APPENDIX L

Drainage & Stormwater Management Report

GANNETT FLEMING

DRAINAGE & STORMWATER MANAGEMENT REPORT –

STEVENSON ROAD NORTH

SCHEDULE 'C' MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT

BETWEEN TAUNTON ROAD WEST AND CONLIN ROAD

February 2025

FIRM PROJECT NO.: 072533 | CLIENT NO.: 0000034724

Prepared for:
City of Oshawa

GANNETT FLEMING

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1 INTRODUCTION

The City of Oshawa has advanced Official Plan Amendments to allow for future industrial development within the area referred to as the Northwood Business Park (N.B.P.). The development of these lands will advance both economic and job creation opportunities for the city. In support of the N.B.P., Gannett Fleming was retained by the city to complete the Environmental Assessment (EA) for the Stevenson Road North (Stevensons Road) improvement within the N.B.P.

1.1 Scope and Location

The City of Oshawa's Stevenson Road EA Study will be used to determine specific improvements needed for Stevenson Road to accommodate the future transportation needs of pedestrian, cyclists, transit users, and motorists with its Official Plan Amendments to allow for industrial development within the area for the N.B.P.

The Stevenson Road EA study area is generally bounded by Taunton Road West to the south and Conlin Road to the north. The site is bounded between two watersheds. To the east, Oshawa Creek and to the west, Goodman Creek. (Figure 1). In 2016, the City of Oshawa retained Greck and Associates Limited to develop the Master Stormwater Management Plan (M.S.M.P.). The Stevenson Road EA falls within the M.S.M.P. and will form the basis for the proposed stormwater management plan for Stevenson Road.

Figure 1: Key Plan

1.2 Objectives

The goals of this drainage and stormwater management for the EA includes the following:

- Document the reference data and approach for the stormwater management (SWM) and drainage design within the Stevenson Road right-of-way (ROW).
- Provide the drainage criteria and SWM objectives utilized to evaluate the existing and proposed site conditions.
- Reviewing the existing rural drainage network and stormwater infrastructure to ensure no changes to drainage patterns for the local environment and/or downstream sewer systems is impacted.
- Prepare the proposed drainage and SWM conditions, in accordance the M.S.M.P. while considering the impacts of the proposed ROW improvements and existing site characteristics.
- Compare the proposed design against the established City of Oshawa and Central Lake Ontario Conservation Authority (CLOCA) stormwater and drainage criteria.

1.3 Reference Data

The following is a list of the reference data used in the SWM study:

- Rainfall data for the 2 to 100-year rainfall IDF curve information is in accordance with the City of Oshawa Design Criteria Manual (2024).
- Drainage, SWM, As-Built, and topographic data provided by the City of Oshawa.
- City of Oshawa Northwood Business Park Master Stormwater Management Plan (M.S.M.P.) – Final Report (Aug, 2016).

Supporting reference data is contained within Appendix A.

1.4 Approach

To support the drainage and analysis the team has undertaken the following:

- Design Storm – 2 to 100-year rainfall IDF curve information in accordance with the City of Oshawa Design Criteria.
    - IDF curve data will be used for storm sewer and ROW design.
    - 12-hour Chicago Storm distribution storms will be used for the hydrologic modelling through Visual OTTHYMO modelling in accordance with the M.S.M.P.
- Catchment Boundary – Refined for localized use of Stevenson Road from the M.S.M.P. Modifications to existing catchments were delineated based independent review, site inspection and survey data.
- Catchment Parameters – Parameters will be based on the M.S.M.P.
    - Runoff coefficients / routing time will be adjusted for localized external catchments where applicable.
- Hydrologic Modelling – Modelling will be conducted using Visual OTTHYMO and the Rational Method.
    - Storm Sewer will be designed using the Rational Method Calculation, based on the City of Oshawa Design Criteria Manual.
    - Visual OTTHYMO will be used to analyze the surrounding watersheds and external drainage areas adjacent to Stevenson Road.
- The following sub-tasks have been undertaken as part of the proposed design:
    - Review the existing rural drainage system and evaluate the drainage network under the proposed ROW conditions.
        - Propose a new storm sewer system to meet the new urbanized roadway layout (i.e., altered curbs, etc..) and review propose suitable connection points for the new proposed storm sewer system.

- Document the any assumptions based on the information available
- Document proposed sewer / stormwater outlets and site improvements within the overall SWM plan

2 DRAINAGE CRITERIA AND SWM OBJECTIVES

2.1 Applicable Standards and Guidelines

The applicable design standards and guidelines considered within the design include the following:

- City of Oshawa Design Criteria Manual (2024)
- City CLOCA and Region of Durham Bylaws
  - By-Law 09-1990 Storm Sewer Connection
  - Region of Durham By-Law 55-2013 Sewer Use
  - Region of Durham Transportation Master Plan
  - City of Oshawa Engineering Design Criteria Manual
- MTO Highway Drainage Design Standards (2024),
- MTO Drainage Management Manual (1997), and,
- MECP Stormwater Management Manual (2003).

2.2 Drainage Criteria

The drainage criteria are summarized as follows:

- Storm Sewer Drainage:
  - Minor System
    - All storm sewers will be analyzed for 1-year storm conveyance.
      - Receiving sewer at Taunton Road is expected to require conveyance of the 10-year event and overcontrol to ensure rates discharged to the sewer will not be exceeded from existing conditions.
  - Major System
    - The site will convey 100-year major system along the Stevenson Road ROW to each respective outfall.
    - Review of major system and potential impacts to the safe passage of vehicles.

The following are the critical target criteria utilized for the crossing, following MTO Highway Drainage Design Standards (March 2024):

- Stevenson road is classified as a type C arterial road.
- The existing culvert structure at this location, rural arterial road, would be required to convey the design storm (25-year event) for culverts spanning less than 6.0m (WC-1, Section 1.1.1)
- The proposed culvert structure at this location, urban arterial road, would be required to convey the design storm (50-year event) for culverts spanning less than 6.0m (WC-1, Section 1.1.1)
- Erosion protection is needed to withstand the scour of the design and check event flows.
- Temporary flow passage with the ability to convey the 2-year flow.

Tables 1 presents the design criteria from the HDDS used to assess the centerline culvert along Stevenson Road.

Table 1: Design classification and sizing criteria

Design Criteria	Site Requirements	Reference
Roadway Classification	Rural Arterial	Functional classification map
Minimum Culvert Size	600 mm diameter for circular culverts 600 mm rise for elliptical or arch culverts 900 mm rise for box culverts	WC-8 Section 3.1
Design Flow (span < 6.0m)	25-yr Return Period	WC-1 Section 1.1.1
Check Flow for Scour (Arterial Road)	115% of 100-yr flow	WC-1 Section 1.1.1
Range of Flows and Upstream Water Surface Elevations	5-yr to 100-yr	WC -1 Sections 2.2
Flood Depth at Culvert	HW/D ≤ 1.5 for culverts with diameter or rise <3m	WC-7 Section 3.5
Freeboard	≥ 1.0 m to the edge of the travelled lane (25-yr storm)	WC-7 Section 3.2
Water Level Generated by the Check Flow	Water Level from Check Flow (115% of 100-yr)	WC-7 Section 3.6
	Water Level < Edge of the travelled lane	

Design Criteria	Site Requirements	Reference
Roadway Classification	Urban Arterial	Functional classification map
Minimum Culvert Size	600 mm diameter for circular culverts 600 mm rise for elliptical or arch culverts 900 mm rise for box culverts	WC-8 Section 3.1
Design Flow (span < 6.0m)	50-yr Return Period	WC-1 Section 1.1.1
Check Flow for Scour (Arterial Road)	130% of 100-yr flow	WC-1 Section 1.1.1
Range of Flows and Upstream Water Surface Elevations	5-yr to 100-yr	WC -1 Sections 2.2
Flood Depth at Culvert	HW/D ≤ 1.5 for culverts with diameter or rise <3m	WC-7 Section 3.5
Freeboard	≥ 1.0 m to the edge of the travelled lane (25-yr storm)	WC-7 Section 3.2
Water Level Generated by the Check Flow	Water Level from Check Flow (115% of 100-yr)	WC-7 Section 3.6
	Water Level < Edge of the travelled lane	

2.3 SWM Objectives

The SWM objectives are summarized as follows:

- Water Quality:
  - In accordance with City practice, prior to discharge to the receiving storm sewer system, high density, commercial and mixed-use lands require on-site water quality treatment in the form of OGS.
  - Where feasible, quality control measures should be designed to provide Enhanced levels of treatment (80% of total suspended solids (TSS)) per MOE guidelines, this may be achieved using a treatment train approach.
- Water Quantity:
  - Maintain Watershed Boundaries – The proposed approach will be made to maintain watershed boundaries and flow patterns. In the event any changes to watershed boundaries occur, the team will have pre-consultation with the City for any proposed change to watershed boundaries.
  - Post-to-Pre-Controls – Post-development peak flows will be designed to not exceed corresponding pre-development rates for all design storm events or as per the Master Environmental Servicing Plan (MESP), or approved watershed, subwatershed or site-specific studies.
  - Overcontrol – If there is a known deficiency in the downstream conveyance system, additional quantity control measures may be proposed based on the capacity of the receiving system.
  - No Downstream Impacts – In some cases, quantity control may not be required due to the nature of the hydrologic responses of creeks and timing of peak flows, as per approved watershed, subwatershed or site-specific studies, and subject to approval.

3 EXISTING CONDITIONS

3.1 Site Characteristics

The existing Stevensons Road is a 2-lane rural cross-section with minimal rural residential properties surrounding the ROW with the drainage sources being roadway, and natural pervious drainage areas (Figure 2 – Existing Conditions). The pervious areas within the study area are a combination of grassed lots and wooded areas. The impervious areas through the study area are roads and from the Stevenson Road ROW.

The study limits contain four (4) distinct outfalls at Conlin Road (Outfall 1), Existing Culvert CL-2 and CL-3 (Outfall 2 and 3, respectively), and Taunton Road West (Outfall 4). Within the study limits, there are no existing SWM/LID features. Each structure was reviewed for condition, which is documented in the Culvert inspection memo located Appendix B.

Conlin Road (OF1):

- Rural road drainage to north extents of the project limits.
    - Stormwater collection and conveyance through roadway ditches.
    - Collection in Ditch Inlet Catch basin (DICB) South-West corner of Conlin Road / Stevenson Road intersection.
    - Crossing is located immediately adjacent to Oshawa Creek.
    - Per the M.S.M.P., quantity control will not be required with its proximity to the main branch of Oshawa Creek.

Culvert CL-2 (OF2):

- Rural road drainage to existing 900 mm Corrugated Steel Pipe (CSP) culvert located at Station 11+630.
    - Stormwater collection and conveyance through roadway ditches.
    - External drainage areas east of Stevenson Road are captured by existing drainage ditches along Stevenson Road.
    - External drainage is conveyed through the W2-1 Sub-Catchment.
        - Total external drainage area west of Stevenson Road is ~17.5 ha per the M.S.M.P.
    - Runoff generated by the external catchments is discharged west-east through CL-2 across Stevenson Road to Oshawa Creek.
    - Per the M.S.M.P., quantity control will not be required with its proximity to the main branch of Oshawa Creek.

Culvert CL-3 (OF3):

- Rural road drainage to existing 450 mm Corrugated Steel Pipe (CSP) culvert located at Station 10+230.
    - Stormwater collection and conveyance through roadway ditches.
    - External drainage areas west of Stevenson Road that is captured by existing drainage ditches along Stevenson Road
    - External drainage is conveyed through the G7-B1 Sub-Catchment. Total external drainage area west of Stevenson Road is ~8.6 ha per the M.S.M.P.
    - Runoff generated by the external catchments is discharged east-west through CL-3 across Stevenson Road to Goodman Creek.

Taunton Road (OF4):

- Rural road drainage to south extents of project limits.
    - Stormwater collection and conveyance through roadway ditches.
    - Collection in DICB in North-East corner of Taunton Road / Stevenson Road intersection.

- Stevenson Road connects to an existing 650mm tee located on Stevenson Road. This tee connects to an existing 900mm sewer along Taunton Road that ultimately discharges to Goodman Creek.
- Per the M.S.M.P., the Taunton Road storm sewer receives flow from the OM-51 Sub-Catchment.

3.2 Soil and Groundwater Conditions

The groundwater level within the project limits is reported to be between 1.5 to 3.9 m deep. The geotechnical investigation was completed in 2022 by Englobe and results have been summarized in Table 2. The geotechnical investigation has been included in Appendix A.

The report indicates shallow groundwater levels near the Taunton Road and Culvert C2, Outlet OF2 and OF4. As a result, limitations occur in the ability to propose low impact development (LID) infiltration facilities, which would normally be a preferred option for the narrow right-of-way of Stevenson Road. As a result, it is recommended that additional monitoring is performed during the detailed design stages of the project to capture seasonal groundwater fluctuations to confirm the suitability of any LID approaches.

Table 2: Groundwater Levels Observed in Monitoring Wells

BH No.	Well Depth (m)	Date Measured	Depth of Groundwater Table (m)	Elevation of Groundwater Table (m)	Approximate Roadway STA.
BH2	3.8	07/11/2022	1.5	140.68	10 +080
BH6	3.8	07/11/2022	2.5	1471.77	10 + 520
BH10	3.8	07/11/2022	3.9	142.52	10 + 940
BH15	3.8	07/11/2022	1.8	147.60	11 + 490
BH19	3.8	07/11/2022	3.9	146.16	11 + 910

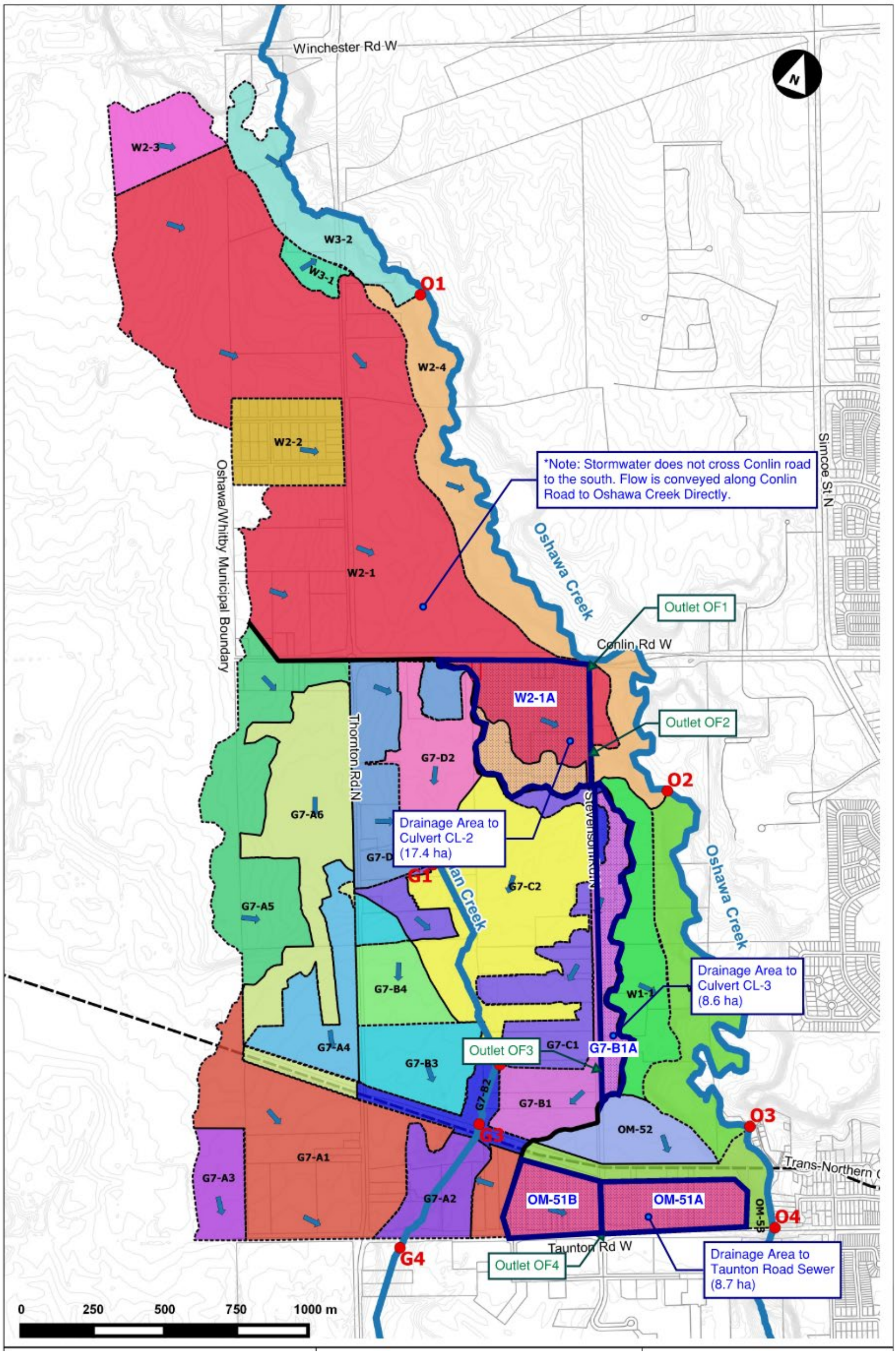

Figure 2: Existing Conditions Drainage at Stevensons Road North

Northwood Business Park Sub-Catchments Modified for Stevenson Road EA (Adapted from M.S.M.P 2016 Report)

3.3 Existing Drainage Infrastructure

3.3.1 Outfalls

As discussed within the section above, The Stevensons Road ROW features four (4) outfalls that discharge directly or indirectly to Oshawa Creek and Goodman Creek. Table 3 documents all outfalls including a description and considerations.

