	25,773	6,333	23,979	0	500	500	5 to 1
	1.25	175.75	26,667	6,555	30,534	0	500	500	5 to 1
1:2yr Water Elevation	**1.45**	**175.95**	**27,403**	**5,516**	**36,050**	**0**	**500**	**500**	**5 to 1**
	1.50	176.00	27,572	6,780	37,314	0	500	500	5 to 1
	1.75	176.25	28,485	7,007	44,321	0	500	500	5 to 1
	2.00	176.50	29,409	7,237	51,558	0	500	500	5 to 1
1:5yr Water Elevation	**2.14**	**176.64**	**29,937**	**4,221**	**55,779**	**0**	**500**	**500**	**5 to 1**
	2.25	176.75	30,343	7,469	59,027	0	500	500	5 to 1
	2.50	177.00	31,287	7,704	66,731	0	500	500	5 to 1
	2.75	177.25	32,238	7,941	74,671	0	500	500	5 to 1
1:10yr Water Elevation	**2.94**	**177.44**	**32,955**	**6,092**	**80,763**	**0**	**500**	**500**	**5 to 1**
	3.00	177.50	33,201	8,180	82,851	0	500	500	5 to 1
	3.25	177.75	34,175	8,422	91,273	0	500	500	5 to 1
	3.50	178.00	35,159	8,667	99,940	0	500	500	5 to 1
1:25yr Water Elevation	**3.54**	**178.04**	**35,323**	**1,468**	**101,408**	**0**	**500**	**500**	**5 to 1**
	3.75	178.25	36,152	8,914	108,854	0	500	500	5 to 1
1:50yr Water Elevation	**3.96**	**178.46**	**37,000**	**7,716**	**116,570**	**0**	**500**	**500**	**5 to 1**
	4.00	178.50	37,156	9,164	118,017	0	500	500	5 to 1
1:100yr Water Elevation	**4.12**	**178.62**	**37,637**	**4,445**	**122,462**	**0**	**500**	**500**	**5 to 1**
	4.25	178.75	38,169	9,416	127,433	0	500	500	5 to 1
	4.50	179.00	39,192	9,670	137,103	0	500	500	5 to 1
	4.75	179.25	40,227	9,927	147,031	0	500	500	5 to 1
1:100yr+20% Water Elevation	**4.88**	**179.38**	**40,751**	**5,241**	**152,271**	**0**	**500**	**500**	**5 to 1**
	5.00	179.50	41,271	10,187	157,218	0	500	500	5 to 1
	5.25	179.75	42,324	10,449	167,667	0	500	500	5 to 1
	5.50	180.00	43,387	10,714	178,381	0	500	500	5 to 1
	6.00	180.50	45,543	22,233	200,614	0	500	500	5 to 1


MRSPA Pond Design: 25 mm 4 hr Chicago Storm - Water Quality
12000.0000
10000.0000
8000.0000
6000.0000
4000.0000
2000.0000
0.0000
Volume (m³)
0.4500
0.4000
0.3500
0.3000
0.2500
0.2000
0.1500
0.1000
0.0500
0.0000
Depth (m)
0:01:00
3:01:00
6:01:00
9:01:00
12:01:00
15:01:00
18:01:00
21:01:00
0:01:00
3:01:00
6:01:00
9:01:00
12:01:00
15:01:00
18:01:00
21:01:00
Full Build Out Pond Volume (m3)
Full Build Out Pond Depth (m)

APPENDIX C

SWM MODELLING OUTPUT RESULTS (1:100 YEAR STORM EVENT) SCENARIO 3

Autodesk® Storm and Sanitary Analysis 2014 - Version 8.1.48 (Build 1)

****
Project Description
****

File Name ..... SC. 3_20150306__MRSPA+Baillargeon, RC=0.40 NWL=174.50-DualDR_model-NEW GRADES.SPF
Description ..... -MRSPA + Baillargeon Drain
-Main Trunk 1950mm dia. storm sewers upsized
to 2100mm dia. from previous design
- Subcatchments restricted to 5yr peak flow
into the minor system via orifice control.
- Four major system outlets
1)MRSPA Pond
2) ETLD
3) Jamsyl Drive
4) Cyr Drain

NWL = 174.5
POND OUTLET = 500L/s

****
Analysis Options
****

Flow Units ..... cms
Subbasin Hydrograph Method. EPA SWMM
Infiltration Method ..... SCS Curve Number
Link Routing Method ..... Hydrodynamic
Storage Node Exfiltration.. None
Starting Date MAR-05-2013 00:00:00
Ending Date MAR-07-2013 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:00:10
Dry Time Step 01:00:00
Routing Time Step ..... 1.00 sec

****
Element Count
****

Number of rain gages 1
Number of subbasins 50
Number of nodes 205
Number of links 238
Number of pollutants 0
Number of land uses 0

****
Raingage Summary
****

Gage ID	Data Source	Data Type	Recording Interval min
Rain Gage-01	Chic 100yr 24hr15min	INTENSITY	15.00

****
Subbasin Summary
****

Subbasin ID	Total Area hectares	Equiv. Width m	Imperv. Area %	Average Slope %	Raingage
3	65.17	136.80	40.00	0.1000	Rain Gage-01
A3868	6.82	309.90	25.00	0.1500	Rain Gage-01
A3876	8.44	272.40	25.00	0.1500	Rain Gage-01
A3877	2.77	256.60	25.00	0.1500	Rain Gage-01
A4	5.92	316.70	25.00	0.1500	Rain Gage-01
A4389	4.75	135.80	20.00	0.1500	Rain Gage-01
A4422	6.72	224.20	25.00	0.1500	Rain Gage-01
A4469	1.62	82.00	20.00	0.1500	Rain Gage-01
A4528	5.80	130.40	25.00	0.1500	Rain Gage-01
A4572	6.76	204.90	20.00	0.1500	Rain Gage-01
A4576	6.46	208.40	20.00	0.1500	Rain Gage-01
A4589	13.74	330.90	15.00	0.1500	Rain Gage-01
A4615	2.88	575.80	25.00	0.1500	Rain Gage-01
A4672	2.93	188.90	40.00	0.1500	Rain Gage-01
A4690	4.21	165.00	40.00	0.1500	Rain Gage-01
A4719	4.92	185.70	40.00	0.1500	Rain Gage-01
A4722	1.29	92.50	40.00	0.1500	Rain Gage-01
A4737	2.04	222.30	40.00	0.1500	Rain Gage-01
A4809	1.74	128.50	35.00	0.1500	Rain Gage-01
A5070	3.21	133.90	35.00	0.1500	Rain Gage-01
CYR-D1	1.89	314.10	33.20	0.1500	Rain Gage-01
CYR-D2	1.89	86.60	21.40	0.1500	Rain Gage-01
CYR-D3	0.23	742.50	76.80	0.1500	Rain Gage-01
CYR-D4	2.10	12.50	42.60	0.1500	Rain Gage-01
CYR-D5	5.72	26.40	28.90	0.1500	Rain Gage-01
ETRD A	27.40	523.00	33.00	0.2000	Rain Gage-01
ETRD C_FU	23.50	435.00	60.00	0.0500	Rain Gage-01
ETRD E_FU	23.30	480.00	45.00	0.1000	Rain Gage-01
Manning Rd Drain A	12.52	331.00	94.00	0.0500	Rain Gage-01
Manning Rd Drain B	27.65	135.00	5.00	0.1500	Rain Gage-01
SPA1	7.70	513.30	28.00	0.1500	Rain Gage-01
SPA100	7.40	203.90	28.00	0.1500	Rain Gage-01
SPA106	5.90	224.30	28.00	0.1500	Rain Gage-01
SPA14	6.20	137.80	28.00	0.1500	Rain Gage-01

SPA21	9.30	195.80	28.00	0.1500	Rain Gage-01
SPA35	12.00	233.00	28.00	0.1500	Rain Gage-01
SPA50	10.20	174.10	28.00	0.1500	Rain Gage-01
SPA51	11.30	299.70	70.00	0.1500	Rain Gage-01
SPA-52	2.50	112.60	3.00	0.1500	Rain Gage-01
SPA62	2.60	54.40	28.00	0.1500	Rain Gage-01
SPA69	4.00	105.30	28.00	0.1500	Rain Gage-01
SPA79	8.70	204.20	28.00	0.1500	Rain Gage-01
SPA86	5.46	152.60	28.00	0.1500	Rain Gage-01
SPA86a	1.94	150.93	71.00	0.1500	Rain Gage-01
Sub-03	12.83	357.63	15.00	0.5000	Rain Gage-01
Sub-04	14.41	404.64	15.00	0.5000	Rain Gage-01
Sub-05	17.73	347.82	15.00	0.5000	Rain Gage-01
Sub-06	4.72	286.14	15.00	0.5000	Rain Gage-01
Sub-08	36.74	445.83	40.00	0.1000	Rain Gage-01
ToPond	6.60	167.90	99.00	0.1500	Rain Gage-01

****
Node Summary
****

Node ID	Element Type	Invert Elevation m	Maximum Depth m	Ponded Area m²	External Inflow
15	JUNCTION	178.60	2.00	0.000	
77a	JUNCTION	176.25	5.75	0.000	
77b	JUNCTION	178.20	3.80	0.000	
Jun-01	JUNCTION	174.00	2.66	0.000	
Jun-02	JUNCTION	172.70	4.35	0.000	
Jun-03	JUNCTION	174.40	2.22	0.000	
Jun-04	JUNCTION	174.38	2.21	0.000	
Jun-05	JUNCTION	174.54	2.29	0.000	
Jun-06	JUNCTION	174.62	2.57	0.000	
Jun-109	JUNCTION	177.35	4.00	0.000	
Jun-11	JUNCTION	174.55	2.58	0.000	
Jun-16	JUNCTION	174.21	2.41	0.000	
Jun-17	JUNCTION	173.87	2.59	0.000	
Jun-18	JUNCTION	174.17	2.17	0.000	
Jun-19	JUNCTION	174.23	2.14	0.000	
Jun-20	JUNCTION	174.19	2.08	0.000	
Jun-21	JUNCTION	174.17	2.22	0.000	
Jun-22	JUNCTION	174.17	2.22	0.000	
Jun-23	JUNCTION	174.17	2.10	0.000	
Jun-24	JUNCTION	174.10	2.10	0.000	
Jun-25	JUNCTION	174.15	2.10	0.000	
Jun-26	JUNCTION	174.07	2.10	0.000	
Jun-27	JUNCTION	174.09	2.04	0.000	
Jun-28	JUNCTION	174.11	2.03	0.000	
Jun-29	JUNCTION	174.13	2.54	0.000	
Jun-30	JUNCTION	174.04	2.54	0.000	

Jun-31	JUNCTION	173.98	2.56	0.000
Jun-32	JUNCTION	174.08	2.56	0.000
Jun-33	JUNCTION	174.03	2.40	0.000
Jun-34	JUNCTION	174.07	2.40	0.000
Jun-35	JUNCTION	173.99	2.31	0.000
Jun-36	JUNCTION	174.01	2.31	0.000
Jun-37	JUNCTION	174.01	2.35	0.000
Jun-38	JUNCTION	172.95	3.47	0.000
Jun-47	JUNCTION	172.91	3.33	0.000
Jun-49	JUNCTION	176.47	2.53	0.000
Jun-50	JUNCTION	176.23	2.77	0.000
Jun-51	JUNCTION	176.15	2.85	0.000
Jun-52	JUNCTION	176.22	2.78	0.000
Jun-53	JUNCTION	176.22	2.78	0.000
Jun-54	JUNCTION	175.75	3.25	0.000
Jun-55	JUNCTION	175.50	3.50	0.000
Jun-56	JUNCTION	175.28	3.73	0.000
Jun-57	JUNCTION	175.21	3.79	0.000
Jun-58	JUNCTION	174.95	4.05	0.000
Jun-59	JUNCTION	174.88	4.12	0.000
STA0+775	JUNCTION	179.90	1.45	0.000
STA0+925	JUNCTION	179.63	1.76	0.000
STA1+025	JUNCTION	179.33	1.90	0.000
STA1+150	JUNCTION	179.15	1.69	0.000
STA1+178	JUNCTION	178.74	1.92	0.000
STA1+200	JUNCTION	179.05	1.56	0.000
STA1+325	JUNCTION	178.79	1.52	0.000
STA1+450	JUNCTION	178.52	1.50	0.000
STA1+700	JUNCTION	178.00	1.50	0.000
ETLD-1	OUTFALL	180.50	1.85	0.000
ETLD-2a	OUTFALL	180.50	1.75	0.000
ETLD-2b	OUTFALL	180.50	1.85	0.000
ETLD-3	OUTFALL	180.50	1.85	0.000
ETLD-4	OUTFALL	180.50	1.85	0.000
Out-01	OUTFALL	172.70	0.00	0.000
Out-02	OUTFALL	175.79	1.95	0.000
Out-03	OUTFALL	176.54	2.29	0.000
Out-04	OUTFALL	173.20	5.00	0.000
Out-11	OUTFALL	175.00	2.00	0.000
CR22 Pond 19900m3	STORAGE	174.20	3.03	0.000
EX0	STORAGE	180.22	2.58	0.000
EX1	STORAGE	180.14	2.36	0.000
EX3	STORAGE	180.07	2.39	0.000
EX3868	STORAGE	180.23	2.20	0.000
EX3869	STORAGE	180.50	2.39	0.000
EX3870	STORAGE	180.39	2.50	0.000
EX3877(MHD)	STORAGE	180.62	2.68	0.000
EX4	STORAGE	180.00	2.40	0.000
EX4322	STORAGE	181.60	1.70	0.000
EX4351	STORAGE	180.76	2.24	0.000
EX4373	STORAGE	181.40	1.60	0.000

EX4374	STORAGE	181.24	2.06	0.000
EX4375	STORAGE	181.06	2.46	0.000
EX4389	STORAGE	181.37	1.63	0.000
EX4390	STORAGE	181.25	1.75	0.000
EX4419	STORAGE	180.62	2.25	0.000
EX4422	STORAGE	180.71	1.99	0.000
EX4469	STORAGE	180.86	2.54	0.000
EX4518	STORAGE	180.88	1.90	0.000
EX4528	STORAGE	180.62	2.28	0.000
EX4615	STORAGE	180.77	2.71	0.000
EX4650	STORAGE	180.47	2.09	0.000
EX4654	STORAGE	180.36	2.20	0.000
EX4658	STORAGE	180.83	1.88	0.000
EX4659	STORAGE	180.90	1.81	0.000
EX4668	STORAGE	181.31	1.86	0.000
EX4672	STORAGE	181.48	1.52	0.000
EX4678	STORAGE	181.12	1.90	0.000
EX4682	STORAGE	180.86	1.94	0.000
EX4686	STORAGE	180.97	2.03	0.000
EX4690	STORAGE	181.13	1.77	0.000
EX4694	STORAGE	181.27	1.53	0.000
EX4695	STORAGE	181.41	1.69	0.000
EX4702	STORAGE	181.26	1.44	0.000
EX4709	STORAGE	180.93	2.55	0.000
EX4710	STORAGE	181.09	2.23	0.000
EX4711	STORAGE	181.22	1.95	0.000
EX4712	STORAGE	181.50	2.00	0.000
EX4717	STORAGE	181.62	1.88	0.000
EX4719	STORAGE	181.60	2.20	0.000
EX4720	STORAGE	181.54	1.96	0.000
EX4721	STORAGE	181.66	1.74	0.000
EX4722	STORAGE	181.84	1.56	0.000
EX4725	STORAGE	181.68	2.02	0.000
EX4729	STORAGE	181.81	1.59	0.000
EX4737	STORAGE	181.98	1.62	0.000
EX4755	STORAGE	181.51	1.49	0.000
EX4809	STORAGE	180.52	2.04	0.000
EX4810	STORAGE	180.66	1.90	0.000
EX5	STORAGE	180.08	2.33	0.000
EX5069	STORAGE	180.74	1.83	0.000
EX5070	STORAGE	180.82	1.75	0.000
EX5077	STORAGE	180.91	1.65	0.000
EX5081	STORAGE	180.98	1.58	0.000
EX5085	STORAGE	181.05	1.51	0.000
Jun-1	STORAGE	175.16	6.84	0.000
Jun-300	STORAGE	179.00	3.55	0.000
Jun-310	STORAGE	177.00	4.30	0.000
Jun-315	STORAGE	176.34	4.20	0.000
Jun-320	STORAGE	175.57	4.31	0.000
Jun-95	STORAGE	176.41	2.49	0.000
MH1	STORAGE	175.03	7.27	0.000

MH100	STORAGE	178.27	3.83	0.000
MH102	STORAGE	178.44	3.47	0.000
MH103	STORAGE	178.65	3.00	0.000
MH105	STORAGE	178.76	2.85	0.000
MH106	STORAGE	178.89	2.63	0.000
MH107	STORAGE	179.09	2.39	0.000
MH108	STORAGE	179.31	2.09	0.000
MH11	STORAGE	175.17	7.23	0.000
MH14	STORAGE	175.32	6.88	0.000
MH15	STORAGE	179.53	2.64	0.000
MH16	STORAGE	179.94	2.21	0.000
MH20	STORAGE	180.39	1.91	0.000
MH21	STORAGE	175.47	6.78	0.000
MH22	STORAGE	178.51	3.99	0.000
MH23	STORAGE	178.68	3.62	0.000
MH25	STORAGE	178.86	3.39	0.000
MH28	STORAGE	179.05	3.40	0.000
MH3	STORAGE	179.54	2.51	0.000
MH31	STORAGE	175.61	7.29	0.000
MH35	STORAGE	175.75	6.75	0.000
MH36	STORAGE	177.79	4.51	0.000
MH38	STORAGE	177.95	3.95	0.000
MH40	STORAGE	178.12	4.28	0.000
MH43	STORAGE	178.33	3.97	0.000
MH46	STORAGE	178.53	3.42	0.000
MH5	STORAGE	179.76	2.39	0.000
MH50	STORAGE	175.96	6.44	0.000
MH51	STORAGE	177.28	4.82	0.000
MH52	STORAGE	177.41	4.39	0.000
MH53	STORAGE	177.54	3.96	0.000
MH54	STORAGE	177.74	3.46	0.000
MH55	STORAGE	177.98	3.12	0.000
MH58	STORAGE	176.25	6.00	0.000
MH59	STORAGE	176.53	5.59	0.000
MH61	STORAGE	176.72	5.23	0.000
MH62	STORAGE	177.01	4.82	0.000
MH63	STORAGE	177.33	4.42	0.000
MH64	STORAGE	177.54	3.76	0.000
MH67	STORAGE	176.77	5.13	0.000
MH69	STORAGE	177.09	4.71	0.000
MH7	STORAGE	180.11	2.14	0.000
MH71	STORAGE	177.32	4.35	0.000
MH72	STORAGE	177.53	4.12	0.000
MH76	STORAGE	176.16	6.38	0.000
MH77	STORAGE	176.48	6.02	0.000
MH78	STORAGE	176.59	5.81	0.000
MH79	STORAGE	176.74	5.56	0.000
MH8	STORAGE	180.12	2.08	0.000
MH80	STORAGE	176.84	4.96	0.000
MH82	STORAGE	176.98	4.62	0.000
MH85	STORAGE	177.14	4.36	0.000

MH86	STORAGE	177.29	4.11	0.000
MH89	STORAGE	177.42	3.88	0.000
MH90	STORAGE	177.61	3.69	0.000
MH93	STORAGE	177.76	3.44	0.000
MH94	STORAGE	177.93	3.07	0.000
MH95	STORAGE	179.01	2.34	0.000
MH97	STORAGE	177.80	4.70	0.000
MH99	STORAGE	178.04	4.26	0.000
MH-A	STORAGE	179.12	3.19	0.000
MH-C	STORAGE	180.00	3.10	0.000
SPA Pond_130360m3	STORAGE	174.50	6.00	0.000
Stor-02	STORAGE	173.50	6.50	0.000
Stor-SPA1	STORAGE	180.35	1.70	0.000
Stor-SPA100	STORAGE	179.95	1.70	0.000
Stor-SPA106	STORAGE	179.60	1.70	0.000
Stor-SPA14	STORAGE	180.45	1.70	0.000
Stor-SPA21	STORAGE	180.60	1.70	0.000
Stor-SPA35	STORAGE	180.20	1.70	0.000
Stor-SPA50	STORAGE	180.30	1.70	0.000
Stor-SPA51	STORAGE	179.20	1.70	0.000
Stor-SPA52	STORAGE	180.05	1.70	0.000
Stor-SPA62	STORAGE	179.90	1.70	0.000
Stor-SPA69	STORAGE	179.75	1.70	0.000
Stor-SPA79	STORAGE	179.95	1.70	0.000
Stor-SPA86	STORAGE	179.55	1.70	0.000
Stor-Spa86a	STORAGE	180.01	1.70	0.000

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Link Summary
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Link ID	From Node	To Node	Element Type	Length m	Slope %	Manning's Roughness
1	Out-11	Jun-1	CONDUIT	90.0	0.3778	0.0150
Culvert D10	Jun-22	Jun-23	CONDUIT	8.0	0.0038	0.0150
Culvert D11	Jun-25	Jun-24	CONDUIT	3.6	1.3812	0.0150
Culvert D12	Jun-27	Jun-26	CONDUIT	5.5	0.3610	0.0150
Culvert D13	Jun-29	Jun-28	CONDUIT	4.6	0.4376	0.0150
Culvert D14	Jun-30	Jun-31	CONDUIT	5.1	1.1650	0.0150
Culvert D15	Jun-32	Jun-33	CONDUIT	5.7	0.8803	0.0150
Culvert D16	Jun-34	Jun-35	CONDUIT	5.1	1.5595	0.0150
Culvert D17	Jun-36	Jun-37	CONDUIT	5.8	0.0052	0.0150
Culvert D7	Jun-16	Jun-17	CONDUIT	4.1	8.3130	0.0130
Culvert D8	Jun-19	Jun-18	CONDUIT	7.9	0.7614	0.0130
Culvert D9	Jun-20	Jun-21	CONDUIT	8.1	0.2481	0.0150
Culvert R1	Jun-06	Jun-05	CONDUIT	31.4	0.2546	0.0150
Culvert R2	Jun-03	Jun-04	CONDUIT	30.5	0.0656	0.0130
Cyr Drain	Jun-109	CR22 Pond 19900m3	CHANNEL	650.0	0.1000	0.0350
CYR-1	STA0+775	STA0+925	CHANNEL	150.0	0.1800	0.0320
CYR-2	STA0+925	STA1+025	CHANNEL	100.0	0.3000	0.0320

CYR-3	STA1+025	STA1+150	CHANNEL	125.0	0.1376	0.0320
CYR-4	STA1+150	STA1+178	CHANNEL	28.0	0.2143	0.0320
CYR-5	STA1+178	STA1+200	CHANNEL	22.0	0.2100	0.0320
CYR-6	STA1+200	STA1+325	CHANNEL	125.0	0.2088	0.0320
CYR-7	STA1+325	STA1+450	CHANNEL	125.0	1.1947	0.0320
CYR-8	STA1+450	STA1+700	CHANNEL	250.0	0.2100	0.0320
CYR-9	STA1+700	Jun-109	CHANNEL	116.0	0.5586	0.0320
Drain R1	Jun-06	Jun-11	CHANNEL	210.5	0.0285	0.0320
Drain R2	Jun-05	Jun-04	CHANNEL	239.2	0.0669	0.0320
Drain R3	Jun-03	Jun-16	CHANNEL	16.0	1.1860	0.0320
Enclosed_ETLD1	Jun-300	Jun-310	CONDUIT	990.1	0.2020	0.0150
EX14a	EX4650	EX4654	CONDUIT	64.0	0.1688	0.0150
EX14b	EX4650	EX4654	CONDUIT	64.0	0.1688	0.0150
EX15b	EX4654	EX3868	CONDUIT	49.0	0.1612	0.0150
EXB1	EX4695	EX4694	CONDUIT	88.0	0.1409	0.0150
EXB10	EX4659	EX4658	CONDUIT	7.0	0.1714	0.0150
EXB11	EX4658	EX4422	CONDUIT	105.0	0.0571	0.0150
EXB12a	EX4422	EX4419	CONDUIT	53.0	0.1679	0.0150
EXB12b	EX4422	EX4419	CONDUIT	53.0	0.1679	0.0150
EXB13a	EX4419	EX4650	CONDUIT	52.0	0.2885	0.0150
EXB13b	EX4419	EX4650	CONDUIT	52.0	0.2885	0.0150
EXB15a	EX4654	EX3868	CONDUIT	49.0	0.1612	0.0150
EXB2	EX4694	EX4690	CONDUIT	69.0	0.1884	0.0150
EXB3	EX4690	EX4686	CONDUIT	97.0	0.1289	0.0150
EXB4	EX4686	EX4682	CONDUIT	61.0	0.1803	0.0150
EXB5	EX4682	EX4422	CONDUIT	119.0	0.1235	0.0150
EXB6	EX4702	EX4690	CONDUIT	83.0	0.1398	0.0150
EXB7	EX4672	EX4668	CONDUIT	93.0	0.1828	0.0150
EXB8	EX4668	EX4678	CONDUIT	71.0	0.2676	0.0150
EXB9	EX4678	EX4659	CONDUIT	70.0	0.0943	0.0150
EXG1	EX5085	EX5081	CONDUIT	70.0	0.1000	0.0150
EXG2	EX5081	EX5077	CONDUIT	83.0	0.0843	0.0150
EXG3	EX5077	EX5070	CONDUIT	86.0	0.1023	0.0150
EXG4	EX5070	EX5069	CONDUIT	85.0	0.0906	0.0150
EXG5	EX5069	EX4810	CONDUIT	57.0	0.1123	0.0150
EXG6	EX4810	EX4809	CONDUIT	103.0	0.0825	0.0150
EXG7	EX4809	EX0	CONDUIT	46.0	0.6043	0.0150
EXG8	EX0	EX1	CONDUIT	113.0	0.0708	0.0150
EXO1	EX4717	EX4712	CONDUIT	132.0	0.0970	0.0150
EXO10	EX5	EX4	CONDUIT	44.0	0.0682	0.0150
EXO11	EX4	77b	CONDUIT	60.0	0.0667	0.0150
EXO12	EX4755	EX4389	CONDUIT	107.0	0.1308	0.0150
EXO13	EX4389	EX4390	CONDUIT	108.0	0.1046	0.0150
EXO14	EX4390	EX4469	CONDUIT	102.0	0.1088	0.0150
EXO15	EX4469	EX4351	CONDUIT	82.0	0.0744	0.0150
EXO16	EX4351	EX3869	CONDUIT	14.0	0.2786	0.0150
EXO2	EX4712	EX4711	CONDUIT	83.0	0.2373	0.0150
EXO3	EX4711	EX4710	CONDUIT	117.0	0.1111	0.0150
EXO4	EX4710	EX4709	CONDUIT	123.0	0.1268	0.0150
EXO5	EX4709	EX4615	CONDUIT	120.0	0.1250	0.0150
EXO6	EX4615	EX3869	CONDUIT	123.0	0.0976	0.0150

EXO7	EX3869	EX3870	CONDUIT	2.0	5.5000	0.0150
EXO8	EX3870	EX3868	CONDUIT	106.0	0.1509	0.0150
EXO9	EX3868	EX5	CONDUIT	63.0	0.1587	0.0150
EXPK10	EX4528	EX1	CONDUIT	134.0	0.0522	0.0150
EXPK11	EX1	EX3	CONDUIT	87.0	0.0632	0.0150
EXPK12	EX3	EX4	CONDUIT	41.0	0.1707	0.0150
EXPK4	EX3877(MHD)	EX4322	CONDUIT	64.0	0.1406	0.0150
EXPK5	EX4322	EX4373	CONDUIT	128.0	0.1328	0.0150
EXPK6	EX4373	EX4374	CONDUIT	144.0	0.0972	0.0150
EXPK7	EX4374	EX4375	CONDUIT	10.0	0.1000	0.0150
EXPK8	EX4375	EX4518	CONDUIT	84.0	0.2024	0.0150
EXPK9	EX4518	EX4528	CONDUIT	113.0	0.2212	0.0150
EXY1	EX4737	EX4729	CONDUIT	125.0	0.1336	0.0150
EXY2	EX4729	EX4725	CONDUIT	88.0	0.1500	0.0150
EXY3	EX4725	EX4719	CONDUIT	65.0	0.1308	0.0150
EXY4	EX4719	EX4720	CONDUIT	59.0	0.0966	0.0150
EXY5	EX4722	EX4721	CONDUIT	114.0	0.1553	0.0150
EXY6	EX4721	EX4719	CONDUIT	49.0	0.1367	0.0150
EXY7	EX4720	EX4712	CONDUIT	45.0	0.0978	0.0150
Link-01	77a	MH76	CONDUIT	20.0	0.1300	0.0150
Link-04	MH-A	MH100	CONDUIT	98.2	0.2505	0.0130
Link-109	Jun-310	Jun-315	CONDUIT	324.3	0.2035	0.0150
Link-110	Jun-315	Jun-320	CONDUIT	387.4	0.1987	0.0150
Link-111	Jun-320	CR22 Pond 19900m3	CONDUIT	187.6	0.1972	0.0150
Link-12	Jun-18	Jun-17	CHANNEL	64.5	0.4652	0.0320
Link-14	Jun-19	Jun-20	CHANNEL	28.5	0.1405	0.0320
Link-16	Jun-21	Jun-22	CHANNEL	28.9	0.0011	0.0320
Link-18	Jun-23	Jun-24	CHANNEL	36.4	0.1921	0.0320
Link-20	Jun-25	Jun-26	CHANNEL	22.2	0.3607	0.0320
Link-22	Jun-28	Jun-27	CHANNEL	12.5	0.1604	0.0320
Link-23	77b	77a	CONDUIT	60.0	0.3000	0.0150
Link-24	Jun-29	Jun-30	CHANNEL	21.1	0.4265	0.0320
Link-26	Jun-32	Jun-31	CHANNEL	11.1	0.9025	0.0320
Link-28	Jun-34	Jun-33	CHANNEL	23.4	0.1707	0.0320
Link-30	Jun-36	Jun-35	CHANNEL	15.3	0.1310	0.0320
Link-32	Jun-38	Jun-37	CHANNEL	23.2	0.2590	0.0320
Link-33	STA1+178	15	CONDUIT	120.6	0.1160	0.0130
Link-38	Jun-03	Jun-16	CHANNEL	14.1	0.0022	0.0320
Link-42	Jun-38	Jun-47	CONDUIT	25.0	0.1400	0.0150
Link-43	Jun-47	Jun-02	CONDUIT	117.0	0.1397	0.0130
Link-44	Stor-02	Out-04	CONDUIT	27.4	1.0953	0.0150
Link-45	Jun-16	Stor-02	CONDUIT	250.9	1.1358	0.0150
Link-46	Jun-17	Stor-02	CONDUIT	249.4	1.1266	0.0150
Link-48	Jun-19	Stor-02	CONDUIT	191.5	1.4152	0.0150
Link-49	Jun-03	Stor-02	CONDUIT	264.3	1.0782	0.0150
Link-51	Jun-95	Jun-49	CONDUIT	127.5	0.1004	0.0150
Link-52	Jun-49	Jun-50	CONDUIT	243.2	0.0983	0.0150
Link-53	Jun-50	Jun-51	CONDUIT	35.1	0.2279	0.0150
Link-54	Jun-52	Jun-51	CONDUIT	103.7	0.0685	0.0150
Link-55	Jun-52	Jun-53	CONDUIT	16.0	0.0063	0.0150
Link-56	Jun-53	Jun-54	CONDUIT	31.4	1.4936	0.0240

Link-57	Jun-54	Jun-55	CONDUIT	127.0	0.3150	0.0150
Link-58	Jun-55	Jun-56	CONDUIT	104.0	0.2163	0.0150
Link-59	Jun-56	Jun-57	CONDUIT	30.3	0.2145	0.0150
Link-60	Jun-57	Jun-58	CONDUIT	209.0	0.1244	0.0150
Link-61	Jun-23	Stor-02	CONDUIT	150.7	1.6924	0.0150
Link-63	Jun-58	Jun-59	CONDUIT	30.0	0.2333	0.0150
Link-64	Jun-59	Jun-11	CONDUIT	230.0	0.1435	0.0150
Link-C-A	MH-C	MH-A	CONDUIT	114.1	0.2498	0.0150
LinkD-C	EX3877(MHD)	MH-C	CONDUIT	21.4	0.0888	0.0150
PipeA	MH76	MH50	CONDUIT	103.2	0.1395	0.0150
Pipe-B	MH50	MH35	CONDUIT	128.0	0.1500	0.0150
Pipe-C	MH35	MH31	CONDUIT	96.0	0.1198	0.0150
Pipe-D	MH31	MH21	CONDUIT	99.0	0.1202	0.0150
Pipe-E	MH21	MH14	CONDUIT	100.0	0.1300	0.0150
Pipe-F	MH14	MH11	CONDUIT	97.0	0.1402	0.0150
Pipe-G	MH11	MH1	CONDUIT	88.0	0.1398	0.0150
PipeTo-Pond	MH1	SPA Pond_130360m3	CONDUIT	20.0	0.1300	0.0150
SPAB1	MH28	MH25	CONDUIT	100.0	0.1700	0.0150
SPAB2	MH25	MH23	CONDUIT	97.0	0.2299	0.0150
SPAB3	MH23	MH22	CONDUIT	97.0	0.2000	0.0150
SPAB4	MH22	MH21	CONDUIT	115.0	0.2000	0.0150
SPABL1	MH8	MH5	CONDUIT	113.0	0.3106	0.0150
SPABL2	MH5	MH3	CONDUIT	99.0	0.2000	0.0150
SPABL3	MH3	MH1	CONDUIT	158.8	0.2198	0.0150
SPAG1	MH95	MH94	CONDUIT	115.0	0.1600	0.0150
SPAG2	MH94	MH93	CONDUIT	78.7	0.2097	0.0150
SPAG3	MH93	MH90	CONDUIT	85.0	0.1518	0.0150
SPAG4	MH90	MH89	CONDUIT	84.0	0.2012	0.0150
SPAG5	MH89	MH86	CONDUIT	84.0	0.1310	0.0150
SPAG6	MH86	MH85	CONDUIT	105.0	0.1305	0.0150
SPAG8	MH82	MH80	CONDUIT	150.8	0.1001	0.0150
SPAG9	MH80	MH79	CONDUIT	104.1	0.1018	0.0150
SPAO1	MH72	MH71	CONDUIT	104.1	0.2104	0.0150
SPAO2	MH71	MH69	CONDUIT	105.0	0.1495	0.0150
SPAO3	MH69	MH67	CONDUIT	151.1	0.2502	0.0150
SPAO4	MH67	MH59	CONDUIT	146.8	0.1996	0.0150
SPAO5	MH59	MH58	CONDUIT	151.0	0.1702	0.0150
SPAO6	MH58	MH50	CONDUIT	151.0	0.1801	0.0150
SPAPK1	MH64	MH63	CONDUIT	105.0	0.1800	0.0150
SPAPK2	MH63	MH62	CONDUIT	151.0	0.2503	0.0150
SPAPK3	MH62	MH61	CONDUIT	149.1	0.2495	0.0150
SPAPK4	MH61	MH59	CONDUIT	89.2	0.2500	0.0150
SPAPL1	MH20	MH7	CONDUIT	153.9	0.1696	0.0150
SPAPL2	MH7	MH16	CONDUIT	86.8	0.2005	0.0150
SPAPL3	MH16	MH15	CONDUIT	121.0	0.3198	0.0150
SPAPL4	MH15	MH14	CONDUIT	95.0	0.2200	0.0150
SPAR1	MH46	MH43	CONDUIT	102.0	0.1706	0.0150
SPAR2	MH43	MH40	CONDUIT	96.0	0.2000	0.0150
SPAR3	MH40	MH38	CONDUIT	91.0	0.1692	0.0150
SPAR4	MH38	MH36	CONDUIT	95.0	0.1505	0.0150
SPAR5	MH36	MH35	CONDUIT	68.0	0.2000	0.0150

SPAY1	MH55	MH54	CONDUIT	107.0	0.2000	0.0150
SPAY2	MH54	MH53	CONDUIT	119.0	0.1504	0.0150
SPAY3	MH53	MH52	CONDUIT	93.0	0.1806	0.0150
SPAY4	MH52	MH51	CONDUIT	96.0	0.1802	0.0150
SPAY5	MH51	MH50	CONDUIT	98.0	0.1796	0.0150
SPG7	MH85	MH82	CONDUIT	105.0	0.1295	0.0150
Z1	MH77	77a	CONDUIT	128.2	0.1303	0.0150
Z10	MH106	MH105	CONDUIT	96.8	0.1405	0.0150
Z11	MH107	MH106	CONDUIT	119.0	0.1504	0.0150
Z12	MH108	MH107	CONDUIT	119.0	0.1697	0.0150
Z2	MH78	MH77	CONDUIT	81.4	0.1302	0.0150
Z3	MH79	MH78	CONDUIT	122.9	0.1098	0.0150
Z4	MH97	MH79	CONDUIT	105.0	0.1800	0.0150
Z5	MH99	MH97	CONDUIT	120.0	0.1700	0.0150
Z6	MH100	MH99	CONDUIT	137.0	0.1701	0.0150
Z7	MH102	MH100	CONDUIT	97.1	0.1699	0.0150
Z8	MH103	MH102	CONDUIT	115.7	0.2204	0.0150
Z9	MH105	MH103	CONDUIT	69.5	0.1597	0.0150
LowFlowPump	SPA Pond_130360m3Jun-300		TYPE2 PUMP			
Pump-02	SPA Pond_130360m3Jun-300		TYPE2 PUMP			
Pump-03	CR22 Pond 19900m3Jun-95		TYPE2 PUMP			
16	Stor-Spa86a	MH90	ORIFICE			
SPA1	Stor-SPA1	MH1	ORIFICE			
SPA100	Stor-SPA100	MH102	ORIFICE			
SPA106	Stor-SPA106	MH106	ORIFICE			
SPA14	Stor-SPA14	MH14	ORIFICE			
SPA21	Stor-SPA21	MH21	ORIFICE			
SPA35	Stor-SPA35	MH35	ORIFICE			
SPA50	Stor-SPA50	MH50	ORIFICE			
SPA51	Stor-SPA51	MH53	ORIFICE			
SPA52	Stor-SPA52	MH51	ORIFICE			
SPA62	Stor-SPA62	MH62	ORIFICE			
SPA69	Stor-SPA69	MH69	ORIFICE			
SPA79	Stor-SPA79	MH79	ORIFICE			
SPA86	Stor-SPA86	MH86	ORIFICE			
01	Stor-SPA14	Stor-SPA1	WEIR			
02	Stor-SPA1	SPA Pond_130360m3	WEIR			
03	Stor-SPA51	ETLD-2a	WEIR			
04	Stor-SPA21	Stor-SPA14	WEIR			
05	Stor-SPA35	ETLD-1	WEIR			
06	Stor-SPA52	ETLD-2b	WEIR			
07	Stor-SPA50	Stor-SPA62	WEIR			
08	Stor-SPA79	Stor-SPA86	WEIR			
09	Stor-SPA100	Stor-SPA106	WEIR			
10	Stor-SPA62	ETLD-3	WEIR			
11	Stor-SPA69	ETLD-4	WEIR			
12	Stor-SPA106	STA1+025	WEIR			
13	Stor-SPA86	STA1+025	WEIR			
14	Stor-SPA50	Stor-SPA52	WEIR			
15	Stor-Spa86a	STA1+025	WEIR			
Weir-01	Jun-01	Jun-02	WEIR			

Weir-02	Jun-04	Jun-03	WEIR
Weir-03	Jun-06	Jun-05	WEIR
Weir-04	Jun-20	Jun-21	WEIR
Weir-05	Jun-22	Jun-23	WEIR
Weir-07	Jun-28	Jun-29	WEIR
Weir-08	Jun-30	Jun-31	WEIR
Weir-09	Jun-18	Jun-19	WEIR
Weir-10	Jun-16	Jun-17	WEIR
Weir-11	Jun-24	Jun-25	WEIR
Weir-12	Jun-26	Jun-27	WEIR
Weir-15	Jun-36	Jun-37	WEIR
Weir-16	Jun-34	Jun-35	WEIR
Weir-17	Jun-32	Jun-33	WEIR
Weir-19	Jun-04	Out-02	WEIR
Weir-20	Jun-06	Out-03	WEIR
Weir-39	Jun-95	Jun-49	WEIR
Outlet-01	Jun-02	Out-01	OUTLET

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Cross Section Summary
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Link ID	Shape	Depth/ Diameter m	Width m	No. of Barrels	Cross Sectional Area m²	Full Flow Hydraulic Radius m	Design Flow Capacity cms
1	CIRCULAR	1.50	1.50	1	1.77	0.38	3.77
Culvert D10	RECT_CLOSED	1.99	3.30	1	6.57	0.62	1.96
Culvert D11	RECT_CLOSED	1.80	5.37	1	9.66	0.67	58.21
Culvert D12	RECT_CLOSED	2.03	2.97	1	6.04	0.60	17.27
Culvert D13	RECT_CLOSED	2.00	3.64	1	7.28	0.65	23.99
Culvert D14	RECT_CLOSED	2.03	2.97	1	6.04	0.60	31.02
Culvert D15	RECT_CLOSED	1.95	3.45	1	6.72	0.62	30.65
Culvert D16	RECT_CLOSED	1.95	2.94	1	5.74	0.59	33.46
Culvert D17	RECT_CLOSED	2.27	4.80	1	10.90	0.77	4.42
Culvert D7	RECT_CLOSED	2.06	2.65	1	5.46	0.58	84.13
Culvert D8	RECT_CLOSED	2.08	3.21	1	6.68	0.63	33.02
Culvert D9	RECT_CLOSED	2.01	3.33	1	6.69	0.63	16.26
Culvert R1	RECT_CLOSED	1.86	5.49	1	10.21	0.69	26.95
Culvert R2	RECT_CLOSED	1.30	5.57	1	7.25	0.53	9.32
Cyr Drain	TRAPEZOIDAL	4.00	17.00	1	36.00	1.91	50.01
CYR-1	IRREGULAR	1.45	15.05	1	10.23	0.72	10.89
CYR-2	IRREGULAR	1.76	20.85	1	16.55	0.85	25.52
CYR-3	IRREGULAR	1.69	15.50	1	12.03	0.93	13.33
CYR-4	IRREGULAR	1.57	16.45	1	11.89	0.81	14.92
CYR-5	IRREGULAR	1.56	17.35	1	12.09	0.78	14.70
CYR-6	IRREGULAR	1.52	19.60	1	15.08	0.75	17.77
CYR-7	IRREGULAR	1.50	63.65	1	48.84	1.99	110.61
CYR-8	IRREGULAR	1.50	23.55	1	16.08	0.67	17.63
CYR-9	IRREGULAR	1.50	23.55	1	16.08	0.67	28.75

Drain R1	IRREGULAR	2.57	20.11	1	15.58	1.31	9.83
Drain R2	IRREGULAR	2.21	34.45	1	15.81	0.85	11.46
Drain R3	IRREGULAR	2.22	35.39	1	13.21	0.40	24.38
Enclosed_ETLD1	CIRCULAR	0.85	0.85	1	0.57	0.21	0.61
EX14a	CIRCULAR	0.68	0.68	1	0.36	0.17	0.30
EX14b	CIRCULAR	0.68	0.68	1	0.36	0.17	0.30
EX15b	CIRCULAR	0.68	0.68	1	0.36	0.17	0.29
EXB1	CIRCULAR	0.53	0.53	1	0.22	0.13	0.14
EXB10	CIRCULAR	0.68	0.68	1	0.36	0.17	0.30
EXB11	CIRCULAR	0.68	0.68	1	0.36	0.17	0.17
EXB12a	CIRCULAR	0.68	0.68	1	0.36	0.17	0.30
EXB12b	CIRCULAR	0.68	0.68	1	0.36	0.17	0.30
EXB13a	CIRCULAR	0.68	0.68	1	0.36	0.17	0.39
EXB13b	CIRCULAR	0.68	0.68	1	0.36	0.17	0.39
EXB15a	CIRCULAR	0.68	0.68	1	0.36	0.17	0.29
EXB2	CIRCULAR	0.53	0.53	1	0.22	0.13	0.16
EXB3	CIRCULAR	0.68	0.68	1	0.36	0.17	0.26
EXB4	CIRCULAR	0.68	0.68	1	0.36	0.17	0.31
EXB5	CIRCULAR	0.68	0.68	1	0.36	0.17	0.26
EXB6	CIRCULAR	0.53	0.53	1	0.22	0.13	0.14
EXB7	CIRCULAR	0.60	0.60	1	0.28	0.15	0.23
EXB8	CIRCULAR	0.68	0.68	1	0.36	0.17	0.38
EXB9	CIRCULAR	0.68	0.68	1	0.36	0.17	0.22
EXG1	CIRCULAR	0.75	0.75	1	0.44	0.19	0.31
EXG2	CIRCULAR	0.75	0.75	1	0.44	0.19	0.28
EXG3	CIRCULAR	0.75	0.75	1	0.44	0.19	0.31
EXG4	CIRCULAR	0.75	0.75	1	0.44	0.19	0.29
EXG5	CIRCULAR	0.75	0.75	1	0.44	0.19	0.32
EXG6	CIRCULAR	0.75	0.75	1	0.44	0.19	0.28
EXG7	CIRCULAR	0.90	0.90	1	0.64	0.23	1.22
EXG8	CIRCULAR	0.90	0.90	1	0.64	0.23	0.42
EXO1	CIRCULAR	0.60	0.60	1	0.28	0.15	0.17
EXO10	CIRCULAR	1.20	1.20	1	1.13	0.30	0.88
EXO11	CIRCULAR	1.35	1.35	1	1.43	0.34	1.19
EXO12	CIRCULAR	0.53	0.53	1	0.22	0.13	0.13
EXO13	CIRCULAR	0.60	0.60	1	0.28	0.15	0.17
EXO14	CIRCULAR	0.60	0.60	1	0.28	0.15	0.18
EXO15	CIRCULAR	1.05	1.05	1	0.87	0.26	0.65
EXO16	CIRCULAR	1.20	1.20	1	1.13	0.30	1.78
EXO2	CIRCULAR	0.60	0.60	1	0.28	0.15	0.26
EXO3	CIRCULAR	0.68	0.68	1	0.36	0.17	0.24
EXO4	CIRCULAR	0.68	0.68	1	0.36	0.17	0.26
EXO5	CIRCULAR	0.68	0.68	1	0.36	0.17	0.26
EXO6	CIRCULAR	0.68	0.68	1	0.36	0.17	0.23
EXO7	CIRCULAR	1.20	1.20	1	1.13	0.30	7.93
EXO8	CIRCULAR	1.20	1.20	1	1.13	0.30	1.31
EXO9	CIRCULAR	1.20	1.20	1	1.13	0.30	1.35
EXPK10	CIRCULAR	0.90	0.90	1	0.64	0.23	0.36
EXPK11	CIRCULAR	0.90	0.90	1	0.64	0.23	0.39
EXPK12	CIRCULAR	1.05	1.05	1	0.87	0.26	0.98
EXPK4	CIRCULAR	0.60	0.60	1	0.28	0.15	0.20

EXPK5	CIRCULAR	0.60	0.60	1	0.28	0.15	0.19
EXPK6	CIRCULAR	0.60	0.60	1	0.28	0.15	0.17
EXPK7	CIRCULAR	0.60	0.60	1	0.28	0.15	0.17
EXPK8	CIRCULAR	0.90	0.90	1	0.64	0.23	0.71
EXPK9	CIRCULAR	0.90	0.90	1	0.64	0.23	0.74
EXY1	CIRCULAR	0.53	0.53	1	0.22	0.13	0.14
EXY2	CIRCULAR	0.53	0.53	1	0.22	0.13	0.14
EXY3	CIRCULAR	0.60	0.60	1	0.28	0.15	0.19
EXY4	CIRCULAR	0.75	0.75	1	0.44	0.19	0.30
EXY5	CIRCULAR	0.53	0.53	1	0.22	0.13	0.15
EXY6	CIRCULAR	0.60	0.60	1	0.28	0.15	0.20
EXY7	CIRCULAR	0.75	0.75	1	0.44	0.19	0.30
Link-01	CIRCULAR	2.10	2.10	1	3.46	0.53	5.42
Link-04	CIRCULAR	0.90	0.90	1	0.64	0.23	0.91
Link-109	CIRCULAR	0.85	0.85	1	0.57	0.21	0.61
Link-110	CIRCULAR	1.50	1.50	1	1.77	0.38	2.73
Link-111	RECT_CLOSED	1.80	2.40	1	4.32	0.51	8.21
Link-12	IRREGULAR	2.17	32.71	1	12.98	0.27	11.61
Link-14	IRREGULAR	2.08	31.74	1	12.90	0.30	6.82
Link-16	IRREGULAR	2.22	35.64	1	16.56	0.93	1.61
Link-18	IRREGULAR	2.10	36.39	1	15.38	0.83	18.60
Link-20	IRREGULAR	2.10	32.56	1	13.58	0.95	24.70
Link-22	IRREGULAR	2.03	40.47	1	14.13	0.81	15.31
Link-23	CIRCULAR	1.35	1.35	1	1.43	0.34	2.53
Link-24	IRREGULAR	2.54	34.62	1	26.59	0.96	52.99
Link-26	IRREGULAR	2.56	31.36	1	25.91	1.05	79.60
Link-28	IRREGULAR	2.40	31.97	1	21.36	1.07	28.83
Link-30	IRREGULAR	2.31	36.88	1	16.19	1.07	19.12
Link-32	IRREGULAR	2.35	36.53	1	22.09	0.90	32.83
Link-33	CIRCULAR	1.20	1.20	1	1.13	0.30	1.33
Link-38	IRREGULAR	2.22	35.39	1	13.21	0.40	1.04
Link-42	RECT_CLOSED	1.80	3.00	1	5.40	0.56	9.18
Link-43	RECT_CLOSED	1.80	3.00	1	5.40	0.56	10.58
Link-44	RECT_CLOSED	5.00	5.00	1	25.00	1.25	202.44
Link-45	RECT_CLOSED	0.15	4.00	1	0.60	0.07	0.74
Link-46	RECT_CLOSED	0.15	4.00	1	0.60	0.07	0.74
Link-48	RECT_CLOSED	0.15	4.00	1	0.60	0.07	0.83
Link-49	RECT_CLOSED	0.15	4.00	1	0.60	0.07	0.72
Link-51	RECT_CLOSED	1.80	2.44	1	4.39	0.52	5.98
Link-52	RECT_CLOSED	1.80	2.40	1	4.32	0.51	5.80
Link-53	RECT_CLOSED	1.80	2.40	1	4.32	0.51	8.83
Link-54	RECT_CLOSED	1.80	2.40	1	4.32	0.51	4.84
Link-55	RECT_CLOSED	2.00	2.50	1	5.00	0.56	1.78
Link-56	CIRCULAR	1.50	1.50	1	1.77	0.38	4.68
Link-57	RECT_CLOSED	1.80	2.40	1	4.32	0.51	10.38
Link-58	RECT_CLOSED	1.80	2.40	1	4.32	0.51	8.60
Link-59	RECT_CLOSED	1.80	4.80	1	8.64	0.65	20.12
Link-60	RECT_CLOSED	1.80	3.00	1	5.40	0.56	8.65
Link-61	RECT_CLOSED	0.15	4.00	1	0.60	0.07	0.90
Link-63	RECT_CLOSED	1.80	4.80	1	8.64	0.65	20.98
Link-64	RECT_CLOSED	1.80	3.00	1	5.40	0.56	9.29

Link-C-A	CIRCULAR	0.90	0.90	1	0.64	0.23	0.78
LinkD-C	CIRCULAR	0.90	0.90	1	0.64	0.23	0.47
PipeA	CIRCULAR	2.10	2.10	1	3.46	0.53	5.61
Pipe-B	CIRCULAR	2.10	2.10	1	3.46	0.53	5.82
Pipe-C	CIRCULAR	2.10	2.10	1	3.46	0.53	5.20
Pipe-D	CIRCULAR	2.10	2.10	1	3.46	0.53	5.21
Pipe-E	CIRCULAR	2.10	2.10	1	3.46	0.53	5.42
Pipe-F	CIRCULAR	2.10	2.10	1	3.46	0.53	5.63
Pipe-G	CIRCULAR	2.10	2.10	1	3.46	0.53	5.62
PipeTo-Pond	CIRCULAR	2.10	2.10	1	3.46	0.53	5.42
SPAB1	CIRCULAR	0.60	0.60	1	0.28	0.15	0.22
SPAB2	CIRCULAR	0.60	0.60	1	0.28	0.15	0.26
SPAB3	CIRCULAR	0.68	0.68	1	0.36	0.17	0.33
SPAB4	CIRCULAR	0.75	0.75	1	0.44	0.19	0.43
SPABL1	CIRCULAR	0.53	0.53	1	0.22	0.13	0.21
SPABL2	CIRCULAR	0.60	0.60	1	0.28	0.15	0.24
SPABL3	CIRCULAR	0.68	0.68	1	0.36	0.17	0.34
SPAG1	CIRCULAR	0.60	0.60	1	0.28	0.15	0.21
SPAG2	CIRCULAR	0.68	0.68	1	0.36	0.17	0.33
SPAG3	CIRCULAR	0.75	0.75	1	0.44	0.19	0.38
SPAG4	CIRCULAR	0.75	0.75	1	0.44	0.19	0.43
SPAG5	CIRCULAR	0.90	0.90	1	0.64	0.23	0.57
SPAG6	CIRCULAR	0.90	0.90	1	0.64	0.23	0.57
SPAG8	CIRCULAR	1.05	1.05	1	0.87	0.26	0.75
SPAG9	CIRCULAR	1.05	1.05	1	0.87	0.26	0.76
SPAO1	CIRCULAR	0.53	0.53	1	0.22	0.13	0.17
SPAO2	CIRCULAR	0.60	0.60	1	0.28	0.15	0.21
SPAO3	CIRCULAR	0.60	0.60	1	0.28	0.15	0.27
SPAO4	CIRCULAR	0.68	0.68	1	0.36	0.17	0.33
SPAO5	CIRCULAR	0.90	0.90	1	0.64	0.23	0.65
SPAO6	CIRCULAR	0.90	0.90	1	0.64	0.23	0.67
SPAPK1	CIRCULAR	0.53	0.53	1	0.22	0.13	0.16
SPAPK2	CIRCULAR	0.53	0.53	1	0.22	0.13	0.19
SPAPK3	CIRCULAR	0.60	0.60	1	0.28	0.15	0.27
SPAPK4	CIRCULAR	0.60	0.60	1	0.28	0.15	0.27
SPAPL1	CIRCULAR	0.53	0.53	1	0.22	0.13	0.15
SPAPL2	CIRCULAR	0.53	0.53	1	0.22	0.13	0.17
SPAPL3	CIRCULAR	0.60	0.60	1	0.28	0.15	0.30
SPAPL4	CIRCULAR	0.68	0.68	1	0.36	0.17	0.34
SPAR1	CIRCULAR	0.53	0.53	1	0.22	0.13	0.15
SPAR2	CIRCULAR	0.60	0.60	1	0.28	0.15	0.24
SPAR3	CIRCULAR	0.75	0.75	1	0.44	0.19	0.40
SPAR4	CIRCULAR	0.82	0.82	1	0.53	0.21	0.48
SPAR5	CIRCULAR	0.82	0.82	1	0.53	0.21	0.56
SPAY1	CIRCULAR	0.53	0.53	1	0.22	0.13	0.17
SPAY2	CIRCULAR	0.75	0.75	1	0.44	0.19	0.37
SPAY3	CIRCULAR	1.05	1.05	1	0.87	0.26	1.01
SPAY4	CIRCULAR	1.05	1.05	1	0.87	0.26	1.00
SPAY5	CIRCULAR	1.05	1.05	1	0.87	0.26	1.00
SPG7	CIRCULAR	0.90	0.90	1	0.64	0.23	0.56
Z1	CIRCULAR	1.50	1.50	1	1.77	0.38	2.21

Z10	CIRCULAR	0.75	0.75	1	0.44	0.19	0.36
Z11	CIRCULAR	0.60	0.60	1	0.28	0.15	0.21
Z12	CIRCULAR	0.53	0.53	1	0.22	0.13	0.15
Z2	CIRCULAR	1.50	1.50	1	1.77	0.38	2.21
Z3	CIRCULAR	1.50	1.50	1	1.77	0.38	2.03
Z4	CIRCULAR	1.20	1.20	1	1.13	0.30	1.43
Z5	CIRCULAR	1.20	1.20	1	1.13	0.30	1.39
Z6	CIRCULAR	1.20	1.20	1	1.13	0.30	1.39
Z7	CIRCULAR	0.90	0.90	1	0.64	0.23	0.65
Z8	CIRCULAR	0.82	0.82	1	0.53	0.21	0.58
Z9	CIRCULAR	0.75	0.75	1	0.44	0.19	0.39

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Transect Summary
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Transect CYR-1
Area:

0.0036	0.0078	0.0124	0.0176	0.0232
0.0293	0.0360	0.0431	0.0507	0.0588
0.0674	0.0765	0.0861	0.0961	0.1067
0.1177	0.1292	0.1412	0.1537	0.1667
0.1802	0.1941	0.2086	0.2235	0.2395
0.2570	0.2759	0.2963	0.3181	0.3414
0.3662	0.3924	0.4200	0.4491	0.4795
0.5106	0.5422	0.5740	0.6062	0.6387
0.6715	0.7046	0.7380	0.7718	0.8060
0.8417	0.8790	0.9178	0.9581	1.0000

Hrad:

0.0374	0.0704	0.1005	0.1286	0.1550
0.1803	0.2047	0.2283	0.2513	0.2808
0.3088	0.3352	0.3604	0.3846	0.4079
0.4305	0.4524	0.4737	0.4946	0.5151
0.5351	0.5549	0.5743	0.5947	0.6231
0.6475	0.6685	0.6868	0.7029	0.7173
0.7303	0.7422	0.7532	0.7637	0.7755
0.7884	0.8053	0.8231	0.8416	0.8605
0.8799	0.8995	0.9194	0.9395	0.9535
0.9631	0.9726	0.9820	0.9921	1.0000

Width:

0.0914	0.1030	0.1146	0.1262	0.1378
0.1495	0.1611	0.1727	0.1843	0.1958
0.2072	0.2186	0.2300	0.2415	0.2529
0.2643	0.2758	0.2872	0.2986	0.3101
0.3215	0.3329	0.3444	0.3581	0.3923
0.4264	0.4605	0.4946	0.5287	0.5628
0.5969	0.6310	0.6651	0.6993	0.7209
0.7358	0.7432	0.7505	0.7578	0.7651
0.7724	0.7797	0.7870	0.7943	0.8186
0.8549	0.8912	0.9274	0.9637	1.0000

Transect CYR-2

Area:

0.0028	0.0061	0.0099	0.0141	0.0188
0.0239	0.0294	0.0354	0.0418	0.0487
0.0560	0.0638	0.0720	0.0806	0.0897
0.0992	0.1091	0.1195	0.1304	0.1416
0.1538	0.1671	0.1814	0.1968	0.2133
0.2305	0.2481	0.2674	0.2915	0.3161
0.3410	0.3667	0.3939	0.4227	0.4530
0.4849	0.5184	0.5531	0.5883	0.6237
0.6592	0.6951	0.7311	0.7674	0.8039
0.8406	0.8776	0.9161	0.9569	1.0000

Hrad:

