FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

150 Steeles Avenue East

Town of Milton

Prepared for

150 Steeles Milton Inc.
Project #: 21-678

March 2025

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1. INTRODUCTION

Urbantech has been retained as consulting engineers by 150 Steeles Milton Inc. and directed to complete a Functional Servicing Report in support of the proposed residential development at the southeast corner of Steeles Avenue East and Bronte Road North in the Town of Milton. The property, located at 150 Steeles Avenue East, is herein referred to as the Subject Property.

The site has an area of 20.81 ha and currently consists of vacant lands as a former industrial site, which was demolished in 2021. The site is bounded:

- To the north by Steeles Avenue
- To the south by the Canadian National Railway
- To the east by Martin Street
- To the west by Bronte Street North

1.1. Purpose

This report presents functional design details and calculations related to drainage, wastewater servicing and water supply for the site in support of draft plan approval/rezoning applications, this report will:

1. Present recommended site grading, water supply and wastewater servicing strategies for the site.
2. Demonstrate compliance with Town, Conservation Halton and MECP design criteria for municipal services and stormwater management (SWM) measures.
3. Identify design measures that make accommodation for future development on the adjacent Honda Lands (170 Steeles Avenue East).

1.2. Planning Context

Prior to the industrial uses on the site, the entire tableland portion of the Subject Property was used for agriculture. The previous factory on the Subject Property was constructed in 1954. Over the life span of the manufacturing facility there were several additions completed to the building in 1957, 1965, 1973, 1988, 1994, 1998 and 1999. The building was originally tooled to manufacture automobile bumpers, which included a chrome plating process. In the 1970's, the factory was re-tooled and continually expanded to manufacture suspension springs for major car manufacturers. At full operational status, the factory had 8 operational manufacturing lines.

An unregulated landfill was created on the Subject Property in the early 1970's. The landfill was situated south of the previous factory and was used to dump waste material from the manufacturing process including mill scale, steel shot, brick and construction debris. The landfill was eventually capped in the late 1980's/early 1990's.

The previous factory uses and landfill resulted in various areas and types of contamination on the Subject Property, as described later in this report.

Major manufacturing operations on the Subject Property were discontinued in 2009 at which point, the factory was transitioned to general warehousing and storage, utilizing about 30% of the 300,000 sq. ft. building. The remainder of the building and Subject Property remained vacant / un-used.

The Subject Property was purchased by 150 Steeles Milton Inc. on April 7, 2021, from the Meritor Suspension Systems Company, Canada (MSSC). The factory was subsequently demolished in late 2021 and remediation activities lands in 2022 following the demolition. For the purposes of completing a Record of Site Condition (RSC) in phases, the Subject Property has been subdivided into six RSC areas/properties.

The servicing and development concept presented within this report are an extension of the information contained in the following reports:

1. Comprehensive Environmental Management Study – 150 Steeles Avenue East, Milton (March2023) by Beacon et al.
2. Slope Stability Assessment – 150 Steeles Avenue East, Milton, Ontario (January 2023) by DS Consultants
3. Scoped Environmental Impact Study – 150 Steeles Avenue East, Milton (March 2025) by Beacon Environmental Limited

1.3. Development Concept

Refer to the **Draft Plan of Subdivision** prepared by Core Architects in **Appendix D**. The development consists of:

1. Town houses,
2. Mid-rise apartments
3. A 1.54 ha stormwater management (SWM) pond,
4. 2600m of 20.117m and 26.213m public road allowances (local and collector respectively),
5. 3.38 ha of natural heritage system and open space.

In the proposed development, there will be 1 street connection to Steeles Avenue at Street A, and 2 street connections to Martin Street at Street A and Street D.

2. EXISTING CONDITIONS

2.1. Drainage Infrastructure

The majority of the Subject Property (11.56 ha) drains from the north to southwest, towards the Sixteen Mile Creek via an overland flow route and existing perched pipe in the valley. A portion of the site (8.70 ha) drains to the southeast towards an existing drainage swale that outlets to Sixteen Mile Creek. Prior to site remediation works, the property was developed and included approximately 75% impervious coverage in the north portion of the Subject Property, approximately 30% impervious coverage in the south-east portion of the Subject Property and no impervious areas in the south-west portion of the Subject Property. Refer to **Drawing STM-1** for the pre-development drainage plan.

Prior to demolition there was one stormwater sewer outfall from the developed portions of the Subject Property that drained into the Sixteen Mile Creek valley, and an overflow spillway from a tailings pond which discharged / spilled to the railway ditch. The line to the stormwater outfall was decommissioned as part of the demolition works and the tailings pond was removed and a restored wetland was created in the natural heritage system (NHS). In addition, as part of the site remediation works, the grades were altered such that overland flow is now directed to an erosion and sediment control (ESC) pond in the southeast corner of the Subject Property. As a result, the storm sewer and tailings pond area no longer convey any flows from the surface to Sixteen Mile Creek

Within Martin Street, there is an existing 300 mm stormwater sewer flowing south. There is also a 375 mm stormwater sewer extending from the intersection of Steeles Avenue and Martin Street flowing east (refer to **STM-1**).

2.2. Existing Conditions – Wastewater System

Wastewater generated from the 150 Steeles Avenue site will be directed south to the Mid-Halton Wastewater Treatment Plant via the Fulton Wastewater Pump Station and the Boyne Trunk Sewer.

Existing wastewater infrastructure immediately adjacent to the Subject Property includes:

1. A 300 mm diameter pipe along Steeles Avenue.
2. A 200-250 mm diameter pipe along Martin Street.
3. A 1050 mm trunk sewer east of Martin Street on Woolworth Street.

Refer to **Drawing SAN-1** for additional information.

2.3. Existing Conditions – Water System

The 150 Steeles Avenue site is located within Water Pressure Zone M5G, a groundwater-based service area. The Milton groundwater system is supplied through the existing Kelso Well Field and Kelso Water Purification Plant.

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Existing water distribution infrastructure immediately adjacent to the Subject Property includes:

1. A 300 mm diameter Zone M5L watermain (lake-based) on Steeles Avenue (TWL 267 m)
2. A 300 mm diameter Zone M5G watermain (groundwater service) along the south side of Steeles Avenue (TWL 257 m)
3. A 300 mm diameter Zone M5G watermain (groundwater service) along Martin Street (TWL 257 m)

There is also an existing service connection to the site, previously servicing the industrial building.

Refer to **Drawing WM-1** for additional information.

2.4. Geotechnical and Hydrogeology Studies

In support of the application, the approved Comprehensive Environmental Management Study (Beacon, 2023). has been referenced for site specific soils and hydrogeological studies.

The topography of the site is relatively flat with a surface elevation of approximately 205-208 masl except for the landfill area (prior to its removal) at the southern portion of the site with maximum elevation of approximately 211 masl. The topography is generally flat with a gentle slope towards the south. The nearest surface water body is Sixteen Mile Creek, located on the southwest side of the Subject Property, which eventually drains into Lake Ontario. The local site topography generally slopes gently downwards towards the south and east.

Shale bedrock belonging to the Queenston Formation was found at approximate depths varying from 15.3 to 18.3m below the existing, pre-remediation ground, corresponding to elevations varying from 188.0 to 190.2m. According to the Ontario Geological Survey, the surficial geology is described as “Till, clay to silty-textured till (derived from glaciolacustrine deposit of shale”.

The hydrogeology at the Subject Property was evaluated using the on-site six (6) monitoring wells installed by DS and nine (9) additional existing monitoring wells installed by other consultants, local domestic wells and existing environmental reports for the area.

Based on the MECP water well records search, all wells within a 500 m radius of the Subject Property were noted as monitoring/test holes or not in use except for five (5) records for domestic, three (3) records for industrial and three (3) records for commercial purposes. The study area (500 m radius of the Subject Property) is fully serviced with municipal water.

Based on groundwater level measurements by DS Consultants, the groundwater table was found at a range between 6.87 to 13.06 mbgs (Elev. 197.15-200.44 masl). Based on groundwater elevations, the flow direction within the Subject Property is inferred to be southwest toward the Sixteen Mile Creek.

A total of fifteen (15) Single Well Response Tests (SWRTs) were completed by DS in monitoring wells on May 5 to 7, 2021 to estimate hydraulic conductivity (k). The values of calculated hydraulic conductivity (k) range from 9.56 × 10-7 to 1.12 × 10-4 m/s.

The CEMS study dated March 2023 is reproduced in **Appendix A**.

3. GRADING DESIGN

The proposed grading design for the Subject Property takes into consideration the following requirements and constraints:

1. Conforms to the Town of Milton's design criteria.
2. Optimizes cut and fill operations to minimize import/export situations.
3. Matches existing boundary conditions and self-contain drainage.
4. Provides overland flow conveyance for major storm conditions.
5. Minimizes the length and height of retaining walls.
6. Provides minimum cover on proposed servicing; and
7. Ensures compatibility with extensions of roads into surrounding lands.

Refer to **Drawing GR-1** for further details.

Retrofitting the pond outlet to connect to the existing ditch southeast of the development was considered. However, this option is not proposed, as it would require raising the site by several meters, making it incompatible with the surrounding residential areas.

4. STORM DRAINAGE AND STORMWATER MANAGEMENT

4.1. Design Criteria

The Town of Milton outlines stormwater management design requirements for SWM in the Engineering and Parks Standards Manual dated September 2024. These recommendations include criteria for surface water quality, quantity, water balance, and erosion control. The following summarizes the SWM targets and design criteria:

1. Provide extended detention drawdown volume for the 25 mm rainfall event based on the erosion threshold target flow rate and a minimum drawdown time within the SWM facility within a range of 24-48 hours
2. Ensure adequate stormwater quality treatment of runoff is provided. Town requires Level 1 Protection (Enhanced – 80% Average Annual Removal of Total Suspended Solids) for all developments
3. Maintain water balance to infiltrate the 90th percentile storm event (27 mm) as required by the CLI ECA.
4. Provide safe overland flow conveyance of the 100-year event.
5. Target release rates for post-development are the pre-development controls for the 2-year to 100-year event as well as the Regional Storm.

The table below outlines the target flows.

Table 1: Pre-development Target Flows

Storm Event	Flow (m^3/s)
2-Year	1.544
5-Year	2.267
10-Year	2.738
25-Year	3.133
50-Year	3.819
100-Year	4.300
Regional (Hazel)	2.143

4.2. Storm Sewer Design

Storm sewers within the subdivision are sized to convey the 5-year storm in accordance with the Town of Milton standards. Local storm sewer pipes generally range in size from 375 mm to 1200 x 1800 mm box sewers. Box sewers are proposed as opposed to the equivalent circular pipe due to cover and crossing constraints. All stormwater within the subdivision is conveyed to the stormwater pond, which is situated in the southeast corner of the Subject Property.

Sizing of the storm sewer is provided in **Appendix B**.

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4.3. Extended Detention and Orifice

The stormwater pond design is required to provide a minimum 24-48 hour drawdown time of the 25mm rainfall event in accordance with the Town of Milton's criteria.

The drawdown time for the pond is 31 hours with the use of a 200 mm orifice tube, as per the Town of Milton standards. Refer to the SWM Calculations provided in **Appendix B**. As such, the proposed drawdown time is in-keeping with the Town's minimum requirements.

4.4. Quality Control

Enhanced (Level 1) water quality protection through the removal of 80% of total suspended solids (TSS) will be provided, as required by the Town of Milton. The required permanent pool volume was calculated using the MECP tables. As per the MOE Stormwater Management Planning and Design Manual 2003, Table 3.2, the permanent pool storage requirement is 3,792.60 m^3 based on 85% impervious. The provided permanent pool volume is 6,599.94 m^3 at an elevation of 201.70 m. As such, the permanent pool is sized to achieve 80% TSS removal.

4.5. Quantity Control

A Visual Otthymo (VO6) hydrology model was used to determine the pond storage required to control post-development flows to the target release rates. In addition to runoff from the site, flows originating from the existing Honda Lands (170 Steeles Avenue East) where there will be future development (outside of this development application), are also to be conveyed to the SWM pond. Post-development drainage areas that were used for modelling are shown on **Drawing STM-2.** Post-development flows for the 2-year to 100-year storms, as well as the Regional storm event, will be controlled to the pre-development flows of the site. The proposed pond has been sized to provide regional control onsite, including conservatively assume that all storage below the 100-year event is full. As such, no impacts to downstream flooding are expected.

The pond will outlet to the Sixteen Mile Creek via a 1500 mm concrete box culvert. Due to the height of the valley in this location, the outlet will be constructed using trenchless methodology to ensure no negative impacts to the intervening NHS lands, including the valley wall. The location of the outfall was coordinated with Beacon Environmental to determine the most appropriate location, from both an engineering and ecological perspective. From an engineering perspective, the outlet needs to be from the furthermost extent of the wet cell and the goal was to achieve the shortest possible distance (pipe length) between the pond and the creek to minimize the amount of infrastructure. The location of the headwall was selected in order to reduce the extent of impact on the wetland that is located at the base of the valley wall.

Additional details with respect to the ecological considerations can be found in the Scoped Environmental Impact Study (Beacon, 2025). Refer to **Drawing STM-2** for details with respect to the size and location of the outlet. The specific details of the outlet structure will be determined during the detailed design process.

A 24-hour Chicago storm distribution based on the Town of Milton IDF parameters was utilized as the design storm. Regional storm storage was calculated using AMCIII conditions and

assuming that storage up to the 100-year event is full. **Table 2** summarizes the flow and storage values required based on the VO6 model.

Table 2: Flow and Required Storage Volume Results

Storm Event	Pre-development Target Flow m^3/s	Post Development Flows m^3/s	Required Volume (m^3)	Pond Elevation (m)
Extended Detention	-	0.02	1,773	202.1
2	1.54	1.53	3,354	202.3
5	2.27	2.24	4,187	202.4
10	2.74	2.69	4,708	202.47
25	3.13	3.01	4,845	202.49
50	3.82	3.77	5,559	202.6
100	4.30	4.26	5,927	202.7
Regional (Hazel)	2.14	2.14	4,105*	203.2

*Required active storage in addition to the 100-year required storage.

Therefore, the pond has been adequately sized to provide the required quantity control up to and including the Regional Storm. Refer to the SWM calculations and VO6 model output provided in **Appendix B** and **Drawing STM-3**.

4.6. Emergency Outlet Design

The pond has been designed to release emergency flows at an elevation of 204.80 m. The emergency spillway characteristics are shown in the **Table 3.**

Table 3: Emergency Outlet Design

Design Element	Post Development
Spillway Invert	204.70 m
Max. spillway water level	205.00 m
Bottom Width; Side Slopes	30 m; 12:1
Storm Event for Spillway Conveyance	100-Year Post-Development uncontrolled
Flow Capacity Required	7.63 m^3/s
Flow Capacity Provided	8.28 m^3/s

4.7. Retaining Wall

Site planning and grading constraints necessitate a retaining wall around a section of the stormwater management pond. While the pond is optimally located the site's lowest point and closest to the outlet to Sixteen Mile Creek, Street D's alignment with Caves Avenue restricts the ability to widen the pond block to meet the storage requirements while following the pond grading criteria for side slopes, etc. The retaining wall as shown on Drawing STM-3 improves the usable storage of the pond in the allowable space. The retaining wall bottom elevation is situated above the Regional and emergency high water levels in the pond and proper maintenance access to the forebay and all pond inlet and outlet structures are provided despite the wall. Structural design information for the retaining walls will be coordinated at the detailed design stage.

4.8. Outlet Construction

The outlet to Sixteen Mile Creek from the proposed stormwater management facility will be installed primarily via trenchless methodology (i.e. microtunneling or jack and bore) to prevent disturbance to the existing woodlot. The outlet headwall will be designed to coincide with the meander belt elevation of the Sixteen Mile Creek wetland complex with appropriate erosion protection (i.e. stone core wetland / spillway). Delivery of materials and equipment for construction of the headwall and spillway within the valley will be completed to the maximum extent possible from within the new pipe (oversized diameter); however, surface access for construction personnel will likely be required separate from the pipe. It is anticipated that temporary surface access (on-foot) for workers can be obtained through the woodlot or existing abandoned corridor adjacent to the site for these purposes. These details will be advanced through detailed design.

4.9. Water Balance and Low Impact Development

In accordance with the Town of Milton's requirements, the first 27 mm of runoff from the proposed development must be retained onsite. The design of the infiltration-based LIDs is subject to the determination of onsite percolation rates and the proximity to groundwater. Infiltration design may be precluded, as it relates to insufficient drawdown times and groundwater interference. If infiltration design is precluded, it is recommended that the water balance only rely on passive measures and that filtration will be incorporated on a best efforts basis.

Table 4 below outlines measures that are suitable for residential land use.

Table 4: LID Measures

LID BMP	Residential Uses	Notes
Rainwater Harvesting	✓	Source control for groundwater recharge if used for irrigation.
Downspout Disconnection	✓	Can enhance groundwater recharge for the townhouse units when used in conjunction with topsoil amendments.

Pits/Infiltration Chambers	✓	Variable source control designs are available for groundwater recharge. *May not be feasible on residential properties due to maintenance issues
Bioretention	✓	Prioritized for employment uses *May not be feasible due to maintenance issues. May take the form of small residential gardens. The Town of Milton does not support ponding/storage in rear lots.
Permeable Pavement	✓	Best used to provide treatment for large parking surfaces associated with employment land uses. May also be used for residential driveways.
Grassed Swales	✓	Conveyance LID BMP to be located on continuous strips of green space.
Additional Topsoil	✓	Minimum 200 mm of topsoil depth in all landscape areas can enhance groundwater recharge and water balance.
Rear Yard Infiltration Trenches/Swales	✓	Rear yard drainage swale with 150mm topsoil granular storage media and perforated underdrain.

5. WASTEWATER SERVICING

5.1. Proposed Sanitary Servicing Strategy

Wastewater from the 150 Steeles Avenue development is proposed to drain from north to south through a network of pipes ranging in size from 200 mm to 450 mm in diameter along Street A, Street E, and Street D.

Flow conveyance will continue external to the site through a new 450 mm sewer along Martin Street from Street D (MH39A) to Woodward Avenue (MH41A), and a new 450 mm sewer along Woodward Avenue from MH41A eastward to the Region's 1050 mm trunk sewer. The existing 250 mm service on Martin Street and 200 mm service on Woodward Avenue are proposed to remain in place as service lateral connections to the new 450 mm sewer would not be permissible under Regional standards.

It is important to note that the sanitary design includes provision for future development of high-density built form on non-participating lands to the east (ex. Honda Lands at 170 Steeles Avenue East). This ensures the Region has an accurate representation of long-term servicing needs and an inclusive overall servicing plan that does not exclude adjacent properties.

Downstream, the Region's 1050 mm trunk sewer conveys flows south to the Fulton Wastewater Pump Station and then to the Boyne Trunk Sewer along Regional Road 25. This trunk serves as the primary wastewater conveyance system for Milton, ultimately directing flows to the Mid-Halton Wastewater Treatment Plant in Oakville.

For details on the site servicing layout and drainage areas, refer to **Drawing SAN-1.** Sanitary sewer design sheets are provided **in Appendix C**. Wastewater infrastructure will be designed in accordance with the Region of Halton's standards and specifications.

5.2. Estimated Wastewater Generation

The future sanitary generation rate for the 150 Steeles Avenue site has been calculated using the following information:

- Site statistics / land use, including unit counts and housing type (where available).
- Region of Halton Built Boundary Housing Occupancy Rates (per the 2022 DC Background Study, Table A-4).
- Region of Halton Water and Wastewater Linear Design Criteria (per capita generation rate, average day demand, peaking factor, and inflow / infiltration rate), as outlined in the 2025 Linear Design Manual.

The total wastewater generation rate projected for the site is as follows, with supporting calculations available in **Appendix C** (sanitary design sheet).

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- Population (150 Steeles Avenue): 8,280 ppl
- Population (170 Steeles Avenue): 2,280 ppl
- Total Population: 10,560 ppl

- Avg. Domestic Per Capita Flow: 215 LPCD
- Peaking Factor (Modified Harmon): 2.93
- Inflow / Infiltration: 4.8 L/s
- Peak Wet Weather Flow: 81.8 L/s

5.3. Wastewater System Capacity

The 150 Steeles Avenue site is located within the Town of Milton Built-Boundary area. In a March 25, 2024 Town of Milton report to Council, regarding the Region of Halton's proposed Allocation Program, the Town of Milton confirmed the following:

- The Town of Milton has been allocated water and wastewater servicing capacity for the equivalent of 12,816 housing units through 2031 to meet their housing pledge. These units can proceed without requiring major upgrades to the Region's water or wastewater system.

- Of these 12,816 units, approximately 3,072 units are currently reserved for Milton's Built Boundary area.

- The Town of Milton controls the distribution of allocated servicing capacity and can reallocate it based on monitoring, development applications received, and evolving needs.

- Development beyond the allocated total of 12,816 will depend on the completion of large-scale Regional water and wastewater capital projects. For the 150 Steeles Avenue property, this includes the expansion of the Mid-Halton Wastewater Treatment Plant, which is anticipated to be complete in the 2030 timeframe. The Region has no other trunk sewer or wastewater pump station upgrade projects planned before 2031 that would impact the 150 Steeles Avenue site.

Based on these factors, it is assumed that sufficient wastewater capacity exists in the Region's downstream sanitary sewer network to support initial growth in the 150 Steeles Avenue site through 2031, with the remainder of the site proceeding immediately after the completion of the treatment plant expansion. Servicing capacity for the development can be further discussed with the Town of Milton as planning proceeds.

In addition, the Region of Halton is currently updating its 2011 Master Servicing Plan, which will define the servicing strategy and system upgrades needed to support growth across the Region through 2051. This update is ongoing, with completion anticipated in winter 2025.

Preliminary findings, presented in January 2025, indicate the potential need for an upgrade project at the downstream Fulton Wastewater Pump Station, planned for the 2041 time horizon,

to support growth within the Milton Built Boundary (including the 150 Steeles Avenue site as well as the broader Milton Major Transit Station Area (MTSA)).

As planning progresses, growth projections for the 150 Steeles Avenue site can be incorporated into the Region's wastewater hydraulic model to confirm capacity availability ahead of the pump station expansion, ensuring sufficient servicing for full site build-out

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6. WATER SERVICING

6.1. Proposed Water Servicing Strategy

The 150 Steeles Avenue development is proposed to connect to the Milton groundwater-based distribution system via the existing 300 mm Zone M5G watermains on Steeles Avenue and on Martin Street. A series of local 200 mm and 300 mm watermains are proposed internal to the development to provide service connections, as well as looping and redundancy for the system. Connections to existing infrastructure are proposed at:

- Steeles Avenue and Street A
- Steeles Avenue and Street B
- Martin Street and Street A
- Martin Street and Street D

New water chambers are proposed at each new connection location.

For details on the watermain layout and proposed connection locations, refer to **Drawing WM-1.** Water infrastructure will be designed in accordance with the Region of Halton's standards and specifications.

6.2. Estimated Water Demand

Proposed domestic water demand for the 150 Steeles Avenue site has been calculated using the following information:

- Site statistics / land use, including unit counts and housing type (where available).
- Region of Halton Built Boundary Housing Occupancy Rates (per the 2022 DC Background Study, Table A-4).
- Region of Halton Water and Wastewater Linear Design Criteria (per capita generation rate, average day demand, peaking factor, and inflow / infiltration rate), as outlined in the 2025 Linear Design Manual.

The domestic water demand projected for the site is as follows:

- Population (150 Steeles Avenue): 8,280 ppl
- Population (170 Steeles Avenue): 2,280 ppl
- Total Population: 10,560 ppl

- Avg. Domestic Per Capita Flow: 265 LPCD
- Average Day Demand: 32.4 L/s
- Max Day Demand: 51.8 L/s
- Max Hour Demand: 97.2 L/s

Fire flow will be estimated at the site plan stage using the Fire Underwriters Survey (2020) methodology when additional information is available regarding built-form, construction type, building use and sprinkler installations. Per Regional criteria, the water system will be designed for the higher of Max Hour or Max Day + Fire Flow.

Hydraulic modelling and hydrant testing will be undertaken to confirm flow and pressure.

6.3. Water System Capacity

Similar to the wastewater discussion in Section 5.3, the Town of Milton has the ability to allocate water servicing capacity to built-boundary developments in accordance with Regional servicing capacity constraints through 2031.

However, unlike wastewater, water capacity for the 150 Steeles Avenue site is not dependent on large-scale Regional water infrastructure projects, as the site is serviced by the local groundwater-based system.

The available capacity at the Kelso wellfield is finite, with no planned expansion of either the wellfield or the Kelso Water Treatment Plant. As growth continues in Milton's core, the Region plans to transition some areas from groundwater to lake-based water service to maintain an acceptable draw from the Kelso wellfields. While the timing and location of this transition remains unknown, given its proximity to existing groundwater services on Steeles Avenue and Martin Street, it is currently assumed that the 150 Steeles Avenue site will remain on groundwater long-term.

As a result, the site does not rely on broader system-wide expansions or upgrades to the Regional lake-based water system, and can proceed at any time from a water servicing perspective.

Additional details may emerge as the Region finalizes its Master Servicing Plan update. It is recommended that hydraulic modeling be conducted at the next stage of planning to confirm flow and pressure within the development site.

7. EROSION AND SEDIMENT CONTROL

Erosion and sediment controls will be implemented during all site construction works including topsoil stripping, bulk earthworks, foundation excavation, site servicing and stockpiling of materials and will conform to ESC guidelines (2019 STEP/TRCA). These measures will include:

1. Installing heavy duty silt control fencing along the perimeter of the site at strategic locations.
2. Installing a temporary mud mat at the construction site entrance.
3. Wrapping the tops of all inlet structures with filter fabric and using install silt sacks.
4. Inspecting all sediment and erosion control controls to maintain them in good repair until such time as the Engineer or the Town approves their removal.

If required, site-specific measures will be determined during the detailed design / site alteration application stage.

8. MONITORING

The below sections outline the general monitoring requirements for the proposed SWM pond, a operation and maintenance manual will be provided for the facility during detailed design.

Construction Phase

All maintenance activities during the construction phase are the responsibility of the developer. Sediment and erosion control measures for the construction of the SWM facility must be in accordance with the approved engineering drawings to prevent sediment-laden drainage from discharging directly into the adjacent creek.

Prior to Assumption

Typical municipal design criteria recommend that prior to assumption, the municipality requires that the developer engage a professional engineer to carry out regular inspections, monitoring and performance assessment of the SWM facility for a period of two years after preliminary acceptance or until final acceptance of the pond by the municipality, whichever is greater.

If requested by the Town, an “Inspection and Monitoring Report” shall be submitted by the developer annually for two years, or until assumption, in order to monitor and evaluate the pond’s performance. Regular cleaning of the SWM pond shall be completed by the owner at the recommendation of the annual report, or at the discretion of the Town.

Prior to final acceptance of the SWM pond by the Town, sediment shall be removed and discarded off-site, and all deficiencies, repair works and planting restorations must be completed by the owner to the satisfaction of the Town.

Operations and Maintenance After Assumption

After assumption of the SWM pond by the Town, it is recommended that the inspection and maintenance procedures detailed in the operation and maintenance report. The maintenance frequency of the SWM facility will be determined based on the results of regular inspections.

9. CONCLUSIONS

This report has demonstrated that:

- The proposed site can be graded to match to existing elevations at all property lines while generally adhering to Town of Milton grading standards and specifications.
- Storm sewers are generally sized based on the 5-year Town IDF parameters. 100-year capture is assumed for external flows.
- Water quality, quantity and erosion control targets outlined by the Town of Milton standards are accomplished in the proposed SWM pond.
- Water balance requirements are achieved through passive and engineered Low Impact Development measures within the developed, which will be quantified as the design advances.
- Wastewater servicing to the site will be provided by upgrading the existing sanitary sewer within Martin Street.
- Water servicing to the site will be provided via two new water connections to the existing watermain on Steeles Avenue and two new water connections to the existing watermain on Martin Street.
- Erosion and sediment control measures will be implemented during all construction works and will be maintained and inspected regularly.

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APPENDIX A

Comprehensive Environmental Management Study

BEACON ENVIRONMENTAL

GUIDING SOLUTIONS IN THE NATURAL ENVIRONMENT

Comprehensive Environmental Management Study

150 Steeles Avenue East, Milton

Prepared For:

Neatt Communities

Prepared By:

Beacon Environmental Limited
DS Consultants Ltd.
Jennifer Lawrence and Associates Inc.
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1. Introduction

This Comprehensive Environmental Management Study (CEMS) has been prepared in response to a request by the Town of Milton (Town), Region of Halton (Region) and Conservation Halton (CH) to demonstrate how natural heritage features and natural hazards associated with the Subject Property may be affected and managed during contamination remediation works.

Terms of Reference (ToR) for this CEMS were prepared based on a Draft Scope of Work that was provided by CH on July 8, 2022, and incorporates comments received from the Town on August 12, 2022. The ToR were approved by the agencies in December 2022 and are included in **Appendix A-1**.

This CEMS includes a detailed characterization of the existing biophysical site conditions, including natural heritage features, natural hazards and the anticipated extent of site contamination. The limits of the Regional Natural Heritage System (RNHS) were also refined by evaluating the significance of natural heritage features, verifying and staking feature limits with agencies, and undertaking technical assessments of natural hazards. The status and extent of remediation works and the potential impacts to Key Features are described, and RNHS components and functions are assessed, and mitigation measures prescribed. Additionally, the CEMS identifies opportunities for enhancing the condition and quality of Key Features to increase biological diversity and improve ecological resiliency over the long-term.

While the primary purpose of the CEMS is to address potential impacts related to site remediation, the study also refines the limits of the RNHS, which can be used to support the rezoning application. This has been achieved by recommending ecologically appropriate buffers to Key Features of the RNHS based on the anticipation of adjacent high density residential development in the future and the need to mitigate associated impacts related to the future change in land use in order to ensure no negative impacts to the RNHS

It is anticipated that, as part of a future development application for the adjacent lands, additional reports may be required that detail how the management recommendations of this CEMS (i.e., development limits, buffers, water supply to natural features, if necessary, etc.) have been incorporated into the site design.

The following definitions are used in this report, and are based on the International Restoration Standards (2nd ed.) by the Society for Ecological Restoration (Gann et al, 2019):

Remediation means “a management activity, such as the removal or detoxification of contaminates or excess nutrients from soil and water, that aims to remove sources of degradation”.

Restoration means “the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed” which “addresses biodiversity conservation and ecological integrity”.

1.1 Site Location and Study Area

The Subject Property, at 150 Steeles Avenue East, is 20.3 hectares (ha) in area and is located south of Steeles Avenue East, north of the Canadian Pacific Railway, and east of the Sixteen Mile Creek valleylands (**Figure 1.1**).

The Study Area for the CEMS includes the Subject Property and adjacent lands within 120 metres (m) as shown on **Figure 1.1**. The Sixteen Mile Creek valleylands, as well as a portion of the tablelands, are mapped and designated as Regional Natural Heritage System (RNHS) by the Region of Halton and portions are designated Natural Heritage System (NHS) by the Town (**Figure 1.2**).

1.2 Site History

Prior to the more recent industrial uses on the site, the entire tableland portion of the Subject Property was used for agriculture for well over a century. In 1954, an industrial manufacturing facility was constructed on the Subject Property. Over the life span of the manufacturing facility there were several additions completed in 1957, 1965, 1973, 1988, 1994, 1998 and 1999. The building was originally tooled to manufacture automobile bumpers, which included a chrome plating process. In the 1970's, the manufacturing facility was re-tooled and continually expanded to manufacture suspension springs for major car manufacturers. At full operational status, the manufacturing facility had 8 operational lines.

In conjunction with the manufacturing facility, an unregulated landfill was created on the Subject Property in the early 1970's. The landfill is situated south of the former industrial building and was used to dump waste material from the manufacturing process including mill scale, steel shot, brick and construction debris. The landfill was eventually capped in the late 1980's/early 1990's.

The manufacturing facility uses and landfill have resulted in various areas and types of contamination on the Subject Property, as described later in this report.

Major manufacturing operations on the Subject Property were discontinued in 2009 at which point, the factory was transitioned to general warehousing and storage, utilizing about 30% of the 300,000 sq. ft. building. The remainder of the building and Subject Property remained vacant / un-used.

The Subject Property was purchased by 150 Steeles Milton Inc. on April 7, 2021, from the Meritor Suspension Systems Company, Canada (MSSC). As part of the purchase process, environmental testing was completed which identified significant plumes/areas of contamination on the Subject Property related to the previous manufacturing uses in the factory. 150 Steeles Milton Inc. has committed to remediating the contaminated soils and groundwater found on site. The remediation program will support the approved land use designation change from Employment to a more sensitive land use of Mixed-Use. The remedial activities will also provide additional benefit to existing residential homes within close proximity to the Subject Property.

The manufacturing facility was demolished in late 2021 and remediation activities commenced in 2022 following the building demolition. For the purposes of completing a Record of Site Condition (RSC) in phases, the Subject Property has been subdivided into six RSC areas / properties (**Figure 1.3**).

1.3 Study Team

The Study Team consists of an interdisciplinary team to address the natural heritage, natural hazard and site contamination aspects of this project and includes:

- Beacon Environmental – natural heritage and report coordination;
- Jennifer Lawrence and Associates Inc. – environmental planning, report and project coordination;
- Urbantech Consulting – water resources engineering and flood plain delineation; and
- DS Consultants – hydrogeology, geology, slope stability and site contamination.

1.4 Environmental Regulatory Framework

The approved ToR for the CEMS requires a summary of applicable environmental legislation, regulations and policies to ensure that all applicable policy components of the relevant legislation are addressed by this study. The following subsections provide an overview of key legislation, regulations and policies that apply to the remediation work. While the remediation works are occurring independently of any applications being made under the *Planning Act*, it is understood that one of the objectives of the CEMS is to identify the future limits of the RNHS which requires interpretation of provincial, regional and local land use planning policies. For these reasons, relevant policy excerpts from land use planning documents have also been included as part of this summary. The approved Terms of Reference (ToR) for this CEMS was developed to ensure that all applicable policy components of relevant legislation are addressed by this study.

This report characterizes the natural heritage resources, natural hazards, man-made hazards and surface and ground water features as required by the Provincial Policy Statement (PPS), the Region of Halton Official Plan (ROP) and the Town of Milton Official Plan (MOP). This includes all Key Features and components of the RNHS as per Section 115 of the ROP as well as areas regulated by CH under Ontario Regulation 162/06. This report also provides details with respect to the contaminants on the Subject Property and the proposed method for remediating these lands.

1.4.1 Federal Fisheries Act and Ontario Fishery Regulations

The purpose of the federal *Fisheries Act* and the Ontario Fishery Regulations (SOR/2007-237) is to ensure the conservation and protection of fish and fish habitat. Sixteen Mile Creek, that traverses a portion of the Subject Property, is frequented by fish. Activities taking place in or near water may adversely affect fish or fish habitat. DFO recommends that proponents of these activities should undergo the following:

- Understand the types of impacts their projects are likely to cause;
- Take measures to avoid and mitigate impacts to the extent possible; and
- Request authorization from the Minister and abide by the conditions of any such authorization, when it is not possible to avoid and mitigate impacts of projects that are likely to cause serious harm to fish.

It should also be noted that terrestrial crayfish species are regulated under the *Fisheries Act* and Ontario Fishery Regulations. The following sections of the *Fisheries Act* and Ontario Fisheries Regulations may apply:

> *29(4) no person shall transport crayfish overland except under a licence to collect fish for scientific purposes issued under the Fish and Wildlife Conservation Act, 1997*
> *34.4(1) No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.*

Such licences are administered provincially, by the Ministry of Natural Resources and Forestry (MNRF).

1.4.2 Migratory Birds Convention Act

The purpose of the federal *Migratory Birds Convention Act* is to protect listed migratory bird species and their nests. To comply with this legislation, activities that can potentially impact breeding birds must be avoided. Compliance with the Act should be demonstrated prior to commencing site preparation, earthworks, and construction.

1.4.3 Species at Risk Act

The purpose of the federal *Species at Risk Act* is to ensure the conservation and protection of federally listed species at risk. Federal jurisdiction typically applies to federal lands and watercourses; therefore, this legislation may only apply to Sixteen Mile Creek on the Subject Property.

1.4.4 Environmental Protection Act

The filing of a Record of Site Condition (RSC) is required in accordance with the *Environmental Protection Act* and Ontario Regulation 153/04 for the proposed change in land use from legacy industrial to future residential. Similarly, the filing of an RSC will also be required for lands contained within the RNHS, that were previously industrial but are proposed to be future publicly owned greenspace.

The RSC filing requires the completion of Environmental Site Assessment reports, or any other reports on the presence of a contaminant on, in or under the Subject Property or the existence of an area of potential environmental concern. In the event that contamination is identified, it must be remediated to meet the applicable site condition standards.

1.4.5 Fish and Wildlife Conservation Act

The *Fish and Wildlife Conservation Act* enables the MNRF to provide sound management of the province's fish and wildlife. The Act provides general prohibitions on the capture or harassment of game wildlife and specially protected wildlife, including mammals, birds, bird nests, reptiles, invertebrates, and amphibians. Section 39 of the Act allows MNRF to issue an authorization to capture, kill or possess wildlife for scientific purposes, including rescue of wildlife.

1.4.6 Endangered Species Act

Clause 9(1)(a) of the *Endangered Species Act* (ESA) prohibits the killing, harming, harassment, capture, or take of an extirpated, endangered or threatened species, except where regulations allow. Subsection 10(a) of the ESA prohibits the damage or destruction of the habitat of extirpated, endangered, or threatened species.

Section 23.18 of the general regulation of the ESA (Ontario Regulation 242/08) provides an exemption to clause 9(1)(a) and subsection 10(1) of the ESA for "work undertaken" … "to remove or clean an area that has been contaminated or polluted". Subsection 23.18(5) provides requirements to meet this exemption, such as:

- Giving the Minister of the Ministry of Environment, Conservation and Parks (MECP) notice of activity;
- Preparation of a mitigation plan and carrying out the work in accordance with this mitigation plan;
- Take reasonable steps to minimize adverse effects to the endangered or threatened species and habitat; and
- If a person observes a species identified in the notice of activity during the works, the person must complete a Species at Risk Observation Reporting Form within three months of the observation.

1.4.7 Provincial Policy Statement

Section 2.0 of the PPS (Wise Use and Management of Resources) provides policy direction related to natural heritage and water, that are applicable to the Subject Property. Specifically, Section 2.1 (Natural Heritage) provides for the following:

2.1.1 Natural features and areas shall be protected for the long term.

2.1.2 The diversity and connectivity of natural features in an area, and the long-term ecological function and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and ground water features.

2.1.3 Natural heritage systems shall be identified in Ecoregions 6E & 7E, recognizing that natural heritage systems will vary in size and form in settlement areas, rural areas and prime agricultural areas.

2.1.4 Development and site alteration shall not be permitted in:

a) significant wetlands in Ecoregions 5E, 6E and 7E, and

b) significant coastal wetlands.

2.1.5 Development and site alteration shall not be permitted in:

a) significant wetlands in the Canadian Shield north of Ecoregions 5E, 6E and 7E;

b) significant woodlands in Ecoregions 6E and 7E (excluding islands in Lake Huron and the St. Marys River);

c) significant valleylands in Ecoregions 6E and 7E (excluding islands in Lake Huron and the St. Marys River);

d) significant wildlife habitat;

e) significant areas of natural and scientific interest; and,
f) coastal wetlands in Ecoregions 5E, 6E and 7E that are not subject to policy 2.1.4b)

Unless it has been demonstrated that there will be no negative impacts on the natural features or their ecological functions.

2.1.6 Development and site alteration shall not be permitted in fish habitat except in accordance with provincial and federal requirements.

2.1.7 Development and site alteration shall not be permitted in habitat of endangered species and threatened species, except in accordance with provincial and federal requirements.

2.1.8 Development and site alteration shall not be permitted on adjacent lands to the natural heritage features and areas identified in policies 2.1.4, 2.1.5, and 2.1.6 unless the ecological function of the adjacent lands has been evaluated and it has been demonstrated that there will be no negative impacts on the natural features or on their ecological functions.

Section 2.2.1 of the PPS addresses policies related to water. Specifically, this section requires that planning authorities shall protect, improve or restore the quality and quantity of water by:

a) using the watershed as the ecologically meaningful scale for integrated and long-term planning, which can be a foundation for considering cumulative impacts of development;
b) minimizing potential negative impacts, including cross-jurisdictional and cross-watershed impacts;
c) evaluating and preparing for the impacts of a changing climate to water resource systems at the watershed level;
d) identifying water resource systems consisting of ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas, which are necessary for the ecological and hydrological integrity of the watershed;
e) maintaining linkages and related functions among ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas;
f) implementing necessary restrictions on development and site alteration to:
    a. protect all municipal drinking water supplies and designated vulnerable areas;
    b. protect, improve or restore vulnerable surface and ground water, sensitive surface water features and sensitive ground water features, and their hydrologic functions.
g) planning for efficient and sustainable use of water resources, through practices for water conservation and sustaining water quality;
h) ensuring consideration of environmental lake capacity, where applicable; and
i) ensuring stormwater management practices minimize stormwater volumes and contaminant loads, and maintain or increase the extent of vegetative and impervious surfaces.