Table 3: Outfall Summary

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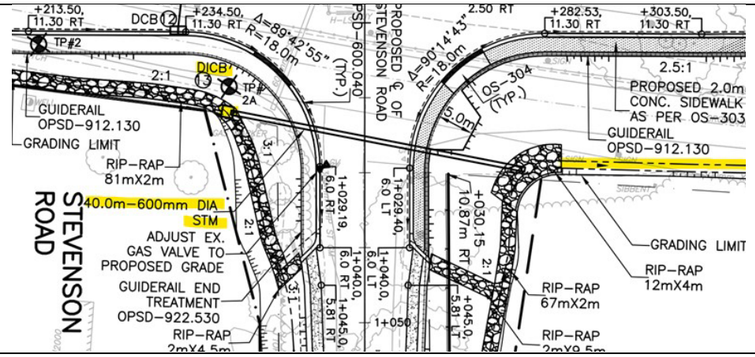
<td> 
</td>
<td><u>Conlin Road (OF1)</u>

Description:
Existing 600mm culvert crossing Stevenson Road. High grade differential from upstream to downstream. Culvert invert is DICB along existing rip-rap ditch. Ditch downstream of culvert directly ties into Oshawa Creek.

Considerations:
Replacement is not required. Roadway does not block existing inlet / outlet. Existing ditch to be maintained and continue discharging to existing DICB. New catch basins in the vicinity of Conlin Road recommended to tie into 600mm culvert.</td>
</tr>
<tr>
<td>  </td>
<td><u>Culvert CL2 (OF2)</u>

Description:
900mm diameter culvert draining directly to Oshawa Creek. Culvert flow is intermittent and receives external flows from catchment W1.

Considerations:
Replacement is recommended due to rusting along the CSP perimeter. Additionally, existing structure is installed shallow to the roadway and will be located within the proposed pavement structure. High water mark does not indicate significant annual flows.</td>
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<tr>
<td>  </td>
<td><u>North Tributary B (OF3)</u>

Description:
450mm diameter culvert receiving rural ditch flow from Stevenson Road. Culvert flow is intermittent and receives external flows from catchment G7-B1.

Considerations:
Replacement is recommended due to rusting along the CSP perimeter and damaged outlet. Additionally, existing structure is installed shallow to the roadway and will be located within the proposed pavement structure. High water mark does not indicate significant annual flows.</td>
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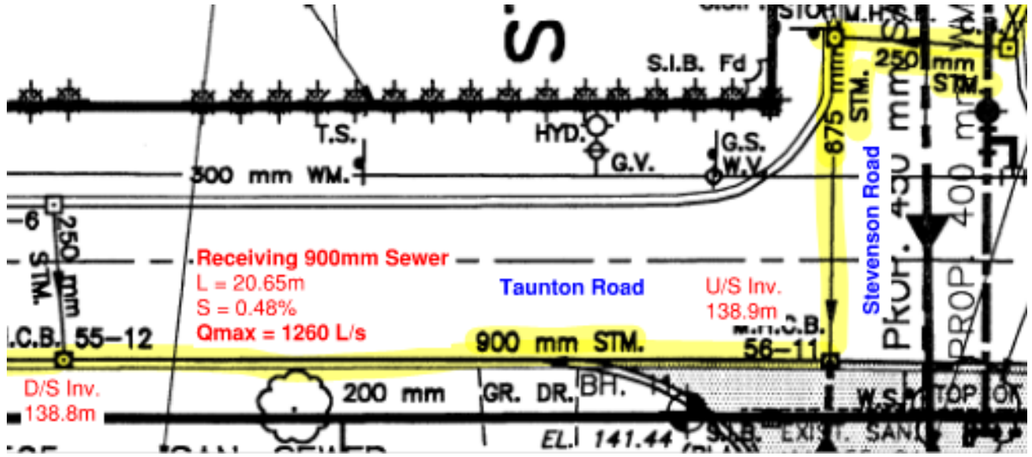


Taunton Road Storm Sewer (OF4)

Description:
900mm storm sewer on Taunton Road receives flow from Stevenson Road in a 675mm Storm Sewer.

Considerations:
The existing sewers were initially built in 1968 and a Storm Sewer Design (SSD) sheet was not available from the City of Oshawa to confirm the hydraulic performance of the system. Based on received city as-builts, the receiving 900mm sewer is estimated to have a full flow capacity of 1260 L/s. Per the watershed hydrologic model within the M.S.M.P., the existing sewer on Taunton Road does not have capacity to appropriately convey to City of Oshawa design standards. As a result, proposed quantity control prior to discharge will ensure proposed discharge rates do not exceed existing discharge rates from the Stevenson to Taunton Road connection.

However, it is recommended that within the detailed design stage of the project a full hydrologic and hydraulic assessment be completed for Taunton Roads sewer system to confirm the capacity of the existing system and validate the assessment completed within the EA.

4 PROPOSED CONDITIONS

4.1 Site Characteristics

The Stevenson Road EA focuses converting the existing 2-lane rural configuration to a 2-lane urban cross section along with a multi-use path and improved profiles (Figure 2 below). The cross-section is expected to include a relocated curb and gutter, multi-use path, and pavement structure to support industrial traffic.

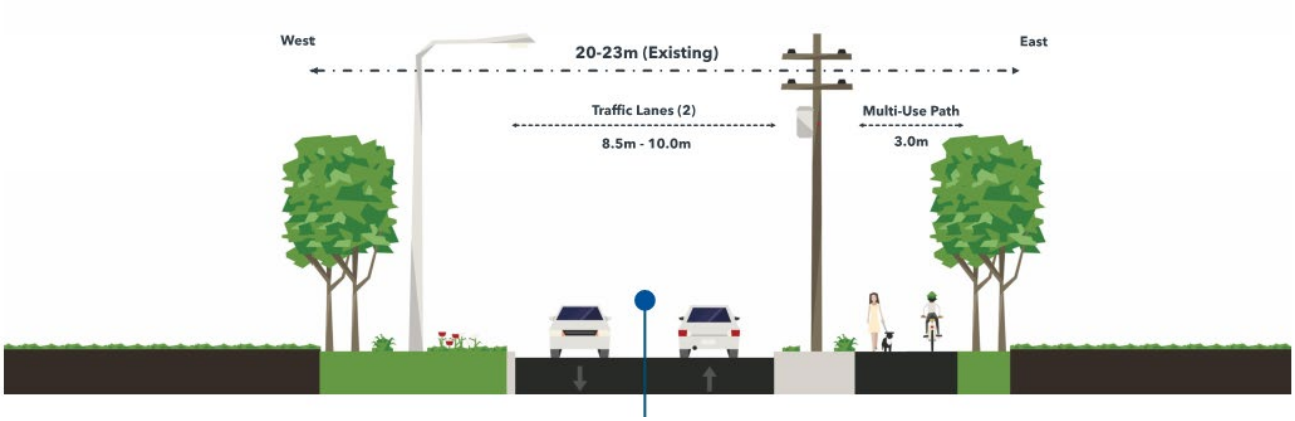


Figure 3: Stevenson Road ROW Cross-Section

The proposed conditions SWM plan will provide recommendations for the outfall improvements, storm drainage system and the stormwater management infrastructure to meet the City and CLOCA requirements. Following feedback from the City, from the PIC #2 design concept review, the design has been streamlined to ensure that the proposed design approach limits the requirements of surface grading and expropriation of property outside the ROW. The overall design approach is illustrated within Figure 4.

4.1.1 Receiving Outfalls

Based on the field investigation, survey data, and proposed design strategy, the following are the recommendations for each outfall:

- OF1, 2, 4 – Maintain existing outfall.
- OF3 – Remove existing culvert crossing, collect storm runoff in DICB and route to OF4.
    - Limited vertical clearance from the existing structure to edge of pavement will fully encroach the proposed pavement structure. No defined stream exists downstream of culvert. Not a suitable culvert for re-instatement.

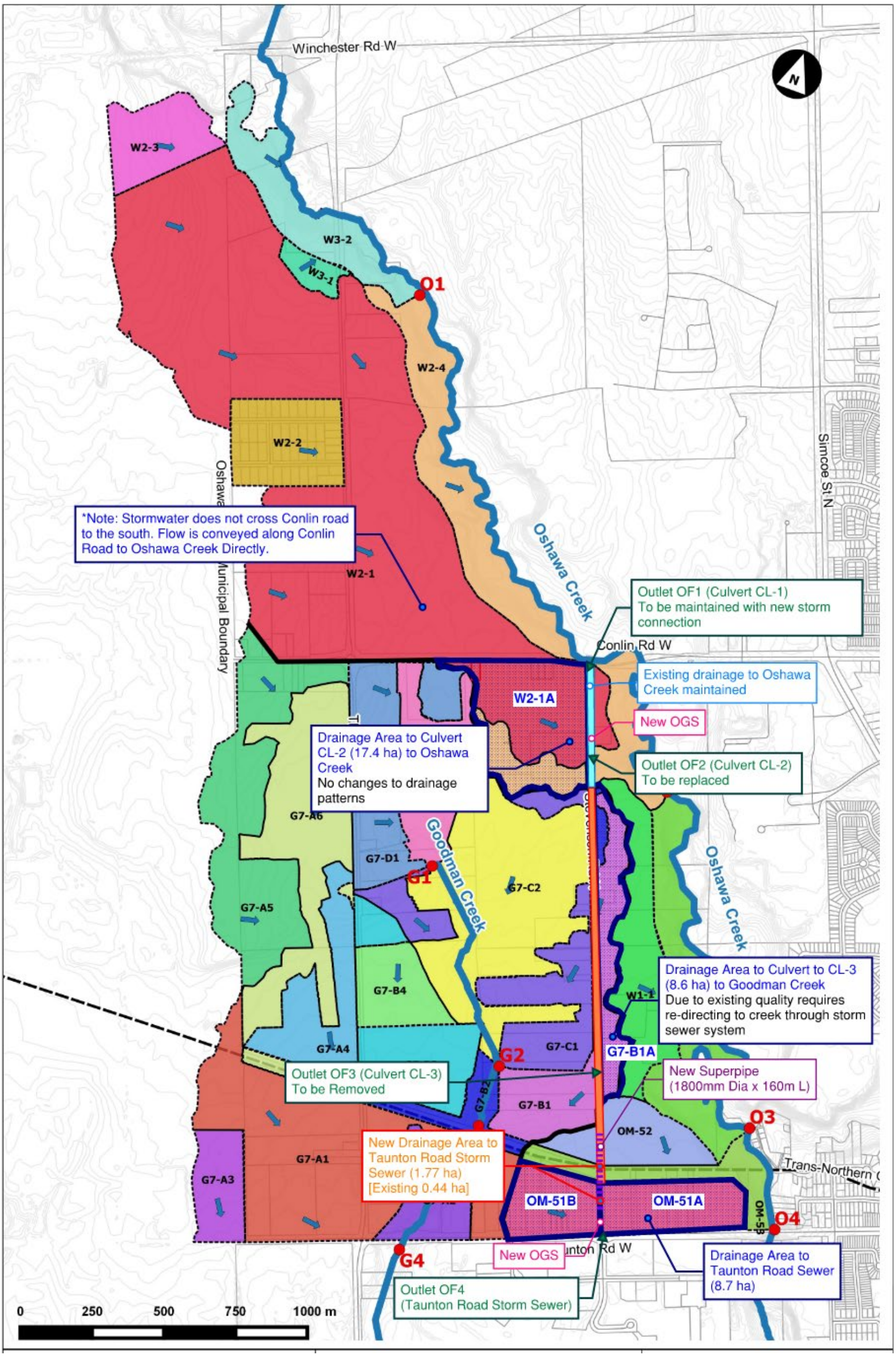


Figure 4: Proposed Conditions Stormwater Management Plan

Northwood Business Park Sub-Catchments Modified for Stevenson Road EA (Adapted from M.S.M.P 2016 Report)

4.2 Hydrologic Analysis

The external hydrologic and analysis of the study area was completed using Visual OTTHYMO 5.0 (VO5) modelling software. The model adopted the parameterization and methodology defined in the Northwood Business Park M.S.M.P. External sub-catchment discharge rates that crosses the site are summarized in Table 4. For detailed analysis results refer to Appendix C.

Table 4: Outfall Flows

Discharge Point*	Scenario [HYD]	Drainage Area (ha)**	Design Storm [m^3/s]					
			2-year	5-year	10 year	25 year	50 year	**100 year**
Goodman's Creek	Existing [44]	19.66	1.67	2.41	2.90	3.60	4.09	**4.59**
	Proposed Uncontrolled [33]		1.78	2.54	3.05	3.75	4.26	**4.75**
	Proposed Controlled** [33]		1.45	2.07	2.48	3.06	3.47	**3.87**
Oshawa Creek	Existing [3]	17.82	0.20	0.37	0.50	0.68	0.83	**0.98**
	Proposed [3]		0.20	0.37	0.50	0.69	0.84	**0.99**

** Refer to Figure 2*
*** Based on catchments intersecting Stevensons Road*
**** Refer to Section 4.6*

4.3 Minor System Conveyance - Storm Sewers

The roadway improvements, including road urbanization, will require implementing a new storm sewer system. Storm sewer sizing was completed by the Rational Method and assessment is included in Appendix D. Additionally, the proposed Storm Sewer layout and catchments plans are in Appendix E. The following are the proposed Stevenson Road storm sewer network features:

Storm Sewer to OF1

- 119m of 250 - 375mm storm sewer conveying runoff south-to-north towards Conlin Road.
  - Connection point at existing 600mm crossing culvert at Conlin Road (OF1)
  - Quantity Control Requirements – No quantity control requirements for Oshawa Creek
  - Quality Control Requirements – Shallow groundwater and a short pipe run make mechanical not cost-effective.
- Connection to existing Culvert crossing Stevensons Road at the north limits of the project limits

Storm Sewer to OF2

- 202m of 375 - 600mm storm sewer conveying runoff north-to-south towards Culvert CL-2.
  - Connection point at Proposed Culvert CL-2 (OF2)
  - Quantity Control Requirements – No quantity control requirements for Oshawa Creek
  - Quality Control Requirements – Proposed OGS; see subsequent sections
- Connection to proposed Culvert CL-2.

Storm Sewer to OF4

- 1514m of 250 - 825mm storm sewer conveying runoff north-to-south towards Taunton Road.

  - Connection point at existing 675mm storm tee connecting to Taunton Road (OF4)
  - Quantity Control Requirements – Proposed superpipe; see subsequent sections
  - Quality Control Requirements – Proposed OGS; see subsequent section
- Connection to existing storm sewer on Taunton Road at the provided existing tee connection at Stevensons Road.
  - It should be noted that the existing capacity of the storm sewer on Taunton Road is required to have its capacity confirmed during the detailed design stages of the project. An existing tee exists for connection; however, appropriate quantity control will be required to ensure the discharge rates do not exceed the existing capacity remaining in the Taunton Road storm sewer.

General

- Single Catch basins with leads connecting to a mainline sewer at 60m intervals

- Double Catch basins required at roadway low points.
  - Road profile low points occur at STA. 11+976 / 11+637 / 11+315 / 11+030 / 10+624 / 10+215 / 10+027
  - 50% blockage factors are to be considered at all low points.

- All driveway culverts are to be relocated or replaced throughout the site limits.

- Ditch Inlet Catch Basins (DICB) within the proposed ditches are to be located at
  - East Ditch – STA. 10+220 / 10 + 025
  - West Ditch – STA. 11+825 / 10+625
  - 50% blockage factors are to be considered at each DICB.

4.4 Major System Conveyance

With the proposed roadway urbanization, major system conveyance will ultimately be confined to the roadway curbed cross section. The proposed roadway alignment ultimately follows a northerly flow path to Conlin Road from the roadway highpoint at Sta. 11+565 to Conlin Road with a sag point at Sta. 11+620. Similarly, the proposed roadway alignment ultimately follows a southernly flow path to Taunton Road from the roadway highpoint at Sta. 11+565 to Taunton Road with 2 sag points at Sta. 11+315 and Sta. 10+625.

As the proposed storm sewer is only required to discharge the 1- Year storm event, a hydraulic grade-line analysis with the proposed catch basin spacing will be required to assess the Major storm potential for capture, spread widths and flooding during the detailed design stage of the project. It is recommended that if the system cannot be reasonably discharged through the confined roadway cross section, curb cut outs to the west side of the proposed road is recommended. Discharging along the west has the benefit of not interfering with the proposed sidewalk and will also follow existing flow paths to Goodman's Creek.

4.5 Culvert CL-2 Replacement

With the proposed roadway works, general widening will occur across the roadway embankment and as a result Culvert CL-2 will be required to be extended. With the existing condition of the culvert and its embedment within the proposed pavement structure it is recommended that the culvert be replaced.

As flows have not been increased for the crossing, the proposed replacement maintained a 900mm pipe while recommending a Reinforced Concrete Pipe (RCP) with the proposed industrialization of the site. The criterion for assessment is per the MTO Highway Drainage Design Standards (HDDS) and results are demonstrated in Table 5 and Table 6 below. The existing conditions were assessed based on Rural Arterial classification and with the new urbanization, the proposed conditions have been assessed on Urban Arterial classification.

Table 5: Hydraulic Parameters – CL-2

Characteristic	Existing Condition	Proposed Culvert
Crest Elevation (m) (Top of Road)	149.37	149.64
Edge of Travelled Lane Elevation (m)	149.06	149.58
Upstream Invert (m)	147.74	147.77
Downstream Invert (m)	146.99	147.13

Table 6: Hydraulics Details – CL-2

Result	Existing Conditions (Rural Arterial Classification)			Proposed Conditions (Urban Arterial Classification)		
	2- Year Storm	25- Year (Design Event)	115% of 100- Year (Check Event)	2- Year Storm	50- Year (Design Event)	130% of 100- Year (Check Event)
Peak Flow (m^3/s)	0.206	0.687	1.126	0.207	0.841	1.289
Water Surface Elevation (m)	148.11	148.49	148.86	148.12	148.58	148.9
Freeboard (m)	0.95	0.57	0.2	1.46	1.0	0.68
Headwater-Depth Ratio (HW/D)	0.41	0.84	1.24	0.39	0.90	1.26
Velocity (m/s)	2.13	2.95	3.32	2.70	3.67	4.03

Based on the existing condition hydraulic analysis, the existing culvert CL-2 fails to meet the MTO HDDS criteria for a minimum freeboard of 1 meter to the edge of the pavement. However, the analysis of the proposed condition indicates that the proposed culvert CL-2 satisfies all MTO HDDS criteria, including freeboard, flow depth, HW/D ratio, and flow containment. Additionally, as velocities exceed maximum permissible velocity of 1.5 m/s, erosion control measures will be required for assessment during the detailed design stage of the project. For detailed analysis results and HY-8 output files, refer to Appendix D.