0.0373	0.0695	0.0990	0.1270	0.1533
0.1785	0.2028	0.2263	0.2493	0.2718
0.2940	0.3158	0.3374	0.3587	0.3799
0.4008	0.4217	0.4424	0.4630	0.4856
0.5134	0.5375	0.5588	0.5777	0.5948
0.6128	0.6320	0.6370	0.6403	0.6502
0.6630	0.6848	0.7046	0.7227	0.7395
0.7552	0.7700	0.7852	0.8025	0.8212
0.8408	0.8612	0.8823	0.9038	0.9257
0.9479	0.9685	0.9792	0.9898	1.0000

Width:

0.0687	0.0799	0.0906	0.1005	0.1105
0.1205	0.1304	0.1404	0.1503	0.1603
0.1702	0.1802	0.1902	0.2001	0.2101
0.2200	0.2300	0.2400	0.2499	0.2629
0.2873	0.3117	0.3362	0.3606	0.3850
0.3935	0.4010	0.5025	0.5547	0.5591
0.5635	0.5983	0.6333	0.6684	0.7034
0.7384	0.7734	0.7918	0.7969	0.8020
0.8071	0.8122	0.8173	0.8224	0.8275
0.8326	0.8452	0.8968	0.9484	1.0000

Transect CYR-3

Area:

0.0039	0.0084	0.0135	0.0191	0.0252
0.0320	0.0392	0.0471	0.0555	0.0644
0.0739	0.0840	0.0946	0.1058	0.1175
0.1298	0.1426	0.1560	0.1700	0.1845
0.1996	0.2152	0.2314	0.2484	0.2665
0.2857	0.3059	0.3267	0.3479	0.3700
0.3931	0.4173	0.4425	0.4687	0.4959
0.5242	0.5535	0.5839	0.6152	0.6475
0.6799	0.7125	0.7451	0.7778	0.8107
0.8440	0.8796	0.9174	0.9576	1.0000

Hrad:

0.0335	0.0629	0.0897	0.1146	0.1381
0.1605	0.1822	0.2031	0.2236	0.2436

0.2633	0.2827	0.3019	0.3209	0.3396
0.3583	0.3768	0.3951	0.4134	0.4316
0.4497	0.4677	0.4857	0.5096	0.5328
0.5540	0.5739	0.5940	0.6186	0.6460
0.6717	0.6957	0.7183	0.7397	0.7599
0.7791	0.7975	0.8150	0.8319	0.8495
0.8687	0.8886	0.9091	0.9302	0.9516
0.9658	0.9755	0.9845	0.9927	1.0000

Width:

0.0966	0.1094	0.1222	0.1349	0.1477
0.1605	0.1733	0.1860	0.1988	0.2116
0.2244	0.2372	0.2500	0.2628	0.2756
0.2883	0.3011	0.3139	0.3267	0.3395
0.3523	0.3651	0.3779	0.4015	0.4279
0.4542	0.4708	0.4807	0.4953	0.5189
0.5425	0.5661	0.5897	0.6133	0.6369
0.6605	0.6841	0.7077	0.7313	0.7431
0.7453	0.7475	0.7497	0.7519	0.7541
0.7886	0.8415	0.8943	0.9472	1.0000

Transect CYR-4

Area:

0.0034	0.0073	0.0118	0.0167	0.0221
0.0280	0.0344	0.0413	0.0487	0.0566
0.0650	0.0739	0.0833	0.0932	0.1036
0.1145	0.1259	0.1378	0.1502	0.1630
0.1764	0.1903	0.2047	0.2202	0.2384
0.2569	0.2757	0.2947	0.3139	0.3340
0.3561	0.3802	0.4063	0.4345	0.4648
0.4968	0.5295	0.5625	0.5957	0.6293
0.6631	0.6973	0.7317	0.7665	0.8017
0.8383	0.8764	0.9161	0.9573	1.0000

Hrad:

0.0359	0.0674	0.0961	0.1227	0.1478
0.1718	0.1949	0.2174	0.2393	0.2608
0.2819	0.3027	0.3233	0.3436	0.3638
0.3838	0.4036	0.4234	0.4430	0.4625
0.4820	0.5014	0.5207	0.5395	0.5584
0.5787	0.5999	0.6217	0.6437	0.6722
0.6977	0.7190	0.7369	0.7520	0.7648
0.7771	0.7919	0.8082	0.8257	0.8441
0.8632	0.8829	0.9030	0.9235	0.9402
0.9532	0.9656	0.9775	0.9890	1.0000

Width:

0.0844	0.0958	0.1073	0.1188	0.1302
0.1417	0.1531	0.1646	0.1760	0.1875
0.1989	0.2104	0.2218	0.2333	0.2447
0.2562	0.2676	0.2791	0.2905	0.3020
0.3134	0.3249	0.3363	0.4165	0.4223
0.4282	0.4340	0.4398	0.4457	0.4843
0.5312	0.5780	0.6248	0.6716	0.7185

0.7477	0.7545	0.7613	0.7682	0.7750
0.7818	0.7886	0.7955	0.8023	0.8243
0.8594	0.8946	0.9297	0.9649	1.0000

Transect CYR-5

Area:

0.0033	0.0071	0.0115	0.0162	0.0215
0.0273	0.0335	0.0403	0.0475	0.0552
0.0634	0.0720	0.0812	0.0908	0.1010
0.1116	0.1227	0.1343	0.1463	0.1589
0.1720	0.1860	0.2012	0.2175	0.2349
0.2531	0.2717	0.2905	0.3096	0.3299
0.3518	0.3753	0.4002	0.4267	0.4547
0.4843	0.5154	0.5480	0.5820	0.6168
0.6520	0.6878	0.7240	0.7606	0.7978
0.8354	0.8739	0.9142	0.9562	1.0000

Hrad:

0.0367	0.0689	0.0982	0.1254	0.1510
0.1756	0.1992	0.2222	0.2446	0.2666
0.2882	0.3095	0.3305	0.3513	0.3720
0.3924	0.4127	0.4329	0.4530	0.4730
0.4956	0.5216	0.5446	0.5652	0.5836
0.6023	0.6221	0.6427	0.6674	0.6954
0.7200	0.7416	0.7608	0.7780	0.7934
0.8075	0.8204	0.8324	0.8446	0.8590
0.8744	0.8905	0.9072	0.9244	0.9419
0.9597	0.9716	0.9815	0.9910	1.0000

Width:

0.0800	0.0909	0.1018	0.1126	0.1235
0.1344	0.1453	0.1561	0.1670	0.1779
0.1887	0.1996	0.2105	0.2214	0.2322
0.2431	0.2540	0.2648	0.2757	0.2866
0.3020	0.3270	0.3519	0.3769	0.4046
0.4122	0.4176	0.4231	0.4391	0.4733
0.5075	0.5417	0.5760	0.6102	0.6444
0.6786	0.7128	0.7470	0.7731	0.7838
0.7945	0.8052	0.8159	0.8265	0.8372
0.8479	0.8814	0.9210	0.9605	1.0000

Transect CYR-6

Area:

0.0026	0.0058	0.0093	0.0133	0.0179
0.0237	0.0307	0.0390	0.0484	0.0590
0.0709	0.0840	0.0977	0.1115	0.1257
0.1401	0.1548	0.1698	0.1850	0.2005
0.2163	0.2323	0.2486	0.2651	0.2820
0.2990	0.3165	0.3353	0.3553	0.3768
0.3997	0.4239	0.4495	0.4764	0.5048
0.5345	0.5652	0.5963	0.6275	0.6590
0.6908	0.7229	0.7552	0.7877	0.8205
0.8537	0.8880	0.9238	0.9612	1.0000

Hrad:

0.0371	0.0692	0.0983	0.1252	0.1523
0.1734	0.1903	0.2051	0.2189	0.2325
0.2459	0.2601	0.2807	0.3026	0.3252
0.3482	0.3715	0.3947	0.4180	0.4412
0.4643	0.4873	0.5101	0.5328	0.5553
0.5776	0.6041	0.6324	0.6577	0.6802
0.7005	0.7189	0.7356	0.7509	0.7651
0.7783	0.7933	0.8099	0.8273	0.8454
0.8641	0.8832	0.9027	0.9225	0.9424
0.9594	0.9700	0.9803	0.9903	1.0000

Width:

0.0727	0.0841	0.0956	0.1070	0.1312
0.1618	0.1924	0.2231	0.2537	0.2843
0.3156	0.3410	0.3478	0.3545	0.3612
0.3680	0.3747	0.3814	0.3882	0.3949
0.4017	0.4084	0.4151	0.4219	0.4286
0.4353	0.4558	0.4905	0.5253	0.5600
0.5947	0.6295	0.6642	0.6990	0.7337
0.7685	0.7807	0.7871	0.7936	0.8001
0.8066	0.8130	0.8195	0.8260	0.8324
0.8494	0.8871	0.9247	0.9624	1.0000

Transect CYR-7

Area:

0.0023	0.0049	0.0079	0.0111	0.0147
0.0187	0.0229	0.0278	0.0333	0.0394
0.0459	0.0528	0.0604	0.0685	0.0772
0.0865	0.0965	0.1072	0.1191	0.1325
0.1474	0.1637	0.1815	0.2006	0.2211
0.2427	0.2654	0.2892	0.3142	0.3403
0.3675	0.3958	0.4253	0.4558	0.4874
0.5193	0.5513	0.5837	0.6162	0.6489
0.6819	0.7150	0.7484	0.7820	0.8161
0.8510	0.8868	0.9236	0.9613	1.0000

Hrad:

0.0370	0.0700	0.1001	0.1283	0.1550
0.1806	0.1996	0.2115	0.2252	0.2485
0.2725	0.2884	0.3048	0.3217	0.3390
0.3550	0.3689	0.3782	0.3719	0.3710
0.3739	0.3798	0.3879	0.4002	0.4159
0.4331	0.4504	0.4680	0.4857	0.5036
0.5216	0.5398	0.5580	0.5763	0.6039
0.6387	0.6732	0.7075	0.7416	0.7754
0.8090	0.8424	0.8755	0.9085	0.9274
0.9414	0.9557	0.9702	0.9850	1.0000

Width:

0.0630	0.0712	0.0795	0.0878	0.0961
0.1044	0.1161	0.1329	0.1496	0.1602
0.1700	0.1850	0.2000	0.2150	0.2300
0.2462	0.2642	0.2864	0.3237	0.3611

0.3985 0.4359 0.4732 0.5072 0.5374
0.5661 0.5949 0.6236 0.6523 0.6810
0.7098 0.7385 0.7672 0.7959 0.8118
0.8173 0.8229 0.8284 0.8340 0.8396
0.8451 0.8507 0.8563 0.8618 0.8807
0.9046 0.9284 0.9523 0.9761 1.0000

Transect CYR-8
Area:
0.0025 0.0054 0.0089 0.0128 0.0172
0.0221 0.0274 0.0332 0.0395 0.0463
0.0536 0.0612 0.0691 0.0773 0.0859
0.0949 0.1041 0.1137 0.1237 0.1339
0.1446 0.1556 0.1670 0.1788 0.1911
0.2038 0.2170 0.2311 0.2482 0.2684
0.2918 0.3184 0.3482 0.3810 0.4165
0.4530 0.4897 0.5267 0.5639 0.6014
0.6390 0.6769 0.7151 0.7534 0.7921
0.8318 0.8724 0.9140 0.9565 1.0000
Hrad:
0.0405 0.0751 0.1063 0.1351 0.1625
0.1887 0.2141 0.2389 0.2632 0.2871
0.3189 0.3554 0.3899 0.4230 0.4547
0.4851 0.5145 0.5430 0.5706 0.5974
0.6234 0.6479 0.6716 0.6945 0.7167
0.7383 0.7594 0.7829 0.7979 0.8033
0.8019 0.7958 0.7868 0.7808 0.7763
0.7798 0.7880 0.7995 0.8136 0.8297
0.8474 0.8663 0.8863 0.9071 0.9247
0.9398 0.9549 0.9700 0.9850 1.0000
Width:
0.0618 0.0727 0.0836 0.0944 0.1053
0.1162 0.1271 0.1379 0.1488 0.1597
0.1687 0.1763 0.1839 0.1916 0.1992
0.2068 0.2144 0.2220 0.2297 0.2373
0.2452 0.2549 0.2646 0.2743 0.2840
0.2937 0.3035 0.3527 0.4244 0.4961
0.5679 0.6402 0.7130 0.7774 0.8272
0.8325 0.8378 0.8430 0.8483 0.8536
0.8589 0.8642 0.8694 0.8747 0.8899
0.9119 0.9339 0.9560 0.9780 1.0000

Transect XS-01
Area:
0.0069 0.0144 0.0225 0.0312 0.0405
0.0504 0.0608 0.0717 0.0830 0.0947
0.1068 0.1193 0.1322 0.1455 0.1592
0.1733 0.1878 0.2026 0.2179 0.2336
0.2497 0.2662 0.2830 0.3003 0.3180
0.3361 0.3545 0.3734 0.3927 0.4124
0.4324 0.4529 0.4738 0.4950 0.5167

0.5388 0.5617 0.5859 0.6111 0.6375
0.6650 0.6937 0.7235 0.7545 0.7866
0.8207 0.8583 0.8993 0.9441 1.0000

Hrad:

0.0370 0.0705 0.1013 0.1301 0.1572
0.1832 0.2088 0.2354 0.2610 0.2857
0.3097 0.3329 0.3556 0.3777 0.3994
0.4206 0.4414 0.4618 0.4819 0.5017
0.5212 0.5405 0.5595 0.5783 0.5969
0.6153 0.6336 0.6517 0.6696 0.6875
0.7051 0.7227 0.7401 0.7575 0.7747
0.7932 0.8160 0.8370 0.8564 0.8744
0.8912 0.9070 0.9219 0.9359 0.9493
0.9684 0.9842 0.9962 1.0052 1.0000

Width:

0.1085 0.1175 0.1265 0.1356 0.1446
0.1533 0.1614 0.1674 0.1734 0.1794
0.1854 0.1914 0.1974 0.2034 0.2094
0.2154 0.2214 0.2274 0.2335 0.2395
0.2455 0.2515 0.2575 0.2635 0.2695
0.2755 0.2815 0.2875 0.2935 0.2996
0.3056 0.3116 0.3176 0.3236 0.3296
0.3379 0.3550 0.3722 0.3894 0.4066
0.4237 0.4409 0.4581 0.4753 0.4924
0.5403 0.5929 0.6456 0.7203 1.0000

Transect XS-02

Area:

0.0062 0.0130 0.0204 0.0281 0.0363
0.0448 0.0537 0.0629 0.0725 0.0824
0.0927 0.1034 0.1145 0.1259 0.1376
0.1498 0.1623 0.1751 0.1884 0.2019
0.2159 0.2302 0.2449 0.2599 0.2753
0.2911 0.3072 0.3237 0.3406 0.3578
0.3754 0.3934 0.4117 0.4303 0.4494
0.4688 0.4886 0.5087 0.5298 0.5539
0.5817 0.6133 0.6513 0.6958 0.7423
0.7904 0.8402 0.8918 0.9450 1.0000

Hrad:

0.0399 0.0772 0.1118 0.1455 0.1776
0.2082 0.2374 0.2655 0.2926 0.3188
0.3442 0.3690 0.3932 0.4168 0.4400
0.4627 0.4851 0.5071 0.5287 0.5501
0.5712 0.5921 0.6127 0.6332 0.6534
0.6735 0.6934 0.7132 0.7328 0.7523
0.7716 0.7909 0.8100 0.8290 0.8480
0.8668 0.8856 0.9043 0.9314 0.9588
0.9786 0.9918 0.9930 0.9879 0.9858
0.9857 0.9875 0.9906 0.9948 1.0000

Width:

0.1181 0.1269 0.1357 0.1424 0.1489

0.1555	0.1620	0.1685	0.1750	0.1815
0.1880	0.1945	0.2010	0.2075	0.2140
0.2205	0.2270	0.2335	0.2400	0.2466
0.2531	0.2596	0.2661	0.2726	0.2791
0.2856	0.2921	0.2986	0.3051	0.3116
0.3181	0.3246	0.3311	0.3376	0.3442
0.3507	0.3572	0.3637	0.3993	0.4650
0.5307	0.6057	0.7567	0.8164	0.8467
0.8770	0.9073	0.9379	0.9690	1.0000

Transect XS-03
Area:

0.0073	0.0152	0.0238	0.0330	0.0428
0.0533	0.0644	0.0761	0.0882	0.1007
0.1135	0.1268	0.1404	0.1544	0.1688
0.1835	0.1986	0.2141	0.2300	0.2462
0.2628	0.2798	0.2971	0.3148	0.3329
0.3514	0.3702	0.3894	0.4090	0.4290
0.4493	0.4700	0.4910	0.5125	0.5343
0.5565	0.5790	0.6019	0.6252	0.6489
0.6729	0.6974	0.7231	0.7514	0.7830
0.8188	0.8592	0.9035	0.9505	1.0000

Hrad:

0.0351	0.0671	0.0967	0.1245	0.1508
0.1759	0.2000	0.2253	0.2512	0.2764
0.3012	0.3253	0.3487	0.3717	0.3941
0.4161	0.4376	0.4588	0.4796	0.5000
0.5202	0.5401	0.5597	0.5791	0.5983
0.6172	0.6360	0.6546	0.6730	0.6912
0.7093	0.7272	0.7451	0.7628	0.7803
0.7978	0.8151	0.8324	0.8495	0.8666
0.8836	0.9005	0.9226	0.9412	0.9605
0.9754	0.9849	0.9908	0.9958	1.0000

Width:

0.1500	0.1625	0.1749	0.1874	0.1999
0.2124	0.2248	0.2346	0.2424	0.2501
0.2574	0.2648	0.2721	0.2794	0.2868
0.2941	0.3014	0.3087	0.3161	0.3234
0.3307	0.3381	0.3454	0.3527	0.3601
0.3674	0.3747	0.3820	0.3894	0.3967
0.4040	0.4114	0.4187	0.4260	0.4334
0.4407	0.4480	0.4553	0.4627	0.4700
0.4773	0.4847	0.5326	0.5852	0.6635
0.7507	0.8378	0.9012	0.9506	1.0000

Transect XS-100
Area:

0.0007	0.0030	0.0067	0.0118	0.0178
0.0246	0.0323	0.0407	0.0497	0.0592
0.0692	0.0796	0.0905	0.1019	0.1137
0.1260	0.1388	0.1521	0.1664	0.1842

0.2057 0.2289 0.2523 0.2759 0.2998
0.3238 0.3481 0.3726 0.3973 0.4222
0.4473 0.4726 0.4982 0.5240 0.5500
0.5763 0.6030 0.6301 0.6577 0.6857
0.7142 0.7431 0.7724 0.8021 0.8323
0.8629 0.8946 0.9280 0.9631 1.0000

Hrad:

0.0178 0.0355 0.0533 0.0747 0.0979
0.1197 0.1406 0.1624 0.1873 0.2114
0.2346 0.2572 0.2792 0.3006 0.3216
0.3422 0.3625 0.3825 0.4045 0.4198
0.4276 0.4373 0.4503 0.4654 0.4820
0.4997 0.5180 0.5368 0.5560 0.5754
0.5949 0.6145 0.6342 0.6538 0.6734
0.6996 0.7257 0.7510 0.7758 0.8000
0.8236 0.8468 0.8695 0.8917 0.9135
0.9349 0.9535 0.9706 0.9860 1.0000

Width:

0.0393 0.0786 0.1179 0.1481 0.1699
0.1916 0.2134 0.2325 0.2449 0.2574
0.2699 0.2824 0.2949 0.3074 0.3199
0.3324 0.3449 0.3574 0.4215 0.5213
0.6112 0.6169 0.6226 0.6283 0.6340
0.6397 0.6454 0.6511 0.6568 0.6626
0.6683 0.6740 0.6797 0.6854 0.6911
0.7021 0.7135 0.7249 0.7363 0.7477
0.7591 0.7705 0.7819 0.7933 0.8047
0.8161 0.8616 0.9077 0.9539 1.0000

Transect XS-100b

Area:

0.0074 0.0151 0.0233 0.0318 0.0406
0.0499 0.0595 0.0694 0.0798 0.0905
0.1017 0.1134 0.1256 0.1383 0.1514
0.1650 0.1791 0.1937 0.2087 0.2243
0.2403 0.2568 0.2737 0.2912 0.3091
0.3275 0.3464 0.3659 0.3863 0.4079
0.4306 0.4545 0.4795 0.5056 0.5329
0.5612 0.5898 0.6186 0.6476 0.6768
0.7063 0.7362 0.7666 0.7975 0.8288
0.8605 0.8927 0.9256 0.9612 1.0000

Hrad:

0.0298 0.0573 0.0830 0.1071 0.1300
0.1517 0.1724 0.1923 0.2115 0.2291
0.2458 0.2621 0.2782 0.2939 0.3095
0.3248 0.3400 0.3550 0.3698 0.3845
0.3991 0.4136 0.4279 0.4422 0.4564
0.4705 0.4845 0.5011 0.5206 0.5390
0.5566 0.5739 0.5910 0.6082 0.6254
0.6443 0.6652 0.6869 0.7091 0.7317
0.7596 0.7888 0.8176 0.8462 0.8745

0.9026 0.9305 0.9565 0.9792 1.0000

Width:

0.1871 0.1962 0.2054 0.2146 0.2237
0.2329 0.2421 0.2512 0.2605 0.2713
0.2832 0.2950 0.3069 0.3188 0.3306
0.3425 0.3543 0.3662 0.3781 0.3899
0.4018 0.4136 0.4255 0.4373 0.4492
0.4611 0.4729 0.4912 0.5194 0.5477
0.5759 0.6041 0.6324 0.6606 0.6889
0.7040 0.7092 0.7143 0.7195 0.7246
0.7345 0.7457 0.7569 0.7681 0.7793
0.7905 0.8017 0.8399 0.9199 1.0000

Transect XS-101a

Area:

0.0066 0.0135 0.0207 0.0282 0.0360
0.0442 0.0527 0.0614 0.0705 0.0800
0.0897 0.0997 0.1101 0.1207 0.1317
0.1430 0.1548 0.1671 0.1798 0.1931
0.2068 0.2210 0.2357 0.2509 0.2666
0.2828 0.2995 0.3167 0.3343 0.3525
0.3711 0.3934 0.4216 0.4520 0.4827
0.5136 0.5447 0.5761 0.6078 0.6401
0.6729 0.7062 0.7401 0.7745 0.8094
0.8448 0.8808 0.9184 0.9581 1.0000

Hrad:

0.0352 0.0677 0.0979 0.1262 0.1528
0.1781 0.2021 0.2252 0.2474 0.2688
0.2895 0.3096 0.3292 0.3483 0.3669
0.3837 0.3982 0.4127 0.4272 0.4419
0.4565 0.4713 0.4860 0.5008 0.5156
0.5305 0.5453 0.5602 0.5751 0.5901
0.6058 0.6224 0.6300 0.6392 0.6521
0.6675 0.6849 0.7050 0.7312 0.7574
0.7836 0.8097 0.8357 0.8617 0.8874
0.9131 0.9381 0.9600 0.9807 1.0000

Width:

0.1568 0.1641 0.1714 0.1787 0.1861
0.1934 0.2007 0.2080 0.2153 0.2227
0.2300 0.2373 0.2446 0.2520 0.2593
0.2682 0.2796 0.2910 0.3024 0.3138
0.3252 0.3367 0.3481 0.3595 0.3709
0.3823 0.3937 0.4051 0.4165 0.4279
0.4511 0.5874 0.7071 0.7118 0.7166
0.7214 0.7262 0.7325 0.7448 0.7571
0.7694 0.7817 0.7940 0.8064 0.8187
0.8310 0.8490 0.8993 0.9497 1.0000

Transect XS-101b

Area:

0.0062 0.0130 0.0204 0.0283 0.0367

0.0458 0.0554 0.0654 0.0758 0.0864
0.0972 0.1083 0.1197 0.1314 0.1433
0.1555 0.1679 0.1807 0.1936 0.2069
0.2204 0.2342 0.2483 0.2626 0.2772
0.2920 0.3073 0.3253 0.3469 0.3721
0.3996 0.4273 0.4552 0.4832 0.5114
0.5398 0.5685 0.5978 0.6275 0.6576
0.6882 0.7193 0.7509 0.7829 0.8156
0.8497 0.8851 0.9220 0.9603 1.0000

Hrad:

0.0315 0.0601 0.0864 0.1110 0.1343
0.1565 0.1777 0.2014 0.2256 0.2490
0.2715 0.2933 0.3146 0.3353 0.3555
0.3753 0.3946 0.4136 0.4322 0.4504
0.4684 0.4861 0.5035 0.5206 0.5376
0.5543 0.5720 0.5873 0.5964 0.6011
0.6077 0.6183 0.6317 0.6471 0.6640
0.6844 0.7090 0.7336 0.7581 0.7826
0.8070 0.8313 0.8554 0.8795 0.9021
0.9234 0.9437 0.9632 0.9820 1.0000

Width:

0.1612 0.1750 0.1889 0.2027 0.2166
0.2304 0.2443 0.2528 0.2591 0.2655
0.2720 0.2786 0.2852 0.2918 0.2984
0.3050 0.3116 0.3182 0.3248 0.3314
0.3380 0.3446 0.3512 0.3578 0.3644
0.3710 0.4013 0.4904 0.5796 0.6687
0.6843 0.6881 0.6920 0.6958 0.6997
0.7065 0.7179 0.7294 0.7409 0.7524
0.7638 0.7753 0.7868 0.7983 0.8262
0.8610 0.8957 0.9305 0.9652 1.0000

Transect XS-102b

Area:

0.0068 0.0139 0.0212 0.0288 0.0366
0.0446 0.0529 0.0616 0.0706 0.0800
0.0898 0.1000 0.1107 0.1218 0.1333
0.1453 0.1577 0.1705 0.1838 0.1975
0.2117 0.2263 0.2413 0.2568 0.2727
0.2890 0.3058 0.3231 0.3416 0.3613
0.3822 0.4043 0.4312 0.4600 0.4890
0.5182 0.5477 0.5779 0.6087 0.6402
0.6723 0.7050 0.7384 0.7724 0.8070
0.8422 0.8784 0.9167 0.9573 1.0000

Hrad:

0.0345 0.0669 0.0974 0.1264 0.1539
0.1803 0.2045 0.2272 0.2492 0.2706
0.2905 0.3095 0.3283 0.3468 0.3651
0.3832 0.4011 0.4188 0.4364 0.4539
0.4713 0.4885 0.5057 0.5227 0.5397
0.5566 0.5735 0.5770 0.5747 0.5745

0.5762 0.5792 0.5843 0.6049 0.6269
0.6497 0.6779 0.7060 0.7336 0.7609
0.7879 0.8146 0.8410 0.8671 0.8929
0.9186 0.9415 0.9622 0.9817 1.0000

Width:

0.1583 0.1639 0.1695 0.1751 0.1807
0.1863 0.1935 0.2019 0.2103 0.2187
0.2282 0.2381 0.2481 0.2581 0.2680
0.2780 0.2879 0.2979 0.3078 0.3178
0.3278 0.3377 0.3477 0.3576 0.3676
0.3776 0.3875 0.4081 0.4352 0.4622
0.4892 0.5384 0.6545 0.6588 0.6630
0.6673 0.6814 0.6958 0.7102 0.7246
0.7391 0.7535 0.7679 0.7823 0.7968
0.8112 0.8484 0.8989 0.9495 1.0000

Transect XS-103b

Area:

0.0073 0.0148 0.0224 0.0302 0.0381
0.0462 0.0544 0.0628 0.0713 0.0801
0.0894 0.0992 0.1095 0.1203 0.1316
0.1434 0.1557 0.1685 0.1818 0.1956
0.2099 0.2247 0.2400 0.2559 0.2722
0.2890 0.3064 0.3242 0.3425 0.3614
0.3811 0.4023 0.4248 0.4488 0.4744
0.5020 0.5315 0.5623 0.5938 0.6261
0.6591 0.6928 0.7272 0.7624 0.7983
0.8349 0.8730 0.9133 0.9556 1.0000

Hrad:

0.0352 0.0680 0.0989 0.1279 0.1554
0.1815 0.2063 0.2300 0.2527 0.2701
0.2861 0.3020 0.3179 0.3337 0.3496
0.3655 0.3814 0.3972 0.4131 0.4289
0.4448 0.4606 0.4765 0.4923 0.5082
0.5240 0.5398 0.5557 0.5715 0.5873
0.6098 0.6308 0.6499 0.6676 0.6894
0.7105 0.7299 0.7510 0.7727 0.7948
0.8172 0.8397 0.8624 0.8852 0.9080
0.9305 0.9489 0.9667 0.9837 1.0000

Width:

0.1628 0.1661 0.1694 0.1728 0.1761
0.1794 0.1827 0.1861 0.1894 0.1986
0.2097 0.2208 0.2319 0.2429 0.2540
0.2651 0.2762 0.2873 0.2983 0.3094
0.3205 0.3316 0.3426 0.3537 0.3648
0.3759 0.3870 0.3980 0.4091 0.4202
0.4495 0.4809 0.5123 0.5437 0.5845
0.6273 0.6699 0.6859 0.7019 0.7179
0.7338 0.7498 0.7658 0.7818 0.7978
0.8162 0.8622 0.9081 0.9541 1.0000

Transect XS-104b

Area:

0.0065	0.0134	0.0206	0.0281	0.0359
0.0441	0.0525	0.0613	0.0704	0.0799
0.0900	0.1012	0.1136	0.1271	0.1410
0.1554	0.1701	0.1852	0.2007	0.2166
0.2328	0.2495	0.2665	0.2840	0.3018
0.3200	0.3386	0.3576	0.3770	0.3968
0.4170	0.4375	0.4585	0.4800	0.5027
0.5265	0.5514	0.5776	0.6055	0.6348
0.6658	0.6982	0.7314	0.7653	0.8006
0.8375	0.8758	0.9157	0.9571	1.0000

Hrad:

0.0326	0.0630	0.0916	0.1187	0.1444
0.1690	0.1927	0.2155	0.2375	0.2588
0.2633	0.2682	0.2750	0.2906	0.3127
0.3344	0.3556	0.3764	0.3969	0.4170
0.4369	0.4565	0.4758	0.4949	0.5137
0.5323	0.5508	0.5691	0.5871	0.6051
0.6229	0.6405	0.6580	0.6807	0.7027
0.7233	0.7427	0.7667	0.7892	0.8102
0.8300	0.8499	0.8708	0.8914	0.9110
0.9299	0.9482	0.9659	0.9831	1.0000

Width:

0.1533	0.1607	0.1681	0.1755	0.1829
0.1903	0.1977	0.2051	0.2124	0.2198
0.2443	0.2707	0.2973	0.3146	0.3235
0.3324	0.3413	0.3502	0.3591	0.3681
0.3770	0.3859	0.3948	0.4037	0.4126
0.4215	0.4304	0.4394	0.4483	0.4572
0.4661	0.4750	0.4839	0.5066	0.5320
0.5574	0.5827	0.6185	0.6548	0.6910
0.7273	0.7518	0.7666	0.7909	0.8258
0.8606	0.8955	0.9303	0.9652	1.0000

Transect XS-105b

Area:

0.0070	0.0142	0.0217	0.0295	0.0376
0.0459	0.0545	0.0633	0.0725	0.0818
0.0916	0.1017	0.1122	0.1232	0.1347
0.1468	0.1594	0.1725	0.1862	0.2004
0.2152	0.2305	0.2463	0.2627	0.2796
0.2971	0.3151	0.3336	0.3527	0.3723
0.3930	0.4148	0.4377	0.4617	0.4868
0.5130	0.5405	0.5696	0.6002	0.6321
0.6648	0.6981	0.7320	0.7666	0.8018
0.8380	0.8759	0.9155	0.9569	1.0000

Hrad:

0.0332	0.0644	0.0939	0.1218	0.1484
0.1739	0.1984	0.2219	0.2447	0.2667
0.2853	0.3033	0.3210	0.3361	0.3510

0.3659	0.3808	0.3959	0.4109	0.4260
0.4411	0.4563	0.4715	0.4867	0.5019
0.5172	0.5325	0.5478	0.5631	0.5818
0.6043	0.6252	0.6449	0.6636	0.6814
0.6986	0.7220	0.7442	0.7653	0.7870
0.8098	0.8328	0.8559	0.8792	0.9025
0.9240	0.9443	0.9636	0.9821	1.0000

Width:

0.1618	0.1679	0.1740	0.1801	0.1861
0.1922	0.1983	0.2044	0.2105	0.2165
0.2255	0.2347	0.2439	0.2558	0.2681
0.2804	0.2926	0.3049	0.3172	0.3295
0.3418	0.3541	0.3664	0.3786	0.3909
0.4032	0.4155	0.4278	0.4401	0.4574
0.4827	0.5079	0.5331	0.5584	0.5836
0.6089	0.6433	0.6781	0.7129	0.7353
0.7500	0.7646	0.7792	0.7939	0.8085
0.8418	0.8813	0.9209	0.9604	1.0000

Transect XS-106b

Area:

0.0067	0.0138	0.0213	0.0291	0.0373
0.0459	0.0548	0.0641	0.0738	0.0839
0.0943	0.1051	0.1162	0.1277	0.1397
0.1522	0.1652	0.1787	0.1926	0.2071
0.2220	0.2374	0.2533	0.2697	0.2866
0.3040	0.3218	0.3402	0.3590	0.3784
0.3991	0.4216	0.4463	0.4731	0.5014
0.5302	0.5595	0.5893	0.6195	0.6503
0.6815	0.7132	0.7454	0.7781	0.8112
0.8456	0.8817	0.9194	0.9589	1.0000

Hrad:

0.0323	0.0622	0.0901	0.1164	0.1413
0.1650	0.1878	0.2096	0.2307	0.2512
0.2711	0.2904	0.3096	0.3272	0.3435
0.3596	0.3757	0.3917	0.4076	0.4234
0.4392	0.4549	0.4705	0.4862	0.5017
0.5173	0.5328	0.5482	0.5636	0.5802
0.6016	0.6256	0.6476	0.6673	0.6871
0.7081	0.7298	0.7520	0.7746	0.7974
0.8204	0.8435	0.8666	0.8898	0.9125
0.9311	0.9493	0.9668	0.9837	1.0000

Width:

0.1645	0.1733	0.1821	0.1909	0.1997
0.2085	0.2173	0.2261	0.2349	0.2437
0.2525	0.2613	0.2699	0.2799	0.2915
0.3032	0.3148	0.3265	0.3381	0.3498
0.3614	0.3731	0.3847	0.3964	0.4080
0.4196	0.4313	0.4429	0.4546	0.4710
0.5141	0.5629	0.6125	0.6621	0.6805
0.6920	0.7035	0.7150	0.7265	0.7380

0.7495 0.7609 0.7724 0.7839 0.7983
0.8387 0.8790 0.9193 0.9597 1.0000

Transect XS-107b
Area:
0.0073 0.0150 0.0229 0.0312 0.0397
0.0486 0.0577 0.0672 0.0770 0.0871
0.0974 0.1081 0.1191 0.1304 0.1421
0.1542 0.1667 0.1796 0.1930 0.2069
0.2212 0.2359 0.2511 0.2667 0.2828
0.2993 0.3163 0.3337 0.3516 0.3699
0.3889 0.4088 0.4297 0.4515 0.4743
0.4981 0.5236 0.5519 0.5828 0.6163
0.6507 0.6856 0.7211 0.7571 0.7937
0.8313 0.8708 0.9121 0.9551 1.0000
Hrad:
0.0366 0.0708 0.1028 0.1330 0.1617
0.1891 0.2153 0.2404 0.2647 0.2881
0.3108 0.3329 0.3544 0.3746 0.3935
0.4113 0.4285 0.4455 0.4625 0.4793
0.4961 0.5128 0.5295 0.5461 0.5627
0.5792 0.5956 0.6121 0.6285 0.6448
0.6488 0.6528 0.6578 0.6639 0.6709
0.6787 0.7028 0.7233 0.7409 0.7627
0.7865 0.8111 0.8364 0.8620 0.8880
0.9124 0.9358 0.9581 0.9794 1.0000
Width:
0.1636 0.1703 0.1769 0.1836 0.1902
0.1969 0.2035 0.2102 0.2168 0.2235
0.2302 0.2368 0.2435 0.2510 0.2593
0.2685 0.2782 0.2880 0.2977 0.3075
0.3172 0.3270 0.3368 0.3465 0.3563
0.3660 0.3758 0.3855 0.3953 0.4050
0.4249 0.4459 0.4668 0.4878 0.5087
0.5297 0.5875 0.6461 0.7047 0.7464
0.7580 0.7695 0.7811 0.7926 0.8041
0.8428 0.8821 0.9214 0.9607 1.0000

Transect XS-108b
Area:
0.0073 0.0150 0.0229 0.0310 0.0394
0.0481 0.0571 0.0664 0.0759 0.0856
0.0957 0.1060 0.1166 0.1276 0.1390
0.1509 0.1635 0.1766 0.1903 0.2046
0.2195 0.2350 0.2510 0.2677 0.2849
0.3027 0.3211 0.3400 0.3596 0.3797
0.4005 0.4218 0.4437 0.4661 0.4892
0.5129 0.5382 0.5653 0.5941 0.6246
0.6570 0.6911 0.7268 0.7629 0.7993
0.8354 0.8744 0.9135 0.9552 1.0000
Hrad:

0.0372 0.0718 0.1040 0.1343 0.1629
0.1900 0.2159 0.2406 0.2643 0.2872
0.3093 0.3304 0.3501 0.3693 0.3837
0.3976 0.4116 0.4259 0.4404 0.4551
0.4699 0.4849 0.4999 0.5151 0.5304
0.5458 0.5612 0.5768 0.5924 0.6080
0.6237 0.6395 0.6553 0.6712 0.6871
0.7065 0.7298 0.7508 0.7699 0.7875
0.8040 0.8196 0.8359 0.8544 0.8767
0.9038 0.9304 0.9563 0.9794 1.0000

Width:

0.1616 0.1674 0.1732 0.1791 0.1849
0.1907 0.1966 0.2024 0.2082 0.2141
0.2199 0.2260 0.2331 0.2402 0.2519
0.2645 0.2772 0.2898 0.3024 0.3150
0.3276 0.3402 0.3528 0.3655 0.3781
0.3907 0.4033 0.4159 0.4285 0.4412
0.4538 0.4664 0.4790 0.4916 0.5042
0.5265 0.5647 0.6029 0.6412 0.6794
0.7176 0.7558 0.7770 0.7818 0.7920
0.8114 0.8309 0.8673 0.9336 1.0000

Transect XS-109b

Area:

0.0076 0.0153 0.0231 0.0311 0.0393
0.0478 0.0568 0.0663 0.0763 0.0869
0.0979 0.1095 0.1215 0.1341 0.1472
0.1608 0.1749 0.1895 0.2047 0.2203
0.2365 0.2531 0.2703 0.2880 0.3062
0.3249 0.3441 0.3638 0.3841 0.4048
0.4261 0.4478 0.4701 0.4929 0.5162
0.5400 0.5647 0.5913 0.6199 0.6506
0.6831 0.7160 0.7492 0.7826 0.8165
0.8508 0.8856 0.9209 0.9587 1.0000

Hrad:

0.0357 0.0687 0.0995 0.1284 0.1542
0.1773 0.1984 0.2190 0.2389 0.2584
0.2776 0.2963 0.3148 0.3331 0.3511
0.3689 0.3865 0.4039 0.4212 0.4384
0.4555 0.4724 0.4893 0.5061 0.5228
0.5394 0.5559 0.5724 0.5888 0.6052
0.6215 0.6378 0.6540 0.6702 0.6864
0.7025 0.7230 0.7435 0.7617 0.7779
0.7936 0.8109 0.8291 0.8519 0.8786
0.9052 0.9317 0.9578 0.9806 1.0000

Width:

0.1771 0.1804 0.1838 0.1871 0.1936
0.2030 0.2149 0.2267 0.2386 0.2504
0.2623 0.2741 0.2860 0.2979 0.3097
0.3216 0.3334 0.3453 0.3571 0.3690
0.3808 0.3927 0.4045 0.4164 0.4282

0.4401	0.4519	0.4638	0.4756	0.4875
0.4994	0.5112	0.5231	0.5349	0.5468
0.5586	0.5932	0.6409	0.6885	0.7361
0.7617	0.7673	0.7728	0.7839	0.7916
0.8022	0.8128	0.8353	0.9176	1.0000

Transect XS-110b
Area:

0.0076	0.0155	0.0239	0.0326	0.0418
0.0513	0.0612	0.0715	0.0822	0.0933
0.1047	0.1166	0.1290	0.1419	0.1552
0.1691	0.1834	0.1981	0.2134	0.2291
0.2453	0.2620	0.2792	0.2968	0.3149
0.3335	0.3526	0.3721	0.3922	0.4127
0.4337	0.4551	0.4771	0.4995	0.5230
0.5483	0.5752	0.6037	0.6339	0.6649
0.6961	0.7275	0.7591	0.7911	0.8232
0.8556	0.8883	0.9231	0.9603	1.0000

Hrad:

0.0320	0.0615	0.0891	0.1151	0.1397
0.1630	0.1854	0.2069	0.2276	0.2478
0.2671	0.2848	0.3022	0.3193	0.3361
0.3527	0.3692	0.3854	0.4014	0.4173
0.4331	0.4488	0.4643	0.4797	0.4951
0.5103	0.5255	0.5406	0.5556	0.5706
0.5855	0.6003	0.6151	0.6304	0.6506
0.6691	0.6865	0.7031	0.7197	0.7387
0.7589	0.7801	0.8047	0.8344	0.8643
0.8942	0.9237	0.9510	0.9763	1.0000

Width:

0.1897	0.1993	0.2088	0.2184	0.2279
0.2375	0.2470	0.2566	0.2661	0.2754
0.2852	0.2968	0.3085	0.3202	0.3319
0.3435	0.3552	0.3669	0.3785	0.3902
0.4019	0.4135	0.4252	0.4369	0.4486
0.4602	0.4719	0.4836	0.4952	0.5069
0.5186	0.5302	0.5419	0.5557	0.5963
0.6369	0.6775	0.7181	0.7531	0.7590
0.7649	0.7708	0.7767	0.7825	0.7884
0.7942	0.8190	0.8793	0.9397	1.0000

Transect XS-112b
Area:

0.0078	0.0156	0.0237	0.0318	0.0401
0.0485	0.0571	0.0658	0.0747	0.0836
0.0927	0.1020	0.1119	0.1223	0.1334
0.1452	0.1576	0.1706	0.1843	0.1986
0.2136	0.2292	0.2455	0.2624	0.2799
0.2981	0.3170	0.3365	0.3566	0.3774
0.3988	0.4209	0.4436	0.4670	0.4910
0.5156	0.5409	0.5669	0.5935	0.6209

0.6499 0.6805 0.7128 0.7473 0.7840
0.8229 0.8632 0.9057 0.9513 1.0000

Hrad:

0.0386 0.0741 0.1068 0.1372 0.1655
0.1920 0.2169 0.2404 0.2627 0.2838
0.3040 0.3201 0.3316 0.3436 0.3561
0.3691 0.3825 0.3963 0.4103 0.4246
0.4391 0.4539 0.4688 0.4839 0.4991
0.5145 0.5299 0.5455 0.5612 0.5770
0.5929 0.6088 0.6249 0.6410 0.6571
0.6733 0.6896 0.7059 0.7223 0.7436
0.7664 0.7880 0.8113 0.8389 0.8654
0.8918 0.9205 0.9477 0.9741 1.0000

Width:

0.1557 0.1584 0.1611 0.1638 0.1665
0.1692 0.1719 0.1746 0.1773 0.1800
0.1827 0.1889 0.2018 0.2146 0.2275
0.2403 0.2532 0.2660 0.2789 0.2917
0.3045 0.3174 0.3302 0.3431 0.3559
0.3688 0.3816 0.3945 0.4073 0.4201
0.4330 0.4458 0.4587 0.4715 0.4844
0.4972 0.5101 0.5229 0.5358 0.5609
0.5936 0.6263 0.6628 0.7080 0.7532
0.7929 0.8155 0.8770 0.9385 1.0000

Transect XS-113b

Area:

0.0067 0.0138 0.0214 0.0295 0.0379
0.0469 0.0562 0.0660 0.0763 0.0870
0.0981 0.1099 0.1221 0.1348 0.1481
0.1619 0.1762 0.1910 0.2063 0.2221
0.2385 0.2554 0.2727 0.2906 0.3091
0.3280 0.3475 0.3674 0.3879 0.4089
0.4304 0.4525 0.4750 0.4981 0.5217
0.5458 0.5704 0.5956 0.6223 0.6505
0.6803 0.7117 0.7447 0.7788 0.8131
0.8477 0.8830 0.9201 0.9591 1.0000

Hrad:

0.0333 0.0639 0.0923 0.1190 0.1441
0.1681 0.1910 0.2133 0.2348 0.2547
0.2735 0.2920 0.3101 0.3280 0.3456
0.3630 0.3802 0.3972 0.4141 0.4308
0.4474 0.4639 0.4803 0.4966 0.5129
0.5290 0.5451 0.5611 0.5770 0.5929
0.6087 0.6245 0.6402 0.6559 0.6716
0.6872 0.7028 0.7222 0.7448 0.7659
0.7859 0.8053 0.8238 0.8437 0.8652
0.8878 0.9162 0.9452 0.9730 1.0000

Width:

0.1653 0.1759 0.1866 0.1972 0.2079
0.2185 0.2292 0.2394 0.2497 0.2613

0.2736 0.2859 0.2983 0.3106 0.3230
0.3353 0.3476 0.3600 0.3723 0.3846
0.3970 0.4093 0.4216 0.4340 0.4463
0.4586 0.4710 0.4833 0.4956 0.5080
0.5203 0.5326 0.5450 0.5573 0.5696
0.5820 0.5943 0.6180 0.6557 0.6934
0.7311 0.7688 0.8071 0.8178 0.8234
0.8290 0.8638 0.9092 0.9546 1.0000

Transect XS-114b
Area:
0.0085 0.0174 0.0267 0.0365 0.0468
0.0575 0.0686 0.0801 0.0920 0.1043
0.1169 0.1300 0.1434 0.1572 0.1714
0.1859 0.2008 0.2161 0.2318 0.2479
0.2643 0.2811 0.2983 0.3159 0.3338
0.3522 0.3709 0.3900 0.4094 0.4293
0.4495 0.4701 0.4911 0.5127 0.5357
0.5600 0.5855 0.6124 0.6406 0.6700
0.7006 0.7315 0.7626 0.7940 0.8257
0.8579 0.8914 0.9262 0.9624 1.0000
Hrad:
0.0308 0.0594 0.0862 0.1115 0.1355
0.1583 0.1806 0.2023 0.2233 0.2436
0.2633 0.2824 0.3011 0.3192 0.3370
0.3544 0.3715 0.3883 0.4047 0.4210
0.4370 0.4527 0.4683 0.4837 0.4989
0.5139 0.5288 0.5436 0.5582 0.5727
0.5871 0.6014 0.6155 0.6335 0.6510
0.6679 0.6844 0.7008 0.7175 0.7346
0.7540 0.7757 0.7984 0.8219 0.8499
0.8814 0.9120 0.9418 0.9711 1.0000
Width:
0.2269 0.2385 0.2501 0.2617 0.2733
0.2853 0.2960 0.3058 0.3157 0.3256
0.3355 0.3454 0.3552 0.3651 0.3750
0.3849 0.3948 0.4046 0.4145 0.4244
0.4343 0.4442 0.4540 0.4639 0.4738
0.4837 0.4936 0.5034 0.5133 0.5232
0.5331 0.5429 0.5528 0.5827 0.6167
0.6507 0.6848 0.7188 0.7528 0.7869
0.8038 0.8100 0.8163 0.8225 0.8335
0.8556 0.8917 0.9278 0.9639 1.0000

Transect XS-20
Area:
0.0058 0.0122 0.0190 0.0263 0.0339
0.0418 0.0500 0.0585 0.0673 0.0764
0.0857 0.0954 0.1054 0.1156 0.1261
0.1370 0.1481 0.1595 0.1712 0.1832
0.1955 0.2081 0.2209 0.2341 0.2475

0.2613 0.2753 0.2896 0.3043 0.3192
0.3344 0.3499 0.3657 0.3817 0.3981
0.4148 0.4317 0.4490 0.4665 0.4843
0.5024 0.5226 0.5492 0.5835 0.6258
0.6783 0.7413 0.8181 0.9064 1.0000

Hrad:

0.0492 0.0941 0.1355 0.1757 0.2161
0.2546 0.2915 0.3269 0.3612 0.3943
0.4264 0.4577 0.4882 0.5180 0.5471
0.5757 0.6037 0.6313 0.6584 0.6851
0.7115 0.7375 0.7632 0.7885 0.8137
0.8385 0.8632 0.8876 0.9118 0.9358
0.9597 0.9833 1.0068 1.0302 1.0534
1.0765 1.0995 1.1224 1.1451 1.1678
1.1903 1.2192 1.2369 1.2348 1.2170
1.1838 1.1411 1.0857 1.0374 1.0000

Width:

0.0631 0.0683 0.0734 0.0776 0.0806
0.0836 0.0867 0.0897 0.0927 0.0958
0.0988 0.1018 0.1048 0.1079 0.1109
0.1139 0.1170 0.1200 0.1230 0.1260
0.1291 0.1321 0.1351 0.1382 0.1412
0.1442 0.1472 0.1503 0.1533 0.1563
0.1594 0.1624 0.1654 0.1684 0.1715
0.1745 0.1775 0.1805 0.1836 0.1866
0.1896 0.2392 0.3157 0.3967 0.4900
0.5995 0.7071 0.8883 0.9442 1.0000

Transect XS-35

Area:

0.0069 0.0141 0.0216 0.0295 0.0377
0.0463 0.0552 0.0644 0.0740 0.0840
0.0943 0.1050 0.1161 0.1276 0.1395
0.1517 0.1643 0.1773 0.1906 0.2043
0.2184 0.2329 0.2477 0.2630 0.2786
0.2945 0.3109 0.3276 0.3447 0.3622
0.3800 0.3982 0.4168 0.4358 0.4551
0.4749 0.4949 0.5154 0.5363 0.5575
0.5791 0.6010 0.6239 0.6487 0.6758
0.7060 0.7480 0.8121 0.8984 1.0000

Hrad:

0.1064 0.2052 0.2975 0.3845 0.4669
0.5453 0.6204 0.6910 0.7588 0.8245
0.8884 0.9507 1.0115 1.0711 1.1296
1.1870 1.2435 1.2992 1.3541 1.4083
1.4619 1.5149 1.5674 1.6194 1.6709
1.7221 1.7728 1.8232 1.8732 1.9230
1.9725 2.0216 2.0706 2.1193 2.1678
2.2161 2.2641 2.3120 2.3597 2.4073
2.4547 2.5020 1.7448 1.6962 1.6208
1.5616 1.4920 1.2022 0.9961 1.0000

Width:

0.0593	0.0621	0.0649	0.0677	0.0705
0.0733	0.0761	0.0791	0.0823	0.0854
0.0886	0.0917	0.0949	0.0981	0.1012
0.1044	0.1075	0.1107	0.1138	0.1170
0.1201	0.1233	0.1264	0.1296	0.1327
0.1359	0.1390	0.1422	0.1453	0.1485
0.1516	0.1548	0.1579	0.1611	0.1642
0.1674	0.1705	0.1737	0.1768	0.1800
0.1831	0.1863	0.2003	0.2164	0.2393
0.2872	0.4300	0.6531	0.7773	1.0000

Transect XS-40

Area:

0.0070	0.0144	0.0225	0.0310	0.0401
0.0498	0.0599	0.0704	0.0813	0.0925
0.1041	0.1160	0.1284	0.1410	0.1541
0.1674	0.1812	0.1953	0.2098	0.2246
0.2398	0.2553	0.2712	0.2874	0.3040
0.3210	0.3383	0.3560	0.3741	0.3925
0.4112	0.4303	0.4498	0.4696	0.4898
0.5104	0.5313	0.5525	0.5742	0.5962
0.6185	0.6412	0.6642	0.6878	0.7153
0.7497	0.7917	0.8415	0.9066	1.0000

Hrad:

0.1517	0.2907	0.4198	0.5410	0.6558
0.5476	0.6281	0.7066	0.7840	0.8589
0.9316	1.0023	1.0712	1.1385	1.2044
1.2689	1.3322	1.3944	1.4556	1.5159
1.5753	1.6339	1.6918	1.7490	1.8056
1.8616	1.9171	1.9721	2.0266	2.0806
2.1343	2.1876	2.2405	2.2930	2.3452
2.3972	2.4488	2.5002	2.5513	2.6021
2.6528	2.7032	2.7534	2.6979	2.3217
2.0038	1.7984	1.6605	1.4325	1.0000

Width:

0.0660	0.0709	0.0758	0.0807	0.0856
0.0905	0.0943	0.0979	0.1012	0.1044
0.1077	0.1110	0.1143	0.1175	0.1208
0.1241	0.1274	0.1306	0.1339	0.1372
0.1405	0.1437	0.1470	0.1503	0.1536
0.1568	0.1601	0.1634	0.1667	0.1699
0.1732	0.1765	0.1798	0.1830	0.1863
0.1896	0.1929	0.1961	0.1994	0.2027
0.2060	0.2092	0.2125	0.2259	0.2809
0.3497	0.4184	0.5067	0.6928	1.0000

Transect XS-45

Area:

0.0067	0.0138	0.0214	0.0294	0.0378
0.0467	0.0561	0.0659	0.0761	0.0867

0.0977 0.1091 0.1208 0.1329 0.1453
0.1581 0.1712 0.1847 0.1986 0.2128
0.2274 0.2423 0.2576 0.2733 0.2893
0.3056 0.3223 0.3394 0.3569 0.3747
0.3928 0.4113 0.4302 0.4494 0.4690
0.4890 0.5093 0.5299 0.5509 0.5723
0.5940 0.6161 0.6386 0.6621 0.6916
0.7280 0.7734 0.8283 0.9039 1.0000

Hrad:

0.1309 0.2517 0.3643 0.4702 0.5706
0.6664 0.7584 0.8467 0.6674 0.7314
0.7935 0.8541 0.9131 0.9708 1.0273
1.0827 1.1372 1.1907 1.2434 1.2954
1.3466 1.3972 1.4473 1.4968 1.5458
1.5943 1.6424 1.6900 1.7373 1.7843
1.8309 1.8772 1.9232 1.9689 2.0144
2.0596 2.1046 2.1494 2.1940 2.2384
2.2826 2.3266 2.3704 2.1657 1.8438
1.6041 1.4012 1.2744 0.9843 1.0000

Width:

0.0674 0.0717 0.0761 0.0804 0.0848
0.0891 0.0934 0.0978 0.1022 0.1057
0.1092 0.1127 0.1162 0.1197 0.1231
0.1266 0.1301 0.1336 0.1371 0.1406
0.1441 0.1476 0.1511 0.1546 0.1581
0.1616 0.1651 0.1686 0.1721 0.1756
0.1791 0.1826 0.1861 0.1896 0.1931
0.1965 0.2000 0.2035 0.2070 0.2105
0.2140 0.2175 0.2210 0.2551 0.3210
0.3960 0.4897 0.5834 0.8775 1.0000

Transect XS-50

Area:

0.0056 0.0117 0.0182 0.0252 0.0327
0.0406 0.0490 0.0577 0.0667 0.0761
0.0857 0.0957 0.1060 0.1167 0.1277
0.1390 0.1507 0.1627 0.1750 0.1877
0.2007 0.2141 0.2278 0.2418 0.2562
0.2709 0.2859 0.3013 0.3170 0.3331
0.3495 0.3662 0.3833 0.4007 0.4184
0.4365 0.4549 0.4736 0.4937 0.5164
0.5417 0.5704 0.6028 0.6387 0.6782
0.7222 0.7801 0.8456 0.9145 1.0000

Hrad:

0.0449 0.0859 0.1237 0.1592 0.1927
0.2247 0.2580 0.2911 0.3231 0.3538
0.3831 0.4117 0.4396 0.4668 0.4936
0.5198 0.5456 0.5711 0.5961 0.6208
0.6452 0.6694 0.6932 0.7169 0.7403
0.7635 0.7865 0.8094 0.8321 0.8546
0.8770 0.8993 0.9214 0.9434 0.9653

0.9871 1.0089 1.0305 1.0585 1.0804
1.1005 1.1181 1.1290 1.1345 1.1359
1.1308 1.1032 1.0774 1.0473 1.0000

Width:

0.0610 0.0660 0.0709 0.0758 0.0807
0.0856 0.0894 0.0926 0.0958 0.0992
0.1027 0.1062 0.1097 0.1133 0.1168
0.1203 0.1239 0.1274 0.1309 0.1344
0.1380 0.1415 0.1450 0.1486 0.1521
0.1556 0.1591 0.1627 0.1662 0.1697
0.1733 0.1768 0.1803 0.1838 0.1874
0.1909 0.1944 0.1980 0.2234 0.2504
0.2821 0.3196 0.3570 0.3945 0.4319
0.5201 0.6720 0.6974 0.7882 1.0000

Transect XS-55

Area:

0.0057 0.0119 0.0186 0.0257 0.0333
0.0415 0.0501 0.0591 0.0685 0.0781
0.0880 0.0982 0.1086 0.1194 0.1304
0.1417 0.1533 0.1651 0.1773 0.1897
0.2024 0.2154 0.2287 0.2422 0.2561
0.2702 0.2846 0.2992 0.3142 0.3294
0.3450 0.3608 0.3769 0.3932 0.4099
0.4268 0.4440 0.4615 0.4793 0.4973
0.5157 0.5343 0.5532 0.5725 0.6020
0.6634 0.7409 0.8214 0.9057 1.0000

Hrad:

0.0479 0.0916 0.1321 0.1700 0.2059
0.2401 0.2729 0.3069 0.3435 0.3784
0.4118 0.4443 0.4759 0.5068 0.5370
0.5665 0.5955 0.6239 0.6519 0.6793
0.7064 0.7331 0.7595 0.7855 0.8112
0.8366 0.8617 0.8866 0.9113 0.9357
0.9600 0.9840 1.0079 1.0316 1.0551
1.0784 1.1017 1.1247 1.1477 1.1705
1.1932 1.2158 1.2383 1.2618 1.2727
1.2043 1.1280 1.0759 1.0366 1.0000

Width:

0.0598 0.0647 0.0696 0.0744 0.0793
0.0842 0.0890 0.0930 0.0955 0.0981
0.1010 0.1038 0.1066 0.1095 0.1123
0.1151 0.1180 0.1208 0.1236 0.1265
0.1293 0.1321 0.1350 0.1378 0.1406
0.1435 0.1463 0.1491 0.1520 0.1548
0.1576 0.1605 0.1633 0.1661 0.1690
0.1718 0.1747 0.1775 0.1803 0.1832
0.1860 0.1888 0.1917 0.2099 0.4714
0.7168 0.8028 0.8161 0.8974 1.0000

Transect XS-60

Area:

0.0064	0.0134	0.0208	0.0288	0.0372
0.0461	0.0556	0.0655	0.0759	0.0866
0.0976	0.1090	0.1207	0.1328	0.1452
0.1580	0.1711	0.1846	0.1984	0.2126
0.2271	0.2420	0.2573	0.2728	0.2888
0.3050	0.3217	0.3386	0.3560	0.3737
0.3917	0.4101	0.4288	0.4479	0.4673
0.4871	0.5072	0.5277	0.5485	0.5697
0.5912	0.6131	0.6354	0.6589	0.6868
0.7228	0.7699	0.8300	0.9059	1.0000