Section 2.2.2 of the PPS notes that:

> *Development and site alteration shall be restricted in or near sensitive surface water features and sensitive ground water features such that these features and their related hydrologic functions will be protected, improved or restored. Mitigative measures and/or alternative development approaches may be required in order to protect, improve or restore sensitive surface water features, sensitive ground water features, and their hydrologic functions.*

In addition to the above, Section 3.0 of the PPS (Protecting Public Health and Safety) also contains policies that are applicable to the CEMS. Specifically, Policy 3.1 (Natural Hazards) and 3.2 (Human-Made Hazards). The relevant portions of these policies, to this study, are provided below.

Policy 3.1.1 states the following:

> *Development shall generally be directed, in accordance with guidance developed by the Province (as amended from time to time), to areas outside of:*
> *a) hazardous lands adjacent to the shorelines of the Great Lakes-St. Lawrence River System and large inland lakes which are impacted by flooding hazards, erosion hazards and/or dynamic beach hazards;*
> *b) hazardous lands adjacent to river, stream and small inland lake systems which are impacted by flooding hazards and/or erosion hazards; and,*
> *c) hazardous sites.*

Subsection 3.3.2 states the following:

> *Sites with contaminants in land or water shall be assessed and remediated as necessary prior to any activity on the site associated with the proposed use such that there will be no adverse effects.*

1.4.8 Greenbelt Plan

The Greenbelt Plan identifies the Sixteen Mile Creek valley as an Urban River Valley (**Figure 1.2**) however, the policies only apply to those portions of a valley that are in public ownership. A portion of the valley is owned by the Town (see **Figure 1.4**). As such, the following Urban River Valley policies are applicable to the Town-owned portion of the valley:

> *6.2.1 Only publicly owned lands are subject to the policies of the Urban River Valley designation. Any privately owned lands within the boundary of the Urban River Valley area are not subject to the policies of this designation. For the purposes of this section, publicly owned lands means lands in the ownership of the Province, a municipality or a local board, including a conservation authority.*
> *6.2.2 The lands are governed by the applicable official plan policies provided they have regard to the objectives of the Greenbelt Plan.*
> *6.2.4 The Protected Countryside policies to not apply except for:*
> *a) The policies of section 3.2.6; and*
> *b) The policies of section 3.3.*

The relevant policies of Section 3.2.6 (mentioned in Policy 6.2.4 above) are as follows:

3.2.6.1 To support the connections between the Greenbelt's Natural System and the local, regional and broader scale natural heritage systems of southern Ontario … the federal government, municipalities, conservation authorities, other agencies and stakeholders should:

- *a) Consider how activities and land use change both within and abutting the Greenbelt relate to the areas of external connections and Urban River Valley areas identified in this Plan;*
- *b) Promote and undertake appropriate planning and design to ensure that external connections and Urban River Valley areas are maintained and/or enhanced*

3.2.6.2 The river valleys that run through existing or approved urban areas and connect the Greenbelt to inland lakes and the Great Lakes, including areas designated as Urban River Valley, are a key component of the long-term health of the Natural System. In recognition of the function of the urban river valleys, municipalities and conservation authorities should:

- *b) In considering land conversions or redevelopments in or abutting an urban river valley, strive for planning approaches that:*
  - *a. Establish or increase the extent or width of vegetation protection zones in natural self-sustaining vegetation, especially in the most ecologically sensitive areas (i.e., near the stream and below the stable top of bank);*
  - *b. Increase or improve fish habitat in streams and in the adjacent riparian lands;*
  - *c. Include landscaping and habitat restoration that increase the ability of native plants and animals to use valley systems as both wildlife habitat and movement corridors; and*
  - *d. Seek to avoid or, if avoidance is not possible, minimize and mitigate adverse impacts associated with the quality and quantity of urban runoff into the valley systems*

Policies within Section 3.3 (Parkland, Open Space and Trails), which is also mentioned in Policy 6.2.4, are related to encouraging the creation of trails and trail planning to provide for accessible recreation opportunities.

1.4.9 Region of Halton Official Plan

The ROP contains policies related to the protection, conservation and enhancement of the natural heritage system, management of natural hazards and requirements related to redevelopment and soil contamination. The latest amendment to the ROP is Region of Halton Official Plan Amendment (ROPA) 49, which was adopted by Regional Council on June 15, 2022. The previous amendment (ROPA 48) was approved by the Ministry of Affairs and Housing on November 10, 2021. Relevant policies reflected in both ROPA 48 and ROPA 49 are outlined below:

Natural Heritage System

115.3 The Regional Natural Heritage System is a systems approach to protecting and enhancing natural features and functions and is scientifically structured on the basis of the following components:

1. *Key Features, which include:*
   - *a)significant habitat of endangered and threatened species,*
   - *b)significant wetlands,*
   - *c)significant coastal wetlands,*
   - *d)significant woodlands,*
   - *e)significant valleylands,*
   - *f) significant wildlife habitat,*
   - *g) significant areas of natural and scientific interest,*
   - *h) fish habitat,*
2. *Key Features that have been identified are shown on Map 1G.*
3. *enhancements to the Key Features including Centres for Biodiversity,*
4. *linkages,*
5. *buffers,*
6. *watercourses that are within a Conservation Authority Regulation Limit or that provide a linkage to a wetland or a significant woodland, and*
7. *wetlands other than those considered significant under Section 115.3(1)b).*

115.4. Included within the Regional Natural Heritage System are:

2. *Regulated Flood Plains as determined, mapped and refined from time to time by the appropriate Conservation Authority.*

116.1 The boundaries of the Regional Natural Heritage System may be refined, with additions, deletions and/or boundary adjustments, through:

- *a) a Sub-watershed Study accepted by the Region and undertaken in the context of an Area-Specific Plan;*
- *b) an individual Environmental Impact Assessment accepted by the Region, as required by this Plan; or*
- *c) similar studies based on terms of reference accepted by the Region.*

Once approved through an approval process under the Planning Act, these refinements are in effect on the date of such approval. The Region will maintain mapping showing such refinements and incorporate them as part of the Region's statutory review of its Official Plan.

118.2 Apply a systems based approach to implementing the Regional Natural Heritage System by:

- *a) Prohibiting development and site alteration within significant wetlands, significant coastal wetlands, significant habitat of endangered and threatened species and fish habitat except in accordance with Provincial and Federal legislation or regulations;*
- *b) Not permitting the alteration of any components of the Regional Natural Heritage System unless it has been demonstrated that there will be no negative impacts on the natural features and areas or their ecological functions; in applying this policy, agricultural operations are considered as compatible and*

complementary uses in those parts of the Regional Natural Heritage System under the Agricultural System and are supported and promoted in accordance with policies of this Plan

c) Refining the boundaries of the Regional Natural Heritage System in accordance with Section 116.1; and

d) Introducing such refinements at an early stage of the development or site alteration application process and in the broadest available context so that there is greater flexibility to enhance the ecological functions of all components of the system and hence improve the long-term sustainability of the system as a whole.

118.3 Require the proponent of any development or site alteration that meets the criteria set out in Section 118(3.1) to carry out an Environmental Impact Assessment (EIA). The purpose of an EIA is to demonstrate that the proposed development or site alteration will result in no negative impacts to that portion of the Regional Natural Heritage System or unmapped Key Features affected by the development or site alteration by identifying components of the Regional Natural Heritage System as listed in Section 115.3 and their associated ecological functions and assessing the potential environmental impacts, requirements for impact avoidance and mitigation measures, and opportunities for enhancement. The EIA, shall, as a first step, identify Key Features on or near the subject site that are not mapped on Map 1G.

Natural Hazards

There are several policies within the ROP related to the management of natural hazards and the protection of life and property including:

118.11. Require that Local Zoning By-laws prohibit new construction and the expansion or replacement of existing non-conforming uses within hazard lands…

118.12. Require that Local Zoning By-laws impose for development appropriate setbacks from Regulated Flood Plains, based on the kind, extent and severity of existing and potential hazard to public safety…

118.13. Encourage the Local Municipalities to adopt a One-Zone Concept whereby new development in the Flood Plains, defined by the regulatory flood standard, is to be prohibited or restricted.

118.14. Encourage the Local Municipalities to:

a) acquire public open space on tableland adjacent to watercourses and along the waterfront within the Urban Area.

The preliminary RNHS limit, based on ROP Maps 1 and 1G, is shown on **Figure 1.2**.

Contaminated Sites

Section 146 (Land) outlines the Region's objectives, including those related to contaminated sites. Specifically, Policy 146.11 states that it is the Region's objective "To ensure that development takes place on sites that are safe from soil contamination."

Section 147 outlines the Region's policies related to contaminated sites including:

> *147.17 Require that, prior to the Region or Local Municipality considering any development proposals, the proponent undertake a process in accordance with the Region's Guidelines (Protocol) for Reviewing Development Applications with Respect to Contaminated or Potentially Contaminated Sites and any applicable Provincial legislation, regulations and guidelines to determine whether there is any potential contamination on the site and the steps necessary to bring the site to a condition suitable for its intended use.*
>
> *147.18 Consider approval for development proposals only when the development site complies with Provincial guidelines, Regional standards and other requirements regarding soil and groundwater quality.*

1.4.10 Town of Milton Official Plan

The MOP contains policies related to the protection, conservation and enhancement of the natural heritage system, management of natural hazards and requirements related to redevelopment and soil contamination. Official Plan Amendment 31 (OPA 31) was endorsed by the Town on June 14, 2010, and approved by the Region on November 22, 2018. The Subject Property is within the Milton 401 Industrial / Business Park Secondary Plan Area (Schedule C.2.A) and the valleylands are generally designated as Natural Heritage System (Schedule 2 of the OPA)). This Natural Heritage System designation is intended to encourage the protection, maintenance and enhancement of significant natural features and areas and, according to Policy 4.8.1.2 of the MOP, includes flood plains, Provincially Significant Wetlands, significant valleylands and significant habitat of endangered and threatened species.

Relevant MOP policies related to natural heritage, natural hazards and site contamination are outlined below:

Natural Heritage

Policy 2.2.3.4 defines the components of the Regional NHS and reflects ROP policy 115.3.

Policy 4.9.3.1 provides mechanisms for application of the RNHS and reflects ROP policy 118(2). Policy 4.9.3.1(a) prohibits development and site alteration within significant wetlands, significant habitat of endangered and threatened species, and fish habitat except in accordance with Provincial or Federal legislation or regulations.

Policy 4.9.3.2 states the following:

The purpose of an EIA is to demonstrate that the proposed development or site alteration will result in no negative impacts to that portion of the Natural Heritage System or unmapped Key Features affected by the development or site alteration by identifying components of the Regional Natural Heritage System as listed in Section 4.9.1.3 and their associated ecological functions and assessing the potential environmental impacts, requirements for impact avoidance and mitigation measures, and opportunities for enhancement. The EIA, shall, as a first step, identify Key Features on or near the subject site that are not mapped on Schedule "M".

Policy 4.9.3.3 requires that site alteration that is located wholly or partially inside or within 120 m of the RNHS requires an EIA.

Policy 4.3.2.12 provides additional requirements for boundary refinement of the RNHS, including consultation with the Town, and reflects the requirements of ROP Policy 116.1.

Natural Hazards

Policy 3.14 addresses the Regulatory Flood Plain and confirms that the Town utilizes the One Zone Concept of flood plain management and that any proposed development within the flood plain requires permission from CH pursuant to Ontario Regulation 162/06.

Site Contamination

The following Environmental Control Objectives are listed in the MOP:

2.3.2.7 To maintain and enhance surface water quality, as well as fish habitat, by reducing sedimentation loading, siltation and contamination caused by soil erosion.

2.3.2.8(b) To identify constraints on land and related resources which require mitigating measures as a requirement of development including … Sites of Potential Contamination

2.3.2.10 To minimize contamination of ground water and soils in and around former industrial and waste disposal sites

The following Site Contamination Policies are included in the MOP:

2.3.3.23 The Town shall only consider development proposals after the proponent undertakes a process in accordance with the Region's Guidelines (Protocol) for Reviewing Development Applications with Respect to Contaminated or Potentially Contaminated Sites and any applicable Provincial legislation, regulations and guidelines to determine whether there is any potential contamination on the site and the steps necessary to bring the site to a condition suitable for its intended use.

2.3.3.24 The Town may only permit development upon determination that the development site complies with Provincial guidelines, Regional standards and other requirements regarding soil and ground water quality. Any studies required to allow the Town or Region of Halton to evaluate the level of risk will be prepared by qualified professionals retained and paid by the proponent to

the satisfaction of the Town and will be in accordance with all Ministry of the Environment guidelines and Regional protocols.

2.3.3.25 *The Town shall co-operate with other public agencies, in an effort to reduce adverse environmental impacts or health hazards associated with closed landfill sites as designated on Schedule "G" and other potentially contaminated sites from previous uses as identified by the Region of Halton. It should be noted that sites other than those identified on Schedule G or by the Region of Halton may also have the potential for site contamination.*

1.4.11 Conservation Authorities Act – Ontario Regulation 162/06

Relevant regulatory policies in CH's *Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Policy Document (November 2020)* include:

2.1 Watercourses, Valleylands, Hazardous Lands, Wetlands and Shorelines Except where allowed under Policies 2.4 – 2.50 (inclusive), development is prohibited within a watercourse, valleyland, hazardous lands, wetland and lands adjacent or close to the shoreline of the Great Lakes – St. Lawrence River System or to inland lakes that may be affected by flooding, erosion or dynamic beaches.

2.2 Lands Adjacent to Watercourses, Valleylands, Hazardous Lands, Wetlands and Shorelines Except where allowed under Policies 2.4 - 2.50, development is prohibited:

- *a) within 15 metres of the stable top of bank of a major valley system … where a valley is apparent;*
- *b) within 15 metres from the greater of the limit of the flood plain or the predicted meander belt width of a watercourse associated with a major valley system … where a valley is not apparent;*
- *c) within 120 metres of a Provincially Significant Wetland and all wetlands greater than or equal to 2 hectares in size;*
- *d) within 30 metres of wetlands less than 2 hectares in size.*

Policies 2.4.1.1 and 2.4.1.2 requires that CH stake the top of bank of valleys greater than 2 m in height and that CH may request a stable slope assessment to determine the long-term stable top of slope. Policy 2.7 requires that CH attend on-site to stake the limit of wetlands. Policy 2.13 is relevant as it relates to construction access and site controls, given that some of the remediation and restoration works will take place within CH's regulated area:

2.13 Any application for development, permitted in accordance with Policies 2.4 – 2.50, must demonstrate that access to the work area and completion of the works can be carried out in an acceptable manner (see Section 4). Consideration must be given to the impacts on flooding, erosion, valley slope and channel stability, water quality, and natural environment (including, but not limited to, wildlife habitat and ecological functions). Information required for review and approval includes, but is not limited to: limit of work area delineation; sediment and erosion controls; deleterious substances; tree protection; staging/phasing, etc.

Finally, Policies 2.25.2.4, 2.35.3, 2.39.3 and 2.40.3 do not permit new development within 15m of the Regional Storm flood plain, 15m of the stable top of bank, 30m of wetlands greater than 2 ha in size and 15m of wetlands less than 2 ha in size, respectively.

The Subject Property contains the following areas that are regulated by CH pursuant to Ontario Regulation 162/06:

- Erosion hazards – stable top of bank of Sixteen Mile Creek valley;
- Flooding hazards – Regional Storm flood plain associated with Sixteen Mile Creek;
- Wetlands – within the valley and on the tablelands; and
- Regulated Allowances – 15m adjacent to the greater of the Regional Storm flood plain or stable top of bank; 30m adjacent to non-Provincially Significant wetlands less than 2 ha in size and 120m adjacent to Provincially Significant wetlands and wetlands greater than 2 ha in size.

In addition to CH's regulatory role, through their MOU with the Province, Conservation Authorities provide the provincial interest comments on issues pertaining to natural hazards.

1.5 Report Outline

The CEMS is presented as follows:

Context and Existing Conditions – describes the existing biophysical conditions, evaluates the significance of natural heritage features, identifies natural hazards, and identifies constraints. The Pre-Remediation Refined RNHS limit is described in this section.

Description of Proposed Works – describes the site remediation works and phases, assesses potential impacts to the RNHS, and demonstrates how the remediation works can avoid or mitigate impacts and enhance the functions of the RNHS in a manner that is consistent with applicable environmental legislation, regulations and planning policies.

Environmental Management – describes the various environmental management strategies to be implemented as part of the remediation works, restoration of remediated areas, constraints to future development and opportunities to enhance the RNHS.

2. Context & Existing Conditions

2.1 Physical Environment

This section characterizes the physical environment of the Study Area and environs. It provides an overview of the bedrock and surficial geology resources, topography, soils, surface water and groundwater resources, including drainage catchments, hydrostratigraphy, groundwater levels and groundwater quality.

2.1.1 Background

The Subject Property is a 20.3 ha (50.1 acre) parcel of land situated within a mixed residential and industrial neighbourhood. The Subject Property is located approximately 220 m east of the intersection of Steeles Avenue East and Bronte Street North and was vacant at the time that this report was prepared.

The tableland portion of the Subject Property is at an elevation of 205 m above sea level (masl) except for one area toward the centre of the property (where the former unregulated landfill was located) where the pre-remediation surface elevation is 211 masl. The Subject Property is located adjacent to, and contains a small portion of, the Sixteen Mile Creek valley. The southwestern portion of the property contains a portion of the valley slopes, Regional Storm flood plain and a short segment of the creek. The valley floor, associated with the creek, is at an elevation of approximately 198 masl.

2.1.2 Bedrock Geology

Based on borehole data logs, shale bedrock belonging to the Queenston Formation was found at approximate depths varying from 15.3 to 18.3 m below the existing ground surface (mbgs), corresponding to elevations varying from 188.0 to 190.2 masl.

2.1.3 Surficial Geology and Soils

The Subject Property is located within the Peel Plain physiographic region (Chapman and Putman 1984). This plain corresponds with the bottom of glacial Lake Peel which formed between an ice front and the Niagara Escarpment. It slopes south to Lake Ontario and follows the topography of the Halton Till. According to the Ontario Geological Survey, the surficial geology is described as till, clay to silty-textured till (derived from glaciolacustrine deposit of shale). Soils on the tablelands are mapped as Chinguacousy Clay Loams and the valley floor is described as consisting of alluvial soils (Gillespie, Wicklund, and Miller, 1971).

2.1.4 Drainage and Topography

The topography of the tableland portion of the Subject Property is relatively flat with a surface elevation of approximately 205–208 masl except for the landfill area at southern portion of the site with maximum elevation of approximately 211 masl. The tablelands slope gently towards the south. The nearest surface water body is Sixteen Mile Creek, located on the southwest side of the Subject Property, which eventually drains into Lake Ontario. The local site topography generally slopes gently downwards towards the south and east. There is a steep drop-off of approximately 5 m, along the west side of the Subject Property, where the land slopes down to the flood plain of Sixteen Mile Creek. Drainage is generally controlled by topography and previously by underground stormwater pipes (when the site had an industrial building on it).

2.1.5 Hydrology

CH is undertaking an Urban Milton Floodplain Mapping Update that establishes the existing peak flows for the Sixteen Mile Creek system. The results of this study were not available at the time of writing this report however, CH has indicated that the current flows have been incorporated into the HEC-RAS model that was provided to Urbantech to determine the existing floodplain as part of this CEMS.

The majority of the Subject Property (11.56 ha) drains from the north to southwest, towards the Sixteen Mile Creek via an overland flow route and existing headwall in the valley. A portion of the site (8.70 ha) drains to the southeast towards an existing drainage swale that outlets to Sixteen Mile Creek. Prior to site remediation works, the property was developed and included approximately 75% impervious coverage in the north portion with site, approximately 30% in the south-east portion of the site and no impervious areas in the south-west portion of the site. Refer to **Appendix D - Drawing 1** for the pre-remediation drainage plan.

There is one historic stormwater sewer outfall from the previously developed portion of the Subject Property that drained into the Sixteen Mile Creek valley, and an overflow spillway from the existing tailings pond which discharged / spilled to the railway ditch with no formal outfall. These lines were decommissioned as part of the demolition works and no longer convey any flows from the surface to Sixteen Mile Creek. Surface water flow during intense precipitation is now anticipated to drain overland and ultimately discharge into Sixteen Mile Creek.

2.1.6 Hydrogeology

The hydrogeology at the Subject Property was evaluated using six (6) on-site monitoring wells installed by DS Consultants and nine (9) additional existing monitoring wells installed by other consultants, as well as from local domestic wells and existing environmental reports for the area.

2.1.7 Local Groundwater Use

As part of the hydrogeological study, DS Consultants completed a search of the MECP Water Well Record (WWR) database. Based on the MECP water well records search, there were seventy-four (74) water wells within a 500 m radius of the Subject Property. All wells were noted as monitoring/test holes or not in use except for five (5) records for domestic, three (3) records for industrial and three (3) records for commercial purposes. To verify the findings of the MECP WWR search, a door to door well survey was completed in February 2022. As part of the survey, DS Consultants staff visited houses and/or properties within 500m of the Subject Lands that were identified to have well records for either industrial/commercial or domestic use. The results of the survey concluded that there are no wells within a 500 m radius that are used for potable purposes.

Figure 2.1 shows the MECP water well location plan. The study area (500 m radius of the Subject Property) is fully serviced with municipal water.

2.1.8 Groundwater Conditions

DS Consultants measured groundwater levels in all newly installed monitoring wells (MW21-1 through MW21-6) along with nine (9) existing monitoring wells (MW101, MW304, MW305, MW411, MW412, IW3, IW4, SW13 and DW5) on May 7, 2021. **Table 1** presents the groundwater levels in all monitoring wells. Based on groundwater level measurements, the groundwater table was found at a range between 6.87 to 13.06 mbgs (197.15-200.44 masl). Based on groundwater elevations, the flow direction within the Subject Property is inferred to be southwest toward the Sixteen Mile Creek.

Table 1. Groundwater Levels in Monitoring Wells

Well ID	Ground Elevation (masl)	Well Depth (mbgs)	Screened Interval (mbgs)	May 7, 2021	
				Depth to Water (mbgs)	Groundwater Elevation (masl)
BH21-1	208.31	18.1	15.1-18.1	9.93	198.38
BH21-2	207.64	12.1	9.1-12.1	7.2	200.44
BH21-3	206.57	13.4	10.4-13.4	7.2	199.37
BH21-4	206.34	15.5	12.5-15.5	8.62	197.72
BH21-5	205.47	12.3	9.3-12.3	6.89	198.58
BH21-6	210.53	22.65	19.65-22.65	13.06	197.47
MW101	207.31	10.9	7.9-10.9	7.88	199.43
MW305	207.64	11.8	8.8-11.8	8.55	199.09
MW304	207.64	10.35	7.35-10.35	8.74	198.9
MW411	205.81	10.7	7.7-10.7	8.66	197.15
MW412	205.81	9.6	6.9-9.9	6.87	198.94
IW3	210.1	16.9	13.9-16.9	12.54	197.56
IW4	205.81	14.65	11.65-14.65	8.33	197.48
SW13	206.04	10.1	7.1-10.1	8.57	197.47
DW5	210.77	20.8	17.8-20.8	12.55	198.22

2.1.9 Hydraulic Conductivity

A total of fifteen (15) Single Well Response Tests (SWRTs) were completed by DS Consultants in monitoring wells on May 5 to 7, 2021 to estimate hydraulic conductivity (k) for the representative geological units in which the wells were completed. SWRTs were completed by performing a rising head test (slug test) with the use of Waterra® tubing to 'instantaneously' remove water from the well. A data logger was placed at the bottom of the wells to monitor recovery. Hydraulic conductivity (k) values were calculated using the Hvorslev method. **Table 2** presents a summary of the hydraulic conductivity (k) results for the representative geological units. The values of calculated hydraulic conductivity (k) range from 9.56×10^{-7} to 1.12×10^{-4} m/s. Due to the heterogeneous nature of soils and the hydrogeological setting of the site, the geo-mean K-value 5.32×10^{-6} m/s was considered in the dewatering assessment.

Table 2. Summary of Hydraulic Conductivity (k) Test Results

Well ID	Screen Interval	Screened Formation	K- Value(m/s)	Geomean (m/s)
BH21-1	15.1-18.1	Sand and gravel/shale bedrock	2.05×10^{-7}	5.32×10^{-6}
BH21-2	9.1-12.1	Clayey silt till	1.65×10^{-7}	
BH21-3	10.4-13.4	Clayey silt/sandy Silt	1.25×10^{-6}	
BH21-4	12.5-15.5	Gravelly sand	2.50×10^{-4}	
BH21-5	9.3-12.3	Silty sand/silt	1.10×10^{-5}	
BH21-6	19.65-22.65	Sandy Silt/shale bedrock	1.12×10^{-4}	
MW101	7.9-10.9	Clayey silt till	1.71×10^{-7}	
MW305	8.8-11.8	Clayey silt till	2.12×10^{-7}	
MW304	7.35-10.35	Sandy silt	2.00×10^{-6}	
MW411	7.7-10.7	Sand/silty sand/sand and gravel	5.39×10^{-5}	
MW412	6.9-9.9	Silt/silty sand/sand and gravel	5.45×10^{-5}	
IW3	13.9-16.9	Silty sand	1.90×10^{-4}	
IW4	11.65-14.65	Silty sand	4.81×10^{-4}	
SW13	7.1-10.1	Clayey silt/silty sand	3.22×10^{-7}	
DW5	17.8-20.8	Silty sand	9.56×10^{-7}	

2.2 Natural Environment

This section characterizes the natural environment by identifying all components of the natural heritage system (NHS) as required by the PPS and the ROP, including Key Features and other components of the RNHS as described in Section 115 of the ROP as well as areas regulated by CH pursuant to Ontario Regulation 162/06.

2.2.1 Background

To identify and characterize the various components of the RNHS, information from the following sources was collected, compiled and mapped:

- MNRF Natural Heritage Information Centre (NHIC) rare species database (accessed December 2022);
- Fisheries and Oceans Canada Aquatic Species at Risk Map (accessed December 2022);
- Slope Stability Assessment; 150 Steeles Avenue East, Milton, Ontario (DS Consultants, January 17, 2023);
- Aerial photographs and topographic mapping; and
- Conservation Halton digital data.

2.2.2 Feature Staking

In accordance with the CEMS ToR, the limits of natural heritage features associated with the Subject Property were staked by agency staff and surveyed. On July 16, 2021, CH staff staked the top of bank along the Sixteen Mile Creek valley as well as the limits of the wetland features which includes two

small wetlands associated with a former tailings pond as well as a short segment of the non-provincially significant Milton Wetland Complex within the valleylands on the Subject Property (**Figure 2.2**). On November 22, 2021, Halton region staff staked the limits of the woodland feature. The staked limits of the wetlands and woodland were surveyed by an Ontario Land Surveyor (OLS) and have been used to prepare the constraint mapping for refining the RNHS boundaries.

2.2.3 Ecological Surveys

This section includes ecological surveys undertaken to identify the components of the RNHS and their respective sensitivities. Field notes are provided in **Appendix B-1**

2.2.3.1 Ecological Surveys & Assessments

Beacon undertook field surveys of the Subject Property an environs on May 19, July 7, October 1, 2021, and August 9, 2022, to classify and map the ecological communities in the Study Area in accordance with the *Ecological Land Classification for Southern Ontario* (Lee *et al*. 1998).

Ten ELC community classes were mapped in the Study Area, plus any associated anthropogenic areas. The corresponding ELC polygons are illustrated on **Figure 2.3**. The boundaries of wetland and woodland communities have been adjusted to be consistent with the feature staking completed by the agencies.

A total of 108 vascular plant species were identified during floristic surveys completed in 2021 and 2022. A list of flora recorded during field surveys is presented in **Appendix B-2**. Of the 108 species, 58 (54%) are non-native in Ontario. All but one native species are ranked S5 or S4 by the NHIC, indicating they are secure (S5) or apparently secure (S4) provincially.

One species, Honey Locust (*Gleditsia triacanthos*), is ranked S2?. A ranking of S2? indicates that the species is imperilled provincially. Honey Locust is not designated endangered or threatened in Ontario. This species was first observed in 2021 near the boundary of ELC Unit 6.0. This species is considered adventive in Halton as naturally occurring populations are restricted to southwestern Ontario.

Based on the vascular plant status list from the Halton Natural Areas Inventory (Crins *et al* 2006), there are 3 species identified from the Subject Property that are considered uncommon in Halton Region and no species that are considered regionally rare. A list of regionally rare and uncommon species and their location is provided in **Table 3**. These species are primarily associated with woodland and wetland ELC Units (2.0, 6.0, and 7.1).

Table 3. Regionally Rare and Uncommon Plant Species

Scientific Name	Common Name	S-Rank	Halton Status	Location (ELC Unit)
Gleditsia triacanthos	Honey Locust	S2?	None	6.0
Hackelia virginiana	Virginia Stickseed	S5	Uncommon	2.0
Oenothera biennis	Evening Primrose	S5	Requires further review	3.1
Solidago gigantea	Giant Goldenrod	S5	Uncommon	7.1
Symphyotrichum urophyllum	Arrow-leaved Aster	S4	Uncommon	7.1

2.2.3.2 Tree Inventory

Prior to remediation works, trees on the tableland portion of the Subject Property with potential to be impacted by the remediation works were inventoried. This inventory was limited to trees with a diameter at breast height (DBH) of at least 15 cm, which were marked with numbered metal forestry tags and inventoried on September 13, 16, 17, and 27, 2021. DBH was measured at 1.4 m above ground surface.

Information collected from individual trees included: species, trunk diameter (DBH), and condition. The condition of each tree was assessed for overall health and structural integrity based on indicators such as live leaves, dead wood, decay, structural defects, and presence of disease. Each tree was assigned a condition rating of good, fair, poor, or dead, based on the following criteria:

- **Poor** – Severe dieback, significant lean, missing leader, major defects, significant decay and/or disease presence. Includes hazardous trees and trees in terminal decline;
- **Fair** – Moderate dieback and/or lean, limb defects, multiple stems, moderate foliage damage from stress; or
- **Good** – Healthy vigorous growth, minor visible defects or damage.

The locations of individual trees were surveyed by an Ontario Land Surveyor (OLS) and are shown on **Appendix B-3 - Drawing 2**. A tree inventory is also provided in **Appendix B-3**.

A total of 402 individual trees were inventoried, primarily within the cultural woodland feature (ELC Unit 2.0). A general summary of tree species and abundance is presented in **Table 4**.

Table 4. Existing Tree Species and Quantity

Scientific Name	Common Name	Quantity
Juglans nigra	Black Walnut	264
Acer negundo	Manitoba Maple	71
Salix sp.	Willow species	15
Ulmus americana	White Elm	13
Populus tremuloides	Trembling Aspen	8
Crataegus sp.	Hawthorn species	7
Pinus sylvestris	Scot's Pine	5
Acer platanoides	Norway Maple	3
Fraxinus pennyslvanica	Green Ash	3
Robinia pseudoacacia	Black Locust	3
Acer saccharum	Sugar Maple	2
Ulmus pumila	Siberian Elm	2
Acer tataricum ssp. ginnala	Tatarian Maple	1
Malus sp.	Apple Species	1
Prunus serotina	Black Cherry	1
Ulmus sp.	Elm species	1
Populus deltoides	Eastern Cottonwood	1
Gleditsia triacanthos	Honey Locust	1

2.2.3.3 Amphibian Surveys

A review of CH Marsh Monitoring Program data from 2007 did not reveal any amphibian observation records from the Subject Property. The closest amphibian data records were from Sixteen Mile Creek approximately 1 km upstream of the Subject Property where a small population of Western Chorus Frog was noted. Great Lakes / St. Lawrence populations of this species are listed as threatened under the *Species at Risk Act*, Schedule 1. This species was not detected in the Study Area during Beacon's amphibian surveys in 2022.

To confirm the presence/absence of breeding frogs and toads, call surveys were completed in accordance with the standard survey protocols of the Marsh Monitoring Program (Bird Studies Canada 2008). Surveys were conducted on the evenings of April 12, April 15, May 5, and June 1, 2022, at six survey stations established proximal to wetland features, including the former tailings pond. The locations of the amphibian call survey stations are illustrated on **Figure 2.4**. Surveys were completed at least a half hour after sunset during suitable weather conditions. Survey details are included in **Table 5.**

Table 5. Anuran Survey Details

Date	Time of Survey	Stations Surveyed	Weather Conditions
April 12, 2022	20:43 – 21:47	1, 2, 3, 4, 5	14°C, wind Beaufort 1, cloud cover 10%, no precipitation
April 15, 2022	21:45 – 22:00	6	11°C, wind Beaufort 3, cloud cover 100%, light drizzle
May 5, 2022	20:40 – 21:33	1, 2, 3, 4, 5, 6	11°C, wind Beaufort 1, cloud cover 20%, no precipitation
June 1, 2022	21:24 – 22:21	1, 2, 3, 4, 5, 6	22°C, wind Beaufort 3, cloud cover 20%, no precipitation

As per the Marsh Monitoring Program, calling anurans detected were identified to species and chorus activity was assigned a code.

Using this code method, areas that support a Code 1 indicates very low population numbers in the local area, and/or low-quality breeding habitat; Code 2 is taken to indicate a moderate population and/or lower quality breeding habitat; and Code 3 is taken to indicate a healthy population and high-quality breeding habitat.

Three frog species, Green Frog (*Lithobates clamitans*), Gray Treefrog (*Hyla versicolor*), and Spring Peeper (*Pseudacris crucifer*) were recorded calling within the Subject Property and Study Area during the amphibian surveys. These species are considered common and abundant in Southern Ontario and are not of conservation concern. Only Spring Peepers were observed in high abundance.

The findings of the 2022 anuran calling surveys are summarized in **Table 6**.

Table 6. Anuran Calling Count Results

Station	Survey 1	Survey 2	Survey 3
1	SPPE 3	SPPE 3	GRTR*
2		-	GRTR*
3	SPPE 1 (1)	SPPE 3; GRTR 1 (1)	GRTR*
4			GRTR 2 (3)
5	SPPE*		GRTR 2 (3)
6		SPPE 1 (1)	GRFR 1 (2)

*=Call recorded from outside station area

GRFR = Green Frog, GRTR = Gray Treefrog, SPPE = Spring Peeper

Chorus Code:

1. Individuals of one species can be counted, calls not simultaneous. Number of individuals observed in brackets;
2. Some calls of one species simultaneous, numbers can be reliably estimated. Number of individuals observed in brackets; and
3. Full chorus, calls continuous and overlapping.

No salamanders or other amphibians were observed incidentally or through flipping cover objects during other ecological surveys.

2.2.3.4 Avifaunal Surveys

Breeding Bird Surveys

Following review of CH data, there are no recent records (within the past 25 years) of breeding bird species within the Study Area.

To document the composition of the resident avian community, breeding bird surveys were completed during the mornings of May 26 and June 5, 2021. The surveys were completed during periods with low to moderate winds (0–2 Beaufort Scale), no precipitation and temperatures within 5°C of normal average temperatures. The breeding bird community was surveyed using a roving-type survey, in which all parts of the Subject Property were walked (**Figure 2.4**). All birds observed and exhibiting evidence of breeding were documented and their locations noted on an aerial photograph (**Appendix B-1**). This survey method is superior to the point count methods as it more comprehensively documents the avian communities present.

A list of all breeding birds observed from the Subject Property is provided in **Appendix B-4**.

Thirty-six (36) bird species were observed / heard during the breeding bird surveys on the Subject Property in 2021 (**Appendix B-4**). The composition of the breeding bird community is reflective of the habitats present on the Subject Property, dominated by open anthropogenic spaces, and riparian habitats.

The avian community is comprised of species that are indicative of anthropogenic, rural settings. The most abundant species was Song Sparrow (*Melospiza melodia*), while Red-winged Blackbird (*Agelaius phoeniceus*), Common Yellowthroat (*Geothlyphis trichas*), House Wren (*Troglodytes aedon*), European Starling (*Sturnus vulgaris*), Baltimore Oriole (*Icterus galbula*), American Robin (*Turdus migratorius*),

Gray Catbird (*Dumetella carolinensis*), and Northern Cardinal (*Cardinalis cardinalis*) all had more than two (2) territories present.

Other Avian Habitat Surveys

The Sixteen Mile Creek wetlands in the Study Area were investigated for evidence of colonially nesting bird breeding habitat (trees/shrubs). The Provincial database (LIO) notes that within the 1 km grid area, there is a Mixed Wader Colony Wildlife Concentration Area, which is a provincially tracked designation. As such, this habitat may be present in the wetlands associated with the Sixteen Mile Creek valleylands. Following investigation on January 23, 2023, no prior colonial nesting evidence was observed on the Subject Property or Study Area. It is possible that portions of the Sixteen Mile Creek wetland and the Milton Mill Pond, located outside of the Study Area, could support such habitat.

During other ecological surveys of the Subject Property / Study Area in 2022 and 2023, three additional bird species were observed as follows:

- 2022-04-12 American Woodcock – East Study Area;
- 2022-08-05 Green Heron – Sixteen Mile Creek wetland (ELC Unit 7.2); and
- 2023-01-23 Red-Tailed Hawk – Sixteen Mile Creek wetland (ELC Unit 7.2).

No species provincially ranked as S1 through S3 (Critically Imperiled through Vulnerable) or species regulated under the ESA were encountered. However, Eastern Wood-Pewee, listed as Special Concern was observed during the breeding bird survey, with one in the vicinity of ELC unit 5.1. Though this species is Special Concern provincially and federally based on a declining trend over their range, these birds remain relatively common in both urban and urbanizing woodlands and common in the Halton Region (McIlveen 2006). They are somewhat tolerant of forest fragmentation and will live in both edge habitats and forest interiors.

Using the bird status from the Halton Natural Areas Inventory (McIlveen 2006), two species observed on the property are regionally uncommon. These individuals were identified in the following areas:

- Black-and-white Warbler (*Mniotilta varia*) — One territory — ELC Unit 4.3; and
- Green Heron (*Butorides virescens*) — One territory (pair) — ELC Unit 7.2.

No regionally rare avian species were observed on the Subject Property.

Prior to the demolition of the manufacturing facility, neither Barn Swallow nor Chimney Swift were observed in the Study Area during breeding bird surveys or incidentally during other ecological surveys in 2022. The interior of the building could not be closely investigated due to health and safety reasons.

2.2.3.5 Reptile Surveys

To confirm the presence of reptiles, surveys for turtles and snakes were undertaken.

Habitats with potential to support turtle populations such as the tailings pond / wetland and Sixteen Mile Creek were surveyed for basking turtles by slowly walking along the outer edge of the features and

surveying the outer edge using binoculars. Surveys were conducted when the air temperature was greater than water temperature and not during inclement weather.

Potential snake hibernaculum areas were also surveyed on the same dates by scanning the edges of vegetation and exposed rubble / rocks and by flipping cover objects in the vicinity of the old rail bed.

Details of these surveys, including weather conditions, are included in **Table 7**.

Table 7. Reptile Survey Details

	Turtle Basking Survey 1	Snake Survey 1	Snake and Turtle Survey 2
Date:	August 5, 2022	August 9, 2022	September 20, 2022
Search time(s):	8:20–9:28 am	12:50–1:05 pm; 4:22–4:30 pm	12:15–1:45 pm
Temp:	21 °C	Approx. 20 °C	23 °C
Wind (Beaufort Scale):	0	Approx. 2	2
Cloud cover:	95%	90%	20%
Precipitation:	None	None	None

No turtles or snakes were noted by Beacon during any field visits on the Subject Property. The observations are as follows:

- The tailings pond / wetland was dry during these surveys and therefore are unlikely to support basking or overwintering habitats for turtles;
- Sixteen Mile Creek water temperature relative to air temperature was conducive to basking behaviour on both dates however, no turtles were observed; and
- No snakes were observed on the tablelands or in the valleylands.

2.2.3.6 Bat Surveys – Snag Trees and Acoustic Monitoring

During the tree inventory, trees with at least 10 cm DBH were also assessed for various bat habitat criteria, as per the MECP updated *'Bat Survey Standards Note 2021'* guideline (undated). This assessment took place on January 26 and 27, 2022.

Potential roosting habitat (tree cavities) for endangered bat species were identified in the Cultural Woodland community on the Subject Property (ELC Unit 2.0).

To confirm the presence / absence of bat species that may be utilizing the woodland, acoustic monitors were deployed in the vicinity of the identified snags and call data was recorded from between June 1 and June 13, 2022 (**Figure 2.4**), in accordance with methods described within *Phase III: Acoustic Surveys* of the *Survey Protocol for Species at Risk Bats within Treed Habitats Little Brown Myotis, Northern Myotis & Tri-Colored Bat* (Guelph District MNRF 2017).

Analysis of the acoustic monitoring data confirmed the occurrence of bat species that are regulated under the ESA. As noted in **Section 2.2.7.1**, the regulation of endangered bat species and habitat will be addressed in accordance with the ESA.

Although roosting habitat on the Subject Property did not meet the criteria for provincial significance for Big Brown Bat (*Eptesicus fuscus*) and Silver-Haired Bat (*Lasionycteris noctivagens*), some calls from these species were also detected during acoustic monitoring.