4.6 Water Quantity Control

This section will describe the proposed approach to Water Quantity Control for the Stevensons EA. As described within Section 3. In summary,

- No quantity control is required for discharge to Oshawa Creek.
- Quantity control is required for discharge to the receiving storm sewer at Taunton Road.
    - As it is expected that the current receiving sewer is undersized, quantity control beyond the post-to-pre reductions will be required to ensure existing discharge rates from Stevenson Road is not exceeded (i.e. overcontrol)

4.6.1 Existing Sewer Capacity Taunton Road

As described within Section 3.3, the existing capacity of the receiving 900mm storm sewer pipe on Taunton Road was unable to be verified during the EA stage. As a result, a preliminary analysis based on the watershed masterplan in the M.S.M.P. was modified to capture the inflow runoff to Stevensons Roads connection with Taunton Road.

Under existing conditions, Stevensons Road contributes ~0.44 ha to Taunton Roads storm sewer system. This is conveyed through an existing DICB inlet. The flows are conveyed to the 675mm tee along Stevensons Road that directly connects to the 900mm storm at the intersection of Taunton and Stevenson Road. Based on the M.S.M.P., the total drainage area to the intersection at Stevenson and Taunton Road is expected to be ~8.7 ha.

Hydrologic modelling was completed in VO5 to assess existing conditions and set baseline expectations for overcontrol. Parameterization has been adopted from the M.S.M.P. and runoff rates are summarized in Table 7 below. VO5 model outputs are illustrated in Appendix C.

Table 7: Existing Sewer Flow

Existing Conditions Flow	Design Storm [m^3/s]					
	2 year	5 year	10 year	*25 year*	*50 year*	*100 year*
Sewer at Stevenson Road	0.081	0.114	0.136	0.165	0.186	0.207
Sewer at Taunton Road	1.457	2.075	2.484	3.062	3.469	3.871

4.6.2 Superpipe Storage

As the site has restrictions imposed by the narrow right of way, shallow groundwater and existing developed properties at the south end of the site limits, it was determined that in-line storage would be the most feasible solution for retention. To avoid potential utility conflicts and secondary sewer lines, superpipes were selected as the preferred method of retention.

The proposed drainage area has increased from 0.44 ha in existing conditions to 10.9 ha[1]. As the receiving storm sewer is the limiting factor for discharge, overcontrol to existing storm discharge rates for the 10- year storm event was the design approach to quantity control. The 10- year storm event is being considered for storage as it expected that the Taunton Road storm sewer is intended to convey this event based on the Region of Durham design standards. The receiving system will require more detailed analysis during the detailed design stage of the project and discharge rates will be required to be confirmed at this stage.

To meet the overcontrol requirements, the design configuration of the proposed super pipe is as follows:

- 3000 mm super pipe.
  - Note this sizing is for storage purposes and cost estimate purposes and it is expected that during the detailed design stage a more efficient and optimized storage system is incorporated.
- 160 m in length.
- 200 mm orifice plate on downstream control manhole structure.
- 1115 m^3 of storage requirements.

Table 8 and Table 9 illustrate the performance of the stormwater management system under existing and proposed conditions for Stevenson's Road and Taunton Road, respectively. The proposed super pipe sizing sheet has been included in Appendix D.

Table 8: Sewer Inflows – Stevensons Road

Scenario	HYD	Area [ha]	VO5 Reporting	Design Storm [m^3/s]					
				2-year	5-year	10 year	25 year	50 year	100 year
Ex. Stevenson Road (VO5 – Adopted from M.S.M.P)	38	0.44	Node	0.081	0.114	**0.136**	0.165	0.186	0.207
Pr. Stevenson Road[1] (VO5 - Uncontrolled)	36	10.96	Node	0.327	0.472	**0.570**	0.695	0.791	0.88
Pr. Stevenson Road (VO5 - Controlled)	42	10.96	Orifice	0.086	0.115	**0.139**	0.139	0.139	0.139
			Bypass	0	0	**0**	0.214	0.297	0.375

[1] *With the increased catchment area to the Taunton Storm Sewer*

- *All 10.96 ha currently drain to Goodman's Creek, the ultimate discharge point of the Taunton Sewer System*
- *1.77 ha are from the new urbanized right of way.*
- *9.19 ha were required to be collected from the existing culvert crossing of Stevensons road in the G7-B1 (OF3) catchment as the existing culvert crossing was to shallow to be supported in the new urbanized right of way.*

Table 9: Sewer Inflows – Taunton Road

Scenario	HYD	Area [ha]	Design Storm [m^3/s]					
			2-year	5-year	10-year	25-year	50-year	100 year
Existing Taunton Road (VO5 – Adopted from M.S.M.P)	46	9.14	1.54	2.19	**2.62**	3.22	3.65	4.08
Proposed Taunton Road (VO5 - Uncontrolled)	33	10.43	1.78	2.54	**3.05**	3.75	4.26	4.75
Proposed Taunton Road (VO5 - Controlled)	33	10.43	1.45	2.07	**2.48**	3.06	3.47	3.87

4.7 Water Quality Control

The pavement widening and roadway improvements along Stevenson Road will capture and convey runoff through the proposed storm sewers to Oshawa and Goodmans Creek. As part of the improvements, MECP Enhanced Levels of Treatment, 80% TSS reduction, is required prior discharge. To meet the SWM/LID servicing requirements for quality, a variety of measures were reviewed during the development of the EA.

Based on site characteristics, significant constraints related to the site's ROW and shallow groundwater levels, as demonstrated in Section 3.2, create concerns with the implementation of low impact development features such as enhanced grass swales and infiltration galleries.

As a result, with the current information available during the EA stage of this project, the implementation of low impact development quality control features is currently demonstrated to be infeasible. It is recommended though that during the detailed design phase of this project, the implementation of low impact development features and a treatment train approach are reviewed for feasibility and implementation with additional groundwater investigations and further review of final grades.

4.7.1 Mechanical Separation

Based on the above discussion, it is currently being proposed that mechanical separation by Oil Grit Seperators (OGS) at both project outfalls.

Based on the CLOCA Technical Guidelines for SWM Submissions (2020) Section 5.4, it is indicated that that units that are CETV verified are approved for removal rates >50%. The proposed units reviewed for the EA stage of the project is therefore units that are CETV verified for 80% TSS removal

Preliminary sizing using Stormceptor® EFO series (CETV Certified) has been completed for long term annual sediment load reduction estimates at OF2 to Oshawa Creek and OF4 to Goodman's Creek. Recommendations are summarized in

Table 10 and sizing reports in Appendix D.

Table 10: Annual TSS Removal Performance.

Discharge Outfall	Drainage Area (ha) / % Impervious	Target TSS Removal (%)	Estimated Net Annual Sediment Load Reduction (%)	Water Quality Runoff Volume Capture (%)	Recommended *Stormceptor* Model
OF2 (Oshawa Creek)	0.6 / 95	80	82	>90	EFO4
OF4 (Goodman's Creek)	2.21 / 95	80	83	>90	EFO8

4.7.2 Future Considerations – Treatment Train Alternative

Various Best Management Practices (BMPs) for stormwater management were reviewed and assessed for their applicability to this project. As discussed above, it has not been proven feasible to provide LID systems / treatment trains for quality control at this stage.

However, during the review, based on space limitations infiltration trenches were reviewed as the most feasible option, however, this is pending groundwater level confirmation.

The bottom of the infiltration trench should be one (1) meter above the seasonally high-water table and should be clear of the roadway pavement structure. As the pavement structure is approximately 1.2 m with the industrial nature of the site, this would require a groundwater table approximately 2.5 – 3 m below surface.

The infiltration trenches are proposed as linear conveyance and settlement facilities lined with geotextile fabric and clean granular fill (50 mm clear stone) for quality treatment of roadway runoff. In addition to removing TSS particles, the granular filter within the trench reduces water temperature impact and enhances stream base flows through groundwater recharge. It also contributes to water balance and controlling downstream erosion by reducing flow velocities. Figure *5* illustrates a schematic of how the system is likely to be implemented, if feasible.

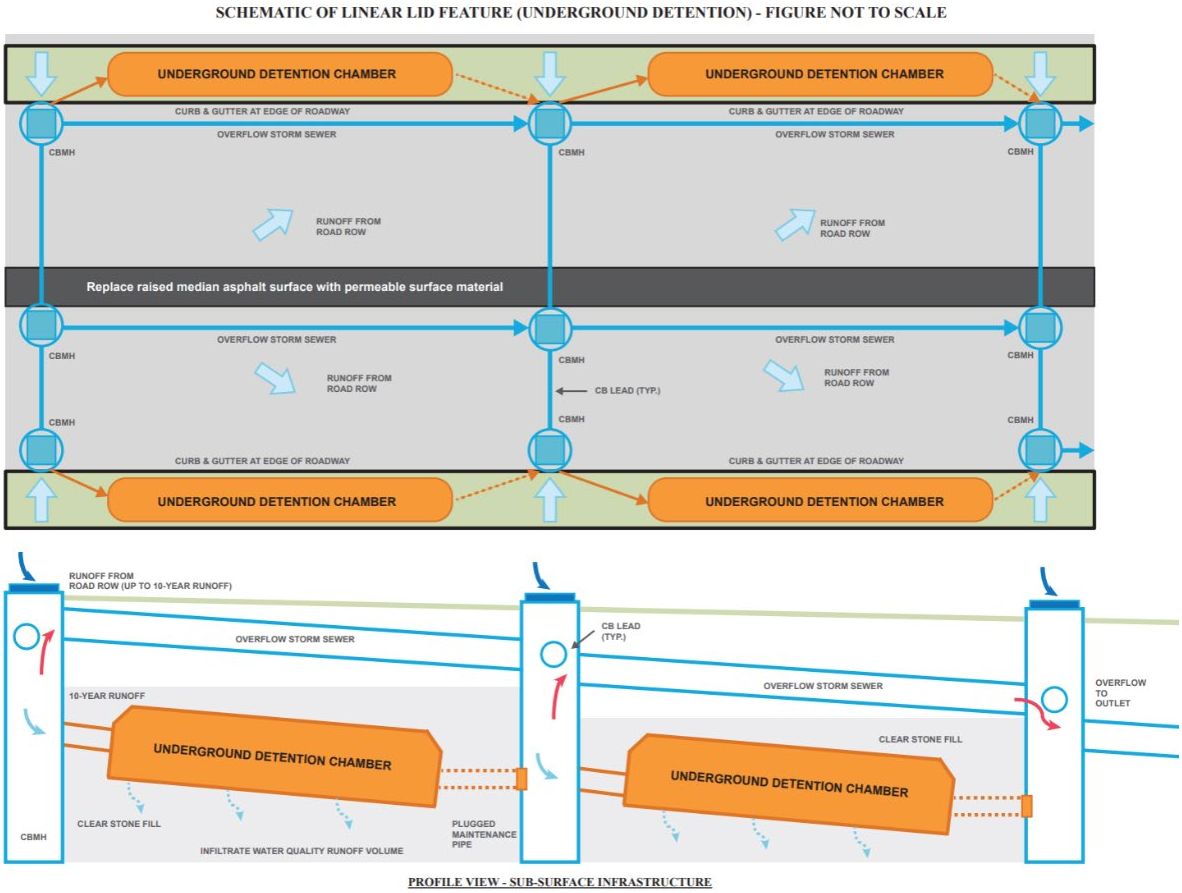


Figure 5: LID Storage in Boulevard

5 CRITERIA SUMMARY

Drainage Criteria:

The drainage criteria are summarized in the following sections:

Storm Sewers

- Minor System - The storm sewer along Stevensons Road has been designed to convey the 1-year storm event.
- Major System - The proposed roadway profile allows for suitable drainage of the 100-year major storm to Oshawa Creek and Goodman's Creek in the event of occurrence. Flow depths have not been completed at this stage of the project and it is recommended that the MNRF flood hazard guidelines be incorporated in the assessment during the detailed design stages of the project.

Water Quality

- Implementations of LID water quality practices has limitations due to shallow groundwater tables and limited right of way space across the site limits.
- Mechanical treatment has been provided to reduce long annual reduction of 80% TSS using OGS units prior to system outfalls.
- It is recommended that during the detailed stage of the project, additionally groundwater monitoring be performed to determine if the opportunity to follow a treatment train approach with vegetated surfaces, mechanical and natural filtration facilities can be achieved.

Water Quantity

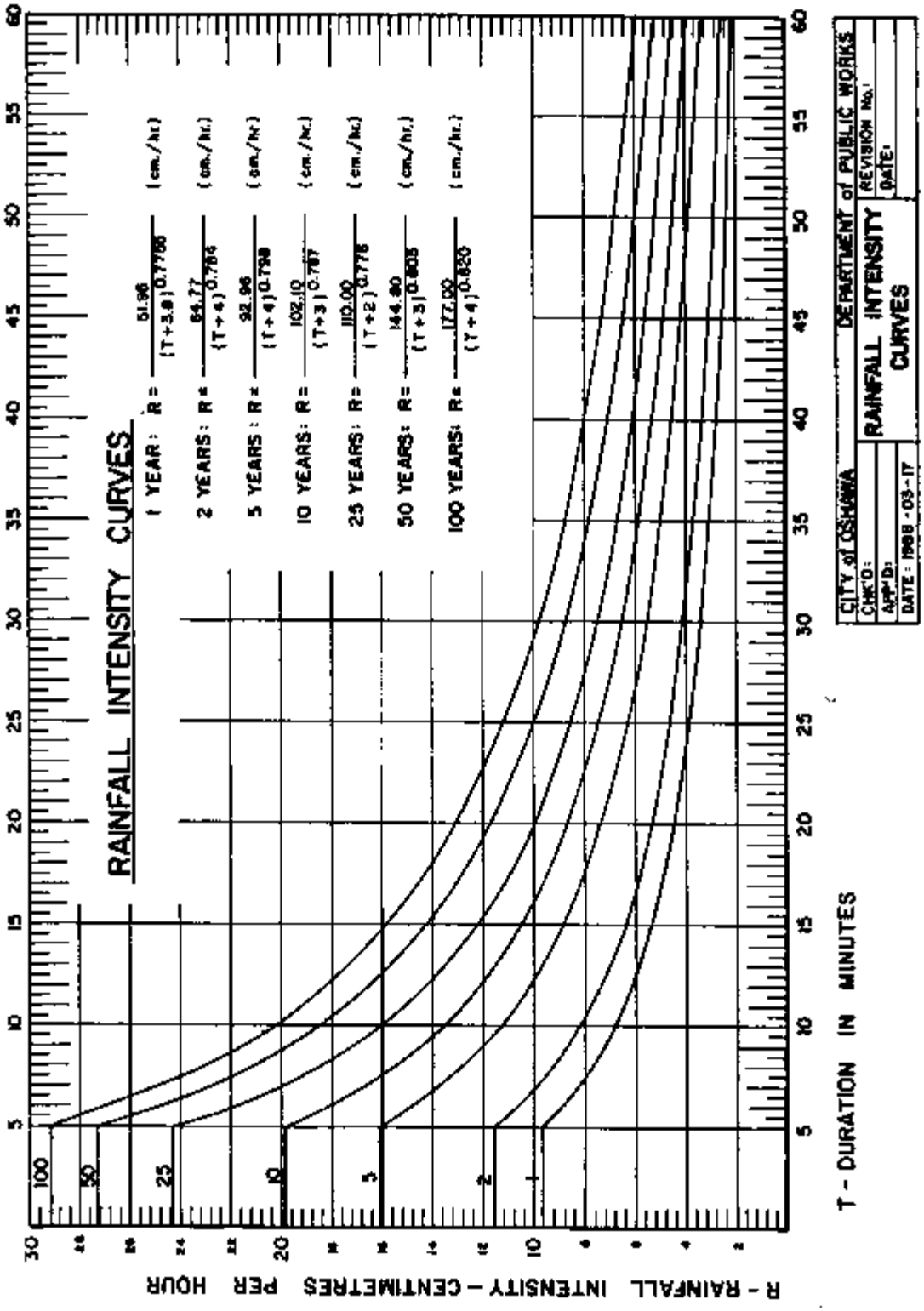
- Flow patterns and watershed boundaries have been maintained within the site.
- No quantity control was required for Oshawa Creek watershed due to its proximity to the main branch of the creek.
- Overcontrol was provided for discharge to the Goodman's Creek watershed at the receiving sewer system at Taunton Road. This was completed as it is presumed
    - The existing capacity of Taunton Road sewer system does not convey the 10- Year event
    - Reductions to the existing discharge rates from Stevensons Road to Taunton was maintained as to not overwhelm the system further.
        - This exceeded the Post-to-Pre control rates.
    - Overcontrol of the 10- year storm to existing flow rates exceeds the increased storage of the 100-year event and thus 100- year quantity control has been achieved.