Hrad:

0.0418	0.0801	0.1156	0.1489	0.1805
0.2106	0.2395	0.2674	0.2977	0.3274
0.3563	0.3838	0.4107	0.4370	0.4627
0.4880	0.5127	0.5371	0.5611	0.5847
0.6080	0.6310	0.6538	0.6763	0.6985
0.7205	0.7424	0.7640	0.7855	0.8068
0.8279	0.8489	0.8698	0.8905	0.9111
0.9316	0.9520	0.9723	0.9924	1.0125
1.0325	1.0525	1.0757	1.1023	1.1275
1.1364	1.1257	1.0978	1.0535	1.0000

Width:

0.0664	0.0714	0.0764	0.0813	0.0863
0.0913	0.0963	0.1012	0.1047	0.1079
0.1112	0.1147	0.1181	0.1216	0.1251
0.1286	0.1321	0.1355	0.1390	0.1425
0.1460	0.1495	0.1529	0.1564	0.1599
0.1634	0.1668	0.1703	0.1738	0.1773
0.1808	0.1842	0.1877	0.1912	0.1947
0.1981	0.2016	0.2051	0.2086	0.2121
0.2155	0.2190	0.2263	0.2398	0.3161
0.4075	0.5286	0.6731	0.8459	1.0000

Transect XS-65

Area:

0.0060	0.0124	0.0193	0.0267	0.0346
0.0429	0.0516	0.0609	0.0705	0.0805
0.0908	0.1014	0.1123	0.1235	0.1350
0.1468	0.1590	0.1714	0.1841	0.1972
0.2105	0.2242	0.2382	0.2524	0.2670
0.2819	0.2971	0.3126	0.3284	0.3445
0.3610	0.3777	0.3947	0.4121	0.4297
0.4477	0.4659	0.4845	0.5034	0.5226
0.5421	0.5619	0.5837	0.6137	0.6521
0.6970	0.7480	0.8116	0.8938	1.0000

Hrad:

0.0479	0.0919	0.1328	0.1713	0.2077
0.2425	0.2760	0.3082	0.3425	0.3769
0.4103	0.4428	0.4745	0.5055	0.5358
0.5654	0.5946	0.6232	0.6513	0.6790

0.7063 0.7333 0.7599 0.7862 0.8122
0.8379 0.8634 0.8886 0.9136 0.9384
0.9630 0.9874 1.0116 1.0357 1.0596
1.0834 1.1070 1.1306 1.1539 1.1772
1.2003 1.2234 1.2411 1.2371 1.2179
1.1991 1.1750 1.1296 1.0698 1.0000

Width:

0.0534 0.0574 0.0614 0.0654 0.0694
0.0735 0.0775 0.0815 0.0845 0.0871
0.0898 0.0924 0.0951 0.0977 0.1003
0.1030 0.1056 0.1082 0.1109 0.1135
0.1162 0.1188 0.1214 0.1241 0.1267
0.1294 0.1320 0.1346 0.1373 0.1399
0.1426 0.1452 0.1478 0.1505 0.1531
0.1557 0.1584 0.1610 0.1637 0.1663
0.1689 0.1716 0.2204 0.2958 0.3589
0.4123 0.4656 0.6205 0.8042 1.0000

Transect XS-70

Area:

0.0040 0.0084 0.0132 0.0183 0.0239
0.0298 0.0361 0.0428 0.0498 0.0572
0.0648 0.0726 0.0808 0.0891 0.0978
0.1067 0.1158 0.1252 0.1349 0.1448
0.1549 0.1654 0.1760 0.1870 0.1982
0.2096 0.2214 0.2333 0.2455 0.2580
0.2708 0.2838 0.2970 0.3105 0.3245
0.3400 0.3590 0.3817 0.4082 0.4388
0.4796 0.5281 0.5794 0.6335 0.6903
0.7489 0.8091 0.8711 0.9347 1.0000

Hrad:

0.0495 0.0942 0.1353 0.1737 0.2099
0.2444 0.2775 0.3095 0.3421 0.3765
0.4099 0.4424 0.4741 0.5051 0.5353
0.5650 0.5941 0.6227 0.6509 0.6786
0.7059 0.7329 0.7596 0.7860 0.8121
0.8379 0.8636 0.8889 0.9141 0.9391
0.9639 0.9886 1.0131 1.0374 1.0686
1.1022 1.1259 1.1369 1.1379 1.1289
1.0925 1.0566 1.0295 1.0092 0.9958
0.9891 0.9871 0.9887 0.9932 1.0000

Width:

0.0635 0.0693 0.0751 0.0809 0.0866
0.0924 0.0982 0.1040 0.1090 0.1130
0.1169 0.1207 0.1246 0.1285 0.1324
0.1363 0.1402 0.1440 0.1479 0.1518
0.1557 0.1596 0.1635 0.1673 0.1712
0.1751 0.1790 0.1829 0.1868 0.1906
0.1945 0.1984 0.2023 0.2062 0.2194
0.2587 0.3155 0.3723 0.4291 0.5123
0.7121 0.7544 0.7967 0.8391 0.8727

0.8982 0.9236 0.9491 0.9745 1.0000

Transect XS-75
Area:

0.0042 0.0089 0.0141 0.0198 0.0261
0.0328 0.0400 0.0475 0.0553 0.0634
0.0718 0.0805 0.0894 0.0987 0.1082
0.1180 0.1280 0.1384 0.1490 0.1599
0.1711 0.1825 0.1943 0.2063 0.2186
0.2312 0.2440 0.2572 0.2706 0.2843
0.2983 0.3125 0.3271 0.3419 0.3570
0.3726 0.3896 0.4096 0.4338 0.4672
0.5100 0.5558 0.6045 0.6561 0.7095
0.7645 0.8211 0.8792 0.9388 1.0000

Hrad:

0.0453 0.0856 0.1224 0.1566 0.1889
0.2196 0.2528 0.2860 0.3191 0.3514
0.3828 0.4133 0.4430 0.4720 0.5004
0.5283 0.5556 0.5825 0.6089 0.6350
0.6607 0.6861 0.7111 0.7359 0.7604
0.7847 0.8088 0.8327 0.8563 0.8798
0.9032 0.9263 0.9493 0.9722 0.9950
1.0234 1.0517 1.0782 1.0914 1.0776
1.0483 1.0256 1.0076 0.9941 0.9867
0.9836 0.9841 0.9872 0.9927 1.0000

Width:

0.0719 0.0801 0.0882 0.0964 0.1045
0.1126 0.1186 0.1239 0.1286 0.1331
0.1376 0.1421 0.1466 0.1511 0.1557
0.1602 0.1647 0.1692 0.1737 0.1782
0.1827 0.1872 0.1917 0.1962 0.2007
0.2052 0.2098 0.2143 0.2188 0.2233
0.2278 0.2323 0.2368 0.2413 0.2458
0.2624 0.2893 0.3565 0.4407 0.6360
0.7171 0.7631 0.8091 0.8499 0.8749
0.8999 0.9249 0.9500 0.9750 1.0000

Transect XS-80
Area:

0.0049 0.0105 0.0169 0.0240 0.0319
0.0406 0.0499 0.0598 0.0700 0.0804
0.0911 0.1020 0.1132 0.1245 0.1361
0.1480 0.1601 0.1724 0.1849 0.1977
0.2107 0.2239 0.2374 0.2511 0.2650
0.2792 0.2936 0.3082 0.3231 0.3382
0.3535 0.3691 0.3849 0.4009 0.4171
0.4336 0.4504 0.4674 0.4872 0.5103
0.5370 0.5680 0.6079 0.6570 0.7087
0.7624 0.8180 0.8757 0.9354 1.0000

Hrad:

0.0413 0.0774 0.1102 0.1406 0.1693

0.1969 0.2259 0.2589 0.2922 0.3262
0.3591 0.3912 0.4225 0.4529 0.4827
0.5118 0.5403 0.5682 0.5956 0.6225
0.6489 0.6750 0.7006 0.7258 0.7507
0.7752 0.7994 0.8233 0.8470 0.8703
0.8934 0.9163 0.9390 0.9614 0.9837
1.0057 1.0276 1.0536 1.0835 1.1039
1.1164 1.1194 1.1026 1.0753 1.0552
1.0404 1.0299 1.0229 1.0187 1.0000

Width:

0.0731 0.0836 0.0941 0.1046 0.1151
0.1256 0.1344 0.1396 0.1438 0.1471
0.1503 0.1535 0.1568 0.1600 0.1633
0.1665 0.1697 0.1730 0.1762 0.1794
0.1827 0.1859 0.1891 0.1924 0.1956
0.1988 0.2021 0.2053 0.2085 0.2118
0.2150 0.2182 0.2215 0.2247 0.2279
0.2312 0.2344 0.2507 0.2936 0.3466
0.3945 0.4802 0.6338 0.7053 0.7332
0.7612 0.7892 0.8171 0.8451 1.0000

Transect XS-85

Area:

0.0060 0.0125 0.0196 0.0273 0.0356
0.0444 0.0537 0.0636 0.0741 0.0852
0.0968 0.1088 0.1211 0.1338 0.1468
0.1601 0.1737 0.1877 0.2020 0.2166
0.2316 0.2469 0.2625 0.2784 0.2946
0.3112 0.3281 0.3454 0.3629 0.3808
0.3990 0.4176 0.4364 0.4556 0.4751
0.4950 0.5151 0.5356 0.5565 0.5776
0.5991 0.6209 0.6432 0.6682 0.6965
0.7308 0.7823 0.8443 0.9131 1.0000

Hrad:

0.0408 0.0778 0.1119 0.1439 0.1740
0.2028 0.2304 0.2571 0.2829 0.3082
0.3338 0.3630 0.3914 0.4192 0.4462
0.4727 0.4987 0.5241 0.5491 0.5737
0.5978 0.6216 0.6451 0.6683 0.6911
0.7137 0.7360 0.7581 0.7800 0.8017
0.8231 0.8444 0.8655 0.8865 0.9072
0.9279 0.9484 0.9687 0.9890 1.0091
1.0291 1.0490 1.0712 1.0929 1.1081
1.1149 1.0964 1.0707 1.0448 1.0000

Width:

0.0596 0.0649 0.0703 0.0756 0.0809
0.0863 0.0916 0.0970 0.1023 0.1076
0.1126 0.1157 0.1188 0.1219 0.1250
0.1281 0.1312 0.1343 0.1374 0.1405
0.1436 0.1467 0.1498 0.1529 0.1560
0.1591 0.1622 0.1653 0.1684 0.1715

0.1746	0.1777	0.1808	0.1839	0.1870
0.1901	0.1932	0.1963	0.1994	0.2025
0.2056	0.2087	0.2220	0.2533	0.2846
0.3996	0.5568	0.6213	0.6858	1.0000

Transect XS-90

Area:

0.0045	0.0095	0.0150	0.0210	0.0274
0.0344	0.0419	0.0498	0.0581	0.0667
0.0754	0.0845	0.0938	0.1034	0.1132
0.1232	0.1336	0.1441	0.1550	0.1660
0.1774	0.1889	0.2008	0.2129	0.2252
0.2378	0.2507	0.2638	0.2771	0.2908
0.3046	0.3187	0.3331	0.3477	0.3626
0.3778	0.3931	0.4088	0.4247	0.4422
0.4664	0.4987	0.5395	0.5881	0.6422
0.7053	0.7759	0.8486	0.9233	1.0000

Hrad:

0.0487	0.0925	0.1326	0.1700	0.2053
0.2390	0.2714	0.3039	0.3415	0.3778
0.4131	0.4473	0.4807	0.5133	0.5451
0.5763	0.6068	0.6368	0.6662	0.6952
0.7237	0.7519	0.7796	0.8070	0.8341
0.8608	0.8873	0.9135	0.9395	0.9652
0.9907	1.0160	1.0411	1.0660	1.0908
1.1154	1.1398	1.1641	1.1882	1.2129
1.2238	1.2153	1.1890	1.1539	1.1212
1.0824	1.0465	1.0234	1.0086	1.0000

Width:

0.0611	0.0674	0.0738	0.0801	0.0865
0.0929	0.0992	0.1051	0.1083	0.1116
0.1148	0.1181	0.1214	0.1246	0.1279
0.1312	0.1344	0.1377	0.1409	0.1442
0.1475	0.1507	0.1540	0.1572	0.1605
0.1638	0.1670	0.1703	0.1736	0.1768
0.1801	0.1833	0.1866	0.1899	0.1931
0.1964	0.1996	0.2029	0.2062	0.2639
0.3631	0.4703	0.5775	0.6614	0.7467
0.8788	0.9227	0.9485	0.9742	1.0000

Transect XS-95

Area:

0.0065	0.0135	0.0211	0.0291	0.0376
0.0467	0.0563	0.0663	0.0769	0.0880
0.0995	0.1114	0.1236	0.1362	0.1491
0.1623	0.1759	0.1898	0.2041	0.2187
0.2336	0.2489	0.2645	0.2805	0.2968
0.3135	0.3305	0.3478	0.3655	0.3835
0.4018	0.4205	0.4396	0.4590	0.4787
0.4987	0.5191	0.5399	0.5610	0.5824
0.6042	0.6263	0.6487	0.6734	0.7037

0.7401 0.7848 0.8400 0.9137 1.0000

Hrad:

0.0415 0.0795 0.1148 0.1478 0.1790
0.2088 0.2373 0.2649 0.2915 0.3177
0.3459 0.3738 0.4011 0.4277 0.4538
0.4792 0.5042 0.5287 0.5528 0.5764
0.5998 0.6228 0.6454 0.6678 0.6899
0.7118 0.7335 0.7549 0.7761 0.7972
0.8181 0.8388 0.8593 0.8797 0.9000
0.9201 0.9401 0.9600 0.9798 0.9994
1.0190 1.0385 1.0579 1.0801 1.0922
1.0976 1.0950 1.0785 1.0396 1.0000

Width:

0.0729 0.0784 0.0839 0.0894 0.0949
0.1003 0.1058 0.1113 0.1168 0.1221
0.1261 0.1299 0.1335 0.1372 0.1409
0.1446 0.1482 0.1519 0.1556 0.1593
0.1630 0.1666 0.1703 0.1740 0.1777
0.1813 0.1850 0.1887 0.1924 0.1961
0.1997 0.2034 0.2071 0.2108 0.2144
0.2181 0.2218 0.2255 0.2292 0.2328
0.2365 0.2402 0.2439 0.2959 0.3581
0.4339 0.5299 0.7081 0.8606 1.0000

Transect XS-BD101

Area:

0.0041 0.0083 0.0125 0.0168 0.0212
0.0256 0.0303 0.0352 0.0403 0.0458
0.0515 0.0576 0.0640 0.0707 0.0777
0.0851 0.0927 0.1007 0.1091 0.1177
0.1267 0.1359 0.1455 0.1554 0.1657
0.1762 0.1871 0.1983 0.2098 0.2217
0.2339 0.2463 0.2591 0.2723 0.2857
0.2995 0.3136 0.3280 0.3427 0.3577
0.3731 0.3888 0.4048 0.4211 0.4378
0.4552 0.4734 0.5228 0.6762 1.0000

Hrad:

0.0872 0.1670 0.2403 0.3082 0.3712
0.4267 0.4766 0.5246 0.5692 0.6095
0.6497 0.6896 0.7293 0.7689 0.8083
0.8476 0.8868 0.9260 0.9650 1.0039
1.0428 1.0817 1.1204 1.1592 1.1979
1.2365 1.2751 1.3137 1.3522 1.3907
1.4292 1.4677 1.5061 1.5445 1.5829
1.6213 1.6597 1.6980 1.7364 1.7747
1.8130 1.8513 1.8896 1.9278 1.9529
1.9458 1.9428 1.7922 1.4068 1.0000

Width:

0.0090 0.0092 0.0093 0.0095 0.0096
0.0099 0.0104 0.0109 0.0115 0.0122
0.0129 0.0136 0.0143 0.0150 0.0157

0.0164 0.0171 0.0178 0.0185 0.0192
0.0199 0.0206 0.0213 0.0220 0.0227
0.0234 0.0241 0.0248 0.0255 0.0262
0.0269 0.0276 0.0283 0.0290 0.0297
0.0304 0.0311 0.0318 0.0325 0.0332
0.0339 0.0346 0.0353 0.0360 0.0370
0.0388 0.0407 0.2191 0.4577 1.0000

Transect XS-BD102
Area:
0.0032 0.0066 0.0099 0.0134 0.0169
0.0204 0.0240 0.0277 0.0315 0.0353
0.0391 0.0431 0.0471 0.0511 0.0552
0.0594 0.0637 0.0682 0.0728 0.0776
0.0826 0.0878 0.0932 0.0987 0.1044
0.1104 0.1164 0.1227 0.1292 0.1358
0.1426 0.1496 0.1568 0.1641 0.1717
0.1794 0.1873 0.1954 0.2043 0.2148
0.2268 0.2403 0.2553 0.2718 0.3113
0.4321 0.5544 0.6783 0.8058 1.0000
Hrad:
0.0810 0.1579 0.2312 0.3011 0.3681
0.4324 0.4941 0.5536 0.6111 0.6665
0.7203 0.7724 0.8230 0.8722 0.9201
0.9639 0.9988 1.0287 1.0591 1.0899
1.1211 1.1526 1.1844 1.2165 1.2489
1.2815 1.3144 1.3474 1.3806 1.4140
1.4475 1.4812 1.5150 1.5489 1.5830
1.6171 1.6514 1.6860 1.7297 1.7595
1.7790 1.7910 1.7979 1.8017 1.5671
1.1844 1.0599 1.0362 1.0538 1.0000
Width:
0.0100 0.0102 0.0104 0.0106 0.0108
0.0110 0.0112 0.0114 0.0115 0.0117
0.0119 0.0121 0.0123 0.0125 0.0127
0.0129 0.0134 0.0139 0.0145 0.0150
0.0156 0.0161 0.0167 0.0172 0.0178
0.0183 0.0189 0.0195 0.0200 0.0206
0.0211 0.0217 0.0222 0.0228 0.0233
0.0239 0.0244 0.0250 0.0297 0.0343
0.0390 0.0436 0.0483 0.0529 0.3099
0.3738 0.3741 0.3846 0.3959 1.0000

Transect XS-BD103
Area:
0.0044 0.0090 0.0136 0.0183 0.0232
0.0281 0.0331 0.0382 0.0435 0.0488
0.0542 0.0597 0.0653 0.0710 0.0769
0.0831 0.0895 0.0962 0.1031 0.1102
0.1176 0.1253 0.1332 0.1413 0.1497
0.1583 0.1672 0.1763 0.1856 0.1952

0.2051 0.2152 0.2255 0.2361 0.2469
0.2580 0.2693 0.2812 0.2950 0.3110
0.3292 0.3495 0.3719 0.3966 0.4240
0.4545 0.4880 0.5246 0.6612 1.0000

Hrad:

0.0791 0.1541 0.2254 0.2934 0.3584
0.4208 0.4806 0.5382 0.5938 0.6475
0.6995 0.7500 0.7989 0.8411 0.8755
0.9099 0.9444 0.9790 1.0136 1.0483
1.0830 1.1178 1.1526 1.1874 1.2223
1.2572 1.2921 1.3270 1.3620 1.3970
1.4320 1.4670 1.5021 1.5371 1.5722
1.6073 1.6424 1.6871 1.7267 1.7541
1.7724 1.7841 1.7915 1.8006 1.8147
1.8235 1.8295 1.8344 1.4746 1.0000

Width:

0.0102 0.0104 0.0106 0.0109 0.0111
0.0113 0.0115 0.0117 0.0120 0.0122
0.0124 0.0126 0.0128 0.0132 0.0138
0.0143 0.0149 0.0154 0.0160 0.0165
0.0171 0.0177 0.0182 0.0188 0.0193
0.0199 0.0204 0.0210 0.0215 0.0221
0.0227 0.0232 0.0238 0.0243 0.0249
0.0254 0.0260 0.0291 0.0339 0.0388
0.0437 0.0486 0.0534 0.0589 0.0658
0.0728 0.0797 0.0866 0.5403 1.0000

Transect XS-BD105

Area:

0.0026 0.0053 0.0082 0.0111 0.0142
0.0175 0.0208 0.0243 0.0279 0.0316
0.0354 0.0394 0.0435 0.0477 0.0521
0.0567 0.0614 0.0663 0.0714 0.0767
0.0821 0.0877 0.0935 0.0995 0.1056
0.1119 0.1184 0.1250 0.1319 0.1389
0.1460 0.1534 0.1609 0.1686 0.1764
0.1845 0.1927 0.2011 0.2096 0.2188
0.2293 0.2411 0.2541 0.2684 0.2895
0.3478 0.4479 0.5898 0.7735 1.0000

Hrad:

0.0923 0.1787 0.2602 0.3375 0.4111
0.4816 0.5494 0.6148 0.6780 0.7394
0.7990 0.8572 0.9137 0.9630 1.0098
1.0563 1.1024 1.1482 1.1938 1.2392
1.2843 1.3292 1.3740 1.4186 1.4630
1.5073 1.5515 1.5956 1.6396 1.6834
1.7272 1.7709 1.8146 1.8581 1.9016
1.9450 1.9884 2.0317 2.0761 2.1499
2.2131 2.2645 2.3064 2.3410 2.2776
1.9545 1.5831 1.3013 1.1205 1.0000

Width:

0.0105 0.0110 0.0115 0.0119 0.0124
0.0129 0.0134 0.0139 0.0144 0.0149
0.0154 0.0158 0.0163 0.0170 0.0177
0.0183 0.0190 0.0197 0.0204 0.0211
0.0217 0.0224 0.0231 0.0238 0.0245
0.0252 0.0258 0.0265 0.0272 0.0279
0.0286 0.0292 0.0299 0.0306 0.0313
0.0320 0.0326 0.0333 0.0341 0.0388
0.0438 0.0487 0.0537 0.0587 0.1474
0.3118 0.4763 0.6407 0.8052 1.0000

Transect XS-R3
Area:
0.0059 0.0128 0.0207 0.0296 0.0395
0.0503 0.0620 0.0741 0.0867 0.0996
0.1128 0.1264 0.1402 0.1544 0.1689
0.1837 0.1989 0.2143 0.2301 0.2462
0.2626 0.2794 0.2964 0.3138 0.3315
0.3495 0.3678 0.3865 0.4055 0.4247
0.4443 0.4643 0.4845 0.5051 0.5260
0.5472 0.5687 0.5905 0.6127 0.6352
0.6580 0.6811 0.7049 0.7302 0.7572
0.7866 0.8247 0.8739 0.9331 1.0000
Hrad:
0.0340 0.0635 0.0903 0.1152 0.1387
0.1613 0.1886 0.2157 0.2442 0.2722
0.2995 0.3262 0.3521 0.3775 0.4023
0.4266 0.4505 0.4739 0.4969 0.5196
0.5419 0.5639 0.5855 0.6069 0.6280
0.6488 0.6694 0.6898 0.7100 0.7300
0.7498 0.7694 0.7888 0.8081 0.8272
0.8462 0.8650 0.8837 0.9023 0.9208
0.9391 0.9574 0.9800 1.0023 1.0219
1.0376 1.0449 1.0374 1.0202 1.0000
Width:
0.0907 0.1047 0.1187 0.1327 0.1467
0.1607 0.1685 0.1755 0.1804 0.1849
0.1894 0.1939 0.1985 0.2030 0.2075
0.2120 0.2165 0.2211 0.2256 0.2301
0.2346 0.2391 0.2436 0.2482 0.2527
0.2572 0.2617 0.2662 0.2707 0.2753
0.2798 0.2843 0.2888 0.2933 0.2978
0.3024 0.3069 0.3114 0.3159 0.3204
0.3250 0.3295 0.3469 0.3701 0.3933
0.4635 0.6179 0.7755 0.8925 1.0000

Transect XS-ResStreet
Area:
0.0006 0.0024 0.0053 0.0095 0.0148
0.0213 0.0291 0.0379 0.0480 0.0593
0.0717 0.0854 0.1002 0.1162 0.1334

0.1518	0.1714	0.1921	0.2141	0.2372
0.2613	0.2856	0.3098	0.3341	0.3584
0.3826	0.4069	0.4311	0.4554	0.4797
0.5039	0.5282	0.5524	0.5767	0.6011
0.6257	0.6507	0.6759	0.7014	0.7271
0.7532	0.7795	0.8061	0.8329	0.8601
0.8875	0.9152	0.9432	0.9715	1.0000

Hrad:

0.0131	0.0263	0.0394	0.0526	0.0657
0.0789	0.0920	0.1051	0.1183	0.1314
0.1446	0.1577	0.1709	0.1840	0.1971
0.2103	0.2234	0.2366	0.2497	0.2629
0.2831	0.3093	0.3355	0.3617	0.3879
0.4141	0.4402	0.4664	0.4925	0.5186
0.5447	0.5708	0.5969	0.6230	0.6490
0.6746	0.6999	0.7248	0.7493	0.7735
0.7974	0.8210	0.8443	0.8674	0.8901
0.9126	0.9348	0.9568	0.9785	1.0000

Width:

0.0414	0.0827	0.1241	0.1654	0.2068
0.2482	0.2895	0.3309	0.3722	0.4136
0.4549	0.4963	0.5377	0.5790	0.6204
0.6617	0.7031	0.7445	0.7858	0.8272
0.8460	0.8460	0.8460	0.8460	0.8460
0.8460	0.8461	0.8461	0.8461	0.8461
0.8461	0.8461	0.8461	0.8462	0.8549
0.8646	0.8743	0.8840	0.8936	0.9033
0.9130	0.9226	0.9323	0.9420	0.9516
0.9613	0.9710	0.9807	0.9903	1.0000

**********	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
**********	---------	-------
Total Precipitation	51.492	108.945
Evaporation Loss	0.000	0.000
Infiltration Loss	9.742	20.613
Surface Runoff	38.785	82.061
Final Surface Storage	2.964	6.272
Continuity Error (%)	-0.000	

**********	Volume	Volume
Flow Routing Continuity	hectare-m	Mliters
**********	---------	---------
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	38.785	387.857
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	29.656	296.562

Surface Flooding	0.000	0.000
Evaporation Loss	0.000	0.000
Initial Stored Volume	0.282	2.824
Final Stored Volume	9.491	94.907
Continuity Error (%)	-0.202	

****
Composite Curve Number Computations Report
****

Subbasin 3

Soil/Surface Description	Area (ha)	Soil Group	CN
-	65.17	-	75.00
Composite Area & Weighted CN	65.17		75.00

Subbasin A3868

Soil/Surface Description	Area (ha)	Soil Group	CN
-	6.82	-	90.00
Composite Area & Weighted CN	6.82		90.00

Subbasin A3876

Soil/Surface Description	Area (ha)	Soil Group	CN
-	8.44	-	90.00
Composite Area & Weighted CN	8.44		90.00

Subbasin A3877

Soil/Surface Description	Area (ha)	Soil Group	CN
-	2.77	-	90.00
Composite Area & Weighted CN	2.77		90.00

Subbasin A4

	Area	Soil

Soil/Surface Description	(ha)	Group	CN
-	5.92	-	90.00
Composite Area & Weighted CN	5.92		90.00

Subbasin A4389

Soil/Surface Description	Area (ha)	Soil Group	CN
-	4.75	-	90.00
Composite Area & Weighted CN	4.75		90.00

Subbasin A4422

Soil/Surface Description	Area (ha)	Soil Group	CN
-	6.72	-	90.00
Composite Area & Weighted CN	6.72		90.00

Subbasin A4469

Soil/Surface Description	Area (ha)	Soil Group	CN
-	1.62	-	90.00
Composite Area & Weighted CN	1.62		90.00

Subbasin A4528

Soil/Surface Description	Area (ha)	Soil Group	CN
-	5.80	-	90.00
Composite Area & Weighted CN	5.80		90.00

Subbasin A4572

Soil/Surface Description	Area (ha)	Soil Group	CN
-	6.76	-	90.00
Composite Area & Weighted CN	6.76		90.00

Subbasin A4576

Soil/Surface Description	Area (ha)	Soil Group	CN
-	6.46	-	90.00
Composite Area & Weighted CN	6.46		90.00

Subbasin A4589

Soil/Surface Description	Area (ha)	Soil Group	CN
-	13.74	-	90.00
Composite Area & Weighted CN	13.74		90.00

Subbasin A4615

Soil/Surface Description	Area (ha)	Soil Group	CN
-	2.88	-	90.00
Composite Area & Weighted CN	2.88		90.00

Subbasin A4672

Soil/Surface Description	Area (ha)	Soil Group	CN
-	2.93	-	90.00
Composite Area & Weighted CN	2.93		90.00

Subbasin A4690

Soil/Surface Description	Area (ha)	Soil Group	CN
-	4.21	-	90.00
Composite Area & Weighted CN	4.21		90.00

Subbasin A4719

Soil/Surface Description	Area (ha)	Soil Group	CN
-	4.92	-	90.00

Composite Area & Weighted CN	4.92		90.00

Subbasin A4722

Soil/Surface Description	Area (ha)	Soil Group	CN
-	1.29	-	90.00
Composite Area & Weighted CN	1.29		90.00

Subbasin A4737

Soil/Surface Description	Area (ha)	Soil Group	CN
-	2.04	-	90.00
Composite Area & Weighted CN	2.04		90.00

Subbasin A4809

Soil/Surface Description	Area (ha)	Soil Group	CN
-	1.74	-	90.00
Composite Area & Weighted CN	1.74		90.00

Subbasin A5070

Soil/Surface Description	Area (ha)	Soil Group	CN
-	3.21	-	90.00
Composite Area & Weighted CN	3.21		90.00

Subbasin CYR-D1

Soil/Surface Description	Area (ha)	Soil Group	CN
-	1.89	-	90.00
Composite Area & Weighted CN	1.89		90.00

Subbasin CYR-D2

	Area	Soil

Soil/Surface Description	(ha)	Group	CN
-	1.89	-	90.00
Composite Area & Weighted CN	1.89		90.00

Subbasin CYR-D3

Soil/Surface Description	Area (ha)	Soil Group	CN
-	1.89	-	90.00
Composite Area & Weighted CN	1.89		90.00

Subbasin CYR-D4

Soil/Surface Description	Area (ha)	Soil Group	CN
-	1.89	-	90.00
Composite Area & Weighted CN	1.89		90.00

Subbasin CYR-D5

Soil/Surface Description	Area (ha)	Soil Group	CN
-	1.89	-	90.00
Composite Area & Weighted CN	1.89		90.00

Subbasin ETRD A

Soil/Surface Description	Area (ha)	Soil Group	CN
-	27.40	-	88.30
Composite Area & Weighted CN	27.40		88.30

Subbasin ETRD C_FU

Soil/Surface Description	Area (ha)	Soil Group	CN
-	23.50	-	92.90
Composite Area & Weighted CN	23.50		92.90

Subbasin ETRD E_FU

Soil/Surface Description	Area (ha)	Soil Group	CN
-	23.30	-	91.60
Composite Area & Weighted CN	23.30		91.60

Subbasin Manning Rd Drain A

Soil/Surface Description	Area (ha)	Soil Group	CN
-	11.00	-	98.00
Composite Area & Weighted CN	11.00		98.00

Subbasin Manning Rd Drain B

Soil/Surface Description	Area (ha)	Soil Group	CN
-	27.65	-	88.30
Composite Area & Weighted CN	27.65		88.30

Subbasin SPA1

Soil/Surface Description	Area (ha)	Soil Group	CN
-	7.70	-	90.00
Composite Area & Weighted CN	7.70		90.00

Subbasin SPA100

Soil/Surface Description	Area (ha)	Soil Group	CN
-	7.40	-	90.00
Composite Area & Weighted CN	7.40		90.00

Subbasin SPA106

Soil/Surface Description	Area (ha)	Soil Group	CN
-	5.90	-	90.00

Composite Area & Weighted CN	5.90		90.00

Subbasin SPA14

Soil/Surface Description	Area (ha)	Soil Group	CN
-	6.20	-	90.00
Composite Area & Weighted CN	6.20		90.00

Subbasin SPA21

Soil/Surface Description	Area (ha)	Soil Group	CN
-	9.30	-	90.00
Composite Area & Weighted CN	9.30		90.00

Subbasin SPA35

Soil/Surface Description	Area (ha)	Soil Group	CN
-	12.00	-	90.00
Composite Area & Weighted CN	12.00		90.00

Subbasin SPA50

Soil/Surface Description	Area (ha)	Soil Group	CN
-	10.20	-	90.00
Composite Area & Weighted CN	10.20		90.00

Subbasin SPA51

Soil/Surface Description	Area (ha)	Soil Group	CN
-	11.30	-	94.10
Composite Area & Weighted CN	11.30		94.10

Subbasin SPA-52

	Area	Soil

Soil/Surface Description	(ha)	Group	CN
-	2.50	-	94.10
Composite Area & Weighted CN	2.50		94.10

Subbasin SPA62

Soil/Surface Description	Area (ha)	Soil Group	CN
-	2.60	-	90.00
Composite Area & Weighted CN	2.60		90.00

Subbasin SPA69

Soil/Surface Description	Area (ha)	Soil Group	CN
-	4.00	-	90.00
Composite Area & Weighted CN	4.00		90.00

Subbasin SPA79

Soil/Surface Description	Area (ha)	Soil Group	CN
-	8.70	-	90.00
Composite Area & Weighted CN	8.70		90.00

Subbasin SPA86

Soil/Surface Description	Area (ha)	Soil Group	CN
-	5.46	-	90.00
Composite Area & Weighted CN	5.46		90.00

Subbasin SPA86a

Soil/Surface Description	Area (ha)	Soil Group	CN
-	1.94	-	90.00
Composite Area & Weighted CN	1.94		90.00

Subbasin Sub-03

Soil/Surface Description	Area (ha)	Soil Group	CN
-	12.83	-	79.00
Composite Area & Weighted CN	12.83		79.00

Subbasin Sub-04

Soil/Surface Description	Area (ha)	Soil Group	CN
-	14.41	-	79.00
Composite Area & Weighted CN	14.41		79.00

Subbasin Sub-05

Soil/Surface Description	Area (ha)	Soil Group	CN
-	17.73	-	79.00
Composite Area & Weighted CN	17.73		79.00

Subbasin Sub-06

Soil/Surface Description	Area (ha)	Soil Group	CN
-	4.72	-	79.00
Composite Area & Weighted CN	4.72		79.00

Subbasin Sub-08

Soil/Surface Description	Area (ha)	Soil Group	CN
-	36.74	-	75.00
Composite Area & Weighted CN	36.74		75.00

Subbasin ToPond

Soil/Surface Description	Area (ha)	Soil Group	CN
-	6.60	-	95.00

Composite Area & Weighted CN 6.60 95.00

****
EPA SWMM Time of Concentration Computations Report
****

Tc = (0.94 * (L^0.6) * (n^0.6)) / ((i^0.4) * (S^0.3))

Where:

Tc = Time of Concentration (min)
L = Flow Length (ft)
n = Manning's Roughness
i = Rainfall Intensity (in/hr)
S = Slope (ft/ft)

Subbasin 3

Flow length (m):	4764.10
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.10000
Computed TOC (minutes):	887.75

Subbasin A3868

Flow length (m):	219.97
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	141.98

Subbasin A3876

Flow length (m):	309.95
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000

Computed TOC (minutes):	174.42

Subbasin A3877

Flow length (m):	107.99
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	92.65

Subbasin A4

Flow length (m):	187.02
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	128.81

Subbasin A4389

Flow length (m):	350.07
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	195.04

Subbasin A4422

Flow length (m):	299.96
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	171.02

Subbasin A4469

Flow length (m):	198.05
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	138.58

Subbasin A4528

Flow length (m):	444.86
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	216.65

Subbasin A4572

Flow length (m):	329.97
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	188.24

Subbasin A4576

Flow length (m):	310.03
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	181.33

Subbasin A4589

Flow length (m):	415.23
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	224.08

Subbasin A4615

Flow length (m):	50.00
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	58.37

Subbasin A4672

Flow length (m):	155.00
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	100.66

Subbasin A4690

Flow length (m):	255.03
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	135.72

Subbasin A4719

Flow length (m):	264.94
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500

Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	138.86

Subbasin A4722

Flow length (m):	140.00
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	94.70

Subbasin A4737

Flow length (m):	91.99
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	73.61

Subbasin A4809

Flow length (m):	135.02
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	97.22

Subbasin A5070

Flow length (m):	239.96
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000

Computed TOC (minutes):	137.28

Subbasin CYR-D1

Flow length (m):	60.20
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	60.87

Subbasin CYR-D2

Flow length (m):	218.59
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	145.48

Subbasin CYR-D3

Flow length (m):	3.14
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	5.48

Subbasin CYR-D4

Flow length (m):	1678.40
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	409.32

Subbasin CYR-D5

Flow length (m):	2166.67
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	542.47

Subbasin ETRD A

Flow length (m):	523.90
Pervious Manning's Roughness:	0.25000
Impervious Manning's Roughness:	0.01300
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.20000
Computed TOC (minutes):	355.03

Subbasin ETRD C_FU

Flow length (m):	540.23
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.05000
Computed TOC (minutes):	232.11

Subbasin ETRD E_FU

Flow length (m):	485.42
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.10000
Computed TOC (minutes):	214.04

Subbasin Manning Rd Drain A

Flow length (m):	378.25
Pervious Manning's Roughness:	0.25000
Impervious Manning's Roughness:	0.01300
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.05000
Computed TOC (minutes):	104.05

Subbasin Manning Rd Drain B

Flow length (m):	2048.15
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	624.07

Subbasin SPA1

Flow length (m):	150.01
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	110.12

Subbasin SPA100

Flow length (m):	362.92
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	187.10

Subbasin SPA106

Flow length (m):	263.04
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500

Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	154.24

Subbasin SPA14

Flow length (m):	449.93
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	212.85

Subbasin SPA21

Flow length (m):	474.97
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	219.88

Subbasin SPA35

Flow length (m):	515.02
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	230.82

Subbasin SPA50

Flow length (m):	585.87
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000

Computed TOC (minutes):	249.38

Subbasin SPA51

Flow length (m):	377.04
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	113.21

Subbasin SPA-52

Flow length (m):	222.02
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	166.60

Subbasin SPA62

Flow length (m):	477.94
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	220.70

Subbasin SPA69

Flow length (m):	379.87
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	192.29

Subbasin SPA79

Flow length (m):	426.05
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	206.00

Subbasin SPA86

Flow length (m):	357.80
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	185.51

Subbasin SPA86a

Flow length (m):	128.54
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.15000
Computed TOC (minutes):	58.16

Subbasin Sub-03

Flow length (m):	358.61
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.50000
Computed TOC (minutes):	143.00

Subbasin Sub-04

Flow length (m):	356.12
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.50000
Computed TOC (minutes):	142.41

Subbasin Sub-05

Flow length (m):	509.85
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.50000
Computed TOC (minutes):	176.62

Subbasin Sub-06

Flow length (m):	164.90
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.50000
Computed TOC (minutes):	89.72

Subbasin Sub-08

Flow length (m):	823.99
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500
Pervious Rainfall Intensity (mm/hr):	4.73674
Impervious Rainfall Intensity (mm/hr):	4.73674
Slope (%):	0.10000
Computed TOC (minutes):	309.78

Subbasin ToPond

Flow length (m):	393.09
Pervious Manning's Roughness:	0.10000
Impervious Manning's Roughness:	0.01500

Pervious Rainfall Intensity (mm/hr): 4.73674
Impervious Rainfall Intensity (mm/hr): 4.73674
Slope (%): 0.15000
Computed TOC (minutes): 76.12

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Subbasin Runoff Summary
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Subbasin ID	Total Rainfall mm	Total Runon mm	Total Evap. mm	Total Infil. mm	Total Runoff mm	Peak Runoff cms	Runoff Coefficient	Time of Concentration days	Time of Concentration hh:mm:ss
3	108.94	0.00	0.00	30.32	66.35	2.35	0.609	0	14:47:44
A3868	108.95	0.00	0.00	17.29	85.75	0.92	0.787	0	02:21:59
A3876	108.95	0.00	0.00	17.29	85.58	1.02	0.785	0	02:54:25
A3877	108.94	0.00	0.00	17.29	85.97	0.48	0.789	0	01:32:39
A4	108.95	0.00	0.00	17.29	85.82	0.85	0.788	0	02:08:48
A4389	108.94	0.00	0.00	18.44	84.22	0.48	0.773	0	03:15:02
A4422	108.94	0.00	0.00	17.29	85.60	0.82	0.786	0	02:51:01
A4469	108.95	0.00	0.00	18.44	84.57	0.20	0.776	0	02:18:34
A4528	108.94	0.00	0.00	17.29	85.28	0.62	0.783	0	03:36:38
A4572	108.94	0.00	0.00	18.44	84.26	0.70	0.773	0	03:08:14
A4576	108.94	0.00	0.00	18.44	84.31	0.68	0.774	0	03:01:19
A4589	108.95	0.00	0.00	19.60	82.75	1.09	0.760	0	03:44:04
A4615	108.95	0.00	0.00	17.29	86.12	0.66	0.790	0	00:58:22
A4672	108.94	0.00	0.00	13.83	89.52	0.59	0.822	0	01:40:39
A4690	108.95	0.00	0.00	13.83	89.39	0.73	0.821	0	02:15:42
A4719	108.95	0.00	0.00	13.83	89.38	0.84	0.820	0	02:18:51
A4722	108.95	0.00	0.00	13.83	89.54	0.27	0.822	0	01:34:41
A4737	108.95	0.00	0.00	13.83	89.61	0.47	0.823	0	01:13:36
A4809	108.95	0.00	0.00	14.99	88.34	0.34	0.811	0	01:37:13
A5070	108.95	0.00	0.00	14.99	88.18	0.52	0.809	0	02:17:16
CYR-D1	108.95	0.00	0.00	15.40	89.66	0.46	0.823	0	01:00:52
CYR-D2	108.94	0.00	0.00	18.12	86.26	0.24	0.792	0	02:25:29
CYR-D3	108.95	0.00	0.00	5.35	100.85	0.08	0.926	0	00:05:29
CYR-D4	108.95	0.00	0.00	13.23	89.63	0.17	0.823	0	06:49:19
CYR-D5	108.94	0.00	0.00	16.39	83.47	0.33	0.766	0	09:02:28
ETRD A	108.94	0.00	0.00	17.79	85.80	3.16	0.788	0	05:55:01
ETRD C_FU	108.94	0.00	0.00	6.73	98.33	2.94	0.903	0	03:52:06
ETRD E_FU	108.94	0.00	0.00	10.81	93.88	3.23	0.862	0	03:34:02
Manning Rd Drain A	108.95	0.00	0.00	0.30	107.48	2.34	0.987	0	01:44:02
Manning Rd Drain B	108.94	0.00	0.00	25.23	70.59	0.61	0.648	0	10:24:04
SPA1	108.95	0.00	0.00	16.60	88.13	1.29	0.809	0	01:50:07
SPA100	108.94	0.00	0.00	16.60	87.75	0.92	0.805	0	03:07:05
SPA106	108.95	0.00	0.00	16.60	87.93	0.82	0.807	0	02:34:14
SPA14	108.95	0.00	0.00	16.60	87.57	0.72	0.804	0	03:32:50
SPA21	108.95	0.00	0.00	16.60	87.52	1.06	0.803	0	03:39:52
SPA35	108.95	0.00	0.00	16.60	87.43	1.32	0.803	0	03:50:49

SPA50	108.94	0.00	0.00	16.60	87.28	1.07	0.801	0	04:09:22
SPA51	108.94	0.00	0.00	4.24	101.54	2.45	0.932	0	01:53:12
SPA-52	108.94	0.00	0.00	13.72	89.82	0.23	0.824	0	02:46:36
SPA62	108.94	0.00	0.00	16.60	87.51	0.29	0.803	0	03:40:42
SPA69	108.94	0.00	0.00	16.60	87.71	0.49	0.805	0	03:12:17
SPA79	108.95	0.00	0.00	16.60	87.62	1.03	0.804	0	03:25:59
SPA86	108.94	0.00	0.00	16.60	87.76	0.69	0.805	0	03:05:30
SPA86a	108.95	0.00	0.00	6.69	99.29	0.58	0.911	0	00:58:09
Sub-03	108.95	0.00	0.00	37.31	67.73	1.04	0.622	0	02:23:00
Sub-04	108.94	0.00	0.00	37.31	67.73	1.17	0.622	0	02:22:24
Sub-05	108.94	0.00	0.00	37.31	67.42	1.30	0.619	0	02:56:37
Sub-06	108.94	0.00	0.00	37.31	68.19	0.51	0.626	0	01:29:43
Sub-08	108.95	0.00	0.00	30.32	74.21	3.36	0.681	0	05:09:46
ToPond	108.95	0.00	0.00	0.12	106.44	1.47	0.977	0	01:16:07

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Node Depth Summary
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Node ID	Average Depth Attained m	Maximum Depth Attained m	Maximum HGL Attained m	Time of Max Occurrence days	Time of Max Occurrence hh:mm	Total Flooded Volume ha-mm	Total Time Flooded minutes	Retention Time hh:mm:ss
15	0.52	1.12	179.72	0	08:24	0	0	0:00:00
77a	1.95	4.25	180.50	0	08:30	0	0	0:00:00
77b	0.49	2.81	181.01	0	08:28	0	0	0:00:00
Jun-01	0.37	0.37	174.37	0	00:00	0	0	0:00:00
Jun-02	0.39	1.66	174.36	0	00:00	0	0	0:00:00
Jun-03	0.72	1.90	176.30	0	08:34	0	0	0:00:00
Jun-04	0.75	1.94	176.32	0	08:34	0	0	0:00:00
Jun-05	0.80	1.93	176.47	0	08:33	0	0	0:00:00
Jun-06	0.73	1.88	176.50	0	08:33	0	0	0:00:00
Jun-109	0.24	1.17	178.52	0	09:02	0	0	0:00:00
Jun-11	0.92	2.06	176.61	0	08:32	0	0	0:00:00
Jun-16	0.89	2.09	176.30	0	08:34	0	0	0:00:00
Jun-17	1.22	2.39	176.26	0	08:35	0	0	0:00:00
Jun-18	0.89	2.02	176.19	0	08:35	0	0	0:00:00
Jun-19	0.82	1.92	176.15	0	08:35	0	0	0:00:00
Jun-20	0.82	1.91	176.10	0	08:35	0	0	0:00:00
Jun-21	0.82	1.89	176.06	0	08:35	0	0	0:00:00
Jun-22	0.79	1.86	176.03	0	08:35	0	0	0:00:00
Jun-23	0.78	1.82	175.99	0	08:35	0	0	0:00:00
Jun-24	0.82	1.85	175.95	0	08:35	0	0	0:00:00
Jun-25	0.76	1.79	175.94	0	08:35	0	0	0:00:00
Jun-26	0.82	1.84	175.91	0	08:35	0	0	0:00:00
Jun-27	0.77	1.76	175.85	0	08:35	0	0	0:00:00
Jun-28	0.73	1.71	175.82	0	08:35	0	0	0:00:00

Jun-29	0.69	1.64	175.77	0	08:34	0	0	0:00:00
Jun-30	0.75	1.69	175.73	0	08:34	0	0	0:00:00
Jun-31	0.79	1.69	175.67	0	08:34	0	0	0:00:00
Jun-32	0.67	1.55	175.63	0	08:33	0	0	0:00:00
Jun-33	0.70	1.55	175.58	0	08:32	0	0	0:00:00
Jun-34	0.62	1.45	175.52	0	08:32	0	0	0:00:00
Jun-35	0.67	1.39	175.38	0	08:32	0	0	0:00:00
Jun-36	0.61	1.27	175.28	0	08:32	0	0	0:00:00
Jun-37	0.59	1.21	175.22	0	08:32	0	0	0:00:00
Jun-38	0.57	1.64	174.59	0	08:32	0	0	0:00:00
Jun-47	0.51	1.50	174.42	0	08:32	0	0	0:00:00
Jun-49	0.55	1.58	178.05	0	08:42	0	0	0:00:00
Jun-50	0.69	1.79	178.02	0	08:41	0	0	0:00:00
Jun-51	0.75	1.85	178.00	0	08:40	0	0	0:00:00
Jun-52	0.64	1.76	177.98	0	08:40	0	0	0:00:00
Jun-53	0.60	1.71	177.93	0	08:39	0	0	0:00:00
Jun-54	0.55	1.58	177.33	0	08:30	0	0	0:00:00
Jun-55	0.51	1.74	177.24	0	08:30	0	0	0:00:00
Jun-56	0.49	1.78	177.06	0	08:30	0	0	0:00:00
Jun-57	0.53	1.82	177.03	0	08:30	0	0	0:00:00
Jun-58	0.60	1.89	176.84	0	08:31	0	0	0:00:00
Jun-59	0.65	1.93	176.81	0	08:31	0	0	0:00:00
STA0+775	0.04	0.33	180.22	0	08:00	0	0	0:00:00
STA0+925	0.04	0.40	180.02	0	08:24	0	0	0:00:00
STA1+025	0.06	0.69	180.02	0	08:24	0	0	0:00:00
STA1+150	0.06	0.63	179.78	0	08:24	0	0	0:00:00
STA1+178	0.38	0.97	179.72	0	08:23	0	0	0:00:00
STA1+200	0.08	0.58	179.62	0	08:22	0	0	0:00:00
STA1+325	0.04	0.51	179.30	0	08:34	0	0	0:00:00
STA1+450	0.13	0.71	179.24	0	08:35	0	0	0:00:00
STA1+700	0.09	0.54	178.53	0	09:02	0	0	0:00:00
ETLD-1	0.00	0.00	180.50	0	00:00	0	0	0:00:00
ETLD-2a	0.00	0.00	180.50	0	00:00	0	0	0:00:00
ETLD-2b	0.00	0.00	180.50	0	00:00	0	0	0:00:00
ETLD-3	0.00	0.00	180.50	0	00:00	0	0	0:00:00
ETLD-4	0.00	0.00	180.50	0	00:00	0	0	0:00:00
Out-01	0.00	0.00	172.70	0	00:00	0	0	0:00:00
Out-02	0.00	0.00	175.79	0	00:00	0	0	0:00:00
Out-03	0.00	0.00	176.54	0	00:00	0	0	0:00:00
Out-04	0.00	0.00	173.20	0	00:00	0	0	0:00:00
Out-11	0.00	0.00	175.00	0	00:00	0	0	0:00:00
CR22 Pond 19900m3	0.32	1.37	175.57	0	11:03	0	0	0:00:00
EX0	0.33	2.02	182.24	0	08:03	0	0	0:00:00
EX1	0.37	2.06	182.20	0	08:03	0	0	0:00:00
EX3	0.40	1.73	181.80	0	08:02	0	0	0:00:00
EX3868	0.47	1.93	182.16	0	09:12	0	0	0:00:00
EX3869	0.38	2.09	182.59	0	08:17	0	0	0:00:00
EX3870	0.43	2.10	182.49	0	08:34	0	0	0:00:00
EX3877(MHD)	0.30	2.38	183.00	0	08:28	0	0	0:00:00
EX4	0.46	1.68	181.68	0	08:01	0	0	0:00:00
EX4322	0.05	1.30	182.90	0	08:03	0	0	0:00:00

EX4351	0.34	1.93	182.69	0	08:11	0	0	0:00:00
EX4373	0.06	1.30	182.70	0	08:28	0	0	0:00:00
EX4374	0.06	1.30	182.54	0	08:02	0	0	0:00:00
EX4375	0.09	1.45	182.51	0	08:02	0	0	0:00:00
EX4389	0.28	1.35	182.72	0	10:48	0	0	0:00:00
EX4390	0.29	1.46	182.71	0	09:04	0	0	0:00:00
EX4419	0.33	1.74	182.36	0	07:54	0	0	0:00:00
EX4422	0.33	1.70	182.41	0	09:07	0	0	0:00:00
EX4469	0.39	2.24	183.10	0	08:02	0	0	0:00:00
EX4518	0.12	1.60	182.48	0	08:16	0	0	0:00:00
EX4528	0.25	1.86	182.48	0	08:02	0	0	0:00:00
EX4615	0.40	2.39	183.16	0	08:00	0	0	0:00:00
EX4650	0.36	1.80	182.27	0	11:09	0	0	0:00:00
EX4654	0.39	1.85	182.21	0	09:19	0	0	0:00:00
EX4658	0.31	1.59	182.42	0	11:12	0	0	0:00:00
EX4659	0.28	1.52	182.42	0	10:12	0	0	0:00:00
EX4668	0.21	1.26	182.57	0	07:55	0	0	0:00:00
EX4672	0.20	1.23	182.71	0	08:41	0	0	0:00:00
EX4678	0.26	1.37	182.49	0	07:54	0	0	0:00:00
EX4682	0.30	1.64	182.50	0	07:55	0	0	0:00:00
EX4686	0.29	1.61	182.58	0	07:54	0	0	0:00:00
EX4690	0.28	1.48	182.60	0	08:17	0	0	0:00:00
EX4694	0.20	1.23	182.50	0	08:51	0	0	0:00:00
EX4695	0.17	1.19	182.60	0	07:54	0	0	0:00:00
EX4702	0.22	1.16	182.41	0	11:28	0	0	0:00:00
EX4709	0.38	2.14	183.07	0	07:56	0	0	0:00:00
EX4710	0.40	1.89	182.98	0	07:56	0	0	0:00:00
EX4711	0.40	1.66	182.88	0	09:58	0	0	0:00:00
EX4712	0.38	1.65	183.15	0	07:57	0	0	0:00:00
EX4717	0.31	1.54	183.16	0	07:56	0	0	0:00:00
EX4719	0.38	1.74	183.33	0	08:00	0	0	0:00:00
EX4720	0.38	1.66	183.20	0	08:05	0	0	0:00:00
EX4721	0.34	1.44	183.11	0	09:14	0	0	0:00:00
EX4722	0.30	1.27	183.11	0	10:45	0	0	0:00:00
EX4725	0.34	1.59	183.27	0	08:00	0	0	0:00:00
EX4729	0.33	1.30	183.11	0	10:22	0	0	0:00:00
EX4737	0.30	1.33	183.31	0	08:38	0	0	0:00:00
EX4755	0.21	1.19	182.71	0	12:25	0	0	0:00:00
EX4809	0.22	1.74	182.26	0	08:06	0	0	0:00:00
EX4810	0.21	1.60	182.26	0	08:17	0	0	0:00:00
EX5	0.46	1.81	181.89	0	08:01	0	0	0:00:00
EX5069	0.19	1.53	182.26	0	08:22	0	0	0:00:00
EX5070	0.18	1.45	182.27	0	08:37	0	0	0:00:00
EX5077	0.13	1.35	182.26	0	09:18	0	0	0:00:00
EX5081	0.11	1.28	182.26	0	09:40	0	0	0:00:00
EX5085	0.10	1.21	182.26	0	09:50	0	0	0:00:00
Jun-1	0.54	1.89	177.05	0	08:00	0	0	0:00:00
Jun-300	0.52	0.64	179.64	0	08:00	0	0	0:00:00
Jun-310	0.58	1.41	178.41	0	08:20	0	0	0:00:00
Jun-315	0.49	1.71	178.05	0	08:15	0	0	0:00:00
Jun-320	0.30	1.29	176.86	0	08:15	0	0	0:00:00

Jun-95	0.71	1.66	178.08	0	08:43	0	0	0:00:00
MH1	2.71	3.60	178.63	0	21:50	0	0	0:00:00
MH100	0.48	3.14	181.41	0	08:43	0	0	0:00:00
MH102	0.43	2.98	181.41	0	08:44	0	0	0:00:00
MH103	0.42	2.74	181.39	0	08:49	0	0	0:00:00
MH105	0.46	2.61	181.36	0	08:58	0	0	0:00:00
MH106	0.46	2.45	181.34	0	09:01	0	0	0:00:00
MH107	0.34	2.20	181.29	0	09:11	0	0	0:00:00
MH108	0.32	1.95	181.26	0	09:27	0	0	0:00:00
MH11	2.63	3.46	178.63	0	21:45	0	0	0:00:00
MH14	2.54	3.30	178.63	0	21:41	0	0	0:00:00
MH15	0.00	0.00	179.53	0	00:00	0	0	0:00:00
MH16	0.00	0.00	179.94	0	00:00	0	0	0:00:00
MH20	0.00	0.00	180.39	0	00:00	0	0	0:00:00
MH21	2.46	3.44	178.91	0	08:30	0	0	0:00:00
MH22	0.09	0.40	178.91	0	08:30	0	0	0:00:00
MH23	0.12	0.23	178.91	0	08:29	0	0	0:00:00
MH25	0.00	0.00	178.86	0	00:00	0	0	0:00:00
MH28	0.00	0.00	179.05	0	00:00	0	0	0:00:00
MH3	0.00	0.00	179.54	0	00:00	0	0	0:00:00
MH31	2.39	3.74	179.35	0	08:32	0	0	0:00:00
MH35	2.31	4.03	179.78	0	08:32	0	0	0:00:00
MH36	0.55	2.00	179.78	0	08:31	0	0	0:00:00
MH38	0.42	1.84	179.79	0	08:31	0	0	0:00:00
MH40	0.30	1.66	179.78	0	08:30	0	0	0:00:00
MH43	0.17	1.45	179.79	0	08:32	0	0	0:00:00
MH46	0.08	1.26	179.79	0	08:31	0	0	0:00:00
MH5	0.00	0.00	179.76	0	00:00	0	0	0:00:00
MH50	2.17	4.23	180.19	0	08:32	0	0	0:00:00
MH51	1.05	3.03	180.30	0	08:31	0	0	0:00:00
MH52	0.95	2.99	180.40	0	08:31	0	0	0:00:00
MH53	0.85	2.95	180.50	0	08:31	0	0	0:00:00
MH54	0.66	2.75	180.50	0	08:30	0	0	0:00:00
MH55	0.49	2.52	180.50	0	08:31	0	0	0:00:00
MH58	1.91	4.02	180.27	0	08:34	0	0	0:00:00
MH59	1.68	3.81	180.34	0	08:36	0	0	0:00:00
MH61	1.53	3.69	180.41	0	08:37	0	0	0:00:00
MH62	1.31	3.52	180.53	0	08:39	0	0	0:00:00
MH63	1.00	3.20	180.53	0	08:40	0	0	0:00:00
MH64	0.83	2.99	180.53	0	08:39	0	0	0:00:00
MH67	1.49	3.69	180.46	0	08:37	0	0	0:00:00
MH69	1.25	3.60	180.69	0	08:39	0	0	0:00:00
MH7	0.00	0.00	180.11	0	00:00	0	0	0:00:00
MH71	1.02	3.37	180.69	0	08:39	0	0	0:00:00
MH72	0.84	3.16	180.69	0	08:39	0	0	0:00:00
MH76	2.01	4.22	180.39	0	08:31	0	0	0:00:00
MH77	1.77	4.16	180.64	0	08:33	0	0	0:00:00
MH78	1.68	4.15	180.75	0	08:33	0	0	0:00:00
MH79	1.58	4.14	180.88	0	08:34	0	0	0:00:00
MH8	0.00	0.00	180.12	0	00:00	0	0	0:00:00
MH80	1.49	4.04	180.89	0	08:36	0	0	0:00:00