2.2.3.7 Raptor Habitat Survey

To detect potential nest sites of woodland raptors and assess the potential for their winter habitat, a survey was conducted on January 22, 2023, during favourable conditions for observing raptors and nests. The wooded portions of the Subject Property were walked to within 50 m to search suitable trees for potential raptor nests. Adjacent woodlands to the southeast of the Subject Property and treed areas to the west, in association with the Sixteen Mile Creek wetland, were also scanned for potential stick nests.

Three stick nests potentially suitable for raptors, particularly Cooper's Hawk, were located in the woodland (ELC Unit 2.0) as shown in **Appendix B-5**. Each of these nests appeared old and one was incomplete, although nests may be reused and repaired by nesting raptors. A large (approximately 1 m across) squirrel drey (nest) was observed in the forest outside the Subject Property to the south, and this may also provide a nesting structure for woodland raptors. No nest building activity was observed in winter 2023.

Seasonal surveys between April and May would be required to determine occupancy of these nests.

No raptor overwintering habitat was observed in winter 2023. The open areas of the Subject Property are primarily unvegetated and have been cleared for soil remediation. As such, these areas would provide poor habitat for small mammal prey of raptors and the area is not considered suitable to support high concentrations of wintering raptors. During the January field visit, raptors were not observed in the open areas of the Subject Property however, one Red-tailed Hawk was observed in the Sixteen Mile Creek wetland (ELC Unit 7.2) on the western edge of the Subject Property.

2.2.3.8 Terrestrial Crayfish Survey

Beacon conducted surveys for terrestrial crayfish in depressions, swales, and wet areas on the Subject Property, primarily in the vicinity of the former tailings pond / wetland on July 27, August 5, August 9, and September 20, 2022. Terrestrial crayfish were identified by the presence of a pile or chimney of dried mud pellets. As terrestrial crayfish excavate their burrows, they bring pellets of mud to the burrow entrance and build a chimney or pile. Terrestrial crayfish live at the depth of groundwater. As these chimneys were surveyed in dry conditions, most of the chimneys were sealed with a mud cap — a means for the crayfish to prevent water loss and desiccation.

A 1.2 m long Dutch-head soil auger was used to determine the presence or depth of shallow groundwater near the burrows on August 9, 2022.

A total of 56 burrows were identified on the Subject Property, in the fall of 2022 (**Appendix B-6**). At this time, the groundwater was more than 1 mbgs. It should be noted that in the literature (Guiasu 2002), digger crayfish (*Fallicambarus fodiens*) have been observed in burrows as deep as 1.5 mbgs.

The 56 burrows were associated with the tailings pond / wetland (ELC Units 5.1, 5.2 and 9). Their locations are noted in **Table 8**.

Table 8. Terrestrial Crayfish Burrow Observations (2022)

ELC Unit or Inclusion	Number of Burrows Observed
Ditch inclusion in ELC Unit 4.6 (CUS1), near CSP that conveys flows to ELC Unit 5.1 (SWT2-5)	2
5.1 (SWT2-5)	48
5.2 (SWT2-5), near CSP inlet conveying flows from ELC Unit 9.0 (MAS2-1)	4
9.0 (MAS2-1)	2

2.2.3.9 Dragonfly, Damselfly and Butterfly Surveys

Field investigations for species of Odonata (dragonflies and damselflies) and Lepidoptera (butterflies, skippers and moths) were conducted by Beacon during warm, sunny days with minimal winds on August 5 and 12, 2022, as described in **Table 9**. Binoculars were used to observe insect species. If required, individuals were captured using a net and examined using a hand lens before being released. Species locations are typically noted if they had a ranking of S4 or lower (more sensitive) or if a species generally occurs in densities low enough as to warrant mention.

Table 9. Dragonfly, Damselfly and Butterfly Survey Details

	Survey 1	Survey 2
Date:	August 5, 2022	August 12, 2022
Area:	Tailings pond / wetland	Sixteen Mile Creek wetlands
Temp:	27 °C	25 °C
Wind (Beaufort Scale):	2	1
Cloud cover:	40%	30%
Precipitation:	None	None

Thirteen species of Odonata and Lepidoptera were found on the Subject Property in 2022, as shown in **Table 10**.

Table 10. Dragonflies and Butterflies Recorded on the Subject Property

Common Name	Scientific Name	Total Recorded	Provincial S rank
Slender Spreadwing	*Lestes rectangularis*	6	S5
Stream Bluet	*Enallagma exsulans*	1	S5
Marsh Bluet	*Enallagma ebrium*	3	S5
Eastern Forktail	*Ischnura verticalis*	8	S5
Common Whitetail	*Plathemis lydia*	5	S5
Clouded Sulphur	*Colias philodice*	1	S5
Cabbage White	*Pieris rapae*	72	SNA
Monarch	*Danaus plexippus*	3	S2N, S4B
Viceroy	*Limenitis archippus*	5	S5
American Lady	*Vanessa virginiensis*	1	S5

Common Name	Scientific Name	Total Recorded	Provincial S rank
Eastern Tailed-Blue	*Cupido comyntas*	2	S5
Common Wood-nymph	*Cercyonis pegala*	6	S5
Least Skipper	*Ancyloxypha numitor*	6	S5

Legend: Provincial Status (Srank): S5 = Secure; S4 = Apparently Secure; S3 = Vulnerable; S2 = Imperiled, SNA = Not applicable (exotic species)

Monarch was observed in the vicinity of the former tailings pond / wetland; however, there was no significant habitat on site as milkweed was not abundant.

2.2.4 Natural Hazards

Section 3.1 of the PPS provides the Province's direction with respect to protecting public health and safety in relation to natural hazards. Relevant portions of Policy 3.1.1 state the following:

> *Development shall generally be directed, in accordance with guidance developed by the Province (as amended from time to time), to areas outside of:*
> *d) hazardous lands adjacent to the shorelines of the Great Lakes-St. Lawrence River System and large inland lakes which are impacted by flooding hazards, erosion hazards and/or dynamic beach hazards;*
> *e) hazardous lands adjacent to river, stream and small inland lake systems which are impacted by flooding hazards and/or erosion hazards; and,*
> *f) hazardous sites.*

Subsections (a) and (c) are not applicable to the Subject Property. The following subsections provide an overview of the components of subsection (b) that are applicable to the Subject Property.

2.2.4.1 Regional Storm Flood Plain

Reach W1 of the Sixteen Mile Creek traverses a small portion of the western edge of the Subject Property however, the majority of the watercourse is located off-site. The HEC-RAS model for this reach (from cross-section 1831 to 1006) scenario "Future Flows" was obtained from CH on October 6, 2022. In addition to the HEC-RAS model, CH's digital elevation model (DEM) files for the Study Area were also obtained to confirm the HEC-RAS model geometry and to facilitate flood plain mapping. It was found that the HEC-RAS sections were consistent with the CH DEM.

The Manning's roughness for the existing corridor (main channel and overbank areas) varied based on the surrounding land use. Cross sections in proximity to road crossings/rail lines had a value of 0.035 for the main channel and 0.08 for overbank areas that was applied to the CH model. Cross sections between road crossings/rail lines had a value of 0.032 for the main channel and 0.045 for overbank areas.

Contraction and expansion coefficients were set to 0.1 and 0.3, respectively, for smooth transitions between cross-sections. At abrupt transitions (i.e., upstream and downstream of culverts or at changes in channel width), the contraction and expansion coefficients were increased to 0.3 and 0.5, respectively.

No changes were made to the CH model as all geometry and parameters appeared to be consistent with acceptable values. CH noted that the peak flows in the HEC-RAS model were based on the preliminary results from the Urban Milton Floodplain Mapping Update that was released in March 2020. Although the flows used in the model are the best available information at this time, CH staff have noted they may be subject to change as the hydraulic model update for the area is finalized. Although this may be the case, the flood plain is contained well within the valley and would not be expected to extend beyond the top of bank. No flow change locations have been included in the model. Flows for the entire reach are shown in **Table 11**.

Table 11. HEC RAS Existing Flows

Flow (m^3/s)						
2-year	**5-year**	**10-year**	**25-year**	**50-year**	**100-year**	**Regional**
10.8	22.49	31.56	45.27	56.76	67.05	243.04

Under existing conditions, three crossings are located in proximity of the Subject Property as outlined in **Table 12**.

Table 12. Summary of Crossing Structures

Location	Type	River Station	Height (m)	Length (m)	Width (m)
East of Bronte Road	Railroad crossing – Two culverts	1772	4.2	66.7	4.2
Bronte Street North	Arch bridge	1630	2	8.34	12.2
South of 150 Steeles	Railroad crossing - beam bridge	1032	3.54	7.12	18.2

Flood mapping was prepared for the existing Regional flow scenario (refer to **Appendix D - Drawing 2**). This flood mapping informs the constraint mapping for the Subject Property. As shown in the drawing, the Regional Storm flood plain is contained within the Sixteen Mile Creek valley and does not impact the tablelands of the Subject Property. **Table 13** outlines the results of the HEC-RAS model for the cross sections in proximity to the Subject Property.

Table 13. Summary of HEC-RAS Model Results

River Station	W.S. Elevation (m)						
	2-year	**5-year**	**10-year**	**25-year**	**50-year**	**100-year**	**Regional**
1831	198.35	198.97	199.38	199.93	200.36	200.73	206.07
1772	Railroad Culvert						
1721	198.11	198.43	198.64	198.92	199.07	199.19	201.42
1645	197.99	198.32	198.53	198.82	198.97	199.08	201.43
1630	Bronte Road Bridge						
1619	197.94	198.18	198.30	198.47	198.61	198.60	201.44
1223	197.26	197.51	197.68	197.93	198.13	198.32	201.41
1109	197.15	197.44	197.62	197.87	198.09	198.28	201.41
1083	197.14	197.43	197.61	197.87	198.08	198.28	201.34
1053	197.10	197.38	197.55	197.81	198.02	198.22	201.44

River Station	W.S. Elevation (m)						
	2-year	5-year	10-year	25-year	50-year	100-year	Regional
1831	198.35	198.97	199.38	199.93	200.36	200.73	206.07
1032	Railroad Bridge						
1006	196.88	197.01	197.11	197.23	197.31	197.53	199.22

2.2.4.2 Long Term Stable Top of Slope

As noted in **Section 2.2.2**, CH staked the limit of the physical top of bank on July 16, 2021, as shown on **Figure 2.2** and **Appendix C-1 - Drawing 1A**. DS Consultants completed a long-term stable top of slope assessment (**Appendix C-1**) and based on the results, the long-term stable slope at Cross-Sections A-A through J-J are presented on **Drawing 5** through **Drawing 14** of **Appendix C-1**. The points representing the long-term stable top of slope (LTSTOS) at the cross-sections are determined using the following criteria:

- If the stable top of slope determined in the slope stability analysis is further away from the creek than the physical top of slope that CH staked, then the stable top of slope determined in the slope stability analysis is considered the LTSTOS; and
- If the stable top of slope determined in the slope stability analysis is closer to the creek than the physical top of slope that CH staked, then the CH staked top of slope is considered the LTSTOS.

As observed while on site with CH on July 16, 2021, there is a localized area of slope erosion in the vicinity of the storm sewer outfall (between points S1-S4 on **Figure 1B, Appendix C-1**). The analysis has considered the location of the LTSTOS with and without stabilization/repairs to this area. Based on the results of the assessment, the points representing the LTSTOS at the west part of the Subject Property (the area of Cross-Sections A-A to D-D, see **Drawing 1B** of **Appendix C-1**) are as follows:

- If the eroded/failed slope in Cross-Section B-B area **is to be** stabilized/repaired, as recommended in **Section 3.3** and **Appendix C-1,** then:
  - Point "S1" on **Drawing 5** represents the LTSTOS at Cross-Section A-A;
  - Point "S2" on **Drawing 6** represents the LTSTOS at Cross-Section B-B;
  - Point "S3" on **Drawing 7** represents the LTSTOS at Cross-Section C-C; and
  - Point "S4" on **Drawing 8** represents the LTSTOS at Cross-Section D-D;
- If the eroded/failed slope in Cross-Section B-B area **is not** stabilized/repaired, then:
  - Point "S1" on **Drawing 5** represents the LTSTOS at Cross-Section A-A;
  - Point "S2a" on **Drawing 6** represents the LTSTOS at Cross-Section B-B;
  - Point "S3a" on **Drawing 7** represents the LTSTOS at Cross-Section C-C; and
  - Point "S4" on **Drawing 8** represents the LTSTOS at Cross-Section D-D.

As such, based on the above, if the eroded/failed slope in the area of Cross-Section B-B **is to be** stabilized/repaired, as described in **Section 3.3** and **Appendix C-1**, the LTSTOS is Line S1-S2-S3-S4, as shown on **Drawing 1B**.

If the eroded/failed slope in the area of Cross-Section B-B **is not to be** stabilized/repaired, LTSTOS at the west part of the site is Line S1-S2a-S3a-S4, as shown on **Drawing 1B.**

Slope stabilization methodology and the associated impact assessment are discussed in **Sections 3.3** and **3.5.1.**

Long-term Stable Top of Slope from Cross-Sections D-D through J-J

For most of the subject slope (from Cross-Sections D-D to J-J, see **Drawing 1A** of **Appendix C-1**), the LTSTOS is located at the top of bank as staked by CH on July 16, 2021, as summarized below:

- Point "S4" on **Drawing 8** represents the LTSTOS at Cross-Section D-D, which is at CH Staked Top of Bank;
- Point "S5" on **Drawing 9** represents the LTSTOS at Cross-Section E-E, which is at CH Staked Top of Bank;
- Point "S6" on **Drawing 10** represents the LTSTOS at Cross-Section F-F, which is at CH Staked Top of Bank;
- Point "S7" on **Drawing 11** represents the LTSTOS at Cross-Section G-G, which is at CH Staked Top of Bank;
- Point "S8" on **Drawing 12** represents the LTSTOS at Cross-Section H-H, which is at CH Staked Top of Bank;
- Point "S9" on **Drawing 13** represents the LTSTOS at Cross-Section I-I, which is at CH Staked Top of Bank; and
- Point "S10" on **Drawing 14** represents the LTSTOS at Cross-Section J-J, which is at CH Staked Top of Bank.

2.2.5 Human-Made Hazards

Section 3.2 of the PPS addresses human-made hazards. Subsection 3.3.2 states the following:

> *Sites with contaminants in land or water shall be assessed and remediated as necessary prior to any activity on the site associated with the proposed use such that there will be no adverse effects.*

The environmental soil and groundwater conditions on the Subject Property have been investigated through numerous past environmental site assessments, including:

- *"Update Phase I Environmental Site Assessment, 150 Steeles Avenue East, Milton, Ontario",* prepared for Meritor Suspension Systems Company, prepared by Pinchin Environmental Ltd., dated July 13, 2009 (Pinchin - 2009 Phase I ESA Update)*;*
- *"Phase II Environmental Site Assessment, 150 Steeles Avenue East, Milton, Ontario"*, prepared by AEL environment, prepared for McMillan LLP, as counsel for MSM Canada Inc., dated December 16, 2013 (AEL – 2013 Phase II ESA);
- *"Supplemental Phase II Environmental Site Assessment – Landfill Test Pitting Program, 150 Steeles Avenue East, Milton, Ontario"*, prepared by AEL environment, prepared for McMillan LLP, as counsel for MSM Canada Inc., dated August 26, 2014 (AEL – 2014 Landfill Test Pitting Program);
- *"Phase II Environmental Site Assessment, 150 Steeles Avenue East, Milton, Ontario"*, prepared by AEL environment, prepared for McMillan LLP, as counsel for MSM Canada Inc., dated October 3, 2014 (AEL – 2014 Phase II ESA Update); *and*

- *"Final Remedial Investigation, 150 Steeles Avenue East, Milton, Ontario",* prepared for NEATT Communities, prepared by Pinchin, dated November 11, 2020 (Pinchin 2020 Remedial Investigation).

Soil and groundwater quality assessments completed to date have indicated that the primary contaminants of concern (COCS) include petroleum hydrocarbons (PHCs) F1 to F4, metals (primarily hexavalent chromium (Cr6+)) and to a lesser extent cadmium, lead, and inorganics electrical conductivity (EC) and sodium adsorption ratio (SAR). In addition to soil/groundwater remediation, a landfill that contains a mixture of construction debris, oily mill scale and soil will be removed. The location and known extent of these contaminants are shown on **Figure 3.1**

Remediation through excavation and off-site disposal is the selected management approach to address the existing impacted (contaminated) soil on-site. The remedial excavation will be concluded with soil verification chemical testing to confirm the remaining soils meet the applicable MECP Site Condition Standards.

There are no groundwater users on the Subject Property, as such the residual groundwater contamination does not pose a hazard to human health. However, the impacted groundwater will be remediated through a pump and treat system, in support of the RSC which will be obtained in the future to support the proposed change in land use.

In addition to the contamination identified on the tablelands, past environmental investigations have included assessment of the sediment quality within Sixteen Mile Creek. This previous testing has confirmed that metal-based contaminant concentrations exceeding the MECP sediment standards are present within the sediment of Sixteen Mile Creek on the Subject Property (see **Appendix C-3** - Figures C1–C3). DS Consultants completed a Due Diligence Risk Assessment (DDRA) to analyze contaminant concentrations and the potential risk to both human and ecological receptors. Elevated risk to human receptors was not identified.

The DDRA identified potential pathways by which aquatic life may be exposed to contaminants in the sediment. These complete exposure pathways include the following:

- Direct contact by benthic invertebrates, aquatic plants and fish;
- Ingestion of aquatic plants by aquatic invertebrates and fish; and
- Ingestion of aquatic invertebrates by fish.

Mammals and birds are not expected to have significant contact with contaminants in the sediment. The ecological risk assessment calculated risk estimates known as hazard quotients which identified that risks from direct contact with nickel and zinc in sediment are above the target of 1.0. Despite the elevated hazard quotient identified for nickel and zinc, it is the professional opinion of DS Consultants that the disruption caused by dredging the sediment and resulting suspension and mobilization of impacted sediment within the ecosystem will result in more environmental harm than leaving the sediment in place.

When the impacts of remedial action will result in more environmental harm than leaving the contaminants in place, the remedial action should not be implemented (MECP, 2008; USEPA, 1998). At this time, prior to any additional lines of evidence of severe toxicity to ecological receptors, it is deemed unnecessary to remove the contaminated sediment within the creek bed.

Based on the elevated risk level identified for aquatic receptors, a review of remediation options was completed as part of the risk assessment process. A summary of potential risk management measures is provided below:

- **Physical Capping** – this is accomplished by applying a cover of clean material on top of the contaminated sediment to effectively eliminate or reduce biogeochemical or physical interaction with the overlying water column. Physical capping is not recommended at this location due to the minimal water depth and high flows within this reach of Sixteen Mile Creek, which would limit the effectiveness of this method;
- **Direct Removal** – physical removal of the shallow sediment within the Subject Property would directly address the primary sources of potential impairment to the habitat. This could include hydraulic dredging as it is an efficient means to remove the target sediments down to a specific elevation without the need to disturb areas outside of the necessary dredge footprint. Mobilization of machinery to complete this work would require either tree removal to approach from the west or destruction of wetland areas adjacent to Sixteen Mile Creek to install a temporary access road. Contaminated sediment would be suspended during dredging activities and would be mobilized to downstream receptors. While the result of the dredging would eventually result in improved sediment quality, there would be significant disruption to aquatic and terrestrial habitat including the removal of benthic organisms and aquatic plants as well as treed areas along the valley slope to gain access to the work area. Sediment removal may also cause harm to aquatic habitat. Direct removal is not recommended; and
- **No-Action Alternative** – when the impacts of a remedial action will result in more environmental harm than leaving the contaminants in place, the remedial action should not be implemented (MECP, 2008; USEPA, 1998).

The No-Action Alternative is recommended by DS Consultants as both of the remedial options identified have considerable negative impacts associated with them and will result in significant physical disruption of the existing ecosystem that would ultimately contribute to net environmental harm and/or complete disruption/removal of the benthic and aquatic habitat.

2.2.6 Surface and Ground Water Features

Section 2.2.1 of the PPS addresses policies related to water. Specifically, this section requires that planning authorities shall protect, improve or restore the quality and quantity of water by:

a) using the watershed as the ecologically meaningful scale for integrated and long-term planning, which can be a foundation for considering cumulative impacts of development;
b) minimizing potential negative impacts, including cross-jurisdictional and cross-watershed impacts;
c) evaluating and preparing for the impacts of a changing climate to water resource systems at the watershed level;
d) identifying water resource systems consisting of ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas, which are necessary for the ecological and hydrological integrity of the watershed;

e) *maintaining linkages and related functions among ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas;*
f) *implementing necessary restrictions on development and site alteration to:*
    a. *protect all municipal drinking water supplies and designated vulnerable areas;*
    b. *protect, improve or restore vulnerable surface and ground water, sensitive surface water features and sensitive ground water features, and their hydrologic functions.*
g) *planning for efficient and sustainable use of water resources, through practices for water conservation and sustaining water quality;*
h) *ensuring consideration of environmental lake capacity, where applicable; and*
i) *ensuring stormwater management practices minimize stormwater volumes and contaminant loads, and maintain or increase the extent of vegetative and impervious surfaces.*

Section 2.2.2 of the PPS notes that:

> *Development and site alteration shall be restricted in or near sensitive surface water features and sensitive ground water features such that these features and their related hydrologic functions will be protected, improved or restored. Mitigative measures and/or alternative development approaches may be required in order to protect, improve or restore sensitive surface water features, sensitive ground water features, and their hydrologic functions*.

Sensitive surface water features and groundwater features are defined by the PPS as "areas that are particularly susceptible to impacts from activities or events including, but not limited to, water withdrawals, and additions of pollutants." The Halton-Hamilton Source Protection Plan (November 2022) does not identify this reach of Sixteen Mile Creek as a sensitive water feature nor is it within an area of sensitive groundwater features.

The Subject Property was within the Study Area for the Sixteen Mile Creek Areas 2 and 7 Subwatershed Study (SWS), prepared by Philips Planning and Engineering Limited (January 2000). Although the main focus of the SWS was the Phase 1 area of Milton, there are a few characterizations that were made with respect to water resources on the Subject Property:

- The Sixteen Mile Creek, flowing to the west of the Subject Property, was identified as a Perennial Stream with Natural Channel Form on Figure 10 of the SWS; and
- Fish sampling stations 2A8 (described as from Bronte Road bridge to 50m downstream) and 2A7 (immediately downstream of footbridge adjacent to Mill Pond) are shown on Figure 11 of the SWS. The fish species recorded in the SWS are consistent with recent CH records (see **Section 2.2.7.7**).

2.2.6.1 Surface Water Features

The Sixteen Mile Creek traverses a small corner of the Subject Property within a confined valley system. The Sixteen Mile Creek is regulated by CH pursuant to Ontario Regulation 162/06.

The surface water features in the valley system (i.e., riparian wetland) is assumed to be maintained primarily by flows from the creek and upstream catchment area and input from the Subject Property is anticipated to be limited, as illustrated on the pre-remediation drainage plan (**Appendix D – Drawing 1**). As discussed in **Section 2.5.1**, a stormwater outlet was decommissioned as part of the demolition works and no longer contributes stormwater into the valley of Sixteen Mile Creek. No indicators of groundwater discharge were observed along the slope at the west limit of the Subject Property, suggesting little to no groundwater input. As the remediation works are not anticipated to impact surface flows in the long-term and will address the presence of pollutants (as outlined in **Section 3**), Sixteen Mile Creek and the riparian wetland are expected to benefit from the site remediation works through the removal of contaminants in nearby soils and groundwater and no negative impacts are anticipated.

2.2.6.2 Ground Water Features

The Study Area is fully serviced by municipal water supply. A door-to-door survey has confirmed that there is no use of groundwater as a source of drinking water within a 500 m radius from the Subject Property. As such, no short-term or long-term impacts on private water wells are anticipated from the proposed dewatering activities to treat the contaminated groundwater.

The Region has previously confirmed that the Subject Property is not located within a wellhead protection area, nor is it located within a highly vulnerable aquifer.

2.2.7 Evaluation of Significant Natural Heritage Features/Functions, Natural Hazards and Water Resources

2.2.7.1 Significant Habitat of Endangered or Threatened Species

Significant habitat of endangered and threatened species is recognized as a Key Feature within the RNHS. It should be reiterated that ROP Policy 118(2)(a) has an exception for development or site alteration that takes place within significant habitat of endangered and threatened species in accordance with Provincial and Federal legislation and regulations.

The ecological surveys, completed in accordance with MECP and OMNR protocols, confirm that the woodland feature on the Subject Property supports habitat for endangered bat species, as delineated by the woodland dripline on **Figure 2.2**. As no other areas of the Subject Property support habitat of endangered or threatened species, the limits correspond with the woodland dripline as staked by the Region.

Any alteration of this Key Feature, which is required to complete the soil remediation in support of RSC filing, which is required under the *Environmental Protection Act*, will be done so in accordance with the ESA. A Notice of Activity form will be submitted to the Ministry, in accordance with Ontario Regulation 242/08, s. 23.18 (Threats to Health and Safety, Not Imminent). Alteration of this Key Feature will be minimized based on the adaptive approach to remediation (**Section 3.2.2**).

2.2.7.2 Significant Wetlands and Non-Significant Wetlands

Wetlands are defined by the PPS and Greenbelt Plan (2017) as:

> *Lands that are seasonally or permanently covered by shallow water, as well as lands where the water table is close to or at the surface. In either case the presence of abundant water has caused the formation of hydric soils and has favoured the dominance of either hydrophytic plants or water tolerant plants. The four major types of wetlands are swamps, marshes, bogs and fens.*
>
> *Periodically soaked or wetlands being used for agricultural purposes which no longer exhibit wetland characteristics are not considered to be wetlands for the purposes of this definition.*

Significant Wetlands are Key Features of the RNHS. As it relates to wetlands and areas of natural and scientific interest, "significant" is defined by the PPS as:

> *An area identified as provincially significant by the Ontario Ministry of Natural Resources and Forestry using evaluation procedures established by the Province, as amended from time to time.*

There are no Provincially Significant Wetlands (PSWs) on or adjacent to the Subject Property. The Milton Wetland Complex associated with the Sixteen Mile Creek floodplain has been evaluated by MNRF; however, it is not provincially significant.

The following definition of significance, from the ROP also needs to be considered for this study:

- *For lands within the Greenbelt Plan Area but outside the Niagara Escarpment Area, Provincially Significant Wetlands and wetlands as defined in the Greenbelt Plan;*
- *For lands within the Regional Natural Heritage System but outside the Greenbelt Plan Area, Provincially Significant Wetlands and wetlands that make an important ecological contribution to the Regional Natural Heritage System; and*
- *Outside the Regional Natural Heritage System, Provincially Significant Wetlands.*

Although the wetland communities associated with Sixteen Mile Creek (i.e., the Milton Wetland Complex) do not meet the provincial definition of significance, they do meet the ROP definition of significance, as the wetlands are within the Urban River Valley designation of the Greenbelt Plan.

While located within the existing RNHS, the small wetland associated with the former tailings pond (ELC Units 5.1, 5.2, and 9.0) does not provide an important ecological contribution to the RNHS. This wetland is a contaminated, anthropogenic feature that is very small in area and therefore not considered to provide an important ecological contribution to the RNHS and would not meet the definition of significant wetland. This feature would instead be considered a '*wetland other than those considered significant under Section 115.3(1)b)*' as per ROP Policy 115.3(6). This wetland is still part of the RNHS but, rather than a Key Feature, it is considered a component of the RNHS.

2.2.7.3 Significant Woodlands

Significant Woodlands are also Key Features of the RNHS. Significant Woodlands are defined in the PPS and in the ROP. Both definitions are consistent with respect to attributes and functions that make a woodland significant, however there is some variability in how they are to be identified.

The PPS defines Significant Woodlands as follows:

> *… an area which is ecologically important in terms of features such as species composition, age of trees and stand history; functionally important due to its contribution to the broader landscape because of its location, size or due to the amount of forest cover in the planning area; or economically important due to site quality, species composition, or past management history. These are to be identified using criteria established by the Ontario Ministry of Natural Resources and Forestry.*

The ROP and MOP include definitions of woodlands and significant woodlands. A Significant Woodland is considered a woodland that is 0.5 ha or larger determined through a Watershed Plan, a Sub-watershed Study or a site-specific Environmental Impact Assessment to meet one or more of the following criteria:

- The woodland contains forest patches over 99 years old;
- The patch size of the woodland is 2 ha or larger if it is located in the Urban Area, or 4 ha or larger if it located outside the Urban Area but below the Escarpment Brow, or 10 ha or larger if it located outside the Urban Area but above the Escarpment Brow;
- The woodland has an interior core area of 4 ha or larger, measured 100 m from the edge; or
- The woodland is wholly or partially within 50 m of a major creek or certain headwater creek or within 150 m of the Escarpment brow.

The following ELC units meet the ROP and MOP definition of a Significant Woodland:

- ELC Unit 2.0 — The tableland-associated cultural woodland community that is 2.4 ha in area;
- ELC Unit 6.0 — The slope-associated deciduous forest community that is 1.2 ha in area and within 50 m of the regulated watercourse of Sixteen Mile Creek; and
- ELC Unit 10.0 — A Sugar Maple forest community outside of the Subject Property, divided by a railway corridor, that is approximately 5.2 ha in area.

The limits of the Significant Woodland on the Subject Property were staked with Region staff on November 22, 2021 (**Figure 2.2**).

Areas of the woodland that will be affected by soil remediation works will be restored through re-vegetation. The existing woodland (ELC Unit 2.0) is early successional and established following abandonment of farming in the 1960's. It is dominated by Black Walnut and Ash, which are not reflective of the original composition of forest communities in this area. There is however a small patch of remnant forest on the property to the south (ELC Unit 10) which has been classified as a Dry–Fresh Sugar Maple Forest (FOD5) and represents a more appropriate target community for restoration. The intention of the Restoration Plan, as discussed in **Section 4.1.2,** will be to direct the ecological trajectory of the woodland towards this target community.

2.2.7.4 Significant Valleylands

Significant Valleylands are also Key Features of the RNHS. As it relates to valleylands, significant is defined by the PPS as:

> *Ecologically important in terms of features, functions, representation or amount, and contributing to the quality and diversity of an identifiable geographic area or natural heritage system …*

Significant valleylands are normally identified by municipalities with input from their agency partners. The ROP and the MOP do not identify significant valleylands and, as such, it is the responsibility of individual proponents to evaluate for significance.

Table 8-1 in the *Natural Heritage Reference Manual* (MNR 2010) provides recommended criteria for evaluating significant valleylands, including criteria relating to landform functions and attributes, ecological features and restored ecological functions. The Sixteen Mile Creek valleyland adjacent to the Subject Property meets many of the criteria in this table and is therefore considered significant valleyland and a Key Feature of the RNHS.

The top of slope of the valleyland on the Subject Property was staked by CH staff on July 16, 2021. DS Consultants subsequently completed a slope stability assessment (**Appendix C-1**) to determine the position of the LTSTOS. For the most part, the staked top of bank was confirmed to be the LTSTOS with the exception of one localized area where a former stormwater outfall has resulted in erosion along the valley wall. Slope stabilization works proposed in this area will have the effect of restoring the physical top of bank to its original location and making it stable, as described in **Section 2.2.4.2**. As such, for the purpose of defining the constraint limits, the physical top of bank, as staked by CH, is considered the ultimate LTSTOS, and this has been used to define the limits of the Significant Valleyland. (**Figure 2.2**)

2.2.7.5 Significant Wildlife Habitat

Significant Wildlife Habitat (SWH) is also a Key Feature of the RNHS. SWH represents a combination of natural heritage features, attributes and functions that are intended to capture the best examples of wildlife habitat within a planning area such as an upper or lower tier municipality. The responsibility for confirming SWH is assigned to the planning authority (i.e., Town, Region); however, many municipalities rely upon proponents to identify potential SWH through planning studies.

The ROP and PPS share a very similar definition of significant as it pertains to SWH:

PPS	ROP
In regard to other features and areas, ecologically important in terms of features, functions, representation or amount, and contributing to the quality and diversity of an identifiable geographic area or natural heritage system	In regard to the other components of the RNHS, ecologically important in terms of features, functions, representation or amount, and contributing to the quality and diversity of an identifiable geographic area or natural heritage system

To determine if any of the natural features on the Subject Property potentially support candidate SWH, the *Significant Wildlife Habitat Criteria Schedules for Ecoregion 7E* (MNRF 2015) was consulted.

According to the *Significant Wildlife Habitat Technical Guide (*OMNR 2000), there are four broad categories of Significant Wildlife Habitat (SWH):

- Habitats of Seasonal Concentration Areas of Animals;
- Rare Vegetation Communities or Specialized Habitat for Wildlife;
- Habitat for Species of Conservation Concern; and
- Animal Movement Corridors.

Within each of these categories, there are multiple types of SWH, each of which is intended to capture a specialized type of habitat that may or may not be captured by other existing feature-based categories (e.g., significant wetlands, significant woodlands).

Based on the *Significant Wildlife Habitat Criteria Schedules for Ecoregion 7E* (MNRF 2015), the woodland habitat and former tailings pond / wetland associated with the Subject Property may satisfy ecoregional criteria for the following habitat types:

- Cultural Woodland — ELC Unit 2.0:
  - Woodland Raptor Nesting (Cooper's Hawk) - **Possible**;
- Former tailings pond / wetland— ELC Units 5.1, 5.2, and 9.0:
  - Special Concern and Rare Wildlife Species (Eastern Wood-Pewee) – **Possible**; and
  - Terrestrial Crayfish.

The following SWH have been identified as possible, on the adjacent lands, and would require further field investigations and/or analysis to confirm:

- Sixteen Mile Creek Wetlands — ELC Unit 7.3:
  - Colonially-Nesting Bird Breeding (Tree/Shrubs) – **Possible** (likely out of Study Area);
- Deciduous Forest — ELC Unit 10.0:
  - Bat Maternity Colonies (**Possible**).

A detailed analysis of SWH is presented in **Appendix B-7.** The locations of the ELC communities that correspond with the SWH described above are illustrated on **Figure 2.3.**

As the former tailings pond / wetland will be removed as a result of the site remediation, Terrestrial Crayfish may be rescued, if feasible and if required by MNRF.

2.2.7.6 Significant Areas of Natural and Scientific Interest

Significant Areas of Natural and Scientific Interest (ANSI) are also Key Features of the RNHS. ANSI are defined by the PPS as:

> *Areas of land and water containing natural landscapes or features that have been identified as having life science or earth science values related to protection, scientific study or education.*

There are no provincially significant ANSI proximal to the Subject Property. The closest ANSI is the Provincially Significant Milton Heights Earth Science ANSI which is located more than 2 km to the west.

2.2.7.7 Fish Habitat

Fish habitat is present in Sixteen Mile Creek on and adjacent to the Subject Property. Records between 2000 and 2022, provided by CH, document the following fish species within the west branch (#16) of Sixteen Mile Creek: Black Crappie (*Pomoxis nigromaculatus*), Bluegill (*Lepomis macrochirus*), Bluntnose Minnow (*Pimephales notatus*), Brassy Minnow (*Hybognathus hankinsoni*), Brook Stickleback (*Culaea inconstans*), Brown Bullhead (*Ameiurus nebulosus*), Brown Trout (*Salmo trutta*), Central Mudminnow (*Umbra limi*), Common Shiner (*Luxilus cornutus*), Creek Chub (*Semotilus atromaculatus*), Fantail Darter (*Etheostoma flabellare*), Fathead Minnow (*Pimephales promelas*), Goldfish (*Carassius auratus*), Hornyhead Chub (*Nocomis biguttatus*), Johnny Darter (*Etheostoma nigrum*), Largemouth Bass (*Micropterus salmoides*), *Lepomis* sp., Longnose Dace (*Rhinichthys cataractae*), Minnow species (*Leuciscidae*), Mottled Sculpin (*Cottus bairdi*), Northern Hog Sucker (*Hypentelium nigricans*), Northern Pike (*Esox lucius*), Pumpkinseed (*Lepomis gibbosus*), Pumpkinseed (*Lepomis gibbosus*), Rainbow Darter (*Etheostoma caeruleum*), Rainbow Trout (*Oncorhynchus mykiss*), River Chub (*Nocomis micropogon*), Rock Bass (*Ambloplites rupestris*), Western Blacknose Dace (*Rhinichthys obtusus*), White Sucker (*Catostomus commersoni*), and Yellow Perch (*Perca flavescens*).

A background review of data related to this reach of Sixteen Mile Creek suggests no recent presence of aquatic species at risk on the Subject Property or Study Area. The closest occurrence of aquatic species at risk (Redside Dace [*Clinostomus elongatus*] and Silver Shiner [*Notropis photogenis*]) was downstream of Mill Pond, approximately 1 km downstream of the Subject Property, according to the DFO Aquatic Species at Risk mapping. According to records provided by CH, Redside Dace was last observed in 1957 in Sixteen Mile Creek, approximately 50 m upstream of the Bronte Street crossing.

There are no surface water features on the tableland portion of the Subject Property that provide for fish passage.

2.2.7.8 Flooding and Erosion Hazards

Flooding hazards are contained within the confined valley system associated with Sixteen Mile Creek and do not extend onto the tableland portion of the Subject Property. Erosion hazards have been determined through the completion of a long-term stable top of slope assessment. The assessment determined that, for the majority of the Subject Property, the physical top of bank as staked by CH is equivalent to the LTSTOS. The one exception is in the area of localized erosion associated with the previous storm sewer outfall. Slope stabilization works are proposed in this area which will have the affect of stabilizing the slope in a manner that makes the physical top of bank coincident with the LTSTOS.

2.2.7.9 Surface and Groundwater Resources

The Sixteen Mile Creek and associated riparian wetland represent the surface water resources on, and immediately adjacent to, the Subject Property and are completely contained within the Sixteen Mile Creek valley. Neither the watercourse nor the groundwater in this area were identified as sensitive water resources within the Halton-Hamilton Source Protection Plan.

2.2.8 Refined Natural Heritage System

The PPS describes natural heritage systems as follows:

> *A system made up of natural heritage features and areas, linked by natural corridors which are necessary to maintain biological and geological diversity, natural functions, viable populations of indigenous species and ecosystems.*

The MOP states that the natural heritage system consists of the RNHS and the Greenbelt Natural Heritage System.

ROP policy 115.3 defines the RNHS as including: Key Features, Enhancements to the Key Features, linkages, buffers, watercourses within Conservation Authority Regulation Limit or those that provide a linkage to a wetland or a significant woodland, wetlands other than those considered significant and the Regional Storm flood plain. Key Features include significant habitat of threatened or endangered species, significant wetlands, significant coastal wetlands, significant woodlands, significant valleylands, significant wildlife habitat, significant ANSI's and fish habitat.

ROP Policy 116.1 and MOP Policy 4.8.3.14 allow boundary adjustments to the RNHS through studies, such as this CEMS, that are based on a ToR accepted by the Region and Town.

Map 1 and Map 1G of the ROP identify the preliminary limits of the RNHS on the Subject Property.

One of the objectives of this CEMS is to refine the limits of the RNHS by identifying RNHS Key Features and components (as per ROP policy 115.3), delineating these areas in consultation with the agencies, as well as natural hazards and ecological buffers.

As the ROP policy 115.3 includes buffers in the RNHS, natural heritage features were evaluated to determine appropriate buffers. In considering an appropriate buffer width, the Study Team has assumed that, in the future, the Subject Property will be developed with high density residential land uses.

The following subsections identify Key Features and components of the RNHS as they relate to the Subject Property. RNHS Key Features and components are identified on **Figure 2.2** and integrated into a Pre-Remediation Refined RNHS boundary in **Figure 2.2**.

Conditional on completion of the proposed slope stabilization / remediation, tailings pond / wetland remediation, and construction of the re-created wetland, the RNHS boundary is proposed to be adjusted, as described in **Section 3.5.1.3**.

2.2.8.1 Key Features

Based on the evaluation of significance presented in **Sections 2.2.7.1 – 2.2.7.9**, the following Key Features have been identified within the Study Area:

- Habitat for Endangered or Threatened Species;
- Significant Wetlands;
- Significant Woodlands;
- Significant Valleylands;

- Significant Wildlife Habitat; and
- Fish Habitat.

2.2.8.2 Enhancements to Key Features

Enhancements to Key Features are another component of the RNHS as defined in ROP policy 115.3.

ROP policy 229.1.1 defines Enhancements to Key Features as follows:

> *Means ecologically supporting areas adjacent to Key Features and/or measures internal to the Key Features that increase the ecological resilience and function of individual Key Features or groups of Key Features.*

For the purpose of this report, this RNHS component is further addressed in **Section 4.1.5.**

2.2.8.3 Linkages

Linkages are another component of the RNHS as defined in ROP policy 115.3.

The Sixteen Mile Creek valleylands are considered to represent Significant Valleylands and recognized as a regional scale linkage. This linkage is defined by the valleyland corridor which is included within the Refined RNHS.

2.2.8.4 Regulated or Linkage Watercourses

Watercourses that are within a Conservation Authority Regulation Limit or that provide a linkage to a wetland, or a significant woodland are another component of the RNHS as defined in ROP policy 115.3.

The Sixteen Mile Creek is the only regulated watercourse within the Study Area and is contained within the Refined RNHS.

2.2.8.5 Non-Significant Wetlands

Wetlands other than those considered significant under ROP policy 115.3(1)(b) represent another component of the RNHS.