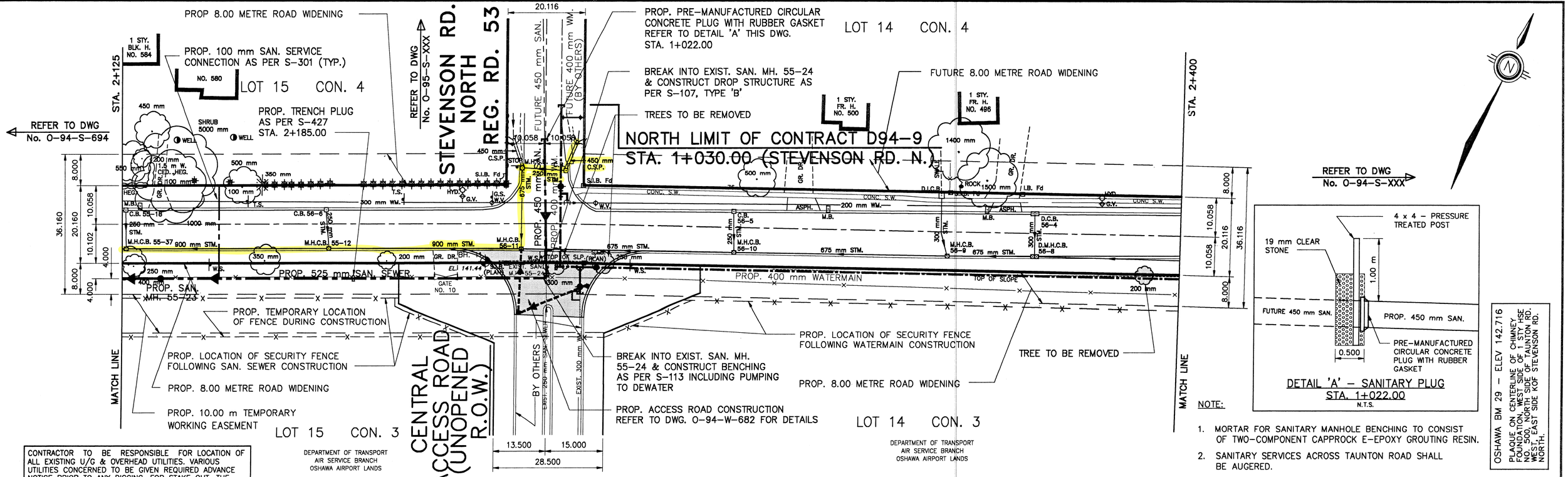
6 CONCLUSIONS

The following illustrates the conclusions associated with the Stevensons Road North EA:

- The supporting background reference data, approach and criteria and objectives for the stormwater management (SWM) and drainage design have been documented.
- The existing drainage and SWM conditions have been documented for the Stevensons Road North EA with the four (4) existing outfall locations.
    - OF1 – the connection to the Conlin Road culvert connection will be maintained.
    - OF2 – the CL-2 culvert will be replaced and stormwater runoff within the site will be treated and discharged through the replaced Culvert CL-2 prior to discharge to Oshawa Creek.
    - OF3 – Will be removed as the future site conditions cannot account for the necessary grading requirements to maintain the Culvert CL-3 crossing.
    - OF4 – Connection to the sewer at Taunton Roads sewer will be overcontrolled and treated prior to discharge. Flows from OF3 will be included at OF4.
- The proposed replacement of Culvert CL-2 meets HDDS Criteria.
- Design has limited its need to expand outside the right-of-way limits where feasible.

Appendix A: Background Information


RAINFALL INTENSITY CURVES
1 YEAR: R = 51.96 / (T+3.8)^0.7788 (cm./hr.)
2 YEARS: R = 84.27 / (T+4)^0.784 (cm./hr.)
5 YEARS: R = 92.96 / (T+4)^0.799 (cm./hr.)
10 YEARS: R = 102.10 / (T+3)^0.787 (cm./hr.)
25 YEARS: R = 110.00 / (T+2)^0.778 (cm./hr.)
50 YEARS: R = 144.80 / (T+3)^0.805 (cm./hr.)
100 YEARS: R = 177.00 / (T+4)^0.820 (cm./hr.)
R - RAINFALL INTENSITY - CENTIMETERS PER HOUR
T - DURATION IN MINUTES
CITY of OSHAWA
DEPARTMENT of PUBLIC WORKS
CHK'D:
APP'D:
DATE: 1988-03-17
RAINFALL INTENSITY CURVES
REVISION No.:
DATE:



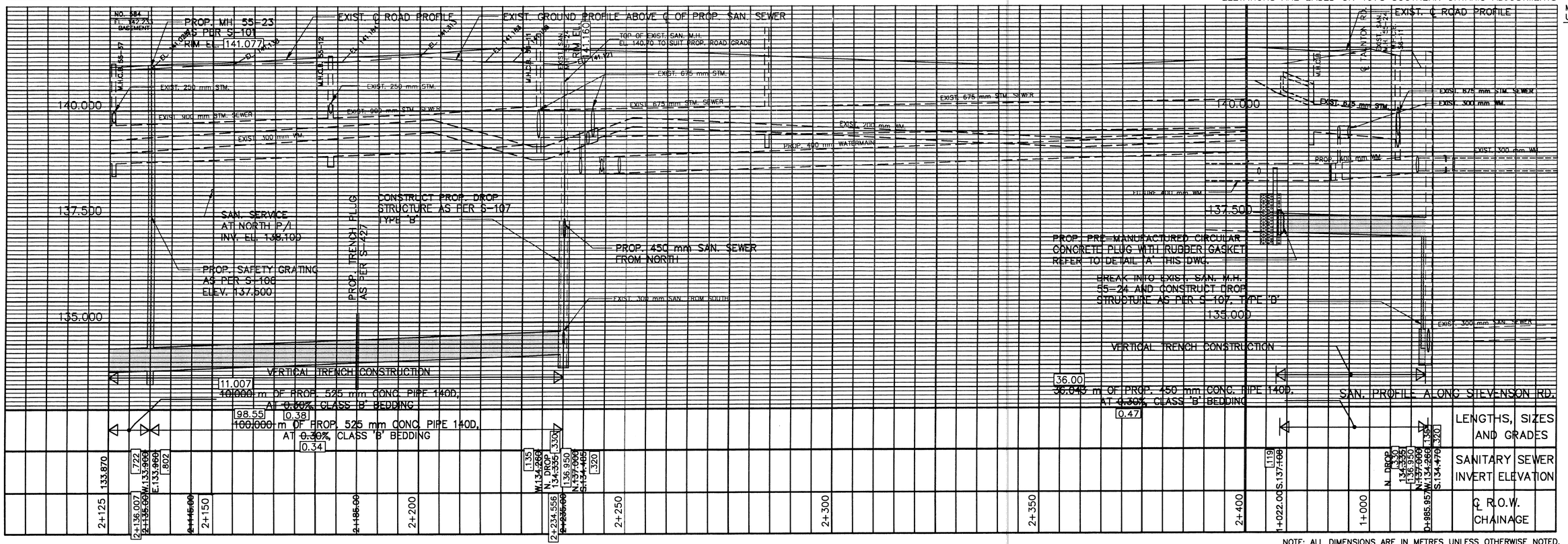
CONTRACTOR TO BE RESPONSIBLE FOR LOCATION OF ALL EXISTING U/G & OVERHEAD UTILITIES. VARIOUS UTILITIES CONCERNED TO BE GIVEN REQUIRED ADVANCE NOTICE PRIOR TO ANY DIGGING, FOR STAKE OUT. THE REGION ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OF THE LOCATION OF EXISTING UTILITIES AS INDICATED ON THIS DRAWING.

NOTE:

1. MORTAR FOR SANITARY MANHOLE BENCHING TO CONSIST OF TWO-COMPONENT CAPPROCK E-EPOXY GROUTING RESIN.
2. SANITARY SERVICES ACROSS TAUNTON ROAD SHALL BE AUGERED.
3. SANITARY SERVICES ACROSS TAUNTON ROAD SHALL BE RISER TYPE AS PER S-302.

ELEVATIONS ARE BASED ON 1978 SOUTHERN ONTARIO ADJUSTMENTS

REGIONAL ROAD 4 - TAUNTON ROAD WEST



METRIC CONVERSION USED ON THIS DWG.

mm	in.
1700	68
1500	60
1400	54
1200	48
1050	42
800	32
700	28
600	24
500	20
450	18
400	16
375	15
350	14
300	12
250	10
200	8
150	6
100	4

NOTE: ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.

AUG. 3, 1994 41622007

Simcoe
SIMCOE ENGINEERING GROUP LIMITED
Consulting Engineers & Architect

UTILITIES VERIFIED

CABLE T.V.	1993 06 28
BELL CANADA	1993 06 21
CONSUMERS GAS	1993 07 02
OSHAWA P.U.C.	1993 06 25
ONTARIO HYDRO	1993 07 07
STORM SEWER	1993 XX XX

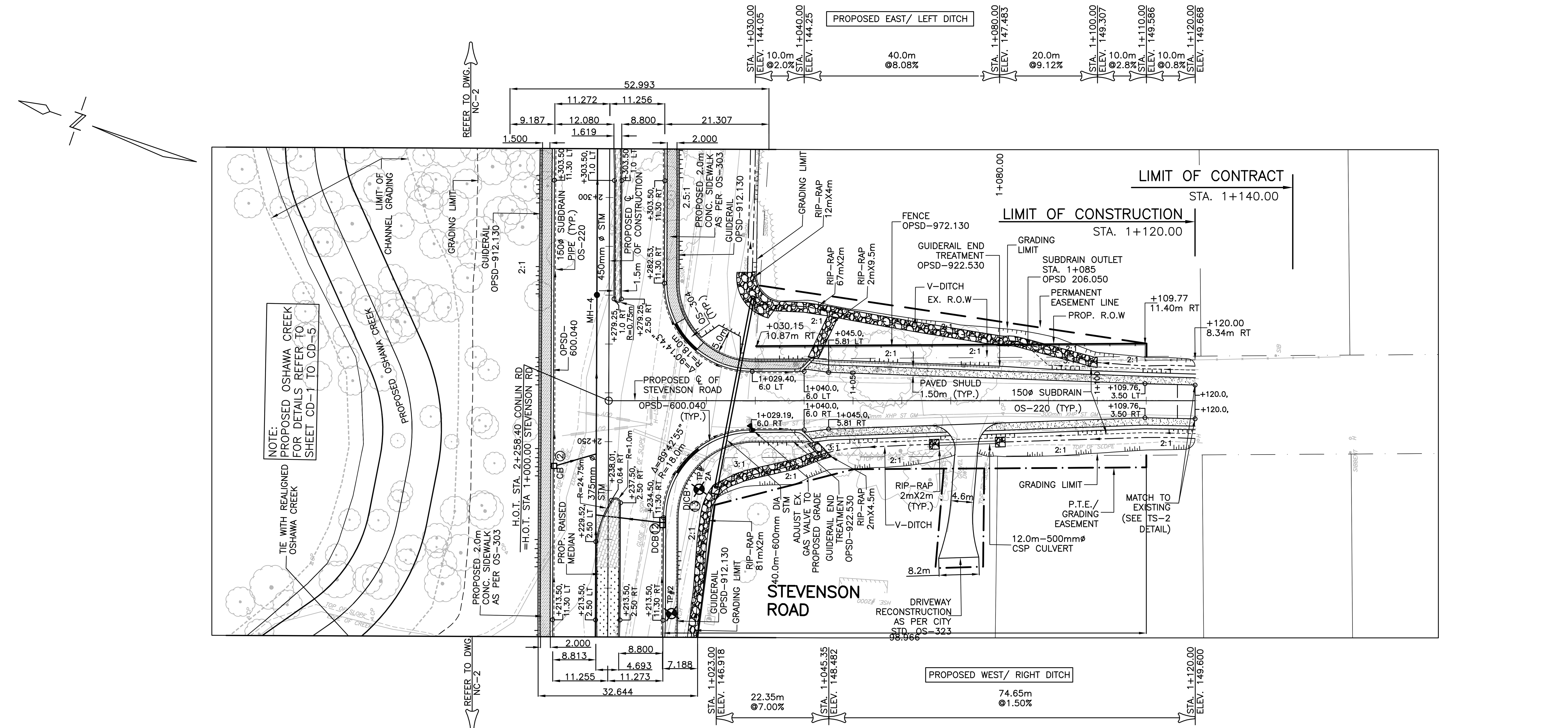
ORIGINAL DRAWING
Sealed by: J. A. MILLS, P. Eng.
On: AUGUST 5th, 1994

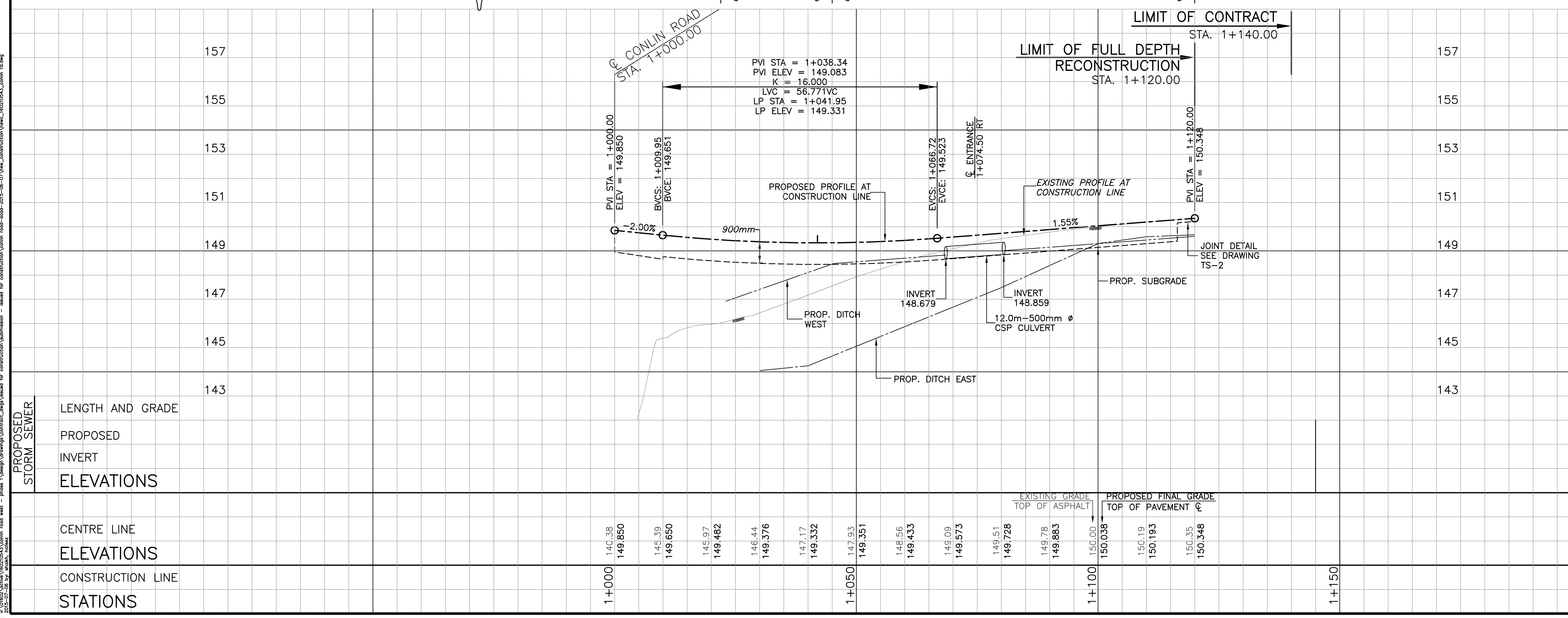
NO.	DATE	NAME	REVISIONS
	96 06	K.M.	AS RECORDED (I. OLIVER)

DRAWN P. IMESON / B. LISCUMB DATE 1994.06.15
DESIGN B. KRAMER DATE 1994.06.15
CHECKED B. KRAMER DATE 1994.06.30
APPROVED J.A. MILLS DATE 1994.07.14
HORIZ. SCALE 10m 0 5 10m
VERT. 1m 0 1m
SURVEY DATA 92-XX-XX DATE

THE REGIONAL MUNICIPALITY OF DURHAM
WORKS DEPARTMENT
WHITBY ONTARIO
REG. RD. 4 - TAUNTON ROAD WEST
FROM 110 m W. OF STEVENSON RD. N. TO 165 m E. OF STEVENSON RD. N.
RD. NO. 4 LOT NO. 14/15 CON. 3/4 TWP. AREA MUN. OSHAWA

CONTRACT NO. D94-9
DRAWING NO. O-94-S-695
2045





Stantec
Stantec Consulting Ltd.
300-675 Cochrane Drive West Tower
Markham ON Canada
L3R 0B8
Tel. 905.944.7777
Fax. 905.474.9889
www.stantec.com

DEPTH OF MATERIAL SHALL BE:	
SURFACE ASPHALT (FUTURE)	50mm
BASE ASPHALT (HL8)	80mm
GRANULAR 'A'	150mm
GRANULAR 'B'	620mm
SELECT SUBGRADE MATERIAL	N/A

NOTE:
SUBGRADE IS TO BE CONSTRUCTED WITH 3% CROSSFALL (SEE TYPICAL SECTIONS)

REFERENCES

UTILITIES VERIFIED BY: BELL CANADA 13 05 21
ENBRIDGE GAS 13 05 21 ,OPUC (HYDRO) 13 05 21
MULTIVIEW LOCATES 13 10 22
NOTE AND REFERENCE SHEET NR-1 (SHEET 1 OF 38)

No.	DATE	REVISION	BY

APPROVALS

STANTEC CONSULTING	REGION OF DURHAM
	N.A.