MH82	1.38	3.91	180.89	0	08:36	0	0	0:00:00
MH85	1.25	3.77	180.91	0	08:37	0	0	0:00:00
MH86	1.13	3.62	180.92	0	08:40	0	0	0:00:00
MH89	1.01	3.49	180.92	0	08:40	0	0	0:00:00
MH90	0.86	3.30	180.92	0	08:41	0	0	0:00:00
MH93	0.72	3.10	180.86	0	09:04	0	0	0:00:00
MH94	0.59	2.94	180.86	0	09:11	0	0	0:00:00
MH95	0.19	1.86	180.87	0	09:10	0	0	0:00:00
MH97	0.70	3.24	181.04	0	08:36	0	0	0:00:00
MH99	0.56	3.17	181.22	0	08:37	0	0	0:00:00
MH-A	0.33	2.85	181.97	0	08:41	0	0	0:00:00
MH-C	0.31	2.73	182.73	0	08:36	0	0	0:00:00
SPA Pond_130360m3	3.04	4.12	178.62	0	21:53	0	0	0:00:00
Stor-02	0.00	0.00	173.50	0	00:00	0	0	0:00:00
Stor-SPA1	0.13	1.58	181.93	0	08:16	0	0	0:00:00
Stor-SPA100	0.18	1.59	181.54	0	08:19	0	0	0:00:00
Stor-SPA106	0.19	1.66	181.26	0	08:24	0	0	0:00:00
Stor-SPA14	0.15	1.55	182.00	0	08:16	0	0	0:00:00
Stor-SPA21	0.15	1.52	182.12	0	08:16	0	0	0:00:00
Stor-SPA35	0.19	1.58	181.78	0	08:26	0	0	0:00:00
Stor-SPA50	0.18	1.56	181.86	0	08:23	0	0	0:00:00
Stor-SPA51	0.15	1.60	180.80	0	08:20	0	0	0:00:00
Stor-SPA52	0.27	1.60	181.65	0	08:28	0	0	0:00:00
Stor-SPA62	0.15	1.57	181.47	0	08:26	0	0	0:00:00
Stor-SPA69	0.16	1.58	181.33	0	08:30	0	0	0:00:00
Stor-SPA79	0.17	1.57	181.52	0	08:16	0	0	0:00:00
Stor-SPA86	0.17	1.60	181.15	0	08:22	0	0	0:00:00
Stor-Spa86a	0.11	1.63	181.64	0	08:10	0	0	0:00:00

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Node Flow Summary
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Node ID	Element Type	Maximum Lateral Inflow cms	Peak Inflow cms	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cms	Time of Peak Flooding Occurrence days	hh:mm
15	JUNCTION	0.458	0.458	0	08:00	0.00		
77a	JUNCTION	0.000	4.977	0	08:09	0.00		
77b	JUNCTION	0.000	3.258	0	08:01	0.00		
Jun-01	JUNCTION	0.000	0.000	0	00:00	0.00		
Jun-02	JUNCTION	0.506	6.690	0	08:31	0.00		
Jun-03	JUNCTION	0.000	5.781	0	08:13	0.00		
Jun-04	JUNCTION	1.174	7.498	0	08:30	0.00		
Jun-05	JUNCTION	0.000	6.716	0	08:30	0.00		
Jun-06	JUNCTION	1.042	6.735	0	08:30	0.00		
Jun-109	JUNCTION	0.000	2.016	0	08:38	0.00		
Jun-11	JUNCTION	0.000	6.046	0	08:25	0.00		

Jun-16	JUNCTION	0.000	5.695	0	08:14	0.00
Jun-17	JUNCTION	0.000	5.661	0	08:14	0.00
Jun-18	JUNCTION	0.000	5.596	0	08:30	0.00
Jun-19	JUNCTION	0.000	5.579	0	08:32	0.00
Jun-20	JUNCTION	0.000	5.576	0	08:33	0.00
Jun-21	JUNCTION	0.000	5.575	0	08:34	0.00
Jun-22	JUNCTION	0.000	5.574	0	08:35	0.00
Jun-23	JUNCTION	0.000	5.574	0	08:36	0.00
Jun-24	JUNCTION	0.000	5.574	0	08:36	0.00
Jun-25	JUNCTION	0.000	5.575	0	08:36	0.00
Jun-26	JUNCTION	0.000	5.575	0	08:37	0.00
Jun-27	JUNCTION	0.000	5.576	0	08:37	0.00
Jun-28	JUNCTION	0.000	5.576	0	08:37	0.00
Jun-29	JUNCTION	0.000	5.577	0	08:37	0.00
Jun-30	JUNCTION	0.000	5.578	0	08:37	0.00
Jun-31	JUNCTION	0.000	5.578	0	08:37	0.00
Jun-32	JUNCTION	0.000	5.579	0	08:37	0.00
Jun-33	JUNCTION	1.303	6.370	0	08:32	0.00
Jun-34	JUNCTION	0.000	6.370	0	08:32	0.00
Jun-35	JUNCTION	0.000	6.370	0	08:32	0.00
Jun-36	JUNCTION	0.000	6.370	0	08:32	0.00
Jun-37	JUNCTION	0.000	6.370	0	08:32	0.00
Jun-38	JUNCTION	0.000	6.370	0	08:32	0.00
Jun-47	JUNCTION	0.000	6.370	0	08:33	0.00
Jun-49	JUNCTION	0.000	2.179	0	09:04	0.00
Jun-50	JUNCTION	0.000	2.230	0	09:05	0.00
Jun-51	JUNCTION	0.000	2.272	0	09:06	0.00
Jun-52	JUNCTION	2.345	4.182	0	08:56	0.00
Jun-53	JUNCTION	0.000	4.196	0	08:56	0.00
Jun-54	JUNCTION	0.000	4.200	0	08:56	0.00
Jun-55	JUNCTION	3.355	6.566	0	08:15	0.00
Jun-56	JUNCTION	0.000	6.495	0	08:14	0.00
Jun-57	JUNCTION	0.000	6.416	0	08:14	0.00
Jun-58	JUNCTION	0.000	6.268	0	08:13	0.00
Jun-59	JUNCTION	0.000	6.071	0	08:12	0.00
STA0+775	JUNCTION	0.321	0.321	0	08:00	0.00
STA0+925	JUNCTION	0.000	0.309	0	08:00	0.00
STA1+025	JUNCTION	0.000	1.543	0	08:22	0.00
STA1+150	JUNCTION	0.000	1.537	0	08:24	0.00
STA1+178	JUNCTION	0.000	1.729	0	08:24	0.00
STA1+200	JUNCTION	0.000	1.730	0	08:24	0.00
STA1+325	JUNCTION	0.000	1.739	0	08:25	0.00
STA1+450	JUNCTION	0.495	2.069	0	08:30	0.00
STA1+700	JUNCTION	0.000	2.022	0	08:36	0.00
ETLD-1	OUTFALL	0.000	0.060	0	08:26	0.00
ETLD-2a	OUTFALL	0.000	0.885	0	08:20	0.00
ETLD-2b	OUTFALL	0.000	0.178	0	08:28	0.00
ETLD-3	OUTFALL	0.000	0.057	0	08:26	0.00
ETLD-4	OUTFALL	0.000	0.083	0	08:30	0.00
Out-01	OUTFALL	0.000	7.476	0	00:00	0.00
Out-02	OUTFALL	0.000	1.858	0	08:34	0.00

Out-03	OUTFALL	0.000	0.000	0	00:00	0.00
Out-04	OUTFALL	0.000	0.000	0	00:00	0.00
Out-11	OUTFALL	2.341	5.473	0	08:00	0.00
CR22 Pond 19900m3	STORAGE	0.609	6.689	0	08:15	0.00
EX0	STORAGE	0.000	0.448	0	08:00	0.00
EX1	STORAGE	0.000	0.930	0	08:19	0.00
EX3	STORAGE	0.000	0.922	0	08:17	0.00
EX3868	STORAGE	0.924	2.962	0	08:00	0.00
EX3869	STORAGE	0.000	1.838	0	08:00	0.00
EX3870	STORAGE	0.000	1.622	0	07:56	0.00
EX3877(MHD)	STORAGE	2.200	2.200	0	08:00	0.00
EX4	STORAGE	0.848	3.259	0	08:01	0.00
EX4322	STORAGE	0.000	0.399	0	07:58	0.00
EX4351	STORAGE	0.000	1.383	0	08:00	0.00
EX4373	STORAGE	0.000	0.315	0	07:57	0.00
EX4374	STORAGE	0.000	0.239	0	08:46	0.00
EX4375	STORAGE	0.000	0.240	0	08:46	0.00
EX4389	STORAGE	0.480	0.480	0	08:00	0.00
EX4390	STORAGE	0.000	0.348	0	12:49	0.00
EX4419	STORAGE	0.000	0.604	0	12:03	0.00
EX4422	STORAGE	0.823	1.088	0	08:00	0.00
EX4469	STORAGE	1.973	1.973	0	08:00	0.00
EX4518	STORAGE	0.000	0.327	0	07:55	0.00
EX4528	STORAGE	0.622	0.651	0	08:02	0.00
EX4615	STORAGE	0.659	0.659	0	08:00	0.00
EX4650	STORAGE	0.000	0.614	0	11:41	0.00
EX4654	STORAGE	0.000	0.813	0	11:40	0.00
EX4658	STORAGE	0.000	0.395	0	12:04	0.00
EX4659	STORAGE	0.000	0.225	0	12:35	0.00
EX4668	STORAGE	0.000	0.347	0	07:51	0.00
EX4672	STORAGE	0.589	0.589	0	08:00	0.00
EX4678	STORAGE	0.000	0.283	0	07:50	0.00
EX4682	STORAGE	0.000	0.290	0	13:38	0.00
EX4686	STORAGE	0.000	0.288	0	13:38	0.00
EX4690	STORAGE	0.731	0.731	0	08:00	0.00
EX4694	STORAGE	0.000	0.171	0	07:55	0.00
EX4695	STORAGE	0.000	0.087	0	07:52	0.00
EX4702	STORAGE	0.000	0.168	0	08:03	0.00
EX4709	STORAGE	0.000	0.361	0	13:13	0.00
EX4710	STORAGE	0.000	0.360	0	13:12	0.00
EX4711	STORAGE	0.000	0.463	0	08:01	0.00
EX4712	STORAGE	0.000	0.498	0	07:50	0.00
EX4717	STORAGE	0.000	0.082	0	07:50	0.00
EX4719	STORAGE	0.845	0.845	0	08:00	0.00
EX4720	STORAGE	0.000	0.553	0	07:51	0.00
EX4721	STORAGE	0.000	0.322	0	08:00	0.00
EX4722	STORAGE	0.268	0.268	0	08:00	0.00
EX4725	STORAGE	0.000	0.252	0	14:57	0.00
EX4729	STORAGE	0.000	0.290	0	08:00	0.00
EX4737	STORAGE	0.475	0.475	0	08:00	0.00
EX4755	STORAGE	0.000	0.086	0	07:50	0.00

EX4809	STORAGE	0.336	0.502	0	07:59	0.00
EX4810	STORAGE	0.000	0.345	0	09:32	0.00
EX5	STORAGE	0.000	2.142	0	11:09	0.00
EX5069	STORAGE	0.000	0.347	0	09:34	0.00
EX5070	STORAGE	0.523	0.523	0	08:00	0.00
EX5077	STORAGE	0.000	0.296	0	07:55	0.00
EX5081	STORAGE	0.000	0.249	0	09:51	0.00
EX5085	STORAGE	0.000	0.088	0	07:55	0.00
Jun-1	STORAGE	3.163	3.163	0	08:00	0.00
Jun-300	STORAGE	0.000	0.545	0	07:48	0.00
Jun-310	STORAGE	0.000	0.683	0	08:01	0.00
Jun-315	STORAGE	2.940	3.315	0	08:15	0.00
Jun-320	STORAGE	3.227	5.992	0	08:15	0.00
Jun-95	STORAGE	0.000	2.000	0	07:50	0.00
MH1	STORAGE	1.472	9.852	0	08:20	0.00
MH100	STORAGE	0.000	1.961	0	07:57	0.00
MH102	STORAGE	0.000	0.657	0	07:57	0.00
MH103	STORAGE	0.000	0.375	0	10:16	0.00
MH105	STORAGE	0.000	0.369	0	10:16	0.00
MH106	STORAGE	0.000	0.472	0	07:52	0.00
MH107	STORAGE	0.000	0.165	0	07:53	0.00
MH108	STORAGE	0.000	0.087	0	07:54	0.00
MH11	STORAGE	0.000	8.285	0	08:39	0.00
MH14	STORAGE	0.000	8.282	0	08:38	0.00
MH15	STORAGE	0.000	0.000	0	00:00	0.00
MH16	STORAGE	0.000	0.000	0	00:00	0.00
MH20	STORAGE	0.000	0.000	0	00:00	0.00
MH21	STORAGE	0.000	7.866	0	08:38	0.00
MH22	STORAGE	0.000	0.040	0	08:16	0.00
MH23	STORAGE	0.000	0.007	0	08:22	0.00
MH25	STORAGE	0.000	0.000	0	00:00	0.00
MH28	STORAGE	0.000	0.000	0	00:00	0.00
MH3	STORAGE	0.000	0.000	0	00:00	0.00
MH31	STORAGE	0.000	7.311	0	08:59	0.00
MH35	STORAGE	0.000	7.295	0	09:00	0.00
MH36	STORAGE	0.000	0.380	0	08:01	0.00
MH38	STORAGE	0.000	0.325	0	08:03	0.00
MH40	STORAGE	0.000	0.248	0	08:03	0.00
MH43	STORAGE	0.000	0.188	0	08:06	0.00
MH46	STORAGE	0.000	0.098	0	08:07	0.00
MH5	STORAGE	0.000	0.000	0	00:00	0.00
MH50	STORAGE	0.000	6.519	0	08:59	0.00
MH51	STORAGE	0.000	1.219	0	07:55	0.00
MH52	STORAGE	0.000	1.191	0	07:56	0.00
MH53	STORAGE	0.000	1.264	0	08:01	0.00
MH54	STORAGE	0.000	0.160	0	07:50	0.00
MH55	STORAGE	0.000	0.068	0	07:50	0.00
MH58	STORAGE	0.000	0.479	0	07:58	0.00
MH59	STORAGE	0.000	0.442	0	09:28	0.00
MH61	STORAGE	0.000	0.180	0	07:52	0.00
MH62	STORAGE	0.000	0.254	0	08:00	0.00

MH63	STORAGE	0.000	0.174	0	08:00	0.00
MH64	STORAGE	0.000	0.098	0	08:01	0.00
MH67	STORAGE	0.000	0.260	0	09:39	0.00
MH69	STORAGE	0.000	0.291	0	08:09	0.00
MH7	STORAGE	0.000	0.000	0	00:00	0.00
MH71	STORAGE	0.000	0.142	0	07:58	0.00
MH72	STORAGE	0.000	0.076	0	07:57	0.00
MH76	STORAGE	0.000	4.975	0	08:09	0.00
MH77	STORAGE	0.000	2.024	0	09:40	0.00
MH78	STORAGE	0.000	2.010	0	09:40	0.00
MH79	STORAGE	0.000	2.290	0	07:56	0.00
MH8	STORAGE	0.000	0.000	0	00:00	0.00
MH80	STORAGE	0.000	0.545	0	10:08	0.00
MH82	STORAGE	0.000	0.534	0	10:08	0.00
MH85	STORAGE	0.000	0.564	0	07:52	0.00
MH86	STORAGE	0.000	0.630	0	07:53	0.00
MH89	STORAGE	0.000	0.372	0	10:07	0.00
MH90	STORAGE	0.000	0.367	0	10:06	0.00
MH93	STORAGE	0.000	0.331	0	08:19	0.00
MH94	STORAGE	0.000	0.206	0	08:01	0.00
MH95	STORAGE	0.000	0.133	0	08:01	0.00
MH97	STORAGE	0.000	1.769	0	07:56	0.00
MH99	STORAGE	0.000	1.848	0	07:56	0.00
MH-A	STORAGE	0.000	1.516	0	07:58	0.00
MH-C	STORAGE	0.000	1.614	0	07:58	0.00
SPA Pond_130360m3	STORAGE	0.000	10.166	0	08:18	0.00
Stor-02	STORAGE	0.000	0.000	0	00:00	0.00
Stor-SPA1	STORAGE	1.287	1.304	0	08:00	0.00
Stor-SPA100	STORAGE	0.924	0.924	0	08:00	0.00
Stor-SPA106	STORAGE	0.820	1.030	0	08:15	0.00
Stor-SPA14	STORAGE	0.719	0.719	0	08:00	0.00
Stor-SPA21	STORAGE	1.057	1.057	0	08:00	0.00
Stor-SPA35	STORAGE	1.324	1.324	0	08:00	0.00
Stor-SPA50	STORAGE	1.071	1.071	0	08:00	0.00
Stor-SPA51	STORAGE	2.453	2.453	0	08:00	0.00
Stor-SPA52	STORAGE	0.229	0.241	0	08:21	0.00
Stor-SPA62	STORAGE	0.295	0.295	0	08:00	0.00
Stor-SPA69	STORAGE	0.492	0.492	0	08:00	0.00
Stor-SPA79	STORAGE	1.028	1.028	0	08:00	0.00
Stor-SPA86	STORAGE	0.685	0.848	0	08:00	0.00
Stor-Spa86a	STORAGE	0.576	0.576	0	08:00	0.00

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Storage Node Summary
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Storage Node ID	Maximum Ponded Volume	Maximum Ponded Volume	Time of Max Ponded Volume	Average Ponded Volume	Average Ponded Volume	Maximum Storage Node Outflow	Maximum Exfiltration Rate	Time of Max. Exfiltration Rate	Total Exfiltrated Volume

	1000 m³	(%)	days	hh:mm	1000 m³	(%)	cms	cmm	hh:mm:ss	1000 m³
CR22 Pond 19900m3	25.108	37	0	11:03	5.626	8	2.00	0.00	0:00:00	0.000
EX0	0.002	0	0	08:03	0.000	0	0.40	0.00	0:00:00	0.000
EX1	0.003	0	0	08:03	0.000	0	0.92	0.00	0:00:00	0.000
EX3	0.002	0	0	08:02	0.000	0	0.92	0.00	0:00:00	0.000
EX3868	3.014	10	0	09:12	0.206	1	2.14	0.00	0:00:00	0.000
EX3869	0.192	1	0	08:17	0.003	0	1.62	0.00	0:00:00	0.000
EX3870	0.002	0	0	08:34	0.000	0	1.62	0.00	0:00:00	0.000
EX3877(MHD)	0.392	1	0	08:28	0.008	0	2.01	0.00	0:00:00	0.000
EX4	0.002	0	0	08:01	0.001	0	3.26	0.00	0:00:00	0.000
EX4322	0.001	0	0	08:03	0.000	0	0.31	0.00	0:00:00	0.000
EX4351	0.002	0	0	08:11	0.000	0	1.38	0.00	0:00:00	0.000
EX4373	0.031	0	0	08:28	0.000	0	0.24	0.00	0:00:00	0.000
EX4374	0.001	0	0	08:02	0.000	0	0.24	0.00	0:00:00	0.000
EX4375	0.002	0	0	08:02	0.000	0	0.24	0.00	0:00:00	0.000
EX4389	1.612	5	0	10:48	0.164	1	0.35	0.00	0:00:00	0.000
EX4390	0.942	3	0	09:04	0.057	0	0.35	0.00	0:00:00	0.000
EX4419	0.002	0	0	07:54	0.000	0	0.61	0.00	0:00:00	0.000
EX4422	1.122	4	0	09:07	0.083	0	0.60	0.00	0:00:00	0.000
EX4469	0.054	0	0	08:02	0.001	0	1.69	0.00	0:00:00	0.000
EX4518	0.035	0	0	08:16	0.000	0	0.26	0.00	0:00:00	0.000
EX4528	0.002	0	0	08:02	0.000	0	0.65	0.00	0:00:00	0.000
EX4615	0.003	0	0	08:00	0.000	0	0.65	0.00	0:00:00	0.000
EX4650	0.705	2	0	11:09	0.048	0	0.81	0.00	0:00:00	0.000
EX4654	0.002	0	0	09:19	0.000	0	0.81	0.00	0:00:00	0.000
EX4658	0.412	1	0	11:12	0.029	0	0.35	0.00	0:00:00	0.000
EX4659	0.963	3	0	10:12	0.089	0	0.40	0.00	0:00:00	0.000
EX4668	0.001	0	0	07:55	0.000	0	0.28	0.00	0:00:00	0.000
EX4672	0.502	2	0	08:41	0.024	0	0.35	0.00	0:00:00	0.000
EX4678	0.002	0	0	07:54	0.000	0	0.23	0.00	0:00:00	0.000
EX4682	0.024	0	0	07:55	0.000	0	0.29	0.00	0:00:00	0.000
EX4686	0.002	0	0	07:54	0.000	0	0.29	0.00	0:00:00	0.000
EX4690	0.195	1	0	08:17	0.004	0	0.48	0.00	0:00:00	0.000
EX4694	0.447	1	0	08:51	0.024	0	0.11	0.00	0:00:00	0.000
EX4695	0.001	0	0	07:54	0.000	0	0.06	0.00	0:00:00	0.000
EX4702	1.311	4	0	11:28	0.152	1	0.26	0.00	0:00:00	0.000
EX4709	0.002	0	0	07:56	0.000	0	0.36	0.00	0:00:00	0.000
EX4710	0.002	0	0	07:56	0.000	0	0.36	0.00	0:00:00	0.000
EX4711	0.976	3	0	09:58	0.118	0	0.36	0.00	0:00:00	0.000
EX4712	0.002	0	0	07:57	0.000	0	0.40	0.00	0:00:00	0.000
EX4717	0.002	0	0	07:56	0.000	0	0.03	0.00	0:00:00	0.000
EX4719	0.002	0	0	08:00	0.000	0	0.84	0.00	0:00:00	0.000
EX4720	0.037	0	0	08:05	0.001	0	0.50	0.00	0:00:00	0.000
EX4721	0.643	2	0	09:14	0.060	0	0.14	0.00	0:00:00	0.000
EX4722	0.736	2	0	10:45	0.116	0	0.14	0.00	0:00:00	0.000
EX4725	0.002	0	0	08:00	0.000	0	0.25	0.00	0:00:00	0.000
EX4729	1.418	5	0	10:22	0.217	1	0.25	0.00	0:00:00	0.000
EX4737	0.464	2	0	08:38	0.024	0	0.22	0.00	0:00:00	0.000
EX4755	0.509	2	0	12:25	0.049	0	0.23	0.00	0:00:00	0.000
EX4809	0.018	0	0	08:06	0.000	0	0.45	0.00	0:00:00	0.000

EX4810	0.015	0	0	08:17	0.000	0	0.35	0.00	0:00:00	0.000
EX5	0.002	0	0	08:01	0.001	0	2.14	0.00	0:00:00	0.000
EX5069	0.016	0	0	08:22	0.000	0	0.34	0.00	0:00:00	0.000
EX5070	0.498	2	0	08:37	0.016	0	0.44	0.00	0:00:00	0.000
EX5077	0.167	1	0	09:18	0.006	0	0.28	0.00	0:00:00	0.000
EX5081	0.103	0	0	09:40	0.004	0	0.26	0.00	0:00:00	0.000
EX5085	0.092	0	0	09:50	0.004	0	0.25	0.00	0:00:00	0.000
Jun-1	0.002	0	0	08:00	0.001	0	3.14	0.00	0:00:00	0.000
Jun-300	0.016	18	0	08:00	0.013	15	0.55	0.00	0:00:00	0.000
Jun-310	0.002	0	0	08:20	0.001	0	0.58	0.00	0:00:00	0.000
Jun-315	0.002	0	0	08:15	0.001	0	3.29	0.00	0:00:00	0.000
Jun-320	0.002	0	0	08:15	0.000	0	5.98	0.00	0:00:00	0.000
Jun-95	1.016	0	0	08:43	0.297	0	2.18	0.00	0:00:00	0.000
MH1	0.004	49	0	21:50	0.003	37	9.85	0.00	0:00:00	0.000
MH100	0.004	82	0	08:43	0.001	13	1.85	0.00	0:00:00	0.000
MH102	0.003	86	0	08:44	0.000	12	0.60	0.00	0:00:00	0.000
MH103	0.019	2	0	08:49	0.001	0	0.38	0.00	0:00:00	0.000
MH105	0.050	5	0	08:58	0.001	0	0.37	0.00	0:00:00	0.000
MH106	0.115	15	0	09:01	0.003	0	0.44	0.00	0:00:00	0.000
MH107	0.151	14	0	09:11	0.004	0	0.15	0.00	0:00:00	0.000
MH108	0.304	29	0	09:27	0.012	1	0.14	0.00	0:00:00	0.000
MH11	0.004	48	0	21:45	0.003	36	8.29	0.00	0:00:00	0.000
MH14	0.004	48	0	21:41	0.003	37	8.29	0.00	0:00:00	0.000
MH15	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH16	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH20	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH21	0.004	51	0	08:30	0.003	36	7.87	0.00	0:00:00	0.000
MH22	0.000	10	0	08:30	0.000	2	0.04	0.00	0:00:00	0.000
MH23	0.000	6	0	08:29	0.000	3	0.00	0.00	0:00:00	0.000
MH25	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH28	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH3	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH31	0.004	51	0	08:32	0.003	33	7.33	0.00	0:00:00	0.000
MH35	0.005	60	0	08:32	0.003	34	7.31	0.00	0:00:00	0.000
MH36	0.002	44	0	08:31	0.001	12	0.32	0.00	0:00:00	0.000
MH38	0.002	46	0	08:31	0.000	11	0.25	0.00	0:00:00	0.000
MH40	0.002	39	0	08:30	0.000	7	0.19	0.00	0:00:00	0.000
MH43	0.002	37	0	08:32	0.000	4	0.10	0.00	0:00:00	0.000
MH46	0.001	37	0	08:31	0.000	2	0.02	0.00	0:00:00	0.000
MH5	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH50	0.005	66	0	08:32	0.002	34	6.55	0.00	0:00:00	0.000
MH51	0.003	63	0	08:31	0.001	22	1.20	0.00	0:00:00	0.000
MH52	0.003	68	0	08:31	0.001	22	1.16	0.00	0:00:00	0.000
MH53	0.003	75	0	08:31	0.001	22	1.21	0.00	0:00:00	0.000
MH54	0.003	80	0	08:30	0.001	19	0.13	0.00	0:00:00	0.000
MH55	0.003	81	0	08:31	0.001	16	0.05	0.00	0:00:00	0.000
MH58	0.005	67	0	08:34	0.002	32	0.48	0.00	0:00:00	0.000
MH59	0.004	68	0	08:36	0.002	30	0.46	0.00	0:00:00	0.000
MH61	0.004	71	0	08:37	0.002	29	0.19	0.00	0:00:00	0.000
MH62	0.004	73	0	08:39	0.001	27	0.18	0.00	0:00:00	0.000
MH63	0.004	72	0	08:40	0.001	23	0.10	0.00	0:00:00	0.000

MH64	0.003	79	0	08:39	0.001	22	0.02	0.00	0:00:00	0.000
MH67	0.004	72	0	08:37	0.002	29	0.27	0.00	0:00:00	0.000
MH69	0.004	76	0	08:39	0.001	26	0.27	0.00	0:00:00	0.000
MH7	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH71	0.004	77	0	08:39	0.001	23	0.08	0.00	0:00:00	0.000
MH72	0.004	77	0	08:39	0.001	20	0.04	0.00	0:00:00	0.000
MH76	0.005	66	0	08:31	0.002	32	4.91	0.00	0:00:00	0.000
MH77	0.005	69	0	08:33	0.002	29	2.04	0.00	0:00:00	0.000
MH78	0.005	72	0	08:33	0.002	29	2.02	0.00	0:00:00	0.000
MH79	0.005	74	0	08:34	0.002	28	2.08	0.00	0:00:00	0.000
MH8	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
MH80	0.005	82	0	08:36	0.002	30	0.56	0.00	0:00:00	0.000
MH82	0.004	85	0	08:36	0.002	30	0.55	0.00	0:00:00	0.000
MH85	0.004	86	0	08:37	0.001	29	0.53	0.00	0:00:00	0.000
MH86	0.004	88	0	08:40	0.001	27	0.56	0.00	0:00:00	0.000
MH89	0.004	1	0	08:40	0.001	0	0.38	0.00	0:00:00	0.000
MH90	0.004	0	0	08:41	0.001	0	0.37	0.00	0:00:00	0.000
MH93	0.567	27	0	09:04	0.027	1	0.36	0.00	0:00:00	0.000
MH94	0.228	30	0	09:11	0.008	1	0.19	0.00	0:00:00	0.000
MH95	0.002	79	0	09:10	0.000	8	0.10	0.00	0:00:00	0.000
MH97	0.004	69	0	08:36	0.001	15	1.70	0.00	0:00:00	0.000
MH99	0.004	75	0	08:37	0.001	13	1.77	0.00	0:00:00	0.000
MH-A	0.003	0	0	08:41	0.000	0	1.41	0.00	0:00:00	0.000
MH-C	0.003	0	0	08:36	0.000	0	1.52	0.00	0:00:00	0.000
SPA Pond_130360m3	122.671	61	0	21:53	88.003	44	0.55	0.00	0:00:00	0.000
Stor-02	0.000	0	0	00:00	0.000	0	0.00	0.00	0:00:00	0.000
Stor-SPA1	0.334	32	0	08:16	0.006	1	1.06	0.00	0:00:00	0.000
Stor-SPA100	0.267	34	0	08:19	0.010	1	0.63	0.00	0:00:00	0.000
Stor-SPA106	0.474	70	0	08:24	0.020	3	0.91	0.00	0:00:00	0.000
Stor-SPA14	0.173	20	0	08:16	0.004	0	0.58	0.00	0:00:00	0.000
Stor-SPA21	0.206	17	0	08:16	0.003	0	0.78	0.00	0:00:00	0.000
Stor-SPA35	0.593	38	0	08:26	0.018	1	0.80	0.00	0:00:00	0.000
Stor-SPA50	0.419	33	0	08:23	0.012	1	0.69	0.00	0:00:00	0.000
Stor-SPA51	0.818	48	0	08:20	0.020	1	1.64	0.00	0:00:00	0.000
Stor-SPA52	0.142	42	0	08:28	0.011	3	0.23	0.00	0:00:00	0.000
Stor-SPA62	0.108	31	0	08:26	0.004	1	0.20	0.00	0:00:00	0.000
Stor-SPA69	0.190	36	0	08:30	0.007	1	0.29	0.00	0:00:00	0.000
Stor-SPA79	0.150	22	0	08:16	0.004	1	0.86	0.00	0:00:00	0.000
Stor-SPA86	0.275	38	0	08:22	0.009	1	0.68	0.00	0:00:00	0.000
Stor-Spa86a	0.122	56	0	08:10	0.002	1	0.40	0.00	0:00:00	0.000

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Outfall Loading Summary
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Outfall Node ID	Flow Frequency (%)	Average Flow cms	Peak Inflow cms

ETLD-1	2.60	0.035	0.060
ETLD-2a	4.02	0.513	0.885
ETLD-2b	9.15	0.070	0.178
ETLD-3	2.58	0.031	0.057
ETLD-4	3.33	0.046	0.083
Out-01	100.00	1.751	7.476
Out-02	6.48	0.993	1.858
Out-03	0.00	0.000	0.000
Out-04	0.00	0.000	0.000
Out-11	99.73	0.287	5.473
System	22.79	3.725	12.641

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Link Flow Summary
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Link ID	Element Type	Time of Peak Flow Occurrence days hh:mm	Maximum Velocity Attained m/sec	Length Factor	Peak Flow during Analysis cms	Design Flow Capacity cms	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged minutes	Reported Condition
1	CONDUIT	0 08:00	2.05	1.00	3.137	3.766	0.83	0.81	0	Calculated
Culvert D10	CONDUIT	0 08:36	0.92	1.00	5.574	1.961	2.84	0.93	0	> CAPACITY
Culvert D11	CONDUIT	0 08:52	0.56	1.00	5.185	58.206	0.09	1.00	0	Calculated
Culvert D12	CONDUIT	0 08:37	1.04	1.00	5.576	17.268	0.32	0.89	0	Calculated
Culvert D13	CONDUIT	0 08:37	0.92	1.00	5.577	23.990	0.23	0.84	0	Calculated
Culvert D14	CONDUIT	0 08:37	1.11	1.00	5.578	31.021	0.18	0.83	0	Calculated
Culvert D15	CONDUIT	0 08:38	1.05	1.00	5.579	30.653	0.18	0.79	0	Calculated
Culvert D16	CONDUIT	0 08:32	1.53	1.00	6.370	33.465	0.19	0.73	0	Calculated
Culvert D17	CONDUIT	0 08:32	1.07	1.00	6.370	4.421	1.44	0.55	0	> CAPACITY
Culvert D7	CONDUIT	0 08:14	1.07	1.00	5.661	84.130	0.07	1.00	38	SURCHARGED
Culvert D8	CONDUIT	0 08:32	0.89	1.00	5.579	33.017	0.17	0.95	0	Calculated
Culvert D9	CONDUIT	0 08:34	0.88	1.00	5.575	16.263	0.34	0.95	0	Calculated
Culvert R1	CONDUIT	0 08:30	0.70	1.00	6.716	26.948	0.25	1.00	23	SURCHARGED
Culvert R2	CONDUIT	0 08:09	0.73	1.00	5.314	9.320	0.57	1.00	280	SURCHARGED
Cyr Drain	CHANNEL	0 09:02	0.74	1.00	1.614	50.008	0.03	0.21	0	Calculated
CYR-1	CHANNEL	0 08:00	0.51	1.00	0.309	10.887	0.03	0.22	0	Calculated
CYR-2	CHANNEL	0 08:01	0.54	1.00	0.294	25.524	0.01	0.31	0	Calculated
CYR-3	CHANNEL	0 08:24	0.72	1.00	1.537	13.325	0.12	0.39	0	Calculated
CYR-4	CHANNEL	0 08:26	0.80	1.00	1.539	14.919	0.10	0.40	0	Calculated
CYR-5	CHANNEL	0 08:24	0.96	1.00	1.730	14.696	0.12	0.39	0	Calculated
CYR-6	CHANNEL	0 08:25	0.71	1.00	1.739	17.768	0.10	0.35	0	Calculated
CYR-7	CHANNEL	0 08:32	0.26	1.00	1.668	110.612	0.02	0.41	0	Calculated
CYR-8	CHANNEL	0 08:36	0.90	1.00	2.022	17.630	0.11	0.41	0	Calculated
CYR-9	CHANNEL	0 08:38	0.85	1.00	2.016	28.754	0.07	0.57	0	Calculated
Drain R1	CHANNEL	0 08:32	0.75	1.00	6.014	9.834	0.61	0.76	0	Calculated
Drain R2	CHANNEL	0 08:32	0.75	1.00	6.691	11.455	0.58	0.88	0	Calculated
Drain R3	CHANNEL	0 08:14	0.71	1.00	3.149	24.381	0.13	0.90	0	Calculated

Enclosed_ETLD1	CONDUIT	0	08:01	1.19	1.00	0.549	0.606	0.91	0.87	0	Calculated
EX14a	CONDUIT	0	11:40	1.14	1.00	0.407	0.299	1.36	1.00	361	SURCHARGED
EX14b	CONDUIT	0	11:40	1.14	1.00	0.407	0.299	1.36	1.00	361	SURCHARGED
EX15b	CONDUIT	0	11:40	1.14	1.00	0.407	0.293	1.39	1.00	369	SURCHARGED
EXB1	CONDUIT	0	07:52	0.41	1.00	0.087	0.140	0.62	1.00	345	SURCHARGED
EXB10	CONDUIT	0	12:04	1.10	1.00	0.395	0.302	1.31	1.00	305	SURCHARGED
EXB11	CONDUIT	0	12:03	0.99	1.00	0.355	0.174	2.04	1.00	321	SURCHARGED
EXB12a	CONDUIT	0	12:03	0.84	1.00	0.302	0.299	1.01	1.00	350	SURCHARGED
EXB12b	CONDUIT	0	12:03	0.84	1.00	0.302	0.299	1.01	1.00	350	SURCHARGED
EXB13a	CONDUIT	0	11:41	0.86	1.00	0.307	0.391	0.79	1.00	353	SURCHARGED
EXB13b	CONDUIT	0	11:41	0.86	1.00	0.307	0.391	0.79	1.00	353	SURCHARGED
EXB15a	CONDUIT	0	11:40	1.14	1.00	0.407	0.293	1.39	1.00	369	SURCHARGED
EXB2	CONDUIT	0	07:52	0.75	1.00	0.162	0.162	1.00	1.00	348	SURCHARGED
EXB3	CONDUIT	0	13:38	0.88	1.00	0.288	0.262	1.10	1.00	348	SURCHARGED
EXB4	CONDUIT	0	13:38	0.81	1.00	0.290	0.309	0.94	1.00	349	SURCHARGED
EXB5	CONDUIT	0	13:38	0.82	1.00	0.292	0.256	1.14	1.00	349	SURCHARGED
EXB6	CONDUIT	0	13:38	1.19	1.00	0.257	0.139	1.84	1.00	347	SURCHARGED
EXB7	CONDUIT	0	07:51	1.24	1.00	0.347	0.228	1.53	1.00	285	SURCHARGED
EXB8	CONDUIT	0	07:50	0.98	1.00	0.283	0.377	0.75	1.00	286	SURCHARGED
EXB9	CONDUIT	0	12:35	0.87	1.00	0.225	0.224	1.01	1.00	290	SURCHARGED
EXG1	CONDUIT	0	09:51	0.56	1.00	0.249	0.305	0.81	1.00	124	SURCHARGED
EXG2	CONDUIT	0	09:52	0.57	1.00	0.251	0.280	0.90	1.00	125	SURCHARGED
EXG3	CONDUIT	0	07:55	0.68	1.00	0.296	0.309	0.96	1.00	127	SURCHARGED
EXG4	CONDUIT	0	09:34	0.78	1.00	0.347	0.290	1.19	1.00	133	SURCHARGED
EXG5	CONDUIT	0	09:32	0.78	1.00	0.345	0.323	1.07	1.00	140	SURCHARGED
EXG6	CONDUIT	0	09:33	0.78	1.00	0.345	0.277	1.25	1.00	159	SURCHARGED
EXG7	CONDUIT	0	08:00	0.70	1.00	0.448	1.220	0.37	1.00	152	SURCHARGED
EXG8	CONDUIT	0	09:33	0.62	1.00	0.398	0.418	0.95	1.00	271	SURCHARGED
EXO1	CONDUIT	0	07:50	0.30	1.00	0.082	0.166	0.49	1.00	430	SURCHARGED
EXO10	CONDUIT	0	11:09	1.89	1.00	2.142	0.882	2.43	1.00	205	SURCHARGED
EXO11	CONDUIT	0	08:01	2.49	1.00	3.258	1.195	2.73	0.88	0	> CAPACITY
EXO12	CONDUIT	0	13:25	1.06	1.00	0.230	0.135	1.71	1.00	335	SURCHARGED
EXO13	CONDUIT	0	12:49	1.23	1.00	0.348	0.172	2.02	1.00	337	SURCHARGED
EXO14	CONDUIT	0	12:49	1.25	1.00	0.349	0.176	1.99	1.00	292	SURCHARGED
EXO15	CONDUIT	0	08:00	1.60	1.00	1.383	0.646	2.14	1.00	234	SURCHARGED
EXO16	CONDUIT	0	08:00	1.22	1.00	1.383	1.784	0.78	1.00	221	SURCHARGED
EXO2	CONDUIT	0	14:18	1.15	1.00	0.326	0.259	1.26	1.00	433	SURCHARGED
EXO3	CONDUIT	0	13:12	1.01	1.00	0.360	0.243	1.48	1.00	432	SURCHARGED
EXO4	CONDUIT	0	13:13	1.01	1.00	0.361	0.259	1.39	1.00	412	SURCHARGED
EXO5	CONDUIT	0	13:13	1.01	1.00	0.361	0.258	1.40	1.00	398	SURCHARGED
EXO6	CONDUIT	0	08:00	1.27	1.00	0.455	0.228	2.00	1.00	343	SURCHARGED
EXO7	CONDUIT	0	07:56	1.43	1.00	1.622	7.926	0.20	1.00	280	SURCHARGED
EXO8	CONDUIT	0	07:56	1.43	1.00	1.622	1.313	1.24	1.00	292	SURCHARGED
EXO9	CONDUIT	0	11:09	1.89	1.00	2.142	1.346	1.59	1.00	259	SURCHARGED
EXPK10	CONDUIT	0	08:19	1.01	1.00	0.646	0.359	1.80	1.00	135	SURCHARGED
EXPK11	CONDUIT	0	08:17	1.45	1.00	0.922	0.395	2.34	1.00	304	SURCHARGED
EXPK12	CONDUIT	0	08:18	1.07	1.00	0.924	0.978	0.94	1.00	262	SURCHARGED
EXPK4	CONDUIT	0	07:58	1.41	1.00	0.399	0.200	2.00	1.00	62	SURCHARGED
EXPK5	CONDUIT	0	07:57	1.14	1.00	0.315	0.194	1.62	1.00	62	SURCHARGED
EXPK6	CONDUIT	0	08:46	0.84	1.00	0.239	0.166	1.44	1.00	68	SURCHARGED
EXPK7	CONDUIT	0	08:46	0.85	1.00	0.240	0.168	1.43	1.00	79	SURCHARGED

EXPK8	CONDUIT	0	08:46	0.47	1.00	0.241	0.706	0.34	1.00	67	SURCHARGED
EXPK9	CONDUIT	0	07:55	0.57	1.00	0.327	0.738	0.44	1.00	86	SURCHARGED
EXY1	CONDUIT	0	07:50	1.04	1.00	0.225	0.136	1.65	1.00	431	SURCHARGED
EXY2	CONDUIT	0	14:57	1.16	1.00	0.252	0.144	1.74	1.00	433	SURCHARGED
EXY3	CONDUIT	0	14:57	0.89	1.00	0.252	0.192	1.31	1.00	433	SURCHARGED
EXY4	CONDUIT	0	07:51	1.25	1.00	0.553	0.300	1.84	1.00	430	SURCHARGED
EXY5	CONDUIT	0	14:23	0.66	1.00	0.144	0.147	0.98	1.00	431	SURCHARGED
EXY6	CONDUIT	0	08:00	1.10	1.00	0.312	0.197	1.58	1.00	433	SURCHARGED
EXY7	CONDUIT	0	07:50	1.13	1.00	0.498	0.302	1.65	1.00	430	SURCHARGED
Link-01	CONDUIT	0	08:09	1.44	1.00	4.975	5.419	0.92	1.00	1473	SURCHARGED
Link-04	CONDUIT	0	07:59	2.22	1.00	1.412	0.906	1.56	1.00	149	SURCHARGED
Link-109	CONDUIT	0	08:42	1.26	1.00	0.575	0.608	0.95	1.00	68	SURCHARGED
Link-110	CONDUIT	0	08:15	1.92	1.00	3.291	2.732	1.20	0.93	0	> CAPACITY
Link-111	CONDUIT	0	08:15	2.32	1.00	5.983	8.212	0.73	0.60	0	Calculated
Link-12	CHANNEL	0	08:30	0.55	1.00	5.596	11.610	0.48	0.97	0	Calculated
Link-14	CHANNEL	0	08:33	0.66	1.00	5.576	6.816	0.82	0.92	0	Calculated
Link-16	CHANNEL	0	08:35	0.63	1.00	5.574	1.608	3.47	0.85	0	> CAPACITY
Link-18	CHANNEL	0	08:36	0.64	1.00	5.574	18.603	0.30	0.87	0	Calculated
Link-20	CHANNEL	0	08:37	0.64	1.00	5.575	24.695	0.23	0.86	0	Calculated
Link-22	CHANNEL	0	08:37	0.69	1.00	5.576	15.310	0.36	0.85	0	Calculated
Link-23	CONDUIT	0	08:01	2.45	1.00	3.239	2.534	1.28	1.00	118	SURCHARGED
Link-24	CHANNEL	0	08:37	0.72	1.00	5.578	52.989	0.11	0.66	0	Calculated
Link-26	CHANNEL	0	08:37	0.71	1.00	5.579	79.596	0.07	0.63	0	Calculated
Link-28	CHANNEL	0	08:32	0.84	1.00	6.370	28.828	0.22	0.62	0	Calculated
Link-30	CHANNEL	0	08:32	1.09	1.00	6.370	19.120	0.33	0.58	0	Calculated
Link-32	CHANNEL	0	08:32	1.65	1.00	6.370	32.829	0.19	0.42	0	Calculated
Link-33	CONDUIT	0	08:00	0.51	1.00	0.442	1.328	0.33	0.87	0	Calculated
Link-38	CHANNEL	0	08:20	0.47	1.00	2.646	1.042	2.54	0.86	0	> CAPACITY
Link-42	CONDUIT	0	08:33	1.35	1.00	6.370	9.180	0.69	0.87	0	Calculated
Link-43	CONDUIT	0	08:34	1.48	1.00	6.372	10.583	0.60	0.85	0	Calculated
Link-44	CONDUIT	0	00:00	0.00	1.00	0.000	202.438	0.00	0.00	0	Calculated
Link-45	CONDUIT	0	00:00	0.00	1.00	0.000	0.740	0.00	0.00	0	Calculated
Link-46	CONDUIT	0	00:00	0.00	1.00	0.000	0.737	0.00	0.00	0	Calculated
Link-48	CONDUIT	0	00:00	0.00	1.00	0.000	0.826	0.00	0.00	0	Calculated
Link-49	CONDUIT	0	00:00	0.00	1.00	0.000	0.721	0.00	0.00	0	Calculated
Link-51	CONDUIT	0	09:04	1.05	1.00	2.179	5.984	0.36	0.85	0	Calculated
Link-52	CONDUIT	0	09:05	0.85	1.00	2.230	5.796	0.38	0.94	0	Calculated
Link-53	CONDUIT	0	09:06	0.79	1.00	2.272	8.827	0.26	1.00	0	Calculated
Link-54	CONDUIT	0	09:06	0.83	1.00	2.294	4.838	0.47	0.99	0	Calculated
Link-55	CONDUIT	0	08:56	1.08	1.00	4.196	1.781	2.36	0.87	0	> CAPACITY
Link-56	CONDUIT	0	08:56	2.38	1.00	4.200	4.680	0.90	1.00	31	SURCHARGED
Link-57	CONDUIT	0	08:55	1.43	1.00	4.214	10.377	0.41	0.88	0	Calculated
Link-58	CONDUIT	0	08:14	1.90	1.00	6.495	8.600	0.76	0.98	0	Calculated
Link-59	CONDUIT	0	08:14	0.97	1.00	6.416	20.115	0.32	0.99	0	Calculated
Link-60	CONDUIT	0	08:13	1.46	1.00	6.268	8.654	0.72	1.00	14	SURCHARGED
Link-61	CONDUIT	0	00:00	0.00	1.00	0.000	0.903	0.00	0.00	0	Calculated
Link-63	CONDUIT	0	08:12	0.84	1.00	6.071	20.979	0.29	1.00	44	SURCHARGED
Link-64	CONDUIT	0	08:25	1.16	1.00	6.046	9.294	0.65	1.00	56	SURCHARGED
Link-C-A	CONDUIT	0	07:58	2.38	1.00	1.516	0.784	1.93	1.00	116	SURCHARGED
LinkD-C	CONDUIT	0	07:58	2.54	1.00	1.614	0.468	3.45	1.00	92	SURCHARGED
PipeA	CONDUIT	0	08:10	1.42	1.00	4.910	5.614	0.87	1.00	1596	SURCHARGED

Pipe-B	CONDUIT	0	08:59	1.89	1.00	6.547	5.821	1.12	1.00	1874	SURCHARGED
Pipe-C	CONDUIT	0	08:59	2.11	1.00	7.311	5.202	1.41	1.00	2147	SURCHARGED
Pipe-D	CONDUIT	0	08:59	2.11	1.00	7.325	5.211	1.41	1.00	2315	SURCHARGED
Pipe-E	CONDUIT	0	08:38	2.27	1.00	7.872	5.419	1.45	1.00	2403	SURCHARGED
Pipe-F	CONDUIT	0	08:39	2.39	1.00	8.285	5.628	1.47	1.00	2400	SURCHARGED
Pipe-G	CONDUIT	0	08:39	2.39	1.00	8.289	5.619	1.48	1.00	2336	SURCHARGED
PipeTo-Pond	CONDUIT	0	08:20	3.11	1.00	9.852	5.419	1.82	1.00	2271	SURCHARGED
SPAB1	CONDUIT	0	00:00	0.00	1.00	0.000	0.219	0.00	0.00	0	Calculated
SPAB2	CONDUIT	0	00:00	0.00	1.00	0.000	0.255	0.00	0.06	0	Calculated
SPAB3	CONDUIT	0	08:22	0.11	1.00	0.007	0.326	0.02	0.28	0	Calculated
SPAB4	CONDUIT	0	08:16	0.26	1.00	0.040	0.432	0.09	0.56	0	Calculated
SPABL1	CONDUIT	0	00:00	0.00	1.00	0.000	0.208	0.00	0.00	0	Calculated
SPABL2	CONDUIT	0	00:00	0.00	1.00	0.000	0.238	0.00	0.00	0	Calculated
SPABL3	CONDUIT	0	00:00	0.00	1.00	0.000	0.342	0.00	0.00	0	Calculated
SPAG1	CONDUIT	0	08:01	0.55	1.00	0.133	0.213	0.62	1.00	141	SURCHARGED
SPAG2	CONDUIT	0	08:01	0.58	1.00	0.206	0.334	0.62	1.00	222	SURCHARGED
SPAG3	CONDUIT	0	10:06	0.76	1.00	0.337	0.376	0.90	1.00	1036	SURCHARGED
SPAG4	CONDUIT	0	10:07	0.84	1.00	0.372	0.433	0.86	1.00	1362	SURCHARGED
SPAG5	CONDUIT	0	10:10	0.59	1.00	0.378	0.568	0.67	1.00	1420	SURCHARGED
SPAG6	CONDUIT	0	07:52	0.99	1.00	0.564	0.567	0.99	1.00	1607	SURCHARGED
SPAG8	CONDUIT	0	10:08	0.63	1.00	0.545	0.749	0.73	1.00	1830	SURCHARGED
SPAG9	CONDUIT	0	10:08	0.64	1.00	0.557	0.755	0.74	1.00	2054	SURCHARGED
SPAO1	CONDUIT	0	07:57	0.41	1.00	0.076	0.171	0.44	1.00	1709	SURCHARGED
SPAO2	CONDUIT	0	07:58	0.51	1.00	0.142	0.206	0.69	1.00	1929	SURCHARGED
SPAO3	CONDUIT	0	09:39	1.06	1.00	0.260	0.266	0.98	1.00	2158	SURCHARGED
SPAO4	CONDUIT	0	09:38	0.76	1.00	0.272	0.326	0.84	1.00	2407	SURCHARGED
SPAO5	CONDUIT	0	09:28	0.73	1.00	0.464	0.647	0.72	1.00	2407	SURCHARGED
SPAO6	CONDUIT	0	09:28	0.76	1.00	0.485	0.666	0.73	1.00	2409	SURCHARGED
SPAPK1	CONDUIT	0	08:01	0.52	1.00	0.098	0.158	0.62	1.00	1429	SURCHARGED
SPAPK2	CONDUIT	0	08:00	0.83	1.00	0.174	0.187	0.93	1.00	1726	SURCHARGED
SPAPK3	CONDUIT	0	09:27	0.90	1.00	0.176	0.266	0.66	1.00	2152	SURCHARGED
SPAPK4	CONDUIT	0	09:28	0.66	1.00	0.187	0.266	0.70	1.00	2407	SURCHARGED
SPAPL1	CONDUIT	0	00:00	0.00	1.00	0.000	0.154	0.00	0.00	0	Calculated
SPAPL2	CONDUIT	0	00:00	0.00	1.00	0.000	0.167	0.00	0.00	0	Calculated
SPAPL3	CONDUIT	0	00:00	0.00	1.00	0.000	0.301	0.00	0.00	0	Calculated
SPAPL4	CONDUIT	0	00:00	0.00	1.00	0.000	0.342	0.00	0.00	0	Calculated
SPAR1	CONDUIT	0	08:07	0.52	1.00	0.098	0.154	0.64	1.00	86	SURCHARGED
SPAR2	CONDUIT	0	08:06	0.77	1.00	0.188	0.238	0.79	1.00	99	SURCHARGED
SPAR3	CONDUIT	0	08:03	0.80	1.00	0.248	0.397	0.62	1.00	107	SURCHARGED
SPAR4	CONDUIT	0	08:03	0.79	1.00	0.325	0.483	0.67	1.00	122	SURCHARGED
SPAR5	CONDUIT	0	08:01	0.78	1.00	0.380	0.556	0.68	1.00	556	SURCHARGED
SPAY1	CONDUIT	0	07:50	0.37	1.00	0.068	0.167	0.41	1.00	184	SURCHARGED
SPAY2	CONDUIT	0	07:50	0.40	1.00	0.160	0.374	0.43	1.00	186	SURCHARGED
SPAY3	CONDUIT	0	07:56	1.37	1.00	1.191	1.006	1.18	1.00	167	SURCHARGED
SPAY4	CONDUIT	0	07:55	1.36	1.00	1.162	1.005	1.16	1.00	777	SURCHARGED
SPAY5	CONDUIT	0	07:54	1.68	1.00	1.199	1.003	1.19	1.00	1420	SURCHARGED
SPG7	CONDUIT	0	10:08	0.86	1.00	0.534	0.565	0.95	1.00	1822	SURCHARGED
Z1	CONDUIT	0	09:37	1.15	1.00	2.039	2.212	0.92	1.00	1984	SURCHARGED
Z10	CONDUIT	0	10:16	0.95	1.00	0.369	0.362	1.02	1.00	158	SURCHARGED
Z11	CONDUIT	0	07:53	0.59	1.00	0.165	0.206	0.80	1.00	156	SURCHARGED
Z12	CONDUIT	0	10:13	0.66	1.00	0.144	0.154	0.94	1.00	152	SURCHARGED

Z2	CONDUIT	0	09:40	1.15	1.00	2.024	2.211	0.92	1.00	1832	SURCHARGED
Z3	CONDUIT	0	09:40	1.14	1.00	2.010	2.031	0.99	1.00	1621	SURCHARGED
Z4	CONDUIT	0	07:55	1.79	1.00	1.697	1.434	1.18	1.00	176	SURCHARGED
Z5	CONDUIT	0	07:56	1.59	1.00	1.769	1.393	1.27	1.00	164	SURCHARGED
Z6	CONDUIT	0	07:56	1.63	1.00	1.848	1.394	1.33	1.00	160	SURCHARGED
Z7	CONDUIT	0	07:56	0.94	1.00	0.595	0.647	0.92	1.00	171	SURCHARGED
Z8	CONDUIT	0	10:17	0.72	1.00	0.382	0.584	0.65	1.00	163	SURCHARGED
Z9	CONDUIT	0	10:16	0.93	1.00	0.375	0.386	0.97	1.00	162	SURCHARGED
LowFlowPump	PUMP	0	04:11			0.045		1.00		473	
Pump-02	PUMP	0	07:48			0.500		1.00		2412	
Pump-03	PUMP	0	07:50			2.000		1.00		2868	
16	ORIFICE	0	08:04			0.351			1.00		
SPA1	ORIFICE	0	08:16			0.738			1.00		
SPA100	ORIFICE	0	07:56			0.525			1.00		
SPA106	ORIFICE	0	07:52			0.472			1.00		
SPA14	ORIFICE	0	08:16			0.417			1.00		
SPA21	ORIFICE	0	08:16			0.722			1.00		
SPA35	ORIFICE	0	08:26			0.739			1.00		
SPA50	ORIFICE	0	08:23			0.636			1.00		
SPA51	ORIFICE	0	08:01			1.264			1.00		
SPA52	ORIFICE	0	08:15			0.059			1.00		
SPA62	ORIFICE	0	08:13			0.173			1.00		
SPA69	ORIFICE	0	08:09			0.291			1.00		
SPA79	ORIFICE	0	08:04			0.613			1.00		
SPA86	ORIFICE	0	08:01			0.490			1.00		
01	WEIR	0	08:16			0.165			0.17		
02	WEIR	0	08:16			0.325			0.26		
03	WEIR	0	08:20			0.885			0.51		
04	WEIR	0	08:16			0.055			0.08		
05	WEIR	0	08:26			0.060			0.11		
06	WEIR	0	08:28			0.178			0.18		
07	WEIR	0	08:23			0.025			0.05		
08	WEIR	0	08:16			0.274			0.23		
09	WEIR	0	08:19			0.423			0.31		
10	WEIR	0	08:26			0.057			0.08		
11	WEIR	0	08:30			0.083			0.11		
12	WEIR	0	08:24			0.906			0.52		
13	WEIR	0	08:22			0.452			0.33		
14	WEIR	0	08:23			0.025			0.05		
15	WEIR	0	08:10			0.063			0.09		
Weir-01	WEIR	0	00:00			0.000			0.00		
Weir-02	WEIR	0	08:32			2.149			0.96		
Weir-03	WEIR	0	00:00			0.000			0.00		
Weir-04	WEIR	0	00:00			0.000			0.00		
Weir-05	WEIR	0	00:00			0.000			0.00		
Weir-07	WEIR	0	00:00			0.000			0.00		
Weir-08	WEIR	0	00:00			0.000			0.00		
Weir-09	WEIR	0	00:00			0.000			0.00		
Weir-10	WEIR	0	08:34			1.157			0.48		
Weir-11	WEIR	0	08:35			0.397			0.39		
Weir-12	WEIR	0	00:00			0.000			0.00		

Weir-15	WEIR	0	00:00	0.000	0.00
Weir-16	WEIR	0	00:00	0.000	0.00
Weir-17	WEIR	0	00:00	0.000	0.00
Weir-19	WEIR	0	08:34	1.858	0.95
Weir-20	WEIR	0	00:00	0.000	0.00
Weir-39	WEIR	0	00:00	0.000	0.00
Outlet-01	OUTLET	0	00:00	7.476	

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Flow Classification Summary
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	--- Fraction of Time in Flow Class ----							Avg.	Avg.
Link	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Froude Number	Flow Change
1	0.00	0.03	0.00	0.00	0.00	0.97	0.00	0.17	0.0000
Culvert D10	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.18	0.0000
Culvert D11	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.11	0.0000
Culvert D12	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.19	0.0000
Culvert D13	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.19	0.0000
Culvert D14	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.19	0.0000
Culvert D15	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.20	0.0000
Culvert D16	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.27	0.0000
Culvert D17	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.18	0.0000
Culvert D7	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.14	0.0001
Culvert D8	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.16	0.0000
Culvert D9	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.17	0.0000
Culvert R1	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.11	0.0000
Culvert R2	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.12	0.0000
Cyr Drain	0.05	0.00	0.00	0.00	0.00	0.00	0.95	0.20	0.0000
CYR-1	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.22	0.0000
CYR-2	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.21	0.0000
CYR-3	0.02	0.00	0.00	0.98	0.00	0.00	0.00	0.19	0.0000
CYR-4	0.04	0.00	0.00	0.88	0.00	0.00	0.08	0.20	0.0000
CYR-5	0.12	0.00	0.00	0.88	0.00	0.00	0.00	0.16	0.0000
CYR-6	0.12	0.00	0.00	0.88	0.00	0.00	0.00	0.24	0.0000
CYR-7	0.00	0.12	0.00	0.88	0.00	0.00	0.00	0.04	0.0000
CYR-8	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.29	0.0000
CYR-9	0.03	0.00	0.00	0.97	0.00	0.00	0.00	0.15	0.0000
Drain R1	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.19	0.0000
Drain R2	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.23	0.0000
Drain R3	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.16	0.0000
Enclosed_ETLD1	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.48	0.0000
EX14a	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.27	0.0000
EX14b	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.27	0.0000
EX15b	0.00	0.00	0.00	0.96	0.00	0.00	0.04	0.22	0.0000
EXB1	0.13	0.01	0.00	0.21	0.00	0.00	0.65	0.02	0.0001
EXB10	0.00	0.00	0.00	0.27	0.00	0.00	0.72	0.48	0.0000