The small wetland associated with the former tailings pond (ELC Units 5.1, 5.2 and 9.0) is considered to be a '*wetland other than those considered significant under Section 115.3(1)b)*' as per ROP Policy 115.3(6). This wetland was excluded from consideration as a Key Feature as it does not provide an important ecological contribution to the RNHS; it is a contaminated, anthropogenic feature that is very small in area. This wetland is included in the Pre-Remediation Refined RNHS shown in **Figure 2.2**.

This non-significant wetland is contaminated and must be removed in order to complete the remediation work. In association with its removal, it is proposed that a new wetland be created. The proposed wetland is of the same size but has been re-configured slightly and has been shifted closer to the

woodland, which will result in a slight change to the Pre-Remediation RNHS limits once buffers are applied. The wetland removal and replacement are discussed further in **Sections 3.2.2.2 (Remediation), 3.5.1 (Impact Assessment)** and **4.1.3 (Ecological Restoration)**.

2.2.8.6 Buffers

No buffers to Key Features or setbacks to natural hazards were implemented as part of the previous industrial land use. Buffers and setbacks are also not required for the remediation works as this would interfere with the objective of site cleanup. The Region's OP mapping appears to include a precautionary buffer of 30 m adjacent to the known wetlands and woodlands on the Subject Property at the time of the ROP map creation. As buffers are considered components of the RNHS and one of the objectives of the CEMS is to refine the limits of the RNHS, it was necessary to determine appropriate buffers and setbacks (to natural hazards) based on the proposed future land use (i.e., high-density residential).

The Region defines buffer as follows:

> *Means an area of land located adjacent to Key Features or watercourses and usually bordering lands that are subject to development or site alteration. The purpose of the buffer is to protect the features and ecological functions of the Regional Natural Heritage System by mitigating impacts of the proposed development or site alteration. The extent of the buffer and activities that may be permitted within it shall be based on the sensitivity and significance of the Key Features and watercourses and their contribution to the long-term ecological functions of the Regional Natural Heritage System as determined through a Sub-watershed Study, an Environmental Impact Assessment or similar studies that examine a sufficiently large area*.

As noted above, while the ROP Map 1 and Map 1G depict precautionary buffers of 30 m adjacent to certain Key Features (woodlands and wetlands) on the Subject Property, ROP policies require that buffer widths be determined through site-specific study taking into consideration the significance and sensitivity of the Key Features and NHS components and the potential impact(s) of the adjacent land use. This CEMS represents a site-specific study that has: (a) collected sufficient information on natural heritage resources and natural hazards to assess their sensitivity and significance; and, (b) determined appropriate buffers and setbacks to mitigate potential impacts related to a future high density residential development of the lands adjacent to the RNHS. Although certain details of the future high density residential development are not available at this time, the buffer recommendations outlined later in this report are based on professional experience with similar scale residential developments in the Town and Region, including recently approved development applications that are proximal to the site.

2.2.8.7 Pre-Remediation Refined RNHS

Based on the above, the Pre-Remediation Refined RNHS has been identified which includes the following, as shown on **Figure 2.2**:

- Key Features of the RNHS:
  - Significant Wetland within the Sixteen Mile Creek valley based on limit staked by CH;
  - Significant Woodland based on dripline staked by the Region;

- Significant Valleyland based on limits of the LTSTOS which is equal to or greater than the physical top of bank as staked by CH;
- Fish Habitat within the Sixteen Mile Creek;
- Significant Habitat of Endangered and Threatened Species:
  - Habitat for Endangered bats – corresponds with limits of Significant Woodland;
- Significant Wildlife Habitat; and
- Terrestrial crayfish – tailings pond / wetland:

- Other Components of the RNHS:
  - Wetland other than those considered significant – tailings pond / wetland;
  - 30 m precautionary buffer adjacent to the Significant Woodland and Significant Wetland as requested to be included by the Region;
  - Linkages – Sixteen Mile Creek valleylands – corresponds with Significant Valleyland; and
  - Regulatory flood plain – Regional Storm flood plain associated with Sixteen Mile Creek.

In addition to the woodland and wetland buffers, the following other natural heritage buffer and natural hazard setbacks have been applied in order to determine the Pre-Remediation Refined RNHS limit (**Figure 2.2**):

- Regulatory Floodplain — 15 m as per CH regulation/policy;
- Long-Term Stable Top of Slope — 15 m as per CH regulation/policy;
- Significant Wetlands — 30 m as per CH regulation/policy; and
- Non-significant Wetlands, less than 2 ha in size — 15 m as per CH regulation/policy.

3. Description of Proposed Works

This section describes the proposed works that are required to remediate contaminated soils and groundwater and to stabilize a localized area of slope failure along the Sixteen Mile Creek valley. For the purpose of this CEMS, the descriptions are focused on activities that will occur within the Pre-Remediation Refined RNHS and CH regulated areas. **Section 3.1** describes the phasing of the contaminant remediation program. **Section 3.2** describes the existing and proposed remediation approach and activities, and **Section 3.3** describes the approach to slope stabilization.

3.1 Phasing of Soil and Groundwater Remediation Works

The remediation works have been phased to allow for agency review and approval of the CEMS, prior to undertaking remediation within the RNHS and CH-regulated area.

Phase 1 Area – This area encompasses a large portion of the overall remediation area that is located outside the limits of the Pre-Remediation. Remediation works in this area consists of both soil and groundwater remediation and removal of the unregistered landfill. The Phase 1 Area includes lands

that are mainly outside of CH's regulated area except for a small area located at the bend in the existing driveway that is within 15 m of the stable top of bank (**Drawing 1001** of **Appendix D**).

The Phase 1 Area encompasses all of RSC Properties 1 and 2, and portions of RSC Properties 4 and 5.

Excavation and removal of contaminated soil began in the Phase 1 Area in July 2022, with approvals from the Region, Town, and CH. A permit was obtained from CH for work in the small area at the perimeter of the regulated area (Permit #7980) in October 2021 for the removal of the former industrial building.

Groundwater remediation in the Phase 1 Area pilot testing has been completed and a Permit to Take Water (PTTW) was granted by the MECP on September 21, 2022. Groundwater remediation is anticipated to begin in early 2023.

Phase 2 Area – Following issuance of permit(s) from CH, as discussed in **Section 3.4.1**, removal of the contaminated fill within the CH-regulated area and a portion of the Pre-Remediation Refined RNHS (wetlands other than those considered significant) but excluding the Key Features (i.e., excluding the Significant Woodland). This will include the removal of contaminated soil in the following areas:

- Within 120 m of a wetland greater than 2 ha in size; and
- Within, and within 30 m of, a wetland less than 2 ha in size.

This area includes RSC Property 3 and a portion of RSC Property 5 and is illustrated on **Drawing 1002** of **Appendix D**.

Phase 3 Area – Based on the current understanding of the extent of contamination, remediation of contaminated soil within the Significant Woodland is anticipated. Additionally, this Phase will include stabilizing the localized area of erosion at the former storm sewer outfall (**Figure 2.2**). The Phase 2 CH permit(s) will also apply to this phase.

Prior to removing trees in the Phase 3 area, the adaptive approach will be taken (**Section 3.2.2**) whereby the excavation of the side walls will be tested, and the remedial excavation will only proceed where exceedances of soil contaminants are identified.

This area includes a portion of RSC Property 5 and is illustrated on **Drawing 1003** of **Appendix D**.

3.2 Description of Soil and Groundwater Remediation Works

This section provides a summary of the contamination remediation works that have already been implemented or are proposed.

3.2.1 Objectives

The objectives of the soil and groundwater remediation are as follows:

- To conduct remediation and remedial monitoring for soil and groundwater aimed at being compliant with Ontario Regulation 153/04 (as amended);
- Communicate updates, with the Region, Town and CH, related to the remediation progress should works extend further into the RNHS and CH regulated areas than anticipated on **Figure 3.1**; and
- Ultimately obtain the required RSC for the proposed future land uses.

3.2.2 Remediation Methodology and Adaptive Management Approach

This section describes the remediation methodologies and adaptive management approach intended to mitigate impacts to the RNHS Key Features and components.

3.2.2.1 Soil Remediation

Remediation of soil began in the Summer of 2022 and involved the remedial excavation of five (5) areas within the Site as shown on **Figure 3.1**. The areas of excavation are hereafter referred to as:

- Area 1 – located on the southwest portion of the former industrial building;
- Area 3 – located on the northcentral portion of the formal industrial building;
- Area 4 – located on the southeastern portion of the former industrial building;
- Area 5 – located near the northeastern portion of the former industrial building; and
- Landfill Excavation – located south of the former industrial building.

Soil remediation primarily includes excavation of contaminated soil. Soil excavation is conducted by conventional construction equipment, such as track excavators, backhoes, scrapers, bulldozers, front-end loaders, power shovels, and large rotary augers depending on the volume and extent of contaminated material.

Given the types of soil contaminants present on the Subject Property, full excavation is the recommended remedial approach. The variation in contaminant types across the Subject Property requires an adaptive approach to address the different contaminants present in the differing media (soil, industrial waste, etc.).

Soil remediation is necessarily an adaptive process, as the full extent of contamination cannot be known until the site has been remediated. Remedial excavation is completed in multiple iterations, including several rounds of soil verification sampling, and additional remedial excavation, as required. In other words, as a remedial excavation expands in area, the side walls and floor of the excavation are tested. If the test indicates a side of the excavated area is contaminated, the remedial excavation proceeds in that direction. Remedial excavation continues until testing indicates the soil at the edge of the excavation meets MECP requirements. Some additional excavation may be required to ensure safe sloping of excavation walls, as required by the *Occupational Health and Safety Act* and regulations. Based on the extensive soil testing that has been completed to date, the extent of contamination has been shown on **Figure 3.1**. There is a fairly high level of confidence that the extent of contamination is as shown on the figure however, variations may exist in the soil that were not picked up due to the location of the various test pits. Additionally, test pits were not completed extensively within the woodland as this would have necessitated the removal of a significant number of trees. As a result, the exact extent of contamination within the wooded area will only be known once excavation begins in that area.

The goal is to disturb the minimal area required to achieve MECP soil quality requirements through the RSC process.

During pre-consultation with agency staff, CH noted that there is one area of known contamination that is very close to the edge of the 15 m regulatory allowance adjacent to the stable top of bank. In order to provide the Study Team, as well as agency staff, a level of confidence in the limits of contamination in this area, and to determine whether it was likely that a Permit would be required from CH to undertake remediation within the 15 m regulatory allowance, five test pits were completed between the limit of the known extent of contamination and into CH's 15 m regulatory allowance adjacent to the stable top of bank (Phase 2/3 Area). The results of the test pitting exercise confirmed the presence of metals and petroleum hydrocarbon-related soil impacts. The zone of soil impacts based on the current understanding is depicted on **Figure 3.1.** Remediation within the forested land along the southern perimeter of the landfill will be required. It should be noted that the test pits identified buried debris including mill-scale, confirming that the lands surrounding the landfill which are currently vegetated were historically subject to dumping activities and will require restoration.

To mitigate the extent of tree removals in the Phase 3 area (i.e., within the Significant Woodland), once the soils are excavated to the extent shown on **Figure 3.1**, the walls of the excavation area will be tested incrementally in 2 m intervals to determine whether additional excavation is required to remove all contaminated soil. The proposed procedure is as follows:

- Within the area of soil contamination as shown on **Figure 3.1**, remove all trees and excavate to the extent shown;
- Conduct remedial excavation, sidewall testing, and/or test pits;
- If testing along the walls of the excavation indicates soil contamination is present, a further encroachment of 2 m beyond the excavation wall will take place (and any necessary tree removal as a result); and
- Continue with the above process until such time as the results indicate extent of soil contamination has been addressed.

If, through the above process, testing indicates that soil contamination is present within 15 m of the stable top of slope, consultation with CH will occur and the necessary Permit will be acquired before proceeding. If this case arises, it is anticipated that CH will require a report from a geotechnical engineer confirming that the excavation within the 15 m regulated allowance will not have a negative impact on slope stability.

Remediation requirements in each Area are outlined below. Remediation Areas are shown on **Figure 3.1**.

Area 5

The first area excavated was Area 5. Area 5 is located along the eastern portion of the Subject Lands and is not situated in the immediate vicinity of the Pre-Remediation Refined NHS limits.

The remedial excavation work was completed in multiple iterations between July 2022 and September 2022, including several rounds of soil verification sampling, and additional remedial excavation, as required. The final footprint of remedial Excavation Area 5 was approximately 1,700 m^2, with final depths ranging between 1 to 4 m below original grade. The final round of soil verification sampling was

completed in September 2022, confirming that the remedial efforts within Excavation Area 5 had been successfully completed.

Area 4

Excavation Area 4 commenced in July 2022. Area 4 is located along the eastern portion of the Subject Lands and is not situated in the immediate vicinity of the Pre-Remediation Refined NHS limits.

The remedial excavation work was completed in multiple iterations between July 2022 and December 2022, including several rounds of soil verification sampling, and additional remedial excavation, as required. The final footprint of remedial Excavation Area 4 was approximately 5,600 m^2, with an approximate average depth of 3.5 m below original grade. The final round of soil verification sampling was completed in December 2022, confirming that the remedial efforts within Excavation Area 4 had been successfully completed.

Area 3

Excavation Area 3 commenced in September 2022. Area 3 is located in the centre of the Subject Lands and is not situated in the immediate vicinity of the Pre-Remediation Refined NHS limits.

The remedial excavation work was completed in multiple iterations between September 2022 and November 2022, including several rounds of soil verification sampling, and additional remedial excavation, as required. The final footprint of Excavation Area 3 was approximately 5,660 m^2, with an approximate average depth of 6 m below original grade. The final round of soil verification sampling was completed in November 2022, confirming that the remedial efforts within Excavation Area 4 had been successfully completed.

Landfill

The remedial excavation within the northeastern portion of the unregistered landfill commenced in September 2022. The landfill excavation is located within the central portion of the Subject Lands, approximately 90 m north of the Pre-Remediation Refined RNHS boundary. The approximate footprint of the landfill excavation, as of December 2022, was 7,800 m^2. The eastern half of the landfill was excavated to an average approximate depth of 6.5 mbgs. The results of the soil verification sampling completed in December 2022 confirmed that the floor and the north and east sidewalls within the eastern half of the excavation satisfied the Table 3 RPI Standards.

The western half of the excavation was cut to an approximate depth of 3 mbgs. Further remedial excavation is required within the western half and is on-hold pending review of the CEMS and confirmation of the proposed restoration efforts within the Pre-Remediation Refined RNHS limit.

Additional remedial excavation along the southern limits of the landfill excavation is required and is scheduled to resume in Spring 2023.

Area 1

Excavation in Area 1 commenced in October 2022. Area 1 is in the west-central portion of the Subject Property and is located just on the edge of the Pre-Remediation Refined RNHS limit.

The remedial excavation work is ongoing. The current extent of the remedial excavation is approximately 2,900 m^2 and the average depth of excavation is approximately 2 m below original grade. The remedial excavation within Area 1 is anticipated to be concluded by spring 2023.

3.2.2.2 Groundwater Remediation

Proposed remediation of groundwater primarily involves removal/treatment of Cr6+ bearing groundwater. **Figure 3.1** shows where Cr6+ concentrations in groundwater are known to exceed the MECP Table 3 SCS. The current known extent of the groundwater impact is limited to the Phase 1 Area and does not extend into the limits of the Pre-Remediation Refined RNHS limit.

A review of remediation methods was conducted resulting in the selection of a groundwater extraction (removal) and treatment of extracted groundwater in an above ground treatment plant that makes use of ion exchange technologies. Treated water that meets reuse standards is reinjected back into the on-site shallow aquifer. A pilot test was undertaken to determine efficacy of the approach and to collect operational data require for scale-up to a full-scale treatment system. Details regarding the pilot test are provided in **Appendix C-2**. A PTTW was granted by the MECP on September 21, 2022 (No. 1000185005) in support of the groundwater remediation system.

The groundwater treatment system is currently being installed and will commence in 2023. It is anticipated that the groundwater treatment will take approximately 12 months to amend the groundwater quality. One year of post-treatment groundwater verification sampling is required by the MECP.

3.2.3 Status of Remediation Works and Anticipated Timeline

This section presents the status of remedial work completed as of January 31, 2023 and anticipated future remedial works.

The current progress of soil remediation excavation in the five areas, as well as the configuration and layout of the RSC properties, is shown on **Figure 3.1** and summarized in **Table 14**.

Table 14. Soil Remediation Status as of January 31, 2023

RSC Identifier	Excavation Area ID	Phase	Status
RSC Property 2	Excavation Area 2	1	**Completed** December 2022. RSC Filing to Commence Spring 2023
	Excavation Area 3		
	Excavation Area 4		
	Excavation Area 5		
RSC Property 3	Tailings Pond	2	**Not started.** Subject to CH

RSC Identifier	Excavation Area ID	Phase	Status
			Permit (Phase 2 Area)
RSC Property 4	Unregulated Landfill	1	**In Progress** Soil remediation to resume Spring 2023. Groundwater Remediation commencing Spring 2023.
RSC Property 5	Part of Unregulated Landfill	2 and possibly 3	**Not started.** Subject to CH Permit (Phase 2 and 3 Areas)
RSC Property 6	N/A	Future phase, if necessary	**Risk Assessment in Progress**. No remediation recommended.

As noted in **Table 14**, while the remediation in some areas is complete, other areas are either partially complete or have not yet started. These additional works in the Phase 2 and Phase 3 Areas are outlined below. Pending review and acceptance of this CEMS and receipt of Permits from CH, this remaining work is scheduled to commence in 2023 and be completed between Q4 of 2023 to Q1 of 2024.

Landfill

To refine the anticipated extent of contamination in the CH-regulated area and RNHS, five additional test pits were conducted along the perimeter of the landfill in the fall of 2022. The results of the test pitting exercise confirmed the presence of metals and petroleum hydrocarbons in the soil, which is attributed to the historical industrial activities on the property, and runoff from the former factory work areas. The extent of soil contamination, based on current understanding, is depicted on **Figure 3.1**. The complete removal of this landfill is expected to be between 70,000 m^3 and 90,000 m^3, of which, approximately 25,000 m^3 has already been removed outside of CH's regulated area and the RNHS limit. Soil remediation will be required along the southern perimeter of the landfill and will extend into the Significant Woodland in the Phase 3 Area. As noted in **Section 3.2.2.1**, the soil remediation will progress in an adaptive manner; such that tree/vegetation removal will only occur in areas where testing indicates the presence of soil contamination.

Tailings Pond / Wetland

This area will require full excavation and testing to remediate. The contaminants identified in the wetland included chromium, nickel, zinc, and petroleum hydrocarbons.

Sixteen Mile Creek

At this stage, it is not anticipated that remedial works will be required in the creek. Current investigations in Sixteen Mile Creek provide some evidence of contaminated sediment (RSC Property 6). The Risk Assessment process has been initiated and is anticipated to take 18 to 24 months to obtain approval from MECP. Remediation works within the creek, if required, will not affect the limits of the Pre-Remediation or Post- Remediation Refined RNHS.

3.2.4 Schedule/Timeline

The boundaries of the following 'RSC Properties' are depicted on **Figure 3.1**.

3.2.4.1 RSC Property 1

The RSC for "RSC Property 1" was completed in December 2022. No further work is required for this portion of the Site.

3.2.4.2 RSC Property 2

The soil remediation works are nearing conclusion, pending completion of the soil remediation within Excavation Area 1. This work is anticipated to be completed within 1–2 months and will be followed by RSC submission. The RSC for Area 2 is anticipated to be completed in 2023.

3.2.4.3 RSC Property 3

RSC Property 3 is situated in the area that contains the former tailings pond, contained within Phase 2 of the Phasing Plan referenced in **Section 3.1**. The contaminants identified within the wetland include chromium, nickel, zinc and petroleum hydrocarbons. Soil remedial excavation will be required to address these impacts before the RSC filing process can commence. Pending review and acceptance of the conclusions of this CEMS and receipt of appropriate permits from CH, this work is scheduled to be completed in Fall 2023. The RSC for "RSC Property 3" is projected to be obtained Q4 of 2023 to Q1 of 2024.

3.2.4.4 RSC Property 4

The soil remediation works are ongoing and anticipated to be completed by spring 2023. The groundwater treatment system is currently being installed and will commence operation in 2023. It is anticipated that the groundwater treatment system will take approximately 12 months to amend the groundwater quality. One (1) year of post treatment groundwater verification sampling will need to be completed in support of future RSC filing efforts. The RSC is projected to be obtained in 2025.

3.2.4.5 RSC Property 5

RSC Property 5 comprises the Pre-Remediation Refined RNHS, situated along the western side of the Subject Lands. Past investigations have identified metals and petroleum hydrocarbon-related impacts in the soil which is attributed to the historical industrial activities on the property, and runoff from the former factory work areas.

Soil remedial excavation will be required to address these impacts before the RSC filing process can commence. Pending review and acceptance of the conclusions of this CEMS and receipt of appropriate permits from CH, this work is scheduled to be commence in 2023. The RSC for "RSC Property 3" is projected to be obtained Q4 of 2023 to Q1 of 2024.

3.2.4.6 RSC Property 6

The Risk Assessment process has been initiated and is anticipated to take 18 to 24 months to obtain approval from the MECP.

3.3 Slope Stabilization

As noted above, there is localized erosion along the valley slope associated with the storm sewer outfall located at Cross Section B-B.

Preliminary consideration was given to an engineered reinforced slope, such as a Tensar Sierra Slope; however, this product does not appear to be conducive to a woodland setting. This product is designed to allow the establishment of herbaceous vegetation and is composed of high-density polyethylene ribs. As the manufacturer specifications require the product to be installed a minimum of 3" from "pavement/obstruction", it is our opinion that tree root growth from the mature trees in the woodland may compromise the integrity of this product. Furthermore, the installation of this product would likely require construction equipment within the valley, necessitating the construction of access roads, etc., resulting in additional disturbance to the valley wall and associated vegetation.

As a result of the anticipated impacts as a result of the construction requirements for a reinforced slope, the Study Team has discussed at length the following proposed methodology to stabilize this slope with rip-rap, with the intention of minimizing disturbance to Key Features:

- Conduct slope stabilization works outside of bird and bat window (discussed in **Section 3.5.2**);
- From the tablelands, use an excavator to remove rubble and anthropogenic debris, including the portion of the storm sewer pipe that is exposed. Cap remaining storm sewer pipe;
- Place geotextile on slopes, to the satisfaction of the geotechnical engineer;
- Using an excavator, install rip-rap from the top of bank over geotextile to stabilize the slope; and
- Plant native vines in native soil at the edge of the rip-rap, and direct vines to grow over the rip-rap.

The above approach is proposed to avoid the need to bring heavy equipment into the valley in order to minimize short-term disturbance and also to provide the best long-term opportunity to maintain slope stability given the mature tree growth around the disturbed area. Based on discussion with DS Consultants, the rip-rap area is anticipated to be an average of 8 m in width and would extend to the base of the valley. These works will require a Permit from CH.

3.4 Permitting and Authorization Requirements

3.4.1 Conservation Halton Permits

A Permit has already been received from CH for the removal of a portion of the industrial building that was located within 15 m of the top of bank. The works associated with that Permit have been implemented and the building has been removed.
Permits will be required from CH including:

- Removal of contaminated soil within 120 m of a wetland greater than 2 ha in size;
- Removal of contaminated soil within, and within 30 m of, a wetland less than 2 ha in size; and
- Slope stabilization in a localized area of erosion.

3.4.1.1 Works within 120m of a Wetland Greater than 2 ha in Size

In order to support the proposed works within 120m of the wetland, that is located within the Sixteen Mile Creek valley, CH advised that a hydrologic evaluation would be required, pursuant to CH Policy 2.39.5. A ToR for this evaluation was developed and approved by CH (**Appendix A-2**). The evaluation is to consider the following:

- Identification of the upstream catchment areas to the wetland;
- Quantification of surface runoff contributions to the wetland from the Subject Property;
- Estimation of the surface runoff contributions from the Subject Property relative to the overall catchment area;
- Assessment of how the site remediation works may affect surface runoff contributions to the wetland under interim conditions;
- Depth to groundwater within the area of the proposed remediation and discussion as to whether the proposed soil removal is anticipated to intercept groundwater;
- If contaminated soil removal is anticipated to intercept groundwater, the amount of dewatering will be estimated;
- Summary of potential adverse impacts on the hydrological functions of the wetland, if any, as the result of any interim changes to surface or groundwater flows; and
- Recommendations for management measures to mitigate potential hydrological impacts to the wetland, if needed.

In addition to the above, a complete application checklist was provided by CH (**Appendix A-3**). Below are the details that CH identified as being required as a component of the hydrologic evaluation.

Upstream Catchment Area

The upstream catchment area to the wetland within the Sixteen Mile Creek valley is 7,969 ha at Bronte Road as shown on **Appendix D – Drawing 1**.

Surface Contributions from Subject Property

As shown on **Appendix D – Drawing 1**, approximately 20.26 ha of the Subject Property drains overland towards the valley / wetland. This represents 0.25% of the overall catchment area to the wetland. Of the 20.26 ha of the Subject Property that drains towards the valley / wetland, approximately 16 ha (or 0.20 % of the overall wetland catchment area) is proposed to be (or is currently being) disturbed as a result of the removal of contaminated soil. To date, no soil has been removed from within CH's regulated area. Under interim conditions, when soil is removed from CH's regulated area, the anticipated impacts include a temporary ponding of surface water, within the excavated area, that would normally have flowed overland to the valley / wetland. It is anticipated that this interim condition will be in place for approximately 8 months, with surface flows to the valley / wetland re-instated once grades are returned to native, pre-landfill conditions. While a minor amount of surface flow will be temporarily prevented from flowing to the valley / wetland, the water will be retained within the excavated area which will allow for some infiltration and potentially benefit groundwater resources during the interim period. Under interim conditions, the side slopes of the excavated area will be seeded to assist with stabilization, once it has been confirmed no further excavation is required along that wall.

Depth to Groundwater

Within the area of the proposed soil removal, the depth to groundwater is approximately 7 mbgs. The excavation is proposed to extend 3.1 mbgs. As a result, groundwater interception is not anticipated.

Impacts to Hydrologic Function of Wetland

Given the very small area of surface water that will be temporarily prevented from flowing towards the wetland, in relation to the wetland's overall catchment area, there are no negative impacts to the hydrologic function of the wetland that are anticipated as a result of the contaminated soil removal. Even if minor impacts were to be anticipated on a temporary basis, the greater benefit of removing contaminated soils from within 120m of the wetland would presumably take precedence.

Summary of Hydrologic Evaluation

Based on the information provided above in this section, there are no management requirements necessary as there are no negative impacts to the hydrologic function of the wetland anticipated.

The above analysis is intended to support a future Permit application to CH.

3.4.1.2 Works Within, and Within 30 m of, a Wetland Less than 2 ha

The soil associated with the tailings pond / wetland, and within 30 m of the wetland, is contaminated and requires removal. The removal of this soil will necessarily result in the removal of the wetland. Significant pre-consultation has taken place with the agencies with respect to the most appropriate method of addressing this impact. It has been agreed that, through the CEMS process, a proposal to remove the wetland and replicate it with a wetland of the same size (0.23 ha), in a slightly different location and configuration would be acceptable to the agencies. CH has also provided a complete application checklist for this Permit application (**Appendix A-3**).

The wetland removal and replication will take place well in advance of any future residential development on the adjacent lands. As such, it was important to ensure that the re-created wetland would be self-sufficient and would not rely on future contributions from developed lands to sustain the hydroperiod. Through discussions with CH, and in consultation with the Region, it was agreed that a pit and mound wetland could be created as shown on **Appendix D - Drawing 3**.

The intention of the pit and mound wetland area is to re-create the habitat heterogeneity found in a mature forest – specifically, ephemeral pools and decomposing fallen trees – that facilitates the establishment of specialist plant, amphibian and invertebrate communities. The intention of this pit and mound wetland area is to create a wetland that is self-sufficient and does not rely on outside sources for water. The wetland has been designed to facilitate breeding amphibians in an average year and have a shallow perimeter that facilitates the growth of emergent vegetation.

The proposed pit and mound wetland is in generally the same location as the existing tailings pond / wetland however, it is proposed to be constructed at the woodland dripline to improve connectivity (wildlife movement, seed and pollen dispersal) to the RNHS Key Features, such as the Significant Woodland and Significant Wetland (within the valley). As the proposed pit and mound wetland will be planted with native species, in accordance with CH Landscaping Guidelines, moving the wetland closer to the woodland (as compared to existing conditions) will provide for complimentary functions and contribute to the overall habitat diversity in the long-term and serve as an Enhancement to Key Feature(s). As noted previously, the existing tailings pond / wetland is a constructed feature that was designed to provide spill containment sufficiently far away from the industrial building and landfill. Based on a review of historical aerial photographs, the tablelands on the Subject Property were farmed prior to industrial use and did not support any natural features like wetlands or woodlands. As such, there is no ecological basis for re-creating the new wetland in the exact same location as the existing tailings pond / wetland.

A water availability analysis for the pit and mound wetland area is provided in **Appendix B-8**.

A detailed landscaping plan will be submitted with a future Permit application to CH.

3.4.1.3 Works within a Confined Valley System – Erosion Hazard

As previously noted, there is a localized area of erosion along the Sixteen Mile Creek valley wall in the location of a stormwater outfall. This outfall is no longer in use and will be capped as part of the slope stabilization work. A portion of the pipe will be removed that is exposed; however, removal of the entire pipe that is buried within the slope is not recommended due to the anticipated impacts to the valley wall.

Pre-consultation related to this work has taken place with CH and a complete application checklist has been provided for the future Permit application (**Appendix A-3**).

The proposed restoration works are described in the slope stability report (**Appendix C-1**). The anticipated methodology and ecological rationale for the proposed slope stabilization approach are discussed in **Section 3.3**.

A Detailed Landscaping Plan, ESC Plan and Staging Plan will be required as part of the future CH Permit application.

3.4.2 Licence to Collect Fish for Scientific Purposes and Wildlife Scientific Collector's Permit Authorization

The Phase 2 remediation activities will require removal of the soil in the former tailings pond / wetland. This tailings pond / wetland contains Terrestrial Crayfish and Spring Peepers (frogs), based on ecological surveys. To rescue these species, prior to the removal of contaminated soil, a licence and authorization will be required from MNRF. A Licence to Collect Fish for Scientific Purposes will be required for the rescue of Terrestrial Crayfish, if it is deemed appropriate and necessary by MNRF. A Wildlife Scientific Collector's Authorization will be required for the rescue of Spring Peepers as they are regulated under the *Fish and Wildlife Conservation Act.* CH staff expressed concern regarding the potential negative impact of releasing wildlife that may be contaminated. This will be communicated to MNRF when applying for license and authorization.

3.5 Impact Assessment and Mitigation

The PPS and *Environmental Protection Act* require that the site be remediated in order to facilitate future land uses such as residential development. As described in **Section 3.2**, soil and groundwater contamination extends into areas that overlap with the Pre-Remediation Refined RNHS and CH-regulated areas. Additionally, as described in **Section 3.3**, slope stabilization works are necessary that will also occur within the RNHS and CH's regulated area.

Both the proposed remediation and slope stabilization works are being undertaken to improve the state and condition of the local ecosystem and are anticipated to result in a positive impact on Key Features of the RNHS over the long-term. There are no alternatives available for addressing the contaminants and slope failure. While the proposed works will result in short-term impacts to Key Features, these impacts can be mitigated over the long-term by using proven rehabilitation methods. In recognition of the temporary impacts, additional measures are proposed to improve and enhance the ecological resiliency of portions of Key Features that will not be affected by the proposed remediation and slope stabilization works. This approach will help to mitigate temporal impacts to ecological functions.

An assessment of impacts associated with the proposed contaminant remediation works and slope stabilization works and recommended mitigation are described in the following sections and described in **Table 15.**

3.5.1 Impacts to the Key Features and Components of the RNHS

Soil remediation is limited primarily to areas that are located outside of the Pre-Remediation Refined RNHS and the CH regulation limits. However, as shown on **Figure 3.1**, there are a few locations where soil excavation will be required within the limit of the Pre-Remediation Refined RNHS (i.e., within the Significant Woodland and the non-significant wetland associated with the former tailings pond) and within CH's regulatory allowances. Additionally, slope stabilization works proposed along the Sixteen Mile Creek valley also overlap with the Pre-Remediation Refined RNHS and CH regulated area (also shown on **Figure 3.1**).

3.5.1.1 RNHS Key Features

The proposed remediation works and slope stabilization works will require clearing of existing vegetation cover from within Key Features of the RNHS to access and remove the contaminated soils and to stabilize the area of slope failure. These activities are unavoidable and will impact the Key Features described below. Impacts to other Key Features of the RNHS such as significant wetlands and fish habitat are not anticipated.

Significant Habitat of Endangered and Threatened Species

The soil remediation and slope stabilization works will result in tree removals (see discussion on Significant Woodlands below) and this may result in the temporary loss of habitat for endangered bats that have been confirmed to be present. This activity can potentially constitute a contravention of Sections 9 and/or 10 of the ESA. To avoid contravention of the ESA, the proponent will file a Notice of Activity with the MECP prior to clearing and prepare a mitigation plan. Mitigation will include restricting clearing activities to periods when the bats are absent, followed by rehabilitation of affected areas by replanting of trees. These impacts are considered neutral over the short term and positive over the long term. See **Table 15** below for further details.

Significant Valleyland

No soil remediation is proposed on the valley slopes and therefore there will be no impacts to the Significant Valleyland as a result of remediation works. Slope stabilization works are however proposed to correct a localized slope failure. These works, described in **Section 3.3,** are very localized and will involve restoring the slope to native grade. The area of disturbance is small and will be rehabilitated by replanting native vegetation. These impacts are considered neutral over the short term and positive over the long term. See **Table 15** below for further details.

Significant Woodland

It is estimated that a 0.61 ha area of Significant Woodland will need to be cleared to facilitate remediation of contaminated soils. An additional 0.02 ha will be cleared to facilitate slope stabilization work along the valley wall. As described in **Section 3.2.2.1**, the remediation work will be completed incrementally to minimize unnecessary vegetation removals. Additionally, the preferred approach to slope stabilization is based on minimizing the disturbance footprint as discussed in **Section 3.3**. Based on tree inventory data collected from the tableland tree survey, it is estimated that the activities required

to excavate and remove the contaminated soils will directly (through physical removal) or indirectly (through impacts to root systems) affect approximately 82 trees. The anticipated impacts to vegetation are outlined in **Table 15**. Following soil remediation, these areas will be restored with appropriate, native vegetation, using CH's Guidelines for Landscaping and Rehabilitation Plans (2022). The impact on woodland habitat is considered to be neutral over the short term and positive over the longer term as the quality and diversity of the vegetation may be improved. See **Table 15** below for further details.

Significant Wildlife Habitat

Terrestrial crayfish have been observed to be associated with the tailings ponds / wetland. This wetland is contaminated and requires remediation which will potentially impact crayfish habitat. Artificial features, especially contaminated ponds, should generally not be considered as candidate SWH. Irrespective, the tailings pond / wetland must be removed to address the contaminants. It is anticipated that the proposed pit and mound wetlands that will be created to replace the wetland functions of the tailings pond / wetland will provide habitat for terrestrial crayfish in the future and that impacts to SWH will only be temporary. As discussed in **Section 3.4.2,** Beacon will be applying for a licence to capture and relocate the crayfish if MNRF deems this necessary. CH staff have indicated that it is their preference not to relocate wildlife that have been exposed to contaminants. The impact on habitat for this species is considered to be neutral over the short term and positive over the longer term as the soil and water conditions will be cleaner post-remediation. See **Table 15** below for further details.

3.5.1.2 RNHS Components

Impacts related to components of the RNHS are limited to non-significant wetlands.

Non-Significant Wetlands

The tailings pond / wetland is identified as a non-significant wetland and forms part of the Pre-Remediation Refined RNHS. As outlined in **Section 3.2.3**, this former tailings pond is contaminated and will be remediated. This is unavoidable and there are no alternatives other than to removal the contaminated soils within the wetland. The removal of contaminated soils is considered a positive impact as it will reduce the potential exposure of wildlife to contaminants. As discussed in **Section 2.1.5,** the tailings pond / wetland is a created feature and not natural. To mitigate the loss of wetland habitat, it is proposed to replace this wetland by creating pit and mound habitat of the same area, following remediation. The proposed pit and mound wetland area will be of the same size as the existing feature (0.23 ha) and will be designed to re-create the habitat heterogeneity found in a mature forest – specifically, ephemeral pools and decomposing fallen trees – that facilitates the establishment of specialist plant, amphibian and invertebrate communities. The intention of this pit and mound wetland area is to create a wetland that is self-sufficient and does not rely on outside sources for water. The pits will be designed to be deep enough to facilitate breeding amphibians in an average year and have a shallow perimeter that facilitates the growth of emergent vegetation. While minor habitat loss impacts will occur over the short-term, contaminants will no longer be present in the soil, which is a long-term benefit to the RNHS. The wetland will be situated immediately adjacent to the woodland, thereby maintaining and improving connectivity (wildlife movement, seed and pollen dispersal) to the adjacent Significant Woodland and Significant Wetland (within the valley). In addition, as the proposed pit and mound wetland will be planted with native species that will compliment and increase the woodland's

plant diversity in the long-term. Through implementation of diversification plantings, the rehabilitation will serve to enhance the Key Features.

In addition to the rehabilitation plantings of the woodland areas to the exact extent of the staked woodland dripline and the re-creation of the tableland wetland at a 1:1 ratio through the creation of pit and mound habitat, the future woodland and wetland buffers will be landscaped in accordance with CH Landscaping Guidelines. This will stabilize the buffer and allow it to become established prior to adjacent land use disturbances.

Although not a component of the RNHS, groundwater remediation will consist of ex-situ extraction and above ground treatment/removal of $Cr6^{+}$. Treated water will be reintroduced to the aquifer close to where it was extracted. The implementation of the in-situ system infrastructure will be conducted outside of the RNHS and areas regulated by CH and therefore no negative impacts will occur due to implementation of this remediation system. However, $Cr6^{+}$ as has a moderate solubility and, as such, the removal of $Cr6^{+}$-bearing groundwater, that could have migrated to the RNHS, the groundwater and potentially Sixteen Mile Creek is a significant long-term benefit to the natural heritage system and ground water system.

Impacts (both negative and positive) to the RNHS are proposed to be phased (see **Section 3.1**) and subject to the adaptive approaches to remediation as outlined in **Section 3.2.2**. Impacts are discussed in detail in **Table 15**.

3.5.1.3 Post-Remediation RNHS Key Features and Components

The Post-Remediation RNHS Key Features and components are to the same as those listed in **Section 2.2.8.7** (**Pre-Remediation Refined RNHS**); however, the non-significant wetland (tailings pond) will be reconfigured such that a pit and mound wetland area of the same size is provided more proximal to the woodland dripline. Recommended buffers to the Post-Remediation RNHS Key Features and components are described in the following section and illustrated on **Figure 3.2**.