CONTRACT
O 14-02

SHEET 9 OF 38

DEVELOPMENT SERVICES DEPARTMENT
CITY OF OSHAWA

STEVENSON ROAD
FROM CONLIN ROAD WEST TO
120m SOUTH OF CONLIN ROAD WEST
NEW CONSTRUCTION

DRAWN BY	LOC.	CONST.	STANTEC	DESIGN BY A.H.S.	CHKD. BY J.A.S.	APPD. BY S.T.M.
DATE	09 07 01	14 02 07	REGION	DESIGN BY __	CHKD. BY __	APPD. BY __

SCALE — HORIZONTAL 10m 0 10m — VERTICAL 2m 0 2m

DWG. No. NC-5

DATE ISSUED APRIL 14, 2014, ISSUED FOR CONSTRUCTION PURPOSES ONLY

CITY OF OSHAWA
NORTHWOOD BUSINESS PARK
MASTER STORMWATER MANAGEMENT PLAN

Final Report

FULL REPORT UNDER SEPARATE COVER

PREPARED FOR:

THE CORPORATION OF THE CITY OF OSHAWA
50 CENTRE STREET SOUTH, 9TH FLOOR
OSHAWA, ONTARIO
L1H 3Z7

PREPARED BY:

GRECK AND ASSOCIATES LIMITED
WATER RESOURCES AND ENVIRONMENTAL ENGINEERING

57 Mill Street N, Unit 208
Brampton, Ontario
L6X 1S9

Project: 313

August, 2016

Geotechnical Investigation Report

Stevenson Road North, Oshawa

FULL REPORT UNDER SEPARATE COVER

Gannett Fleming
Final Report (Revised)

January 14, 2025
02112515.000-0100-GE-R-0001-01

eNGLOBe

Appendix B: Culvert Inspection Memo

| City of Oshawa
Stevenson Road improvement
SITE INSPECTION MEMO

Ontario City of Oshawa Stevenson Street Environmental Assessment	
Date:	Nov 18, 2022
To:	City of Oshawa
From:	David Jackson, P. Eng. – Gannett Fleming - Drainage Lead
RE:	Site Inspection Memo

INTRODUCTION

Gannet Fleming was retained by the City of Oshawa to overtake improvement of Stevenson Road Street that includes stormwater management study, and the environmental assessment within the study area.

The stormwater management study includes investigating existing and outfall conditions from the road corridor, highlighting potential drainage impacts resulting from the proposed road improvements to both the minor and major system, and performing hydrologic and hydraulic analysis of the existing drainage conditions and assessment of the potential impact of the proposed road improvements.

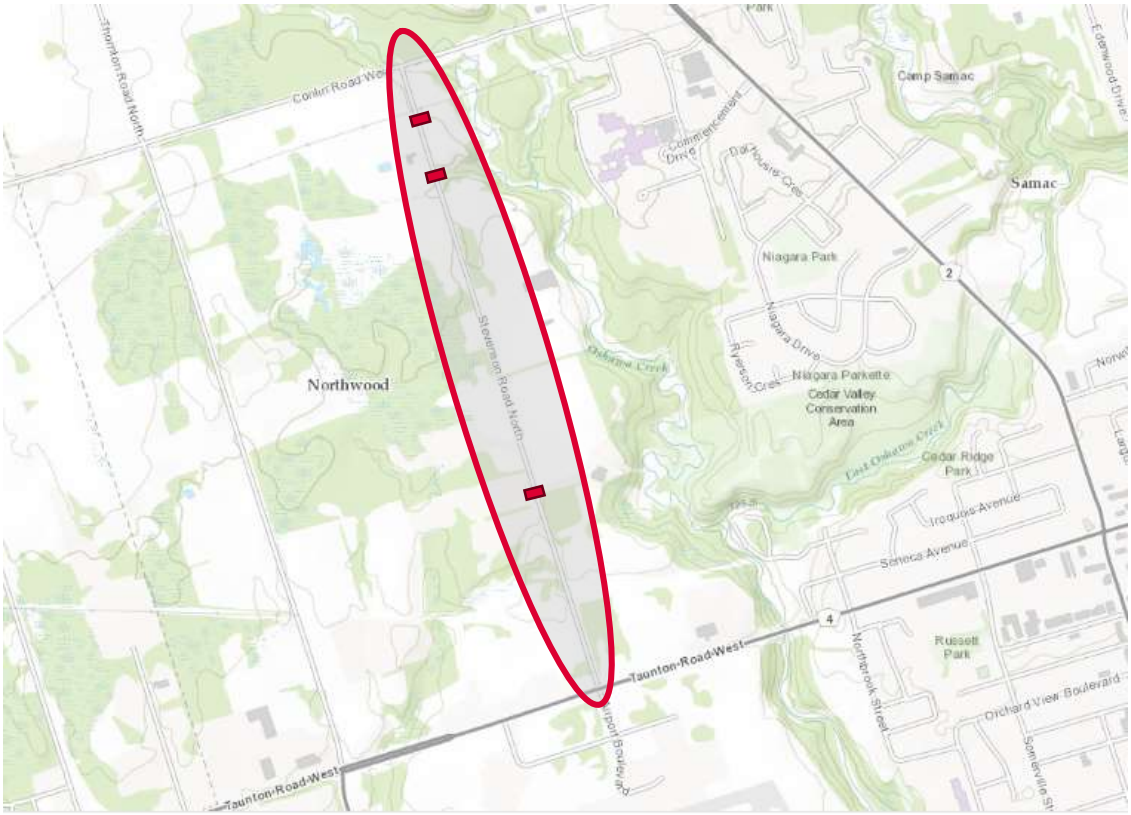


Figure 1- Study limits

PURPOSE

This technical memorandum is aimed to:

- Outline the existing culverts drainage outlet within the project area.
- Provide field observations to establish a design basis.
- Report inspected functional conditions of existing culverts crossings.

OBSERVATIONS

- There are three centreline culverts capturing the flow Stevenson Road. Figure 1 shows the centerline culver location. TABLE 1 summarizes the these culverts information from field observation:
- Driveway culverts along houses on Stevenson Road were observed. Culvert diameter various from 300 to 450mm 300mm and the material was CSP, concrete and HDPE. Culvert photos and field investigations are shown in Table 3.

	Culvert end	Material	Dimensions	Clearance	High Water Mark	Debris	Watercourse Type	Creek Material	Bank Conditions	Channel Dimensions (side slopes)	Channel Dimensions (m)	Channel Dimensions (m)	Observed Flow Conditions	Road Condition	Physical Culvert Condition
Centerline Culvert 1	Down stream	CSP	450	Dry	Not clear	Vegetation debris	Permanent - Ditch	Grass	Stable	2:1 side slopes	0.6	2	Ditch	Cracks	Poor Condition
	Upstream	CSP	450	Dry	Not clear	Vegetation debris	Permanent - Ditch	Grass	Stable	2:1 side slopes	0.6	2	Ditch		
Centerline Culvert 2	Down stream	CSP	900	Dry	300	Nothing inside	Permanent - Ditch	Rip rap	Erosion - Minor	2:1 side slopes	1m	3	Ditch	Cracks	Maintenance (see note1)
	Upstream	CSP	900	Dry	300	Vegetation debris	Permanent - Ditch	Vegetation	Stable	5:1 side slopes	0.9	5	Ditch		
Centerline Culvert 3	Down stream	CSP	450	Dry	250	Woody debris	Permanent - Ditch	Vegetation	Stable	5:1 side slopes	0.6	5	Ditch	Cracks; Erosion	Poor Condition
	Upstream	CSP	450	Dry	Not clear	Vegetation debris	Permanent - Ditch	Vegetation	Stable	5:1 side slopes	0.6	5	Ditch		

note 1:There is a hole in the middle (culvert has two sections)

Table 2- Centerline culverts

#1-Centerline Culvert 1, outlet

#2- Centerline Culvert 1, looking east

#3-Centerline Culvert 1, inlet

#4- Centerline Culvert 1, looking west

<table>
<tr><td colspan="2">Table 2- Centerline culverts</td></tr>
<tr><td>#5-Centerline Culvert 2, outlet
  </td><td>#6- Centerline Culvert 2, looking east
  </td></tr>
<tr><td>#7-Centerline Culvert 2, inside the culvert
  </td><td>#8-Centerline Culvert 2, looking west
  </td></tr>
</table>

GANNETT FLEMING

Table 2- Centerline culverts	
#9-Centerline Culvert 3, outlet 	#10- Centerline Culvert 3, looking east 
#11-Centerline Culvert 3, inside the culvert 	#12-Centerline Culvert 3, looking west 

Table 3- Driveway culverts	
C1: 450mm CSP, [-78.8984 43.9289 decimal degrees], Culvert condition is good but some maintenance requires)	
#1-C1 looking north 	#2-C1 looking south 

Table 3- Driveway culverts , Cont'.	
C2:(450mm CSP, -78.8986 43.9294 decimal degrees], Culvert condition is good)	
#3-C2 South outlet 	#4-C2 looking south 
#5-C2 North inlet 	#6-C2 looking north 

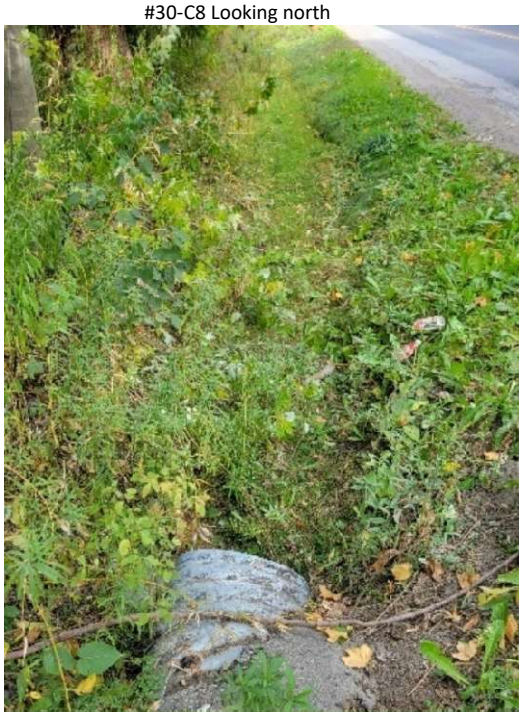
<table>
<tr><td colspan="2">Table 3- Driveway culverts, Cont’.</td></tr>
<tr><td colspan="2">C3:(450mm CSP, [-78.8988 43.9297 decimal degrees], Culvert is damaged, requires replacement of end sections)</td></tr>
<tr><td>#7-C3 South outlet
  </td><td>#8-C3 looking south
  </td></tr>
<tr><td>#9-C3 North inlet
  </td><td>#10-C3 looking north
  </td></tr>
</table>

<table>
<tr><td colspan="2">Table 3- Driveway culverts, Cont’.</td></tr>
<tr><td colspan="2">C4:(450mm concrete, [-78.8991 43.9302 decimal degrees], Culvert is fine but probably needs replacement)</td></tr>
<tr><td>#11-C4 South outlet
  </td><td>#12-C4 looking south
  </td></tr>
<tr><td>#13-C4 North inlet
  </td><td>#14-C4 looking north
  </td></tr>
</table>

Table 3- Driveway culverts, Cont'.	
C5:(450mm concrete, [-78.8995 43.931 decimal degrees], Culvert is fine)	
#15-C5 South outlet 	#16-C5 looking south 
#17-C5 North inlet 	#18-C5 looking north 

<table>
<tr><td colspan="2">Table 3- Driveway culverts, Cont’.</td></tr>
<tr><td colspan="2">**C6**:(450mm CSP, [-78.8995 43.931 decimal degrees], Culvert is fine but maintenance requires)</td></tr>
<tr><td>#19-C6 South outlet
  </td><td>#20-C6 Looking south
  </td></tr>
<tr><td>#21-C6 North inlet
  </td><td>#22-C6 Looking north
  </td></tr>
</table>

<table>
<tr><td colspan="2">Table 3- Driveway culverts, Cont’.</td></tr>
<tr><td colspan="2">C7:(unable to confirm the size, CSP, [-78.8998 43.9318 decimal degrees], Culvert is crushed)</td></tr>
<tr><td>#23-C7 South outlet
  </td><td>#24-C7 Looking south
  </td></tr>
<tr><td>#25-C7 North inlet
  </td><td>#26-C7 Looking north
  </td></tr>
</table>

Table 3- Driveway culverts, Cont'.	
C8:(450mm, CSP, [-78.9004 43.9331 decimal degrees], Culvert is fine, clean and good shape)	
#27-C8 South outlet 	#28-C8 Looking south 
#29-C8 North inlet 	#30-C8 Looking north 

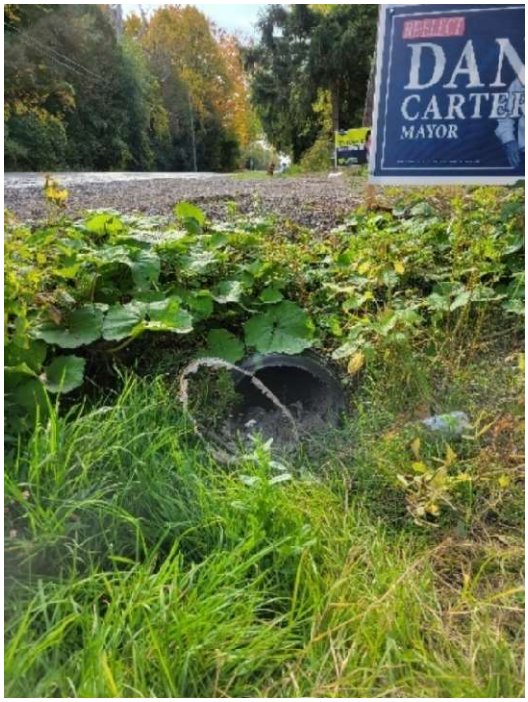
<table>
<tr><td colspan="2">Table 3- Driveway culverts, Cont’.</td></tr>
<tr><td colspan="2">C9:(300mm, HDPE, [-78.9006 43.9336 decimal degrees], Culvert is fine, clean and good shape)</td></tr>
<tr><td>#31-C9 South outlet
  </td><td>#32-C9 Looking south
  </td></tr>
<tr><td>#33-C9 North inlet
 
</td><td>#34-C9 Looking north
  </td></tr>
</table>

Table 3- Driveway culverts, Cont'.

C10:(450mm, HDPE, [-78.9007 43.9341 decimal degrees], top of culvert is exposed)

#35-C10 South outlet

#36-C10 Looking south

#37-C10 North inlet

#38-C10 Looking north

<table>
<tr><td colspan="2">Table 3- Driveway culverts, Cont’.</td></tr>
<tr><td colspan="2">C11:(450mm, HDPE, [-78.901 43.9344 decimal degrees], culvert has poor condition and top of culvert is exposed)</td></tr>
<tr><td>#39-C11 South outlet
  </td><td>#40-C11 Looking south
  </td></tr>
<tr><td>#41-C11 North inlet
  </td><td>#41-C11 Looking north
  </td></tr>
</table>

Table 3- Driveway culverts, Cont'.

C12:(450mm, CSP [-78.9014 43.9352 decimal degrees], culvert is fine but ditch maintenance requires)

#42-C12 South outlet

#43-C12 Looking south

#44-C12 North inlet

#44-C12 Looking north

Table 3- Driveway culverts, Cont'.	
C13:(450mm, CSP [-78.9015 43.9355 decimal degrees], culvert is fine but north end needs to be fixed)	
#45-C13 South outlet 	#46-C13 Looking south 
#47-C13 North inlet 	#48-C13 Looking north 

Table 3- Driveway culverts, Cont'.	
C14:(450mm, CSP [-78.9018 43.9362 decimal degrees], culvert is fine but both ends need to be fixed)	
#49-C14 South outlet 	#50-C14 Looking south 
#51-C14 North inlet 	#52-C14 Looking north 

Table 3- Driveway culverts, Cont'.

C15:(not able to measure the diameter, CSP [-78.9021 43.9369 decimal degrees], culvert is crushed and needs to be replaced)

#53-C15 South outlet

#54-C15 Looking south

#55-C15 North inlet

#56-C15 Looking north

Table 3- Driveway culverts, Cont'.	
C16:(450mm, Concrete [-78.9022 43.9372 decimal degrees], culvert is fine but ditch needs to be maintained)	
#57-C16 South outlet 	#58-C16 Looking south 
#59-C16 North inlet 	#60-C16 Looking north 

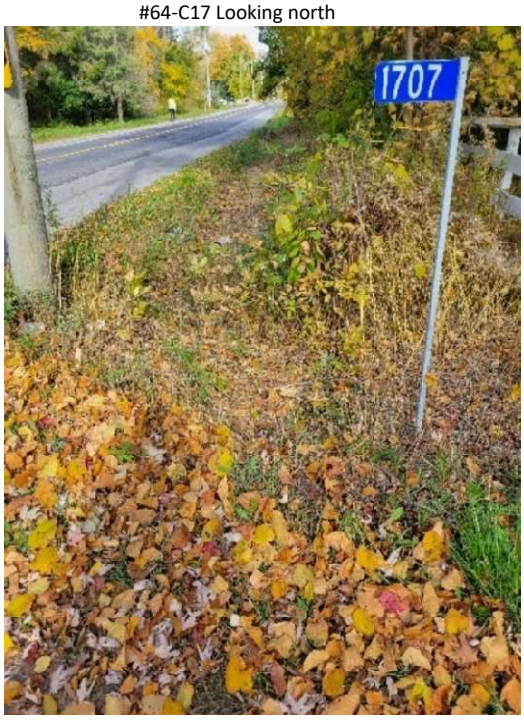
<table>
<tr><td colspan="2">Table 3- Driveway culverts, Cont’.</td></tr>
<tr><td colspan="2">C17:(300mm, CSP [-78.9021 43.9373 decimal degrees], culvert has poor condition and needs to be replaced)</td></tr>
<tr><td>#61-C17 South outlet
  </td><td>#62-C17 Looking south
  </td></tr>
<tr><td>#63-C17 North Inlet
  </td><td>#64-C17 Looking north
 
</td></tr>
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Table 3- Driveway culverts, Cont'.

C18:(450mm, Cement [-78.9026 43.938 decimal degrees], culvert has poor condition and needs to be replaced)

#65-C18 South outlet

#66-C18 Looking south

#67-C18 North inlet

#68-C18 Looking north

Table 3- Driveway culverts, Cont'.