EXB11	0.01	0.00	0.00	0.44	0.00	0.00	0.55	0.23	0.0000
EXB12a	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.37	0.0000
EXB12b	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.37	0.0000
EXB13a	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.38	0.0000
EXB13b	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.38	0.0000
EXB15a	0.00	0.00	0.00	0.96	0.00	0.00	0.04	0.22	0.0000
EXB2	0.09	0.56	0.00	0.35	0.00	0.00	0.00	0.00	0.0000
EXB3	0.00	0.00	0.00	0.29	0.00	0.00	0.71	0.35	0.0000
EXB4	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.36	0.0000
EXB5	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.22	0.0000
EXB6	0.06	0.54	0.00	0.41	0.00	0.00	0.00	0.00	0.0001
EXB7	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.36	0.0000
EXB8	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.22	0.0000
EXB9	0.00	0.00	0.00	0.19	0.00	0.00	0.80	0.30	0.0000
EXG1	0.14	0.00	0.00	0.21	0.00	0.00	0.65	0.00	0.0000
EXG2	0.58	0.14	0.00	0.28	0.00	0.00	0.00	0.01	0.0000
EXG3	0.04	0.54	0.00	0.42	0.00	0.00	0.00	0.01	0.0000
EXG4	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.28	0.0000
EXG5	0.00	0.00	0.00	0.95	0.00	0.00	0.05	0.27	0.0000
EXG6	0.00	0.00	0.00	0.25	0.00	0.00	0.75	0.29	0.0000
EXG7	0.00	0.00	0.00	0.54	0.10	0.00	0.36	0.59	0.0000
EXG8	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.09	0.0000
EXO1	0.00	0.49	0.00	0.51	0.00	0.00	0.00	0.00	0.0000
EXO10	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.27	0.0000
EXO11	0.01	0.00	0.00	0.02	0.00	0.00	0.97	0.54	0.0000
EXO12	0.01	0.57	0.00	0.43	0.00	0.00	0.00	0.00	0.0000
EXO13	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.25	0.0000
EXO14	0.00	0.00	0.00	0.22	0.00	0.00	0.78	0.36	0.0001
EXO15	0.00	0.00	0.00	0.41	0.00	0.00	0.59	0.39	0.0000
EXO16	0.00	0.00	0.00	0.25	0.00	0.00	0.75	0.70	0.0000
EXO2	0.00	0.00	0.00	0.26	0.00	0.00	0.74	0.44	0.0000
EXO3	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.22	0.0000
EXO4	0.02	0.00	0.00	0.95	0.00	0.00	0.04	0.30	0.0000
EXO5	0.01	0.01	0.00	0.98	0.00	0.00	0.00	0.22	0.0000
EXO6	0.00	0.00	0.00	0.25	0.00	0.00	0.75	0.33	0.0000
EXO7	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.67	0.0000
EXO8	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.29	0.0000
EXO9	0.00	0.00	0.00	0.64	0.00	0.00	0.36	0.43	0.0000
EXPK10	0.00	0.00	0.00	0.25	0.00	0.00	0.75	0.29	0.0000
EXPK11	0.00	0.00	0.00	0.97	0.00	0.00	0.02	0.13	0.0000
EXPK12	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.04	0.0000
EXPK4	0.15	0.79	0.00	0.05	0.00	0.01	0.00	0.01	0.0000
EXPK5	0.15	0.00	0.00	0.08	0.00	0.00	0.77	0.03	0.0000
EXPK6	0.15	0.00	0.00	0.11	0.00	0.00	0.74	0.03	0.0000
EXPK7	0.15	0.00	0.00	0.12	0.00	0.00	0.74	0.04	0.0000
EXPK8	0.14	0.01	0.00	0.20	0.00	0.00	0.65	0.02	0.0000
EXPK9	0.01	0.66	0.00	0.32	0.00	0.00	0.00	0.00	0.0000
EXY1	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.25	0.0000
EXY2	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.25	0.0000
EXY3	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.08	0.0000
EXY4	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.26	0.0000

EXY5	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.24	0.0000
EXY6	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.06	0.0000
EXY7	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.24	0.0000
Link-01	0.01	0.00	0.00	0.93	0.00	0.00	0.06	0.09	0.0000
Link-04	0.01	0.00	0.00	0.09	0.00	0.00	0.90	0.77	0.0000
Link-109	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.49	0.0000
Link-110	0.00	0.00	0.00	0.70	0.30	0.00	0.00	0.88	0.0000
Link-111	0.00	0.00	0.00	0.08	0.00	0.00	0.92	0.69	0.0000
Link-12	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.12	0.0000
Link-14	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.21	0.0000
Link-16	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.20	0.0000
Link-18	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.20	0.0000
Link-20	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.20	0.0000
Link-22	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.22	0.0000
Link-23	0.02	0.00	0.00	0.57	0.00	0.00	0.42	0.50	0.0000
Link-24	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.23	0.0000
Link-26	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.20	0.0000
Link-28	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.23	0.0000
Link-30	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.27	0.0000
Link-32	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.49	0.0000
Link-33	0.00	0.05	0.00	0.95	0.00	0.00	0.00	0.01	0.0000
Link-38	0.00	0.00	0.00	0.92	0.00	0.00	0.08	0.13	0.0003
Link-42	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.40	0.0000
Link-43	0.00	0.00	0.00	0.36	0.00	0.00	0.64	0.58	0.0000
Link-44	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-45	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-46	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-48	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-49	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-51	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.34	0.0000
Link-52	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.26	0.0000
Link-53	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.19	0.0000
Link-54	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.20	0.0000
Link-55	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.29	0.0000
Link-56	0.00	0.00	0.00	0.47	0.53	0.00	0.00	0.90	0.0000
Link-57	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.57	0.0000
Link-58	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.59	0.0000
Link-59	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.30	0.0000
Link-60	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.39	0.0000
Link-61	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-63	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.21	0.0000
Link-64	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.18	0.0000
Link-C-A	0.01	0.00	0.00	0.08	0.00	0.00	0.91	0.67	0.0000
LinkD-C	0.00	0.00	0.00	0.06	0.00	0.00	0.94	0.54	0.0000
PipeA	0.01	0.00	0.00	0.94	0.00	0.00	0.06	0.07	0.0000
Pipe-B	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.07	0.0000
Pipe-C	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.07	0.0000
Pipe-D	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.06	0.0000
Pipe-E	0.00	0.00	0.00	0.98	0.00	0.00	0.01	0.07	0.0000
Pipe-F	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.07	0.0000
Pipe-G	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.07	0.0000

PipeTo-Pond	0.00	0.00	0.00	0.81	0.00	0.00	0.19	0.15	0.0000
SPAB1	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPAB2	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPAB3	0.60	0.07	0.00	0.04	0.00	0.00	0.29	0.01	0.0000
SPAB4	0.45	0.15	0.00	0.29	0.00	0.01	0.11	0.02	0.0000
SPABL1	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPABL2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPABL3	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPAG1	0.15	0.00	0.00	0.10	0.00	0.00	0.75	0.02	0.0000
SPAG2	0.22	0.02	0.00	0.77	0.00	0.00	0.00	0.00	0.0000
SPAG3	0.04	0.12	0.00	0.84	0.00	0.00	0.00	0.00	0.0000
SPAG4	0.01	0.00	0.00	0.91	0.00	0.00	0.08	0.07	0.0000
SPAG5	0.02	0.00	0.00	0.98	0.00	0.00	0.00	0.04	0.0000
SPAG6	0.01	0.00	0.00	0.97	0.00	0.00	0.02	0.06	0.0000
SPAG8	0.02	0.00	0.00	0.96	0.00	0.00	0.02	0.05	0.0000
SPAG9	0.02	0.01	0.00	0.97	0.00	0.00	0.00	0.02	0.0000
SPAO1	0.14	0.01	0.00	0.85	0.00	0.00	0.00	0.00	0.0000
SPAO2	0.02	0.12	0.00	0.86	0.00	0.00	0.00	0.00	0.0000
SPAO3	0.01	0.00	0.00	0.88	0.00	0.00	0.11	0.08	0.0000
SPAO4	0.02	0.00	0.00	0.96	0.00	0.00	0.02	0.06	0.0000
SPAO5	0.02	0.00	0.00	0.90	0.00	0.00	0.08	0.06	0.0000
SPAO6	0.02	0.00	0.00	0.98	0.00	0.00	0.00	0.01	0.0000
SPAPK1	0.15	0.00	0.00	0.84	0.00	0.00	0.01	0.00	0.0000
SPAPK2	0.03	0.11	0.00	0.85	0.00	0.00	0.00	0.00	0.0000
SPAPK3	0.02	0.00	0.00	0.85	0.00	0.00	0.13	0.07	0.0000
SPAPK4	0.03	0.00	0.00	0.87	0.00	0.00	0.09	0.07	0.0000
SPAPL1	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPAPL2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPAPL3	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPAPL4	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
SPAR1	0.44	0.00	0.00	0.56	0.00	0.00	0.00	0.00	0.0000
SPAR2	0.34	0.01	0.00	0.65	0.00	0.00	0.00	0.00	0.0000
SPAR3	0.27	0.01	0.00	0.72	0.00	0.00	0.00	0.00	0.0000
SPAR4	0.21	0.00	0.00	0.79	0.00	0.00	0.00	0.00	0.0000
SPAR5	0.15	0.01	0.00	0.84	0.00	0.00	0.00	0.00	0.0000
SPAY1	0.24	0.01	0.00	0.74	0.00	0.00	0.00	0.00	0.0000
SPAY2	0.05	0.11	0.00	0.83	0.00	0.00	0.00	0.00	0.0000
SPAY3	0.01	0.00	0.00	0.98	0.00	0.00	0.01	0.08	0.0000
SPAY4	0.01	0.00	0.00	0.98	0.00	0.00	0.01	0.07	0.0000
SPAY5	0.01	0.00	0.00	0.85	0.00	0.00	0.13	0.08	0.0000
SPG7	0.02	0.00	0.00	0.97	0.00	0.00	0.02	0.06	0.0000
Z1	0.00	0.00	0.00	0.89	0.00	0.00	0.11	0.06	0.0000
Z10	0.01	0.00	0.00	0.92	0.00	0.00	0.07	0.40	0.0000
Z11	0.03	0.62	0.00	0.34	0.00	0.00	0.00	0.00	0.0000
Z12	0.14	0.01	0.00	0.14	0.00	0.00	0.72	0.01	0.0000
Z2	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.06	0.0000
Z3	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.06	0.0000
Z4	0.02	0.00	0.00	0.84	0.00	0.00	0.13	0.12	0.0000
Z5	0.02	0.00	0.00	0.77	0.00	0.00	0.21	0.19	0.0000
Z6	0.02	0.00	0.00	0.97	0.00	0.00	0.01	0.29	0.0000
Z7	0.01	0.00	0.00	0.98	0.00	0.00	0.01	0.34	0.0000

Z8	0.02	0.01	0.00	0.97	0.00	0.00	0.00	0.38	0.0000
Z9	0.02	0.00	0.00	0.40	0.00	0.00	0.58	0.46	0.0000

****
****
Routing Time Step Summary
****

Minimum Time Step	:	0.50 sec
Average Time Step	:	0.88 sec
Maximum Time Step	:	1.00 sec
Percent in Steady State	:	0.00
Average Iterations per Step	:	2.01

Analysis began on: Wed Apr 08 08:15:30 2015
Analysis ended on: Wed Apr 08 08:16:52 2015
Total elapsed time: 00:01:22

APPENDIX D

FINAL CORRESPONDENCE

DILLON CONSULTING

Langlois, Ryan <rlanglois@dillon.ca>

MRSPA Modelling Memo

John Henderson <JHenderson@erca.org> Wed, Apr 8, 2015 at 10:01 AM
To: "Forest, Flavio" <fforest@dillon.ca>
Cc: "Langlois, Ryan" <rlanglois@dillon.ca>, Phil Bartnik <pbartnik@tecumseh.ca>, Tim Byrne <TByrne@erca.org>, Mike Nelson <MNelson@erca.org>

Good morning Flavio,

As per our phone conversation yesterday, we have reviewed your revised Functional Servicing Modelling Memo for the MRSPA in the Town of Tecumseh dated March 2015. The revised report was provided in response to questions/comments that ERCA provided regarding the original memo. In general, the revised information appears to address our previously submitted questions/comments. Based on the revised submission, however, clarification is required on the following additional items:

1. In Table 2, the lowest proposed MRSPA surface elevation is noted as 180.750 m. On Figure 3 the lowest surface elevation appears to be 180.700 m and on Figure 9 it appears to be 180.650 m. Please confirm. In addition, the road elevations shown on Figures 7 and 8 are not readable. Please confirm that all road elevations used in the modelling and shown on the Figures are consistent.

2. Sections 6.2 and 6.2.2 discuss the pumping rates for the quality storm event. Based on this information, it appears that the pumping rate starts at 45 l/s and increases to 545 l/s when the active storage depth of 0.190 m is reached. Do the small quality pumps shut off at elevation 174.920 m (0.420m active depth) or do they remain on until the pond is pumped to the normal water level. Based on the rest of the report, it was our understanding that the maximum release rate from the pond was 500 l/s. Please clarify.

3. Section 7.3.2 identifies that improvements are required to the Jamsyl Drive/Sylvestre Drive intersection and the Jamsyl Drive/Manning Road intersection. Who will be responsible for completing this improvements when they are required for development to proceed?

4. It appears there is a minor typo in Section 8.0. Section 4.1.1 is referred to in the text. It appears it should be Section 4.2.1.

5. Based on the HGL plots in Appendix A, the HGL at MH 108 is approximately 181.300 m. The proposed road elevation immediately east of MH108 at MH94 is 180.700 m. What is the HGL at MH94?

6. General information about the pond (ie. volumes, water levels, etc.) is provided in text and tables within the report. It is our understanding that the actual pond will be designed by others when the first development proceeds. It is recommended that a plan be included showing the configuration of the pond that was used in this study. It is further recommended that the plan include typical cross-sections and dimensions that can be finalized as part of the detailed design that will be completed by others.

7. The storm sewer layout and pipe diameters used in the analysis are shown in Figure 11.0. To ensure consistency as development proceeds in this area, the storm sewer slopes and inverts used in the analysis should also be included. We recommend that your preliminary storm sewer design sheets be included to be used as a guide for future design of the individual developments.

8. It is our understanding that the preliminary proposals for future improvements to Manning Road include the enclosure of the East Townline Drain. As part of the MRSPA proposal, 1:100 year overland flow routes are proposed to direct water to the East Townline Drain. How will these overland routes be maintained when the East Townline Drain is enclosed in the future?

9. Modeling input parameters are included in Appendix B. A developed CN value of 90 has been considered for the residential areas. Based on the historic soil mapping, the majority of this area appears to be brookston clay. Please provide your supporting information your curve number selection.

10. In general the report provides a lot of information/criteria that will need to be implemented at different stages of the future buildout of this area. How will this information/criteria be tracked to ensure that all future works recommended in this report are implemented as development proceeds?

11. As per our previous comments, we recommend that, due to the complexities of this development area, the Town of Tecumseh should engage Dillon Consulting Ltd. to review the future individual development submissions to ensure they are in compliance with the functional design study.

If you have any questions, please contact our office.

John Henderson, P. Eng.

Essex Region Conservation Authority (ERCA)

360 Fairview Avenue West, Suite 311

Essex, Ontario N8M 1Y6

519-776-5209 ext. 246

Fax: 519-776-8688

Please consider the environment before printing this email

DILLON CONSULTING

Langlois, Ryan <rlanglois@dillon.ca>

MRSPA Modelling Memo

Forest, Flavio <fforest@dillon.ca> Thu, Apr 9, 2015 at 9:33 AM
To: John Henderson <JHenderson@erca.org>
Cc: "Langlois, Ryan" <rlanglois@dillon.ca>, Phil Bartnik <pbartnik@tecumseh.ca>, Tim Byrne <TByrne@erca.org>, Mike Nelson <MNelson@erca.org>

John, thanks for your timely review and comments. As discussed, we understand that ERCA is satisfied that the Modelling Memo has now addressed your comments to date. The final corrections and clarifications, as outlined below, will be incorporated into the final Modelling Memo (where appropriate) that will be included as an Appendix to the Addendum report and that will form the basis for the functional servicing report that will serve to guide the detailed design of the MRSPA drainage solution. You will receive a copy of the updated Addendum Report, as well as a copy of the Functional Servicing Report (once it is finalized with the Town). Our responses to your comments are as follows:

1. In Table 2, the lowest proposed MRSPA surface elevation is noted as 180.750 m. On Figure 3 the lowest surface elevation appears to be 180.700 m and on Figure 9 it appears to be 180.650 m. Please confirm. In addition, the road elevations shown on Figures 7 and 8 are not readable. Please confirm that all road elevations used in the modelling and shown on the Figures are consistent.

- We will update the tables and figures for consistency.

2. Sections 6.2 and 6.2.2 discuss the pumping rates for the quality storm event. Based on this information, it appears that the pumping rate starts at 45 l/s and increases to 545 l/s when the active storage depth of 0.190 m is reached. Do the small quality pumps shut off at elevation 174.920 m (0.420m active depth) or do they remain on until the pond is pumped to the normal water level. Based on the rest of the report, it was our understanding that the maximum release rate from the pond was 500 l/s. Please clarify.

- We will include a clarification in the report confirming that during the initial 25mm event, the active storage volume between a 0.19m to 0.34m depth will be discharged with both the low flow and high flow pumps operating simultaneously, resulting in a discharge rate of 545 L/s. This will result in a water quality drawdown time of 24-48 hours. Above an active storage depth of 0.34m, the discharge rate will be 500 L/s.

3. Section 7.3.2 identifies that improvements are required to the Jamsyl Drive/Sylvestre Drive intersection and the Jamsyl Drive/Manning Road intersection. Who will be responsible for completing this improvements when they are required for development to proceed?

- We have confirmed with the Town that the modifications to Jamsyl Drive required to accommodate overland flows to the ETLD will be the responsibility of the developers.

4. It appears there is a minor typo in Section 8.0. Section 4.1.1 is referred to in the text. It appears it should be Section 4.2.1.

- We will update the report, as noted.

5. Based on the HGL plots in Appendix A, the HGL at MH 108 is approximately 181.300 m. The proposed road elevation immediately east of MH108 at MH94 is 180.700 m. What is the HGL at

MH94?

- The SSA modelling for the MRSPA area provides the following Hydraulic Gradeline Elevations during the Chicago 1:100yr-24 event at the corresponding Manholes for your information:
  - HGL @ MH 108 = 181.26
  - HGL @ MH 94 = 180.87

6. General information about the pond (ie. volumes, water levels, etc.) is provided in text and tables within the report. It is our understanding that the actual pond will be designed by others when the first development proceeds. It is recommended that a plan be included showing the configuration of the pond that was used in this study. It is further recommended that the plan include typical cross-sections and dimensions that can be finalized as part of the detailed design that will be completed by others.

- Drawings of the pond geometry, including dimensions and typical cross sections are provided within Figure 15 & Figure 16 of the MRSPA Class EA Study Report (April 2010), which has been referenced in our Addendum report. No changes to the proposed MRSPA pond have been identified as part of this Addendum report.

7. The storm sewer layout and pipe diameters used in the analysis are shown in Figure 11.0. To ensure consistency as development proceeds in this area, the storm sewer slopes and inverts used in the analysis should also be included. We recommend that your preliminary storm sewer design sheets be included to be used as a guide for future design of the individual developments.

- The storm sewer slopes and inverts,including preliminary storm sewer design sheets, will be included within Appendix B of the Functional Servicing Report for the MRSPA.

8. It is our understanding that the preliminary proposals for future improvements to Manning Road include the enclosure of the East Townline Drain. As part of the MRSPA proposal, 1:100 year overland flow routes are proposed to direct water to the East Townline Drain. How will these overland routes be maintained when the East Townline Drain is enclosed in the future?

- Once detailed design of the enclosure of the East Townline Drain commences, the overland flows from the MRSPA are to be included within the design. It is expected that future overland flows will be captured through the use of ditch inlet catchbasins to convey flows into the future enclosure. The County of Essex is currently considering a proposal from Dillon Consulting Limited to update the Preliminary Design Report for the CR 19/22 Improvements as it relates to drainage, which is expected to incorporate these overland drainage requirements.

9. Modeling input parameters are included in Appendix B. A developed CN value of 90 has been considered for the residential areas. Based on the historic soil mapping, the majority of this area appears to be brookston clay. Please provide your supporting information your curve number selection.

- The developed CN value of 90 was used for residential areas with Type D soils (Brookston Clay). This value is consistent with the curve numbers used for residential districts by average lot sizes ranging from 500 m^2 to 1000m^2. *(Urban Hydrology for Small Watersheds TR-55, USDA).* A CN value of 90 is considered conservative within the design of the MRSPA as an impervious value is also being used within the model.

10. In general the report provides a lot of information/criteria that will need to be implemented at

different stages of the future buildout of this area. How will this information/criteria be tracked to ensure that all future works recommended in this report are implemented as development proceeds?

- The information and stormwater management criteria outlined is identified within the main body of the MRSPA Functional Servicing Report. The detailed designers for each stage of development will be required to review the Functional Servicing Report prior to any detailed design of the lands commence (ie. grading, storm servicing etc.).

11. As per our previous comments, we recommend that, due to the complexities of this development area, the Town of Tecumseh should engage Dillon Consulting Ltd. to review the future individual development submissions to ensure they are in compliance with the functional design study.

- We have confirmed with the Town that it is their intention to continue having Dillon involved in the review of the drainage design for all individual development submissions to ensure the proper stormwater management criteria has been met.

At this time, the Town is proceeding to table the Addendum Report at the April 14 Council meeting, including the updates outlined herein.
We appreciate your time and input into this process, and the valuable feedback that you provided. As a result of this collaborative effort, we believe that the resulting report will provide a valuable reference for the effective implementation of this drainage solution in the Town of Tecumseh.
Sincerely,

DILLON CONSULTING

Flavio Forest
Partner
Dillon Consulting Limited
3200 Deziel Drive Suite 608
Windsor, Ontario, N8W 5K8
T - 519.948.4243 ext. 3233
F - 519.948.5054
M - 519.791.2166
FForest@dillon.ca
www.dillon.ca

[Quoted text hidden]

Our File: 11-5366 (Corr.)

DILLON CONSULTING

February 11, 2015

3200
Deziel Drive
Suite 608
Windsor, Ontario
Canada
N8W 5K8
Telephone
(519) 948-5000
Fax
(519) 948-5054

Essex Region Conservation Authority
360 Fairview Avenue West, Suite 311
Essex, ON
N8M 1Y6

Attention: Mr. John Henderson, P.Eng.

Manning Road Secondary Plan Area Stormwater Management Class Environmental Assessment Addendum
Response to ERCA Comments

Further to your email dated January 19, 2015 in response to the Notice of Addendum for the noted project, including subsequent discussions, emails and our recent meeting of February 3, 2015, we are hereby confirming our approach for addressing your comments and the additional information that will form part of the preferred stormwater management solution that has been identified for this area.

The following were in attendance during our meeting of February 3, 2015:

John Henderson, P.Eng .	-	Essex Region Conservation Authority
Phil Roberts	-	Windsor International Airport
Brian Hillman	-	Town of Tecumseh
Daniel Piescic	-	Town of Tecumseh
Flavio Forest	-	Dillon Consulting Limited
Ryan Langlois	-	Dillon Consulting Limited

At this meeting, the following matters were addressed:

1.0 WINDSOR INTERNATIONAL AIRPORT

It was confirmed that the proposed MRSPA pond is not located within the runway approach and outer surface limits affecting the Windsor Airport.

The Windsor Airport offered suggestions to limit waterfowl attraction, which may present a nuisance to local area residents in the future, including allowing grass in buffer areas to grow taller, planting trees and naturalized treatments in the embankment areas, and use of coarse shrubs in lower lying areas of the pond.

...continued

2.0 OVERLAND DRAINAGE SYSTEM CHARACTERISTICS

2.1 MRSPA

It was agreed that more specific stormwater management (SWM) design criteria would be included as part of the SWM and functional servicing reports for the MRSPA, particularly surface storage and runoff control requirements.

The opportunities to direct overland flow to the proposed MRSPA SWM pond are limited based on the existing topography. It has been recommended that inlet control devices be incorporated within roadway catchbasins to provide an appropriate balance between runoff being conveyed by the minor storm sewer system and the temporary surface storage required within roadways for more significant storm events.

In order to determine the surface storage that could be accommodated within the right-of-way, a representative roadway surface storage calculation was completed based on the proposed site grades with a 0.3m maximum ponding depth. It was determined that the maximum average roadway surface storage volume would be approximately 91 m^3/ha. The preliminary modeling results will be updated based on other aspects of our discussion presented herein, though it would appear that this surface storage capacity would address more than 50 percent of, but not all of the 1:100 year requirements.

Due to the benefits of modifications in the watershed boundaries and the over-restricted release rate from the MRSPA SWM pond, it was proposed that overland flows exceeding the available roadway surface storage capacity be permitted to overflow to the Cyr Drain and to the East Townline Drain. It was agreed that this would be acceptable, subject to confirmation of the following:

- That the rate of overflow would not exceed the 1:2 year existing conditions runoff rate (assumed to represent the existing outlet drain capacity); and
- That these overflow rates were accounted for in the design of the East Townline Drain pump station outlet at Lake St. Clair.

Furthermore, there were challenges identified with the ability to fully implement these overland flow outlets based on the phased approach to development in the MRSPA. In particular, a continuous overland flow outlet to the Cyr Drain may not be possible due to land ownership constraints, which may only be resolved once a fuller extent of development takes place in the north part of the MRSPA. As requested, we will give consideration to the opportunities and related limitations of overland flow solutions under interim development conditions in the MRSPA.

...continued

2.2 Baillargeon Drain Area

As noted in the December 2014 modeling memo, the Baillargeon Drain area generally slopes easterly towards the MRSPA and northerly towards County Road 22. The drainage characteristics of the Baillargeon Drain area under major storm events were determined based on a review of existing grades along its boundary with MRSPA. It was observed that there may be two locations that provide potential overland flow to the MRSPA, which were found to exhibit the following characteristics:

- An emergency overland flood route was previously designated within an easement that was established between existing homes on Charlene Lane:
    - The existing grades within the existing overland flow easement appear to be at least 0.3 m higher than the existing roadway elevations.

- A lower lying area on Candlewood Drive, directly south of the Agnes Drive intersection at the location of the Baillargeon Drain:
    - The lot grading of the existing properties are approximately 0.5 m higher than the existing roadway elevations.

There are no alterations being proposed to the existing grading along this boundary that would result in an increase to overland flow contributions between the Baillargeon Drain area and the MRSPA.

Accordingly, the Baillargeon Drain area was modeled based on surface storage of overland flows being temporarily contained within the existing drainage area under major storm events, with conveyance by the minor storm sewer system (1:2 year level of service). The complete 1:100 runoff volume was considered in assessing the operation of the proposed MRSPA SWM pond.

It was agreed that in cases of more extreme events exceeding the 1:100 year condition, that the following measures would be appropriate:

- Extension of the existing overland flow easement, interconnecting Charlene Lane with the MRSPA roadway network and the proposed overland flow network that would be available for overland flow relief to the East Townline Drain and the proposed MRSPA pond.

- Incorporating a new ditch inlet catchbasin at the downstream end of the overland flow easement that would be directly connected into the proposed MRSPA storm sewer system.

...continued

3.0 BAILLARGEON DRAIN AREA RUNOFF CHARACTERISTICS AND DRAINAGE SYSTEM PERFORMANCE

3.1 Modeling Approach and Runoff Parameters

The modeling approach for the Baillargeon Drain included discretizing the watershed into a total of 19 sub-catchments and incorporating existing storm sewers exceeding 600 mm diameter. Each sub-catchment was assigned a percent impervious value based on an evaluation of aerial images.

The modeled peak flows for the 1:2 year storm event were initially found to exceed the existing storm sewer capacities. Adjustments were made to percent impervious values for select sub-catchment areas to calibrate the model to the existing storm sewer capacities. The percentage impervious values for the sub-catchment areas vary from 25% to 40%.

3.2 Drainage System Performance

The hydraulic performance of the Baillargeon Drain will improve as a result of being redirected to the proposed MRSPA storm sewer system and pond facility. Furthermore, the controlled outlet from the proposed MRSPA pond will provide considerable relief to the East Townline Drain.

The outlet conditions at the confluence of the 1350 mm diameter Baillargeon Drain storm sewer with the proposed MRSPA storm sewer will consist of a drop of approximately 1.8 m, while the northern portion of the area will be separately served by extending an existing 900 mm diameter storm sewer stub on Gouin Street to the MRSPA storm sewer. In addition, the tailwater conditions at the proposed MRSPA pond are considerably lower than the available hydraulic conditions in the East Townline Drain.

A comparison of the hydraulic grade lines under existing and future conditions for MH EX4, located directly upstream of the Baillargeon Drain, is outlined below in Table 1.

Table 1: Hydraulic Grade Line Comparison

Storm Event (12 hr)	Existing Conditions HGL @ U/S MH EX4 (m)	Future Conditions HGL @ U/S MH EX4 (m)
1:2	181.53	180.64
1:5	181.70	180.75
1:100	181.82	181.78

...continued

3.3 Runoff Quality Treatment

Incorporating the Baillargeon Drain into the proposed MRSPA SWM pond provides an opportunity to improve runoff quality for this drainage area that currently has no such measures in place. The criteria used in the model included the 25 mm, 4 hour Chicago storm, which resulted in the following:

- 25 mm water surface elevation in MRSPA pond = 174.87
- Water quality drawdown time = 37 hours

4.0 MRSPA RUNOFF CHARACTERISTICS

A slightly reduced runoff coefficient of 0.35 for the residential portion of the MRSPA was originally selected as the basis for the proposed storm sewer design to account for the beneficial effects of the required disconnection of roof leaders and sump pumps.

Upon further review, it has been agreed to increase the runoff coefficient for the design of storm sewers in residential areas to 0.4, which may be considered to provide an added buffer in the level of service. The hydrodynamic model will also be updated accordingly.

5.0 MRSPA POND DRAWDOWN TIME

In order to address the comments related to the increased 1:100 year pond drawdown time of approximately 100 hours, a risk analysis was completed to confirm the resiliency of the MRSPA pond to accommodate subsequent storm events within the drawdown period. The following Table 2 summarizes the incremental storage available (up to an extreme high water surface elevation of 180.50 m) during the drawdown period following a 1:100 year storm, and the corresponding storm event that could be accommodated at each interval of time:

Table 2: MRSPA Pond Drawdown Summary

Drawdown Time (hrs)	WSEL (m)	Active Storage Available (m^3)	Active Storage Needed for Storm Event (m^3)	Storm Event Capacity in MRSPA Pond @ Time
24	178.84	73,517	54,959	1:5 year
48	177.91	107,935	106,079	1:25 year
72	176.67	148,050	130,928	1:100 year
96	175.13	189,854	130,928	1:100 year
120	174.6	202,048	130,928	1:100 year

...continued

These preliminary results will be reconfirmed, but it was suggested that on the basis of the storage volume available up to an extreme water surface elevation of 180.5 m, that the MRSPA SWM pond would provide a reasonable level of service to address the risk of storm events occurring shortly following a major 1:100 year storm.

6.0 CLIMATE CHANGE CONSIDERATIONS

While the Provincial Policy Statement references the need to consider the potential impacts of climate change while accommodating projected needs, there is a lack of direction on the degree of increases/decreases and frequency of climatic changes that should be used for such assessments. It was agreed that the adaptability of the proposed solution to potential changes in climate would be addressed, both in terms of the solution as currently proposed and the potential opportunities for future modifications.

7.0 MODELING MEMO CLARIFICATIONS AND UPDATES

It was agreed that the modeling memo would be updated as outlined herein, including the additional functional design information that will facilitate the detailed design for each phase of development in the MRSPA. In addition, the report figures will be updated and additional descriptions will be included for clarity.

8.0 CLOSURE

We trust that we have confirmed the manner in which we are proceeding to address your comments, as discussed during our meeting of February 3, 2015. The modeling memo will be updated accordingly, and a final copy will be provided to you, based on which we would be pleased to meet with you to present our findings and address any remaining questions you might have.

Yours sincerely,

DILLON CONSULTING LIMITED

Flavio R. Forest, P.Eng.,
Project Manager

FRF:d
Cc: Mr. Brian Hillman, Town of Tecumseh
Mr. Daniel Piescic, P.Eng., Town of Tecumseh

---------- Forwarded message ----------
From: **John Henderson** <JHenderson@erca.org>
Date: Fri, Jan 23, 2015 at 11:44 AM
Subject: FW: Addendum to MRSPA
To: "Forest, Flavio" <fforest@dillon.ca>
Cc: Phil Bartnik <pbartnik@tecumseh.ca>, Daniel Piescic <dpiescic@tecumseh.ca>, Tim Byrne <TByrne@erca.org>, Mike Nelson <MNelson@erca.org>

Hi Flavio,

Thank you for calling to discuss the comments that we provided in our January 19, 2015 e-mail. As per our call, the following additional items were discussed:

a. It is identified that, during a major storm event, temporary on-site storage will be required for each development within the MRSPA to allow the minor system time to drain water to the pond. A chart showing temporary on-site storage requirement for each catchment area would be helpful. Also, with the natural fall of these lands being from south to north, will it be possible for the individual developments to actually provide the required on-site storage. The potential storage available on a typical roadway, with the existing south to north fall, should be analysed to see if the on-site storage requirements can be achieved. Please note that on-site storage should only include storage that is available within the municipally owned road right of way.

b. Potential climate change considerations were discussed. Your initial thoughts were that the pond outlet could be reviewed and that the pond has not been design to minimum storage requirements. Due to the uniqueness of the MRSPA and lack of overland routing, the minimum temporary on-site storage for each individual development may also need to be considered.

c. Numerous figures/plots are provided in Appendix B. Tabular presentation of some of this information would be helpful.

d. The proposed road grade elevation shown at the north end of the site in Figure 3 (low elevation = 180.650 m) does not appear to match the existing grade elevations shown on the truck sewer profile plots in Appendix A. In addition, the plotted HGL appears to be above the proposed road grade elevation.

If you have any questions, please do not hesitate to contact our office.

John Henderson, P. Eng.
Essex Region Conservation Authority (ERCA)
360 Fairview Avenue West, Suite 311
Essex, Ontario N8M 1Y6
519-776-5209 ext. 246
Fax: 519-776-8688

——— Forwarded message ———
From: **John Henderson** <JHenderson@erca.org>
Date: Mon, Jan 19, 2015 at 5:23 PM
Subject: Addendum to MRSPA
To: Phil Bartnik <pbartnik@tecumseh.ca>
Cc: Tim Byrne <TByrne@erca.org>, Mike Nelson <MNelson@erca.org>, "Forest, Flavio" <fforest@dillon.ca>

Good afternoon Mr. Bartnik,

We received the Town of Tecumseh MRSPA SWM Environmental Study Report Addendum date December 2104. Due to time constraints we have only completed a preliminary/screening review of this document.

As per our discussions during the original EA preparation, it remains our position that the best location for the pond to service these lands is at the north end of the development area near County Road No. 22 due to the significant fall on these lands from south to north. Through the original EA process, however, the preferred solution was to have the pond at the south end of the development. As a result, it is not possible to have direct overland flow routes to the pond for major storm events. Instead, each portion of the development will be required to be designed with temporary on-site storage to detain water until the minor storm sewer system can convey the runoff to the proposed pond. Control/provision of the temporary on-site storage in each development is critical in order for the drainage from this entire planning area to function as designed. All future development designs must consider the functional servicing modelling that was prepared by Dillon Consulting Ltd. for this addendum. We recommend that the Town of Tecumseh clearly outline the modelling requirements and parameters for each development within this planning area to ensure that the site drainage will function as proposed in the functional servicing study. We further recommend that the Town of Tecumseh engage Dillon Consulting Ltd. to review the individual development submissions to ensure that they meet the intent of their functional design study.

Based on our current screening review, the following comments are provided:

MRSPA SWM Environmental Study Report Addendum (December 2014)

1. Section 5.0 Public and Agency Consultation – It is identified that no significant concerns were identified at our August 15, 2014 meeting. During this meeting ERCA raised concerns about the lack of overland flow routes to the pond and the potential challenges of having to temporarily manage major storm events within individual developments. There was also substantial discussion regarding how the existing Baillargeon drainage area functions during a major storm event under existing conditions and how it would be provided for in the proposal to direct it into the MRSPA pond.

Functional Servicing Modelling Memo (December 2014)

2. Section 4.1.2 Baillargeon Drainage Area and Section 4.2 Assumptions - The following comments from these sections are noted:

a. "It appears that surface runoff for major storm events are generally contained within the Baillargeon Drain drainage area boundaries, with limited overflow to the MRSPA".

b. It is assumed that "sufficient temporary surface storage exists within the Baillargeon drainage area".

c. It is assumed that "All runoff volumes are contained within each drainage area boundary with no losses from overland drainage outside of those boundaries."

These issues were the focus of some of the discussions during our August 15, 2014 meeting. The exact functioning of the Baillargeon drainage area during minor and major events must be completely understood in order to determine if the development of the MRSPA will adversely impact these existing lands. Based on the statements contained in the report, it does not appear that a complete review of the existing drainage patterns/conditions within the Baillargeon drainage area has been completed. It appears that bulk areas have be used in the current modelling to account for flows from this area. We would suggest that a more detailed assessment is required to determine how this area functions under both minor and major events and if sufficient on-site temporary storage is available for all storms up to and including the 1:100 year event. If temporary on-site storage is not available, where does the major event go? How do the hydraulic gradelines within the Baillargeon drainage area compare before and after the development of the MRSPA?

3. As per table 2, the proposed pond drawdown time for Scenario 3 is 98 hours. This is significantly higher than the typical maximum drawdown time of 48 hours. What was the rationale for determining that a 98 hour drawdown time is acceptable? Has another storm within the 98 hour drawdown time been considered? Is there any safety factor in the existing pond freeboard? Does the Windsor Airport have concerns with the proposed 98 hour drawdown time?

4. In Table 3 it is noted that the quality requirements are based on Table 3.2 of the MOECC manual for 'normal' protection. Was the 25 mm 4 hour Chicago storm also considered.

5. In section 6.2 it is identified that the % impervious was reduced because the MRSPA is zoned low density residential. In section 6.1 of the addendum report, the MRSPA is identified as low density residential, medium density residential, general commercial, neighbourhood commercial, community facility and recreational. Please clarify. In addition, in Table 3 of the functional servicing modeling memo the % impervious is estimated as 33% for the MRSPA and 25 % for the Baillargeon Drain area. These estimates seem low. Based on a quick review of a few random properties within the Baillargeon drainage area, it would appear that the % impervious may be well above 25%. In addition, we do not know the proposed lot size within the MRSPA, however, with smaller lots that are typically proposed within many new developments, an estimate of 33% impervious may also be low. Additional consideration should be given to the estimates of the % impervious.

6. In Appendix A, hydraulic gradeline (HGL) profiles are shown for the 100 year storm for Scenarios 2 and 3 from MH 108 to the SPA Pond. It was anticipated that Scenario 3 would have a slightly lower HGL because the normal and high water elevations in the pond are lower. In review of the two HGL plots, however, it appears that the HGL for Scenario 2 is slightly lower. Please clarify.

7. Summary figures are provided in Appendix B. Additional clarification would be helpful on some of these figures.

8. It does not appear that the potential impact of climate change have been considered in the assessment for these lands.

As noted above, we did not have time to undertake a complete review of the entire document. The comments provided above relate to our preliminary/screening review of the document. We would suggest that a meeting may be beneficial with the Town and Dillon to review the above information.

If you have any questions, please do not hesitate to contact our office.

John Henderson, P. Eng.
Essex Region Conservation Authority (ERCA)
360 Fairview Avenue West, Suite 311
Essex, Ontario N8M 1Y6
519-776-5209 ext. 246
Fax: 519-776-8688

APPENDIX B

PUBLIC CONSULTATION AND CORRESPONDENCE

Town of Tecumseh
Tecumseh Hamlet Class EA
Agency Contact List
December 2014

	Surname	First Name	Organization	Department	Title	Address	City/Prov	Postal Code	Tel.	Fax	E-Mail
Local Representatives											
Mr.	Houston	Brian	Town of Tecumseh		Ward 3 Councilor	917 Lesperance Road	Tecumseh, ON	N8N 1W9	519-735-2184	519-735-6712	
Town of Tecumseh											
Ms.	Moy	Laura	Town of Tecumseh		Dir of Staff Services & Clerk	917 Lesperance Road	Tecumseh, ON	N8N 1W9	519-735-2184	519-735-6712	lmoy@tecumseh.ca
County of Essex											
Ms.	Brennan	Mary			County Clerk	360 Fairview Avenue West	Essex, ON	N8M 1Y6	519-776-6441	519-776-1253	
Mr.	King	Bill	County of Essex		Manager of Planning Services	360 Fairview Avenue West	Essex, ON	N8M 1Y6	519-776-6441	519-776-1253	bking@county.essex.on.ca
Mr.	Bateman	Tom	County of Essex		County Engineer	360 Fairview Avenue West	Essex, ON	N8M 1Y6	519-776-6441	519-776-1253	tbateman@county.essex.on.ca
Conservation Authority											
Mr.	Money	Kevin	Essex Region Conservation Authority		Director, Conservation Services	360 Fairview Avenue West, Suite 311	Essex, ON	N8M 1Y6	(519) 776-5209		
Mr.	Bryne	Tim	Essex Region Conservation Authority		Director, Watershed Management Services	360 Fairview Avenue West, Suite 311	Essex, ON	N8M 1Y6	(519) 776-5209		
Federal Agencies											
Mr.	Thompson	Dan	Fisheries and Oceans Canada		Fisheries Biologist	73 Meg Drive	London, ON	N6E 2V2	519-668-3502	519-668-1772	deLarondeJM@dfo-mpo.gc.ca
Mr.	Woods	Geoff	Canadian National Railway Properties Inc		Development Review Coordinator-Ontario	1 Administration Road	Concord, ON	L4K 1B9			
Mr	Rojik	Orest	Canadian Pacific Railway			1290 Central Pkwy West, 8th Floor	Mississauga, ON	L5C 4R3			
			VIA Rail Canada			65 Front Street West, Room 222	Toronto, ON	M5J 1E6			
Provincial Ministries											
Ms.	Hatcher	Laura	Ministry of Tourism, Culture, and Sport	Culture Services Unit, Programs and Services Branch	A/Team Lead - Heritage Land Use Planning	401 Bay Street, Suite 1700	Toronto, ON	M7A 0A7	4163143108	(416) 212-1802	laura.e.hatcher@ontario.ca
Mr.	McDougall	Doug	Ministry of the Environment	Windsor Area Office	Area Supervisor	4510 Rhodes Drive, Unit 620	Windsor, ON	N8W 5K5	5199486024	519-948-2396	doug.mcdougall@ontario.ca
Mr.	Newton	Craig	Ministry of the Environment	Southwestern Region, London Regional Office	Environmental Planner	733 Exeter Road	London, ON	N6E 1L3	519-873-5014	519-873-5020	craig.newton@ontario.ca
Mr.	Curtis	Bruce	Ministry of Municipal Affairs and Housing	Community Planning and Development	Manager	659 Exeter Road, 2nd Floor	London, ON	N6E 1L3	(519) 873-4026	(519) 873-4018	bruce.curtis@ontario.ca
Ms.	Ryall	Tammy	Ministry of Municipal Affairs and Housing	Municipal Services Office		659 Exeter Road, 2nd Floor	London, ON	N6E 1L3	(519) 873-4026	(519) 873-4018	
Mr.	Morrisey	John	Ministry of Transportation	West Region	Corridor Management Officer	659 Exeter Road, 4th Floor	London, ON	N6E 1L3	519-873-4597	519-873-4600	John.Morrisey@ontario.ca
Ms.	Riddell	Heather	Ministry of Natural Resources	Aylmer District	District Planner	615 John Street	Aylmer, ON	N5H 2S8	5197734757		heather.riddell@ontario.ca
First Nations											
Mr.	Jacobs	Dean	Walpole Island First Nation / Bkejwanong Territory		Heritage Centre Director	R.R. #3	Wallaceburg, ON	N8A 4K9			
Chief	Kewayosh Jr.	Burton	Walpole Island First Nation / Bkejwanong Territory		Chief	R.R. #3	Wallaceburg, ON	N8A 4K9	5196285700	519-628-4185	joseph.gilbert@wifn.org
	Watson	Melody	Caldwell First Nation		Band Administrator	P.O. Box 388	Leamington, ON	N8H 3W3	519-326-6914	519-322-1533	mdwatson@mnsi.net
Chief	Hillier	Louise	Caldwell First Nation		Chief	P.O. Box 388	Leamington, ON	N8H 3W3	519-326-6914	519-322-1533	cfnchief@live.com
Chief	Peters	Greg	Moravian of the Thames		Chief	RR3	Thamesville, ON	N0P 2K0	(519) 692-3936		
Property Owners in MRSPA Study Area											
	Lecce	Rocco & Anna				1850 Lesperance Road	Windsor, ON	N8N 1Y3			
	Zohil	Romano & Jadranka				1762 Lesperance Road	Windsor, ON	N8N 1Y3			
	Le Blanc	Philippe James & Maureen Agnes				1706 Lesperance Road	Windsor, ON	N8N 1Y3			
	c/o Sylvestre	Jeannette	851381 Ontario Ltd.		Trustee	1865 Manning Road, RR1	Tecumseh, ON	N8N 2L9			
			Jamsyl Group Inc.			1865 Manning Road	Windsor, ON	N8N 2L9			
			2024120 Ontario Ltd.			25 Amy Croft Drive	Lakeshore, Ontario	N9K 1C7			
Ms.	Fitzpatrick	Susan Geraldine				1686 Lesperance Road	Windsor, ON	N8N 1Y3			

Town of Tecumseh
Tecumseh Hamlet Class EA
Agency Contact List
December 2014

	Surname	First Name	Organization	Department	Title	Address	City/Prov	Postal Code	Tel.	Fax	E-Mail
	Koeser	Karl Wilhelm & Eva Marie				1670 Lesperance Road	Windsor, ON	N8N 1Y3			
	Mc Graw	Bernard Joseph & Diana Lynn				1662 Lesperance Road	Windsor, ON	N8N 1Y3			
Ms.	Biggar	Barbara Kathleen				1778 Lesperance Road	Windsor, ON	N8N 1Y3			
		Richard Jay Joseph Demarse & Diane Lee Vincent				1754 Lesperance Road	Windsor, ON	N8N 1Y3			
	Lombardi	Domenic & Yolanda				1734 Lesperance Road	Windsor, ON	N8N 1Y3			
	Wright	Steven & Janet				1732 Lesperance Road	Windsor, ON	N8N 1Y3			
Ms.	Mustapic	Iva				1790 Lesperance Road	Windsor, ON	N8N 1Y3			
	Mainella	Felice & Antonia				1786 Lesperance Road	Windsor, ON	N8N 1Y3			
	Bolivar	Jerry & Melissa				1975 Manning Road, RR1	Tecumseh, ON	N8N 2L9			
	Sylvester	Jeannette				RR1, Stn Tecumseh	Windsor, ON	N9N 2L9			
			851381 Ontario Ltd.			1865 Manning Road, RR1	Windsor, ON	N8N 2L9			
			1046399 Ontario. Ltd.			1880 Deslippe Drive	Windsor, ON	N9K 1C6			
			860831 Ontario Limited			25 Amy Croft Drive	Tecumseh, ON	N9K 1C7			
			James Sylvestre development Ltd.			1865 Manning Road, RR1	Windsor, ON	N8N 2L9			
Mr.	Valente	Mario				25 Amy Croft Drive	Lakeshore, Ontario	N9K 1C7			
	Sylvestre	James				1865 Manning Road, RR1	Tecumseh, ON	N8N 2L9			
			Mary Louise Lesperance & Mary Dragicevic			230 St. Charles Street	Victoria, BC	V8S 3M7			
	Demarse	Richard Jay Joseph & Lena Agnes				12401 Renaud Street	Windsor, ON	N8N 1P5			
	Kennette	Normand Lenard & Rosemary Anne				1726 Lesperance Road	Windsor, ON	N8N 1Y3			
	Desjardins	James Arthur & Ellen				1722 Lesperance Road	Windsor, ON	N8N 1Y3			
			Fairlane Developments Inc.			1614 Lesperance Road	Windsor, ON	N8N 1Y3			

File No. 11-5366

August 11, 2014

DILLON CONSULTING

3200
Deziel Drive
Suite 608
Windsor, Ontario
Canada
N8W 5K8
Telephone
(519) 948-5000
Fax
(519) 948-5054

Ministry of the Enviornment
Southwestern Region
733 Exeter Road
London, ON
N6E 1L3

Attention: Mr. Craig Newton
Regional Environmental Planner/EA

Addendum to Manning Road Secondary Plan Area
Stormwater Management Study
Class Environmental Assessment
Town of Tecumseh

Dear Mr. Netwon:

The Town of Tecumseh has retained Dillon Consulting Limited to review the potential for modifications to specific aspects of the preferred solution for stormwater management identified in the Manning Road Secondary Plan Area – Stormwater Management Class EA Environmental Study Report (ESR) (April 2010).

The preferred solution, as shown in Figure 14.1 from the noted ESR, consists of a regional stormwater management facility to service the Manning Road Secondary Plan Area (Areas A and B on the attached Figure 14.1).

The Town is now considering opportunities to optimize the preferred solution, including expanding the design drainage area.

This letter is to advise MOE that we anticipate the changes to the preferred solution will be considered significant enough to trigger an Addendum to the Class EA. The extent of any changes to the preferred solution will be reviewed and documented in an Addendum Report, which is anticipated to be completed in early Fall 2014.

Please advise if you would like to receive additional information on the changes prior to the Addendum Report being finalized.

Yours sincerely,

DILLON CONSULTING LIMITED

Laura Herlehy

Laura Herlehy, P.Eng.
for Flavio R. Forest, P.Eng.
Project Manager

LMH:ks
cc: Corporation of the Town of Tecumseh, Mr. Phil Bartnik, P.Eng.

APPENDIX C

NATURAL ENVIRONMENT EXISTING CONDITIONS REVIEW

MEMO

DILLON CONSULTING

TO: File

FROM: Nicholas Trevisan, Dillon Consulting Limited

DATE: October 17, 2014

SUBJECT: Species at Risk Screening for Proposed Enclosure of the Baillargeon Drain

OUR FILE: 11-5366

The following memo summarizes the *Endangered Species Act* (ESA), *2007* screening for Species at Risk (SAR) potentially affected by the enclosure of Baillargeon Drain, associated with the current Manning Road Secondary Plan Area Stormwater Management Class Environmental Assessment Addendum.

A similar memo was sent to the Ministry of Natural Resources, Alymer District Office on June 23, 2014. The memo has been updated to reflect changes to the study process being followed.

Property Information

The Study Area is provided in **Figure 1**.

The Baillargeon Drain is located on a property with frontage to Manning Road in the Town of Tecumseh. Baillargeon Drain receives stormwater via an enclosed section of the drain underneath the residential subdivision to the west and flows in an easterly direction where it outlets to the East Townline Drain adjacent to Manning Road. East Townline Drain flows north and outlets at Lake St. Clair approximately 2.75 km north of the Study Area.

A preliminary aerial photo review indicates the property is currently used for agriculture and the lands directly adjacent to the drain are actively farmed crop fields. Riparian vegetation directly adjacent to the drain consists primarily of ground vegetation and scattered/sparse shrubs and trees. At the southwestern extent of the drain on the property is a small open meadow or wetland community that is not actively farmed.

Photos of the Study Area are included herein.

Proposed Activities

The Baillargeon Drain is an open drain that crosses the Manning Road Secondary Plan Area (MRSPA), serving as a drainage outlet from an enclosed storm sewer system that serves the existing residential lands to the west, and flows in an easterly direction to the East Townline Drain at Manning Road. As outlined in the 2010 ESR, the open portion of the Bailargeon Drain was proposed to be enclosed with a 1350 mm diameter concrete pipe to accommodate development within the MRSPA, but was not to be integrated as part of the proposed MRSPA storm drainage system.

Consideration is now being given to incorporating the Baillargeon Drain within the proposed storm sewer and stormwater management system that is required to serve the development of the MRSPA. Activities would include expanding the design drainage area of the 2010 proposed MRSPA stormwater management facility to include the Baillargeon Drainage area. Limited design modifications are required to the pond. Additional property is not required as the pond footprint has not been significantly altered.

NHIC Search Results and Preliminary Comment on SAR Records

A search of the Ministry of Natural Resources and Forestry (MNRF) Natural Heritage Information Centre (NHIC) database was conducted in April 2014 to obtain records of Species at Risk (SAR) and to determine preliminarily if SAR may be impacted by the proposed activities. Occurrence records for the following species were found for the 1KM square that encompasses the Baillargeon Drain and adjacent areas (17LG4854):

- Swamp Rose-mallow (*Hibiscus moscheutos);*
- Common Hoptree (*Ptelea trifoliate);*
- Climbing Prairie Rose (*Rosa setigera);*
- Dense Blazing Star (*Liatris spicata);*
- Willowleaf Aster (*Symphyotrichum praealtum);*
- American Chestnut (*Castanea dentate);*
- Pygmy Pocket Moss (*Fissidens exilis);*
- Barn Owl (*Tyto alba);*
- Snapping Turtle (*Chelydra serpentine);*
- Northern Riffleshell (*Epioblasma torulosa rangiana);*
- Eastern Mole (*Scalopus aquaticus);*
- Massasauga (Carolinian population) (*Sistrurus catenatus pop. 2);* and
- Restricted records for three species.

Additional information, such as the potential for SAR and/or SAR habitat on the subject property, identified during the NHIC search is provided in **Appendix 3**. While there is potential for some SAR to occur on the subject lands given their historical occurrences in the general area of the project and the open country habitat type as determined through air photo

interpretation, it is unlikely that these species currently occupy the study area given the level of local disturbance, quality of residual habitat and the lack of suitable habitat to fulfill one or more of their life processes.

A site investigation will be conducted in July 2014 to document existing terrestrial and aquatic environment conditions and record incidental observation of SAR and potential SAR habitat.

Correspondence from Ministry of Natural Resources and Forestry

By letter dated August 8, 2014 attached, MNRF advised there are no known occurrences of SAR in the general area of the project. Eastern Foxsnake (endangered) is known to widely occur in the County of Essex.

DILLON CONSULTING

October 2013

Project No. 11-5366-1000

Manning Road Secondary Plan Area Functional Design Study

in the Town of Tecumseh

FIGURE 1.0
STUDY AREA

Appendix 3: Species at Risk Identified in NHIC Search with Preliminary Determination of Potential for Occurrences or Habitat in the Study Area (1KM square 17LG4854)

Common Name	Scientific Name	SARA Status	ESA Status	Last Observation	Habitat	Potential Habitat On Site	Species Affected by the Proposed Activity
Plants							
Swamp Rose-mallow	*Hibiscus moscheutos*	SC	SC	2002	Swamp marshes, wet woods and ponds	No	No
Common Hoptree	*Ptelea trifoliata*	THR	THR	1982	Shorelines and other dry sites	No	No
Climbing Prairie Rose	*Rosa setigera*	SC	SC	2000-2001	Open woods and thickets	No	No
Dense Blazing Star	*Liatris spicata*	THR	THR	2008	Prairies, savannahs and open sandy woods, occasionally adventive	No	No
Willowleaf Aster	*Symphyotrichum praealtum*	THR	THR	1986	Openings of oak savannahs, occasionally along railways, roadsides and in abandoned farm fields	Yes - subject to the botanical field investigation. Not one of the 13 known sites in Windsor, on Walpole Island, and in Lambton County around Sarnia.	Unknown - Subject to the botanical/ELC field investigation to determine suitable habitat and occurrence.
American Chestnut	*Castanea dentata*	END	END	2001-2002	Moist to well drained forests on sand, occasionally heavy soils	No	No
Mosses							
Pygmy Pocket Moss	*Fissidens exilis*	SC	SC	1981	Low-lying woodland, on sheltered banks, molehills, streamsides, and in damp fields and grassland	Yes – potential habitat if damp fields/grassland exists.	Unknown - Subject to the botanical/ELC field investigation to determine suitable habitat and occurrence.
Birds							
Barn Owl	*Tyto alba*	END	END	1936	Open areas such as fields, agricultural lands with scattered woodlots, buildings and/or orchards; grasslands, sedge meadows, marshes; snow-cover limits ability to catch prey; species has intolerance to severe cold; nests in hollow trees and live trees >46 cm dbh; also nests in barns, abandoned buildings	Yes – potential marginal foraging habitat based on size and expected diversity of flora community (no potential nesting habitat - e.g., outbuildings).	No – Activity will not affect nesting/potential foraging habitat.
Turtles							
Snapping Turtle	*Chelydra serpentina*	SC	SC	1989	Permanent, semi-permanent fresh water; marshes, swamps or bogs; rivers and streams with soft muddy banks or bottoms; often uses soft soil or clean dry sand on south-facing slopes for nest sites; may nest at some distance from water; often hibernate together in groups in mud under water; home range size ~28 ha	Yes – potential marginal movement/foraging area along drain; however, the drain does not connect two habitats and does not contain suitable overwintering and nesting habitat (subject to field confirmation).	No – Can mitigate potential effects of the activity on turtles moving/foraging along the drain during construction.
Mussels							
Northern Rifflesheell	*Epioblasma torulosa rangiana*	END	END	1890	Highly oxygenated riffle areas of rivers and streams on rocky and sandy bottoms (substrates) or firmly packed sand and fine-to-coarse gravel	No	No
Mammals							
Eastern Mole	*Scalopus aquaticus*	SC	SC	1997	Prefers areas of deep, sandy or sandy-loam soils in pastures, meadows or lawns; occasionally open woodland; often found in	Yes – subject to the field investigation of soil substrates (type/moisture) and	No – Can mitigate potential effects of the activity on moles if potential habitat is

					moist bottomlands	confirmation of meadow habitat.	determined to be present.
Snakes							
Massasauga (Carolinian population)	*Sistrurus catenatus pop. 2*	END	THR	1930 (extirpated)	Use upland, old field in summer; marsh, shrub swamp or bog; rivers and streams that provide sedge or low vegetative growth; in fall and winter; hibernate underground in mammal burrows, under rotting stumps, in rock crevices	Yes – potential marginal movement/foraging area along drain; however, the drain does not connect two habitats and does not contain suitable overwintering and nesting habitat (subject to field confirmation).	No – Can mitigate potential effects of the activity on snakes moving/foraging along the drain during construction.
Restricted Records							
EOID: 4958—please provide information							
EOID: 13452 —please provide information							
EOID: 16210 —please provide information							

Ministry of Natural Resources and Forestry
615 John Street North
Aylmer ON N5H 2S8
Tel: 519-773-9241
Fax: 519-773-9014

Ministère des Richesses Naturelles et des forêts
615, rue John Nord
Aylmer ON N5H 2S8
Tél: 519-773-9241
Téléc: 519-773-9014

Ontario

August 8, 2014

AYL-L-066-14

Nicholas Trevisan
Dillon Consulting Limited
235 Yorkland Boulevard Suite 800
Toronto, ON M2J 4Y8

Dear Mr. Trevisan:

RE: Baillergeon Drain and the *Endangered Species Act, 2007*

The Ministry of Natural Resources and Forestry (MNRF) has reviewed the information provided for the proposed Baillergeon Drain project to assess the potential impacts of the proposal on endangered and threatened species and their habitats. From the information provided, it is our understanding that the proposed project falls within the following parameters:

Project Location:
- Baillergeon Drain: Lots 155 & 156 Concession 1 Petite Cote, and Lot 153 Concession 3 Petite Cote, in the Town of Tecumseh, County of Essex.