Table 15. Impact Assessment and Mitigation

Category	Feature/Function	Proposed or Potential Impacts	Recommended Mitigation/Management	Net Effect		
				Phase 1	Phase 2	Phase 3 and Long-Term
Soils	**Topsoil and Subsoils**	Removal of existing contaminants in soils, including petroleum hydrocarbons (PHCs), metals, inorganics electrical conductivity (EC) and sodium adsorption ratio (SAR). An unregistered landfill will also be removed, which contains a mixture of construction debris, oily mill scale and soil. Removal of these soils will prevent the migration of contaminants into groundwater and the natural environment.	• Implement Best Management Practices (BMPs) such as proper separation, stockpiling and erosion control measures. • Following remediation, restore grades in disturbed portion of RNHS and CH regulated area with clean fill such that pre-landfill grades are re-instated and pre-remediation drainage patterns are provided to the extent possible. • Following restoration of grades within the RNHS, disturbed soils will be stabilized with the appropriate CH seed mix and tree planting as per the Restoration and Enhancement Plan	Positive	Positive	Positive
Groundwater	**Groundwater Flows**	The groundwater flow direction within the Site is inferred to be southwest toward the Sixteen Mile Creek. Ex-situ remediation of contaminated groundwater is not anticipated to have a significant impact on the groundwater flow regime outside of the groundwater treatment zone.	• No mitigation or management required as no impacts anticipated.	Neutral	Neutral	Neutral
	Groundwater Quality	Remediation of existing contaminants in groundwater, that may include PHCs, metals, inorganics EC and SAR. Remediation of groundwater will prevent migration of contaminants in the direction of Sixteen Mile Creek.	• Contaminated groundwater will be treated in an on-site treatment plant. Where treated water meets reuse standards, this treated water will be reinjected back into the on-site shallow aquifer.	Positive	Positive	Positive
Regional Natural Heritage System	**Habitat of Endangered or Threatened Species (Key Feature)**	Works within the woodland can be in contravention of sections 9 and/or 10 of the ESA.	In accordance with the requirements of the ESA and regulations: • A Notice of Activity will be registered with the Ministry • A mitigation plan will be prepared, followed and kept on record if the Ministry conducts an audit • Although not a requirement of the ESA, the Restoration Plan will include artificial bat roosts to provide an Enhancement to this Key Feature	—	—	Neutral – Positive
	Significant Wetlands (Key Feature)	There are no significant wetlands within the area to be remediated. Significant wetlands on the Subject Property include the Milton Wetland Complex within the Sixteen Mile Creek valley. Due to the migration of existing contaminants via groundwater, the remediation works are anticipated to prevent migration of contaminants towards the Significant Wetland.	• See groundwater mitigation and management above	Neutral – Positive	Neutral – Positive	Neutral – Positive
	Significant Woodlands (Key Feature)	Significant Woodlands occur on site and their outer boundary has been delineated by the Region. As noted above, excavation of contaminated soils in the significant woodland is anticipated to occur during the Stage 3 remediation. The limits of remedial excavation in the Stage 3 area will be refined through the iterative testing to the satisfaction of MECP (as discussed in **Section 3.2.2**). A best estimate of the disturbance area in this feature is 0.61 ha.	• Implement staged remediation plan with staged ESC fencing to protect features prior to approvals and permits • Undertake incremental additional soil removal, until soil contamination is removed, as outlined in **Section 3.2.2.1**. • Vegetation clearing should occur outside of the migratory bird nesting window and bat roosting window. • Restore remediated areas with clean topsoil, locally native vegetation, and tree plantings based on CH Landscaping Guidelines. • Following remediation, implement 10m woodland buffer and naturalize in accordance with CH Landscaping Guidelines.	—	Neutral	Neutral – Positive
	Significant Valleylands (Key Feature)	As noted in the *Slope Stability Assessment* by DS, there is erosion in one localized area along the valley slope at the location of a storm sewer pipe that serviced the previous	• Implement staged remediation plan with staged ESC fencing to protect features prior to approvals and permits	—	Neutral	Neutral – Positive

Category	Feature/Function	Proposed or Potential Impacts	Recommended Mitigation/Management	Net Effect		
				Phase 1	Phase 2	Phase 3 and Long-Term
		development (**Figure 2.2**). DS has provided a recommended approach to stabilize this slope, which would mitigate the potential migration of sediment into the Sixteen Mile Creek watercourse and re-establish the stable top of bank at the limit of the physical top of bank.	• Implement valley slope stabilization outlined in *Slope Stability Assessment* to mitigate existing erosion risk. • Restore disturbed areas by planting locally native vegetation based on CH Landscaping Guidelines. • Implement 15m long-term stable top of slope buffers and setbacks and naturalize in accordance with CH guidelines.			
	Significant Wildlife Habitat (Key Feature)	No confirmed SWH was identified on the Subject Property prior to the field surveys. Candidate SWH is present in the significant woodland, the former tailings pond / wetland (**Appendix B-7**). The proposed remediation is phased to impact these SWH features as follows: • Phase 1 — No impact • Phase 2 — Removal of former tailings pond / wetland and potential SWH for Terrestrial Crayfish and Eastern Wood-Pewee • Phase 3 — Partial removal at the perimeter of potential SWH for Woodland Raptor Nesting	• Implement staged remediation plan with staged ESC fencing to protect features prior to approvals and permits • If required by MNRF, wildlife rescue and relocation for terrestrial crayfish will be conducted after the issuance of a license from MNRF • As noted above, the significant woodland feature will be restored in remediated areas with clean topsoil, locally native vegetation, and tree plantings. • Raptor perches or snags will be included in the Restoration Plan • Following remediation, implement recommended 10m woodland dripline buffer, proposed pit and mound wetland and 15m wetland buffer	—	Neutral	Neutral – Positive
	Fish Habitat (Key Feature)	There is a potential for remediation activities to indirectly impact downstream fish habitat within Sixteen Mile Creek if sediment migrates to the watercourse or if water is released without appropriate mitigation measures. Due to the potential migration of existing contaminants via groundwater, the remediation works are anticipated to prevent the long-term migration of contaminants towards these features	• Implement the ESC recommendations as detailed in **Section** Error! Reference source not found..**1** • Implement the slope stabilization outlined in **Section 3.3** to mitigate the existing risk of erosion and sedimentation to the Sixteen Mile Creek.	Neutral – Positive	Neutral – Positive	Positive
	Linkages	The Sixteen Mile Creek valleylands are assumed to be significant valleylands and assumed to represent a regional scale linkage. The linkage function of these valleylands is not proposed to be altered.	• None required	—	—	—
	Watercourses	There is a potential for remediation to indirectly impact the CH-regulated watercourse if sediment migrates to the watercourse or if water is released without appropriate mitigation measures. Due to the potential migration of existing contaminants via groundwater, the remediation works are anticipated to prevent the long-term migration of contaminants towards the watercourse	• Implement the Erosion and Sediment Control (ESC) recommendations as detailed in **Section 3.5.2.1**	Neutral – Positive	Neutral – Positive	Positive
	Wetlands other than those considered Significant	As discussed in **Section 2.2.7.5** and shown on **Figure 2.2**, a non-significant wetland has been delineated within ELC Units 5.1, 5.2, and 9.0. This wetland served as a former tailings pond and contains contaminated soil; therefore, the feature is proposed for remediation by excavation in Stage 2. This will result in a temporary loss of wetland habitat.	• Implement staged remediation plan with staged ESC fencing to protect features prior to approvals and permits • If required by MNRF, conduct wildlife rescues (amphibians, terrestrial crayfish) with relevant collection permits • Vegetation clearing may only be permitted outside of the migratory bird nesting window and bat roosting window. • Removed wetland will be replaced at a 1:1 ratio with created pit and mound wetlands, to the satisfaction of the Region and CH.	—	Neutral – Positive	Positive

3.5.2 Mitigation Measures

In addition to the mitigation measures noted in **Table 15**, the following more detailed measures will also be implemented during remediation to minimize the disturbance and negative impacts to the RNHS and CH-regulated areas in the short-term. As noted in **Table 15**, drainage patterns will be retained to the extent possible such that pre-landfill grades are restored as demonstrated in **Drawing 4** (**Appendix D)**.

3.5.2.1 Erosion and Sediment Control

An erosion and sediment control strategy has been approved for the Subject Property in support of the on-site soil remediation works. Permit # 7980 was issued by CH in October 2021 for remediation work within the CH Regulated Area Boundary as shown on approved **Drawing 1001** (**Appendix D**). ESC details are provided on **Drawing 1001A** (**Appendix D**).

Erosion and sediment control measures will be implemented for all construction activities. The erosion and sediment control measures will be updated at each phase of soil remediation as shown in ESC **Drawings 1001-1004** (**Appendix D**). The following are ESC measures that will be implemented during remediation:

- Gravel mud mats will be installed at construction vehicle access points to minimize off-site tracking of sediments;
- Sediment control fence, and silt soxx have been installed prior to commencement of earthworks and remediation activities;
- Rock check-dams and cut-off swales have been installed to control, slow down and direct runoff to sediment basins;
- Sediment traps and ponds have been installed as shown; and
- All temporary erosion and sediment control measures will be routinely inspected / monitored and repaired during construction (on a weekly basis and after precipitation events).

The proposed ESC strategy was developed to be in general conformance with the following guidelines:

- CSA Erosion and Sediment Control Inspection and Monitoring (CAN/CSA-W202-18);
- Guidelines for Erosion and Sediment Control for Urban Construction Sites (TRCA, 2019); and
- Ministry of Transportation Environmental Guide for Erosion and Sediment Control (MTO, 2007).

Construction and ESC monitoring is discussed in **Section 4.2.1**.

3.5.2.2 Timing for Wildlife

Tree removal and grubbing will be timed to avoid harm to both bat species regulated under the ESA and bird species regulated under the *Migratory Bird Convention Act*. As such, vegetation clearing in the Phase 2 area and Phase 3 area is recommended to occur between November 1 and March 31.

3.5.2.3 Runoff Contingency Plan / Spills Management Plan

The proposed remediation strategy of excavation and off-site disposal of impacted soils does not involve storage or handling of any liquids, other than fuel required for site machinery. Impacted soils generated be remedial excavation, that are not immediately transported off-site for disposal, should be temporarily stockpiled when not actively worked. The erosion and sediment control measures described in **Section 3.5.2.1** will be adhered to in order to minimize potential mobilization of contaminants.

The groundwater treatment system involves solid media cartridges and, as such, spill management measures are not anticipated to be required. The treatment system involves extraction of groundwater from monitoring wells, which is run through the treatment media, and then re-infiltrated through post-treatment injection wells. Pressure checks are performed on a routine basis within the extraction system to ensure that there are no ongoing leaks of groundwater within the system. As a backup measure, the system is equipped with a spill containment kit to prevent migration of groundwater away from the groundwater treatment system, in the event of a spill. The system does not operate under inherent pressure (i.e., requires active power source to extract groundwater). As such, there is no concern with the ability to contain a leak, in the event that one is discovered. If a leak is detected, the system can be quickly deactivated, and the leak repaired.

As noted above, proper implementation and monitoring of ESC measures will provide the necessary site containment of sediments.

3.5.2.4 Restoration

The above mitigation serves to avoid or minimize impacts to the RNHS. Residual temporary impacts to the RNHS, caused by the remedial excavation or slope stabilization, will be mitigated by ecological restoration of the impacted area. The Conceptual Restoration Plan is discussed in **Section 4.1.**

3.6 Adaptive Environmental Management and Monitoring of Remediation Works

The remediation process is itself an adaptive process, with iterative monitoring of soil and groundwater contaminants as described below:

- As the limits of soil contamination cannot be precisely known until remediation is complete, the understanding of the extent of contamination will evolve over the course of the remediation work however, there is a fairly high level of confidence in the approximate extent of contamination as shown on **Figure 3.1**;
- In the interest of mitigating impacts to natural features, and not disposing of more soil than is required, the soil remediation will result in the minimal area disturbed to achieve MECP soil quality requirements;
- Similarly, groundwater remediation will occur until MECP requirements are achieved;
- If, during the course of remedial excavation, testing indicates the exceedance of soil contaminants within 15 m of the LTSTOS, consultation with CH will occur and the necessary Permit will be acquired before proceeding with remediation; and

- If the Risk Assessment process related to the Sixteen Mile Creek watercourse and/or wetlands leads to the requirement for remedial works within the watercourse, consultation with the relevant agencies will occur and the necessary permits will be acquired before proceeding with remediation.

Additional monitoring requirements are discussed in **Section 4.2**.

4. Post-Remediation Environmental Management

The goals of the Post-Remediation Environmental Management, as outlined in the CEMS ToR are as follows:

- Assess / identify opportunities to enhance the ecological integrity and resiliency of existing natural features and functions of the RNHS;
- Assess / identify opportunities to enhance natural corridors among hydrologic, hydrogeologic features, aquatic and wildlife linkages, terrestrial habitat corridors and restore degraded natural features; and
- Identify ecologically appropriate buffers that are based on the sensitivity and significance of the existing natural features and functions and potential impacts associated with future residential development.

The CEMS includes work to achieve each of these goals in the following ways:

- Through the ecological assessment and analyses, Key Features and opportunities to enhance Key Features were identified. These enhancements are independent of the long-term benefit of contamination remediation and are discussed in detail in **Section 4.1.5**;
- Through soil and groundwater testing analysis, geotechnical analysis and ecological analyses, the anticipated limits of contamination and stabilization in Key Features were identified. These area swill ultimately be planted with native trees, shrubs and ground covers where appropriate. Requirements to enhance / restore existing linkages and restore degraded habitat are discussed in detail in **Sections 4.1.1 – 4.1.3**; and
- Through the ecological analyses, the sensitivity of the existing Key Features was identified, along with the potential impacts of adjacent development. Requirements for ecologically appropriate buffers are discussed in detail in **Section 4.1.4**.

As per the CEMS ToR, a Conceptual Restoration Plan has been prepared to meet the above goals (**Figures 4.1A – 4.1D**). The Conceptual Restoration Plan outlines the restoration approaches to be applied to areas affected by remediation and slope stabilization works and a proposed design for the pit and mound habitats that will serve to replace the tailings pond wetlands that will be removed through remediation. Following approval of the CEMS and this Conceptual Restoration Plan, a Detailed Landscaping Plan will be prepared and submitted with the CH permit application required to initiate the remediation and slope stabilization works within CH's regulated area.

4.1 Conceptual Restoration Plan

The following subsections describe the components of the Conceptual Restoration Plan (**Figures 4.1A – 4.1D**).

4.1.1 Restoration of Area Affected by Slope Stabilization

The storm sewer pipe and outfall infrastructure that was previously constructed within the valleylands to service the manufacturing facility has resulted in erosion and slope failure along the valley wall in a localized area. As discussed in **Section 3.3**, to prevent further erosion and restore a degraded natural feature, it is proposed that the affected area be stabilized. This will also serve to enhance a natural corridor along a hydrologic linkage. The extent of this restoration work is illustrated on **Figure 4.1A** of the Conceptual Restoration Plan.

As the valleylands form part of the RNHS, a key objective for selecting a preferred approach to slope stabilization is reducing the disturbance footprint so as to protect as much of the existing vegetation along the slope as possible and thereby limit impacts to natural features and functions. The slope stabilization work provides an opportunity to improve the quality of vegetation in this area through planting of more suitable native species. While vegetation cover in the eroded area is generally low, it is comprised predominantly of non-native species and provides fewer supportive functions to the RNHS than native species.

The proposed construction and restoration approach for this area was developed to fulfil the following objectives:

- Restore the slope to match the adjacent valley slopes while minimizing the need to access or grade adjacent areas;
- Utilize construction methods that can perform most of the stabilization work without the need to access the valley with equipment;
- Minimize impacts to the flood plain wetland and creek by installing ESC measures at the toe of slope;
- Implement invasive species control measures within the work area;
- Stabilize disturbed areas by applying erosion blanket protection and revegetate by seeding area with a CH approved cover crop;
- Plant disturbed areas with container grown native groundcovers, vines, shrubs and trees to the satisfaction of the approval agencies; and
- Monitor the establishment of vegetation cover to identify deficiencies and replacement plantings.

4.1.2 Restoration of Woodland Areas Affected by Remediation

Portions of the tableland woodland feature (ELC Unit 2.0) overlap with the former landfill and require remediation due to the presences of contaminated soils (see **Figure 3.1** for estimated extents of remedial excavation). The soil remediation works will be conducted to minimize impacts to the remaining areas of the woodland that will not require remediation. Specific mitigation measures and incremental staging has been proposed to minimize impacts as described in **Section 3.2.2**.

As the woodland forms part of the RNHS, it is important that the restoration objectives align with maintaining the functions of Key Features and the broader ecological objectives for the RNHS. As was stated previously, the tableland woodland that will be affected by the remediation works is relatively young and has established on former agricultural lands that were abandoned in the 1960's (see **Appendix E**). The composition of this community does not reflect that of natural analogs.

Based on its history and the presence of a remnant forest community to the south of the Subject Property, it is proposed that the woodland be restored with the goal of directing its ecological trajectory towards a Dry–Fresh Sugar Maple Forest (FOD5). It should be noted that native plantings, with a shrub and groundcover layer, will serve to improve native plant diversity and community structure.

The proposed construction and restoration approach for this area were developed to fulfil the following objectives:

- Implement ESC measures;
- Minimize impacts to trees by following an incremental approach to remediation;
- Restore finished grades to original pre-landfill elevations;
- Apply clean topsoil to areas affected by remediation activities;
- Implement invasive species control measures within affected areas;
- Stabilize disturbed areas by applying erosion blanket protection and revegetate by seeding area with a CH approved cover crop;
- Plant disturbed areas with container grown native groundcovers, vines, shrubs and trees to the satisfaction of the agencies; and
- Monitor the establishment of vegetation cover to identify deficiencies and replacement plantings.

A conceptual design for the woodland restoration is provided in **Figure 4.1C**.

A Detailed Landscaping Plan will be prepared following agency acceptance of the CEMS and Conceptual Restoration Plan.

4.1.3 Wetland Restoration / Replacement of Wetland Affected by Remediation

The existing non-significant wetland is a degraded feature associated with a former tailings pond. This feature will be remediated and restored with pit-and-mound wetlands. The design goal of the pit-and-mound wetland was to re-create a wetland area equivalent to the combined area of the tailings pond / wetland with similar or improved ecological functions. The objectives of this wetland restoration are outlined below.

The pit-and-mound wetlands will be created adjacent to the Significant Woodland to improve connectivity (wildlife movement, seed and pollen dispersal) with RNHS Key Features. This improved connectivity will serve as a functional Enhancement to Key Features.

One pit will be designed to meet criteria for amphibian breeding and development. At the recommendation of CH staff, one pit will larger than the others to sustain a sufficient hydroperiod to support amphibian breeding. To ensure this larger pit receives as much water as possible, alternative designs were evaluated (as discussed in **Appendix B-8**). The preferred alternative was to place the larger pit at the at the downstream end of the wetland re-creation area to maximize catchment area.

This pit is anticipated to hold water in average years between February and July. The remaining pits will have shorter hydroperiods but will also support wetland communities.

A conceptual design for the wetland restoration is provided on **Figure 4.1B**.

The wetland restoration details, including a landscaping plan with native species, ESC measures, staging plan and wildlife rescue plan, if necessary, will be prepared to the satisfaction of CH, the Town, the Region and MNRF (if necessary) and will be submitted as part of a future Permit application to CH.

4.1.4 Buffers

The boundaries of the Pre-Remediation RNHS and Post-Remediation RNHS presented in this CEMS are nearly identical with three exceptions, as explained below:

- The limit of the Pre-Remediation Refined RNHS in the vicinity of the slope failure is based on the existing LTSTOS plus the 15 m setback. Once this section of slope is stabilized, the LTSTOS will become coincident with the CH staked top of slope and this is reflected in the Post-Remediation Refined RNHS;
- The limits of the Pre-Remediation Refined RNHS in the vicinity of the existing tailings pond / wetland is based on the CH staked wetland limits and the application of a 15 m buffer. Following remediation, the wetland will be replaced by an equivalent area of pit and mound habitat, but this habitat will be created slightly closer to the Significant Woodland as a buffer is not warranted between these two natural features. Consistent with CH policy for wetlands less than 2 ha in size, a 15 m buffer will be applied to the created pit and mound habitat and will form the boundary of the Post-Remediation RNHS at this location; and
- The Region's precautionary 30 m buffer adjacent to significant woodlands, as shown in the Pre-Remediation Refined RNHS, has been refined to a 10 m buffer applied to the staked dripline of the Significant Woodland in the Post- Remediation Refined RNHS. This 10 m buffer is considered ecologically appropriate to mitigate potential impacts of future residential development on the adjacent lands for the following reasons:
    - The buffer is sufficiently large to protect the root zones of existing trees. The cultural woodland and trees within it are relatively young (as shown in **Appendix E**) and many of the edge trees will be newly planted as a result of the remediation works;
    - The cultural woodland feature does not support habitat for species that are particularly sensitive to the proposed future uses. The wildlife species that are present, including endangered bats, are highly tolerant of urban conditions and adapted to stressors such as noise and light from the existing rail corridor, roads and adjacent industrial and residential lands uses;
    - The buffer offers sufficient space to implement dense plantings of trees and shrubs and will be fenced, both of which will serve to discourage encroachment and trespassing;
    - The buffer and adjacent Key Features will be dedicated to the municipality through the planning process;
    - Education signage can be posted on the fence to discourage trespassing;
    - The risk of informal trail development within the woodland is low considering it does not offer shortcuts to desired destinations; and
    - No trail is proposed within the 10 m buffer. Any future trail or active transportation connections within the adjacent community will be provided outside of the buffer.

In addition to the above, the recommended 10 m buffer is also consistent with CH's Land Use Planning policies relating to significant woodlands (S.3.6.4) which recommends that, in the absence of a Subwatershed Study, a minimum 10 m buffer to significant woodlands, outside of the Greenbelt Plan Area, be provided, to be confirmed through an EIS. As outlined in **Section 1.4.8**, the Greenbelt Plan Urban River Valley designation follows the Sixteen Mile Creek along the western limit of the Subject Property. The Urban River Valley policies of the Greenbelt Plan only apply to those lands that are publicly owned, which would include the lands owned by the Town at the base of the valley, immediately west of the Subject Property. The Significant Woodland extends outside of the lands owned by the Town and onto the Subject Property and, as such, the Urban River Valley policies of the Greenbelt Plan, and its minimum vegetated protection zone, would not apply to the woodland.

Implementation of the above recommended woodland and wetland buffers will mitigate potential impacts related to anticipated future residential uses on the Subject Property. In addition, it is recommended that any future trail be located outside of the 10 m buffer to the woodland, the 15 m buffer to the stable top of bank and the 15 m buffer to the wetland.

The proposed buffer and its treatment are identified on the Conceptual Restoration Plan (**Figures 4.1A-D**).

A Detailed Landscaping Plan will be prepared following agency acceptance of the CEMS and Conceptual Restoration Plan.

Additional aspects of the Conceptual Restoration Plan are discussed in **Section 4.1**.

4.1.5 Enhancements to Key Features

ROP policy 229.1.1 defines Enhancements to Key Features as follows:

> *Means ecologically supporting areas adjacent to Key Features and/or measures internal to the Key Features that increase the ecological resilience and function of individual Key Features or groups of Key Features.*

For the purpose of the CEMS, the Enhancements to Key Features have been subdivided into two categories discussed below: (1) enhancements related to the remediation and slope stabilization, and (2) enhancements that are supplementary to the remediation and slope stabilization works.

Project Related Enhancements

The proposed remediation and slope stabilization works represent enhancements to Key Features of the RNHS as these activities are being undertaken to address soil and groundwater contamination and anthropogenically induced slope failure, both of which impair the resiliency and function of the RNHS. These measures, internal to the Key Features, will have the effect of increasing ecological resilience and function of the Key Features by removing pollution from land and water to improve the ecological state and condition of the RNHS.

The following is a summary of project related activities that are considered Enhancements to Key Features of the RNHS:

- The remediation of groundwater and soil resources will remove contamination from affected Key Features and thereby prevent further degradation of land and water in the RNHS;
- Soils will be remediated in Key Features including: Habitat of Endangered or Threatened Species, Significant Woodlands, and Significant Wildlife Habitat;
- The potential migration of contaminants to the following Key Features by groundwater will be mitigated thereby protecting the Significant Wetlands and Fish Habitat;
- The localized area of slope instability, which occurs in Habitat of Endangered or Threatened Species, Significant Woodlands, Significant Valleyland and SWH will be stabilized and restored with rock and native vegetation which will mitigate further erosion and potential for sedimentation of Fish Habitat; and
- In remediated areas, the Key Features will be restored to pre-landfill grades with clean topsoil, locally native vegetation and tree plantings to the satisfaction of CH, the Town and Region.

Additional Enhancements

In addition to the above enhancements that are directly related to the remediation and slope stabilization, the CEMS has identified opportunities to enhance the portions of the Significant Woodland that are not directly affected by the remediation and slope stabilization works. These areas are identified on the Conceptual Restoration Plan (**Figures 4.1A-D**). In these areas, opportunities for enhancement include:

- Removal of anthropogenic refuse and waste;
- Removal or control of invasive species;
- Diversification of vegetation by underplanting with native species; and
- Creation of supplemental wildlife habitat using natural or artificial structures.

These additional enhancements will be included as part of the Detailed Landscaping Plan which will be prepared following agency acceptance of the CEMS and Conceptual Restoration Plan.

4.2 Monitoring

In addition to the remediation-specific monitoring described in **Section 3.2.2**, this section describes additional monitoring measures to ensure that the specified mitigation measures have been implemented and are performing as anticipated.

This section has been divided into Erosion and Sediment Control monitoring and Ecological Restoration monitoring.

4.2.1 ESC Monitoring

As described in **Section 3.5.2.1**, an ESC Strategy was prepared in relation to the remediation works. The strategy outlines the various measures that will be implemented to address erosion and sedimentation during the remediation work phases and is provided in **Appendix D - Drawings 1001–1003**.

The following list provides a summary of key components of the ESC Strategy:

- Inspections conducted by a competent person (e.g., CAN-CISEC);
- Inspections frequency on weekly basis, at a minimum:
  - Prior to predicted rain events;
  - After rain events;
  - After significant snow melt; and
  - Daily during extended rain or snow melt;
- Damaged ESC measures to be repaired within 48 hours of inspection;
- ESC Strategies on **Drawings 1001–1003** are not static and should be adaptively managed as needed to prevent sediment release;
- Sediment accumulation by ESC measures to be inspected and cleaned, if required, to maintain function; and
- ESC Strategies shall continue until site achieves 80% stabilization, as per CAN/CSA-W202-18.

4.2.2 Restoration Monitoring

Restoration monitoring will be conducted for three-years post-remediation to ensure that long-term impacts to the RNHS are as anticipated. A network of monumented photo stations will be established to document the evolution of the RNHS during the monitoring period. Monitoring activities and requirements are outlined in **Table 16** below.

Table 16. Restoration Monitoring and Adaptive Management

Category	Monitoring Target(s)	Adaptive Management Action(s)	Methods	Monitoring Frequency	Reporting Requirements	Responsibilities for Monitoring
Landscaped Areas: 1) Slope Stabilization Area 2) Remediated Woodland Area 3) Re-created Wetland Area 4) Buffer Area 5) Additional Enhancement Area(s)	In conformance with landscaping plans and CH planting densities Conditions of planting warranty are met by end of two-year period	Any planting deficiencies to be corrected by landscaping contractor	Inventory and assess landscaped areas	At time of installation Prior to expiration of planting warranty	In first annual report, include confirmation of planting conformance with landscaping plans In third annual report, include confirmation that planting warranty conditions are met	Beacon
Hydrology of Re-Created Wetland	Appropriate hydroperiod for the establishment of wetland vegetation	If necessary, modify pit and mounds to achieve desired hydrology	Continuous monitoring of water depth in large pit via pressure transducer Confirm and map the extent of hydrophytic and water tolerant vegetation using the OWES wetland plant list	As required for continuous monitoring Annually for wetland plant establishment	In each annual report, include: - results of continuous water level monitoring in the large pit; and - mapping of extent of wetland vegetation. If amphibians or terrestrial crayfish are observed during annual surveys, these observations will be included in the monitoring report	Beacon
Anthropogenic Refuse/Waste in Woodland	In conformance with landscaping plans	Direct contractor to rectify deficiencies	Inventory of previously mapped refuse/waste	Within the season that waste was removed	In first annual report, include confirmation of conformance with landscaping plans	Beacon
Invasive Species Treatment in Tableland Woodland	In conformance with landscaping plans Post treatment or removal to have 10% or less of previous cover	Direct contractor to rectify deficiencies	Mapping/ inventory of areas identified for invasive species management	If herbicide application is specified, compliance monitoring shall occur at the time of herbicide application If removal is specified, compliance monitoring may occur within the same season All treatments/ removals shall be subject to performance monitoring	In first annual report, include confirmation of conformance with landscaping plans In each annual report following the first year, include mapping of invasive species extent	Beacon
Supplemental Wildlife Habitat Structures	In conformance with landscaping plans In functional state in subsequent years	Direct contractor to rectify deficiencies	Visual inspection	At time of installation Once annually in subsequent years	Include status of habitat structures in all annual reports	Beacon

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4.3 Next Steps

4.3.1 CH Permits

As was noted in **Section 3.4.1**, permits will be required from CH to address the following:

- Removal of contaminated soils within 120 m of a wetland greater than 2 ha in size;
- Removal of contaminated soils within, and within 30 m of, a wetland less than 2 ha in size; and
- Slope stabilization of the eroding valley wall at the site of a former stormwater outfall.

Pre-consultation related to this work has taken place with CH and complete application checklists have been provided for the future Permit applications (**Appendix A-3**). In anticipation of the CH permitting requirements, included within this CEMS is a Hydrologic Evaluation that examines impacts to drainage catchment areas and flows as resulting from the remediation works. This evaluation was prepared in accordance with separate ToR developed and approved by CH (**Appendix A-2**). Additionally, a Water Availability Analysis was also prepared for the pit and mound wetland area to confirm that it can support wetland and habitat for pond breeding amphibians (**Appendix B-8**).

4.3.2 Rezoning Application for Future Residential Development

This CEMS is a comprehensive document that is supported by extensive technical study and analyses. The ToR for the CEMS were prepared with the objective of fulfilling the technical study requirements necessary to support a zoning by-law amendment to refine the RNHS limit. In addition, the buffers to the Key Features have been recommended based on a future planning application for residential development on the Subject Property.

A key objective of the CEMS was to identify the boundaries of the RNHS as this is necessary to establish the limits of future developments and support rezoning and draft plan applications. As described in this report, the limits of the Post-Remediation Refined RNHS (**Figure 3.2**) have been established by applying ecologically appropriate buffers that will provide RNHS components with necessary protection, in support future residential land uses. In this regard, the CEMS report satisfies the requirements of an Environmental Impact Assessment (EIA) or Subwatershed Impact Study (SIS), as outlined in ROP Policy 116.1. As such, upon approval of the CEMS, it is the opinion of the Study Team that further impact studies or impact assessments would not be required to support rezoning and/or draft plan applications.

5. Conclusion

This CEMS has been prepared in accordance with the agency approved ToR contained in **Appendix A-1**.

The primary purpose of the CEMS is to describe the extent of contaminant remediation works proposed for portions of the Subject Property that overlap with RNHS and CH regulated areas and to develop environmental management strategies that can mitigate adverse impacts and enhance the functions of the RNHS. In addition, the CEMS has refined the RNHS boundary, in accordance with regional policies,

to establish limits of development to support the re-zoning and draft plan applications for future re-development of the Subject Property.

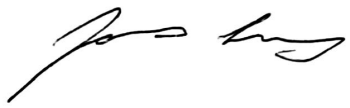
The CEMS is a comprehensive study that has been prepared by a multi-disciplinary team. The information used to characterize the biophysical resources in the Study Area was derived from background reviews, field investigations and are supported by technical analyses as per the ToR.

The CEMS has evaluated the existing biophysical resources and natural hazards to identify all Key Features and other components of the RNHS in accordance with regional policies. The limits of Key Features and natural hazards were confirmed through field verification with agencies or through technical analyses and used to establish the boundaries of the Pre-Remediation Refined RNHS.

The impact assessment describes in detail the proposed remediation and slope stabilization works and related mitigative and restoration measures and their short and long-term impacts on various components of the RNHS. The impact assessment finds that the proposed activities will have a positive impact on the RNHS and its functions. A Conceptual Restoration Plan has been included in the CEMS that identifies how affected areas will be rehabilitated and restored, including plans for creating an equivalent area of pit and mound habitat to replace the tailings pond / wetland that will be affected by the remediation activities. Additionally, the Conceptual Restoration Plan includes management recommendations for enhancing the ecological functions of portions of the Significant Woodland unaffected by the remediation works.

The boundaries of the Post-Remediation RNHS were further refined by applying ecologically appropriate buffers to the created pit and mound wetland (15 m), Significant Woodland (10 m) and CH regulatory setbacks to the final Long Term Stable Top of Slope (15 m). Buffers were prescribed based on the sensitivities of the natural features and functions and their suitability for mitigating impacts related to future residential land uses.

Prepared by:
Beacon Environmental



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APPENDIX B
Stormwater Calculations

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urbantech.com

STORM SEWER DESIGN SHEET

5 Year Storm + CONST. FLOWS (PIPE SIZING)

150 STEELES AVENUE

Town of Milton

PROJECT DETAILS

Project No: 21-678

Date: 1-Mar-25
Last Updated: 7-Mar-25
Designed by: M.H.
Checked by: S.R.

DESIGN CRITERIA

Minimum Diameter =	300	mm	Rainfall Intensity =	A
Mannings 'n'=	0.013			(Tc+B)^c
Starting Tc =	10	min	A =	959
			B =	5.7
Factor of Safety =	20	%	c =	0.8024

NOMINAL PIPE SIZE USED

STREET	FROM MANHOLE	TO MANHOLE	AREA (A) (ha)	RUNOFF COEFFICIENT (R)	'A*R'	ACCUM. 'A*R'	RAINFALL INTENSITY (mm/hr)	FLOW (Q5) (m3/s)	CONSTANT FLOW (Q100-Q5) (m3/s)	ACCUM. CONSTANT FLOW (Q100-Q5) (m3/s)	TOTAL FLOW (Q TOTAL) (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL TIME OF CONC. (Tc) (min)	TIME OF CONCENTRATION (Tc) (min)	ACCUMULATED TIME OF CONCENTRATION (Tc) (min)	PERCENT FULL (%)
PARK		1	0.16	0.25	0.04	0.04	105.3	0.012	0.002	0.002	0.014	19.0	0.50	300	0.068	0.97	10.00	0.33	10.33	20%
	1	2	0.48	0.90	0.43	0.47	103.5	0.136		0.002	0.138	12.0	0.50	450	0.202	1.27	10.33	0.16	10.49	68%
ST A	2	3	0.62	0.95	0.59	1.06	102.7	0.303		0.002	0.305	58.0	0.50	600	0.434	1.54	10.49	0.63	11.11	70%
	4	3	0.22	0.90	0.20	0.20	105.3	0.058	0.015	0.015	0.073	15.0	0.50	375	0.124	1.12	10.00	0.22	10.22	59%
	3	5				1.26	99.6	0.348		0.017	0.365	22.0	0.50	675	0.594	1.66	11.11	0.22	11.34	61%
	5	6				1.26	98.6	0.345		0.017	0.362	59.0	0.50	675	0.594	1.66	11.34	0.59	11.93	61%
	7	8	0.70	0.90	0.63	0.63	105.3	0.184			0.184	8.0	0.50	525	0.304	1.40	10.00	0.09	10.09	61%
ST C	8	6	0.24	0.90	0.22	0.85	104.7	0.246			0.246	48.0	0.50	525	0.304	1.40	10.09	0.57	10.66	81%
	9	6	0.94	0.90	0.85	0.85	105.3	0.247	0.022	0.022	0.269	17.0	0.50	600	0.434	1.54	10.00	0.18	10.18	62%
ST A	6	10	0.38	0.95	0.36	3.31	95.9	0.882		0.039	0.921	81.0	0.50	900	1.280	2.01	11.93	0.67	12.60	72%
	11	10	1.38	0.90	1.24	1.24	105.3	0.363			0.363	15.0	0.50	675	0.594	1.66	10.00	0.15	10.15	61%
	12	10	0.41	0.90	0.37	0.37	105.3	0.108			0.108	11.0	0.50	450	0.202	1.27	10.00	0.14	10.14	54%
ST A	10	13				4.92	93.1	1.273		0.039	1.312	32.0	0.30	1200	2.135	1.89	12.60	0.28	12.88	61%
PARK	14	13	0.09	0.25	0.02	0.02	105.3	0.007			0.007	12.0	0.50	300	0.068	0.97	10.00	0.21	10.21	10%
ST A	13	15				4.95	91.9	1.263		0.039	1.302	24.0	0.30	1200	2.135	1.89	12.88	0.21	13.09	61%
ST B	16	17	0.29	0.95	0.28	0.28	105.3	0.081			0.081	56.0	0.50	375	0.124	1.12	10.00	0.83	10.83	65%
	18	17	0.52	0.90	0.47	0.47	105.3	0.137			0.137	16.0	0.50	450	0.202	1.27	10.00	0.21	10.21	68%
	17	19	0.39	0.95	0.37	1.11	101.0	0.312			0.312	60.0	0.50	600	0.434	1.54	10.83	0.65	11.48	72%
	20	19	0.24	0.90	0.22	0.22	105.3	0.063			0.063	16.0	0.50	375	0.124	1.12	10.00	0.24	10.24	51%
	21	19	2.56	0.90	2.30	2.30	105.3	0.674			0.674	9.0	0.50	825	1.015	1.90	10.00	0.08	10.08	66%
	19	22				3.63	97.9	0.988			0.988	62.0	0.50	900	1.280	2.01	11.48	0.51	12.00	77%
	22	23	0.15	0.95	0.14	3.78	95.6	1.003			1.003	39.0	0.50	900	1.280	2.01	12.00	0.32	12.32	78%
	23	15				3.78	94.2	0.989			0.989	24.0	0.50	900	1.280	2.01	12.32	0.20	12.52	77%
ST A	15	24	0.18	0.95	0.17	8.89	91.1	2.251		0.039	2.290	18.0	0.25	1200x1800 (BOX)	4.204	1.95	13.09	0.15	13.25	54%
	24	25	0.15	0.95	0.14	9.04	90.5	2.272		0.039	2.311	29.0	0.25	1200x1800 (BOX)	4.204	1.95	13.25	0.25	13.50	55%

Urbantech Consulting, A Division of Leighton-Zec Ltd.
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STORM SEWER DESIGN SHEET

5 Year Storm + CONST. FLOWS (PIPE SIZING)

150 STEELES AVENUE

Town of Milton

PROJECT DETAILS

Project No: 21-678

Date: 1-Mar-25
Last Updated: 7-Mar-25
Designed by: M.H.
Checked by: S.R.