C19:(300mm, CSP at south & HDPE at north side [-78.9026 43.9381 decimal degrees], culvert has poor condition and needs to be replaced)

#69-C19 South outlet

#70-C19 Looking south

#71-C19 North inlet

#72-C19 Looking north

Table 3- Driveway culverts, Cont'.	
C20:(300mm, CSP [-78.9025 43.9381 decimal degrees], culvert has poor condition and needs to be replaced)	
#73-C20 South outlet 	#74-C20 Looking south 
#75-C20 North inlet 	#76-C20 Looking north 

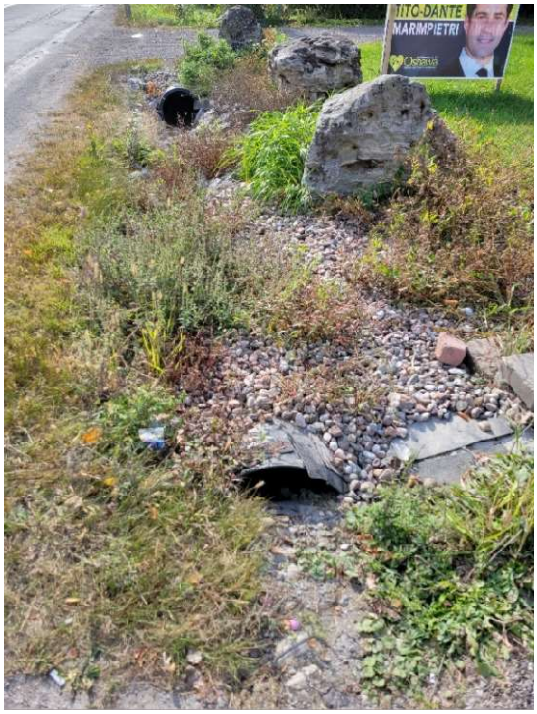
<table>
<tr><td colspan="2">Table 3- Driveway culverts, Cont’.</td></tr>
<tr><td colspan="2">C21:(300mm, HDPE [-78.9027 43.9382 decimal degrees] culvert has poor condition and needs to be replaced)</td></tr>
<tr><td>#77-C21 South outlet
  </td><td>#78-C21 Looking south
  </td></tr>
<tr><td>#79-C21 North inlet
  </td><td>#79-C21 Looking north
  </td></tr>
</table>

Table 3- Driveway culverts, Cont'.

C22:(300mm, HDPE [-78.9027 43.9382 decimal degrees] culvert has poor condition and needs to be replaced, south side is not clear)

#80-C22 South outlet

#81-C22 Looking south

#82-C22 Looking north

Table 3- Driveway culverts, Cont'.

C23:(300mm, HDPE [-78.9027 43.9383 decimal degrees] culvert has poor condition and needs to be replaced, south side is not clear)

#83-C23 South outlet

#84-C23 Looking south

#85-C23 North inlet

#85-C23 Looking north

Table 3- Driveway culverts, Cont'.

C24:(300mm, CSP [-78.9027 43.9383 decimal degrees] culvert has poor condition and needs to be replaced)

#86-C24 South outlet

#87-C24 Looking south

#88-C24 North inlet

#89-C24 Looking north

<table>
<tr><td colspan="2">Table 3- Driveway culverts, Cont’.</td></tr>
<tr><td colspan="2">C25:(300mm, HDPE [-78.9026 43.9383 decimal degrees] culvert condition is fine but ends need to be cut)</td></tr>
<tr><td>#90-C25 South outlet
  </td><td>#91-C25 Looking south
  </td></tr>
<tr><td>#92-C25 North inlet
  </td><td>#93-C25 Looking north
  </td></tr>
</table>

Table 3- Driveway culverts, Cont'.

C26:(300mm, CSP [-78.903 43.9388 decimal degrees] culvert has poor condition and needs to be replaced)

#94-C26 South outlet

#95-C27 Looking south

#96-C26 North inlet

#97-C27 Looking north

Table 3- Driveway culverts, Cont'.

C27:(300mm, HDPE [-78.9029 43.939 decimal degrees] culvert has poor condition and needs to be replaced)

#98-C27 South outlet

#99-C27 Looking south

#100-C27 North inlet

Table 3- Driveway culverts, Cont'.	
C28:(300mm, CSP [-78.903 43.9394 decimal degrees] culvert has poor condition and needs to be replaced)	
#101-C28 South outlet 	#102-C28 Looking south 
#103-C28 North inlet 	#104-C28Looking north 

<table>
<tr><td colspan="2">Table 3- Driveway culverts, Cont’.</td></tr>
<tr><td colspan="2">C29:(300mm, HDPE [-78.9036 43.9403 decimal degrees] culvert has poor condition and needs to be replaced)</td></tr>
<tr><td>#105-C29 South outlet
  </td><td>#106-C30 Looking south
  </td></tr>
<tr><td>#107-C29 North inlet
  </td><td>#108-C30 Looking north
  </td></tr>
</table>

Table 3- Driveway culverts, Cont'.	
C30:(450mm, CSP [-78.9058 43.9452 decimal degrees] culvert has no issue)	
#105-C29 South inlet 	#106-C30 Looking south 
#107-C29 North outlet 	#108-C30 Looking north 

SUMMARY

Overall, the team has prepared the above memo document to provide the existing condition of the site and the storm water management facilities. This information can be used as a reference for the drainage design and Improvement plan.
If City of Oshawa has any commentary or questions related to the above approach and criteria, please do not hesitate to send to the team.

Appendix C: Hydrologic Analysis

EXISTING CONDITIONS HYDROLOGY										
Catchment Area	Catchment Land Coverage			Runoff Coefficient, C		SCS Curve Number, CN		Summary		
	Total Drainage Area [ha]	*Impervious Area* [ha]	Pervious Area [ha]	*Impervious Area* 0.9	Pervious Area 0.2	*Impervious Area* 98	Pervious Area 76	*C*	*CN*	*Ia*
External Area										
W2-1A	17.82	0.50	17.32	2.8%	97.2%	2.8%	97.2%	0.22	76.6	5.8
OM-51A*	8.26			85.0%	0.0%	0.0%	0.0%		62.0	1.5
G7B1-A	8.60	0.38	8.22	4.4%	95.6%	4.4%	95.6%	0.23	77.0	5.7

Note: The catchment area attributes for OM-51A are derived from the City of Oshawa's Northwood Business Park Master Stormwater Management Plan. OM-51A is a subcatchment of OM-51.

EXISTING CONDITION TIME TO PEAK CALCULATION

Catchment Area	Catchment Characteristics					Time to Peak Calculation				
	Total Drainage Area	*Slope*	*Flow Length*	Catchment Width	C	*HYMO*	*HYMO*	*Airport Formula*	*Bransby-Williams*	*Average*
	[ha]	[%]	[m]	[m]	[-]	*Long*	*Short*			
External Area										
W2-1A	17.82	0.79	1017.90	175.07	0.22	0.34	0.44	1.09	0.54	**0.66**
G7B1-A	8.60	0.48	1126.97	76.31	0.23	0.36	0.45	1.33	0.56	**0.75**

Designed By: PT - September 17, 2024
Checked By: DJ - September 17, 2024

PROPOSED CONDITIONS HYDROLOGY										
Catchment Area	Catchment Land Coverage			Runoff Coefficient, C		SCS Curve Number, CN		Summary		
	Total Drainage Area [ha]	*Impervious Area* [ha]	Pervious Area [ha]	*Impervious Area* 0.9	Pervious Area 0.2	*Impervious Area* 98	Pervious Area 76	*C*	*CN*	*Ia*
External Area										
W2-1A	17.50	0.36	17.14	2.1%	97.9%	2.1%	97.9%	0.21	76.5	5.9
OM-51A*	8.26			85.0%	0.0%	0.0%	0.0%		62.0	1.5
G7B1-A	8.60	0.38	8.22	4.4%	95.6%	4.4%	95.6%	0.23	77.0	5.7

Note: The catchment area attributes for OM-51A are derived from the City of Oshawa's Northwood Business Park Master Stormwater Management Plan. OM-51A is a subcatchment of OM-51.

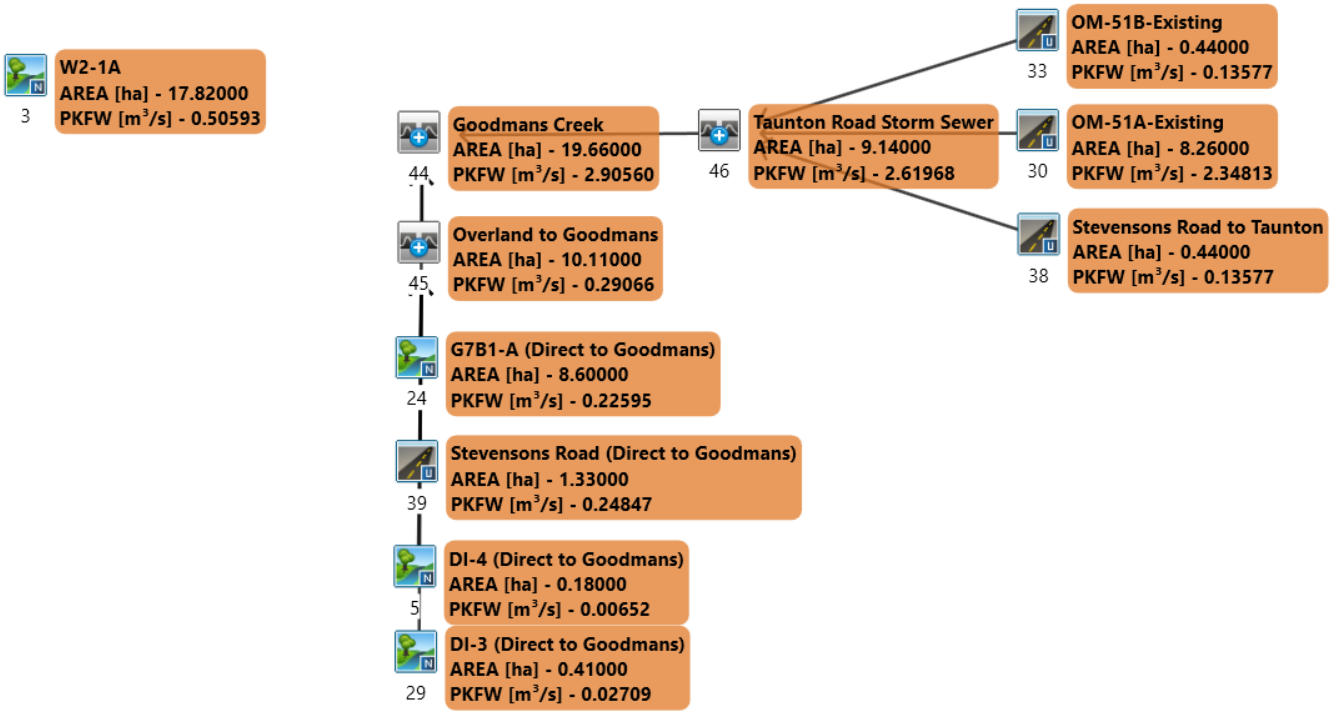
Designed By: PT - September 17, 2024
Checked By: DJ - September 17, 2024

PROPOSED CONDITION TIME TO PEAK CALCULATION

Catchment Area	Catchment Characteristics					Time to Peak Calculation				
	Total Drainage Area	*Slope*	*Flow Length*	Catchment Width	C	*HYMO*	*HYMO*	*Airport Formula*	*Bransby-Williams*	*Average*
	[ha]	[%]	[m]	[m]	[-]	*Long*	*Short*			
External Area										
W2-1A	17.50	0.57	700.00	250.00	0.21	0.36	0.52	1.01	0.53	**0.63**
G7B1-A	8.60	0.48	1126.97	76.31	0.23	0.36	0.45	1.33	0.56	**0.75**

Designed By: PT - September 17, 2024
Checked By: DJ - September 17, 2024

Visual OTTHYMO Schematic- Existing Peak Flows



```
       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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 *****

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Summary filename: C:\Users\emay\AppData\Local\Civica\VH5\e1c6be58-a9e2-48fa-8862-b94ee87dad4f\0843d529-515d-43e5-812b-184e109b8353\scenari

DATE: 10/28/2024 TIME: 03:25:24

USER:

COMMENTS: _____

****
** SIMULATION : 010yr 12hr 10min Chicago **
****

| CHICAGO STORM |
| Ptotal= 61.10 mm |

IDF curve parameters: A=1232.390
B= 5.180
C= 0.833
used in: INTENSITY = A / (t + B)^C

Duration of storm = 12.00 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	0.92	3.00	3.70	6.00	2.77	9.00	1.28
0.17	0.95	3.17	4.63	6.17	2.59	9.17	1.24
0.33	0.99	3.33	6.27	6.33	2.43	9.33	1.21
0.50	1.04	3.50	9.93	6.50	2.30	9.50	1.18
0.67	1.08	3.67	26.03	6.67	2.17	9.67	1.15
0.83	1.14	3.83	127.73	6.83	2.07	9.83	1.12
1.00	1.19	4.00	34.92	7.00	1.97	10.00	1.10
1.17	1.26	4.17	17.19	7.17	1.88	10.17	1.07
1.33	1.33	4.33	11.37	7.33	1.80	10.33	1.05

1.50	1.42	4.50	8.51	7.50	1.73	10.50	1.03
1.67	1.52	4.67	6.83	7.67	1.66	10.67	1.00
1.83	1.63	4.83	5.72	7.83	1.60	10.83	0.98
2.00	1.76	5.00	4.93	8.00	1.54	11.00	0.96
2.17	1.92	5.17	4.35	8.17	1.49	11.17	0.94
2.33	2.12	5.33	3.89	8.33	1.44	11.33	0.93
2.50	2.36	5.50	3.53	8.50	1.40	11.50	0.91
2.67	2.68	5.67	3.23	8.67	1.36	11.67	0.89
2.83	3.10	5.83	2.98	8.83	1.32	11.83	0.88

CALIB			
NASHYD (0003)	Area (ha)= 17.82	Curve Number (CN)= 76.6	
ID= 1 DT= 5.0 min	Ia (mm)= 5.80	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.66		

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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Unit Hyd Qpeak (cms)= 1.031

PEAK FLOW (cms)= 0.506 (i)

TIME TO PEAK (hrs)= 4.750
RUNOFF VOLUME (mm)= 23.009
TOTAL RAINFALL (mm)= 61.097
RUNOFF COEFFICIENT = 0.377

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
NASHYD (0005)	Area (ha)= 0.18	Curve Number (CN)= 76.2	
ID= 1 DT= 5.0 min	Ia (mm)= 5.90	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.46		

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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Unit Hyd Qpeak (cms)= 0.015

PEAK FLOW (cms)= 0.007 (i)
TIME TO PEAK (hrs)= 4.500
RUNOFF VOLUME (mm)= 22.640
TOTAL RAINFALL (mm)= 61.097
RUNOFF COEFFICIENT = 0.371

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB STANDHYD (0039) ID= 1 DT= 5.0 min	Area (ha)= 1.33 Total Imp(%)= 85.00 Dir. Conn.(%)= 10.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.13	0.20
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	94.16	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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Max.Eff.Inten.(mm/hr)=		127.73	545.60
	over (min)	5.00	10.00
Storage Coeff. (min)=		2.75 (ii)	6.33 (ii)
Unit Hyd. Tpeak (min)=		5.00	10.00
Unit Hyd. peak (cms)=		0.28	0.15

			TOTALS
PEAK FLOW (cms)=	0.05	0.22	0.248 (iii)
TIME TO PEAK (hrs)=	4.00	4.08	4.00
RUNOFF VOLUME (mm)=	60.10	42.66	44.40
TOTAL RAINFALL (mm)=	61.10	61.10	61.10
RUNOFF COEFFICIENT =	0.98	0.70	0.73

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!
***** WARNING:FOR AREAS WITH IMPERVIOUS RATIOS BELOW 20%
YOU SHOULD CONSIDER SPLITTING THE AREA.

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 62.0 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			
NASHYD (0024)	Area (ha)=	8.60	Curve Number (CN)= 77.0
ID= 1 DT= 5.0 min	Ia (mm)=	5.70	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)=	0.75	

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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89

2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Unit Hyd Qpeak (cms)= 0.438

PEAK FLOW (cms)= 0.226 (i)
TIME TO PEAK (hrs)= 4.833
RUNOFF VOLUME (mm)= 23.378
TOTAL RAINFALL (mm)= 61.097
RUNOFF COEFFICIENT = 0.383

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD HYD (0045)		AREA	QPEAK	TPEAK	R.V.
1 + 2 = 3		(ha)	(cms)	(hrs)	(mm)
	ID1= 1 (0024):	8.60	0.226	4.83	23.38
	+ ID2= 2 (0039):	1.33	0.248	4.00	44.40
	ID = 3 (0045):	9.93	0.288	4.08	26.19

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0045)		AREA	QPEAK	TPEAK	R.V.
3 + 2 = 1		(ha)	(cms)	(hrs)	(mm)
	ID1= 3 (0045):	9.93	0.288	4.08	26.19
	+ ID2= 2 (0005):	0.18	0.007	4.50	22.64
	ID = 1 (0045):	10.11	0.291	4.08	26.13

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB
STANDHYD (0038) | Area (ha)= 0.44
ID= 1 DT= 5.0 min | Total Imp(%)= 85.00 Dir. Conn.(%)= 85.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.37	0.07
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	54.16	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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18

0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Max.Eff.Inten.(mm/hr)=	127.73	29.66		
over (min)	5.00	10.00		
Storage Coeff. (min)=	1.97 (ii)	5.17 (ii)		
Unit Hyd. Tpeak (min)=	5.00	10.00		
Unit Hyd. peak (cms)=	0.31	0.16		
			TOTALS	
PEAK FLOW (cms)=	0.13	0.00	0.136 (iii)	
TIME TO PEAK (hrs)=	4.00	4.08	4.00	
RUNOFF VOLUME (mm)=	60.10	16.50	53.55	
TOTAL RAINFALL (mm)=	61.10	61.10	61.10	
RUNOFF COEFFICIENT =	0.98	0.27	0.88	

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 62.0 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 (0030)	Area (ha)=	8.26
ID= 1 DT= 5.0 min	Total Imp(%)=	85.00 Dir. Conn.(%)= 85.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	7.02	1.24
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	0.38
Length	(m)=	234.66	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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

			TOTALS
Max.Eff.Inten.(mm/hr)=	127.73	17.85	
over (min)	5.00	30.00	
Storage Coeff. (min)=	3.86 (ii)	27.01 (ii)	
Unit Hyd. Tpeak (min)=	5.00	30.00	
Unit Hyd. peak (cms)=	0.25	0.04	
PEAK FLOW (cms)=	2.34	0.03	2.348 (iii)
TIME TO PEAK (hrs)=	4.00	4.42	4.00
RUNOFF VOLUME (mm)=	60.10	16.50	53.56
TOTAL RAINFALL (mm)=	61.10	61.10	61.10
RUNOFF COEFFICIENT =	0.98	0.27	0.88

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 62.0 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 (0033)| Area (ha)= 0.44
|ID= 1 DT= 5.0 min | Total Imp(%)= 85.00 Dir. Conn.(%)= 85.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.37	0.07
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	54.16	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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Max.Eff.Inten.	(mm/hr)=	127.73	29.66	
	over (min)	5.00	10.00	
Storage Coeff.	(min)=	1.97 (ii)	5.17 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	10.00	
Unit Hyd. peak	(cms)=	0.31	0.16	
				TOTALS
PEAK FLOW	(cms)=	0.13	0.00	0.136 (iii)
TIME TO PEAK	(hrs)=	4.00	4.08	4.00
RUNOFF VOLUME	(mm)=	60.10	16.50	53.55
TOTAL RAINFALL	(mm)=	61.10	61.10	61.10
RUNOFF COEFFICIENT	=	0.98	0.27	0.88

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 62.0 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.

ADD HYD (0046)
1 + 2 = 3

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0030):	8.26	2.348	4.00	53.56
+ ID2= 2 (0033):	0.44	0.136	4.00	53.55
ID = 3 (0046):	8.70	2.484	4.00	53.56

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0046)
3 + 2 = 1

	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0046):	8.70	2.484	4.00	53.56
+ ID2= 2 (0038):	0.44	0.136	4.00	53.55
ID = 1 (0046):	9.14	2.620	4.00	53.56

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

CALIB	
NASHYD (0029)	Area (ha)= 0.41 Curve Number (CN)= 81.9
ID= 1 DT= 5.0 min	Ia (mm)= 4.20 # of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.29

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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05

1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Unit Hyd Qpeak (cms)= 0.054

PEAK FLOW (cms)= 0.027 (i)
TIME TO PEAK (hrs)= 4.250
RUNOFF VOLUME (mm)= 28.626
TOTAL RAINFALL (mm)= 61.097
RUNOFF COEFFICIENT = 0.469

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

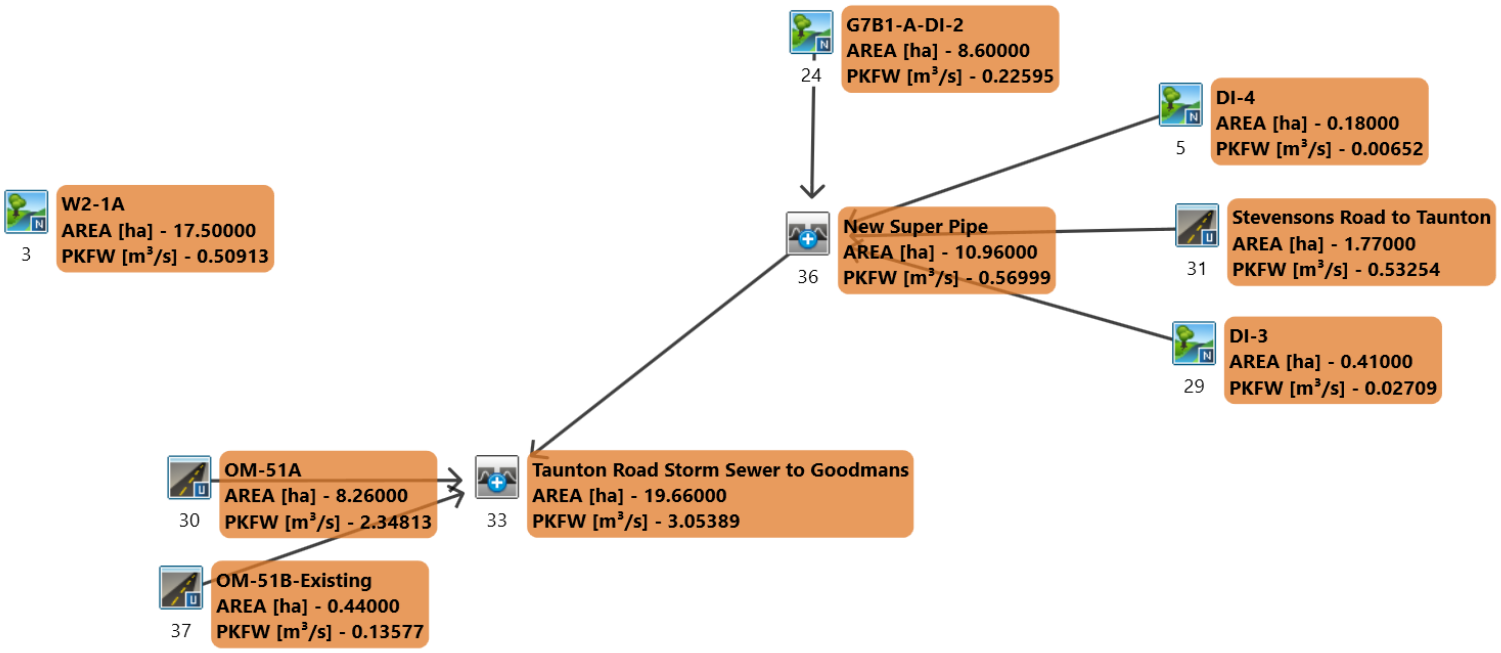
ADD HYD (0044)					
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0029):	0.41	0.027	4.25	28.63
+ ID2= 2 (0045):	10.11	0.291	4.08	26.13
ID = 3 (0044):	10.52	0.311	4.08	26.23

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0044)					
3 + 2 = 1	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0044):	10.52	0.311	4.08	26.23
+ ID2= 2 (0046):	9.14	2.620	4.00	53.56
ID = 1 (0044):	19.66	2.906	4.00	38.93

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

Visual OTTHYMO Schematic- Proposed Uncontrolled Peak Flows