Project Timing:
- Project is proposed to take place before June 30, 2015.

Project Activities:
- Proposed work consists of enclosure of the Drain.

Species at Risk (SAR):
- There are no known occurrences of SAR in the general area of the project location, however Eastern Foxsnake (END) is known to occur widely in the County of Essex.

Activities are proposed to take place under the following Section(s) of the *Drainage Act* that may be covered under Section 4.4 of the Agreement (AY-23D-010-10) under the *Endangered Species Act, 2007* (ESA 2007):

☐ 3(18) – Maintenance of a ditch constructed under *Ditches and Watercourses Act* chapter 109
☐ **4 – New Petition Drain (*NOT covered under Agreement*)**
☐ 74 – Maintenance and/or Repair Work
☐ 77 – Deepening, widening or extending without report of engineer
☒ 78 – Construction and/or Improvements, upon examination and report of engineer
☐ 124 – Authorization of Emergency Work

Based on a review of the above information, MNRF staff have determined that the Activities associated with the project, as currently proposed, are covered under the Agreement, and have concluded that the project **will likely not contravene** section 9 and/or section 10 of the ESA 2007 for species at risk (SAR) **provided the following recommendation is implemented**:

1. Should you encounter any SAR individuals during the proposed work, follow the measures outlined in Schedule C (Mitigation Plan) of the Agreement.

This Letter to Proponent (AYL-L-066-14) is valid until June 30, 2015.

Should any of the project parameters change, or if it is not possible to comply with the above recommendations, notify MNRF Aylmer District office to obtain advice on whether the changes may result in the requirement for an authorization under the ESA 2007.

It is important to be aware that species not listed on Schedule B of the Agreement may occur within your Municipality and that changes may occur in both species and habitat protection for species that are listed on Schedule B. The ESA 2007 applies to species listed on the Species at Risk in Ontario List (http://www.ontario.ca/environment-and-energy/species-risk-ontario-list). The Committee on the Status of Species in Ontario (COSSARO) meets regularly to evaluate species for listing and/or re-evaluate species already listed. As a result, species designations may change that could in turn change the level of protection they receive under the ESA 2007. Also, habitat protection provisions for a species may change e.g. if a species-specific habitat regulation comes into effect. The regulation would prescribe the area as the habitat of the species.

Please be advised that it is your responsibility to be aware of and comply with all other relevant provincial or federal legislation, municipal by-laws, other MNRF approvals or required approvals from other agencies.

If you have any questions or concerns regarding this letter, please contact me at 519-773-4745 or by email at ESAScreeningRequest.AylmerDistrict@ontario.ca.

Sincerely,

Kate MacIntyre

Kate MacIntyre
A / Management Biologist, Aylmer District
Ministry of Natural Resources and Forestry

APPENDIX D

STAGE 1 ARCHAEOLOGICAL ASSESSMENT

FISHER ARCHAEOLOGICAL CONSULTING
452 Jackson St. W.,
Hamilton, Ontario,
L8P 1N4
Tel: (905) 525-1240
Fax: (905) 525-4683

JACQUELINE FISHER, M.A., A.P.A.
Principal Archaeologist

Administrative Co-ordinator
Ministry of Tourism, Culture and Sport
Culture Programmes Unit
401 Bay Street, Suite 1700
Toronto, Ontario, M7A 0A7

16th October, 2014

RE: MANNING ROAD SECONDARY PLAN AREA, STORMWATER MANAGEMENT STUDY, CLASS EA ADDENDUM, TOWN OF TECUMSEH, ESSEX COUNTY, ONTARIO

ARCHAEOLOGICAL STAGE 1: BACKGROUND STUDY Final Report, Original;
PIF # P042-0405-2014; Licensee: Jacqueline Fisher, P042 (PIF is valid)

Dear Administrative Co-ordinator,

Please find submitted the Ministry of Tourism, Culture and Sport's (MTCS) one electronic copy of the above named final report. If you have any questions, please do not hesitate to contact me at the above numbers.

The following points address MTCS report submission requirements:
1) the archaeological work was conducted as part of the Class EA addendum;
2) the currently available mapping is also submitted;
3) no field work has been conducted, therefore there are no avoidance schedules;
4) the results of the Stage 1 work has been discussed with the proponent;
5) there are no previous reports associated with this project.

Sincerely

Jacqueline Fisher
(President, FAC)
cc: Brandon Fox, Dillon Consulting Limited; Phil Bartnik, Town of Tecumseh;

COVER LETTER

1) Licensee Information:

Name:	Jacqueline Fisher
Company Name:	Fisher Archaeological Consulting
Licence #:	P042
Contact Information:	452 Jackson St. West Hamilton, Ontario, L8P 1N4. Tel.: 905 525-1240; Fax: 905 525-4683 Email: jacquie.fisher@sympatico.ca

2) Project Information:

PIF:	P042-0405-2014; PIF is valid
Archaeological fieldwork stages: Stage 1	
Development Name:	MANNING ROAD SECONDARY PLAN AREA, STORMWATER MANAGEMENT STUDY, CLASS EA ADDENDUM, TOWN OF TECUMSEH, ESSEX COUNTY, ONTARIO
Property Location:	Part Lots 154, 155 and 156, Concession 1; Part Lots 152 and 153, Concession 2; and Part Lots 155 and 156, Concession 3, (geographic Township of Sandwich East), Town of Tecumseh, County of Essex, Ontario

3) Proponent Information:

Proponent:	Town of Tecumseh
Contact:	Phil Bartnik, Manager of Engineering Services 917 Lesperance Road, Tecumseh, ON N8N 1W9 Telephone: 519 735-2184; Email: pbartnik@tecumseh.ca
Alternate Contact:	Dillon Consulting Limited 320 Deziel Drive, Suite 608, Windsor, Ontario N8W 5K8 Brandon Fox - Telephone: 519-438-1288 ext. 1307; Fax: 519 - 672-8209; Email: BFox@dillon.ca
Project No.:	11-5366-7000

4) Approval Authority:

Name:	Ministry of the Environment and Climate Change, Southwestern Region, 733 Exeter Road, London, ON N6E 1L3
Contact Name:	Craig Newton
Contact Information:	Tel.: 519-873-5014; Email: craig.newton@ontario.ca
Regulatory Process:	Class EA Addendum

5) Reporting Information

Date Report Filed:	final report 16th October, 2014, original

6) Previous Reports: *NA*

List of Supplementary Information: A) Development Map

Borden Registration Form: NA

I the undersigned hereby declare that, to the best of my knowledge, the information in this report and submitted in support of this report is complete and accurate in every way, and I am aware of the penalties against providing false information under section 69 of the *Ontario Heritage Act*.

Jacqueline Fisher
(Licensee)

FISHER ARCHAEOLOGICAL CONSULTING

MANNING ROAD SECONDARY PLAN AREA, STORMWATER MANAGEMENT STUDY CLASS EA ADDENDUM, TOWN OF TECUMSEH, ESSEX COUNTY, ONTARIO

ARCHAEOLOGICAL STAGE 1: BACKGROUND STUDY

FINAL REPORT
Original

P042-0405-2014
16 October, 2014

MANNING ROAD SECONDARY PLAN AREA, STORMWATER MANAGEMENT STUDY, CLASS EA ADDENDUM TOWN OF TECUMSEH, ESSEX COUNTY, ONTARIO

ARCHAEOLOGICAL STAGE 1: BACKGROUND STUDY FINAL REPORT

Original

Property Location

Part Lots 154, 155 and 156, Concession 1; Part Lots 152 and 153, Concession 2; and Part Lots 155 and 156, Concession 3, (geographic Township of Sandwich East), Town of Tecumseh, County of Essex, Ontario

Submitted to:

Ontario Ministry of Tourism, Culture and Sport

&

Phil Bartnik, P. Eng.
Manager of Engineering Services
917 Lesperance Road
Tecumseh, ON N8N 1W9
phone: 519 735-2184
email: pbartnik@tecumseh.ca

&

Brandon Fox
Dillon Consulting Limited
320 Deziel Drive, Suite 608
Windsor, Ontario N8W 5K8
phone: 519-438-1288 ext. 1307
fax: 519 - 672-8209
email: BFox@dillon.ca

Project No.: 11-5366-7000

Prepared by:

Jacqueline Fisher
Fisher Archaeological Consulting
452 Jackson St. W.
Hamilton, Ontario, L8P 1N4
phone 905 525-1240
fax 905 525-4683
e-mail: jacquie.fisher@sympatico.ca

Archaeological Licence Number: P042, Jacqueline Fisher
PIF# P042-0405-2014
(PIF is valid)
16 October, 2014

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MANNING ROAD SECONDARY PLAN AREA, STORMWATER MANAGEMENT STUDY CLASS EA ADDENDUM, TOWN OF TECUMSEH, ESSEX COUNTY, ONTARIO

ARCHAEOLOGICAL STAGE 1: BACKGROUND STUDY

EXECUTIVE SUMMARY

Fisher Archaeological Consulting (FAC) was contracted by Dillon Consulting Limited to undertake the Stage 1 Background Research for the Manning Road Secondary Plan Area, Stormwater Management Study on Part Lots 154, 155 and 156, Concession 1; Part Lots 152 and 153, Concession 2; and Part Lots 155 and 156, Concession 3, (geographic Township of Sandwich East), Town of Tecumseh, County of Essex, Ontario (***Figure 1***). The maximum boundaries of the Study Area are to the north is County Road 22, on the south is the Canadian Pacific Railway (CPR) track, and on the east is Manning Road/County Road 19. The furthest west edge of the Study Area abuts the subdivisions off Lesperance Road (see ***Figures 2*** and ***3***).

The Study Area is within the Essex Clay Plain, and has no natural water sources within 300 metres. There are also no registered archaeological sites within a kilometre of the Study Area. The Study Area is primarily agricultural land, with a few houses and farmsteads along Manning Road, and includes the backyards of some properties that front Lesperance Road. The post-European contact period settlement of these lots ranges from *ca* 1800 to the mid 1800s, with settlement primarily by French immigrants. Both Manning Road and Lesperance Road are considered early settlement roads.

The background research has indicated a low potential for Aboriginal sites within the Study Area and high Euro/Afro-Canadian archaeological potential present in association with the historic Manning Road/County Road 19, Lesperance Road and the CPR track. The results are displayed on ***Figure 7***. Therefore, as a result of the Stage 1: Background Study, FAC recommends the following:

1) That the areas of high archaeological potential within the Study Area as defined on ***Figure 7*** and described in **Section 3.0** be subjected to Stage 2 Assessment prior to any development. This recommendation acknowledges that the potential may be reduced during the Stage 2 Assessment due to extensive modern disturbances;

2) That areas of low potential within the Study Area as defined on ***Figure 7*** do not require further archaeological work.

MANNING ROAD SECONDARY PLAN AREA, STORMWATER MANAGEMENT STUDY CLASS EA ADDENDUM, TOWN OF TECUMSEH, ESSEX COUNTY, ONTARIO

ARCHAEOLOGICAL STAGE 1: BACKGROUND STUDY FINAL REPORT

1.0 INTRODUCTION

The following is a Stage 1 report, prepared for review by the Ontario Ministry of Tourism, Culture and Sport (MTCS). Archaeological consultants, licensed by MTCS, are required to follow the *Standards and Guidelines for Consulting Archaeologists* (MTCS 2011) during land use planning as part of the evaluation of cultural heritage resources. This includes reporting all findings to MTCS. There are four stages for archaeological work — Stages 1 to 4.

Stage 1 — Background Study and Property Inspection. The purpose of the Stage 1 archaeological assessment is two-fold. Firstly, it is to determine the potential for the presence of as yet undocumented cultural heritage resources, and secondly, to determine whether known cultural heritage resources are extant on the subject land(s).

Stage 2 — Field work. Stage 2 is the actual field examination of high potential areas, and involves either surface survey of ploughed fields or shovel testing in areas that are undisturbed or cannot be cultivated.

Stage 3 — Testing. The purpose of the Stage 3 is to ascertain the dimensions of the site, its cultural affiliation (if possible), and to evaluate its significance. If the site in question is determined to be archaeologically significant, then appropriate mitigation measures will be decided upon.

Stage 4 — Mitigation. Stage 4 involves the mitigation of the development impacts to the archaeological site through either site excavation or avoidance (preservation).

Stage 1 determines the amount of Stage 2 work required. Stage 2 determines if Stage 3 is warranted, and Stage 3, in turn, determines if the archaeological resources are significant and warrant a full excavation (Stage 4) or if the site may be preserved.

All work was conducted under archaeological licence P042. The Stage 1 Background Study pertains to project information number P042-0405-2014.

1.1 Development Context

Fisher Archaeological Consulting (FAC) was contracted by Dillon Consulting Limited to undertake the Stage 1 Background Research for the Manning Road Secondary Plan Area, Stormwater Management Study on Part Lots 154, 155 and 156, Concession 1; Part Lots 152 and 153, Concession 2; and Part Lots 155 and 156, Concession 3, (geographic Township of Sandwich East), Town of Tecumseh, County of Essex, Ontario (***Figure 1***). The maximum boundaries of the Study Area are: to the north is County Road 22; on the south is the Canadian Pacific Railway (CPR) track; and on the east is Manning Road/County Road 19. The furthest west edge of the Study Area abuts the subdivisions off Lesperance Road (see ***Figures 2*** and ***3***).

The Stage 1 Background Study is part of the Class Environmental Assessment Addendum for the stormwater management study. Access to the Study Area for the property inspection was restricted to public land and right-of-ways (ROWs). The archaeological work is being conducted in the pre-design phase of the study.

1.2 Archaeological Context

The Study Area is comprised of agricultural land, scrub or wood lots, a few farmsteads or rural residential lots fronting Manning Road, and the rear portion of some residential lots fronting Lesperance Road. The natural topography is relatively flat, and there are dredged ditches along the roads to aid in drainage. The agricultural fields are divided by hedgerows (see ***Figure 2***).

The following discussion details the environmental and cultural setting of the research area. This provides a framework for conducting the archaeological potential survey.

1.2.1 Physiographic Features[1]

The topography of southern Ontario is primarily due to glacial and post-glacial action. Glacial Lake Whittlesey and Lake Warren, which covered Essex County, left most if it "smoothed by shallow deposits of lacustrine clay which settled in the depressions while the knolls were being lowered by wave action" (Chapman & Putnam 1984:147). These shallow deposits were laid on the clay till that overlies the limestone or shale base. This whole area, encompassing most of Essex County and part of the former Kent County, is known as the St. Clair Clay Plains (*ibid*). The St. Clair Clay Plains region has little relief, lying between 172.5 and 210 metres above sea level (a.s.l.), with the exception of a moraine at Ridgetown (*ibid*). Within this larger region is the Essex Clay Plain, between the basins of Lake Erie and Lake St. Clair. The Study Area is located within the Essex Clay Plain.

The general topography of northern Essex County area is flat to gently undulating, but there are some areas of slightly higher ground, representing old shorelines or low hills. The Study Area is at approximately 600' or 180 metres a.s.l. as indicated on the National Topographic Series (NTS) 40 J/7 mapping (see ***Figures 1 and 6***). The landscape within the Study Area is naturally level to gently undulating, with artificial berms providing the only rise in topography.

1.2.2 Soils

The Study Area is located primarily in the Brookston Clay of the Essex Clay Plain, but there is an area of Brookston Clay Sand Spot Phase in the northern half (***Figure 4***). The Brookston Clays are described as dark clays over mottled clays, down on to blue-grey gritty clay subsoil. The Brookston Clay Sand Spot phase is found is a series of shallow sand knolls, with less than three feet to the clay base. Both these soil types are found on almost level terrain with poor natural drainage (Richards *et al* 1949: Soil Map of Essex County). Man-made ditches and tile underdrains have been constructed throughout the county to aid in drainage (Chapman & Putnam 1984:149), including within the Study Area.

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1 FAC has previously conducted Stage 1 research on lots within the Study Area, and therefore much of Section 1.2 and 1.3 is taken directly from that report (see FAC 2012).

Generally, a preference for settlement sites would be on well-drained soils, rather than poor ones such as clay or muck soils. However, the soil type cannot be used as a sole criterion for predictive modelling of site locations, as has been observed through archaeological survey and excavation.

1.2.3 Water Sources and Vegetation

The distance to a water source is a major factor in determining an area's archaeological potential. Other factors include soil, vegetation and landscape features. Generally, areas within 300 metres to a seasonal or year round source of water are considered to be of high archaeological potential (MTCS 2011: 20).

The Study Area is situated between Pike Creek and Little River, approximately 2.5 kilometres south of the current south shore of Lake St. Clair (the shoreline having been extended out into the lake in the 20th century), and is also in the vicinity of two other major sources of water: Lake Erie to the south and the Detroit River to the west, that connect the two lakes. The closest natural water to the Study Area is Pike Creek, one kilometre south of the CPR tracks at the southern end of the Study Area. There are also dredged ditches along the field edges in the northern section of the Study Area, and a channelized drain that crosses the middle of the Study Area in a roughly east/west alignment.

The Detroit River corridor is unquestionably an area of high cultural and historical significance not only to the First Nations and Metis, but to the Europeans who followed in the more recent centuries. For thousands of years, the river has facilitated the movement of both peoples and goods throughout the interior of the continent, providing a route between Lake Erie, Lake St. Clair and northwards to Lake Huron. In addition, the rich resources found in the water and the surrounding lands encouraged intensive Aboriginal and early European settlement along its banks. The lakes provided navigable watercraft routes, accessible footpaths along their shores, and many natural resources within a short distance.

The general region of the Study Area was once covered in swamp, and the vegetation would have reflected those wet conditions. Prior to clearing of the land by various groups of settlers, the region would have been covered in forests of "elm, black and white ash, silver maple, and other moisture-loving trees" (Chapman & Putnam 1984:149). On the drier grounds there would have been tall prairie grasses. Marshes would have been excellent sources for a variety of waterfowl, fish, and other fauna, as well as varied flora for Aboriginal peoples to utilize.

1.2.4 Lithic Sources

Sources of siliceous stone, specifically chert, for making tools were often focal areas for pre-contact Aboriginal peoples. There are no immediate primary sources of chert in the area. The nearest primary chert sources are the Kettle Point Formation found off the southern shore of Lake Huron and Bayport chert in Michigan. Further afield sources would have included the Onondaga Formation found along the northeast shore of Lake Erie (Eley and von Bitter 1990:4). The area has a heavy till load of cobble and pebble cherts and these were utilized by various Aboriginal groups through the millennia.

1.2.5 Archaeological Sites

Historic research and known archaeological sites provide a cultural background in which to place the Study Area and any archaeological resources that might be found during an assessment. FAC requested a search of the Ontario Archaeological Sites Database (OASD) by the Ministry of Tourism, Culture and

Sport to determine the number of registered sites within one kilometre of the Study Area. There are no registered sites within the one kilometre radius.

1.2.6 Previous Archaeological Work

Tecumseh Hamlet Servicing Plan between County Roads 22 & 42, (geographic Township of Sandwich East), Town of Tecumseh, Essex County, Ontario. Archaeological Stage 1: Background Study. FAC 2013; PIF# P042-288-2012.

FAC previously conducted a Stage 1 Background Study for the Tecumseh Hamlet Servicing Plan to the west and south of the current Study Area. Section 3 of the Servicing Plan abutted the southern edge of the CPR track below and within 50 metres of the Study Area; the remainder of the Servicing Plan area was more than 500 metres from the current Study Area. The Stage 1 report concluded that "Section 3 has high archaeological potential only within 100 metres of the CPR line, where it is not disturbed by the gas pipeline, and within 100 metres of the County Road 19 ROW" (FAC 2013: 21), and noted that there was disturbance along Manning Road from the drainage ditch and potential modern disturbance on the house lots (*ibid*).

Archaeological Assessment (Stage 1), Manning Road Corridor, St. Gregory's Road to Sylvestre Drive, Town of Lakeshore, Essex County, Ontario. Archaeologix Inc. 2002. CIF# 2002-005-093, Licence 2002-005.

This report was part of an Environmental Assessment of the Manning Road ROW, the southern end of its study area, approximately 100 metres south of Sylvestre Drive, abuts the northeast corner of the current Study Area. The report indicated high potential for historic Euro-Canadian sites in agricultural lands adjacent to, or within, the Manning Road corridor and low potential for Aboriginal sites (Archaeologix Inc. 2002: 7, 12, 13). The section of the Manning Road ROW adjacent to the current Study Area was assigned high potential (*ibid*).

Archaeological Assessment (Stage 2), Manning Road Corridor, St. Gregory's Road to Sylvestre Drive, Town of Lakeshore, Essex County, Ontario. Archaeologix Inc. 2004. CIF# P001-101.

This report documents the Stage 2 Assessment of areas of potential as outlined in its preceding Stage 1 report (Archaeologix Inc. 2002). Nothing of archaeological significance was identified during the Stage 2 field work (Archaeologix Inc. 2004: 10).

1.3 Historical Context

1.3.1 Aboriginal History

Aboriginal peoples have inhabited Southern Ontario for over 11,000 years, and there is potential to find evidence of the earliest groups (Early and Late Paleo-Indian) through to the post-European contact period in the general Windsor area (CRM *et al.* 2002:5-16). After the final retreat of the glaciers and the opening up of the Great Lakes basin, people moved into the area. What follows is a brief synopsis of the

peoples who came before the European settlers — from Paleo-Indians to Late Woodlands people when first contact was made[2].

During the geological time frame of Lake Algonquin there is direct evidence that people were inhabiting southern Ontario (Ellis & Deller 1990:39). These people are known to researchers as Paleo-Indians who were non-agriculturalists and depended upon hunting and foraging of wild foods to survive. They would have moved their camps on a regular basis to the areas that would have provided resources as they became available. The size of the groups of people would in part depend upon the size and nature of those resources available at a particular location (Ellis & Deller 1990:52). People would have gathered or dispersed through the year depending on the availability of resources and social constraints. The environmental conditions of spruce parkland/woodland to pine forests would have necessitated frequent moves and a large range of territory in order acquire adequate resources.

In the Windsor area, there is the potential for finding both Early and Late Paleo-Indian tools and sites. For Essex County, there is only one registered site (AaHs-16) containing a Late Paleo-Indian component. The site is multicomponent, situated southwest of Amherstburg. While the Paleo-Indian period lasted for a millennium, the Archaic horizon lasted for approximately seven times that length spanning from 8,000 B.C. to 850 B.C. It would appear that the Archaic peoples in Southern Ontario were subsisting in smaller territories than the former Paleo-Indians, thereby becoming more regionalized. Their population was increasing, probably due to the more reliable food resources as well as greater biodiversity in these resources. The broad divisions in the Archaic may be broken down into the Early, Middle and Late Archaic. The Early Archaic peoples continued with some characteristics from the Paleo-Indians, but developed some of their own, as any culture is never static.

The water levels of the Great Lakes by the end of the Late Archaic were essentially modern, so there would have been no restrictions concerning habitation because of this factor. Windsor would have been a prime area for Late Archaic Aboriginal people, and there would have been movement from Michigan and Ohio to up around the shores of Lake Huron.

One of the major differences between the Late Archaic and Early Woodland (800 B.C. to *ca.* 0 B.C.) in the archaeological record of southern Ontario was the appearance of pottery. By the time of the Middle Woodland, there was a major shift in the way people settled the landscape and procured foods. It is at this time (500 B.C. to A.D. 700) that people were making fish a more important aspect of their diet, although hunting and foraging were done as well. As a consequence, rich and large sites began to appear on river valley floors. The sites were inhabited periodically for sometimes hundreds of years, and represented a warm season macroband base camp, to take advantage of spawning fish. People kept returning to particular fish spawning grounds, and became more reliant on this resource. People were becoming more sedentary and had a restricted band territory, compared to the people of the Archaic.

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2 The following discussion of the general Paleo-Indian, Archaic and Woodland history of Aboriginal peoples in southwestern Ontario is taken directly from the CRM group 2002 report, as the author of the cultural section in the 2002 report is the editor for this current report and grants permission for its use in this section.

When exactly the Late Woodland began and the Middle Woodland ended has been debated by archaeologists, but the designation has been based on a number of materially distinct differences from the Middle Woodland. Differences include things such as new settlement and subsistence strategies, a new type of pottery construction, different pottery decorating techniques, and a variety of projectile point forms. Based on these characteristics, it is generally felt that the Late Woodland period began at around 800 A.D. and continued until A.D. 1650, after which the time frame is designated as post-contact period.

Archaeological work has shown that Aboriginal peoples in the Windsor area include Archaic period camps dating back to 1,800 to 1,500 B.C. and people continued to live in the area in villages with sites dating to *ca.* A.D. 1100. The arrival of Europeans brought extensive changes to the Aboriginal groups in the area. Populations were decimated and social upheaval ensued, including re-location and re-organization. Conflict between the Algonquians and the Neutral that had started in the 15th century, continued into the 16th century, and by the mid-1500s, the Algonkian groups shifted out of southwestern Ontario (CRM *et al.* 2002:2-13).

The earliest historic references to Aboriginal villages in the Windsor area are drawn from mid-17th century French explorers, who indicated a Neutral village and a mixed Neutral/Wenro village present (Lajeunesse 1960:xxxi). Across the river on the Detroit side, there was a mixed Huron (Wendat/Wyandot) and Tionontati village established near Detroit in 1679. Once Fort Pontchartrain du Détroit was established in 1701, the Odawa[3] moved to its vicinity since the area had been a summering ground for them at least since the 1680s. The two main Aboriginal groups to establish permanent settlements in the Windsor area during the 1700s were the Odawa and the Hurons (establishing a village next to the French Jesuit mission (de Léry 1752 in CRM *et al.* 2002:2-14).

The Odawa village moved extensively in the early 1700s. By 1721, the village was listed as being located on the south shore of the river, and is described as being inhabited by "the Outaouais who, together with the Hurons and the Poutouatamis have made wastes[4] containing about two leagues frontage by eight arpents deep" their home (Lajeunesse 1960:26). By 1752, three villages are shown – the Odawa and Huron villages are on the south side of the river, and a Potawatomi village is on the north side, opposite the Huron village.

It was not until 1790 that a formal cession of Aboriginal lands was drafted by Alexander McKee (an Indian Department agent) and 27 chiefs of the Ottawa, Poutouatamis, Huron, and Chippewa at Detroit. McKee had "been instructed to purchase all the shoreline between Long Point on Lake Erie and the Chenal Ecarté River...which empties into the St. Clair River" (Surtees 1994:108). The chiefs agreed to the lands on the eastern side of the Detroit River to be surrendered, and retained two specific parcels of land – the Huron Reserve [Anderdon Township] and the Huron Church Reserve (Surtees 1994:108; Lajeunesse 1960:171 [full transcript]), which are to the southwest and west of the Study Area.

[3]Odawa and Ottawa are generally interchangeable terms.

[4]The original French word is *deserts*, more appropriately translated as deserted or uninhabited lands.

Today, the nearest First Nation on the Ontario side is Bkejwanong (Walpole Island), some 50 kilometres to the northeast around Lake St. Clair. The descendants of the Huron are today known by various names, including Wendat and Wyandot. Wyandot Nations include the Wyandot Nation of Anderdon in Trenton, Michigan, the Huron-Wendat Nation at Wendake, Quebec, Wyandot Nation of Kansas, Kansas City, and Wyandotte Nation of Oklahoma, located at Wyandotte, Oklahoma.

Another distinct Aboriginal group are the Métis, who are the result of intermarriage and liaisons between fur traders and Aboriginal women. "This Métis people were connected through the highly mobile fur trade network, seasonal rounds, extensive kinship connections and a collective identity (i.e., common culture, language, way of life, etc.). Distinct Métis settlements emerged throughout what was then called "the Northwest". In Ontario, historic Métis settlements emerged along the rivers and watersheds of the province, surrounding the Great Lakes and throughout to the northwest of the province. These settlements formed regional Métis communities in Ontario that are an indivisible part of the Metis Nation" (Métis Nation Ontario 2013).

1.3.2 Essex County, Township of Sandwich East, & Town of Tecumseh

The Detroit River shoreline comprises the earliest continuous European settlement in Ontario. The European influx began in the early 18th century with French settlement that grew up around Fort Ponchartrain (later Fort Detroit) on the north side of the river. In the mid 18th century, French families were encouraged by the governor of Québec to settle and farm the land by the river in order to promote trade in Detroit (CRM *et al.* 2002:2-16). The earliest surveys (including the early British surveys) were accomplished in the French manner with long, thin lots backing onto the waterfront around the river and up along the southern shores of St. Clair. The Study Area is within this lot system (Lajeunesse 1960: Figure 14).

With the American Revolution, United Empire Loyalists began moving into the region, and in the late 18th and early 19th centuries, the British re-surveyed the area, gradually moving inland and encouraging settlement in the interior. By the 1790s, British settlement was underway, and although the interior of Essex County was surveyed, the population remained concentrated along the lakes and river shores for many decades (CRM *et al.* 2002:16). In 1792, Essex County was formally recognized, as well as eighteen other counties under the newly established province of Upper Canada (County of Essex 2010).

The Township of Sandwich was surveyed first under the French, then completed by the British in 1791. In 1861 the Township of Sandwich was divided into Sandwich East and Sandwich West (Town of Tecumseh, 2012). In 1893, Sandwich East was further subdivided and Sandwich South was created. In 1966 Sandwich East was once again subdivided, and this time was dissolved, being annexed into both the City of Windsor, and the Township of Sandwich South. Thirty-three years late, in 1999, the Township of Sandwich South was amalgamated, along with the village of St. Clair Beach, into the Town of Tecumseh. In 2003 the City of Windsor annexed 23 square kilometers from the Town of Tecumseh; the annexed portion is beyond the Study Area boundaries (*ibid*).

The village of Tecumseh was established at the junction of the Tecumseh Road and the Great Western Rail line, on the eastern edge of the township (see ***Figure 5***). This intersection is over half a kilometre north from the northern most point of the Study Area. The French were the initial European settlers of

this area, the majority of them descendants of those who had established their seigneural land holdings along the banks of the river in the late 1700s (Town of Tecumseh, 2012). At this time there were only three families which had settled in the area (*ibid*). The first post office at Tecumseh, and therefore the community, was known as "Ryegate" until 1912, when the village was renamed Tecumseh in honour of Tecumseh, a Shawnee warrior who was killed at battle in the War of 1812 (Town of Tecumseh, 2012).

The construction of Tecumseh Road in 1838 and the establishment of the Great Western Railway opened up the area even further for settlement. As the Town of Windsor grew after the 1860s, Tecumseh began to grow as well due to the overflow of new immigrants. The first post office was located on the northeast corner of Tecumseh Road and Lesperance Road and was operated by a Mr. Christie. Some of the first businesses in Tecumseh included a lumber mill,a grocery store, a cheese factory on Banwell Road operated by Joseph Breault, a bakery, three butcher shops, a canning factory and a brewery (*ibid*). The village became an important railway depot and stopover for travellers on their way to Windsor as County residents could take a horse and buggy into Tecumseh and then transfer onto the train. Several popular hotels were started in Tecumseh as a result to accommodate travellers, such as the Bedell Hotel, the Soulliere Inn, the Hebert and the Hotel Perreault (*ibid*).

The border communities and townships of Essex County in the 19th century were home to a growing population of African-Canadians beginning after the War of 1812 and continuing throughout the century, many of whom came to Canada on the Underground Railroad from the States (Walls 2013). Sandwich East (later South), was one of the locations where this often marginalized group settled and formed a community. Communities are recorded at Little River, Pike Creek and Puce River, typically with at least one church and maybe a school (*ibid* and Walls n.d.).

As the townships developed, the road network also increased. The Study Area fronts two major roads: County Road 22 in the north and Manning Road/County Road 19 on the east. Manning Road is the historic boundary road between Maidstone and Sandwich Townships, while County Road 22 in this location is a modern road right-of-way (ROW). The Great Western Railway Company (GWR) was constructed through Tecumseh in the 1870s, however their purchasing of land began in the 1850s and was completed in the 1870s (**Appendix A**). The location of the GWR promoted the growth of the village of Tecumseh and its immediate environs.

By the end of the 19th century, Windsor was becoming an industrial city important for international trade and shipping, a trend that expanded rapidly in the 20th century with the influx of automobile plants and other manufacturing complexes. The expansion of Windsor aided in the continuing development of the surrounding townships and villages.

1.3.3 19th Century History of Lots within the Study Area

A number of historical documents were consulted when conducting the background research of the above lots in Sandwich (East and then South) Township. Primary resources such as land registry records and historic maps, were utilized in conjunction with secondary sources. **Appendix A** provides tables of the relevant transactions from the Land Registry Abstract Index; unfortunately some of the records have been lost (Lot 155, Concession 3 among them), and many of the records are illegible. Here follows a summary of the research results.

Lots 154, 155 & 156, Concession

Both Lots 154 and 156, Concession 1, were patented to Jean Baptiste Bouke in 1800, and then sold to the land speculator John Askin in 1802. His son Charles was then sold both lots in 1806/1816. The Askin family held Lot 154 until the 1860s. Charles Askin began subdividing Lot 156 however in the 1830s to families such as Latourneau, Lafleur and Graham, while still keeping a portion in the Askin holdings. In 1869, Askin's will was registered (it appears he passed away much earlier), and in 1870, Latourneau's will was registered. The next land transfers in the 1870s again involved only portions of Lot 156 among other lands.

The first page of records for Lot 155, Concession 1, is missing. However, the following records indicate that the Askins also held Lot 155, Concession 1 into the 1870s. In 1873, A. Askin transferred part of Lot 155 along with other lands to Elzear Jacque, who had also just obtained part of Lot 156.

Lots 152 & 153, Concession 2

Lot 152, Concession 2 was patented three times to Charles Lesperance (alternately spelled L'Esperance), in 1790, 1801 and 1835. Lesperance did not subdivide his lot, apart from a small section sold to the GWR in 1852 and another to the Township of Sandwich in 1858, possibly for developments in the village of Tecumseh. Charles Lesperance's will was registered in 1861. The Lesperance family retained the remainder of the lot as a whole into the 1880s when a portion was sold to M.A. McHugh in 1885. This was followed by two registered Plans, one of the McHugh lands (Plan 279 in 1885) and one of the Lesperance lands (Plan 395 in 1892). A portion of the Study Area is within Plan 395 Lot 6. A review of Plan 395 indicates how the west half of Lot 152 Concessions 1 and 2 were subdivided into small farm holdings for various members of the Lesperance family. The plan indicates that Lesperance also owned Lot 152, Concession 1. Plan 395 Lot 6 was a 28.5 acre parcel owned by Cariol Lesperance. There is no indication that the Lesperance homestead would have been within the Study Area, and it was more likely either closer to the lake or to Tecumseh Road.

The southern 85 acres of Lot 153, Concession 2, was patented to Bejamin Lavallee in 1818, and this is followed by a direction to look at a certain record book for explanation; unfortunately the source is illegible. Somehow Lavalle had obtained the rest of the lot, and sold 160 acres to Alexandre Duchine in 1847. Again, many of the following entries were illegible but appeared to be primarily associated with mortgages.

Lots 155 & 156, Concession 3

The records for Lot 155, Concession 3 are missing entirely, however there is a partial Land Registry record for Lot 156. In 1912, part of the lot among other lands is sold by the widow Lemire to Florence Hebert.

Summary

The above research indicates that some of the lots were patented to, or quickly obtained by, land speculators such as John Askin. It appears that most of the lots were then first officially farmed in the early to mid-1800s, however they do not discount the possibility of squatters on the land prior to the patents. Lot 152, Concession 2, the Lesperance farm lot, is possibly an exception as Charles Lesperance

both obtained his patent early and then appears to have settled and improved the lot, leaving it as a family holding. The settlers' names indicate the strong French connection of the region.

Historic structures or associated sites could be expected fronting any of the 19th century roads, although the only house depicted on the 19th century mapping is the Cochoy farmstead on Lot 153 in the *Historic Atlas*, south of the Study Area (however it should be noted that the historic atlas' often depicted only the homes of subscribers).

1.3.4 20th Century Land Use of the Study Area

Knowing the former land uses of the Study Area aids in determining the archaeological potential for both the preceding millennia and the more recent historic periods. This section provides a detailed description of the land use in the 20th century based on topographic maps and aerial/satellite imagery. A summary of the information gathered from these sources is presented in **Table 2.**

Table 1
Summary of Maps & Aerial Images Relevant to the Study Area

Image	Year	Comments
Illustrated Historical Atlas of the Counties of Essex and Kent. ***Figure 5*** -provides a starting point for the 20th Century maps	1881	-Little development present, mostly farm lots; village of Tecumseh is developing at the intersection of Lesperance Rd & Tecumseh Rd -Banwell, Lesperance, Manning, and County Road 42 are present in similar locations; -County Road 22 not present; -House on south end of lot 153, belonging to L. Cochoy, beyond the Study Area boundaries; no structures indicated within the Study Area -Great Western Railway present north of the Study Area.
National Topographic Series 40 J/7 Edition 1 ***Figure 6a***	1908	-Shows the village of Tecumseh to the north of the Study Area; -Canadian Pacific Railway (CPR) is extant; -Study Area is agricultural; small wood lots ar epresent in the thewest portion of the Study Area; three farmhouses are indicated fronting Manning Road within the Study Area -County Road 22 is not yet constructed; -houses are depicted fronting Lesperance Road, but no inner subdivision streets yet east of Lesperance (apart from the village to the north); -600' contour line crosses the Study Area;
National Topographic Series 40 J/7 Edition 3 ***Figure 6b***	1957	-Barns now depicted along with the houses on the Manning Road farmsteads within the Study Area; there are now 4 houses & 3 barns; -Increase in development and start of subdivisions along Lesperance Road; a secondary structure is present east of a house & possibly within the Study Area; -Tecumseh increases in size; -contour line is more irregular (natural).

Image	Year	Comments
National Topographic Series 40 J/7 Edition 4 ***Figure 6c***	1978	-Highway 2 (current County Road 22) has been constructed across the northern end of the Study Area; -Increase in subdivisions along Lesperance Road on the west perimetre of the Study Area; farmsteads on Manning Road similar to previous edition; -The 600' contour has altered and no longer is depicted crossing the south half of the Study Area but still enters the north half.
National Topographic Series 40 J/7 Edition 5 ***Figure 6d***	1986	-Highway 2/County Road 22 is extended to form County Road 22 as it exists in alignment in modernity; -There is a structure in the northwest portion of the Study Area; -The number of structures associated with the farmsteads on Manning Road have changed; there is also a dug pond in the north corner of the Study Area fronting Manning Road; -There are no contours depicted within the Study Area.
National Topographic Series 40 J/7 Edition 6	1994	-Increased development in the surveys off Lesperance Road; -Tecumseh expands in the north along the lakeshore, and south to meet new subdivisions; -There is a tranformer station between the Study Area & Lesperance Rd; -The farmsteads & houses are still present on Manning Road within the Study Area; -The dug pond is no longer depicted fronting Manning Road within the Study Area.
National Topographic Series 40 J/7 Edition 7 ***Figure 1***	1999	-The only change from the 1994 6th edition within the Study Area is the inclusion of a dredged drainage channel in an east/west alignment from Manning Road to the subdivision by Lesperance Road.
Aerial Image (Geocortex, County of Essex)	2000	-Northwest edge of the Study Area is residential back yards; - 3 farmsteads or rural residential lots front Manning Road within the Study Area; southernmost former house appears to be demolished; -Remainder of Study Area is either cultivated or scrub/wood lot with hedgerows between fields & drainage ditches apparent.
Aerial Image (Geocortex, County of Essex)	2004	-There appear to be open tracks & other signs of disturbance (eg possible berms) in some of the scrub/wood lots; - Remainder of Study Area is similar to 2000 aerial.
Aerial Image (Geocortex, County of Essex)	2006	-Field tiling is visible in the cultivated lots.
Aerial Image (Geocortex, County of Essex)	2008, 2010, 2013	-No significant changes from 2006 Image.

Image	Year	Comments
Ontario Base Map 1:10,000 ***Figure 1***	2012	-Two additional drain channels are indicated, north/south alignments, along field edges coming south from County Road 22.

Based on the information from the above table, the Study Area has had a varied history. The following provides highlights of this history, as well as summarizing the previous table.

At the turn of the 20th century, the lands within the Study Area were predominantly utilized for agriculture, with a few farmsteads fronting Manning Road (***Figures 5 and 6a***). At this time Tecumseh is a small village at the intersection of the Great Western Railway (GWR) and Tecumseh Road. By 1908, the GWR had been bought out and renamed the Canada National Railway (CNR). Small roads are being constructed parallel to Lesperance Road, and the number of residential lots in that region is increasing. It is possible that the farmsteads within the Study Area, were present and not indicated in the *Historic Atlas*. Both Lesperance and Manning Roads are considered historic roads based on their 19th century construction.

By the end of the 1950s however, Tecumseh is extending south into the suburbs off Lesperance Road and continues to grow in density until the 1990s when the survey development fully abuts the western edge of the Study Area (compare ***Figures 6b*** and ***1***). Throughout the 20th century, the Study Area remained primarily agricultural, with an increase in structures and facilities associated with some of the farmsteads on Manning Road, and another structure in the northwest corner of the Study Area (1986 NTS, ***Figure 6d***). For a brief period in the 1980s and 90s, there was also an excavated pond north of the farmsteads on Manning Road, within the Study Area.

The Canadian Pacific Railway (CPR) would have been constructed in the late 19th century, as it was not depicted in the *Historic Atlas* but was present on the 1908 NTS map (see ***Figures 5*** and ***6a***). In 1961, Highway 2 (renamed County Road 22 in the 1990s) was realigned with the construction of the Pike Creek Bypass from Pike Creek to Banwell Road, and in the 1970s it was extended further west creating what would be recognizable as County Road 22 today (Kings Highways 2012).

The only major change to the Study Area during the 21st century appears to have been the demolition of a house fronting Manning Road ca 2000 and disturbances within the scrub or wood lots, as seen on the aerial imagery.

1.3.5 Historic Plaques

A search for historical plaques was conducted. The nearest historical plaque, The Founding of Tecumseh, is approximately 1.5 kilometers north of the Study Area on Lesperance Road (Ontario Plaques). Another plaque of interest although at a distance from the Study Area, is the Puce River Black Community plaque on County Road 42 east of Puce River. While specifically referring to the Puce River Black community, the plaque also commemorates the Refugee Home Society and the refugees slaves whom the Society aided to settle on 25 acre lots in Sandwich and Maidstone Townships (OHT 2008: 1). This plaque reinforces the importance of African-Canadian heritage to the region.

1.3.6 Historic Research Summary

The results of the historic background research indicate that Aborginal peoples were living in this region of Essex County during the late 18th and into the 19th centuries. The onset of European settlement during that same period first centralized and then dispersed the Aboriginal groups. There is no documented record of Aboriginal sites within the Study Area itself. During the mid-19th century, the Study Area was settled by French, British and possibly African-Canadians, and the land cleared for farming.

The CPR railway was constructed in the 19th century, as were all the roads associated with the Study Area apart from County Road 22, which was constructed in the late 20th century. The Study Area has remained primarily agricultural to the present day, although the number of structures has increased over the past 100 years. On the eastern side, these structures are typically associated with the same farmsteads on Manning Road that were present from at least the early to mid 20th century, while on the western side there are outbuildings related to the adjoining 20th century subdivisions.

2.0 METHODOLOGY

Information about the archaeological potential was gathered from various sources. The archaeological potential for Aboriginal sites has been assessed using the data collected from the Ontario Sites Database (OSD), and from environmental data collected from geological, soils, NTS topographic and Ontario maps. Euro-Canadian/African-Canadian site potential has been assessed using data from the OSD system, historic plaques, historic maps, and from primary and secondary historic sources.

During the limited property inspection conducted on 25th September, 2014, under partly sunny skies, the Study Area was checked for current land use, if the land had been extensively disturbed, the presence of any structures and physiographic features. Access was restricted to public land and ROWs. Documents from the limited property inspection include the photograph catalogue (**Appendix B**) and field notes.

3.0 ANALYSIS AND CONCLUSION

The Study Area is situated in a region of the Essex Clay Plain with low relief and pockets of sandier soils that do not greatly improve the general drainage. There are no immediate sources of chert for tool making, apart from till chert. There are also no natural water sources on or within 300 metres of the Study Area. There are no registered archaeological sites within a kilometre of the Study Area. Therefore, there is low potential for the discovery of Aboriginal archaeological sites within the Study Area.

The Euro-Canadian settlement of the Study Area vicinity appears to have begun in the early to mid 1800s, primarily by French immigrants. Lot 152, Concession 2 may have been settled as early as *ca* 1800 by Charles Lesperance, however many of the lots were held by land speculators well into the 19th century. There are no identified early 19th century settlement locations within the Study Area itself.

The same environmental factors that increase the potential for Aboriginal sites also pertain to the early Euro/African-Canadian settlement patterns, with the addition of transportation networks (road and rail). Manning Road/County Road 19 and Lesperance Road are both historic roadways with a high potential for the discovery of sites within 100 metres of the roads. Likewise, there is high potential for archaeological resources associated with the construction of the railway within 100 metres of the CPR line.

While there has been a slight increase in development of the Study Area within the past century, it remains primarily agricultural land. Both the background research and the property inspection indicated a potential for intensive modern land disturbance. Visible modern disturbances noted during the inspection were: the farmstead yards fronting Manning Road; along the northeastern boundary where a berm divides the fields from the adjacent industrial land; a berm at the east end of Westlake Street off Lesperance Road; and general landscaping of the backyards behind the Lesperance Road subdivision in the northwest corner of the Study Area. Other potential disturbances include the construction of County Road 22, construction of the adjacent subdivisions and industrial lots, as well as use of the scrub land within the Study Area for stockpiling etc during such construction. Any of these disturbances may reduce the potential to some degree, however the precise level of disturbance will have to be determined during the Stage 2 Assessment of the areas of high potential. The limited property inspection noted that the majority of the Study Area is cultivated and was in soy beans during the time of the inspection.

The *Standards and Guidelines for Consulting Archaeologists* indicates that a distance of 300M from "features of archaeological potential" such as water courses, registered sites and areas of early Euro-Canadian settlement, retain high potential for archaeological resources (MTCS 2011: 20, 21). In addition to these features, a distance of 100M from historic transportation routes such as roads, trails and railways, is considered to have high potential (MTCS 2011: 18, 21). ***Figure 7*** displays the potential results for the Study Area based on these criteria.

To conclude, there is low potential for Aboriginal archaeological sites within the Study Area, and high potential for Euro-Canadian/Afro-Canadian sites only within 100 metres of Manning Road/County Road 19, Lesperance Road and the CPR line. Modern disturbance and land alteration may have impacted some of the Study Area, particularly around the farmsteads and adjacent to the Lesperance Road subdivisions and the County Road 22 construction. The level of disturbance will have to be confirmed during a Stage 2 Assessment of the areas of otherwise high potential.

4.0 RECOMMENDATIONS

Based on the Stage 1 Background Research, there is high potential for archaeological resources in association with the historic roads and railways. Therefore, FAC recommends the following:

1) That the areas of high archaeological potential within the Study Area as defined on ***Figure 7*** and described in **Section 3.0** are subjected to Stage 2 Assessment prior to any development. This recommendation acknowledges that the potential may be reduced during the Stage 2 Assessment due to extensive modern disturbances;

2) That areas of low potential within the Study Area as defined on ***Figure 7*** do not require further archaeological work.

5.0 ADVICE ON COMPLIANCE WITH LEGISLATION

1) This report is submitted to the Minister of Culture as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, R.S.O. 1990, c0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Tourism and Culture, a letter will be issued by the minister stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.

2) It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeoloigcal site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has complete archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeology Reports referred to in Section 65.1 of the *Ontario Heritage Act.*

3) Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48(1) of the *Ontario Heritage Act.* The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with sec. 48(1) of the *Ontario Heritage Act.*

4) The Cemeteries Act, R.S.O. 1990 c. C.4 and the *Funeral, Burial and Cremation Services Act*, 2002, c.33 (when proclaimed in force) requires that any person discovering human remains must notify the police or coroner and the Registrar of cemeteries, Ministry of Consumer Services (416 326-8406).

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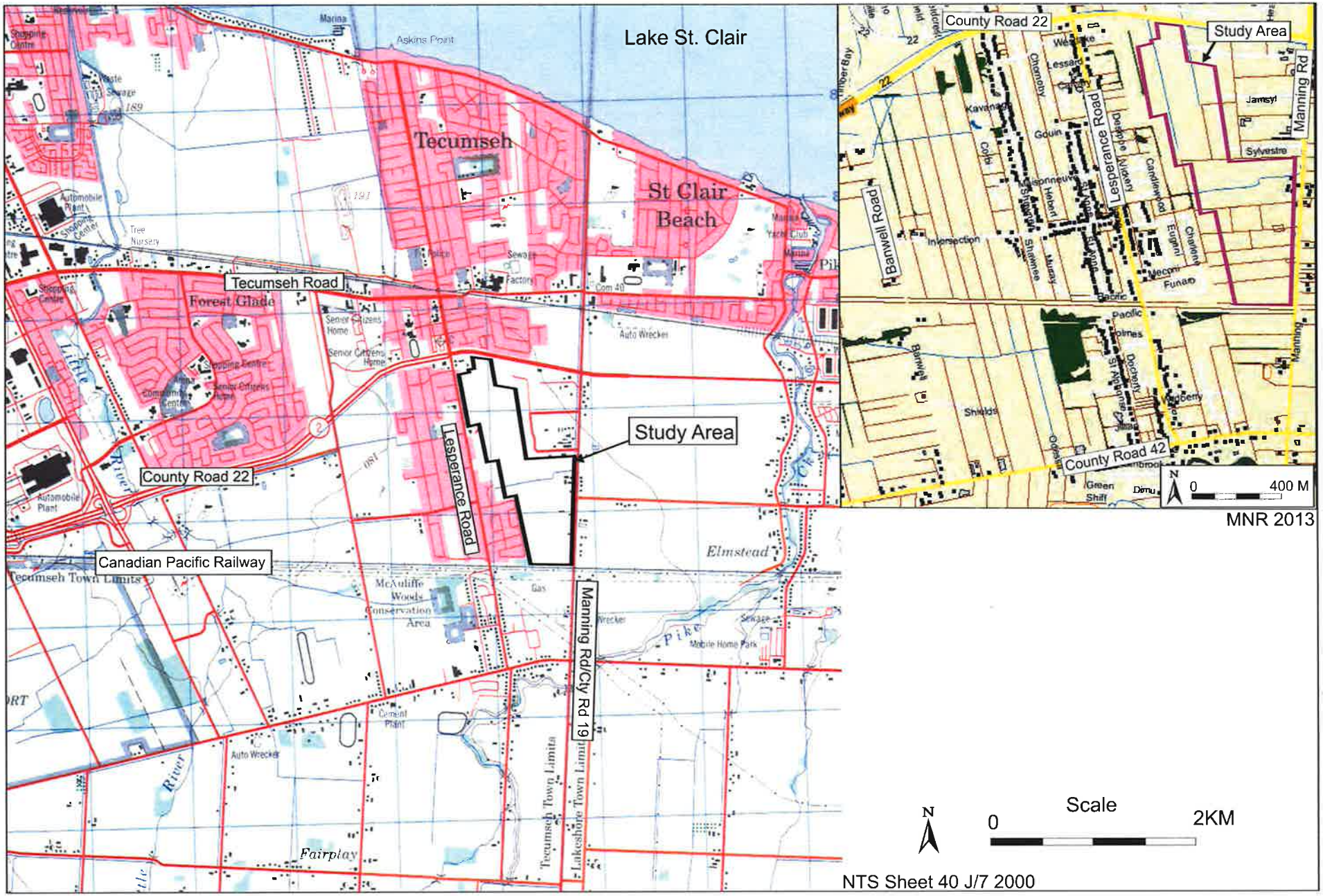
PROJECT PERSONNEL

Project Manager:	Jacqueline Fisher (P042)
Limited Property Inspection:	Jon Cousins (R296) Emma Gordon
Background Research:	Katherine Graham Barbara Johnson Ruth Macdougall
Report Authors:	Ruth Macdougall (P359)
Graphics:	Garett Hunt Ruth Macdougall Jon Cousins
Report Editor:	Jacqueline Fisher

NPD Table for the Manning Road Secondary Plan
Archaeological Stage 1: Background Research

Permission was obtained to enter the property described in the above report		Only public & ROWS
The licensee had permission to remove any archaeological objects recovered during the scope of the above named project		NA
The archaeological record will be curated at FAC's facilities		
Property Inspection Dates	**Weather**	**Ground Conditions**
25th September 2014	Partly sunny	clear, dry



Fisher Archaeological Consulting

MANNING ROAD SECONDARY PLAN AREA - STORMWATER MANAGEMENT STUDY
Dillon Consulting Limited

Figure 1: Study Area, Location and Topography

Google Earth Imagery, 2013

Fisher Archaeological Consulting

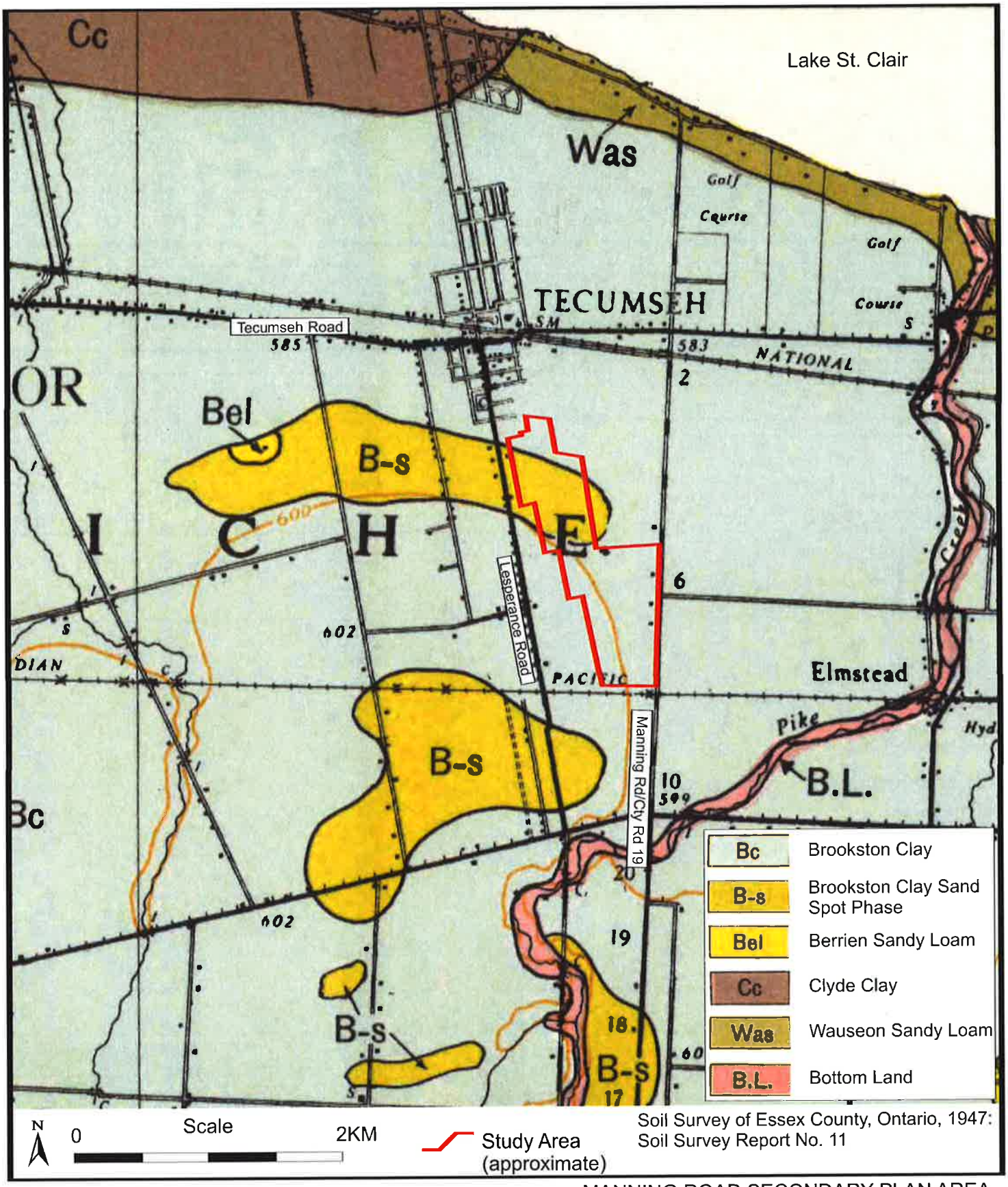
MANNING ROAD SECONDARY PLAN AREA - STORMWATER MANAGEMENT STUDY
Dillon Consulting Limited

Figure 2: Aerial View of the Study Area & Context

Fisher Archaeological Consulting

MANNING ROAD SECONDARY PLAN AREA - STORMWATER MANAGEMENT STUDY
Dillon Consulting Limited

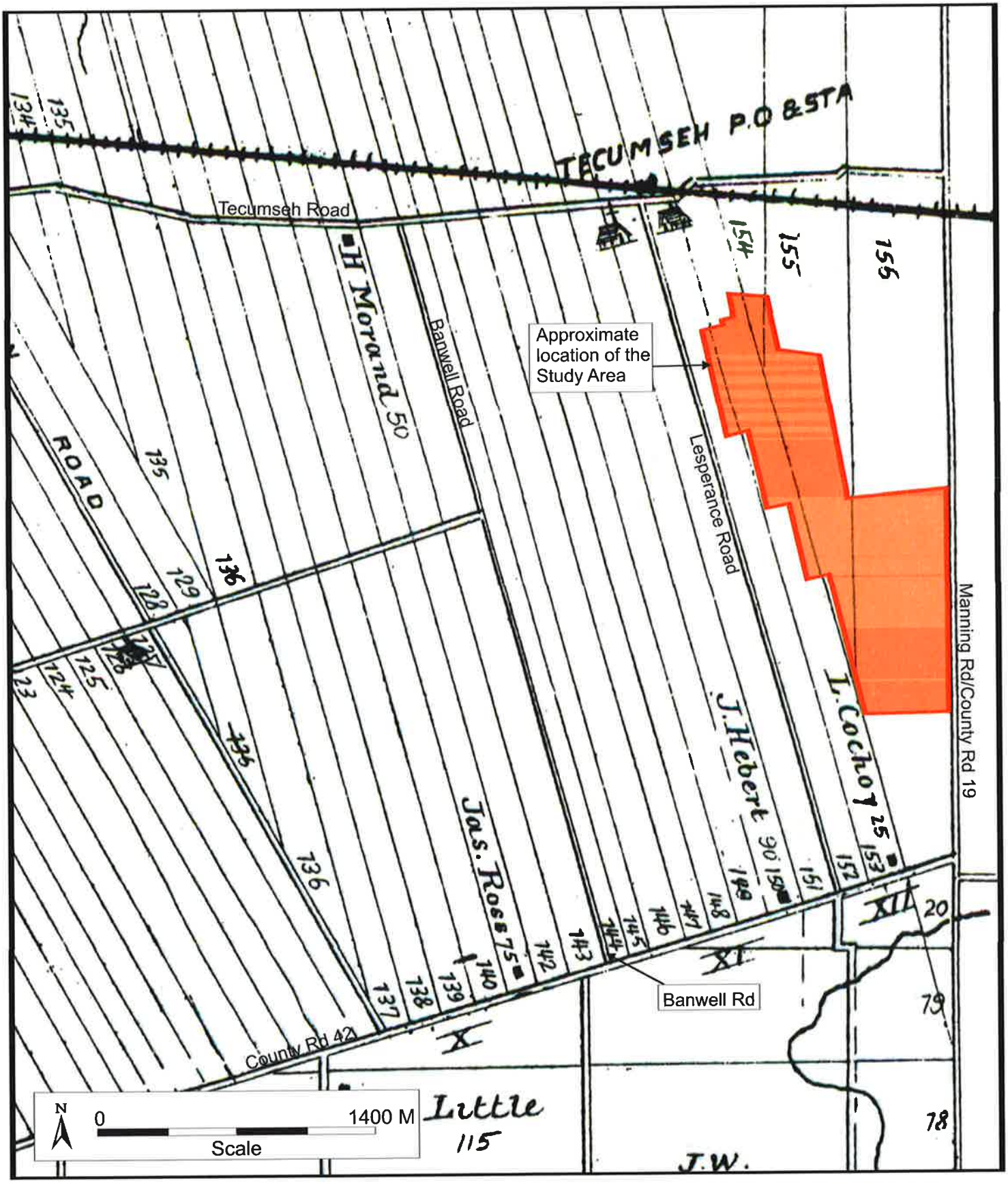
Figure 3: Development Plan



Fisher Archaeological Consulting

MANNING ROAD SECONDARY PLAN AREA - STORMWATER MANAGEMENT STUDY
Dillon Consulting Limited

Figure 4: Soils Map of Essex County



Fisher Archaeological Consulting

MANNING ROAD SECONDARY PLAN AREA - STORMWATER MANAGEMENT STUDY
Dillon Consulting Limited

Figure 5: Historic Atlas of Essex County, 1881
Northeast Corner of Sandwich Township

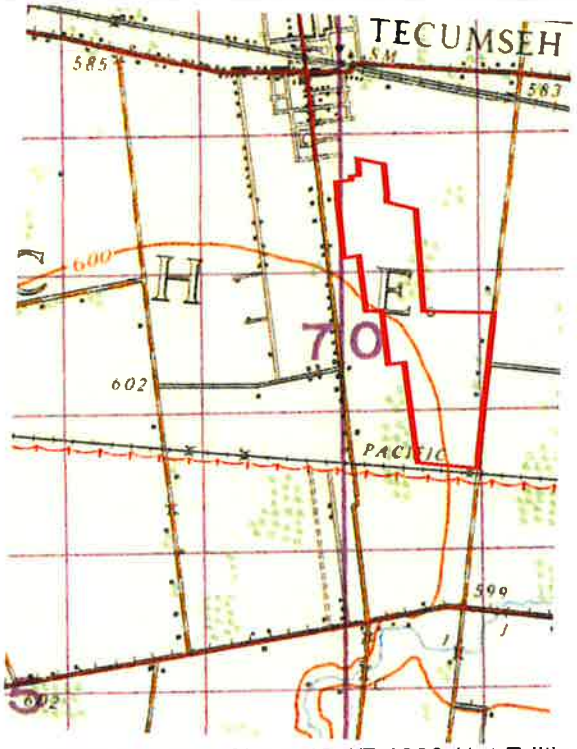


Figure 6a: NTS Sheet 40 J/7 1908 (1st Edition)

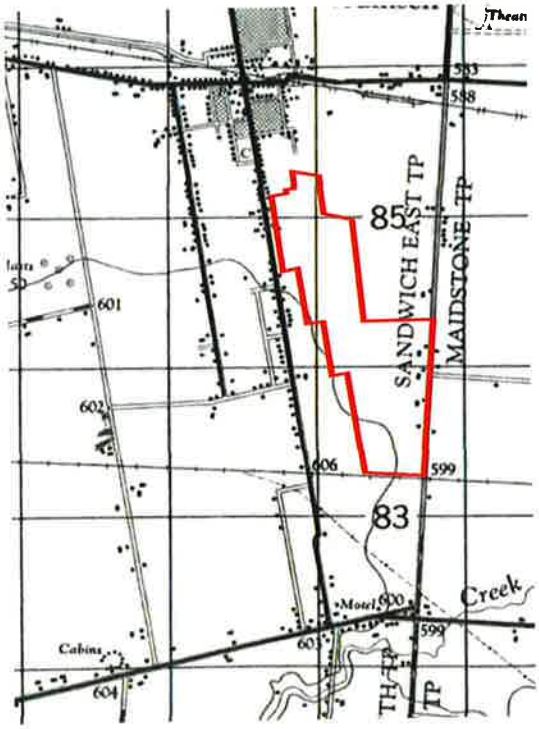


Figure 6b: NTS Sheet 40 J/7 1957 (3rd Edition)

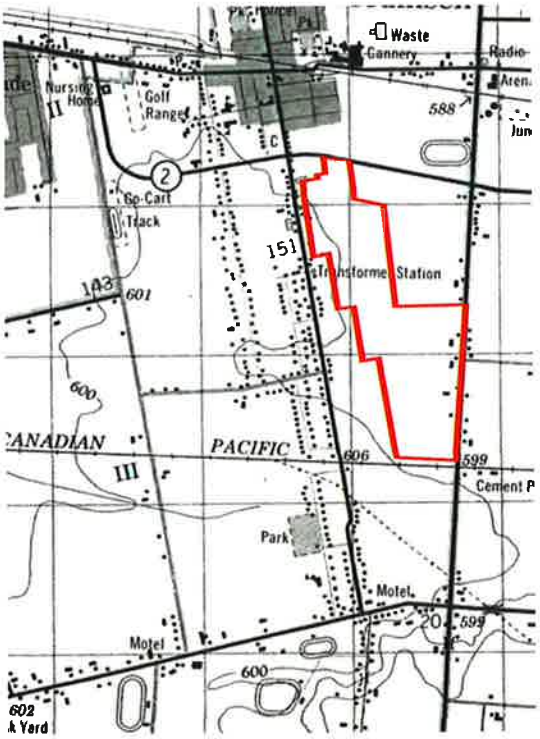


Figure 6c: NTS Sheet 40 J/7 1978 (4th Edition)

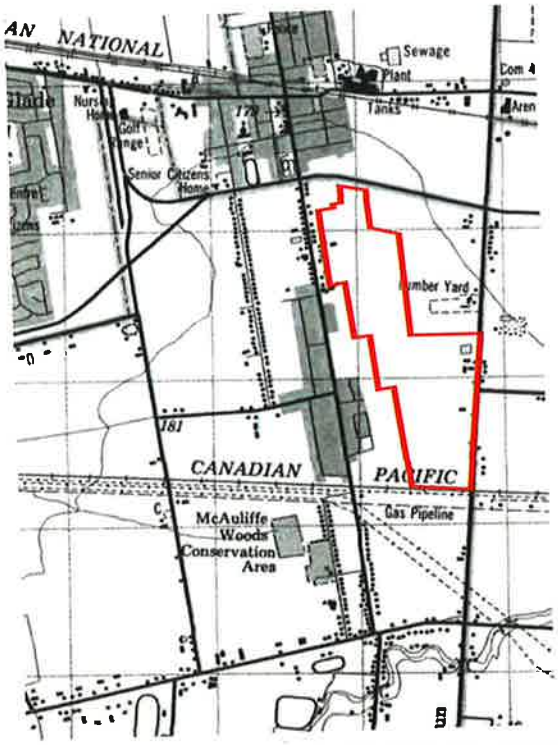


Figure 6d: NTS Sheet 40 J/7 1986 (5th Edition)

N

Scale

0 2 KM

Study Area (approximate)

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MANNING ROAD SECONDARY PLAN AREA - STORMWATER MANAGEMENT STUDY
Dillon Consulting Limited

Figure 6: Superceded National Topographic Series Maps

Fisher Archaeological Consulting

MANNING ROAD SECONDARY PLAN AREA - STORMWATER MANAGEMENT STUDY
Dillon Consulting Limited

Figure 7: Archaeological Potential Results

Plate 1: Looking SW across the soybean fields from the west end of Sylvestre Drive

Plate 2: Looking south from Sylvestre Drive; there is a large berm visible along the east edge of the Study Area.