DESIGN CRITERIA

Minimum Diameter =	300	mm	Rainfall Intensity =	A
Mannings 'n'=	0.013			(Tc+B)^c
Starting Tc =	10	min	A =	959
			B =	5.7
Factor of Safety =	20	%	c =	0.8024

NOMINAL PIPE SIZE USED

STREET	FROM MANHOLE	TO MANHOLE	AREA (A) (ha)	RUNOFF COEFFICIENT (R)	'A*R'	ACCUM. 'A*R'	RAINFALL INTENSITY (mm/hr)	FLOW (Q5) (m3/s)	CONSTANT FLOW (Q100-Q5) (m3/s)	ACCUM. CONSTANT FLOW (Q100-Q5) (m3/s)	TOTAL FLOW (Q TOTAL) (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL TIME OF CONC. (Tc) (min)	TIME OF CONCENTRATION (Tc) (min)	ACCUMULATED TIME OF CONCENTRATION (Tc) (min)	PERCENT FULL (%)
ST A	26	27	0.19	0.95	0.18	0.18	105.3	0.053	0.035	0.035	0.088	64.0	0.30	450	0.156	0.98	10.00	1.09	11.09	56%
	27	28	0.32	0.95	0.30	0.48	99.8	0.134		0.035	0.169	47.0	0.30	525	0.236	1.09	11.09	0.72	11.81	72%
	29	28	0.72	0.75	0.54	0.54	105.3	0.158			0.158	11.0	0.50	525	0.304	1.40	10.00	0.13	10.13	52%
	28	25				1.02	96.4	0.274		0.035	0.309	46.0	0.30	675	0.460	1.29	11.81	0.60	12.40	67%
	30	25	0.45	0.90	0.41	0.41	105.3	0.118			0.118	11.0	0.50	450	0.202	1.27	10.00	0.14	10.14	59%
ST E	25	31	0.29	0.95	0.28	10.74	89.6	2.672		0.074	2.746	74.0	0.25	1200x1800 (BOX)	4.204	1.95	13.50	0.63	14.13	65%
	32	31	0.41	0.90	0.37	0.37	105.3	0.108			0.108	10.0	0.50	450	0.202	1.27	10.00	0.13	10.13	54%
	31	33				11.11	87.3	2.693		0.074	2.767	32.0	0.25	1200x1800 (BOX)	4.204	1.95	14.13	0.27	14.40	66%
	34	33	0.43	0.90	0.39	0.39	105.3	0.113			0.113	10.0	0.50	450	0.202	1.27	10.00	0.13	10.13	56%
	35	33	0.95	0.75	0.71	0.71	105.3	0.208			0.208	6.0	0.50	525	0.304	1.40	10.00	0.07	10.07	69%
	33	36				12.21	86.3	2.927		0.074	3.001	52.0	0.25	1200x1800 (BOX)	4.204	1.95	14.40	0.45	14.85	71%
PARK	37	38	1.04	0.25	0.26	0.26	105.3	0.076			0.076	11.0	0.50	375	0.124	1.12	10.00	0.16	10.16	61%
ST D	38	39	0.40	0.95	0.38	0.64	104.4	0.186			0.186	15.0	0.50	525	0.304	1.40	10.16	0.18	10.34	61%
	39	36				0.64	103.5	0.184			0.184	104.0	0.50	525	0.304	1.40	10.34	1.23	11.58	60%
	36	40	0.18	0.95	0.17	13.02	84.8	3.067		0.074	3.141	57.0	0.25	1200x1800 (BOX)	4.204	1.95	14.85	0.49	15.34	75%
ST D	41	42	0.19	0.95	0.18	0.18	105.3	0.053	0.064	0.064	0.117	20.0	0.30	450	0.156	0.98	10.00	0.34	10.34	75%
	43	42	0.21	0.90	0.19	0.19	105.3	0.055			0.055	13.0	0.50	375	0.124	1.12	10.00	0.19	10.19	45%
	42	44				0.37	103.5	0.106		0.064	0.170	51.0	0.30	525	0.236	1.09	10.34	0.78	11.12	72%
	45	44	0.24	0.90	0.22	0.22	105.3	0.063			0.063	14.0	0.50	375	0.124	1.12	10.00	0.21	10.21	51%
	46	44	0.36	0.90	0.32	0.32	105.3	0.095			0.095	8.0	0.50	375	0.124	1.12	10.00	0.12	10.12	76%
	44	40	0.13	0.95	0.12	1.03	99.6	0.286		0.064	0.350	36.0	0.30	750	0.610	1.38	11.12	0.43	11.56	57%
	40	HW				14.05	83.2	3.249		0.138	3.387	23.0	0.25	1200x1800 (BOX)	4.204	1.95	15.34	0.20	15.53	81%

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PROJECT DETAILS	
Title1:	**STORM SEWER DESIGN SHEET**
Title2:	**Constant Flow Calculations**
Project Name:	**150 STEELES AVENUE**
Municipality:	**Town of Milton**
Project No:	**21-678**
Date:	**1-Mar-25**
Designed by:	**M.H.**
Checked by:	**S.R.**

IDF Parameters for Milton			
		5-yr	100-yr
$I=A/(T+b)^c$	A	959	1435
	B	5.7	5.2
	C	0.8024	0.7751

CAPTURE LOCATION	AREA ID	CAPTURE POINT (MH)	Area ha	R	AR	Flow Length m	Velocity m/s	Tc* min	I5 mm/hr	I100 mm/hr	Q5 m3/s	Q100 m3/s	Q100-Q5 m3/s	Const. flow m3/s
STREET 'A'	1	MH 27	0.19	0.95	0.18	50.00	2.00	10.01	105.2	174.0	0.053	0.088	0.035	**0.035**
STREET 'D'	2	MH 41	0.35	0.95	0.33	50.00	2.00	10.01	105.2	174.0	0.097	0.161	0.064	**0.064**
PARK	3	MH 0	0.05	0.25	0.01	10.00	2.00	10.00	105.2	174.1	0.004	0.006	0.002	**0.002**
BLOCK 19	4	MH 4	0.09	0.90	0.08	10.00	2.00	10.00	105.2	174.1	0.024	0.039	0.015	**0.015**
BLOCK 20	5	MH9	0.13	0.9	0.12	10.00	2.00	10.00	105.2	174.1	0.034	0.057	0.022	**0.022**

*Where available, Tc is calculated from design sheet or overland flow calculation

Tc calcs *where Tc = starting Tc + flow length/velocity*
(starting Tc = 10min)

Assumed Velocities for Calculation of time of Concentration
Pipe Flow Velocity= 2.0 m/s
OLF Velocity= 1.5 m/s
External Flow Velocity= 0.25 m/s

P:\Projects\21-678 - 150 Steeles Ave E. (Neatt Comm.- Milton - Halton)\Reports\Functional Servicing Report\Calculations & Models\Storm Sewer Design Sheets\[21-678_STM (5 yr) a

URBANTECH®

SWM POND DESIGN CALCULATION - POND
TARGET SUMMARY

Project Name: 150 Steeles Avenue East
Municipality: Town of Milton
Project No.: 21-678
Date: 11-Mar-25

Prepared by: J.P.O

POND

Area	18.14
Imperviosuness	84%

Wet Pond *(Per MOE Stormwater Management Planning and Design Manual 2003, Table 3.2)*

Impervious Level (%)	Water Quality Storage Vol m^3/ha	Extended Detention m^3/ha	Permanent Pool m^3/ha
35%	140	40	100
55%	190	40	150
70%	225	40	185
85%	250	40	210
Interpolated Storage Requiremen			
84.4%	249	40	**209**

	Area [ha]	IMP%
Total Contributing Area	18.14	84%
Quantity Control Only	18.14	84%
Quality Control Only	18.14	84%

URBANTECH

SWM DESIGN CALCULATIONS - POND
Contributing Drainage Area and Land Use

Project Name: 150 Steeles Avenue East
Municipality: Town of Milton
Project No.: 21-678
Date: 11-Mar-25

Prepared by: J.P.O

POND

POND	From	To	Area [ha]	Runoff Coefficient	Imperviousness %IMP=100 X (C-0.2)/0.7	Design Requirement		
						Conveyance	Quantity	Quality
Total Drainage Area to HW-1 (including pond block)			18.14	0.81	87.1	•	•	•
Total Drainage Area (Quality Control Only)			**18.14**	**0.81**	87.1			
Total Drainage Area (Quantity Control Only)			**18.14**	**0.81**	87.1			
Total Drainage Area to Pond			**18.14**	**0.81**	87.1	**18.14**	**18.14**	**18.14**

URBANTECH®

SWM POND DESIGN CALCULATIONS
Drawdown Time

Project Name: 150 Steeles Avenue East
Municipality: Town of Milton
Project No.: 21-678
Date: 11-Mar-25

Prepared by: J.P.O

Pond

Detention Time Calculations

$t = (0.66C_2h^{1.5}+2C_3h^{0.5})/2.75Ao$ *(MOECC Eq'n 4.11)*

t= 124079 *drawdown time in seconds*
t= 34 *drawdown time in hours*

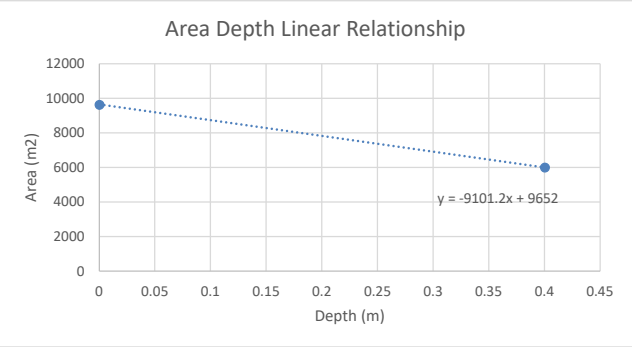
d = 0.150 *diameter of orifice (m)*
A_0= 0.0177 *cross-sectional area of the orifice (m^2)*
h= 0.325 *maximum water elevation above orifice (m)*

$Q_{ext\ det}$ = 0.0268 *proposed extended detention release rate (m3/s)*

C_2= 2469.75 *slope coefficient from the area-depth linear regression*
C_3= 5024 *intercept from the area-depth linear regression*

Pond area-depth relationship for linear regression:

	Elevation (m)	Area (m^2)	Depth (m)
PERM POOL	201.70	5024	0.00
EXT DET	202.10	6012	0.40



The drawdown time for the Pond is 34.5 hours (1.4 days)

URBANTECH

SWM DESIGN CALCULATIONS
EMERGENCY SPILLWAY WEIR

Project Name: 150 Steeles Avenue East
Municipality: Town of Milton
Project No.: 21-678
Date: 2025-03-11

Prepared by: J.P.O

POND

Input Parameters:

Side Slope, S_1	12	:1
Side Slope, S_2	12	:1
Spillway Invert	204.70	m
Water Level	205.0	m
Flow Depth, H	0.3	m
Bottom Width, B:	30.0	m

Weir equation:	**$Q = BxC_dxH^{3/2} + SxC_dxH^{5/2}$**
	C_d = 1.5
where:	*Q=flow rate (m3/s)*
	H= head on the weir (m)
	B=width of the weir (m)
	S = side slopes of weir (H:V)

Computed Values:

Capacity, Q at 205m	**8.28**	m^3/s
Emergency Flow Required via Spillway	**7.63**	m^3/s

The proposed emergency spillway provides sufficient capacity.

2-100 Year Event

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       V    V   I    SSSSS  U   U    A    L             (v 6.2.2019)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****


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859b3fbb-4aad-4232-aa22-0887b1eb072d\


DATE: 03-10-2025                          TIME: 09:04:16

USER:


COMMENTS: _____________________________________________________________


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  ************************************************
  ** SIMULATION : 1 - 25mm                      **
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|    READ STORM    |    Filename: C:\Users\jannaormond\AppD
|                  |              ata\Local\Temp\
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|                  |              aeda89c8-bf39-4d75-9adb-30208b7c7670\cdc1c382
| Ptotal= 12.00 mm |    Comments: 25MM4HRC_10min Edited 2012
-------------------
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.00    0.00 |  0.83    0.00 |  1.67    5.04 |  2.50    0.72
                0.08    0.00 |  0.92   12.24 |  1.75    5.04 |  2.58    0.00
                0.17    0.72 |  1.00   12.24 |  1.83    0.00 |  2.67    0.72
                0.25    0.72 |  1.08    0.00 |  1.92    2.88 |  2.75    0.72
                0.33    0.00 |  1.17   33.12 |  2.00    2.88 |  2.83    0.00
                0.42    0.72 |  1.25   33.12 |  2.08    0.00 |  2.92    0.72
                0.50    0.72 |  1.33    0.00 |  2.17    1.44 |  3.00    0.72
                0.58    0.00 |  1.42    9.36 |  2.25    1.44 |
                0.67    4.32 |  1.50    9.36 |  2.33    0.00 |
                0.75    4.32 |  1.58    0.00 |  2.42    0.72 |

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| CALIB            |
| STANDHYD (  0001)|   Area    (ha)=  14.86
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  50.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.43         7.43
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     314.75        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      33.12         0.98
               over (min)        10.00        55.00
     Storage Coeff.  (min)=       7.91 (ii)   52.88 (ii)
     Unit Hyd. Tpeak (min)=      10.00        55.00
     Unit Hyd. peak  (cms)=       0.13         0.02
                                                      *TOTALS*
     PEAK FLOW       (cms)=       0.43         0.01          0.431 (iii)
     TIME TO PEAK    (hrs)=       1.33         2.42           1.33
     RUNOFF VOLUME    (mm)=      11.00         0.95           5.97
     TOTAL RAINFALL   (mm)=      12.00        12.00          12.00
     RUNOFF COEFFICIENT   =       0.92         0.08           0.50


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| CALIB            |
| STANDHYD (  0004)|   Area    (ha)=  18.20
|ID= 1 DT= 5.0 min |   Total Imp(%)=  95.00   Dir. Conn.(%)=  95.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      17.29         0.91
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     348.33        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      33.12         1.56
               over (min)        10.00        15.00
     Storage Coeff.  (min)=       8.40 (ii)   11.79 (ii)
     Unit Hyd. Tpeak (min)=      10.00        15.00
     Unit Hyd. peak  (cms)=       0.12         0.09
                                                      *TOTALS*
     PEAK FLOW       (cms)=       0.97         0.00          0.975 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.67           1.33
     RUNOFF VOLUME    (mm)=      11.00         0.95          10.50
     TOTAL RAINFALL   (mm)=      12.00        12.00          12.00
     RUNOFF COEFFICIENT   =       0.92         0.08           0.87


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| RESERVOIR(  0005)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000      0.0000   |    2.7380      0.4708
                          0.0268      0.2254   |    3.1330      0.4845
                          1.5440      0.3354   |    3.8190      0.5559
                          2.2670      0.4187   |    4.3000      0.5927

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0004)     18.200      0.975      1.33      10.50
   OUTFLOW: ID= 1 (  0005)     18.200      0.021      3.17      10.38

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  2.16
                  TIME SHIFT OF PEAK FLOW         (min)=110.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.1773
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 FINISH
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       V    V   I    SSSSS  U   U    A    L             (v 6.2.2019)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat

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DATE: 03-10-2025                          TIME: 09:04:14

USER:


COMMENTS: _____________________________________________________________


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** SIMULATION : 2 - 2-Year 24hr Chic - Milton **
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CHICAGO STORM
Ptotal= 47.70 mm

IDF curve parameters: A= 779.000
B= 6.000
C= 0.821
used in: INTENSITY = A / (t + B)^C

Duration of storm = 24.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.37	6.00	1.29	12.00	1.14	18.00	0.53
0.17	0.38	6.17	1.41	12.17	1.10	18.17	0.52
0.33	0.38	6.33	1.55	12.33	1.06	18.33	0.52
0.50	0.39	6.50	1.73	12.50	1.03	18.50	0.51
0.67	0.40	6.67	1.96	12.67	1.00	18.67	0.50
0.83	0.41	6.83	2.26	12.83	0.97	18.83	0.50
1.00	0.42	7.00	2.70	13.00	0.94	19.00	0.49
1.17	0.42	7.17	3.37	13.17	0.92	19.17	0.48
1.33	0.43	7.33	4.53	13.33	0.89	19.33	0.48
1.50	0.44	7.50	7.13	13.50	0.87	19.50	0.47
1.67	0.45	7.67	18.18	13.67	0.85	19.67	0.47
1.83	0.46	7.83	80.06	13.83	0.83	19.83	0.46
2.00	0.47	8.00	24.18	14.00	0.81	20.00	0.46
2.17	0.49	8.17	12.21	14.17	0.79	20.17	0.45
2.33	0.50	8.33	8.15	14.33	0.78	20.33	0.45
2.50	0.51	8.50	6.13	14.50	0.76	20.50	0.44
2.67	0.53	8.67	4.94	14.67	0.74	20.67	0.44
2.83	0.54	8.83	4.14	14.83	0.73	20.83	0.43
3.00	0.56	9.00	3.58	15.00	0.71	21.00	0.43
3.17	0.57	9.17	3.16	15.17	0.70	21.17	0.42
3.33	0.59	9.33	2.83	15.33	0.69	21.33	0.42
3.50	0.61	9.50	2.57	15.50	0.67	21.50	0.41
3.67	0.63	9.67	2.36	15.67	0.66	21.67	0.41
3.83	0.65	9.83	2.18	15.83	0.65	21.83	0.41
4.00	0.68	10.00	2.02	16.00	0.64	22.00	0.40
4.17	0.71	10.17	1.89	16.17	0.63	22.17	0.40
4.33	0.73	10.33	1.78	16.33	0.62	22.33	0.39
4.50	0.77	10.50	1.68	16.50	0.61	22.50	0.39
4.67	0.80	10.67	1.59	16.67	0.60	22.67	0.39
4.83	0.84	10.83	1.51	16.83	0.59	22.83	0.38
5.00	0.88	11.00	1.44	17.00	0.58	23.00	0.38
5.17	0.93	11.17	1.38	17.17	0.57	23.17	0.38
5.33	0.98	11.33	1.32	17.33	0.56	23.33	0.37
5.50	1.04	11.50	1.27	17.50	0.55	23.50	0.37
5.67	1.12	11.67	1.22	17.67	0.55	23.67	0.37
5.83	1.20	11.83	1.18	17.83	0.54	23.83	0.36

CALIB
STANDHYD (0001)
ID= 1 DT= 5.0 min

Area (ha)= 14.86
Total Imp(%)= 50.00 Dir. Conn.(%)= 50.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	7.43	7.43
Dep. Storage	(mm)=	1.00	5.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	314.75	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.37	6.083	1.29	12.083	1.14	18.08	0.53
0.167	0.37	6.167	1.29	12.167	1.14	18.17	0.53
0.250	0.38	6.250	1.41	12.250	1.10	18.25	0.52
0.333	0.38	6.333	1.41	12.333	1.10	18.33	0.52
0.417	0.38	6.417	1.55	12.417	1.06	18.42	0.52
0.500	0.38	6.500	1.55	12.500	1.06	18.50	0.52
0.583	0.39	6.583	1.73	12.583	1.03	18.58	0.51
0.667	0.39	6.667	1.73	12.667	1.03	18.67	0.51
0.750	0.40	6.750	1.96	12.750	1.00	18.75	0.50
0.833	0.40	6.833	1.96	12.833	1.00	18.83	0.50
0.917	0.41	6.917	2.26	12.917	0.97	18.92	0.50
1.000	0.41	7.000	2.26	13.000	0.97	19.00	0.50
1.083	0.42	7.083	2.70	13.083	0.94	19.08	0.49
1.167	0.42	7.167	2.70	13.167	0.94	19.17	0.49
1.250	0.42	7.250	3.37	13.250	0.92	19.25	0.48
1.333	0.42	7.333	3.37	13.333	0.92	19.33	0.48
1.417	0.43	7.417	4.53	13.417	0.89	19.42	0.48
1.500	0.43	7.500	4.53	13.500	0.89	19.50	0.48
1.583	0.44	7.583	7.13	13.583	0.87	19.58	0.47
1.667	0.44	7.667	7.13	13.667	0.87	19.67	0.47
1.750	0.45	7.750	18.18	13.750	0.85	19.75	0.47
1.833	0.45	7.833	18.18	13.833	0.85	19.83	0.47
1.917	0.46	7.917	80.06	13.917	0.83	19.92	0.46
2.000	0.46	8.000	80.06	14.000	0.83	20.00	0.46
2.083	0.47	8.083	24.18	14.083	0.81	20.08	0.46
2.167	0.47	8.167	24.18	14.167	0.81	20.17	0.46
2.250	0.49	8.250	12.21	14.250	0.79	20.25	0.45
2.333	0.49	8.333	12.21	14.333	0.79	20.33	0.45
2.417	0.50	8.417	8.15	14.417	0.78	20.42	0.45
2.500	0.50	8.500	8.15	14.500	0.78	20.50	0.45
2.583	0.51	8.583	6.13	14.583	0.76	20.58	0.44
2.667	0.51	8.667	6.13	14.667	0.76	20.67	0.44
2.750	0.53	8.750	4.94	14.750	0.74	20.75	0.44
2.833	0.53	8.833	4.94	14.833	0.74	20.83	0.44
2.917	0.54	8.917	4.14	14.917	0.73	20.92	0.43
3.000	0.54	9.000	4.14	15.000	0.73	21.00	0.43
3.083	0.56	9.083	3.58	15.083	0.71	21.08	0.43
3.167	0.56	9.167	3.58	15.167	0.71	21.17	0.43
3.250	0.57	9.250	3.16	15.250	0.70	21.25	0.42
3.333	0.57	9.333	3.16	15.333	0.70	21.33	0.42
3.417	0.59	9.417	2.83	15.417	0.69	21.42	0.42
3.500	0.59	9.500	2.83	15.500	0.69	21.50	0.42
3.583	0.61	9.583	2.57	15.583	0.67	21.58	0.41
3.667	0.61	9.667	2.57	15.667	0.67	21.67	0.41
3.750	0.63	9.750	2.36	15.750	0.66	21.75	0.41
3.833	0.63	9.833	2.36	15.833	0.66	21.83	0.41
3.917	0.65	9.917	2.18	15.917	0.65	21.92	0.41
4.000	0.65	10.000	2.18	16.000	0.65	22.00	0.41
4.083	0.68	10.083	2.02	16.083	0.64	22.08	0.40
4.167	0.68	10.167	2.02	16.167	0.64	22.17	0.40
4.250	0.71	10.250	1.89	16.250	0.63	22.25	0.40
4.333	0.71	10.333	1.89	16.333	0.63	22.33	0.40
4.417	0.73	10.417	1.78	16.417	0.62	22.42	0.39
4.500	0.73	10.500	1.78	16.500	0.62	22.50	0.39
4.583	0.77	10.583	1.68	16.583	0.61	22.58	0.39
4.667	0.77	10.667	1.68	16.667	0.61	22.67	0.39
4.750	0.80	10.750	1.59	16.750	0.60	22.75	0.39
4.833	0.80	10.833	1.59	16.833	0.60	22.83	0.39
4.917	0.84	10.917	1.51	16.917	0.59	22.92	0.38
5.000	0.84	11.000	1.51	17.000	0.59	23.00	0.38
5.083	0.88	11.083	1.44	17.083	0.58	23.08	0.38
5.167	0.88	11.167	1.44	17.167	0.58	23.17	0.38
5.250	0.93	11.250	1.38	17.250	0.57	23.25	0.38
5.333	0.93	11.333	1.38	17.333	0.57	23.33	0.38
5.417	0.98	11.417	1.32	17.417	0.56	23.42	0.37
5.500	0.98	11.500	1.32	17.500	0.56	23.50	0.37
5.583	1.04	11.583	1.27	17.583	0.55	23.58	0.37
5.667	1.04	11.667	1.27	17.667	0.55	23.67	0.37
5.750	1.12	11.750	1.22	17.750	0.55	23.75	0.37
5.833	1.12	11.833	1.22	17.833	0.55	23.83	0.37
5.917	1.20	11.917	1.18	17.917	0.54	23.92	0.36
6.000	1.20	12.000	1.18	18.000	0.54	24.00	0.36

			TOTALS
Max.Eff.Inten.(mm/hr)=		80.06	25.25
over (min)		5.00	20.00
Storage Coeff. (min)=		5.56 (ii)	17.80 (ii)
Unit Hyd. Tpeak (min)=		5.00	20.00
Unit Hyd. peak (cms)=		0.20	0.06
PEAK FLOW	(cms)=	1.43	0.29 1.544 (iii)
TIME TO PEAK	(hrs)=	8.00	8.25 8.00
RUNOFF VOLUME	(mm)=	46.70	20.83 33.76
TOTAL RAINFALL	(mm)=	47.70	47.70 47.70
RUNOFF COEFFICIENT	=	0.98	0.44 0.71

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 85.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB
STANDHYD (0004)
ID= 1 DT= 5.0 min

Area (ha)= 18.20
Total Imp(%)= 95.00 Dir. Conn.(%)= 95.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	17.29	0.91
Dep. Storage	(mm)=	1.00	5.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	348.33	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.37	6.083	1.29	12.083	1.14	18.08	0.53
0.167	0.37	6.167	1.29	12.167	1.14	18.17	0.53
0.250	0.38	6.250	1.41	12.250	1.10	18.25	0.52
0.333	0.38	6.333	1.41	12.333	1.10	18.33	0.52
0.417	0.38	6.417	1.55	12.417	1.06	18.42	0.52
0.500	0.38	6.500	1.55	12.500	1.06	18.50	0.52
0.583	0.39	6.583	1.73	12.583	1.03	18.58	0.51
0.667	0.39	6.667	1.73	12.667	1.03	18.67	0.51
0.750	0.40	6.750	1.96	12.750	1.00	18.75	0.50
0.833	0.40	6.833	1.96	12.833	1.00	18.83	0.50
0.917	0.41	6.917	2.26	12.917	0.97	18.92	0.50
1.000	0.41	7.000	2.26	13.000	0.97	19.00	0.50
1.083	0.42	7.083	2.70	13.083	0.94	19.08	0.49
1.167	0.42	7.167	2.70	13.167	0.94	19.17	0.49
1.250	0.42	7.250	3.37	13.250	0.92	19.25	0.48
1.333	0.42	7.333	3.37	13.333	0.92	19.33	0.48
1.417	0.43	7.417	4.53	13.417	0.89	19.42	0.48

1.500	0.43	7.500	4.53	13.500	0.89	19.50	0.48
1.583	0.44	7.583	7.13	13.583	0.87	19.58	0.47
1.667	0.44	7.667	7.13	13.667	0.87	19.67	0.47
1.750	0.45	7.750	18.18	13.750	0.85	19.75	0.47
1.833	0.45	7.833	18.18	13.833	0.85	19.83	0.47
1.917	0.46	7.917	80.06	13.917	0.83	19.92	0.46
2.000	0.46	8.000	80.06	14.000	0.83	20.00	0.46
2.083	0.47	8.083	24.18	14.083	0.81	20.08	0.46
2.167	0.47	8.167	24.18	14.167	0.81	20.17	0.46
2.250	0.49	8.250	12.21	14.250	0.79	20.25	0.45
2.333	0.49	8.333	12.21	14.333	0.79	20.33	0.45
2.417	0.50	8.417	8.15	14.417	0.78	20.42	0.45
2.500	0.50	8.500	8.15	14.500	0.78	20.50	0.45
2.583	0.51	8.583	6.13	14.583	0.76	20.58	0.44
2.667	0.51	8.667	6.13	14.667	0.76	20.67	0.44
2.750	0.53	8.750	4.94	14.750	0.74	20.75	0.44
2.833	0.53	8.833	4.94	14.833	0.74	20.83	0.44
2.917	0.54	8.917	4.14	14.917	0.73	20.92	0.43
3.000	0.54	9.000	4.14	15.000	0.73	21.00	0.43
3.083	0.56	9.083	3.58	15.083	0.71	21.08	0.43
3.167	0.56	9.167	3.58	15.167	0.71	21.17	0.43
3.250	0.57	9.250	3.16	15.250	0.70	21.25	0.42
3.333	0.57	9.333	3.16	15.333	0.70	21.33	0.42
3.417	0.59	9.417	2.83	15.417	0.69	21.42	0.42
3.500	0.59	9.500	2.83	15.500	0.69	21.50	0.42
3.583	0.61	9.583	2.57	15.583	0.67	21.58	0.41
3.667	0.61	9.667	2.57	15.667	0.67	21.67	0.41
3.750	0.63	9.750	2.36	15.750	0.66	21.75	0.41
3.833	0.63	9.833	2.36	15.833	0.66	21.83	0.41
3.917	0.65	9.917	2.18	15.917	0.65	21.92	0.41
4.000	0.65	10.000	2.18	16.000	0.65	22.00	0.41
4.083	0.68	10.083	2.02	16.083	0.64	22.08	0.40
4.167	0.68	10.167	2.02	16.167	0.64	22.17	0.40
4.250	0.71	10.250	1.89	16.250	0.63	22.25	0.40
4.333	0.71	10.333	1.89	16.333	0.63	22.33	0.40
4.417	0.73	10.417	1.78	16.417	0.62	22.42	0.39
4.500	0.73	10.500	1.78	16.500	0.62	22.50	0.39
4.583	0.77	10.583	1.68	16.583	0.61	22.58	0.39
4.667	0.77	10.667	1.68	16.667	0.61	22.67	0.39
4.750	0.80	10.750	1.59	16.750	0.60	22.75	0.39
4.833	0.80	10.833	1.59	16.833	0.60	22.83	0.39
4.917	0.84	10.917	1.51	16.917	0.59	22.92	0.38
5.000	0.84	11.000	1.51	17.000	0.59	23.00	0.38
5.083	0.88	11.083	1.44	17.083	0.58	23.08	0.38
5.167	0.88	11.167	1.44	17.167	0.58	23.17	0.38
5.250	0.93	11.250	1.38	17.250	0.57	23.25	0.38
5.333	0.93	11.333	1.38	17.333	0.57	23.33	0.38
5.417	0.98	11.417	1.32	17.417	0.56	23.42	0.37
5.500	0.98	11.500	1.32	17.500	0.56	23.50	0.37
5.583	1.04	11.583	1.27	17.583	0.55	23.58	0.37
5.667	1.04	11.667	1.27	17.667	0.55	23.67	0.37
5.750	1.12	11.750	1.22	17.750	0.55	23.75	0.37
5.833	1.12	11.833	1.22	17.833	0.55	23.83	0.37
5.917	1.20	11.917	1.18	17.917	0.54	23.92	0.36
6.000	1.20	12.000	1.18	18.000	0.54	24.00	0.36

Max.Eff.Inten.(mm/hr)=	80.06	31.43		
over (min)	5.00	10.00		
Storage Coeff. (min)=	5.90 (ii)	8.28 (ii)		
Unit Hyd. Tpeak (min)=	5.00	10.00		
Unit Hyd. peak (cms)=	0.19	0.13		
			TOTALS	
PEAK FLOW (cms)=	3.28	0.06	3.325 (iii)	
TIME TO PEAK (hrs)=	8.00	8.08	8.00	
RUNOFF VOLUME (mm)=	46.70	20.83	45.41	
TOTAL RAINFALL (mm)=	47.70	47.70	47.70	
RUNOFF COEFFICIENT =	0.98	0.44	0.95	

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 85.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(0005)	OVERFLOW IS OFF			
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	2.7380	0.4708
	0.0268	0.2254	3.1330	0.4845
	1.5440	0.3354	3.8190	0.5559
	2.2670	0.4187	4.3000	0.5927

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0004)	18.200	3.325	8.00	45.41
OUTFLOW: ID= 1 (0005)	18.200	1.530	8.17	45.29

PEAK FLOW REDUCTION [Qout/Qin](%)= 46.02
TIME SHIFT OF PEAK FLOW (min)= 10.00
MAXIMUM STORAGE USED (ha.m.)= 0.3354

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V V I SSSSS U U A L (v 6.2.2019)

V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSSS UUUUU A A LLLLL

OOO TTTTT TTTTT H H Y Y M M OOO TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO

***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat

Output filename:
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DATE: 03-10-2025 TIME: 09:04:14

USER:

COMMENTS: _____

** SIMULATION : 3 - 5-Year 24hr Chic- Milton **

CHICAGO STORM	IDF curve parameters: A= 959.000
Ptotal= 67.05 mm	B= 5.700
	C= 0.802
used in: INTENSITY = A / (t + B)^C	

Duration of storm = 24.00 hrs
Storm time step = 10.00 min

Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	0.57	6.00	1.93	12.00	1.70	18.00	0.81
0.17	0.58	6.17	2.10	12.17	1.64	18.17	0.80
0.33	0.59	6.33	2.30	12.33	1.59	18.33	0.79
0.50	0.60	6.50	2.55	12.50	1.55	18.50	0.78
0.67	0.61	6.67	2.88	12.67	1.50	18.67	0.77
0.83	0.63	6.83	3.31	12.83	1.46	18.83	0.76
1.00	0.64	7.00	3.92	13.00	1.42	19.00	0.75
1.17	0.65	7.17	4.85	13.17	1.38	19.17	0.74
1.33	0.67	7.33	6.45	13.33	1.35	19.33	0.73
1.50	0.68	7.50	9.95	13.50	1.31	19.50	0.72
1.67	0.70	7.67	24.45	13.67	1.28	19.67	0.72
1.83	0.71	7.83	105.25	13.83	1.25	19.83	0.71
2.00	0.73	8.00	32.26	14.00	1.23	20.00	0.70
2.17	0.75	8.17	16.67	14.17	1.20	20.17	0.69
2.33	0.76	8.33	11.31	14.33	1.17	20.33	0.69
2.50	0.78	8.50	8.62	14.50	1.15	20.50	0.68
2.67	0.80	8.67	7.00	14.67	1.13	20.67	0.67
2.83	0.83	8.83	5.92	14.83	1.10	20.83	0.66
3.00	0.85	9.00	5.14	15.00	1.08	21.00	0.66
3.17	0.88	9.17	4.56	15.17	1.06	21.17	0.65
3.33	0.90	9.33	4.11	15.33	1.04	21.33	0.64
3.50	0.93	9.50	3.74	15.50	1.02	21.50	0.64
3.67	0.96	9.67	3.44	15.67	1.01	21.67	0.63
3.83	1.00	9.83	3.19	15.83	0.99	21.83	0.62
4.00	1.03	10.00	2.97	16.00	0.97	22.00	0.62
4.17	1.07	10.17	2.79	16.17	0.96	22.17	0.61
4.33	1.11	10.33	2.63	16.33	0.94	22.33	0.61
4.50	1.16	10.50	2.48	16.50	0.92	22.50	0.60
4.67	1.21	10.67	2.36	16.67	0.91	22.67	0.60
4.83	1.27	10.83	2.25	16.83	0.90	22.83	0.59
5.00	1.33	11.00	2.14	17.00	0.88	23.00	0.59
5.17	1.40	11.17	2.05	17.17	0.87	23.17	0.58
5.33	1.48	11.33	1.97	17.33	0.86	23.33	0.57
5.50	1.57	11.50	1.89	17.50	0.85	23.50	0.57
5.67	1.67	11.67	1.82	17.67	0.83	23.67	0.57
5.83	1.79	11.83	1.76	17.83	0.82	23.83	0.56

CALIB			
STANDHYD (0001)	Area (ha)= 14.86		
ID= 1 DT= 5.0 min	Total Imp(%)= 50.00	Dir. Conn.(%)= 50.00	
	IMPERVIOUS	PERVIOUS (i)	
Surface Area (ha)=	7.43	7.43	

```
Dep. Storage     (mm)=       1.00         5.00
Average Slope     (%)=       1.00         2.00
Length            (m)=     314.75        40.00
Mannings n           =      0.013        0.250

    NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.57	6.083	1.93	12.083	1.70	18.08	0.81
0.167	0.57	6.167	1.93	12.167	1.70	18.17	0.81
0.250	0.58	6.250	2.10	12.250	1.64	18.25	0.80
0.333	0.58	6.333	2.10	12.333	1.64	18.33	0.80
0.417	0.59	6.417	2.30	12.417	1.59	18.42	0.79
0.500	0.59	6.500	2.30	12.500	1.59	18.50	0.79
0.583	0.60	6.583	2.55	12.583	1.55	18.58	0.78
0.667	0.60	6.667	2.55	12.667	1.55	18.67	0.78
0.750	0.61	6.750	2.88	12.750	1.50	18.75	0.77
0.833	0.61	6.833	2.88	12.833	1.50	18.83	0.77
0.917	0.63	6.917	3.31	12.917	1.46	18.92	0.76
1.000	0.63	7.000	3.31	13.000	1.46	19.00	0.76
1.083	0.64	7.083	3.92	13.083	1.42	19.08	0.75
1.167	0.64	7.167	3.92	13.167	1.42	19.17	0.75
1.250	0.65	7.250	4.85	13.250	1.38	19.25	0.74
1.333	0.65	7.333	4.85	13.333	1.38	19.33	0.74
1.417	0.67	7.417	6.45	13.417	1.35	19.42	0.73
1.500	0.67	7.500	6.45	13.500	1.35	19.50	0.73
1.583	0.68	7.583	9.95	13.583	1.31	19.58	0.72
1.667	0.68	7.667	9.95	13.667	1.31	19.67	0.72
1.750	0.70	7.750	24.45	13.750	1.28	19.75	0.72
1.833	0.70	7.833	24.45	13.833	1.28	19.83	0.72
1.917	0.71	7.917	105.25	13.917	1.25	19.92	0.71
2.000	0.71	8.000	105.25	14.000	1.25	20.00	0.71
2.083	0.73	8.083	32.26	14.083	1.23	20.08	0.70
2.167	0.73	8.167	32.26	14.167	1.23	20.17	0.70
2.250	0.75	8.250	16.67	14.250	1.20	20.25	0.69
2.333	0.75	8.333	16.67	14.333	1.20	20.33	0.69
2.417	0.76	8.417	11.31	14.417	1.17	20.42	0.69
2.500	0.76	8.500	11.31	14.500	1.17	20.50	0.69
2.583	0.78	8.583	8.62	14.583	1.15	20.58	0.68
2.667	0.78	8.667	8.62	14.667	1.15	20.67	0.68
2.750	0.80	8.750	7.00	14.750	1.13	20.75	0.67
2.833	0.80	8.833	7.00	14.833	1.13	20.83	0.67
2.917	0.83	8.917	5.92	14.917	1.10	20.92	0.66
3.000	0.83	9.000	5.92	15.000	1.10	21.00	0.66
3.083	0.85	9.083	5.14	15.083	1.08	21.08	0.66
3.167	0.85	9.167	5.14	15.167	1.08	21.17	0.66
3.250	0.88	9.250	4.56	15.250	1.06	21.25	0.65
3.333	0.88	9.333	4.56	15.333	1.06	21.33	0.65
3.417	0.90	9.417	4.11	15.417	1.04	21.42	0.64
3.500	0.90	9.500	4.11	15.500	1.04	21.50	0.64
3.583	0.93	9.583	3.74	15.583	1.02	21.58	0.64
3.667	0.93	9.667	3.74	15.667	1.02	21.67	0.64
3.750	0.96	9.750	3.44	15.750	1.01	21.75	0.63
3.833	0.96	9.833	3.44	15.833	1.01	21.83	0.63
3.917	1.00	9.917	3.19	15.917	0.99	21.92	0.62
4.000	1.00	10.000	3.19	16.000	0.99	22.00	0.62
4.083	1.03	10.083	2.97	16.083	0.97	22.08	0.62
4.167	1.03	10.167	2.97	16.167	0.97	22.17	0.62
4.250	1.07	10.250	2.79	16.250	0.96	22.25	0.61
4.333	1.07	10.333	2.79	16.333	0.96	22.33	0.61
4.417	1.11	10.417	2.63	16.417	0.94	22.42	0.61
4.500	1.11	10.500	2.63	16.500	0.94	22.50	0.61
4.583	1.16	10.583	2.48	16.583	0.92	22.58	0.60
4.667	1.16	10.667	2.48	16.667	0.92	22.67	0.60
4.750	1.21	10.750	2.36	16.750	0.91	22.75	0.60
4.833	1.21	10.833	2.36	16.833	0.91	22.83	0.60
4.917	1.27	10.917	2.25	16.917	0.90	22.92	0.59
5.000	1.27	11.000	2.25	17.000	0.90	23.00	0.59
5.083	1.33	11.083	2.14	17.083	0.88	23.08	0.59
5.167	1.33	11.167	2.14	17.167	0.88	23.17	0.59
5.250	1.40	11.250	2.05	17.250	0.87	23.25	0.58
5.333	1.40	11.333	2.05	17.333	0.87	23.33	0.58
5.417	1.48	11.417	1.97	17.417	0.86	23.42	0.57
5.500	1.48	11.500	1.97	17.500	0.86	23.50	0.57
5.583	1.57	11.583	1.89	17.583	0.85	23.58	0.57
5.667	1.57	11.667	1.89	17.667	0.85	23.67	0.57
5.750	1.67	11.750	1.82	17.750	0.83	23.75	0.57
5.833	1.67	11.833	1.82	17.833	0.83	23.83	0.57
5.917	1.79	11.917	1.76	17.917	0.82	23.92	0.56
6.000	1.79	12.000	1.76	18.000	0.82	24.00	0.56

```
Max.Eff.Inten.(mm/hr)=     105.25        54.31
           over (min)        5.00        15.00
Storage Coeff.  (min)=       4.98 (ii)   13.99 (ii)
Unit Hyd. Tpeak (min)=       5.00        15.00
Unit Hyd. peak  (cms)=       0.22         0.08
                                                 *TOTALS*
PEAK FLOW       (cms)=       1.94         0.59          2.267 (iii)
TIME TO PEAK    (hrs)=       8.00         8.17           8.00
RUNOFF VOLUME    (mm)=      66.05        36.02          51.03
TOTAL RAINFALL   (mm)=      67.05        67.05          67.05
RUNOFF COEFFICIENT   =        0.99         0.54           0.76