```
       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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 *****

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Output filename: C:\Users\emay\AppData\Local\Civica\VH5\e1c6be58-a9e2-48fa-8862-b94ee87dad4f\83d5f2b0-bd1e-4c9b-b7a5-fa26cf378724\scenari
Summary filename: C:\Users\emay\AppData\Local\Civica\VH5\e1c6be58-a9e2-48fa-8862-b94ee87dad4f\83d5f2b0-bd1e-4c9b-b7a5-fa26cf378724\scenari

DATE: 10/28/2024 TIME: 02:56:55

USER:

COMMENTS: _____

****
** SIMULATION : 010yr 12hr 10min Chicago **
****

| CHICAGO STORM |
| Ptotal= 61.10 mm |

IDF curve parameters: A=1232.390
B= 5.180
C= 0.833
used in: INTENSITY = A / (t + B)^C

Duration of storm = 12.00 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	0.92	3.00	3.70	6.00	2.77	9.00	1.28
0.17	0.95	3.17	4.63	6.17	2.59	9.17	1.24
0.33	0.99	3.33	6.27	6.33	2.43	9.33	1.21
0.50	1.04	3.50	9.93	6.50	2.30	9.50	1.18
0.67	1.08	3.67	26.03	6.67	2.17	9.67	1.15
0.83	1.14	3.83	127.73	6.83	2.07	9.83	1.12
1.00	1.19	4.00	34.92	7.00	1.97	10.00	1.10
1.17	1.26	4.17	17.19	7.17	1.88	10.17	1.07
1.33	1.33	4.33	11.37	7.33	1.80	10.33	1.05

1.50	1.42	4.50	8.51	7.50	1.73	10.50	1.03
1.67	1.52	4.67	6.83	7.67	1.66	10.67	1.00
1.83	1.63	4.83	5.72	7.83	1.60	10.83	0.98
2.00	1.76	5.00	4.93	8.00	1.54	11.00	0.96
2.17	1.92	5.17	4.35	8.17	1.49	11.17	0.94
2.33	2.12	5.33	3.89	8.33	1.44	11.33	0.93
2.50	2.36	5.50	3.53	8.50	1.40	11.50	0.91
2.67	2.68	5.67	3.23	8.67	1.36	11.67	0.89
2.83	3.10	5.83	2.98	8.83	1.32	11.83	0.88

CALIB			
NASHYD (0003)	Area (ha)= 17.50	Curve Number (CN)= 76.5	
ID= 1 DT= 5.0 min	Ia (mm)= 5.90	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.63		

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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Unit Hyd Qpeak (cms)= 1.061

PEAK FLOW (cms)= 0.509 (i)

TIME TO PEAK (hrs)= 4.667
RUNOFF VOLUME (mm)= 22.869
TOTAL RAINFALL (mm)= 61.097
RUNOFF COEFFICIENT = 0.374

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB	
STANDHYD (0030)	Area (ha)= 8.26
ID= 1 DT= 5.0 min	Total Imp(%)= 85.00 Dir. Conn.(%)= 85.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	7.02	1.24
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	0.38
Length	(m)=	234.66	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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Max.Eff.Inten.(mm/hr)= 127.73 17.85

over (min)	5.00	30.00	
Storage Coeff. (min)=	3.86 (ii)	27.01 (ii)	
Unit Hyd. Tpeak (min)=	5.00	30.00	
Unit Hyd. peak (cms)=	0.25	0.04	
			TOTALS
PEAK FLOW (cms)=	2.34	0.03	2.348 (iii)
TIME TO PEAK (hrs)=	4.00	4.42	4.00
RUNOFF VOLUME (mm)=	60.10	16.50	53.56
TOTAL RAINFALL (mm)=	61.10	61.10	61.10
RUNOFF COEFFICIENT =	0.98	0.27	0.88

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 62.0 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 (0037)	Area (ha)= 0.44
ID= 1 DT= 5.0 min	Total Imp(%)= 85.00 Dir. Conn.(%)= 85.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.37	0.07
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	54.16	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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96

2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Max.Eff.Inten.(mm/hr)=	127.73	29.66	
over (min)	5.00	10.00	
Storage Coeff. (min)=	1.97 (ii)	5.17 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.31	0.16	
			TOTALS
PEAK FLOW (cms)=	0.13	0.00	0.136 (iii)
TIME TO PEAK (hrs)=	4.00	4.08	4.00
RUNOFF VOLUME (mm)=	60.10	16.50	53.55
TOTAL RAINFALL (mm)=	61.10	61.10	61.10
RUNOFF COEFFICIENT =	0.98	0.27	0.88

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 62.0 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			
NASHYD (0024)	Area (ha)=	8.60	Curve Number (CN)= 77.0
ID= 1 DT= 5.0 min	Ia (mm)=	5.70	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)=	0.75	

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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03

1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Unit Hyd Qpeak (cms)= 0.438

PEAK FLOW (cms)= 0.226 (i)
TIME TO PEAK (hrs)= 4.833
RUNOFF VOLUME (mm)= 23.378
TOTAL RAINFALL (mm)= 61.097
RUNOFF COEFFICIENT = 0.383

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
NASHYD (0005)	Area (ha)= 0.18	Curve Number (CN)= 76.2	
ID= 1 DT= 5.0 min	Ia (mm)= 5.90	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.46		

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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98

2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Unit Hyd Qpeak (cms)= 0.015

PEAK FLOW (cms)= 0.007 (i)
TIME TO PEAK (hrs)= 4.500
RUNOFF VOLUME (mm)= 22.640
TOTAL RAINFALL (mm)= 61.097
RUNOFF COEFFICIENT = 0.371

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
NASHYD (0029)	Area (ha)=	0.41	Curve Number (CN)= 81.9
ID= 1 DT= 5.0 min	Ia (mm)=	4.20	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)=	0.29	

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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94

2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Unit Hyd Qpeak (cms)= 0.054

PEAK FLOW (cms)= 0.027 (i)
TIME TO PEAK (hrs)= 4.250
RUNOFF VOLUME (mm)= 28.626
TOTAL RAINFALL (mm)= 61.097
RUNOFF COEFFICIENT = 0.469

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB STANDHYD (0031)	Area (ha)= 1.77
ID= 1 DT= 5.0 min	Total Imp(%)= 85.00 Dir. Conn.(%)= 85.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.50	0.27
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	108.63	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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96

2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Max.Eff.Inten.(mm/hr)=	127.73	29.66	
over (min)	5.00	10.00	
Storage Coeff. (min)=	3.00 (ii)	6.19 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.28	0.15	
			TOTALS
PEAK FLOW (cms)=	0.52	0.02	0.533 (iii)
TIME TO PEAK (hrs)=	4.00	4.08	4.00
RUNOFF VOLUME (mm)=	60.10	16.50	53.56
TOTAL RAINFALL (mm)=	61.10	61.10	61.10
RUNOFF COEFFICIENT =	0.98	0.27	0.88

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 62.0 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.

ADD HYD (0036)					
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0024):	8.60	0.226	4.83	23.38
+ ID2= 2 (0029):	0.41	0.027	4.25	28.63
ID = 3 (0036):	9.01	0.237	4.83	23.62

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

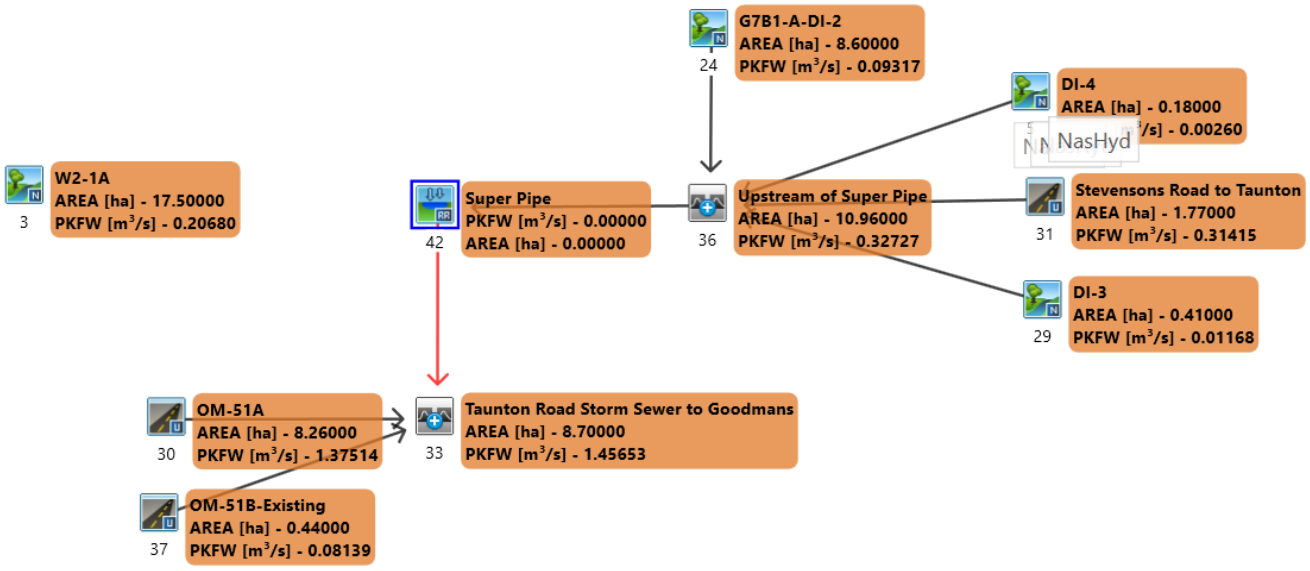
ADD HYD (0036)					
3 + 2 = 1	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0036):	9.01	0.237	4.83	23.62
+ ID2= 2 (0031):	1.77	0.533	4.00	53.56
ID = 1 (0036):	10.78	0.569	4.00	28.53

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0036)					
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0036):	10.78	0.569	4.00	28.53
+ ID2= 2 (0005):	0.18	0.007	4.50	22.64

```
        ID = 3 (  0036):    10.96   0.570     4.00    28.44

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0033)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0030):     8.26   2.348     4.00    53.56
      + ID2= 2 (  0036):    10.96   0.570     4.00    28.44
        ==================================================
        ID = 3 (  0033):    19.22   2.918     4.00    39.23

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------


--------------------
| ADD HYD  (  0033)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0033):    19.22   2.918     4.00    39.23
      + ID2= 2 (  0037):     0.44   0.136     4.00    53.55
        ==================================================
        ID = 1 (  0033):    19.66   3.054     4.00    39.55

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
```

Visual OTTHYMO Schematic- Proposed Controlled Peak Flows



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================================================================================
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       V    V   I    SSSSS  U   U    A    L              (v 6.2.2017)
       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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DATE: 02/11/2025                              TIME: 10:55:30

USER:



COMMENTS: _____________________________________________________________


--------------------------------------------------------------------------------
-------------------------
  ************************************************
  ** SIMULATION : 010yr 12hr 10min Chicago      **
  ************************************************


--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1232.390
| Ptotal= 61.10 mm |                          B=   5.180
--------------------                          C=   0.833
                       used in:   INTENSITY =  A / (t + B)^C