Plate 3: Former house lot fronting Manning Road; facing west.

Plate 4: Looking SW across the Study Area towards the CPR rail line from Manning Road.

Plate 5: Backyards off Lesperance Road; looking NNE from the north end of Deslippe Drive.

Plate 6: Showing scrub brush and tree hedgerows off the eastern end of Westlake Drive; facing SE.

APPENDIX A: Land Registry Abstract Index, Selected Records, Sandwich East Township

Instr. = Instrument; No. = Instrument Number; Reg. = Registration

Lot 154, Concession 1

Inst. / No.	Inst. Date	Reg. Date	Grantor	Grantee	Land / Amount	Remarks
Patent	4 Sep 1800		Crown	John Baptiste Bouke	All	
B&S / 172	12 Dec 1802	19 Feb 1811	Jean Baptiste Bouk *et ux*	John Askin (Sr)	Lot 154, among other lands	
Deed Poll / C 241	11 Dec 1806	8 Dec 1816	John Askin Sr	Charles Askin	Lot 154, among other lands	Western ½ of Lot No 154
B&S / D -26	2 Dec 1816	8 Jan 1819	Archinge(sp ?) Askin	Charles Askin	Lot 154, among other lands	Eastern ½ of Lot No 154
Arbitration / 10	26 Mar 1853	26 Apr 1852	awarding £ to be paid by	GW Rway for right of way		
Deed / S -6	9 July 1853	13 July 1853	John David Askin, M. Askin wife of Charles Asking, & Samuel Smith McDonell	The GWRR Co	Lot 154, among other lands	Pt of Lot No 154 in 1st Con
P of Atty / 614 & 615	1855 & 1857	1857	Alfred Askin & John David Askin	Charles Asking & John A Askin		
B&S / 294	14 Mar 1864	29 Apr 1864	Charles Askin, John David Askin, *et al* (4 more Askins)	John McAllistry	100 ac parcel	Pt of Lot No 154
Will / 49	4 Mar 1851	19 Jul 1869	Charles Askin	see Will of		

Lot 155, Concession 1

Missing the first page of records. Earliest remaining recorded transfer (not including mortgages & discharges of mortgages) is 1872, and this is illegible. The records indicate that the Askins also held Lot 155, Concession 1 into the 1870s. In 1873, A. Askin transferred part of Lot 155 along with other lands to Elzear Jacque.

Lot 156, Concession 1

Inst. / No.	Inst. Date	Reg. Date	Grantor	Grantee	Land / Amount	Remarks
Patent / 533	4 Sep 1800		Crown	John Baptiste Bouke	all	all
B&S / A 72	12 Dec 1802	18 Feb 1804	Jean Baptiste Bouk *et ux*	John Askin Sr	among other lands	Lot No 156
Deed Poll / -41	11 Dec 1806	8 Dec 1816	John Askin Sr	Charles Askin	among other lands	Western ½ of Lot No 156
B&S / –26	2 Dec 1816	8 Jan 1818	Archange (sp?) Askin	Charles Askin	among other lands	Eastern ½ of Lot No 156
B&S / -543	8 Oct 1835	8 Oct 1835	Charles Askin	illegible		
B&S / -63	26Apr 1838	28 Apr 1838	Frances Latourneau	Joseph Lafleur		Pt Lot 156
B&S / 404	1 Aug 1837	6 Aug 1838	Joseph Lafleur	John Graham		pt Lot 156
Arbitration / 10	filed	26 Apr 1853	GWRC corporation			
Deed / 6	9 Jul 1853	13 Jul 1853	John David Askin, Monique Askin & Samuel Smith Macdonell	The GWRRC	among other lands	Pt of Lot 156, 1st Con
P of Atty / 614 & 615	see Lot 154	Con 1				
Will / 49	4 Mar 1851	19 Jul 1869	Charles Askin	see Will of		
Will / 1021	16 Nov 1869	20 Jun 1870	Francois Latourneau	see Will of		
Deed / H 1401	12 Feb 1872	21 Feb 1873	Archango M. Askin	Elzear Jacques	among other lands	part of Lot 156
Deed / 2129	29 Jan 1877	25 Feb 1877	Elzear Jacques *et ux*	The GW Ry Co		part of Lot 156
Deed / 2205	6 Jun 1877	8 Jun 1877	Charles H Askin *et al*	Jean St Louis	among other lands	part of Gore Lot 156

Lot 152, Concession 2

Inst. / No.	Inst. Date	Reg. Date	Grantor	Grantee	Land / Amount	Remarks
Patent	24 Oct 1790		Crown	Charles Lesperance	200 ac	see if this applies
Patent	10 Aug 1801	(double deed)	Crown	Charles L'Esperance	200 ac	All
Patent	12 Sep 1835		Crown	Charles L'Esperance	95 ac	S part
Deed / -28	18 Feb 1852	19 Feb 1852	Charles L'Esperance *et ux*	The GWRR Co	1 + ac	part Lot 152 1st & 2nd Con
Will / -	22 Dec 1860	12 Jan 1861	Charles Lesperance	See Will of		
B&S / -	20 Aug 1858	17 Jan 1861	Francois L'Esperance	The Municipality of the Township of Sandwich		Pt of Lot 152, 2nd Con
a number of illegible entries, inlcuding mulitple mortgages & discharged mortgages						
Deed / -77	16 Oct 1883	16 May 1884	Archangel Lesperance	Aimi Baillargeen		part of Lot 152
Deed / -	31 Oct 1884	9 Feb 1885	- P. Lesperance *et al*	Michael A. McHugh	25 ac	part of Lot -
Plan / No 279	25 Feb 1885	25 Feb 1885	The Property of M.A. McHugh Esq. of Lot 152 in the 1st & 2nd Con			
Plan / 395	10 Mar 1892	10 Mar 1892	Archangel Lesperance *et al*	by A.J. Halford, PDS	Sub of Lots 152 1st & 2nd	See Book C

Lot 153, Concession 2

Inst. / No.	Inst. Date	Reg. Date	Grantor	Grantee	Land / Amount	Remarks
Patent	26 Nov 1818		Crown	Benjamin Lavallee	85 ac	S Part of 153
0072	See *** from ** department on explaining Patent to this Lot					
B&S / 255	14 Jan 1847	21 Jan 1847	Benjamin Lavallee	Alexandre Duchine	160 ac	Lot No 153 2nd Con
B&S / 190	11 May 1849	11 May 1849	Alexander Duchine	Francois Duchine	80 ac	E ½ of Lot 153 in 2nd Con.
Deed / -	22 Feb 1853	15 Mar 1858	Francois Carron (?) *et ux*, Jean Baptiste Liberty *et ux*	The GWRR Co		Part of Lot 153 in 1st & 2nd Con
Deed / -	19 Aug 1853	30 Aug 1853	Francois Duchone *et ux*	The GWRR Co		Part of Lot 153, 1st & 2nd Con
series of illegible entries, mostly mortgages & discharge of mortgages						
Plan / 702	5 May 1906	31 Dec 1913	Gilbert Bedell	By JS Laird	Book E, pg 2851	Pt of Lot 153

Lot 156, Concession 3[5]

Inst./No.	Inst. Date	Reg. Date	Grantor	Grantee	Land / Amount	Remarks
Deed 10062	22 Jan, 1912	14 Jan 1912	Wm D. ? + wife	J—? E. R—?	A.O.L. $500	S part of Lot 156
Deed 2128	29 May, 1912	31 Jun, 1912	Desilda Lemire, widow + Amanda Lemire, family	Florence Hubert	A.O.L. $150	S part of Lot 156

[5] The Land Registry Abstract for Lot 155 and the earliest records of Lot 156 are missing.

Appendix B - Manning Road Secondary Plan, Stage 1 Photographic Catalogue

Photo No.	Description	Direction
Photographs taken with Fuji Film FinePix S5700		
25 Sept 2014		
6469	Showing extreme north end of Study Area with CR22 in background	NNW
6470	Showing extreme north end of Study Area	NW
6471	Showing extreme north end of Study Area	West
6472	Showing extreme north end of Study Area	WSW
6473	Showing extreme north end of Study Area	SW
6474	Showing extreme north end of Study Area	South
6475	Showing extreme north end of Study Area	SE
6476	Showing extreme north end of Study Area with large berm along edge of Study Area in background	ESE
6477	Looking into North end of Study Area with berm in background	South
6478	Looking in to South end of Study Area from Sylvestre Drive	South
6479	Looking in to South end of Study Area from Sylvestre Drive	South
6480	Looking into South end of Study Area from Manning Road	West
6482	Looking into South end of Study Area from Manning Road w/farm	West
6483	Looking into South end of Study Area from Manning Road w/farm	West
6484	Farm buildings in South end of Study Area along Manning Road	West
6485	Looking into South end of Study Area from Manning Road w/farm	West
6486	Looking into South end of Study Area from Manning Road	West
6487	Looking into South end of Study Area from Manning Road w/farm	West
6488	Looking into South end of Study Area from Manning Road w/farm	West
6489	Looking into South end of Study Area from Manning Road	West
6490	Looking into South end of Study Area from Manning Road	West
6491	Looking into South end of Study Area from Manning Road	West
6492	Looking into South end of Study Area from Manning Road	West
6493	Looking into South end of Study Area from Manning Road	West
6494	Looking into South end of Study Area from Manning Road	West
6495	Looking into South end of Study Area from Manning Road w/farm	North

Photo No.	Description	Direction
6497	Looking into South end of Study Area from Manning Road	West
6498	Looking into South end of Study Area from Manning Road	West
6499	Looking into South end of Study Area from Manning Road with rail corridor in background	SW
6500	Looking into South end of Study Area from Manning Road	West
6501	Looking into South end of Study Area from Manning Road with rail corridor to the left	SW
6502	West side of Study Area on Deslippe Drive	SE
6503	West side of Study Area on Deslippe Drive	East
6504	West side of Study Area on Deslippe Drive	NE
Ipad #1	West side of Study Area at end of Deslippe Drive	NW
2	West side of Study Area at end of Deslippe Drive	NNW
3	West side of Study Area at end of Deslippe Drive	NE
4	West side of Study Area at end of Deslippe Drive	ENE
5	Extreme North end with berm on West side of Study Area	East
6	Extreme North end with berm and trees on West side of Study Area	South
7	Extreme North end with berm and trees on West side of Study Area	East
8	Extreme North end with berm and trees on West side of Study Area	SE
9	Extreme North end with trees on West side of Study Area	South

APPENDIX E

MRSPA SMW CLASS EA
ESR (2010)

**(Appendices to Report
Available for Review Upon Request)**

APPENDIX F

RESPONSE TO COMMENTS RECEIVED DURING 30 DAY PUBLIC AND AGENCY REVIEW PERIOD

ADVERTISING PROOF

■ SHORELINE ☐ LASALLE POST ☐ Lakeshore News ☐ TILBURY TIMES ☐ Kingsville REPORTER ☐ WindsorParent MAGAZINE ☐ RIVERSIDE SHORELINE Proof # _____

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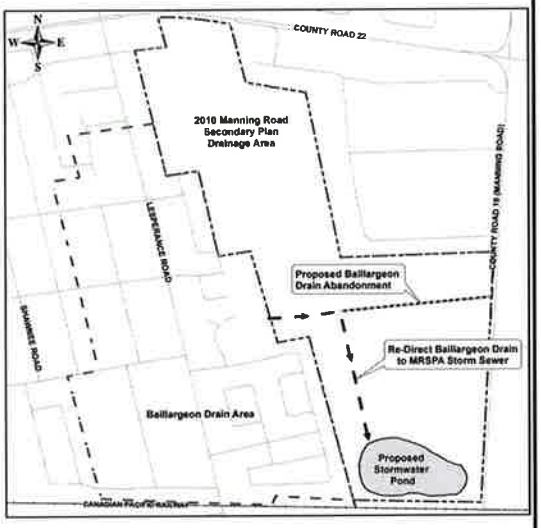
POSTMEDIA COMMUNITY PUBLISHING

Town of Tecumseh
Manning Road Secondary Plan Area
Stormwater Management
Class Environmental Assessment
Environmental Study Report Notice of Filing of Addendum

DILLON CONSULTING

Storm drainage improvements for the Manning Road Secondary Plan Area (MRSPA) were identified in the Stormwater Management Class Environmental Assessment (EA) Environmental Study Report (ESR) completed in 2010. The preferred solution was to service the area through a regional stormwater management pond, located just north of the CPR tracks, as shown on the following key plan.



Prior to initiating the design and construction of the required storm drainage infrastructure for the MRSPA, the Town of Tecumseh retained Dillon Consulting Limited to review the alternative of expanding the drainage area to be served by the proposed pond to include the Baillargeon Drain area. Based on a technical and environmental evaluation, this alternative has now been determined to be the preferred solution.

Redirecting the Baillargeon Drain to the proposed pond would result in the following benefits:

- Optimizes the available capacity of the proposed pond to provide further control of peak storm runoff rates and improve the quality of storm runoff from both the MRSPA and the Baillargeon Drain areas;
- Serves as a more cost-effective infrastructure solution for servicing the MRSPA, as well as for future downstream storm drainage improvements; and
- Improves the overall quality and function of the downstream storm drainage system.

This preferred solution will not require changes to the size and shape of the proposed pond from its original design, although there will be changes to its operational characteristics.

An Addendum to the Environmental Study Report was completed to document the technical and environmental benefits and impacts of the preferred solution, including recommended mitigation measures.

This Notice confirms that the Addendum is now available for the required public and agency review period in accordance with the Municipal Class Environmental Assessment process. Subject to the comments that are received, the Town intends to base the implementation of storm drainage improvements in this area on the preferred solution that has now been identified.

The Addendum is available for public review at the following locations:

Town of Tecumseh, Clerk's Office
917 Lesperance Road
Tecumseh, Ontario, N8N 1W9
Tel: (519)-735-2184

Essex County Library – Tecumseh Branch
13675 St. Gregory's Road
Tecumseh, Ontario, N8N 3E4
Tel: (226)-946-1529 Ext. 230

If you have comments on the Addendum, please provide them in writing by January 19, 2015 to:

Mr. Phil Bartnik, P.Eng. Manager, Engineering Services
Town of Tecumseh
917 Lesperance Road
Tecumseh, Ontario,
N8N 1W9

If concerns regarding the revisions to the preferred solution cannot be resolved through discussions with the Town, a person may request that the Minister of the Environment and Climate Change make an order for the project to comply with Part II of the Environmental Assessment Act (referred to as a Part II Order), which addresses individual environmental assessments. Requests must be received by the Minister at the address below by January 19, 2015. A copy of the request must also be sent to the Town of Tecumseh. If no request is received by January 19, 2015, the Town intends to base the implementation of storm drainage improvements in this area on the preferred solution that has now been identified.

Minister of the Environment and Climate Change
77 Wellesley Street West
11th Floor, Ferguson Block
Toronto, Ontario
M7A 2T5

From: **Phil Bartnik** <pbartnik@tecumseh.ca>
Date: Mon, Jan 5, 2015 at 9:55 AM
Subject: FW: Sylvestre Property
To: "Flavio Forest (fforest@dillon.ca)" <fforest@dillon.ca>
Cc: Brian Hillman <bhillman@tecumseh.ca>, Daniel Piescic <dpiescic@tecumseh.ca>, Rick Wellwood <rwellwood@tecumseh.ca>

Flavio,
As discussed, please see the Sylvestre's issues below in advance of _____ meeting.
Thanks

Phil Bartnik, P. Eng., PMP
Manager, Engineering Services
The Corporation of the Town of Tecumseh

From: Matthew Baird [mailto:mattjbaird@crozierbaird.ca]
Sent: January-05-15 _____
To: Phil Bartnik
Subject: Sylvestre Property

Happy New Year Phil!

I hope you enjoyed your time off.

I had left you a message prior to the holiday concerning Jim Sylvestre's property off of Manning Road. I met with both Jim and Jeff in December about the EA (or rather the amendment) being prepared by Dillon.

Basically, there are two items I'd like to bring to your attention:

1) The Sylvestre's would like to incorporate their land south of the railway into the regional storm pond.
2) The road layout (and therefore the storm sewer layout) is not their preferred layout.

I'm not sure whether Dillon had met with stakeholders previously or not.

Anyways, I think it would be preferable for them to take the above two points into account prior to completion of their amendment to the EA.

Thanks for your help,

Matthew J. Baird, P.Eng. PMP SCPM
President
[cid:8272E03A-43C1-4CAE-9258-B0D0E0BFB820]

102-27 Princess Street
Leamington, ON N8H 2X8
t. 519.326.6161
c. 519.329.4877
mattjbaird@crozierbaird.ca<mailto:mattjbaird@crozierbaird.ca>
www.crozierbaird.ca<http://www.crozierbaird.ca/>

——— Forwarded message ———
From: **John Henderson** <JHenderson@erca.org>
Date: Fri, Jan 23, 2015 at 11:44 AM
Subject: FW: Addendum to MRSPA
To: "Forest, Flavio" <fforest@dillon.ca>
Cc: Phil Bartnik <pbartnik@tecumseh.ca>, Daniel Piescic <dpiescic@tecumseh.ca>, Tim Byrne <TByrne@erca.org>, Mike Nelson <MNelson@erca.org>

Hi Flavio,

Thank you for calling to discuss the comments that we provided in our January 19, 2015 e-mail. As per our call, the following additional items were discussed:

a. It is identified that, during a major storm event, temporary on-site storage will be required for each development within the MRSPA to allow the minor system time to drain water to the pond. A chart showing temporary on-site storage requirement for each catchment area would be helpful. Also, with the natural fall of these lands being from south to north, will it be possible for the individual developments to actually provide the required on-site storage. The potential storage available on a typical roadway, with the existing south to north fall, should be analysed to see if the on-site storage requirements can be achieved. Please note that on-site storage should only include storage that is available within the municipally owned road right of way.

b. Potential climate change considerations were discussed. Your initial thoughts were that the pond outlet could be reviewed and that the pond has not been design to minimum storage requirements. Due to the uniqueness of the MRSPA and lack of overland routing, the minimum temporary on-site storage for each individual development may also need to be considered.

c. Numerous figures/plots are provided in Appendix B. Tabular presentation of some of this information would be helpful.

d. The proposed road grade elevation shown at the north end of the site in Figure 3 (low elevation = 180.650 m) does not appear to match the existing grade elevations shown on the truck sewer profile plots in Appendix A. In addition, the plotted HGL appears to be above the proposed road grade elevation.

If you have any questions, please do not hesitate to contact our office.

John Henderson, P. Eng.
Essex Region Conservation Authority (ERCA)
360 Fairview Avenue West, Suite 311
Essex, Ontario N8M 1Y6
519-776-5209 ext. 246
Fax: 519-776-8688

——— Forwarded message ———
From: **John Henderson** <JHenderson@erca.org>
Date: Mon, Jan 19, 2015 at 5:23 PM
Subject: Addendum to MRSPA
To: Phil Bartnik <pbartnik@tecumseh.ca>
Cc: Tim Byrne <TByrne@erca.org>, Mike Nelson <MNelson@erca.org>, "Forest, Flavio" <fforest@dillon.ca>

Good afternoon Mr. Bartnik,

We received the Town of Tecumseh MRSPA SWM Environmental Study Report Addendum date December 2104. Due to time constraints we have only completed a preliminary/screening review of this document.

As per our discussions during the original EA preparation, it remains our position that the best location for the pond to service these lands is at the north end of the development area near County Road No. 22 due to the significant fall on these lands from south to north. Through the original EA process, however, the preferred solution was to have the pond at the south end of the development. As a result, it is not possible to have direct overland flow routes to the pond for major storm events. Instead, each portion of the development will be required to be designed with temporary on-site storage to detain water until the minor storm sewer system can convey the runoff to the proposed pond. Control/provision of the temporary on-site storage in each development is critical in order for the drainage from this entire planning area to function as designed. All future development designs must consider the functional servicing modelling that was prepared by Dillon Consulting Ltd. for this addendum. We recommend that the Town of Tecumseh clearly outline the modelling requirements and parameters for each development within this planning area to ensure that the site drainage will function as proposed in the functional servicing study. We further recommend that the Town of Tecumseh engage Dillon Consulting Ltd. to review the individual development submissions to ensure that they meet the intent of their functional design study.

Based on our current screening review, the following comments are provided:

MRSPA SWM Environmental Study Report Addendum (December 2014)

1. Section 5.0 Public and Agency Consultation – It is identified that no significant concerns were identified at our August 15, 2014 meeting. During this meeting ERCA raised concerns about the lack of overland flow routes to the pond and the potential challenges of having to temporarily manage major storm events within individual developments. There was also substantial discussion regarding how the existing Baillargeon drainage area functions during a major storm event under existing conditions and how it would be provided for in the proposal to direct it into the MRSPA pond.

Functional Servicing Modelling Memo (December 2014)

2. Section 4.1.2 Baillargeon Drainage Area and Section 4.2 Assumptions - The following comments from these sections are noted:

a. "It appears that surface runoff for major storm events are generally contained within the Baillargeon Drain drainage area boundaries, with limited overflow to the MRSPA".

b. It is assumed that "sufficient temporary surface storage exists within the Baillargeon drainage area".

c. It is assumed that "All runoff volumes are contained within each drainage area boundary with no losses from overland drainage outside of those boundaries."

These issues were the focus of some of the discussions during our August 15, 2014 meeting. The exact functioning of the Baillargeon drainage area during minor and major events must be completely understood in order to determine if the development of the MRSPA will adversely impact these existing lands. Based on the statements contained in the report, it does not appear that a complete review of the existing drainage patterns/conditions within the Baillargeon drainage area has been completed. It appears that bulk areas have be used in the current modelling to account for flows from this area. We would suggest that a more detailed assessment is required to determine how this area functions under both minor and major events and if sufficient on-site temporary storage is available for all storms up to and including the 1:100 year event. If temporary on-site storage is not available, where does the major event go? How do the hydraulic gradelines within the Baillargeon drainage area compare before and after the development of the MRSPA?

3. As per table 2, the proposed pond drawdown time for Scenario 3 is 98 hours. This is significantly higher than the typical maximum drawdown time of 48 hours. What was the rationale for determining that a 98 hour drawdown time is acceptable? Has another storm within the 98 hour drawdown time been considered? Is there any safety factor in the existing pond freeboard? Does the Windsor Airport have concerns with the proposed 98 hour drawdown time?

4. In Table 3 it is noted that the quality requirements are based on Table 3.2 of the MOECC manual for 'normal' protection. Was the 25 mm 4 hour Chicago storm also considered.

5. In section 6.2 it is identified that the % impervious was reduced because the MRSPA is zoned low density residential. In section 6.1 of the addendum report, the MRSPA is identified as low density residential, medium density residential, general commercial, neighbourhood commercial, community facility and recreational. Please clarify. In addition, in Table 3 of the functional servicing modeling memo the % impervious is estimated as 33% for the MRSPA and 25 % for the Baillargeon Drain area. These estimates seem low. Based on a quick review of a few random properties within the Baillargeon drainage area, it would appear that the % impervious may be well above 25%. In addition, we do not know the proposed lot size within the MRSPA, however, with smaller lots that are typically proposed within many new developments, an estimate of 33% impervious may also be low. Additional consideration should be given to the estimates of the % impervious.

6. In Appendix A, hydraulic gradeline (HGL) profiles are shown for the 100 year storm for Scenarios 2 and 3 from MH 108 to the SPA Pond. It was anticipated that Scenario 3 would have a slightly lower HGL because the normal and high water elevations in the pond are lower. In review of the two HGL plots, however, it appears that the HGL for Scenario 2 is slightly lower. Please clarify.

7. Summary figures are provided in Appendix B. Additional clarification would be helpful on some of these figures.

8. It does not appear that the potential impact of climate change have been considered in the assessment for these lands.

As noted above, we did not have time to undertake a complete review of the entire document. The comments provided above relate to our preliminary/screening review of the document. We would suggest that a meeting may be beneficial with the Town and Dillon to review the above information.

If you have any questions, please do not hesitate to contact our office.

John Henderson, P. Eng.
Essex Region Conservation Authority (ERCA)
360 Fairview Avenue West, Suite 311
Essex, Ontario N8M 1Y6
519-776-5209 ext. 246
Fax: 519-776-8688

DILLON CONSULTING

Langlois, Ryan <rlanglois@dillon.ca>

MRSPA Modelling Memo

John Henderson <JHenderson@erca.org> Wed, Apr 8, 2015 at 10:01 AM
To: "Forest, Flavio" <fforest@dillon.ca>
Cc: "Langlois, Ryan" <rlanglois@dillon.ca>, Phil Bartnik <pbartnik@tecumseh.ca>, Tim Byrne <TByrne@erca.org>, Mike Nelson <MNelson@erca.org>

Good morning Flavio,

As per our phone conversation yesterday, we have reviewed your revised Functional Servicing Modelling Memo for the MRSPA in the Town of Tecumseh dated March 2015. The revised report was provided in response to questions/comments that ERCA provided regarding the original memo. In general, the revised information appears to address our previously submitted questions/comments. Based on the revised submission, however, clarification is required on the following additional items:

1. In Table 2, the lowest proposed MRSPA surface elevation is noted as 180.750 m. On Figure 3 the lowest surface elevation appears to be 180.700 m and on Figure 9 it appears to be 180.650 m. Please confirm. In addition, the road elevations shown on Figures 7 and 8 are not readable. Please confirm that all road elevations used in the modelling and shown on the Figures are consistent.

2. Sections 6.2 and 6.2.2 discuss the pumping rates for the quality storm event. Based on this information, it appears that the pumping rate starts at 45 l/s and increases to 545 l/s when the active storage depth of 0.190 m is reached. Do the small quality pumps shut off at elevation 174.920 m (0.420m active depth) or do they remain on until the pond is pumped to the normal water level. Based on the rest of the report, it was our understanding that the maximum release rate from the pond was 500 l/s. Please clarify.

3. Section 7.3.2 identifies that improvements are required to the Jamsyl Drive/Sylvestre Drive intersection and the Jamsyl Drive/Manning Road intersection. Who will be responsible for completing this improvements when they are required for development to proceed?

4. It appears there is a minor typo in Section 8.0. Section 4.1.1 is referred to in the text. It appears it should be Section 4.2.1.

5. Based on the HGL plots in Appendix A, the HGL at MH 108 is approximately 181.300 m. The proposed road elevation immediately east of MH108 at MH94 is 180.700 m. What is the HGL at MH94?

6. General information about the pond (ie. volumes, water levels, etc.) is provided in text and tables within the report. It is our understanding that the actual pond will be designed by others when the first development proceeds. It is recommended that a plan be included showing the configuration of the pond that was used in this study. It is further recommended that the plan include typical cross-sections and dimensions that can be finalized as part of the detailed design that will be completed by others.

7. The storm sewer layout and pipe diameters used in the analysis are shown in Figure 11.0. To ensure consistency as development proceeds in this area, the storm sewer slopes and inverts used in the analysis should also be included. We recommend that your preliminary storm sewer design sheets be included to be used as a guide for future design of the individual developments.

8. It is our understanding that the preliminary proposals for future improvements to Manning Road include the enclosure of the East Townline Drain. As part of the MRSPA proposal, 1:100 year overland flow routes are proposed to direct water to the East Townline Drain. How will these overland routes be maintained when the East Townline Drain is enclosed in the future?

9. Modeling input parameters are included in Appendix B. A developed CN value of 90 has been considered for the residential areas. Based on the historic soil mapping, the majority of this area appears to be brookston clay. Please provide your supporting information your curve number selection.

10. In general the report provides a lot of information/criteria that will need to be implemented at different stages of the future buildout of this area. How will this information/criteria be tracked to ensure that all future works recommended in this report are implemented as development proceeds?

11. As per our previous comments, we recommend that, due to the complexities of this development area, the Town of Tecumseh should engage Dillon Consulting Ltd. to review the future individual development submissions to ensure they are in compliance with the functional design study.

If you have any questions, please contact our office.

John Henderson, P. Eng.

Essex Region Conservation Authority (ERCA)

360 Fairview Avenue West, Suite 311

Essex, Ontario N8M 1Y6

519-776-5209 ext. 246

Fax: 519-776-8688

Please consider the environment before printing this email

DILLON CONSULTING

Langlois, Ryan <rlanglois@dillon.ca>

MRSPA Modelling Memo

Forest, Flavio <fforest@dillon.ca> Thu, Apr 9, 2015 at 9:33 AM
To: John Henderson <JHenderson@erca.org>
Cc: "Langlois, Ryan" <rlanglois@dillon.ca>, Phil Bartnik <pbartnik@tecumseh.ca>, Tim Byrne <TByrne@erca.org>, Mike Nelson <MNelson@erca.org>

John, thanks for your timely review and comments. As discussed, we understand that ERCA is satisfied that the Modelling Memo has now addressed your comments to date. The final corrections and clarifications, as outlined below, will be incorporated into the final Modelling Memo (where appropriate) that will be included as an Appendix to the Addendum report and that will form the basis for the functional servicing report that will serve to guide the detailed design of the MRSPA drainage solution. You will receive a copy of the updated Addendum Report, as well as a copy of the Functional Servicing Report (once it is finalized with the Town). Our responses to your comments are as follows:

1. In Table 2, the lowest proposed MRSPA surface elevation is noted as 180.750 m. On Figure 3 the lowest surface elevation appears to be 180.700 m and on Figure 9 it appears to be 180.650 m. Please confirm. In addition, the road elevations shown on Figures 7 and 8 are not readable. Please confirm that all road elevations used in the modelling and shown on the Figures are consistent.

- We will update the tables and figures for consistency.

2. Sections 6.2 and 6.2.2 discuss the pumping rates for the quality storm event. Based on this information, it appears that the pumping rate starts at 45 l/s and increases to 545 l/s when the active storage depth of 0.190 m is reached. Do the small quality pumps shut off at elevation 174.920 m (0.420m active depth) or do they remain on until the pond is pumped to the normal water level. Based on the rest of the report, it was our understanding that the maximum release rate from the pond was 500 l/s. Please clarify.

- We will include a clarification in the report confirming that during the initial 25mm event, the active storage volume between a 0.19m to 0.34m depth will be discharged with both the low flow and high flow pumps operating simultaneously, resulting in a discharge rate of 545 L/s. This will result in a water quality drawdown time of 24-48 hours. Above an active storage depth of 0.34m, the discharge rate will be 500 L/s.

3. Section 7.3.2 identifies that improvements are required to the Jamsyl Drive/Sylvestre Drive intersection and the Jamsyl Drive/Manning Road intersection. Who will be responsible for completing this improvements when they are required for development to proceed?

- We have confirmed with the Town that the modifications to Jamsyl Drive required to accommodate overland flows to the ETLD will be the responsibility of the developers.

4. It appears there is a minor typo in Section 8.0. Section 4.1.1 is referred to in the text. It appears it should be Section 4.2.1.

- We will update the report, as noted.

5. Based on the HGL plots in Appendix A, the HGL at MH 108 is approximately 181.300 m. The proposed road elevation immediately east of MH108 at MH94 is 180.700 m. What is the HGL at

MH94?

- The SSA modelling for the MRSPA area provides the following Hydraulic Gradeline Elevations during the Chicago 1:100yr-24 event at the corresponding Manholes for your information:
  - HGL @ MH 108 = 181.26
  - HGL @ MH 94 = 180.87

6. General information about the pond (ie. volumes, water levels, etc.) is provided in text and tables within the report. It is our understanding that the actual pond will be designed by others when the first development proceeds. It is recommended that a plan be included showing the configuration of the pond that was used in this study. It is further recommended that the plan include typical cross-sections and dimensions that can be finalized as part of the detailed design that will be completed by others.

- Drawings of the pond geometry, including dimensions and typical cross sections are provided within Figure 15 & Figure 16 of the MRSPA Class EA Study Report (April 2010), which has been referenced in our Addendum report. No changes to the proposed MRSPA pond have been identified as part of this Addendum report.

7. The storm sewer layout and pipe diameters used in the analysis are shown in Figure 11.0. To ensure consistency as development proceeds in this area, the storm sewer slopes and inverts used in the analysis should also be included. We recommend that your preliminary storm sewer design sheets be included to be used as a guide for future design of the individual developments.

- The storm sewer slopes and inverts,including preliminary storm sewer design sheets, will be included within Appendix B of the Functional Servicing Report for the MRSPA.

8. It is our understanding that the preliminary proposals for future improvements to Manning Road include the enclosure of the East Townline Drain. As part of the MRSPA proposal, 1:100 year overland flow routes are proposed to direct water to the East Townline Drain. How will these overland routes be maintained when the East Townline Drain is enclosed in the future?

- Once detailed design of the enclosure of the East Townline Drain commences, the overland flows from the MRSPA are to be included within the design. It is expected that future overland flows will be captured through the use of ditch inlet catchbasins to convey flows into the future enclosure. The County of Essex is currently considering a proposal from Dillon Consulting Limited to update the Preliminary Design Report for the CR 19/22 Improvements as it relates to drainage, which is expected to incorporate these overland drainage requirements.

9. Modeling input parameters are included in Appendix B. A developed CN value of 90 has been considered for the residential areas. Based on the historic soil mapping, the majority of this area appears to be brookston clay. Please provide your supporting information your curve number selection.

- The developed CN value of 90 was used for residential areas with Type D soils (Brookston Clay). This value is consistent with the curve numbers used for residential districts by average lot sizes ranging from 500 m^2 to 1000m^2. *(Urban Hydrology for Small Watersheds TR-55, USDA).* A CN value of 90 is considered conservative within the design of the MRSPA as an impervious value is also being used within the model.

10. In general the report provides a lot of information/criteria that will need to be implemented at

different stages of the future buildout of this area. How will this information/criteria be tracked to ensure that all future works recommended in this report are implemented as development proceeds?

- The information and stormwater management criteria outlined is identified within the main body of the MRSPA Functional Servicing Report. The detailed designers for each stage of development will be required to review the Functional Servicing Report prior to any detailed design of the lands commence (ie. grading, storm servicing etc.).

11. As per our previous comments, we recommend that, due to the complexities of this development area, the Town of Tecumseh should engage Dillon Consulting Ltd. to review the future individual development submissions to ensure they are in compliance with the functional design study.

- We have confirmed with the Town that it is their intention to continue having Dillon involved in the review of the drainage design for all individual development submissions to ensure the proper stormwater management criteria has been met.

At this time, the Town is proceeding to table the Addendum Report at the April 14 Council meeting, including the updates outlined herein.
We appreciate your time and input into this process, and the valuable feedback that you provided. As a result of this collaborative effort, we believe that the resulting report will provide a valuable reference for the effective implementation of this drainage solution in the Town of Tecumseh.
Sincerely,

DILLON CONSULTING

Flavio Forest
Partner
Dillon Consulting Limited
3200 Deziel Drive Suite 608
Windsor, Ontario, N8W 5K8
T - 519.948.4243 ext. 3233
F - 519.948.5054
M - 519.791.2166
FForest@dillon.ca
www.dillon.ca

[Quoted text hidden]

Our File No. 11-5366 (Corr.)

March 6, 2015

Corporation of the
Town of Tecumseh
917 Lesperance Road
Tecumseh, ON
N8N 1W9

Attention: Mr. Phil Bartnik, P.Eng.,
Manager, Engineering Services

Addendum to Manning Road Secondary Plan Area
Stormwater Management Study
Class Environmental Assessment
Town of Tecumseh

DILLON
CONSULTING

3200
Deziel Drive
Suite 608
Windsor, Ontario
Canada
N8W 5K8
Telephone
(519) 948-5000
Fax
(519) 948-5054

Dear Sir:

The MRSPA SWM Environmental Study Report Addendum (December 2014) has undergone a 30 day public and agency review period that ended on January 19, 2015. During this period, the following comments have been received:

1. On January 5, 2015, representatives of James and Jeannette Sylvestre submitted a request for consideration to be given to incorporating their lands south of the CP railway into the proposed MRSPA storm pond.
2. On January 16, 2015, the Ministry of Tourism, Culture and Sport (MTCS) requested clarification of the potential impacts of this project on archaeological, built heritage and cultural heritage resources.
3. On January 19, 2015, the Ministry of Natural Resources and Forestry (MNRF) advised that while there are no known occurrences of Species at Risk (SAR), there is a potential for specific SAR to occur in the project area.
4. On January 19, 2015 the Essex Region Conservation Authority (ERCA) requested clarification of the hydraulic modeling results, as well as additional details to confirm the functional design requirements associated with the preferred MRSPA SWM solution.

These public and agency comments were addressed, as outlined below:

1. Sylvestre Comments

A meeting was held with the Sylvestre's and their representatives, the Town and Dillon on January 7, 2015 to discuss their request in further detail. At this meeting, it was agreed that Dillon would prepare an evaluation and cost comparison of the alternative stormwater management solution that was identified.

...continued

The attached memo summarizes the results of our evaluation, which confirm that the MRSPA SWM solution identified in the December 2014 Addendum Report is considered to be the preferred solution. The results of our evaluation were presented to the Sylvestre's at a meeting that was held on March 3, 2015.

2. MTCS Comments

As part of the December 2014 Addendum report, the Town completed a Stage 1 Archaeological Assessment confirming that while the majority of the study area has low potential for the discovery of archaeological artifacts, there are areas of higher potential requiring further study. The areas of higher potential include a portion of the lands on which the proposed pond is located. The Town of Tecumseh has now authorized that a Stage 2 Archaeological Assessment of the higher potential areas along the CPR tracks and Manning Road be completed in 2015 as site conditions permit.

As requested by MTCS, Dillon completed the Screening for Impacts to Built Heritage and Cultural Heritage Landscapes, which confirmed that this project will not impact these features.

The attached letter and screening checklist has been provided to MTCS in response to the request.

3. MNRF Comments

In response to MNRF's comments regarding the potential for the presence of SAR in the project area, the attached information sheets will now form part of the updated Addendum Report, as outlined in the attached letter.

4. ERCA Comments

The attached letter dated February 11, 2015 confirms the results of our meeting of February 3, 2015, including preliminary results of additional hydraulic modeling that was completed as a result of ERCA's comments.

We met again with the Town and ERCA on February 20, 2015 to confirm the outcome of the additional hydraulic modeling and to establish the accepted approach to finalizing the preferred solution. While it was confirmed that the preferred solution is consistent with the December 2014 Addendum Report, additional details have now been developed to facilitate the detailed design of a fully integrated drainage solution for the MRSPA.

It was agreed that the December 2014 Addendum Report would be updated based on the additional hydraulic modeling that has now been completed. The MRSPA Functional Servicing Report will also be updated to incorporate additional functional design details.

...continued

CLOSURE

Based on the resolution of the comments that have been received within the required 30 day public and agency review period, this project is now considered to be approved under the Municipal Class Environmental Assessment process.

We will provide a final copy of the Addendum Report for this project once it has been updated, as outlined herein.

Yours sincerely,

DILLON CONSULTING LIMITED

Flavio R. Forest, P.Eng.
Project Manager

FRF:dt
Encl.

MEMO

DILLON CONSULTING

TO: Daniel Piescic, P.Eng., Town of Tecumseh

FROM: Flavio Forest, P.Eng.
Ryan Langlois, EIT

PROJECT NO.: 11-5366-7000

DATE: February 25, 2015

SUBJECT: Tecumseh Hamlet South East Area – Stormwater Management Servicing Options

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Further to our meeting of January 7, 2015, we have completed a relative comparison of stormwater management servicing options for the proposed development area bounded to the north by the CP Railway, to the east by Manning Road and to the south and west by the Hydro One corridor. These lands, referred to as the southeast Tecumseh Hamlet (SE Hamlet) lands form part of a separate Secondary Plan and Class Environmental Assessment process being undertaken by the Town.

BACKGROUND

An addendum to the Class Environmental Assessment for the proposed stormwater management (SWM) facility that will serve the Manning Road Secondary Plan Area (MRSPA) was completed by the Town in December 2014, the approval of which is subject to a 30 day public review period that ended January 19, 2015. The property owners of the lands in the SE Hamlet area (Sylvestre) have approached the Town with a request to consider incorporating their lands within the MRSPA SWM facility.

The following SWM options have been considered to address the Sylvestre's comments:

Option 1 – Consolidated SWM Solution (Figure 1):

- Utilizing the MRSPA SWM facility to provide water quantity and quality control for both the SE Hamlet and MRSPA, including the Baillargeon Drain.
- Stormwater runoff from the SE Hamlet area conveyed to the MRSPA SWM facility by a storm sewer crossing the CP Rail tracks based on:
    - Unrestricted runoff from the 1:5 year storm event;
    - On-site surface storage for less frequent storms up to the 1:100 year event, conveyed to the MRSPA SWM facility through the minor storm sewer system; and
    - Overland flow to the East Townline Drain (ETLD) for storm events in excess of the 1:100 year storm event.
- Upgraded storm pump station outlet to the ETLD.

...continued

Option 2 – Separate SWM Solution (Figure 2):

- Separate SWM facility (wet pond) south of the CP Rail tracks that provides both water quantity and quality control for the SE Hamlet area and existing flows from the Antaya Drain;
- No impact to the MRSPA SWM facility, as defined in the MRSPA SWM Environmental Study Report Addendum *(December 2014)*; and
- Both SWM facilities discharge through separate pump stations to the ETLD.

DESIGN CRITERIA

The functional design for both design options outlined above are based on the following criteria for the SE Hamlet development, while the design criteria for the MRSPA area has been previously identified within the SWM Class EA Addendum *(December, 2014)*:

Water Quality Storm Criteria

- Water quality control to a Normal Level (70 % TSS removal):
  - Permanent Pool Storage = 1,315 m^3 required.
- In-stream erosion control volume is based on 40 cu-m/ha detained for 24 - 48 hours:
  - Extended Detention Storage = 1,096 m^3 required.

Water Quantity Storm Criteria

- The SWM facility and storm sewer network will service a total area of approximately 27.4 Ha. This area is composed of:
  - 20 ha for the SE Hamlet area, including residential land, park and pond block areas; and
  - 7.4 ha for the Antaya Drain catchment area.
    - We understand that the drainage boundary for this portion of the area that is external to the SE Hamlet development lands is not yet well defined, and will require further evaluation by the Town/Drainage Engineer.
- The Antaya Drain will be incorporated into the stormwater management pond, as follows:
  - Both major and minor system flows will be directed to the pond;
  - The downstream portion of the Antaya Drain will be enclosed; and
  - Any alterations in the drainage boundaries for the Antaya Drain and adjacent watersheds must be formalized under appropriate Drainage Act legislation.
- Water quantity control volume is based on 100 year post-development runoff volume assuming a worst case scenario of a zero release rate, as required by ERCA to address winter conditions.
- A storm pump station outlet, controlling the peak discharge to the ETLD to the 2 year pre-development runoff of 340 L/s.

...continued

EVALUATION OF SWM OPTIONS

Option 1: Consolidated SWM Solution Preliminary Design Requirements

To convey runoff from the SE Hamlet and Antaya Drain areas, a 1500 mm diameter storm sewer outlet must be extended across the CP Rail tracks to the proposed MRSPA pond.

It has been confirmed that the MRSPA SWM pond and pump station can only accommodate the MRSPA development and the existing flows from the Baillargeon Drain, with the addition of the Baillargeon Drain having essentially consumed all its available capacity. If the SE Hamlet area were to be added into the MRSPA SWM facility without any modifications to the pond volume or discharge capacity, there would be a 0.51 m increase to the 1:100 year water surface elevation, which would negatively impact the hydraulic characteristics of the upstream drainage system.

To maintain the original water surface elevation within the MRSPA SWM facility for the 1:100 year storm event, the discharge rate from the pond would have to be increased to approximately 1000 L/s. The results of our preliminary evaluations are summarized below in **Table 1**:

Table 1: MRSPA Pond Water Surface Elevations

Description	1:5 Year Storm Event		1:100 Year Storm Event		Outflow
	Water Elevation (m)	Active Volume (m)	Water Elevation (m)	Active Volume (m)	Pump Station (L/s)
1) MRSPA + Baillargeon	176.21	43,294	178.67	124,285	500
2) MRSPA + Baillargeon + SE Hamlet	176.42	49,181	179.18	144,134	500
3) MRSPA + Baillargeon + SE Hamlet	176.14	41,158	178.64	123,256	1,000

Option 2: Separate SWM Solution Preliminary Design Requirements

A preliminary design was completed for a separate SWM facility and pump station to serve the SE Hamlet area and the Antaya Drain based on the following design parameters:

- Permanent Pool Volume = 2,482 m^3 (1,315 m^3 required);
- Extended Detention Volume = 1,134 m^3 (1,096 m^3 required);
- Active Storage Volume = 25,4250 m^3 (23,062 m^3 required with zero release);
- Low Flow Discharge Rate = 25 L/s;
- Peak Flow Discharge Rate = 300 L/s; and
- 1.46 ha (3.6 acres) SWM facility footprint, with pond depths (permanent pool/extended detention/active storage), length:width ratios, and slide slopes based on MOE guidelines.

The following design requirements were considered based on preliminary discussions with ERCA:

- Water quantity control volume is based on storage of 1:100 year runoff volume without a pumped discharge, as required to account for potential ice blockage in the ETLD under winter conditions.

...continued

- Overland flow would be directed to the proposed SWM facility, with emergency overflow (beyond 100 year rainfall event) provided along the original Antaya Drain alignment to the ETLD.

- Additional storage may be available within the storm sewer system and surface storage within the roadways. This storage capacity is in excess of the 1:100 year event storage volume.

Cost Comparison

As requested, we have completed a preliminary cost estimate for each alternative SWM solution, and have prepared a summary of these costs in **Table 2**.

Table 2: Cost Comparison Summary

Infrastructure Works	Option 1: Consolidated SWM Solution		Option 2: Separate SWM Solution	
	SE HAMLET	MRSPA	SE HAMLET	MRSPA
SWM Facility (excavation and landscaping)	$1,194,000 Pro-rated development charge for MRSPA pond	$3,996,000 Pro-rated development charge for MRSPA pond	$450,000	$5,190,000 Based on MRSPA Development Charges
Pump Station	$680,000 Pro-rated development charge for MRSPA PS + PS upgrading	$708,000 Pro-rated development charge for MRSPA 500 L/s PS	$700,000	$920,000 Based on MRSPA Development Charges
1500 mm dia. Storm Outlet from SE Hamlet Lands	$850,000	-	-	-
SWM Pond Land Valuation Costs	$340,000 Pro-rated development charge for MRSPA SWM lands	$1,138,000 Pro-rated development charge for MRSPA SWM lands	$317,000 Based on 1.46 ha pond at the MRSPA pond land values	$1,478,000 Based on assessed land value for 6.8 ha pond
Total Estimated Cost (including Engineering and Contingency)	**$3,064,000** ($153,200/ha of developable portion)	**$5,842,000** ($63,900/ha of developable portion)	**$1,467,000** ($73,350/ha of developable portion)	**$7,588,000** ($83,000/ha of developable portion)
	$8,906,000		**$9,055,000**	

The cost sharing for the SWM facility and associated land valuation for Option 1 was based on a ratio of the following land area contributions:

- MRSPA, excluding 6.8 ha SWM Pond and the Baillargeon Drain Area = 91.4 ha (77%); and
- SE Hamlet Area, including Antaya Drain = 27.4 ha (23%).

The cost sharing of the pump station for Option 1 was based on the following:

- Upgrading cost to add a 500 L/s pump and the associated increase in the wet well size is 100% attributable to the SE Hamlet lands; and
- Cost sharing of the original MRSPA 500 L/s pump station is based on the above land area ratios.

...continued

CONCLUSIONS

Due to the following factors, Option 2: Separate SWM Solution is considered to be the preferred alternative:

- The overall costs for either option are relatively equal, though the cost/ha for the SE Hamlet area in Option 1 would appear to be disproportionately high.

- Development of the SE Hamlet lands still requires resolution of servicing constraints, particularly the need to establish sanitary drainage capacity for these lands, but also storm drainage as it relates to confirmation of the Antaya Drain drainage boundary. In contrast, development of the MRSPA lands has been largely established through planning, site servicing and development charges studies that are nearing completion. Accordingly, any further changes to this servicing strategy would unduly delay development of the MRSPA lands.

- Incorporating the Baillargeon Drain within the proposed MRSPA SWM facility provides significant relief to the ETLD, thereby presenting further flexibility in the drainage solutions available to the County of Essex, as well as for the SE Hamlet lands.

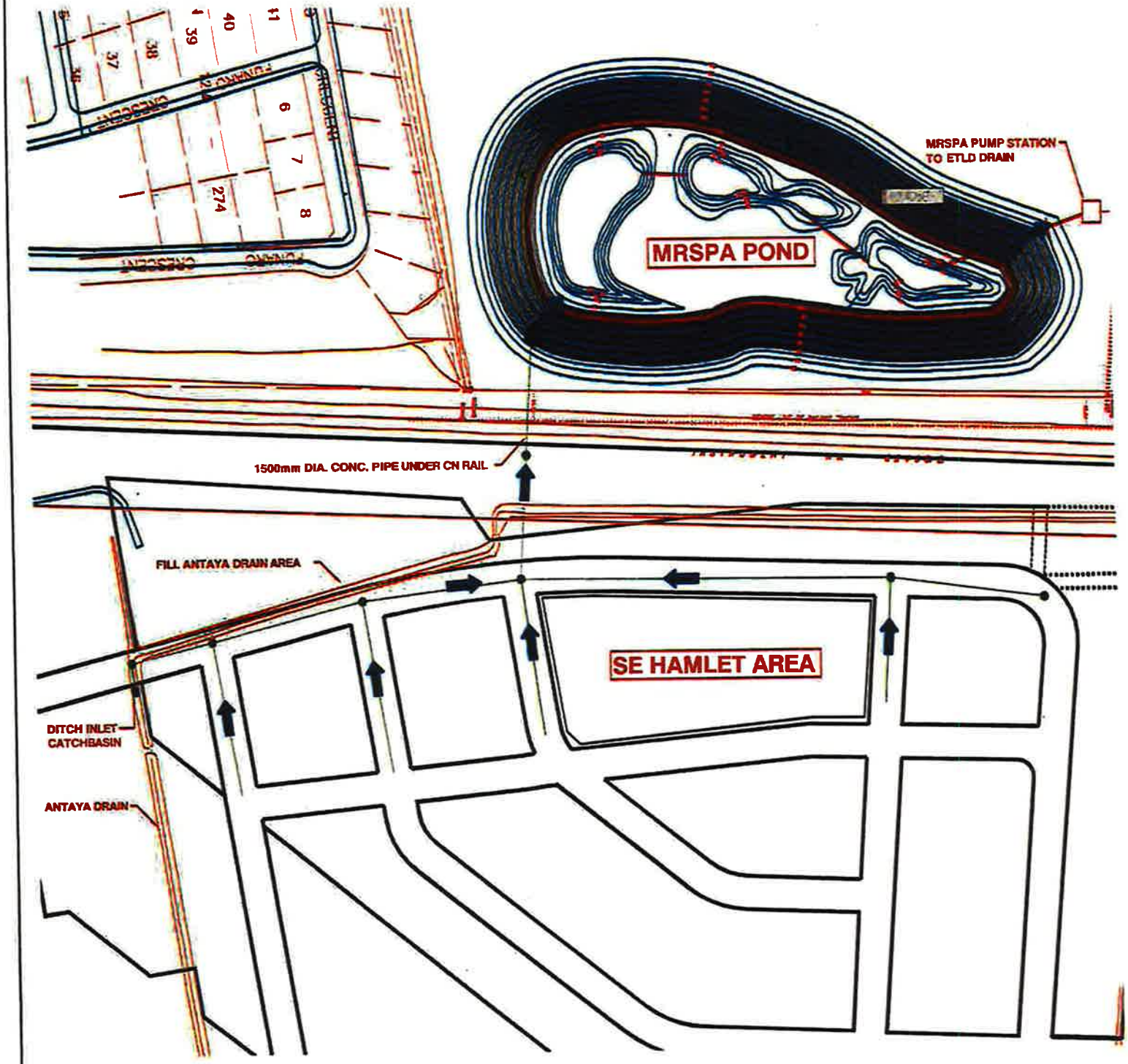
We would be pleased to meet with the Town and the stakeholders to review the results of our evaluation in further detail. Should you have any further questions, please do not hesitate to contact the undersigned.