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  85.0    Ia = Dep. Storage  (Above)
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      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| CALIB            |
| STANDHYD (  0004)|   Area    (ha)=  18.20
|ID= 1 DT= 5.0 min |   Total Imp(%)=  95.00   Dir. Conn.(%)=  95.00
--------------------
                        IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      17.29         0.91
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     348.33        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.57	6.083	1.93	12.083	1.70	18.08	0.81
0.167	0.57	6.167	1.93	12.167	1.70	18.17	0.81
0.250	0.58	6.250	2.10	12.250	1.64	18.25	0.80
0.333	0.58	6.333	2.10	12.333	1.64	18.33	0.80
0.417	0.59	6.417	2.30	12.417	1.59	18.42	0.79
0.500	0.59	6.500	2.30	12.500	1.59	18.50	0.79
0.583	0.60	6.583	2.55	12.583	1.55	18.58	0.78
0.667	0.60	6.667	2.55	12.667	1.55	18.67	0.78
0.750	0.61	6.750	2.88	12.750	1.50	18.75	0.77
0.833	0.61	6.833	2.88	12.833	1.50	18.83	0.77
0.917	0.63	6.917	3.31	12.917	1.46	18.92	0.76
1.000	0.63	7.000	3.31	13.000	1.46	19.00	0.76
1.083	0.64	7.083	3.92	13.083	1.42	19.08	0.75
1.167	0.64	7.167	3.92	13.167	1.42	19.17	0.75
1.250	0.65	7.250	4.85	13.250	1.38	19.25	0.74
1.333	0.65	7.333	4.85	13.333	1.38	19.33	0.74
1.417	0.67	7.417	6.45	13.417	1.35	19.42	0.73
1.500	0.67	7.500	6.45	13.500	1.35	19.50	0.73
1.583	0.68	7.583	9.95	13.583	1.31	19.58	0.72
1.667	0.68	7.667	9.95	13.667	1.31	19.67	0.72
1.750	0.70	7.750	24.45	13.750	1.28	19.75	0.72
1.833	0.70	7.833	24.45	13.833	1.28	19.83	0.72
1.917	0.71	7.917	105.25	13.917	1.25	19.92	0.71
2.000	0.71	8.000	105.25	14.000	1.25	20.00	0.71
2.083	0.73	8.083	32.26	14.083	1.23	20.08	0.70
2.167	0.73	8.167	32.26	14.167	1.23	20.17	0.70
2.250	0.75	8.250	16.67	14.250	1.20	20.25	0.69
2.333	0.75	8.333	16.67	14.333	1.20	20.33	0.69
2.417	0.76	8.417	11.31	14.417	1.17	20.42	0.69
2.500	0.76	8.500	11.31	14.500	1.17	20.50	0.69
2.583	0.78	8.583	8.62	14.583	1.15	20.58	0.68
2.667	0.78	8.667	8.62	14.667	1.15	20.67	0.68
2.750	0.80	8.750	7.00	14.750	1.13	20.75	0.67
2.833	0.80	8.833	7.00	14.833	1.13	20.83	0.67
2.917	0.83	8.917	5.92	14.917	1.10	20.92	0.66
3.000	0.83	9.000	5.92	15.000	1.10	21.00	0.66
3.083	0.85	9.083	5.14	15.083	1.08	21.08	0.66
3.167	0.85	9.167	5.14	15.167	1.08	21.17	0.66
3.250	0.88	9.250	4.56	15.250	1.06	21.25	0.65
3.333	0.88	9.333	4.56	15.333	1.06	21.33	0.65
3.417	0.90	9.417	4.11	15.417	1.04	21.42	0.64
3.500	0.90	9.500	4.11	15.500	1.04	21.50	0.64
3.583	0.93	9.583	3.74	15.583	1.02	21.58	0.64
3.667	0.93	9.667	3.74	15.667	1.02	21.67	0.64
3.750	0.96	9.750	3.44	15.750	1.01	21.75	0.63
3.833	0.96	9.833	3.44	15.833	1.01	21.83	0.63
3.917	1.00	9.917	3.19	15.917	0.99	21.92	0.62
4.000	1.00	10.000	3.19	16.000	0.99	22.00	0.62
4.083	1.03	10.083	2.97	16.083	0.97	22.08	0.62
4.167	1.03	10.167	2.97	16.167	0.97	22.17	0.62
4.250	1.07	10.250	2.79	16.250	0.96	22.25	0.61
4.333	1.07	10.333	2.79	16.333	0.96	22.33	0.61
4.417	1.11	10.417	2.63	16.417	0.94	22.42	0.61
4.500	1.11	10.500	2.63	16.500	0.94	22.50	0.61
4.583	1.16	10.583	2.48	16.583	0.92	22.58	0.60
4.667	1.16	10.667	2.48	16.667	0.92	22.67	0.60
4.750	1.21	10.750	2.36	16.750	0.91	22.75	0.60
4.833	1.21	10.833	2.36	16.833	0.91	22.83	0.60
4.917	1.27	10.917	2.25	16.917	0.90	22.92	0.59
5.000	1.27	11.000	2.25	17.000	0.90	23.00	0.59
5.083	1.33	11.083	2.14	17.083	0.88	23.08	0.59
5.167	1.33	11.167	2.14	17.167	0.88	23.17	0.59
5.250	1.40	11.250	2.05	17.250	0.87	23.25	0.58
5.333	1.40	11.333	2.05	17.333	0.87	23.33	0.58
5.417	1.48	11.417	1.97	17.417	0.86	23.42	0.57
5.500	1.48	11.500	1.97	17.500	0.86	23.50	0.57
5.583	1.57	11.583	1.89	17.583	0.85	23.58	0.57
5.667	1.57	11.667	1.89	17.667	0.85	23.67	0.57
5.750	1.67	11.750	1.82	17.750	0.83	23.75	0.57
5.833	1.67	11.833	1.82	17.833	0.83	23.83	0.57
5.917	1.79	11.917	1.76	17.917	0.82	23.92	0.56
6.000	1.79	12.000	1.76	18.000	0.82	24.00	0.56

```
Max.Eff.Inten.(mm/hr)=     105.25        54.31
           over (min)        5.00        10.00
Storage Coeff.  (min)=       5.29 (ii)    7.42 (ii)
Unit Hyd. Tpeak (min)=       5.00        10.00
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     Unit Hyd. peak  (cms)=       0.21         0.13
                                                      *TOTALS*
     PEAK FLOW       (cms)=       4.45         0.10          4.536 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.08           8.00
     RUNOFF VOLUME    (mm)=      66.05        36.02          64.55
     TOTAL RAINFALL   (mm)=      67.05        67.05          67.05
     RUNOFF COEFFICIENT   =       0.99         0.54           0.96


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| RESERVOIR(  0005)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           0.0000      0.0000   |    2.7380      0.4708
                           0.0268      0.2254   |    3.1330      0.4845
                           1.5440      0.3354   |    3.8190      0.5559
                           2.2670      0.4187   |    4.3000      0.5927

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0004)     18.200      4.536      8.00      64.55
   OUTFLOW: ID= 1 (  0005)     18.200      2.243      8.17      64.43

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 49.46
                  TIME SHIFT OF PEAK FLOW         (min)= 10.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.4187

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================================================================================
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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2019)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                    *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat

  Output  filename:
C:\Users\jannaormond\AppData\Local\Civica\VH5\3343a733-fb9e-41c8-9272-7af20af75cda\
ef4708e3-322e-4088-93b8-6c58dd9f6e33\
  Summary filename:
C:\Users\jannaormond\AppData\Local\Civica\VH5\3343a733-fb9e-41c8-9272-7af20af75cda\
ef4708e3-322e-4088-93b8-6c58dd9f6e33\


DATE: 03-10-2025                          TIME: 09:04:15

USER:



COMMENTS: _____________________________________________________


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  ***********************************************
  ** SIMULATION : 4 - 10-Year 24hr Chic - Milto **
  ***********************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1089.000
| Ptotal= 80.06 mm |                          B=   5.700
--------------------                          C=   0.795
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  = 24.00 hrs
                         Storm time step    = 10.00 min
                         Time to peak ratio =  0.33

              TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
               hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
             0.00    0.71 |  6.00    2.35 | 12.00    2.08 | 18.00    1.00
             0.17    0.72 |  6.17    2.55 | 12.17    2.01 | 18.17    0.99
             0.33    0.73 |  6.33    2.80 | 12.33    1.95 | 18.33    0.97
             0.50    0.74 |  6.50    3.10 | 12.50    1.89 | 18.50    0.96
             0.67    0.76 |  6.67    3.49 | 12.67    1.84 | 18.67    0.95
             0.83    0.77 |  6.83    4.01 | 12.83    1.78 | 18.83    0.94
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             1.00    0.79 |  7.00    4.74 | 13.00    1.74 | 19.00    0.93
             1.17    0.80 |  7.17    5.85 | 13.17    1.69 | 19.17    0.91
             1.33    0.82 |  7.33    7.75 | 13.33    1.65 | 19.33    0.90
             1.50    0.84 |  7.50   11.89 | 13.50    1.61 | 19.50    0.89
             1.67    0.86 |  7.67   28.81 | 13.67    1.57 | 19.67    0.88
             1.83    0.88 |  7.83  121.81 | 13.83    1.54 | 19.83    0.87
             2.00    0.90 |  8.00   37.88 | 14.00    1.50 | 20.00    0.86
             2.17    0.92 |  8.17   19.77 | 14.17    1.47 | 20.17    0.85
             2.33    0.94 |  8.33   13.48 | 14.33    1.44 | 20.33    0.84
             2.50    0.97 |  8.50   10.31 | 14.50    1.41 | 20.50    0.84
             2.67    0.99 |  8.67    8.40 | 14.67    1.38 | 20.67    0.83
             2.83    1.02 |  8.83    7.12 | 14.83    1.35 | 20.83    0.82
             3.00    1.05 |  9.00    6.20 | 15.00    1.33 | 21.00    0.81
             3.17    1.08 |  9.17    5.51 | 15.17    1.30 | 21.17    0.80
             3.33    1.11 |  9.33    4.96 | 15.33    1.28 | 21.33    0.79
             3.50    1.14 |  9.50    4.53 | 15.50    1.26 | 21.50    0.79
             3.67    1.18 |  9.67    4.17 | 15.67    1.23 | 21.67    0.78
             3.83    1.22 |  9.83    3.86 | 15.83    1.21 | 21.83    0.77
             4.00    1.27 | 10.00    3.61 | 16.00    1.19 | 22.00    0.76
             4.17    1.31 | 10.17    3.38 | 16.17    1.17 | 22.17    0.76
             4.33    1.37 | 10.33    3.19 | 16.33    1.15 | 22.33    0.75
             4.50    1.42 | 10.50    3.02 | 16.50    1.14 | 22.50    0.74
             4.67    1.48 | 10.67    2.87 | 16.67    1.12 | 22.67    0.74
             4.83    1.55 | 10.83    2.73 | 16.83    1.10 | 22.83    0.73
             5.00    1.63 | 11.00    2.61 | 17.00    1.09 | 23.00    0.72
             5.17    1.71 | 11.17    2.50 | 17.17    1.07 | 23.17    0.72
             5.33    1.81 | 11.33    2.40 | 17.33    1.05 | 23.33    0.71
             5.50    1.92 | 11.50    2.31 | 17.50    1.04 | 23.50    0.70
             5.67    2.04 | 11.67    2.23 | 17.67    1.03 | 23.67    0.70
             5.83    2.18 | 11.83    2.15 | 17.83    1.01 | 23.83    0.69


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| CALIB            |
| STANDHYD (  0001)|   Area    (ha)=  14.86
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  50.00
--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       7.43         7.43
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     314.75        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
```

```
                hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
              0.083    0.71 | 6.083    2.35 |12.083    2.08 | 18.08    1.00
              0.167    0.71 | 6.167    2.35 |12.167    2.08 | 18.17    1.00
              0.250    0.72 | 6.250    2.55 |12.250    2.01 | 18.25    0.99
              0.333    0.72 | 6.333    2.55 |12.333    2.01 | 18.33    0.99
              0.417    0.73 | 6.417    2.80 |12.417    1.95 | 18.42    0.97
              0.500    0.73 | 6.500    2.80 |12.500    1.95 | 18.50    0.97
              0.583    0.74 | 6.583    3.10 |12.583    1.89 | 18.58    0.96
              0.667    0.74 | 6.667    3.10 |12.667    1.89 | 18.67    0.96
              0.750    0.76 | 6.750    3.49 |12.750    1.84 | 18.75    0.95
              0.833    0.76 | 6.833    3.49 |12.833    1.84 | 18.83    0.95
              0.917    0.77 | 6.917    4.01 |12.917    1.78 | 18.92    0.94
              1.000    0.77 | 7.000    4.01 |13.000    1.78 | 19.00    0.94
              1.083    0.79 | 7.083    4.74 |13.083    1.74 | 19.08    0.93
              1.167    0.79 | 7.167    4.74 |13.167    1.74 | 19.17    0.93
              1.250    0.80 | 7.250    5.85 |13.250    1.69 | 19.25    0.91
              1.333    0.80 | 7.333    5.85 |13.333    1.69 | 19.33    0.91
              1.417    0.82 | 7.417    7.75 |13.417    1.65 | 19.42    0.90
              1.500    0.82 | 7.500    7.75 |13.500    1.65 | 19.50    0.90
              1.583    0.84 | 7.583   11.89 |13.583    1.61 | 19.58    0.89
              1.667    0.84 | 7.667   11.89 |13.667    1.61 | 19.67    0.89
              1.750    0.86 | 7.750   28.81 |13.750    1.57 | 19.75    0.88
              1.833    0.86 | 7.833   28.81 |13.833    1.57 | 19.83    0.88
              1.917    0.88 | 7.917  121.81 |13.917    1.54 | 19.92    0.87
              2.000    0.88 | 8.000  121.81 |14.000    1.54 | 20.00    0.87
              2.083    0.90 | 8.083   37.88 |14.083    1.50 | 20.08    0.86
              2.167    0.90 | 8.167   37.88 |14.167    1.50 | 20.17    0.86
              2.250    0.92 | 8.250   19.77 |14.250    1.47 | 20.25    0.85
              2.333    0.92 | 8.333   19.77 |14.333    1.47 | 20.33    0.85
              2.417    0.94 | 8.417   13.48 |14.417    1.44 | 20.42    0.84
              2.500    0.94 | 8.500   13.48 |14.500    1.44 | 20.50    0.84
              2.583    0.97 | 8.583   10.31 |14.583    1.41 | 20.58    0.84
              2.667    0.97 | 8.667   10.31 |14.667    1.41 | 20.67    0.84
              2.750    0.99 | 8.750    8.40 |14.750    1.38 | 20.75    0.83
              2.833    0.99 | 8.833    8.40 |14.833    1.38 | 20.83    0.83
              2.917    1.02 | 8.917    7.12 |14.917    1.35 | 20.92    0.82
              3.000    1.02 | 9.000    7.12 |15.000    1.35 | 21.00    0.82
              3.083    1.05 | 9.083    6.20 |15.083    1.33 | 21.08    0.81
              3.167    1.05 | 9.167    6.20 |15.167    1.33 | 21.17    0.81
              3.250    1.08 | 9.250    5.51 |15.250    1.30 | 21.25    0.80
              3.333    1.08 | 9.333    5.51 |15.333    1.30 | 21.33    0.80
              3.417    1.11 | 9.417    4.96 |15.417    1.28 | 21.42    0.79
              3.500    1.11 | 9.500    4.96 |15.500    1.28 | 21.50    0.79
              3.583    1.14 | 9.583    4.53 |15.583    1.26 | 21.58    0.79
              3.667    1.14 | 9.667    4.53 |15.667    1.26 | 21.67    0.79
              3.750    1.18 | 9.750    4.17 |15.750    1.23 | 21.75    0.78
              3.833    1.18 | 9.833    4.17 |15.833    1.23 | 21.83    0.78
              3.917    1.22 | 9.917    3.86 |15.917    1.21 | 21.92    0.77
              4.000    1.22 |10.000    3.86 |16.000    1.21 | 22.00    0.77
              4.083    1.27 |10.083    3.61 |16.083    1.19 | 22.08    0.76
```

4.167	1.27	10.167	3.61	16.167	1.19	22.17	0.76
4.250	1.31	10.250	3.38	16.250	1.17	22.25	0.76
4.333	1.31	10.333	3.38	16.333	1.17	22.33	0.76
4.417	1.37	10.417	3.19	16.417	1.15	22.42	0.75
4.500	1.37	10.500	3.19	16.500	1.15	22.50	0.75
4.583	1.42	10.583	3.02	16.583	1.14	22.58	0.74
4.667	1.42	10.667	3.02	16.667	1.14	22.67	0.74
4.750	1.48	10.750	2.87	16.750	1.12	22.75	0.74
4.833	1.48	10.833	2.87	16.833	1.12	22.83	0.74
4.917	1.55	10.917	2.73	16.917	1.10	22.92	0.73
5.000	1.55	11.000	2.73	17.000	1.10	23.00	0.73
5.083	1.63	11.083	2.61	17.083	1.09	23.08	0.72
5.167	1.63	11.167	2.61	17.167	1.09	23.17	0.72
5.250	1.71	11.250	2.50	17.250	1.07	23.25	0.72
5.333	1.71	11.333	2.50	17.333	1.07	23.33	0.72
5.417	1.81	11.417	2.40	17.417	1.05	23.42	0.71
5.500	1.81	11.500	2.40	17.500	1.05	23.50	0.71
5.583	1.92	11.583	2.31	17.583	1.04	23.58	0.70
5.667	1.92	11.667	2.31	17.667	1.04	23.67	0.70
5.750	2.04	11.750	2.23	17.750	1.03	23.75	0.70
5.833	2.04	11.833	2.23	17.833	1.03	23.83	0.70
5.917	2.18	11.917	2.15	17.917	1.01	23.92	0.69
6.000	2.18	12.000	2.15	18.000	1.01	24.00	0.69

Max.Eff.Inten.(mm/hr)=		121.81	70.49	
over (min)		5.00	15.00	
Storage Coeff. (min)=		4.70 (ii)	12.81 (ii)	
Unit Hyd. Tpeak (min)=		5.00	15.00	
Unit Hyd. peak (cms)=		0.22	0.08	
				TOTALS
PEAK FLOW	(cms)=	2.28	0.80	2.738 (iii)
TIME TO PEAK	(hrs)=	8.00	8.17	8.00
RUNOFF VOLUME	(mm)=	79.06	46.99	63.02
TOTAL RAINFALL	(mm)=	80.06	80.06	80.06
RUNOFF COEFFICIENT	=	0.99	0.59	0.79

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 85.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
STANDHYD (0004)	Area (ha)=	18.20	
ID= 1 DT= 5.0 min	Total Imp(%)=	95.00	Dir. Conn.(%)= 95.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	17.29	0.91
Dep. Storage	(mm)=	1.00	5.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	348.33	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.71	6.083	2.35	12.083	2.08	18.08	1.00
0.167	0.71	6.167	2.35	12.167	2.08	18.17	1.00
0.250	0.72	6.250	2.55	12.250	2.01	18.25	0.99
0.333	0.72	6.333	2.55	12.333	2.01	18.33	0.99
0.417	0.73	6.417	2.80	12.417	1.95	18.42	0.97
0.500	0.73	6.500	2.80	12.500	1.95	18.50	0.97
0.583	0.74	6.583	3.10	12.583	1.89	18.58	0.96
0.667	0.74	6.667	3.10	12.667	1.89	18.67	0.96
0.750	0.76	6.750	3.49	12.750	1.84	18.75	0.95
0.833	0.76	6.833	3.49	12.833	1.84	18.83	0.95
0.917	0.77	6.917	4.01	12.917	1.78	18.92	0.94
1.000	0.77	7.000	4.01	13.000	1.78	19.00	0.94
1.083	0.79	7.083	4.74	13.083	1.74	19.08	0.93
1.167	0.79	7.167	4.74	13.167	1.74	19.17	0.93
1.250	0.80	7.250	5.85	13.250	1.69	19.25	0.91
1.333	0.80	7.333	5.85	13.333	1.69	19.33	0.91
1.417	0.82	7.417	7.75	13.417	1.65	19.42	0.90
1.500	0.82	7.500	7.75	13.500	1.65	19.50	0.90
1.583	0.84	7.583	11.89	13.583	1.61	19.58	0.89
1.667	0.84	7.667	11.89	13.667	1.61	19.67	0.89
1.750	0.86	7.750	28.81	13.750	1.57	19.75	0.88
1.833	0.86	7.833	28.81	13.833	1.57	19.83	0.88
1.917	0.88	7.917	121.81	13.917	1.54	19.92	0.87
2.000	0.88	8.000	121.81	14.000	1.54	20.00	0.87
2.083	0.90	8.083	37.88	14.083	1.50	20.08	0.86
2.167	0.90	8.167	37.88	14.167	1.50	20.17	0.86
2.250	0.92	8.250	19.77	14.250	1.47	20.25	0.85
2.333	0.92	8.333	19.77	14.333	1.47	20.33	0.85
2.417	0.94	8.417	13.48	14.417	1.44	20.42	0.84
2.500	0.94	8.500	13.48	14.500	1.44	20.50	0.84
2.583	0.97	8.583	10.31	14.583	1.41	20.58	0.84
2.667	0.97	8.667	10.31	14.667	1.41	20.67	0.84
2.750	0.99	8.750	8.40	14.750	1.38	20.75	0.83
2.833	0.99	8.833	8.40	14.833	1.38	20.83	0.83
2.917	1.02	8.917	7.12	14.917	1.35	20.92	0.82
3.000	1.02	9.000	7.12	15.000	1.35	21.00	0.82
3.083	1.05	9.083	6.20	15.083	1.33	21.08	0.81
3.167	1.05	9.167	6.20	15.167	1.33	21.17	0.81
3.250	1.08	9.250	5.51	15.250	1.30	21.25	0.80
3.333	1.08	9.333	5.51	15.333	1.30	21.33	0.80
3.417	1.11	9.417	4.96	15.417	1.28	21.42	0.79
3.500	1.11	9.500	4.96	15.500	1.28	21.50	0.79
3.583	1.14	9.583	4.53	15.583	1.26	21.58	0.79
3.667	1.14	9.667	4.53	15.667	1.26	21.67	0.79
3.750	1.18	9.750	4.17	15.750	1.23	21.75	0.78
3.833	1.18	9.833	4.17	15.833	1.23	21.83	0.78
3.917	1.22	9.917	3.86	15.917	1.21	21.92	0.77
4.000	1.22	10.000	3.86	16.000	1.21	22.00	0.77
4.083	1.27	10.083	3.61	16.083	1.19	22.08	0.76
4.167	1.27	10.167	3.61	16.167	1.19	22.17	0.76
4.250	1.31	10.250	3.38	16.250	1.17	22.25	0.76
4.333	1.31	10.333	3.38	16.333	1.17	22.33	0.76
4.417	1.37	10.417	3.19	16.417	1.15	22.42	0.75
4.500	1.37	10.500	3.19	16.500	1.15	22.50	0.75
4.583	1.42	10.583	3.02	16.583	1.14	22.58	0.74
4.667	1.42	10.667	3.02	16.667	1.14	22.67	0.74
4.750	1.48	10.750	2.87	16.750	1.12	22.75	0.74
4.833	1.48	10.833	2.87	16.833	1.12	22.83	0.74
4.917	1.55	10.917	2.73	16.917	1.10	22.92	0.73
5.000	1.55	11.000	2.73	17.000	1.10	23.00	0.73
5.083	1.63	11.083	2.61	17.083	1.09	23.08	0.72
5.167	1.63	11.167	2.61	17.167	1.09	23.17	0.72
5.250	1.71	11.250	2.50	17.250	1.07	23.25	0.72
5.333	1.71	11.333	2.50	17.333	1.07	23.33	0.72
5.417	1.81	11.417	2.40	17.417	1.05	23.42	0.71
5.500	1.81	11.500	2.40	17.500	1.05	23.50	0.71
5.583	1.92	11.583	2.31	17.583	1.04	23.58	0.70
5.667	1.92	11.667	2.31	17.667	1.04	23.67	0.70
5.750	2.04	11.750	2.23	17.750	1.03	23.75	0.70
5.833	2.04	11.833	2.23	17.833	1.03	23.83	0.70
5.917	2.18	11.917	2.15	17.917	1.01	23.92	0.69
6.000	2.18	12.000	2.15	18.000	1.01	24.00	0.69

Max.Eff.Inten.(mm/hr)=		121.81	70.49	
over (min)		5.00	10.00	
Storage Coeff. (min)=		4.99 (ii)	7.00 (ii)	
Unit Hyd. Tpeak (min)=		5.00	10.00	
Unit Hyd. peak (cms)=		0.22	0.14	
				TOTALS
PEAK FLOW	(cms)=	5.23	0.13	5.347 (iii)
TIME TO PEAK	(hrs)=	8.00	8.08	8.00
RUNOFF VOLUME	(mm)=	79.06	46.99	77.45
TOTAL RAINFALL	(mm)=	80.06	80.06	80.06
RUNOFF COEFFICIENT	=	0.99	0.59	0.97

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 85.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(0005)	OVERFLOW IS OFF			
IN= 2---> OUT= 1				
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	2.7380	0.4708
	0.0268	0.2254	3.1330	0.4845
	1.5440	0.3354	3.8190	0.5559
	2.2670	0.4187	4.3000	0.5927

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0004)	18.200	5.347	8.00	77.45
OUTFLOW: ID= 1 (0005)	18.200	2.695	8.17	77.34

PEAK FLOW REDUCTION [Qout/Qin](%)= 50.40
TIME SHIFT OF PEAK FLOW (min)= 10.00
MAXIMUM STORAGE USED (ha.m.)= 0.4708

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V V I SSSSS U U A L (v 6.2.2019)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSSS UUUUU A A LLLLL

OOO TTTTT TTTTT H H Y Y MM MM OOO TM
O O T T H H Y Y M M M O O
O O T T H H Y M M O O
OOO T T H H Y M M OOO

***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat

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  Output  filename:
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7f2107f0-d7c9-4f11-ae3f-7a472943ee20\
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DATE: 03-10-2025                          TIME: 09:04:15

USER:



COMMENTS: _____________________________________________________


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  ************************************************
  ** SIMULATION : 5 - 25-year 24hr Chic - Milto **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1234.000
| Ptotal= 65.15 mm |                          B=   5.500
--------------------                          C=   0.786
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  =  4.00 hrs
                       Storm time step    = 10.00 min
                       Time to peak ratio =  0.33

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.00    4.31 |  1.00   34.08 |  2.00   10.19 |  3.00    5.13
                0.17    4.94 |  1.17  143.01 |  2.17    8.67 |  3.17    4.76
                0.33    5.82 |  1.33   44.65 |  2.33    7.57 |  3.33    4.45
                0.50    7.15 |  1.50   23.56 |  2.50    6.74 |  3.50    4.18
                0.67    9.42 |  1.67   16.20 |  2.67    6.09 |  3.67    3.95
                0.83   14.31 |  1.83   12.46 |  2.83    5.56 |  3.83    3.74


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| CALIB            |
| STANDHYD (  0001)|   Area    (ha)=  14.86
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  50.00
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                           IMPERVIOUS    PERVIOUS (i)
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--------------------
                           IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=      17.29         0.91
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     348.33        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    4.31 | 1.083   34.08 | 2.083   10.19 |  3.08    5.13
               0.167    4.31 | 1.167   34.08 | 2.167   10.19 |  3.17    5.13
               0.250    4.94 | 1.250  143.01 | 2.250    8.67 |  3.25    4.76
               0.333    4.94 | 1.333  143.01 | 2.333    8.67 |  3.33    4.76
               0.417    5.82 | 1.417   44.65 | 2.417    7.57 |  3.42    4.45
               0.500    5.82 | 1.500   44.65 | 2.500    7.57 |  3.50    4.45
               0.583    7.15 | 1.583   23.56 | 2.583    6.74 |  3.58    4.18
               0.667    7.15 | 1.667   23.56 | 2.667    6.74 |  3.67    4.18
               0.750    9.42 | 1.750   16.20 | 2.750    6.09 |  3.75    3.95
               0.833    9.42 | 1.833   16.20 | 2.833    6.09 |  3.83    3.95
               0.917   14.31 | 1.917   12.46 | 2.917    5.56 |  3.92    3.74
               1.000   14.31 | 2.000   12.46 | 3.000    5.56 |  4.00    3.74

     Max.Eff.Inten.(mm/hr)=     143.01        72.81
               over (min)        5.00        10.00
     Storage Coeff.  (min)=       4.68 (ii)    6.57 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.22         0.14
                                                    *TOTALS*
     PEAK FLOW       (cms)=       6.24         0.14          6.352 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.42           1.33
     RUNOFF VOLUME    (mm)=      64.15        34.47          62.67
     TOTAL RAINFALL   (mm)=      65.15        65.15          65.15
     RUNOFF COEFFICIENT   =       0.98         0.53           0.96

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| RESERVOIR(  0005)|     OVERFLOW IS OFF
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     Surface Area     (ha)=       7.43         7.43
     Dep. Storage     (mm)=       1.00         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     314.75        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    4.31 | 1.083   34.08 | 2.083   10.19 |  3.08    5.13
               0.167    4.31 | 1.167   34.08 | 2.167   10.19 |  3.17    5.13
               0.250    4.94 | 1.250  143.01 | 2.250    8.67 |  3.25    4.76
               0.333    4.94 | 1.333  143.01 | 2.333    8.67 |  3.33    4.76
               0.417    5.82 | 1.417   44.65 | 2.417    7.57 |  3.42    4.45
               0.500    5.82 | 1.500   44.65 | 2.500    7.57 |  3.50    4.45
               0.583    7.15 | 1.583   23.56 | 2.583    6.74 |  3.58    4.18
               0.667    7.15 | 1.667   23.56 | 2.667    6.74 |  3.67    4.18
               0.750    9.42 | 1.750   16.20 | 2.750    6.09 |  3.75    3.95
               0.833    9.42 | 1.833   16.20 | 2.833    6.09 |  3.83    3.95
               0.917   14.31 | 1.917   12.46 | 2.917    5.56 |  3.92    3.74
               1.000   14.31 | 2.000   12.46 | 3.000    5.56 |  4.00    3.74

     Max.Eff.Inten.(mm/hr)=     143.01        72.81
               over (min)        5.00        15.00
     Storage Coeff.  (min)=       4.41 (ii)   12.42 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.23         0.08
                                                    *TOTALS*
     PEAK FLOW       (cms)=       2.71         0.83          3.133 (iii)
     TIME TO PEAK    (hrs)=       1.33         1.50           1.33
     RUNOFF VOLUME    (mm)=      64.15        34.47          49.31
     TOTAL RAINFALL   (mm)=      65.15        65.15          65.15
     RUNOFF COEFFICIENT   =       0.98         0.53           0.76

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| CALIB            |
| STANDHYD (  0004)|   Area    (ha)=  18.20
|ID= 1 DT= 5.0 min |   Total Imp(%)=  95.00   Dir. Conn.(%)=  95.00
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| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000      0.0000   |    2.7380      0.4708
                          0.0268      0.2254   |    3.1330      0.4845
                          1.5440      0.3354   |    3.8190      0.5559
                          2.2670      0.4187   |    4.3000      0.5927

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0004)     18.200      6.352      1.33      62.67
   OUTFLOW: ID= 1 (  0005)     18.200      3.013      1.50      62.55

                PEAK   FLOW   REDUCTION [Qout/Qin](%)= 47.44
                TIME SHIFT OF PEAK FLOW         (min)= 10.00
                MAXIMUM  STORAGE   USED       (ha.m.)=  0.4845

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================================================================================
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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2019)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat

  Output  filename:
C:\Users\jannaormond\AppData\Local\Civica\VH5\3343a733-fb9e-41c8-9272-7af20af75cda\
996e83f8-b648-4675-94a9-f8a5826c9a8e\
  Summary filename:
C:\Users\jannaormond\AppData\Local\Civica\VH5\3343a733-fb9e-41c8-9272-7af20af75cda\
996e83f8-b648-4675-94a9-f8a5826c9a8e\


DATE: 03-10-2025                          TIME: 09:04:15
```

USER:

COMMENTS: _____

**** SIMULATION : 6 - 50-Year 24hr Chic - Milto **

| CHICAGO STORM | Ptotal=110.01 mm |

IDF curve parameters: A=1323.000
B= 5.300
C= 0.779
used in: INTENSITY = A / (t + B)^C

Duration of storm = 24.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	1.05	6.00	3.38	12.00	3.00	18.00	1.47
0.17	1.07	6.17	3.66	12.17	2.90	18.17	1.45
0.33	1.08	6.33	4.00	12.33	2.82	18.33	1.43
0.50	1.10	6.50	4.42	12.50	2.73	18.50	1.41
0.67	1.12	6.67	4.96	12.67	2.66	18.67	1.40
0.83	1.14	6.83	5.67	12.83	2.59	18.83	1.38
1.00	1.17	7.00	6.66	13.00	2.52	19.00	1.36
1.17	1.19	7.17	8.15	13.17	2.46	19.17	1.35
1.33	1.21	7.33	10.70	13.33	2.40	19.33	1.33
1.50	1.24	7.50	16.13	13.50	2.34	19.50	1.32
1.67	1.27	7.67	37.84	13.67	2.29	19.67	1.30
1.83	1.29	7.83	158.18	13.83	2.23	19.83	1.29
2.00	1.32	8.00	49.42	14.00	2.19	20.00	1.27
2.17	1.35	8.17	26.31	14.17	2.14	20.17	1.26
2.33	1.39	8.33	18.21	14.33	2.10	20.33	1.25
2.50	1.42	8.50	14.08	14.50	2.05	20.50	1.23
2.67	1.46	8.67	11.56	14.67	2.01	20.67	1.22
2.83	1.50	8.83	9.86	14.83	1.98	20.83	1.21
3.00	1.54	9.00	8.63	15.00	1.94	21.00	1.20
3.17	1.58	9.17	7.70	15.17	1.90	21.17	1.19
3.33	1.63	9.33	6.96	15.33	1.87	21.33	1.17
3.50	1.68	9.50	6.37	15.50	1.84	21.50	1.16
3.67	1.73	9.67	5.88	15.67	1.81	21.67	1.15
3.83	1.79	9.83	5.47	15.83	1.78	21.83	1.14
4.00	1.85	10.00	5.12	16.00	1.75	22.00	1.13
4.17	1.92	10.17	4.81	16.17	1.72	22.17	1.12
4.33	1.99	10.33	4.55	16.33	1.69	22.33	1.11
4.50	2.07	10.50	4.31	16.50	1.67	22.50	1.10
4.67	2.16	10.67	4.10	16.67	1.64	22.67	1.09
4.83	2.26	10.83	3.91	16.83	1.62	22.83	1.08
5.00	2.36	11.00	3.74	17.00	1.59	23.00	1.07
5.17	2.48	11.17	3.59	17.17	1.57	23.17	1.06
5.33	2.62	11.33	3.45	17.33	1.55	23.33	1.05
5.50	2.77	11.50	3.32	17.50	1.53	23.50	1.04
5.67	2.95	11.67	3.20	17.67	1.51	23.67	1.04
5.83	3.15	11.83	3.10	17.83	1.49	23.83	1.03

| CALIB | STANDHYD (0001) | ID= 1 DT= 5.0 min |

Area (ha)= 14.86
Total Imp(%)= 50.00 Dir. Conn.(%)= 50.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	7.43	7.43
Dep. Storage	(mm)=	1.00	5.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	314.75	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.05	6.083	3.38	12.083	3.00	18.08	1.47
0.167	1.05	6.167	3.38	12.167	3.00	18.17	1.47
0.250	1.07	6.250	3.66	12.250	2.90	18.25	1.45
0.333	1.07	6.333	3.66	12.333	2.90	18.33	1.45
0.417	1.08	6.417	4.00	12.417	2.82	18.42	1.43
0.500	1.08	6.500	4.00	12.500	2.82	18.50	1.43
0.583	1.10	6.583	4.42	12.583	2.73	18.58	1.41
0.667	1.10	6.667	4.42	12.667	2.73	18.67	1.41
0.750	1.12	6.750	4.96	12.750	2.66	18.75	1.40
0.833	1.12	6.833	4.96	12.833	2.66	18.83	1.40
0.917	1.14	6.917	5.67	12.917	2.59	18.92	1.38
1.000	1.14	7.000	5.67	13.000	2.59	19.00	1.38
1.083	1.17	7.083	6.66	13.083	2.52	19.08	1.36
1.167	1.17	7.167	6.66	13.167	2.52	19.17	1.36
1.250	1.19	7.250	8.15	13.250	2.46	19.25	1.35
1.333	1.19	7.333	8.15	13.333	2.46	19.33	1.35
1.417	1.21	7.417	10.70	13.417	2.40	19.42	1.33
1.500	1.21	7.500	10.70	13.500	2.40	19.50	1.33
1.583	1.24	7.583	16.13	13.583	2.34	19.58	1.32
1.667	1.24	7.667	16.13	13.667	2.34	19.67	1.32
1.750	1.27	7.750	37.84	13.750	2.29	19.75	1.30
1.833	1.27	7.833	37.85	13.833	2.29	19.83	1.30
1.917	1.29	7.917	158.18	13.917	2.23	19.92	1.29
2.000	1.29	8.000	158.18	14.000	2.23	20.00	1.29
2.083	1.32	8.083	49.42	14.083	2.19	20.08	1.27
2.167	1.32	8.167	49.42	14.167	2.19	20.17	1.27
2.250	1.35	8.250	26.31	14.250	2.14	20.25	1.26
2.333	1.35	8.333	26.31	14.333	2.14	20.33	1.26
2.417	1.39	8.417	18.21	14.417	2.10	20.42	1.25
2.500	1.39	8.500	18.21	14.500	2.10	20.50	1.25
2.583	1.42	8.583	14.08	14.583	2.05	20.58	1.23
2.667	1.42	8.667	14.08	14.667	2.05	20.67	1.23
2.750	1.46	8.750	11.56	14.750	2.01	20.75	1.22
2.833	1.46	8.833	11.56	14.833	2.01	20.83	1.22
2.917	1.50	8.917	9.86	14.917	1.98	20.92	1.21
3.000	1.50	9.000	9.86	15.000	1.98	21.00	1.21
3.083	1.54	9.083	8.63	15.083	1.94	21.08	1.20
3.167	1.54	9.167	8.63	15.167	1.94	21.17	1.20
3.250	1.58	9.250	7.70	15.250	1.90	21.25	1.19
3.333	1.58	9.333	7.70	15.333	1.90	21.33	1.19
3.417	1.63	9.417	6.96	15.417	1.87	21.42	1.17
3.500	1.63	9.500	6.96	15.500	1.87	21.50	1.17
3.583	1.68	9.583	6.37	15.583	1.84	21.58	1.16
3.667	1.68	9.667	6.37	15.667	1.84	21.67	1.16
3.750	1.73	9.750	5.88	15.750	1.81	21.75	1.15
3.833	1.73	9.833	5.88	15.833	1.81	21.83	1.15
3.917	1.79	9.917	5.47	15.917	1.78	21.92	1.14
4.000	1.79	10.000	5.47	16.000	1.78	22.00	1.14
4.083	1.85	10.083	5.12	16.083	1.75	22.08	1.13
4.167	1.85	10.167	5.12	16.167	1.75	22.17	1.13
4.250	1.92	10.250	4.81	16.250	1.72	22.25	1.12
4.333	1.92	10.333	4.81	16.333	1.72	22.33	1.12
4.417	1.99	10.417	4.55	16.417	1.69	22.42	1.11
4.500	1.99	10.500	4.55	16.500	1.69	22.50	1.11
4.583	2.07	10.583	4.31	16.583	1.67	22.58	1.10
4.667	2.07	10.667	4.31	16.667	1.67	22.67	1.10
4.750	2.16	10.750	4.10	16.750	1.64	22.75	1.09
4.833	2.16	10.833	4.10	16.833	1.64	22.83	1.09
4.917	2.26	10.917	3.91	16.917	1.62	22.92	1.08
5.000	2.26	11.000	3.91	17.000	1.62	23.00	1.08
5.083	2.36	11.083	3.74	17.083	1.59	23.08	1.07
5.167	2.36	11.167	3.74	17.167	1.59	23.17	1.07
5.250	2.48	11.250	3.59	17.250	1.57	23.25	1.06
5.333	2.48	11.333	3.59	17.333	1.57	23.33	1.06
5.417	2.62	11.417	3.45	17.417	1.55	23.42	1.05
5.500	2.62	11.500	3.45	17.500	1.55	23.50	1.05
5.583	2.77	11.583	3.32	17.583	1.53	23.58	1.04
5.667	2.77	11.667	3.32	17.667	1.53	23.67	1.04
5.750	2.95	11.750	3.20	17.750	1.51	23.75	1.04
5.833	2.95	11.833	3.20	17.833	1.51	23.83	1.04
5.917	3.15	11.917	3.10	17.917	1.49	23.92	1.03
6.000	3.15	12.000	3.10	18.000	1.49	24.00	1.03

				TOTALS
Max.Eff.Inten.(mm/hr)=		158.18	108.11	
over (min)		5.00	15.00	
Storage Coeff. (min)=		4.23 (ii)	11.07 (ii)	
Unit Hyd. Tpeak (min)=		5.00	15.00	
Unit Hyd. peak (cms)=		0.24	0.09	
PEAK FLOW	(cms)=	3.03	1.29	3.819 (iii)
TIME TO PEAK	(hrs)=	8.00	8.17	8.00
RUNOFF VOLUME	(mm)=	109.01	73.59	91.30
TOTAL RAINFALL	(mm)=	110.01	110.01	110.01
RUNOFF COEFFICIENT	=	0.99	0.67	0.83

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 85.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB | STANDHYD (0004) | ID= 1 DT= 5.0 min |

Area (ha)= 18.20
Total Imp(%)= 95.00 Dir. Conn.(%)= 95.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	17.29	0.91
Dep. Storage	(mm)=	1.00	5.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	348.33	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.05	6.083	3.38	12.083	3.00	18.08	1.47
0.167	1.05	6.167	3.38	12.167	3.00	18.17	1.47
0.250	1.07	6.250	3.66	12.250	2.90	18.25	1.45
0.333	1.07	6.333	3.66	12.333	2.90	18.33	1.45
0.417	1.08	6.417	4.00	12.417	2.82	18.42	1.43

0.500	1.08	6.500	4.00	12.500	2.82	18.50	1.43
0.583	1.10	6.583	4.42	12.583	2.73	18.58	1.41
0.667	1.10	6.667	4.42	12.667	2.73	18.67	1.41
0.750	1.12	6.750	4.96	12.750	2.66	18.75	1.40
0.833	1.12	6.833	4.96	12.833	2.66	18.83	1.40
0.917	1.14	6.917	5.67	12.917	2.59	18.92	1.38
1.000	1.14	7.000	5.67	13.000	2.59	19.00	1.38
1.083	1.17	7.083	6.66	13.083	2.52	19.08	1.36
1.167	1.17	7.167	6.66	13.167	2.52	19.17	1.36
1.250	1.19	7.250	8.15	13.250	2.46	19.25	1.35
1.333	1.19	7.333	8.15	13.333	2.46	19.33	1.35
1.417	1.21	7.417	10.70	13.417	2.40	19.42	1.33
1.500	1.21	7.500	10.70	13.500	2.40	19.50	1.33
1.583	1.24	7.583	16.13	13.583	2.34	19.58	1.32
1.667	1.24	7.667	16.13	13.667	2.34	19.67	1.32
1.750	1.27	7.750	37.84	13.750	2.29	19.75	1.30
1.833	1.27	7.833	37.85	13.833	2.29	19.83	1.30
1.917	1.29	7.917	158.18	13.917	2.23	19.92	1.29
2.000	1.29	8.000	158.18	14.000	2.23	20.00	1.29
2.083	1.32	8.083	49.42	14.083	2.19	20.08	1.27
2.167	1.32	8.167	49.42	14.167	2.19	20.17	1.27
2.250	1.35	8.250	26.31	14.250	2.14	20.25	1.26
2.333	1.35	8.333	26.31	14.333	2.14	20.33	1.26
2.417	1.39	8.417	18.21	14.417	2.10	20.42	1.25
2.500	1.39	8.500	18.21	14.500	2.10	20.50	1.25
2.583	1.42	8.583	14.08	14.583	2.05	20.58	1.23
2.667	1.42	8.667	14.08	14.667	2.05	20.67	1.23
2.750	1.46	8.750	11.56	14.750	2.01	20.75	1.22
2.833	1.46	8.833	11.56	14.833	2.01	20.83	1.22
2.917	1.50	8.917	9.86	14.917	1.98	20.92	1.21
3.000	1.50	9.000	9.86	15.000	1.98	21.00	1.21
3.083	1.54	9.083	8.63	15.083	1.94	21.08	1.20
3.167	1.54	9.167	8.63	15.167	1.94	21.17	1.20
3.250	1.58	9.250	7.70	15.250	1.90	21.25	1.19
3.333	1.58	9.333	7.70	15.333	1.90	21.33	1.19
3.417	1.63	9.417	6.96	15.417	1.87	21.42	1.17
3.500	1.63	9.500	6.96	15.500	1.87	21.50	1.17
3.583	1.68	9.583	6.37	15.583	1.84	21.58	1.16
3.667	1.68	9.667	6.37	15.667	1.84	21.67	1.16
3.750	1.73	9.750	5.88	15.750	1.81	21.75	1.15
3.833	1.73	9.833	5.88	15.833	1.81	21.83	1.15
3.917	1.79	9.917	5.47	15.917	1.78	21.92	1.14
4.000	1.79	10.000	5.47	16.000	1.78	22.00	1.14
4.083	1.85	10.083	5.12	16.083	1.75	22.08	1.13
4.167	1.85	10.167	5.12	16.167	1.75	22.17	1.13
4.250	1.92	10.250	4.81	16.250	1.72	22.25	1.12
4.333	1.92	10.333	4.81	16.333	1.72	22.33	1.12
4.417	1.99	10.417	4.55	16.417	1.69	22.42	1.11
4.500	1.99	10.500	4.55	16.500	1.69	22.50	1.11
4.583	2.07	10.583	4.31	16.583	1.67	22.58	1.10
4.667	2.07	10.667	4.31	16.667	1.67	22.67	1.10
4.750	2.16	10.750	4.10	16.750	1.64	22.75	1.09
4.833	2.16	10.833	4.10	16.833	1.64	22.83	1.09
4.917	2.26	10.917	3.91	16.917	1.62	22.92	1.08
5.000	2.26	11.000	3.91	17.000	1.62	23.00	1.08
5.083	2.36	11.083	3.74	17.083	1.59	23.08	1.07
5.167	2.36	11.167	3.74	17.167	1.59	23.17	1.07
5.250	2.48	11.250	3.59	17.250	1.57	23.25	1.06
5.333	2.48	11.333	3.59	17.333	1.57	23.33	1.06
5.417	2.62	11.417	3.45	17.417	1.55	23.42	1.05
5.500	2.62	11.500	3.45	17.500	1.55	23.50	1.05
5.583	2.77	11.583	3.32	17.583	1.53	23.58	1.04
5.667	2.77	11.667	3.32	17.667	1.53	23.67	1.04
5.750	2.95	11.750	3.20	17.750	1.51	23.75	1.04
5.833	2.95	11.833	3.20	17.833	1.51	23.83	1.04
5.917	3.15	11.917	3.10	17.917	1.49	23.92	1.03
6.000	3.15	12.000	3.10	18.000	1.49	24.00	1.03

Max.Eff.Inten.(mm/hr)=	158.18	108.11	
over (min)	5.00	10.00	
Storage Coeff. (min)=	4.50 (ii)	6.31 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.23	0.15	
			TOTALS
PEAK FLOW (cms)=	6.96	0.20	7.146 (iii)
TIME TO PEAK (hrs)=	8.00	8.08	8.00
RUNOFF VOLUME (mm)=	109.01	73.59	107.24
TOTAL RAINFALL (mm)=	110.01	110.01	110.01
RUNOFF COEFFICIENT =	0.99	0.67	0.97

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 85.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(0005)|	OVERFLOW IS OFF			
IN= 2---> OUT= 1				
DT= 5.0 min |	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	2.7380	0.4708
	0.0268	0.2254	3.1330	0.4845
	1.5440	0.0354	3.8190	0.5559
	2.2670	0.4187	4.3000	0.5927

	AREA	QPEAK	TPEAK	R.V.
INFLOW : ID= 2 (0004)	18.200	7.146	8.00	107.24
OUTFLOW: ID= 1 (0005)	18.200	3.774	8.08	107.12

PEAK FLOW REDUCTION [Qout/Qin](%)= 52.82
TIME SHIFT OF PEAK FLOW (min)= 5.00
MAXIMUM STORAGE USED (ha.m.)= 0.5559

```
      V    V   I    SSSSS  U   U    A    L              (v 6.2.2019)
      V    V   I    SS     U   U   A A   L
       V  V    I     SS    U   U  AAAAA  L
       V  V    I      SS   U   U  A   A  L
        VV     I    SSSSS  UUUUU  A   A  LLLLL

       OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
      O   O    T      T    H   H   Y Y   MM MM  O   O
      O   O    T      T    H   H    Y    M   M  O   O
       OOO     T      T    H   H    Y    M   M   OOO
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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat

Output filename:
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Summary filename:
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DATE: 03-10-2025 TIME: 09:04:14

USER:

COMMENTS: _____

****
** SIMULATION : 7 - 100-year 24hr Chic - Milt **
****

CHICAGO STORM |	IDF curve parameters: A=1435.000
Ptotal=122.41 mm |	B= 5.200
	C= 0.775

used in: INTENSITY = A / (t + B)^C

Duration of storm = 24.00 hrs
Storm time step = 10.00 min
Time to peak ratio = 0.33

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	1.18	6.00	3.80	12.00	3.36	18.00	1.66
0.17	1.20	6.17	4.11	12.17	3.26	18.17	1.64
0.33	1.22	6.33	4.49	12.33	3.16	18.33	1.61
0.50	1.25	6.50	4.95	12.50	3.07	18.50	1.59
0.67	1.27	6.67	5.55	12.67	2.99	18.67	1.58
0.83	1.29	6.83	6.34	12.83	2.91	18.83	1.56
1.00	1.32	7.00	7.44	13.00	2.83	19.00	1.54
1.17	1.34	7.17	9.10	13.17	2.76	19.17	1.52
1.33	1.37	7.33	11.90	13.33	2.69	19.33	1.50
1.50	1.40	7.50	17.89	13.50	2.63	19.50	1.49
1.67	1.43	7.67	41.69	13.67	2.57	19.67	1.47
1.83	1.46	7.83	174.10	13.83	2.51	19.83	1.45
2.00	1.49	8.00	54.37	14.00	2.46	20.00	1.44
2.17	1.53	8.17	29.07	14.17	2.41	20.17	1.42
2.33	1.56	8.33	20.18	14.33	2.36	20.33	1.41
2.50	1.60	8.50	15.63	14.50	2.31	20.50	1.39
2.67	1.64	8.67	12.86	14.67	2.27	20.67	1.38
2.83	1.69	8.83	10.98	14.83	2.22	20.83	1.37
3.00	1.73	9.00	9.62	15.00	2.18	21.00	1.35
3.17	1.78	9.17	8.59	15.17	2.14	21.17	1.34
3.33	1.83	9.33	7.78	15.33	2.11	21.33	1.33
3.50	1.89	9.50	7.12	15.50	2.07	21.50	1.31
3.67	1.95	9.67	6.58	15.67	2.03	21.67	1.30
3.83	2.02	9.83	6.12	15.83	2.00	21.83	1.29
4.00	2.09	10.00	5.73	16.00	1.97	22.00	1.28
4.17	2.16	10.17	5.39	16.17	1.94	22.17	1.26
4.33	2.24	10.33	5.09	16.33	1.91	22.33	1.25
4.50	2.33	10.50	4.83	16.50	1.88	22.50	1.24
4.67	2.43	10.67	4.60	16.67	1.85	22.67	1.23
4.83	2.54	10.83	4.39	16.83	1.82	22.83	1.22
5.00	2.66	11.00	4.20	17.00	1.80	23.00	1.21
5.17	2.79	11.17	4.03	17.17	1.77	23.17	1.20
5.33	2.94	11.33	3.87	17.33	1.75	23.33	1.19

5.50	3.11	11.50	3.73	17.50	1.72	23.50	1.18
5.67	3.31	11.67	3.60	17.67	1.70	23.67	1.17
5.83	3.53	11.83	3.48	17.83	1.68	23.83	1.16

CALIB			
STANDHYD (0001)	Area (ha)= 14.86		
ID= 1 DT= 5.0 min	Total Imp(%)= 50.00	Dir. Conn.(%)= 50.00	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	7.43	7.43
Dep. Storage	(mm)=	1.00	5.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	314.75	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.18	6.083	3.80	12.083	3.36	18.08	1.66
0.167	1.18	6.167	3.80	12.167	3.36	18.17	1.66
0.250	1.20	6.250	4.11	12.250	3.26	18.25	1.64
0.333	1.20	6.333	4.11	12.333	3.26	18.33	1.64
0.417	1.22	6.417	4.49	12.417	3.16	18.42	1.61
0.500	1.22	6.500	4.49	12.500	3.16	18.50	1.61
0.583	1.25	6.583	4.95	12.583	3.07	18.58	1.59
0.667	1.25	6.667	4.95	12.667	3.07	18.67	1.59
0.750	1.27	6.750	5.55	12.750	2.99	18.75	1.58
0.833	1.27	6.833	5.55	12.833	2.99	18.83	1.58
0.917	1.29	6.917	6.34	12.917	2.91	18.92	1.56
1.000	1.29	7.000	6.34	13.000	2.91	19.00	1.56
1.083	1.32	7.083	7.44	13.083	2.83	19.08	1.54
1.167	1.32	7.167	7.44	13.167	2.83	19.17	1.54
1.250	1.34	7.250	9.10	13.250	2.76	19.25	1.52
1.333	1.34	7.333	9.10	13.333	2.76	19.33	1.52
1.417	1.37	7.417	11.90	13.417	2.69	19.42	1.50
1.500	1.37	7.500	11.90	13.500	2.69	19.50	1.50
1.583	1.40	7.583	17.89	13.583	2.63	19.58	1.49
1.667	1.40	7.667	17.89	13.667	2.63	19.67	1.49
1.750	1.43	7.750	41.69	13.750	2.57	19.75	1.47
1.833	1.43	7.833	41.70	13.833	2.57	19.83	1.47
1.917	1.46	7.917	174.10	13.917	2.51	19.92	1.45
2.000	1.46	8.000	174.09	14.000	2.51	20.00	1.45
2.083	1.49	8.083	54.37	14.083	2.46	20.08	1.44
2.167	1.49	8.167	54.37	14.167	2.46	20.17	1.44
2.250	1.53	8.250	29.07	14.250	2.41	20.25	1.42
2.333	1.53	8.333	29.07	14.333	2.41	20.33	1.42
2.417	1.56	8.417	20.18	14.417	2.36	20.42	1.41
2.500	1.56	8.500	20.18	14.500	2.36	20.50	1.41
2.583	1.60	8.583	15.63	14.583	2.31	20.58	1.39
2.667	1.60	8.667	15.63	14.667	2.31	20.67	1.39
2.750	1.64	8.750	12.86	14.750	2.27	20.75	1.38
2.833	1.64	8.833	12.86	14.833	2.27	20.83	1.38
2.917	1.69	8.917	10.98	14.917	2.22	20.92	1.37
3.000	1.69	9.000	10.98	15.000	2.22	21.00	1.37
3.083	1.73	9.083	9.62	15.083	2.18	21.08	1.35
3.167	1.73	9.167	9.62	15.167	2.18	21.17	1.35
3.250	1.78	9.250	8.59	15.250	2.14	21.25	1.34
3.333	1.78	9.333	8.59	15.333	2.14	21.33	1.34
3.417	1.83	9.417	7.78	15.417	2.11	21.42	1.33
3.500	1.83	9.500	7.78	15.500	2.11	21.50	1.33
3.583	1.89	9.583	7.12	15.583	2.07	21.58	1.31
3.667	1.89	9.667	7.12	15.667	2.07	21.67	1.31
3.750	1.95	9.750	6.58	15.750	2.03	21.75	1.30
3.833	1.95	9.833	6.58	15.833	2.03	21.83	1.30
3.917	2.02	9.917	6.12	15.917	2.00	21.92	1.29
4.000	2.02	10.000	6.12	16.000	2.00	22.00	1.29
4.083	2.09	10.083	5.73	16.083	1.97	22.08	1.28
4.167	2.09	10.167	5.73	16.167	1.97	22.17	1.28
4.250	2.16	10.250	5.39	16.250	1.94	22.25	1.26
4.333	2.16	10.333	5.39	16.333	1.94	22.33	1.26
4.417	2.24	10.417	5.09	16.417	1.91	22.42	1.25
4.500	2.24	10.500	5.09	16.500	1.91	22.50	1.25
4.583	2.33	10.583	4.83	16.583	1.88	22.58	1.24
4.667	2.33	10.667	4.83	16.667	1.88	22.67	1.24
4.750	2.43	10.750	4.60	16.750	1.85	22.75	1.23
4.833	2.43	10.833	4.60	16.833	1.85	22.83	1.23
4.917	2.54	10.917	4.39	16.917	1.82	22.92	1.22
5.000	2.54	11.000	4.39	17.000	1.82	23.00	1.22
5.083	2.66	11.083	4.20	17.083	1.80	23.08	1.21
5.167	2.66	11.167	4.20	17.167	1.80	23.17	1.21
5.250	2.79	11.250	4.03	17.250	1.77	23.25	1.20
5.333	2.79	11.333	4.03	17.333	1.77	23.33	1.20
5.417	2.94	11.417	3.87	17.417	1.75	23.42	1.19
5.500	2.94	11.500	3.87	17.500	1.75	23.50	1.19
5.583	3.11	11.583	3.73	17.583	1.72	23.58	1.18
5.667	3.11	11.667	3.73	17.667	1.72	23.67	1.18
5.750	3.31	11.750	3.60	17.750	1.70	23.75	1.17
5.833	3.31	11.833	3.60	17.833	1.70	23.83	1.17
5.917	3.53	11.917	3.48	17.917	1.68	23.92	1.16
6.000	3.53	12.000	3.48	18.000	1.68	24.00	1.16

Max.Eff.Inten.(mm/hr)=	174.10	124.61	
over (min)	5.00	15.00	
Storage Coeff. (min)=	4.07 (ii)	10.54 (ii)	
Unit Hyd. Tpeak (min)=	5.00	15.00	
Unit Hyd. peak (cms)=	0.24	0.09	
			TOTALS
PEAK FLOW (cms)=	3.36	1.51	4.300 (iii)
TIME TO PEAK (hrs)=	8.00	8.17	8.00
RUNOFF VOLUME (mm)=	121.40	84.97	103.19
TOTAL RAINFALL (mm)=	122.41	122.41	122.41
RUNOFF COEFFICIENT =	0.99	0.69	0.84

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 85.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
STANDHYD (0004)	Area (ha)= 18.20		
ID= 1 DT= 5.0 min	Total Imp(%)= 95.00	Dir. Conn.(%)= 95.00	

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	17.29	0.91
Dep. Storage	(mm)=	1.00	5.00
Average Slope	(%)=	1.00	2.00
Length	(m)=	348.33	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.18	6.083	3.80	12.083	3.36	18.08	1.66
0.167	1.18	6.167	3.80	12.167	3.36	18.17	1.66
0.250	1.20	6.250	4.11	12.250	3.26	18.25	1.64
0.333	1.20	6.333	4.11	12.333	3.26	18.33	1.64
0.417	1.22	6.417	4.49	12.417	3.16	18.42	1.61
0.500	1.22	6.500	4.49	12.500	3.16	18.50	1.61
0.583	1.25	6.583	4.95	12.583	3.07	18.58	1.59
0.667	1.25	6.667	4.95	12.667	3.07	18.67	1.59
0.750	1.27	6.750	5.55	12.750	2.99	18.75	1.58
0.833	1.27	6.833	5.55	12.833	2.99	18.83	1.58
0.917	1.29	6.917	6.34	12.917	2.91	18.92	1.56
1.000	1.29	7.000	6.34	13.000	2.91	19.00	1.56
1.083	1.32	7.083	7.44	13.083	2.83	19.08	1.54
1.167	1.32	7.167	7.44	13.167	2.83	19.17	1.54
1.250	1.34	7.250	9.10	13.250	2.76	19.25	1.52
1.333	1.34	7.333	9.10	13.333	2.76	19.33	1.52
1.417	1.37	7.417	11.90	13.417	2.69	19.42	1.50
1.500	1.37	7.500	11.90	13.500	2.69	19.50	1.50
1.583	1.40	7.583	17.89	13.583	2.63	19.58	1.49
1.667	1.40	7.667	17.89	13.667	2.63	19.67	1.49
1.750	1.43	7.750	41.69	13.750	2.57	19.75	1.47
1.833	1.43	7.833	41.70	13.833	2.57	19.83	1.47
1.917	1.46	7.917	174.10	13.917	2.51	19.92	1.45
2.000	1.46	8.000	174.09	14.000	2.51	20.00	1.45
2.083	1.49	8.083	54.37	14.083	2.46	20.08	1.44
2.167	1.49	8.167	54.37	14.167	2.46	20.17	1.44
2.250	1.53	8.250	29.07	14.250	2.41	20.25	1.42
2.333	1.53	8.333	29.07	14.333	2.41	20.33	1.42
2.417	1.56	8.417	20.18	14.417	2.36	20.42	1.41
2.500	1.56	8.500	20.18	14.500	2.36	20.50	1.41
2.583	1.60	8.583	15.63	14.583	2.31	20.58	1.39
2.667	1.60	8.667	15.63	14.667	2.31	20.67	1.39
2.750	1.64	8.750	12.86	14.750	2.27	20.75	1.38
2.833	1.64	8.833	12.86	14.833	2.27	20.83	1.38
2.917	1.69	8.917	10.98	14.917	2.22	20.92	1.37
3.000	1.69	9.000	10.98	15.000	2.22	21.00	1.37
3.083	1.73	9.083	9.62	15.083	2.18	21.08	1.35
3.167	1.73	9.167	9.62	15.167	2.18	21.17	1.35
3.250	1.78	9.250	8.59	15.250	2.14	21.25	1.34
3.333	1.78	9.333	8.59	15.333	2.14	21.33	1.34
3.417	1.83	9.417	7.78	15.417	2.11	21.42	1.33
3.500	1.83	9.500	7.78	15.500	2.11	21.50	1.33
3.583	1.89	9.583	7.12	15.583	2.07	21.58	1.31
3.667	1.89	9.667	7.12	15.667	2.07	21.67	1.31
3.750	1.95	9.750	6.58	15.750	2.03	21.75	1.30
3.833	1.95	9.833	6.58	15.833	2.03	21.83	1.30
3.917	2.02	9.917	6.12	15.917	2.00	21.92	1.29
4.000	2.02	10.000	6.12	16.000	2.00	22.00	1.29
4.083	2.09	10.083	5.73	16.083	1.97	22.08	1.28
4.167	2.09	10.167	5.73	16.167	1.97	22.17	1.28
4.250	2.16	10.250	5.39	16.250	1.94	22.25	1.26
4.333	2.16	10.333	5.39	16.333	1.94	22.33	1.26
4.417	2.24	10.417	5.09	16.417	1.91	22.42	1.25
4.500	2.24	10.500	5.09	16.500	1.91	22.50	1.25
4.583	2.33	10.583	4.83	16.583	1.88	22.58	1.24
4.667	2.33	10.667	4.83	16.667	1.88	22.67	1.24
4.750	2.43	10.750	4.60	16.750	1.85	22.75	1.23
4.833	2.43	10.833	4.60	16.833	1.85	22.83	1.23
4.917	2.54	10.917	4.39	16.917	1.82	22.92	1.22
5.000	2.54	11.000	4.39	17.000	1.82	23.00	1.22
5.083	2.66	11.083	4.20	17.083	1.80	23.08	1.21
5.167	2.66	11.167	4.20	17.167	1.80	23.17	1.21
5.250	2.79	11.250	4.03	17.250	1.77	23.25	1.20
5.333	2.79	11.333	4.03	17.333	1.77	23.33	1.20

```
               5.417    2.94 |11.417    3.87 |17.417    1.75 | 23.42    1.19
               5.500    2.94 |11.500    3.87 |17.500    1.75 | 23.50    1.19
               5.583    3.11 |11.583    3.73 |17.583    1.72 | 23.58    1.18
               5.667    3.11 |11.667    3.73 |17.667    1.72 | 23.67    1.18
               5.750    3.31 |11.750    3.60 |17.750    1.70 | 23.75    1.17
               5.833    3.31 |11.833    3.60 |17.833    1.70 | 23.83    1.17
               5.917    3.53 |11.917    3.48 |17.917    1.68 | 23.92    1.16
               6.000    3.53 |12.000    3.48 |18.000    1.68 | 24.00    1.16

     Max.Eff.Inten.(mm/hr)=     174.10       124.61
               over (min)        5.00        10.00
     Storage Coeff.  (min)=       4.33 (ii)    6.07 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.23         0.15
                                                          *TOTALS*
     PEAK FLOW       (cms)=       7.72         0.24          7.940 (iii)
     TIME TO PEAK    (hrs)=       8.00         8.08           8.00
     RUNOFF VOLUME    (mm)=     121.40        84.97         119.58
     TOTAL RAINFALL   (mm)=     122.41       122.41         122.41
     RUNOFF COEFFICIENT   =       0.99         0.69           0.98

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  85.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0005)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           0.0000      0.0000   |    2.7380      0.4708
                           0.0268      0.2254   |    3.1330      0.4845
                           1.5440      0.3354   |    3.8190      0.5559
                           2.2670      0.4187   |    4.3000      0.5927

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0004)     18.200      7.940      8.00     119.58
   OUTFLOW: ID= 1 (  0005)     18.200      4.262      8.08     119.47

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 53.68
                  TIME SHIFT OF PEAK FLOW         (min)=  5.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.5927

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Regional Storm

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       V    V   I    SSSSS  U   U    A    L             (v 6.2.2019)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                  *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat

  Output  filename:
C:\Users\jannaormond\AppData\Local\Civica\VH5\3343a733-fb9e-41c8-9272-7af20af75cda\
5d5c1358-fe67-469d-bd30-25a5eb5cbd2a\
  Summary filename:
C:\Users\jannaormond\AppData\Local\Civica\VH5\3343a733-fb9e-41c8-9272-7af20af75cda\
5d5c1358-fe67-469d-bd30-25a5eb5cbd2a\


DATE: 03-10-2025                          TIME: 09:56:01

USER:



COMMENTS: _____________________________________________________________


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  ************************************************
  ** SIMULATION : Hazel                         **
  ************************************************


--------------------
|    READ STORM    |    Filename: C:\Users\jannaormond\AppD
|                  |              ata\Local\Temp\
```

```
|                  |              5e1d8e1f-07e7-4e4f-b2ba-d02c474b8865\008167ef
| Ptotal=212.00 mm |    Comments: HAZEL
--------------------
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.00    6.00 |  3.00   13.00 |  6.00   23.00 |  9.00   53.00
               1.00    4.00 |  4.00   17.00 |  7.00   13.00 | 10.00   38.00
               2.00    6.00 |  5.00   13.00 |  8.00   13.00 | 11.00   13.00

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| CALIB            |
| STANDHYD (  0001)|   Area    (ha)=  14.86
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  50.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        7.43          7.43
     Dep. Storage     (mm)=        1.00          0.00
     Average Slope     (%)=        1.00          2.00
     Length            (m)=      314.75         40.00
     Mannings n             =      0.013         0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    6.00 | 3.083   13.00 | 6.083   23.00 |  9.08   53.00
               0.167    6.00 | 3.167   13.00 | 6.167   23.00 |  9.17   53.00
               0.250    6.00 | 3.250   13.00 | 6.250   23.00 |  9.25   53.00
               0.333    6.00 | 3.333   13.00 | 6.333   23.00 |  9.33   53.00
               0.417    6.00 | 3.417   13.00 | 6.417   23.00 |  9.42   53.00
               0.500    6.00 | 3.500   13.00 | 6.500   23.00 |  9.50   53.00
               0.583    6.00 | 3.583   13.00 | 6.583   23.00 |  9.58   53.00
               0.667    6.00 | 3.667   13.00 | 6.667   23.00 |  9.67   53.00
               0.750    6.00 | 3.750   13.00 | 6.750   23.00 |  9.75   53.00
               0.833    6.00 | 3.833   13.00 | 6.833   23.00 |  9.83   53.00
               0.917    6.00 | 3.917   13.00 | 6.917   23.00 |  9.92   53.00
               1.000    6.00 | 4.000   13.00 | 7.000   23.00 | 10.00   53.00
               1.083    4.00 | 4.083   17.00 | 7.083   13.00 | 10.08   38.00
               1.167    4.00 | 4.167   17.00 | 7.167   13.00 | 10.17   38.00
               1.250    4.00 | 4.250   17.00 | 7.250   13.00 | 10.25   38.00
               1.333    4.00 | 4.333   17.00 | 7.333   13.00 | 10.33   38.00
               1.417    4.00 | 4.417   17.00 | 7.417   13.00 | 10.42   38.00
               1.500    4.00 | 4.500   17.00 | 7.500   13.00 | 10.50   38.00
               1.583    4.00 | 4.583   17.00 | 7.583   13.00 | 10.58   38.00
               1.667    4.00 | 4.667   17.00 | 7.667   13.00 | 10.67   38.00
               1.750    4.00 | 4.750   17.00 | 7.750   13.00 | 10.75   38.00
               1.833    4.00 | 4.833   17.00 | 7.833   13.00 | 10.83   38.00
               1.917    4.00 | 4.917   17.00 | 7.917   13.00 | 10.92   38.00
               2.000    4.00 | 5.000   17.00 | 8.000   13.00 | 11.00   38.00
               2.083    6.00 | 5.083   13.00 | 8.083   13.00 | 11.08   13.00
               2.167    6.00 | 5.167   13.00 | 8.167   13.00 | 11.17   13.00
               2.250    6.00 | 5.250   13.00 | 8.250   13.00 | 11.25   13.00
               2.333    6.00 | 5.333   13.00 | 8.333   13.00 | 11.33   13.00
               2.417    6.00 | 5.417   13.00 | 8.417   13.00 | 11.42   13.00
               2.500    6.00 | 5.500   13.00 | 8.500   13.00 | 11.50   13.00
               2.583    6.00 | 5.583   13.00 | 8.583   13.00 | 11.58   13.00
               2.667    6.00 | 5.667   13.00 | 8.667   13.00 | 11.67   13.00
               2.750    6.00 | 5.750   13.00 | 8.750   13.00 | 11.75   13.00
               2.833    6.00 | 5.833   13.00 | 8.833   13.00 | 11.83   13.00
               2.917    6.00 | 5.917   13.00 | 8.917   13.00 | 11.92   13.00
               3.000    6.00 | 6.000   13.00 | 9.000   13.00 | 12.00   13.00

     Max.Eff.Inten.(mm/hr)=      53.00        52.53
               over (min)        5.00        20.00
     Storage Coeff.  (min)=      6.55 (ii)   15.68 (ii)
     Unit Hyd. Tpeak (min)=      5.00        20.00
     Unit Hyd. peak  (cms)=      0.18         0.07
                                                    *TOTALS*
     PEAK FLOW       (cms)=      1.09         1.05         2.143 (iii)
     TIME TO PEAK    (hrs)=     10.00        10.00          10.00
     RUNOFF VOLUME    (mm)=    211.00       196.94         203.97
     TOTAL RAINFALL   (mm)=    212.00       212.00         212.00
     RUNOFF COEFFICIENT   =      1.00         0.93           0.96


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  94.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| CALIB            |
| STANDHYD (  0002)|   Area    (ha)=  18.14
|ID= 1 DT= 5.0 min |   Total Imp(%)=  88.00   Dir. Conn.(%)=  88.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       15.96         2.18
     Dep. Storage     (mm)=        1.00         0.00
     Average Slope     (%)=        1.00         2.00
     Length            (m)=      347.75        40.00
     Mannings n             =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
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                          ---- TRANSFORMED HYETOGRAPH ----
                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
               0.083    6.00 | 3.083   13.00 | 6.083   23.00 |  9.08   53.00
               0.167    6.00 | 3.167   13.00 | 6.167   23.00 |  9.17   53.00
               0.250    6.00 | 3.250   13.00 | 6.250   23.00 |  9.25   53.00
               0.333    6.00 | 3.333   13.00 | 6.333   23.00 |  9.33   53.00
               0.417    6.00 | 3.417   13.00 | 6.417   23.00 |  9.42   53.00
               0.500    6.00 | 3.500   13.00 | 6.500   23.00 |  9.50   53.00
               0.583    6.00 | 3.583   13.00 | 6.583   23.00 |  9.58   53.00
               0.667    6.00 | 3.667   13.00 | 6.667   23.00 |  9.67   53.00
               0.750    6.00 | 3.750   13.00 | 6.750   23.00 |  9.75   53.00
               0.833    6.00 | 3.833   13.00 | 6.833   23.00 |  9.83   53.00
               0.917    6.00 | 3.917   13.00 | 6.917   23.00 |  9.92   53.00
               1.000    6.00 | 4.000   13.00 | 7.000   23.00 | 10.00   53.00
               1.083    4.00 | 4.083   17.00 | 7.083   13.00 | 10.08   38.00
               1.167    4.00 | 4.167   17.00 | 7.167   13.00 | 10.17   38.00
               1.250    4.00 | 4.250   17.00 | 7.250   13.00 | 10.25   38.00
               1.333    4.00 | 4.333   17.00 | 7.333   13.00 | 10.33   38.00
               1.417    4.00 | 4.417   17.00 | 7.417   13.00 | 10.42   38.00
               1.500    4.00 | 4.500   17.00 | 7.500   13.00 | 10.50   38.00
               1.583    4.00 | 4.583   17.00 | 7.583   13.00 | 10.58   38.00
               1.667    4.00 | 4.667   17.00 | 7.667   13.00 | 10.67   38.00
               1.750    4.00 | 4.750   17.00 | 7.750   13.00 | 10.75   38.00
               1.833    4.00 | 4.833   17.00 | 7.833   13.00 | 10.83   38.00
               1.917    4.00 | 4.917   17.00 | 7.917   13.00 | 10.92   38.00
               2.000    4.00 | 5.000   17.00 | 8.000   13.00 | 11.00   38.00
               2.083    6.00 | 5.083   13.00 | 8.083   13.00 | 11.08   13.00
               2.167    6.00 | 5.167   13.00 | 8.167   13.00 | 11.17   13.00
               2.250    6.00 | 5.250   13.00 | 8.250   13.00 | 11.25   13.00
               2.333    6.00 | 5.333   13.00 | 8.333   13.00 | 11.33   13.00
               2.417    6.00 | 5.417   13.00 | 8.417   13.00 | 11.42   13.00
               2.500    6.00 | 5.500   13.00 | 8.500   13.00 | 11.50   13.00
               2.583    6.00 | 5.583   13.00 | 8.583   13.00 | 11.58   13.00
               2.667    6.00 | 5.667   13.00 | 8.667   13.00 | 11.67   13.00
               2.750    6.00 | 5.750   13.00 | 8.750   13.00 | 11.75   13.00
               2.833    6.00 | 5.833   13.00 | 8.833   13.00 | 11.83   13.00
               2.917    6.00 | 5.917   13.00 | 8.917   13.00 | 11.92   13.00
               3.000    6.00 | 6.000   13.00 | 9.000   13.00 | 12.00   13.00

     Max.Eff.Inten.(mm/hr)=      53.00        52.53
               over (min)        5.00        15.00
     Storage Coeff.  (min)=      6.96 (ii)   11.06 (ii)
     Unit Hyd. Tpeak (min)=      5.00        15.00
     Unit Hyd. peak  (cms)=      0.17         0.09
                                                    *TOTALS*
     PEAK FLOW       (cms)=      2.35         0.32         2.665 (iii)
     TIME TO PEAK    (hrs)=     10.00        10.00          10.00
     RUNOFF VOLUME    (mm)=    211.00       196.94         209.31
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     TOTAL RAINFALL   (mm)=     212.00       212.00         212.00
     RUNOFF COEFFICIENT   =       1.00         0.93           0.99


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  94.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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-------------------
| RESERVOIR(  0003)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
-------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000      0.0000   |    2.1430      0.4105
                          1.5001      0.2100   |    0.0000      0.0000

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0002)     18.140      2.665     10.00     209.31
   OUTFLOW: ID= 1 (  0003)     18.140      2.143     10.17     209.31

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 80.39
                  TIME SHIFT OF PEAK FLOW         (min)= 10.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.4105

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 FINISH
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APPENDIX C
Wastewater Servicing Calculations

SANITARY SEWER DESIGN SHEET

150 STEELES AVE (MERITOR)

Town of Milton, Halton Region

PROJECT DETAILS

Project No: 21-678
Date: MAR 2025
Designed by: MH
Checked by: SR

DESIGN CRITERIA

Min Diameter =	200	mm	Avg. Domestic Flow =	215.0	l/c/d
Mannings 'n'=	0.013		Infiltration =	0.286	l/s/ha
Min. Velocity =	0.6	m/s	Max. Peaking Factor =	4.50	
Max. Velocity =	3.0	m/s	Min. Peaking Factor=	2.00	
Factor of Safety =	30	%			

NOMINAL PIPE SIZE USED

STREET	FROM MH	TO MH	RESIDENTIAL							COMMERCIAL/INDUSTRIAL/INSTITUTIONAL						FLOW CALCULATIONS								PIPE DATA					
			AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENSITY (P/ha)	DENSITY (P/unit)	POP	ACCUM. RES. POP.	AREA (ha)	ACC. AREA (ha)	EQUIV. POP. (p/ha)	FLOW RATE (l/s/ha)	EQUIV. POP.	ACCUM. EQUIV. POP.	INFILTRATION (l/s)	TOTAL ACCUM. POP.	PEAKING FACTOR	RES. FLOW (l/s)	COMM. FLOW (l/s)	ACCUM. COMM. FLOW (l/s)	TOTAL FLOW (l/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (l/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)	PERCENT FULL (%)
	1A	2A	0.49	0.49	411		1.9	781	781							0.1	781	3.87	7.5			7.7		1.00	200	32.8	1.0	0.82	23%
	2A	3A	0.54	1.03					781							0.3	781	3.87	7.5			7.8		0.50	200	23.2	0.7	0.64	34%
	4A	3A	0.40	0.40	80		1.9	152	152							0.1	152	4.19	1.6			1.7		1.00	200	32.8	1.0	0.54	5%
	3A	5A		1.43					933							0.4	933	3.82	8.9			9.3		0.50	200	23.2	0.7	0.69	40%
	5A	6A		1.43					933							0.4	933	3.82	8.9			9.3		0.50	200	23.2	0.7	0.69	40%
	7A	6A	0.96	0.96	295		1.9	561	561							0.3	561	3.95	5.5			5.8		1.00	200	32.8	1.0	0.78	18%
	8A	6A	0.74	0.74	424		1.9	806	806							0.2	806	3.86	7.7			8.0		1.00	200	32.8	1.0	0.85	24%
	6A	9A	0.65	3.78					2300							1.1	2300	3.54	20.2			21.3		0.50	250	42.0	0.9	0.85	51%
	10A	9A	1.40	1.40	949		1.9	1804	1804							0.4	1804	3.62	16.3			16.7		1.00	200	32.8	1.0	1.03	51%
	11A	9A	0.54	0.54	388		1.9	738	738							0.2	738	3.88	7.1			7.3		1.00	200	32.8	1.0	0.82	22%
	9A	12A		5.72					4842							1.6	4842	3.26	39.3			40.9		0.50	300	68.4	1.0	1.00	60%
	12A	13A		5.72					4842							1.6	4842	3.26	39.3			40.9		0.50	300	68.4	1.0	1.00	60%
	14A	15A	0.56	0.56	329		1.9	626	626							0.2	626	3.92	6.1			6.3		1.00	200	32.8	1.0	0.79	19%
	15A	16A	0.69	1.25					626							0.4	626	3.92	6.1			6.5		0.50	200	23.2	0.7	0.63	28%
	17A	16A	0.28	0.28	209		1.9	398	398							0.1	398	4.02	4.0			4.1		1.00	200	32.8	1.0	0.70	12%
	18A	16A	2.61	2.61	1200		1.9	2280	2280							0.7	2280	3.54	20.1			20.8		1.00	250	59.5	1.2	1.09	35%
	16A	19A		4.14					3304							1.2	3304	3.41	28.0			29.2		0.50	300	68.4	1.0	0.90	43%
	19A	20A		4.14					3304							1.2	3304	3.41	28.0			29.2		0.50	300	68.4	1.0	0.90	43%
	20A	13A	0.09	4.23					3304							1.2	3304	3.41	28.0			29.2		0.50	300	68.4	1.0	0.90	43%
	13A	21A		9.95					8146							2.8	8146	3.04	61.7			64.5		0.50	375	124.0	1.1	1.11	52%
	21A	22A	0.53	10.48					8146							3.0	8146	3.04	61.7			64.7		0.50	375	124.0	1.1	1.11	52%
	23A	24A	0.74	0.74		260		193	193							0.2	193	4.15	2.0			2.2		1.00	200	32.8	1.0	0.60	7%
	24A	22A		0.74					193							0.2	193	4.15	2.0			2.2		0.50	200	23.2	0.7	0.47	10%
	25A	22A	0.49	0.49	202		1.9	384	384							0.1	384	4.03	3.9			4.0		1.00	200	32.8	1.0	0.70	12%
	22A	26A		11.71					8723							3.3	8723	3.01	65.4			68.8		0.50	375	124.0	1.1	1.13	55%

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SANITARY SEWER DESIGN SHEET

150 STEELES AVE (MERITOR)

Town of Milton, Halton Region

PROJECT DETAILS

Project No: 21-678
Date: MAR 2025
Designed by: MH
Checked by: SR

DESIGN CRITERIA

Min Diameter =	**200**	**mm**	**Avg. Domestic Flow =**	**215.0** l/c/d
Mannings 'n'=	**0.013**		**Infiltration =**	**0.286** l/s/ha
Min. Velocity =	**0.6**	**m/s**	**Max. Peaking Factor =**	**4.50**
Max. Velocity =	**3.0**	**m/s**	**Min. Peaking Factor=**	**2.00**
Factor of Safety =	**30**	**%**		

NOMINAL PIPE SIZE USED

			RESIDENTIAL							COMMERCIAL/INDUSTRIAL/INSTITUTIONAL						FLOW CALCULATIONS								PIPE DATA					
STREET	**FROM MH**	**TO MH**	**AREA (ha)**	**ACC. AREA (ha)**	**UNITS (#)**	**DENSITY (P/ha)**	**DENSITY (P/unit)**	**POP**	**ACCUM. RES. POP.**	**AREA (ha)**	**ACC. AREA (ha)**	**EQUIV. POP. (p/ha)**	**FLOW RATE (l/s/ha)**	**EQUIV. POP.**	**ACCUM. EQUIV. POP.**	**INFILTRATION (l/s)**	**TOTAL ACCUM. POP.**	**PEAKING FACTOR**	**RES. FLOW (l/s)**	**COMM. FLOW (l/s)**	**ACCUM. COMM. FLOW (l/s)**	**TOTAL FLOW (l/s)**	**LENGTH (m)**	**SLOPE (%)**	**PIPE DIAMETER (mm)**	**FULL FLOW CAPACITY (l/s)**	**FULL FLOW VELOCITY (m/s)**	**ACTUAL VELOCITY (m/s)**	**PERCENT FULL (%)**
	27A	26A	0.47	0.47	187		1.9	356	356							0.1	356	4.05	3.6			3.7		1.00	200	32.8	1.0	0.69	11%
	26A	28A	0.24	12.42					9079							3.6	9079	3.00	67.7			71.2		0.50	375	124.0	1.1	1.13	57%
	29A	28A	0.48	0.48	316		1.9	601	601							0.1	601	3.93	5.9			6.0		1.00	200	32.8	1.0	0.78	18%
	30A	28A	1.01	1.01		260		263	263							0.3	263	4.10	2.7			3.0		1.00	200	32.8	1.0	0.65	9%
	28A	31A		13.91					9943							4.0	9943	2.96	73.2			77.1		0.50	375	124.0	1.1	1.16	62%
	32A	33A	1.04	1.04		40		42	42							0.3	42	4.33	0.5			0.7		1.00	200	32.8	1.0	0.41	2%
	33A	31A	0.81	1.85					42							0.5	42	4.33	0.5			1.0		0.50	200	23.2	0.7	0.35	4%
	31A	34A		15.76					9985							4.5	9985	2.96	73.4			77.9		0.50	375	124.0	1.1	1.16	63%
	35A	34A	0.45	0.45	125		1.9	238	238							0.1	238	4.12	2.4			2.6		1.00	200	32.8	1.0	0.62	8%
	36A	34A	0.40	0.40	177		1.9	337	337							0.1	337	4.06	3.4			3.5		1.00	200	32.8	1.0	0.69	11%
	34A	37A		16.61					10560							4.8	10560	2.93	77.0			81.8		0.50	375	124.0	1.1	1.18	66%
	38A	37A																						1.00	200	32.8	1.0	0.27	
	37A	39A		16.61					10560							4.8	10560	2.93	77.0			81.8		0.50	450	201.6	1.3	1.18	41%
	39A	40A		16.61					10560							4.8	10560	2.93	77.0			81.8		0.50	450	201.6	1.3	1.18	41%
	40A	41A		16.61					10560							4.8	10560	2.93	77.0			81.8		0.50	450	201.6	1.3	1.18	41%
	41A	42A		16.61					10560							4.8	10560	2.93	77.0			81.8		0.50	450	201.6	1.3	1.18	41%
	42A	43A		16.61					10560							4.8	10560	2.93	77.0			81.8		0.50	450	201.6	1.3	1.18	41%
	43A	EX		16.61					10560							4.8	10560	2.93	77.0			81.8		0.50	450	201.6	1.3	1.18	41%

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APPENDIX D
Figures and Drawings

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