Yours sincerely,

DILLON CONSULTING LIMITED

Flavio R. Forest, P.Eng.,
Project Manager

FRF:d
Encl.



TOWN OF TECUMSEH
SE HAMLET AREA

SE Hamlet Design Option 1

FIGURE 1

PROPOSED STORM SEWER

FLOW DIRECTION

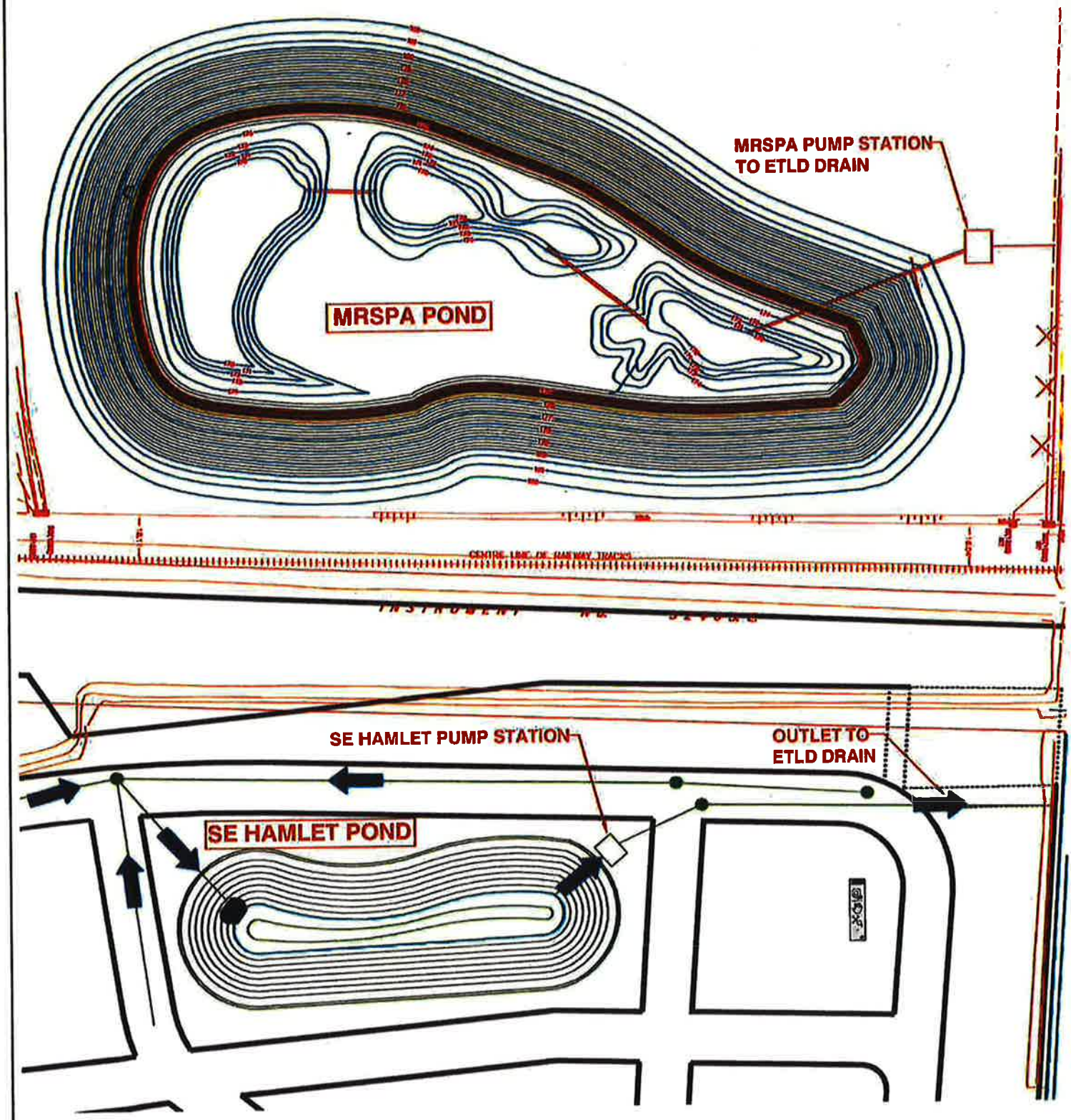
SCALE: NTS

CREATED BY: RTL
CHECKED BY: FRF
DESIGNED BY: RTL

File Location: g:\cad\11S\reports\figures\se hamlet_mrspa option figures\20150116 stm serv options.dwg January, 20, 2015 7:38 AM

DILLON CONSULTING

PROJECT: 11-8288
STATUS: DRAFT
DATE: 01/xx/2015



TOWN OF TECUMSEH
SE HAMLET AREA

PROPOSED STORM SEWER

FLOW DIRECTION

SE Hamlet Design Option 2

FIGURE 2

DILLON CONSULTING

CREATED BY: RTL
CHECKED BY: FAF
DESIGNED BY: RTL

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s:\cad\115366\figures\se hamlet_mrspa option figure\20150116 plan serv. options.dwg January 26, 2015 7:37 AM

SCALE: NTS

PROJECT: 11-5366 STATUS: DRAFT DATE: 01/16/2015

Ministry of Tourism, Culture and Sport

Culture Services Unit
Programs and Services Branch
401 Bay Street, Suite 1700
Toronto ON M7A 0A7
Tel: 416 314 7145
Fax: 416 212 1802

Ministère du Tourisme, de la Culture et du Sport

Unité des services culturels
Direction des programmes et des services
401, rue Bay, Bureau 1700
Toronto ON M7A 0A7
Tél: 416 314 7145
Téléc: 416 212 1802

Ontario

January 16, 2015 (EMAIL ONLY)

Mr. Phil Bartnik, P.Eng
Manager, Engineering Services
Town of Tecumseh
917 Lesperance Road
Tecumseh, ON N8N 1W9
E: pbartnik@tecumseh.ca

RE: MTCS file #: 0002299
Proponent: Town of Tecumseh
Subject: Notice of Commencement
Manning Road Secondary Plan Area
Stormwater Management Class Environmental Assessment
Location: Town of Tecumseh, Essex County, Ontario

Dear Phil Bartnik:

Thank you for providing the Ministry of Tourism, Culture and Sport (MTCS) with the Notice of Commencement for your project. MTCS's interest in this EA project relates to its mandate of conserving Ontario's cultural heritage, which includes:

- Archaeological resources, including land-based and marine;
- Built heritage resources, including bridges and monuments; and,
- Cultural heritage landscapes.

Under the EA process, the proponent is required to determine a project's potential impact on cultural heritage resources.

While some cultural heritage resources may have already been formally identified, others may be identified through screening and evaluation. Aboriginal communities may have knowledge that can contribute to the identification of cultural heritage resources, and we suggest that any engagement with Aboriginal communities includes a discussion about known or potential cultural heritage resources that are of value to these communities. Municipal Heritage Committees, historical societies and other local heritage organizations may also have knowledge that contributes to the identification of cultural heritage resources.

Archaeological Resources
Your EA project may impact archaeological resources and you should screen the project with the MTCS *Criteria for Evaluating Archaeological Potential* to determine if an archaeological assessment is needed. MTCS archaeological sites data are available at archaeologicalsites@ontario.ca. If your EA project area exhibits archaeological potential, then an archaeological assessment (AA) should be undertaken by an archaeologist licenced under the *OHA*, who is responsible for submitting the report directly to MTCS for review. As noted in the report addendum, the Stage 1 AA identifies a portion of the study area as warranting further Stage 2 AA.

Built Heritage and Cultural Heritage Landscapes
The attached MTCS checklist *Screening for Impacts to Built Heritage and Cultural Heritage Landscapes* should be completed to help determine whether your EA project may impact cultural heritage resources. The Clerks for the Town of Tecumseh and Essex County can provide information on property registered or designated under the *Ontario Heritage Act*. Municipal Heritage Planners can also provide information that will assist you in completing the checklist.

If potential or known heritage resources exist, MTCS recommends that a Heritage Impact Assessment (HIA), prepared by a qualified consultant, should be completed to assess potential project impacts. Our Ministry's *Info Sheet #5: Heritage Impact Assessments and Conservation Plans* outlines the scope of HIAs. Please send the HIA to MTCS for review, and make it available to local organizations or individuals who have expressed interest in heritage.

Environmental Assessment Reporting
All technical heritage studies and their recommendations are to be addressed and incorporated into EA projects. Please advise MTCS whether any technical heritage studies will be completed for your EA project, and provide them to MTCS before issuing a Notice of Completion. If your screening has identified no known or potential cultural heritage resources, or no impacts to these resources, please include the completed checklists and supporting documentation in the EA report or file.

Thank-you for consulting MTCS on this project: please continue to do so through the EA process, and contact me for any questions or clarification.

Sincerely,

Joseph Muller, RPP/MCIP
Heritage Planner
Joseph.Muller@Ontario.ca

Copied to: Flavio R. Forest, Project Manager, Dillon Consulting

Our File: 11-5366

DILLON CONSULTING

January 19, 2015

Ministry of Tourism, Culture and Sport
Culture Services Unit
Programs and Services Branch
401 Bay Street, Suite 1700
Toronto, ON M7A 0A7

Sent via email: Joseph.Muller@Ontario.ca

Attention: Mr. Joseph Muller, RPP/MCIP
Heritage Planner

Town of Tecumseh
Manning Road Secondary Plan Area Stormwater Management
Class Environmental Assessment
MTCS File No. 0002299

Dear Mr. Muller:

This letter is in response to your January 16, 2015, letter regarding the project's potential impact on archaeological, built heritage and cultural heritage landscape resources.

As part of the December 2014 Addendum report, a Stage 1 Archaeological Assessment was completed. The assessment identified areas of high potential related to the drain enclosure and pond that will require a Stage 2 assessment prior to construction. The additional assessment will be submitted to MTCS, and a Stage 3 and Stage 4 assessment completed, if required.

As requested, enclosed is the completed Screening for Impacts to Built Heritage and Cultural Heritage Landscapes. The screening confirms the project will not impact these features.

Yours sincerely,

DILLON CONSULTING LIMITED

Flavio R. Forest, P.Eng.
Project Manager

SNS:d
Encl.
cc: Mr. Phil Bartnik, P.Eng., Town of Tecumseh

3200
Deziel Drive
Suite 608
Windsor, Ontario
Canada
N8W 5K8
Telephone
(519) 948-5000
Fax
(519) 948-5054

Dillon Consulting
Limited

Screening for Impacts to Built Heritage and Cultural Heritage Landscapes

This checklist is intended to help proponents determine whether their project could affect known or potential cultural heritage resources. The completed checklist should be returned to the appropriate Heritage Planner or Heritage Advisor at the Ministry of Tourism and Culture.

Step 1 – Screening for Recognized Cultural Heritage Value

YES	NO	Unknown	
☐	☑	☐	1. Is the subject property designated or adjacent* to a property designated under the *Ontario Heritage Act*?
☐	☑	☐	2. Is the subject property listed on the municipal heritage register or a provincial register/list? (e.g. Ontario Heritage Bridge List)
☐	☑	☐	3. Is the subject property within or adjacent to a Heritage Conservation District?
☐	☑	☐	4. Does the subject property have an Ontario Heritage Trust easement or is it adjacent to such a property?
☐	☑	☐	5. Is there a provincial or federal plaque on or near the subject property?
☐	☑	☐	6. Is the subject property a National Historic Site?
☐	☑	☐	7. Is the subject property recognized or valued by an Aboriginal community?

Step 2 – Screening Potential Resources

YES	NO	Unknown	
			Built heritage resources
			1. Does the subject property or an adjacent property contain any buildings or structures **over forty years old**[1] that are:
☐	☑	☐	▪ Residential structures (e.g. house, apartment building, shanty or trap line shelter)
☐	☑	☐	▪ Farm buildings (e.g. barns, outbuildings, silos, windmills)
☐	☑	☐	▪ Industrial, commercial or institutional buildings (e.g. a factory, school, etc.)
☐	☑	☐	▪ Engineering works (e.g. bridges, water or communications towers, roads, water/sewer systems, dams, earthworks, etc.)
☐	☑	☐	▪ Monuments or Landmark Features (e.g. cairns, statues, obelisks, fountains, reflecting pools, retaining walls, boundary or claim markers, etc.)
☐	☑	☐	2. Is the subject property or an adjacent property associated with a known architect or builder?
☐	☑	☐	3. Is the subject property or an adjacent property associated with a person or event of historic interest?
☐	☑	☐	4. When the municipal heritage planner was contacted regarding potential cultural heritage value of the subject property, did they express interest or concern?
			Cultural heritage landscapes
			5. Does the subject property contain landscape features such as:
☐	☑	☐	• Burial sites and/or cemeteries
☐	☑	☐	▪ Parks or gardens
☐	☑	☐	• Quarries, mining, industrial or farming operations
☐	☑	☐	• Canals
☐	☑	☐	▪ Prominent natural features that could have special value to people (such as waterfalls, rocky outcrops, large specimen trees, caves, etc.)
☐	☑	☐	• Evidence of other human-made alterations to the natural landscape (such as trails, boundary or way-finding markers, mounds, earthworks, cultivation, non-native species, etc.)
☐	☑	☐	6. Is the subject property within a Canadian Heritage River watershed?
☐	☑	☐	7. Is the subject property near the Rideau Canal Corridor UNESCO World Heritage Site?
☐	☑	☐	8. Is there any evidence from documentary sources (e.g., local histories, a local recognition program, research studies, previous heritage impact assessment reports, etc.) or local knowledge or Aboriginal oral history, associating the subject property/ area with historic events, activities or persons?

Note:

If the answer is "yes" to any question in Step 1, proceed to Step 3.

The following resources can assist in answering questions in Step 1:

Municipal Clerk or Planning Department – Information on properties designated under the Ontario Heritage Act (individual properties or Heritage Conservation Districts) and properties listed on a Municipal Heritage register.

Ontario Heritage Trust – Contact the OHT directly regarding easement properties. A list of OHT plaques can be found on the website: Ontario Heritage Trust

Parks Canada – A list of National Historic Sites can be found on the website: Parks Canada

Ministry of Tourism and Culture – The Ontario Heritage Properties Database includes close to 6000 identified heritage properties. Note while this database is a valuable resource, it has not been updated since 2005, and therefore is not comprehensive or exhaustive. Ontario Heritage Properties Database

Local or Provincial archives

Local heritage organizations, such as the municipal heritage committee, historical society, local branch of the Architectural Conservancy of Ontario, etc.

Consideration should also be given to obtaining oral evidence of CHRs. For example, in many Aboriginal communities, an important means of maintaining knowledge of cultural heritage resources is through oral tradition.

If the answer is "yes" to any question in Step 2, an evaluation of cultural heritage value is required. If cultural heritage resources are identified, proceed to Step 3.

If the answer to any question in Step 1 or to questions 2-4, 6-8 in Step 2, is "unknown", further research is required.

If the answer is "yes" to any of the questions in Step 3, a heritage impact assessment is required.

If uncertainty exists at any point, the services of a qualified person should be retained to assist in completing this checklist. All cultural heritage evaluation reports and heritage impact assessment reports must be prepared by a qualified person. Qualified persons means individuals (professional engineers, architects, archaeologists, etc.) having relevant, recent experience in the identification and conservation of cultural heritage resources. Appropriate evaluation involves gathering and recording information about the property sufficient to understand and substantiate its heritage value; determining cultural heritage value or interest based on the advice of qualified persons and with appropriate community input. If the property meets the criteria in Ontario Regulation 9/06 under the Ontario Heritage Act, it is a cultural heritage resource.

† The 40 year old threshold is an indicator of potential when conducting a preliminary survey for identification of cultural heritage resources. While the presence of a built feature that is 40 or more years old does not automatically signify cultural heritage value, it does make it more likely that the property could have cultural heritage value or interest. Similarly, if all the built features on a property are less than 40 years old, this does not automatically mean the property has no cultural heritage value. Note that age is not a criterion for designation under the *Ontario Heritage Act*.

Step 3 – Screening for Potential Impacts		
YES	**NO**	**Will the proposed undertaking/project involve or result in any of the following potential impacts to the subject property or an adjacent* property?**
☐	☑	**Destruction, removal or relocation** of any, or part of any, heritage attribute or feature.
☐	☑	**Alteration** (which means a change in any manner and includes restoration, renovation, repair or disturbance).
☐	☑	**Shadows** created that alter the appearance of a heritage attribute or change the exposure or visibility of a natural feature or plantings, such as a garden.
☐	☑	**Isolation** of a heritage attribute from its surrounding environment, context or a significant relationship.
☐	☑	**Direct or indirect obstruction** of significant views or vistas from, within, or to a built or natural heritage feature.
☐	☑	**A change in land use** such as rezoning a battlefield from open space to residential use, allowing new development or site alteration to fill in the formerly open spaces.
☐	☑	**Soil disturbance** such as a change in grade, or an alteration of the drainage pattern, or excavation, etc.

* For the purposes of evaluating potential impacts of development and site alteration "adjacent" means: contiguous properties as well as properties that are separated from a heritage property by narrow strip of land used as a public or private road, highway, street, lane, trail, right-of way, walkway, green space, park, and/or easement or as otherwise defined in the municipal official plan.

Our File No. 11-5366 (Corr.)

December 10, 2014

DILLON
CONSULTING

3200
Deziel Drive
Suite 608
Windsor, Ontario
Canada
N8W 5K8
Telephone
(519) 948-5000
Fax
(519) 948-5054

Ministry of Natural Resources
Aylmer District
615 John Street
Aylmer, ON
N5H 2S8

Attention: Ms. Heather Riddell,
District Planner

Addendum to Manning Road Secondary Plan Area
Stormwater Management Study
Class Environmental Assessment
Town of Tecumseh

Dear Ms. Ridell:

As outlined in the attached notice, the Town of Tecumseh retained Dillon Consulting Limited to review the preferred solution for stormwater management identified in the Manning Road Secondary Plan Area – Stormwater Management Class Environmental Assessment (EA) Environmental Study Report (April 2010) and identify opportunities to optimize the proposed infrastructure.

The review identified the potential to expand the drainage area for the Manning Road Secondary Plan Area pond (location shown on the attached notice) to include flows from the Baillargeon Drain drainage area.

The assessment completed to revise the pond drainage areas is documented in the Manning Road Secondary Plan Area Stormwater Management Class EA Environmental Study Report Addendum (2014). The addendum is now available for public review, as outlined in the notice.

Yours sincerely,

DILLON CONSULTING LIMITED

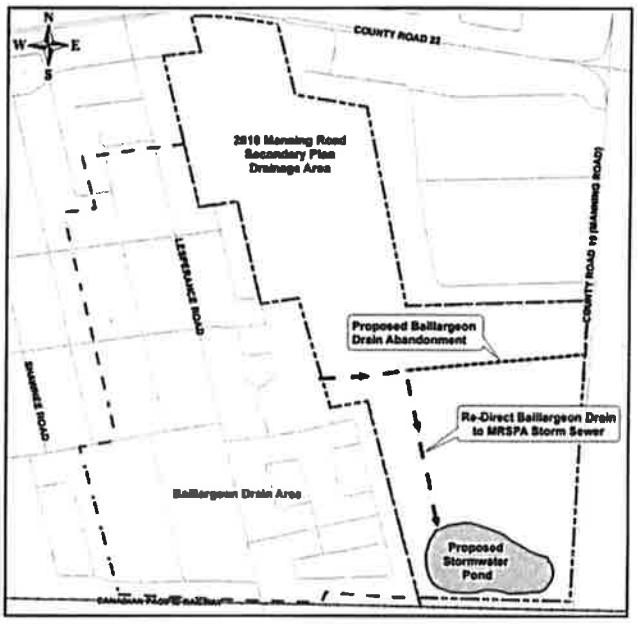
Flavio R. Forest, P.Eng.,
Project Manager

FRF:d
Encl.
cc: Mr. Phil Bartnik, P.Eng., Corporation of the Town of Tecumseh

Town of Tecumseh
Manning Road Secondary Plan Area
Stormwater Management Class Environmental Assessment
Environmental Study Report
Notice of Filing of Addendum

Storm drainage improvements for the Manning Road Secondary Plan Area (MRSPA) were identified in the Stormwater Management Class Environmental Assessment (EA) Environmental Study Report (ESR) completed in 2010. The preferred solution was to service the area through a regional stormwater management pond, located just north of the CPR tracks, as shown on the following key plan.

Prior to initiating the design and construction of the required storm drainage infrastructure for the MRSPA, the Town of Tecumseh retained Dillon Consulting Limited to review the alternative of expanding the drainage area to be served by the proposed pond to include the Baillargeon Drain area. Based on a technical and environmental evaluation, this alternative has now been determined to be the preferred solution.



Redirecting the Baillargeon Drain to the proposed pond would result in the following benefits:

- Optimizes the available capacity of the proposed pond to provide further control of peak storm runoff rates and improve the quality of storm runoff from both the MRSPA and the Baillargeon Drain areas;
- Serves as a more cost-effective infrastructure solution for servicing the MRSPA, as well as for future downstream storm drainage improvements; and
- Improves the overall quality and function of the downstream storm drainage system.

This preferred solution will not require changes to the size and shape of the proposed pond from its original design, although there will be changes to its operational characteristics.

An Addendum to the Environmental Study Report was completed to document the technical and environmental benefits and impacts of the preferred solution, including recommended mitigation measures.

This Notice confirms that the Addendum is now available for the required public and agency review period in accordance with the Municipal Class Environmental Assessment process. Subject to the comments that are received, the Town intends to base the implementation of storm drainage improvements in this area on the preferred solution that has now been identified.

The Addendum is available for public review at the following locations:

Town of Tecumseh, Clerk's Office
917 Lesperance Road
Tecumseh, Ontario, N8N 1W9
Tel: (519)-735-2184

Essex County Library – Tecumseh Branch
13675 St. Gregory's Road
Tecumseh, Ontario, N8N 3E4
Tel: (226)-946-1529 Ext. 230

If you have comments on the Addendum, please provide them in writing by **January 19, 2015** to:

Mr. Phil Bartnik, P.Eng. Manager, Engineering Services
Town of Tecumseh
917 Lesperance Road
Tecumseh, Ontario,
N8N 1W9

If concerns regarding the revisions to the preferred solution cannot be resolved through discussions with the Town, a person may request that the Minister of the Environment and Climate Change make an order for the project to comply with Part II of the *Environmental Assessment Act* (referred to as a Part II Order), which addresses individual environmental assessments. Requests must be received by the Minister at the address below by **January 19, 2015**. A copy of the request must also be sent to the Town of Tecumseh. If no request is received by **January 19, 2015**, the Town intends to base the implementation of storm drainage improvements in this area on the preferred solution that has now been identified.

Minister of the Environment and Climate Change
77 Wellesley Street West
11th Floor, Ferguson Block
Toronto, Ontario
M7A 2T5

Our File: 11-5366 (Corr.)

DILLON
CONSULTING

January 28, 2015

3200
Deziel Drive
Suite 608
Windsor, Ontario
Canada
N8W 5K8
Telephone
(519) 948-5000
Fax
(519) 948-5054

Ministry of Natural Resources and Forestry
Aylmer District
615 John Street
Aylmer, ON
N5H 2S8

Sent via email: Heather.Riddell@ontario.ca

Attention: Ms. Heather Riddell,
District Planner

Town of Tecumseh
Manning Road Secondary Plan Area Stormwater Management
Class Environmental Assessment Addendum

Dear Ms. Riddell:

This letter is in response to your January 19, 2015, email regarding the Notice of Addendum for the Manning Road Secondary Plan Area Stormwater Management Class EA. Your email provided an initial Species at Risk (SAR) Screening for the proposed project referenced above.

The 2010 Environmental Study Report (ESR) documents the existing natural environment within the project Study Area.

As documented in the Addendum Report, a background review and site reconnaissance was completed in 2014 to assess changes to the natural environment and document existing conditions along the Baillargeon Drain and within the study area.

The background review identified thirteen historical occurrence records for SAR within 1 km of the Baillargeon Drain. Based on the historical nature of the records, the level of local disturbance and lack of suitable habitat, it is unlikely these species currently occupy the Study Area. The SAR Screening completed for the Baillargeon Drain was sent to MNRF for review.

...continued

MNRF confirmed by letter dated August 8, 2014, that there were no known occurrences of SAR in the general area of the project (MNRF letter AYL-L-066-14). It was also noted that Eastern Fox Snake is known to occur widely in the County of Essex, though not specifically noted in the Study Area. Developers and their contractors will be advised of the potential for the species listed in your January 19, 2015 email to occur. Information sheets on these species will be included in an Appendix to the Addendum report, consisting of photos and relevant information on required measures if these species are encountered.

Yours sincerely,

DILLON CONSULTING LIMITED

Flavio R. Forest, P.Eng.,
Project Manager

BJF:d
cc: Mr. Phil Bartnik, P.Eng., Corporation of the Town of Tecumseh

Contractor Information Sheet for Species at Risk

Barn Swallow

(Hirundo rustica)

Species overview

The Barn Swallow *(Hirundo rustica)* is a specialized aerial eater and uses human made structures, such as barns, bridges or culverts, as habitat. Found throughout much of Ontario the Barn Swallow is often seen in rural settings and near shallow water bodies.

Species-at-Risk status

Provincial:
Threatened under the
Ontario Endangered Species Act (ESA)
Federal:
Not Listed

Identification

Medium sized song bird that is easily recognized by its steely-blue upper parts and cinnamon coloured under parts. The species also has a distinct tail which is deeply forked.

What to do if found

If the Barn Swallow is found within the construction zone, the following procedure must be followed:

- If possible take a photo.
- Fill out the observation record form on the back of this sheet.
- Protect species from construction activities.
- Contact Town of Tecumseh & MNRF for required mitigation measures.
- Report all SAR sightings to an MNRF Management Biologist– Aylmer District (519-773-9241) within 2 business days.
- Any injured species must be reported immediately to MNRF and to:

  Ontario SPCA –Windsor/Essex County Human Society1375 Provincial Road
  Windsor, ON, N8W 5V8
  (519) 966-5751
  Email: melanie@windsorhumane.ca

Key Identification Features

1. Steely-blue upper parts
2. Cinnamon coloured under parts

Key Identification Features

3. Deeply forked tail

Record of Species Observation

#	Date	Approximate Location & Description	Approximate Size
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

References:

COSSARO. 2011. COSSARO Candidate Species at Risk Evaluation Form for Barn Swallow (*Hirundo rustica*). Committee on the Status of Species at Risk in Ontario (COSSARO). Accessed online January 2013 http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@species/documents/research/stdprod_091151.pdf

Contractor Information Sheet for Species at Risk

Butler's Gartersnake

(*Thamnophis butleri*)

Species overview

Similar to the eastern gartersnake, the Butler's Gartersnake is small, less than 50 cm in length. The Butler's Gartersnake feeds on worms and leeches and is found in open, moist habitats such as dense grasslands and old fields.

Species-at-Risk status

Provincial:
Endangered under the
Ontario Endangered Species Act (ESA)
Federal:
Endangered

Identification

Non-venomous snake, 25 to 57 cm long. Tiny head and yellow to orange stripes running lengthwise on a dark brown-black background. Hard to distinguish between the common Gartersnake.

What to do if found

If the Butler's Gartersnake is found within the construction zone, the following procedure must be followed:

- If possible take a photo.
- Fill out the observation record form on the back of this sheet.
- Protect species from construction activities.
- Contact Town of Tecumseh & MNRF for required mitigation measures.
- Report all SAR sightings to an MNRF Management Biologist– Aylmer District (519-773-9241) within 2 business days.
- Any injured species must be reported immediately to MNRF and to:

  Ontario SPCA –Windsor/Essex County Human Society1375 Provincial Road
  Windsor, ON, N8W 5V8
  (519) 966-5751
  Email: melanie@windsorhumane.ca

Key Identification Features

1. Yellow to orange stripes on dark brown-black background
2. Tiny head
3. Overall small (25 – 57 cm in length)

Record of Species Observation

#	Date	Approximate Location & Description	Approximate Size
1			
2			
3			
4			
5			
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7			
8			
9			
10			

References:

MNRF. 2014. Butler's Gartersnake. Accessed online January 2015. http://www.ontario.ca/environment-and-energy/butlers-gartersnake

Contractor Information Sheet for Species at Risk

Eastern Foxsnake

(Carolinian Population)
(*Pantherophis gloydi*)

Species overview

Found in old fields, marshes, along hedgerows, drainage canals and shorelines. Females lay their eggs in rotting logs, manure or compost pile, which naturally incubate the eggs until they hatch.

Species-at-Risk status

Provincial:
Endangered under the
Ontario Endangered Species Act (ESA)
Federal:
Endangered

Identification

Reaching over 1.7 m in length the Eastern Foxsnake has a shiny, rusty orange head and golden to light brown body with dark blotches. The belly is light yellow and black.

What to do if found

If the Eastern Foxsnake is found within the construction zone, the following procedure must be followed:

- If possible take a photo.
- Fill out the observation record form on the back of this sheet.
- Protect species from construction activities.
- Contact Town of Tecumseh & MNRF for required mitigation measures.
- Report all SAR sightings to an MNRF Management Biologist– Aylmer District (519-773-9241) within 2 business days.
- Any injured species must be reported immediately to MNRF and to:

  Ontario SPCA –Windsor/Essex County Human Society1375 Provincial Road
  Windsor, ON, N8W 5V8
  (519) 966-5751
  Email: melanie@windsorhumane.ca

Key Identification Features

1. Rusty Orange Head
2. Golden to light brown body

Photo Credit: Carolinian Canada, 2015

Record of Species Observation

#	Date	Approximate Location & Description	Approximate Size
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

References:

MNRF. 2014. Eastern Foxsnake. Accessed online January 2015. http://www.ontario.ca/environment-and-energy/eastern-foxsnake

Contractor Information Sheet for Species at Risk

Kentucky Coffee-Tree

(*Gymnocladus dioicus*)

Species overview

Kentucky Coffee-Tree is found in a variety of habitats, but grows best in moist, rich soil. Consequently, it is often found in floodplains, though it will tolerate shallow rocky or sandy soils.

Species-at-Risk status

Provincial:
Threatened under the Ontario Endangered Species Act (ESA)
Federal:
Threatened

Identification

The Kentucky Coffee-Tree grows 15 to 25 m tall. The leaves are as big as 60 by 90 cm. The leaves are twice compounded, divided into many small bluish-green leaflets. The flowers are greenish-white in colour.

What to do if found

If the Kentucky Coffee-Tree is found within the construction zone, the following procedure must be followed:

- If possible take a photo.
- Fill out the observation record form on the back of this sheet.
- Protect species from construction activities.
- Contact Town of Tecumseh & MNRF for required mitigation measures.
- Report all SAR sightings to an MNRF Management Biologist– Aylmer District (519-773-9241) within 2 business days.
- Any injured species must be reported immediately to MNRF and to:

  Ontario SPCA –Windsor/Essex County Human Society1375 Provincial Road Windsor, ON, N8W 5V8
  (519) 966-5751
  Email: melanie@windsorhumane.ca

Key Identification Features

1. Double Compound Leaves divided into many small bluish-green leaflets

Key Identification Features

2. 15 – 25 m tall

Photo Credit: MNRF, 2014

Record of Species Observation

#	Date	Approximate Location & Description	Approximate Size
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

References:

Government of Canada. 2014. Recovery Strategy for the Kentucky Coffee-Tree (Gymnocladus dioicus) in Canada. Accessed online January 2015. http://www.sararegistry.gc.ca/virtual_sara/files/plans/rs_kentucky_coffee_tree_e_final.pdf

Contractor Information Sheet for Species at Risk

Willowleaf Aster

(*Symphyotrichum praealtum*)

Species overview

The Willowleaf Aster is a herbaceous perennial with a relatively smooth and waxy stem growing up to 1.5 m tall. Found in Southwestern Ontario in populations within Lambton, Essex, and Middlesex Counties and the Municipality of Chatham-Kent.

Species-at-Risk status

Provincial:
Threatened under the
Ontario Endangered Species Act (ESA)
Federal:
Threatened

Identification

Growing up to 1.5 m tall this herbaceous plant has a fairly smooth, waxy stem. The small daisy-like flowers have pale blue-violet petals and a yellow centre that turns purple with age. The upper leaves are narrow and grass-like with a few small teeth along the edge.

What to do if found

If the Willowleaf Aster is found within the construction zone, the following procedure must be followed:

- If possible take a photo.
- Fill out the observation record form on the back of this sheet.
- Protect species from construction activities.
- Contact Town of Tecumseh & MNRF for required mitigation measures.
- Report all SAR sightings to an MNRF Management Biologist– Aylmer District (519-773-9241) within 2 business days.
- Any injured species must be reported immediately to MNRF and to:

  Ontario SPCA –Windsor/Essex County Human Society1375 Provincial Road
  Windsor, ON, N8W 5V8
  (519) 966-5751
  Email: melanie@windsorhumane.ca

Key Identification Features

1. Daisy-like small pale flowers
2. Yellow centre turning purple with age

Key Identification Features

3. Narrow upper leaves with small teeth

Record of Species Observation

#	Date	Approximate Location & Description	Approximate Size
1			
2			
3			
4			
5			
6			
7			
8			
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10			

References:

MNR. 2013. Willowleaf Aster (Symphyotrichum praealtum) in Ontario. Ontario Recovery Strategy Series. Accessed online January 2015. http://files.ontario.ca/environment-and-energy/species-at-risk/mnr_sar_rs_wllwlf_astr_en.pdf

Our File: 11-5366 (Corr.)

DILLON CONSULTING

February 11, 2015

3200
Deziel Drive
Suite 608
Windsor, Ontario
Canada
N8W 5K8
Telephone
(519) 948-5000
Fax
(519) 948-5054

Essex Region Conservation Authority
360 Fairview Avenue West, Suite 311
Essex, ON
N8M 1Y6

Attention: Mr. John Henderson, P.Eng.

Manning Road Secondary Plan Area Stormwater Management
Class Environmental Assessment Addendum
Response to ERCA Comments

Further to your email dated January 19, 2015 in response to the Notice of Addendum for the noted project, including subsequent discussions, emails and our recent meeting of February 3, 2015, we are hereby confirming our approach for addressing your comments and the additional information that will form part of the preferred stormwater management solution that has been identified for this area.

The following were in attendance during our meeting of February 3, 2015:

John Henderson, P.Eng .	-	Essex Region Conservation Authority
Phil Roberts	-	Windsor International Airport
Brian Hillman	-	Town of Tecumseh
Daniel Piescic	-	Town of Tecumseh
Flavio Forest	-	Dillon Consulting Limited
Ryan Langlois	-	Dillon Consulting Limited

At this meeting, the following matters were addressed:

1.0 WINDSOR INTERNATIONAL AIRPORT

It was confirmed that the proposed MRSPA pond is not located within the runway approach and outer surface limits affecting the Windsor Airport.

The Windsor Airport offered suggestions to limit waterfowl attraction, which may present a nuisance to local area residents in the future, including allowing grass in buffer areas to grow taller, planting trees and naturalized treatments in the embankment areas, and use of coarse shrubs in lower lying areas of the pond.

...continued

2.0 OVERLAND DRAINAGE SYSTEM CHARACTERISTICS

2.1 MRSPA

It was agreed that more specific stormwater management (SWM) design criteria would be included as part of the SWM and functional servicing reports for the MRSPA, particularly surface storage and runoff control requirements.

The opportunities to direct overland flow to the proposed MRSPA SWM pond are limited based on the existing topography. It has been recommended that inlet control devices be incorporated within roadway catchbasins to provide an appropriate balance between runoff being conveyed by the minor storm sewer system and the temporary surface storage required within roadways for more significant storm events.

In order to determine the surface storage that could be accommodated within the right-of-way, a representative roadway surface storage calculation was completed based on the proposed site grades with a 0.3m maximum ponding depth. It was determined that the maximum average roadway surface storage volume would be approximately 91 m^3/ha. The preliminary modeling results will be updated based on other aspects of our discussion presented herein, though it would appear that this surface storage capacity would address more than 50 percent of, but not all of the 1:100 year requirements.

Due to the benefits of modifications in the watershed boundaries and the over-restricted release rate from the MRSPA SWM pond, it was proposed that overland flows exceeding the available roadway surface storage capacity be permitted to overflow to the Cyr Drain and to the East Townline Drain. It was agreed that this would be acceptable, subject to confirmation of the following:

- That the rate of overflow would not exceed the 1:2 year existing conditions runoff rate (assumed to represent the existing outlet drain capacity); and
- That these overflow rates were accounted for in the design of the East Townline Drain pump station outlet at Lake St. Clair.

Furthermore, there were challenges identified with the ability to fully implement these overland flow outlets based on the phased approach to development in the MRSPA. In particular, a continuous overland flow outlet to the Cyr Drain may not be possible due to land ownership constraints, which may only be resolved once a fuller extent of development takes place in the north part of the MRSPA. As requested, we will give consideration to the opportunities and related limitations of overland flow solutions under interim development conditions in the MRSPA.

...continued

2.2 Baillargeon Drain Area

As noted in the December 2014 modeling memo, the Baillargeon Drain area generally slopes easterly towards the MRSPA and northerly towards County Road 22. The drainage characteristics of the Baillargeon Drain area under major storm events were determined based on a review of existing grades along its boundary with MRSPA. It was observed that there may be two locations that provide potential overland flow to the MRSPA, which were found to exhibit the following characteristics:

- An emergency overland flood route was previously designated within an easement that was established between existing homes on Charlene Lane:
    - The existing grades within the existing overland flow easement appear to be at least 0.3 m higher than the existing roadway elevations.

- A lower lying area on Candlewood Drive, directly south of the Agnes Drive intersection at the location of the Baillargeon Drain:
    - The lot grading of the existing properties are approximately 0.5 m higher than the existing roadway elevations.

There are no alterations being proposed to the existing grading along this boundary that would result in an increase to overland flow contributions between the Baillargeon Drain area and the MRSPA.

Accordingly, the Baillargeon Drain area was modeled based on surface storage of overland flows being temporarily contained within the existing drainage area under major storm events, with conveyance by the minor storm sewer system (1:2 year level of service). The complete 1:100 runoff volume was considered in assessing the operation of the proposed MRSPA SWM pond.

It was agreed that in cases of more extreme events exceeding the 1:100 year condition, that the following measures would be appropriate:

- Extension of the existing overland flow easement, interconnecting Charlene Lane with the MRSPA roadway network and the proposed overland flow network that would be available for overland flow relief to the East Townline Drain and the proposed MRSPA pond.

- Incorporating a new ditch inlet catchbasin at the downstream end of the overland flow easement that would be directly connected into the proposed MRSPA storm sewer system.

...continued

3.0 BAILLARGEON DRAIN AREA RUNOFF CHARACTERISTICS AND DRAINAGE SYSTEM PERFORMANCE

3.1 Modeling Approach and Runoff Parameters

The modeling approach for the Baillargeon Drain included discretizing the watershed into a total of 19 sub-catchments and incorporating existing storm sewers exceeding 600 mm diameter. Each sub-catchment was assigned a percent impervious value based on an evaluation of aerial images.

The modeled peak flows for the 1:2 year storm event were initially found to exceed the existing storm sewer capacities. Adjustments were made to percent impervious values for select sub-catchment areas to calibrate the model to the existing storm sewer capacities. The percentage impervious values for the sub-catchment areas vary from 25% to 40%.

3.2 Drainage System Performance

The hydraulic performance of the Baillargeon Drain will improve as a result of being redirected to the proposed MRSPA storm sewer system and pond facility. Furthermore, the controlled outlet from the proposed MRSPA pond will provide considerable relief to the East Townline Drain.

The outlet conditions at the confluence of the 1350 mm diameter Baillargeon Drain storm sewer with the proposed MRSPA storm sewer will consist of a drop of approximately 1.8 m, while the northern portion of the area will be separately served by extending an existing 900 mm diameter storm sewer stub on Gouin Street to the MRSPA storm sewer. In addition, the tailwater conditions at the proposed MRSPA pond are considerably lower than the available hydraulic conditions in the East Townline Drain.

A comparison of the hydraulic grade lines under existing and future conditions for MH EX4, located directly upstream of the Baillargeon Drain, is outlined below in Table 1.

Table 1: Hydraulic Grade Line Comparison

Storm Event (12 hr)	Existing Conditions HGL @ U/S MH EX4 (m)	Future Conditions HGL @ U/S MH EX4 (m)
1:2	181.53	180.64
1:5	181.70	180.75
1:100	181.82	181.78

...continued

3.3 Runoff Quality Treatment

Incorporating the Baillargeon Drain into the proposed MRSPA SWM pond provides an opportunity to improve runoff quality for this drainage area that currently has no such measures in place. The criteria used in the model included the 25 mm, 4 hour Chicago storm, which resulted in the following:

- 25 mm water surface elevation in MRSPA pond = 174.87
- Water quality drawdown time = 37 hours

4.0 MRSPA RUNOFF CHARACTERISTICS

A slightly reduced runoff coefficient of 0.35 for the residential portion of the MRSPA was originally selected as the basis for the proposed storm sewer design to account for the beneficial effects of the required disconnection of roof leaders and sump pumps.

Upon further review, it has been agreed to increase the runoff coefficient for the design of storm sewers in residential areas to 0.4, which may be considered to provide an added buffer in the level of service. The hydrodynamic model will also be updated accordingly.

5.0 MRSPA POND DRAWDOWN TIME

In order to address the comments related to the increased 1:100 year pond drawdown time of approximately 100 hours, a risk analysis was completed to confirm the resiliency of the MRSPA pond to accommodate subsequent storm events within the drawdown period. The following Table 2 summarizes the incremental storage available (up to an extreme high water surface elevation of 180.50 m) during the drawdown period following a 1:100 year storm, and the corresponding storm event that could be accommodated at each interval of time:

Table 2: MRSPA Pond Drawdown Summary

Drawdown Time (hrs)	WSEL (m)	Active Storage Available (m^3)	Active Storage Needed for Storm Event (m^3)	Storm Event Capacity in MRSPA Pond @ Time
24	178.84	73,517	54,959	1:5 year
48	177.91	107,935	106,079	1:25 year
72	176.67	148,050	130,928	1:100 year
96	175.13	189,854	130,928	1:100 year
120	174.6	202,048	130,928	1:100 year

...continued

These preliminary results will be reconfirmed, but it was suggested that on the basis of the storage volume available up to an extreme water surface elevation of 180.5 m, that the MRSPA SWM pond would provide a reasonable level of service to address the risk of storm events occurring shortly following a major 1:100 year storm.

6.0 CLIMATE CHANGE CONSIDERATIONS

While the Provincial Policy Statement references the need to consider the potential impacts of climate change while accommodating projected needs, there is a lack of direction on the degree of increases/decreases and frequency of climatic changes that should be used for such assessments. It was agreed that the adaptability of the proposed solution to potential changes in climate would be addressed, both in terms of the solution as currently proposed and the potential opportunities for future modifications.

7.0 MODELING MEMO CLARIFICATIONS AND UPDATES

It was agreed that the modeling memo would be updated as outlined herein, including the additional functional design information that will facilitate the detailed design for each phase of development in the MRSPA. In addition, the report figures will be updated and additional descriptions will be included for clarity.

8.0 CLOSURE

We trust that we have confirmed the manner in which we are proceeding to address your comments, as discussed during our meeting of February 3, 2015. The modeling memo will be updated accordingly, and a final copy will be provided to you, based on which we would be pleased to meet with you to present our findings and address any remaining questions you might have.

Yours sincerely,

DILLON CONSULTING LIMITED

Flavio R. Forest, P.Eng.,
Project Manager

FRF:d
Cc: Mr. Brian Hillman, Town of Tecumseh
Mr. Daniel Piescic, P.Eng., Town of Tecumseh

DILLON CONSULTING

Durocher, Maggie <mdurocher@dillon.ca>

RE: Manning Road Secondary Plan Area Stormwater Management - Reply Letter

1 message

Riddell, Heather (MNRF) <Heather.Riddell@ontario.ca> Wed, Apr 8, 2015 at 5:15 PM
To: "Durocher, Maggie" <mdurocher@dillon.ca>, 115366 <115366@dillon.ca>
Cc: Sabrina Stanlake-Wong <sstanlake@dillon.ca>, Flavio Forest <fforest@dillon.ca>, Phil Bartnik <pbartnik@tecumseh.ca>

Hi Maggie,

The reply letter, dated January 28, 2015 refers to a Letter to Proponent (LOA #AYL-L-066-14) that was issued on August 8, 2014. This LOA was specific to Baillergeon Drain and activities being conducted under section 78 of the *Drainage Act* and is only valid until June 30, 2015.

The Notice of Addendum that MNRF responded to on January 19, 2015 was for a project area significantly larger than the scope of the Baillergeon Drain project.

Therefore, MNRF recommends that our comments/information provided on January 19, 2015 should still be considered. Please see the attached updated technical memo for further information on MNRF Aylmer District's SAR Screening process.

Regards,

Heather

Heather Riddell

District Planner

Ministry of Natural Resources and Forestry

Aylmer District

615 John Street North

Aylmer, ON N5H 2S8

Tel: 519-773-4757

heather.riddell@ontario.ca

From: Durocher, Maggie [mailto:mdurocher@dillon.ca]
Sent: January-28-15 4:11 PM

To: Riddell, Heather (MNRF); 115366
Cc: Sabrina Stanlake-Wong; Flavio Forest; Phil Bartnik
Subject: Manning Road Secondary Plan Area Stormwater Management - Reply Letter

See attached reply letter for the above noted project.

Thanks

Maggie

Maggie Durocher
Dillon Consulting Limited
3200 Deziel Drive Suite 608
Windsor, Ontario, N8W 5K8
T - 519.948.4243 ext. 3265
F - 519.948.5054
MDurocher@dillon.ca
www.dillon.ca

Please consider the environment before printing this email

3 attachments

noname.eml
953K

MNRF Reply Letter.pdf
75K

2015-03_SAR Screening Process_Technical Memo.pdf
130K

Durocher, Maggie

From: Riddell, Heather (MNRF) <Heather.Riddell@ontario.ca>
Sent: Monday, January 19, 2015 5:20 PM
Subject: Manning Road Secondary Plan Area - SWM Study - Notice of Filing of Addendum
Attachments: Manning Rd Secondary Plan Area.pdf

Attn: Mr. Phil Bartnik, P.Eng. Manager, Engineering Services
Town of Tecumseh
917 Lesperance Road
Tecumseh, ON N8N 1W9

Dear Mr. Bartnik,

The Ministry of Natural Resources and Forestry (MNRF) has received the attached Notice of Filing of Addendum for the Town of Tecumseh's Manning Road Secondary Plan Area Stormwater Management Class EA.

The Species at Risk in Ontario (SARO) List (http://www.ontario.ca/environment-and-energy/species-risk-ontario-list) is Ontario Regulation 230/08 issued under the *Endangered Species Act, 2007* (ESA). The ESA came into force on June 30, 2008, and provides both species protection (section 9) and habitat protection (section 10) to species listed as endangered or threatened on the SARO List.

MNRF has completed an initial SAR screening for the proposed project area shown in the attached notice.

There are no known occurrences of SAR in the project area but there are known occurrences of the following SAR in the general area with the potential to occur on in the project area:

- Butler's Gartersnake (endangered with general habitat protection)
- Barn Swallow (threatened with general habitat protection)
- Willowleaf Aster (threatened with general habitat protection)
- Kentucky Coffee-tree (threatened with general habitat protection)

Eastern Foxsnake (Carolinian population) and its habitat are protected under the ESA. This species regularly inhabits agricultural lands throughout the area, and so, woodlands, farm hedgerows, old fields, wetlands, and drainage corridors can be important habitats as well as seasonal migration linkages. Specific features such as rotting logs or stumps, piles of organic material (such as compost, sawdust, or woodchips), rock piles, brush piles, and dump sites of old agricultural debris/equipment are likely to provide habitat functions for Eastern Foxsnake in the project area. This species may also utilize old bridges, culverts, and foundations as communal over-wintering sites. If any of the above features are found to occur, they must be protected from all disturbances that would result in damage or destruction of their habitat functions.

Please note that this is an initial screening for SAR and the absence of an element occurrence does not indicate the absence of species. The province has not been surveyed comprehensively for the presence or absence of SAR, and MNRF data relies on observers to report sightings of SAR. Field assessments by a qualified professional may be necessary if there is a high likelihood for SAR species and/or habitat to occur within the project footprint.

It is important to note that changes may occur in both species and habitat protection which could affect whether proposed projects may have adverse effects on SAR. The Committee on the Status of Species at Risk in Ontario (COSSARO) meets regularly to evaluate new species for listing and/or re-evaluate species already on the SARO List. As a result, species designations may change, which could in turn change the level of protection they receive under the ESA. Also, habitat protection provisions for a species may change if a species-specific habitat regulation comes into effect.

If an activity or project will result in adverse effects to endangered or threatened species and/or their habitat, additional action would need to be taken in order to remain in compliance with the ESA. Additional action could be applying for an authorization under section 17(2)c of the ESA, or completing an online registry for an ESA regulation, if the project is eligible.

Please be advised that applying for an authorization does not guarantee approval and the process can take several months. Please visit MNRF's website to determine whether a project may be eligible for the online registry process

(http://www.ontario.ca/environment-and-energy/natural-resources-approvals). Questions about the registry process should be directed to MNRF's Registry and Approval Services Centre at 1-855-613-4256 or at mnr.rasc@ontario.ca.

If you have any questions, please contact me.

Regards,
Heather

Heather Riddell
District Planner
Ministry of Natural Resources and Forestry
Aylmer District
615 John Street North
Aylmer, ON N5H 2S8
Tel: 519-773-4757
heather.riddell@ontario.ca

Ministry of Natural Resources and Forestry
615 John Street North
Aylmer ON N5H 2S8
Tel: 519-773-9241
Fax: 519-773-9014

Ministère des Richesses naturelles et des Forêts
615, rue John Nord
Aylmer ON N5H 2S8
Tél: 519-773-9241
Téléc: 519-773-9014

Ontario

Technical Memo: Aylmer District Species at Risk Screening Process

The intent of this technical memo is to clarify the process for engaging the Ministry of Natural Resources and Forestry (**MNRF**) Aylmer District Office regarding the *Endangered Species Act, 2007* (**ESA**). Please refer to page 2 for MNRF Aylmer District staff contact information.

The ESA came into force on June 30, 2008, and provides both species protection (Section 9) and habitat protection (Section 10) to species listed as Endangered or Threatened on the Species at Risk in Ontario List (http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_080230_e.htm). MNRF Aylmer District provides the service of responding to species at risk (**SAR**) information requests (Stage 1) and project screening requests (Stage 2) when:

1. The request comes from the property owner or consultants on their behalf; and,
2. A specific project/activity is proposed.

Stage 1: Information Request

MNRF encourages landowners/their consultants proposing to conduct site alteration on their property to request SAR information from the district prior to beginning the project. For MNRF to respond to an information request, the following information is required:

- Proponent information (i.e. name, mailing address, and email address);
- Detailed property location information (maps are beneficial);
- Digital photos of the property, including the vegetation on-site, if available;
- General description of all proposed activities and extent of development footprint (e.g. residential, driveway, vegetation clearing);
- Current state of vegetation and history of property maintenance (e.g. mowing regime);
- Timing and duration of proposed activities;
- Copies of past correspondence with MNRF about the property, if applicable; and,
- Type and status of municipal planning or Environmental Assessment process, if any.

Once the above information has been provided, MNRF will review SAR data on file to determine if SAR individuals and their habitat(s) are known or likely to occur on or in the general area of the requested property. MNRF's response will be one of the following:

1. There is a **high** likelihood for SAR species and/or habitat to occur: MNRF may recommend that a qualified biologist be retained to complete field assessments on site.
    - MNRF will expect the qualified biologist to use the information provided in the information request response to scope and design the field assessments, including identifying appropriate survey methodologies and timing windows.
    - MNRF is available to provide guidance on field assessments (i.e. review of proposed work plans). Some field assessment methodologies may require MNRF authorizations under the ESA and the *Fish and Wildlife Conservation Act*.
    - After field assessments have been completed, proceed to Stage 2: project screening request.

2. There is a **low** likelihood for SAR species and/or habitat to occur and/or be impacted: A letter to proponent (**LOA**) can be provided, if requested. The LOA may include recommendations to avoid impacts to SAR.
    - A Stage 2: project screening request will not be needed.

Stage 2: Project Screening
After MNRF responds to the information request and appropriate field assessments have been completed by a qualified biologist, a project screening request can be submitted to MNRF. For MNRF to respond to a project screening request, the following information should be provided using the Information Gathering Form available at the following website link: (http://www.forms.ssb.gov.on.ca/mbs/ssb/forms/ssbforms.nsf/MinistryResults?Openform&SRT=T&MAX=5&ENV=WWE&STR=1&TAB=PROFILE&MIN=018&BRN=21&PRG=31):

- Name and qualifications of the biologist;
- Dates and weather conditions of field assessment days;
- Survey methodologies and survey times, frequencies and durations;
- Maps and coordinates of locations of observed SAR individuals and/or habitat features;
- Detailed description of all proposed activities and extent of development footprint (e.g. driveway, septic, vegetation clearing); and,
- Analysis of results from field work including size and quality of SAR habitat area that could be impacted based on proposed project footprint area.

MNRF will use the above information to determine the likelihood that the project may contravene either Section 9 (impacts to protected individuals) or Section 10 (impacts to protected habitat) of the ESA. MNRF's response will be one of the following:

1. Contravention under the ESA is **not likely** to occur: A LOA can be provided, if requested. The LOA may include recommendations to avoid impacts to SAR; or,
2. Contravention under the ESA is **likely** to occur: MNRF will initiate discussions regarding the permit process or alternative regulatory processes. Please be advised that applying for a permit does not guarantee approval and processes can take several months before a permit may be issued.

MNRF Aylmer District Staff Contact Information
Information requests and project screenings must be submitted to MNRF Aylmer District through one of the following applicable one-window email accounts:

- Requests for SAR/natural heritage information related to a planning file (e.g. a *Planning Act* application, an Environmental Assessment under the *Environmental Assessment Act*) should be directed to the District Planner for the applicable municipality.
    - Counties of Essex and Lambton, Municipality of Chatham-Kent, and City of Windsor: heather.riddell@ontario.ca
    - Counties of Elgin, Middlesex, Norfolk, and Oxford, and City of London: andrea.fleischhauer@ontario.ca.
- SAR-specific requests not related to a planning file should be directed to the Management Biologists at ESAScreeningRequest.AylmerDistrict@ontario.ca.

**NOTE: MNRF responses may take 6 - 8 weeks after receipt of all required information due to the high volume of requests received.*

Our File: 11-5366 (Corr.)

DILLON CONSULTING

3200
Deziel Drive
Suite 608
Windsor, Ontario
Canada
N8W 5K8
Telephone
(519) 948-5000
Fax
(519) 948-5054

April 9, 2015

Essex Region Conservation Authority
360 Fairview Avenue West, Suite 311
Essex, ON
N8M 1Y3

Attention: Mr. John Henderson, P.Eng.,
Water Resources Engineer

Finalized Addendum to Class Environmental Assessment
Manning Road Secondary Plan Area (MRSPA)
Stormwater Management Study

Dear Sir:

On behalf of the Town of Tecumseh, we hereby confirm that the Essex Region Conservation Authority's comments in response to the Notice of Filing of Addendum for the MRSPA SWM Environmental Study Report Addendum (December 2014) have been addressed, as outlined herein.

The Town of Tecumseh and Dillon Consulting Limited met with you on February 3, 2015, to review a wide range of questions and comments related to the detailed hydraulic and hydrologic modeling that was undertaken as part of this project. The results of these discussions and our preliminary findings were summarized in our letter dated February 11, 2015.

Following further detailed modeling, we met again on February 20, 2015, to review our findings and to confirm the basis for finalizing various functional design parameters associated with the preferred solution. The updated Modeling Memo was distributed for your final review on March 16, 2015, followed by an April 1, 2015, review meeting.

Further to our email of April 9, 2015, we understand that ERCA's comments have now been addressed and that the minor corrections you have identified will be incorporated into the final Modelling Memo. As agreed, the Class EA Addendum Report will be updated and will form the basis for defining the design requirements for the overall storm drainage solution in the MRSPA.

As a result of having addressed all the comments that have been received during this project, the MRSPA SWM Environmental Study Report Addendum is now being finalized and is considered to be approved under the Municipal Class Environmental Assessment process.

...continued

We appreciate your valuable input during this process.

Yours sincerely,

DILLON CONSULTING LIMITED

Flavio R. Forest, P.Eng.
Project Manager

FRF:d
Cc: Mr. Phil Bartnik, P.Eng., Town of Tecumseh

Our File: 11-5366 (Corr.)

DILLON CONSULTING

3200
Deziel Drive
Suite 608
Windsor, Ontario
Canada
N8W 5K8
Telephone
(519) 948-5000
Fax
(519) 948-5054

April 9, 2015

James Sylvestre Developments Ltd.
1865 Manning Road
Tecumseh, ON
N8N 2L9

Attention: Mr. James Sylvestre

Finalized Addendum to Class Environmental Assessment
Manning Road Secondary Plan Area (MRSPA)
Stormwater Management Study

Dear Sir:

On behalf of the Town of Tecumseh, we hereby confirm that the comments submitted on your behalf in response to the Notice of Filing of Addendum for the MRSPA SWM Environmental Study Report Addendum (December 2014) have been addressed, as outlined herein.

The Town of Tecumseh and Dillon Consulting Limited met with you on January 7, 2015, to review your comments and agreed to prepare a preliminary design and cost comparison for an alternative to the preferred solution that would involve the addition of your lands south of the CP Railway tracks as part of the proposed MRSPA SWM pond.

We subsequently met with you on March 3, 2015 to present the results of our evaluation that were summarized in a memo dated February 25, 2015, a copy of which was provided during our meeting. It was confirmed that the preferred solution for the MRSPA SWM pond should not be altered to accommodate your lands south of the CP Railway tracks.

As a result of having addressed all the comments that have been received during this project, the MRSPA SWM Environmental Study Report Addendum is now being finalized and is considered to be approved under the Municipal Class Environmental Assessment process.

We appreciate your input and participation.

Yours sincerely,

DILLON CONSULTING LIMITED

Flavio R. Forest, P.Eng.
Project Manager

FRF:d
Cc: Mr. Phil Bartnik, P.Eng., Town of Tecumseh