                       Duration of storm  = 12.00 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    0.92 |  3.00    3.70 |  6.00    2.77 |  9.00    1.28
                0.17    0.95 |  3.17    4.63 |  6.17    2.59 |  9.17    1.24
                0.33    0.99 |  3.33    6.27 |  6.33    2.43 |  9.33    1.21
                0.50    1.04 |  3.50    9.93 |  6.50    2.30 |  9.50    1.18
                0.67    1.08 |  3.67   26.03 |  6.67    2.17 |  9.67    1.15
                0.83    1.14 |  3.83  127.73 |  6.83    2.07 |  9.83    1.12
                1.00    1.19 |  4.00   34.92 |  7.00    1.97 | 10.00    1.10
                1.17    1.26 |  4.17   17.19 |  7.17    1.88 | 10.17    1.07
                1.33    1.33 |  4.33   11.37 |  7.33    1.80 | 10.33    1.05
```

1.50	1.42	4.50	8.51	7.50	1.73	10.50	1.03
1.67	1.52	4.67	6.83	7.67	1.66	10.67	1.00
1.83	1.63	4.83	5.72	7.83	1.60	10.83	0.98
2.00	1.76	5.00	4.93	8.00	1.54	11.00	0.96
2.17	1.92	5.17	4.35	8.17	1.49	11.17	0.94
2.33	2.12	5.33	3.89	8.33	1.44	11.33	0.93
2.50	2.36	5.50	3.53	8.50	1.40	11.50	0.91
2.67	2.68	5.67	3.23	8.67	1.36	11.67	0.89
2.83	3.10	5.83	2.98	8.83	1.32	11.83	0.88

CALIB NASHYD (0003)	Area (ha)= 17.50	Curve Number (CN)= 76.5
ID= 1 DT= 5.0 min	Ia (mm)= 5.90	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= 0.63	

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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Unit Hyd Qpeak (cms)= 1.061

PEAK FLOW (cms)= 0.509 (i)

TIME TO PEAK (hrs)= 4.667
RUNOFF VOLUME (mm)= 22.869
TOTAL RAINFALL (mm)= 61.097
RUNOFF COEFFICIENT = 0.374

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
NASHYD (0024)	Area (ha)= 8.60	Curve Number (CN)= 77.0	
ID= 1 DT= 5.0 min	Ia (mm)= 5.70	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= 0.75		

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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Unit Hyd Qpeak (cms)= 0.438

PEAK FLOW (cms)= 0.226 (i)
TIME TO PEAK (hrs)= 4.833
RUNOFF VOLUME (mm)= 23.378
TOTAL RAINFALL (mm)= 61.097
RUNOFF COEFFICIENT = 0.383

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0005)	Area (ha)=	0.18	Curve Number (CN)=	76.2
ID= 1 DT= 5.0 min	Ia (mm)=	5.90	# of Linear Res.(N)=	3.00
	U.H. Tp(hrs)=	0.46		

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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Unit Hyd Qpeak (cms)= 0.015

PEAK FLOW (cms)= 0.007 (i)
TIME TO PEAK (hrs)= 4.500
RUNOFF VOLUME (mm)= 22.640
TOTAL RAINFALL (mm)= 61.097
RUNOFF COEFFICIENT = 0.371

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| CALIB            |
| NASHYD   (  0029)|   Area    (ha)=   0.41   Curve Number   (CN)= 81.9
|ID= 1 DT= 5.0 min |   Ia      (mm)=   4.20   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.29

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

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

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    Unit Hyd Qpeak  (cms)=   0.054

    PEAK FLOW       (cms)=   0.027 (i)
    TIME TO PEAK    (hrs)=   4.250
    RUNOFF VOLUME    (mm)=  28.626
    TOTAL RAINFALL   (mm)=  61.097
    RUNOFF COEFFICIENT   =   0.469

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| CALIB            |
| STANDHYD (  0031)|   Area    (ha)=   1.77
|ID= 1 DT= 5.0 min |   Total Imp(%)=  85.00   Dir. Conn.(%)=  85.00
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		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.50	0.27
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	108.63	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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Max.Eff.Inten.	(mm/hr)=	127.73	29.66	
	over (min)	5.00	10.00	
Storage Coeff.	(min)=	3.00 (ii)	6.19 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	10.00	
Unit Hyd. peak	(cms)=	0.28	0.15	
				TOTALS
PEAK FLOW	(cms)=	0.52	0.02	0.533 (iii)
TIME TO PEAK	(hrs)=	4.00	4.08	4.00
RUNOFF VOLUME	(mm)=	60.10	16.50	53.56
TOTAL RAINFALL	(mm)=	61.10	61.10	61.10
RUNOFF COEFFICIENT	=	0.98	0.27	0.88

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

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      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  62.0    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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| ADD HYD  (  0036)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0024):     8.60   0.226     4.83    23.38
     + ID2= 2 (  0029):     0.41   0.027     4.25    28.63
       ==================================================
       ID = 3 (  0036):     9.01   0.237     4.83    23.62

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
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--------------------
| ADD HYD  (  0036)|
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 3 (  0036):     9.01   0.237     4.83    23.62
     + ID2= 2 (  0031):     1.77   0.533     4.00    53.56
       ==================================================
       ID = 1 (  0036):    10.78   0.569     4.00    28.53

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0036)|
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
       ID1= 1 (  0036):    10.78   0.569     4.00    28.53
     + ID2= 2 (  0005):     0.18   0.007     4.50    22.64
       ==================================================
       ID = 3 (  0036):    10.96   0.570     4.00    28.44

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
--------------------
| RESERVOIR(  0042)|     OVERFLOW IS ON
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE    |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)    |    (cms)     (ha.m.)
                          0.0000      0.0000    |     0.1083      0.0708
                          0.0442      0.0059    |     0.1210      0.0910
                          0.0625      0.0161    |     0.1250      0.0970
                          0.0765      0.0285    |     0.1289      0.1025
                          0.0884      0.0423    |     0.1326      0.1072
                          0.0988      0.0566    |     0.1398      0.1131

                                  AREA     QPEAK     TPEAK       R.V.
                                  (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0036)     10.960      0.570      4.00       28.44
   OUTFLOW: ID= 1 (  0042)     10.950      0.140      5.75       28.27
   OVERFLOW:ID= 3 (  0003)      0.010      0.009      5.75       28.27

                  TOTAL NUMBER OF SIMULATION OVERFLOW  =     1
                  CUMULATIVE TIME OF OVERFLOW  (HOURS) =  0.08
```

PERCENTAGE OF TIME OVERFLOWING (%) = 0.51

PEAK FLOW REDUCTION [Qout/Qin](%)= 24.51
TIME SHIFT OF PEAK FLOW (min)=105.00
MAXIMUM STORAGE USED (ha.m.)= 0.1131

CALIB	
STANDHYD (0030)	Area (ha)= 8.26
ID= 1 DT= 5.0 min	Total Imp(%)= 85.00 Dir. Conn.(%)= 85.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	7.02	1.24
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	1.00	0.38
Length	(m)=	234.66	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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94
2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Max.Eff.Inten.(mm/hr)=		127.73	17.85
over (min)		5.00	30.00

Storage Coeff. (min)=	3.86 (ii)	27.01 (ii)	
Unit Hyd. Tpeak (min)=	5.00	30.00	
Unit Hyd. peak (cms)=	0.25	0.04	
			TOTALS
PEAK FLOW (cms)=	2.34	0.03	2.348 (iii)
TIME TO PEAK (hrs)=	4.00	4.42	4.00
RUNOFF VOLUME (mm)=	60.10	16.50	53.56
TOTAL RAINFALL (mm)=	61.10	61.10	61.10
RUNOFF COEFFICIENT =	0.98	0.27	0.88

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 62.0 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 (0037)	Area (ha)=	0.44	
ID= 1 DT= 5.0 min	Total Imp(%)=	85.00	Dir. Conn.(%)= 85.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	0.37	0.07
Dep. Storage	(mm)=	1.00	1.50
Average Slope	(%)=	0.50	2.00
Length	(m)=	54.16	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	0.92	3.083	3.70	6.083	2.77	9.08	1.28
0.167	0.92	3.167	3.70	6.167	2.77	9.17	1.28
0.250	0.95	3.250	4.63	6.250	2.59	9.25	1.24
0.333	0.95	3.333	4.63	6.333	2.59	9.33	1.24
0.417	0.99	3.417	6.27	6.417	2.43	9.42	1.21
0.500	0.99	3.500	6.27	6.500	2.43	9.50	1.21
0.583	1.04	3.583	9.93	6.583	2.30	9.58	1.18
0.667	1.04	3.667	9.93	6.667	2.30	9.67	1.18
0.750	1.08	3.750	26.03	6.750	2.17	9.75	1.15
0.833	1.08	3.833	26.03	6.833	2.17	9.83	1.15
0.917	1.14	3.917	127.72	6.917	2.07	9.92	1.12
1.000	1.14	4.000	127.73	7.000	2.07	10.00	1.12
1.083	1.19	4.083	34.92	7.083	1.97	10.08	1.10
1.167	1.19	4.167	34.92	7.167	1.97	10.17	1.10
1.250	1.26	4.250	17.19	7.250	1.88	10.25	1.07
1.333	1.26	4.333	17.19	7.333	1.88	10.33	1.07
1.417	1.33	4.417	11.37	7.417	1.80	10.42	1.05
1.500	1.33	4.500	11.37	7.500	1.80	10.50	1.05
1.583	1.42	4.583	8.51	7.583	1.73	10.58	1.03
1.667	1.42	4.667	8.51	7.667	1.73	10.67	1.03
1.750	1.52	4.750	6.83	7.750	1.66	10.75	1.00
1.833	1.52	4.833	6.83	7.833	1.66	10.83	1.00
1.917	1.63	4.917	5.72	7.917	1.60	10.92	0.98
2.000	1.63	5.000	5.72	8.000	1.60	11.00	0.98
2.083	1.76	5.083	4.93	8.083	1.54	11.08	0.96
2.167	1.76	5.167	4.93	8.167	1.54	11.17	0.96
2.250	1.92	5.250	4.35	8.250	1.49	11.25	0.94

2.333	1.92	5.333	4.35	8.333	1.49	11.33	0.94
2.417	2.12	5.417	3.89	8.417	1.44	11.42	0.93
2.500	2.12	5.500	3.89	8.500	1.44	11.50	0.93
2.583	2.36	5.583	3.53	8.583	1.40	11.58	0.91
2.667	2.36	5.667	3.53	8.667	1.40	11.67	0.91
2.750	2.68	5.750	3.23	8.750	1.36	11.75	0.89
2.833	2.68	5.833	3.23	8.833	1.36	11.83	0.89
2.917	3.10	5.917	2.98	8.917	1.32	11.92	0.88
3.000	3.10	6.000	2.98	9.000	1.32	12.00	0.88

Max.Eff.Inten.(mm/hr)=	127.73	29.66	
over (min)	5.00	10.00	
Storage Coeff. (min)=	1.97 (ii)	5.17 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.31	0.16	
			TOTALS
PEAK FLOW (cms)=	0.13	0.00	0.136 (iii)
TIME TO PEAK (hrs)=	4.00	4.08	4.00
RUNOFF VOLUME (mm)=	60.10	16.50	53.55
TOTAL RAINFALL (mm)=	61.10	61.10	61.10
RUNOFF COEFFICIENT =	0.98	0.27	0.88

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

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 62.0 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.

ADD HYD (0033)					
1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 1 (0030):	8.26	2.348	4.00	53.56
+ ID2= 2 (0037):	0.44	0.136	4.00	53.55
ID = 3 (0033):	8.70	2.484	4.00	53.56

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

ADD HYD (0033)					
3 + 2 = 1	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
ID1= 3 (0033):	8.70	2.484	4.00	53.56
+ ID2= 2 (0042):	0.01	0.009	5.75	28.27
ID = 1 (0033):	8.71	2.484	4.00	53.53

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

Appendix D: Hydraulic Analysis

APPENDIX D-1 – CULVERT ANALYSIS -EXISTING CONDITION

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow
Minimum Flow: 0.11 cms
Design Flow: 0.24 cms
Maximum Flow: 0.45 cms

Table 1 - Summary of Culvert Flows at crossing: CL-1 Existing VO

Headwater Elevation (m)	Total Discharge (cms)	Culvert 1 Discharge (cms)	Roadway Discharge (cms)	Iterations
149.65	0.11	0.11	0.00	1
149.72	0.15	0.15	0.00	1
149.78	0.18	0.18	0.00	1
149.85	0.21	0.21	0.00	1
149.91	0.24	0.24	0.00	1
150.04	0.28	0.28	0.00	1
150.16	0.32	0.32	0.00	1
150.30	0.35	0.35	0.00	1
150.44	0.38	0.38	0.00	1
150.48	0.42	0.39	0.02	10
150.49	0.45	0.40	0.06	6
150.46	0.39	0.39	0.00	Overtopping

Rating Curve Plot for crossing: CL-1 Existing VO

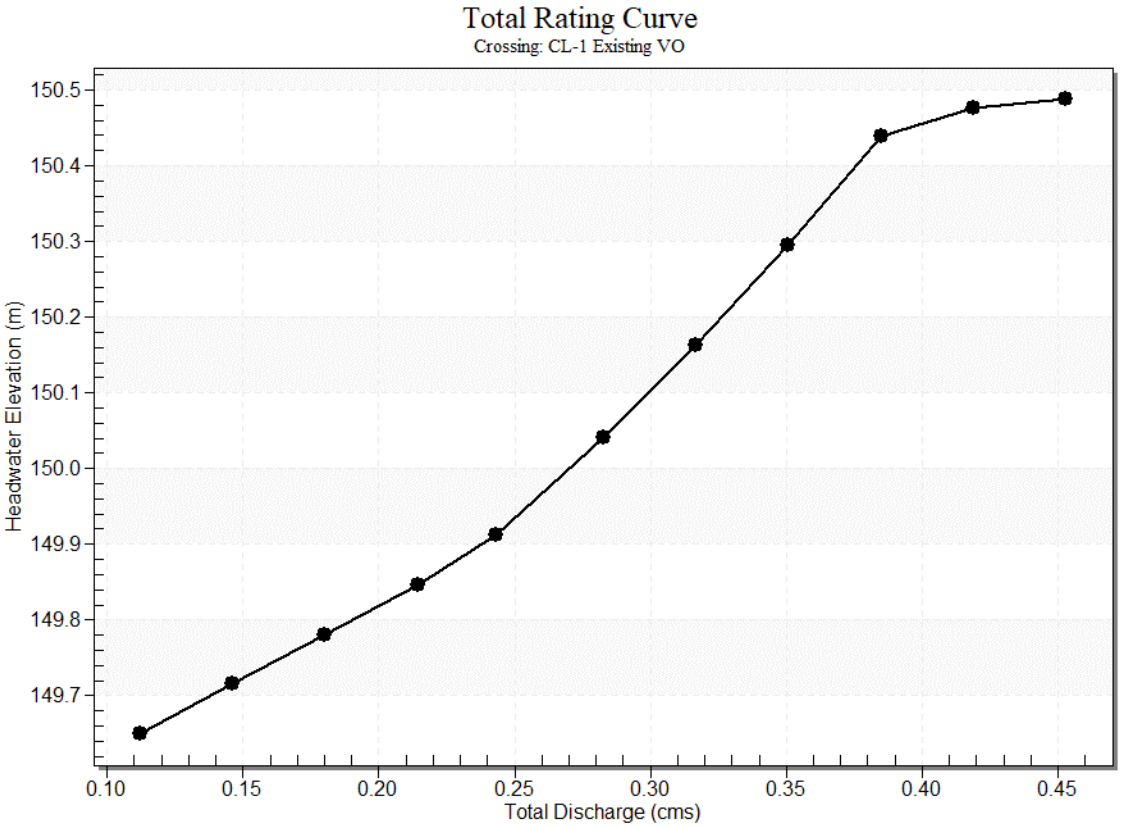
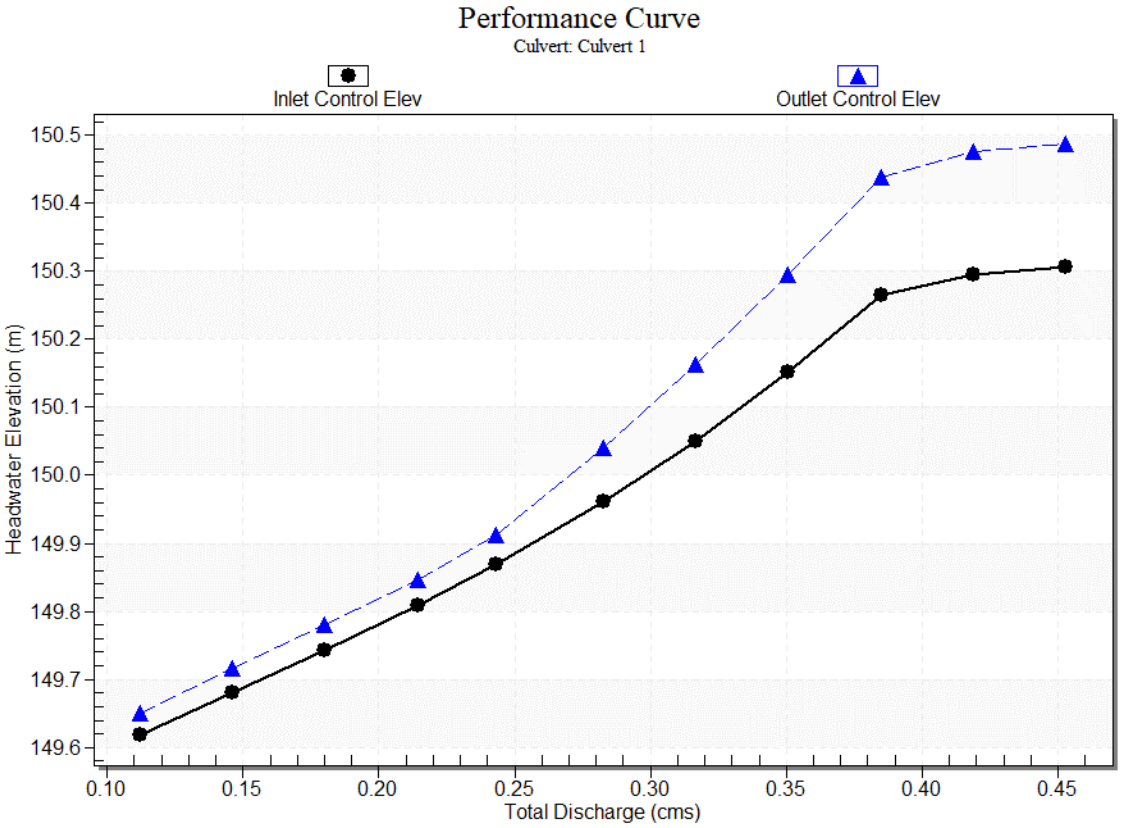


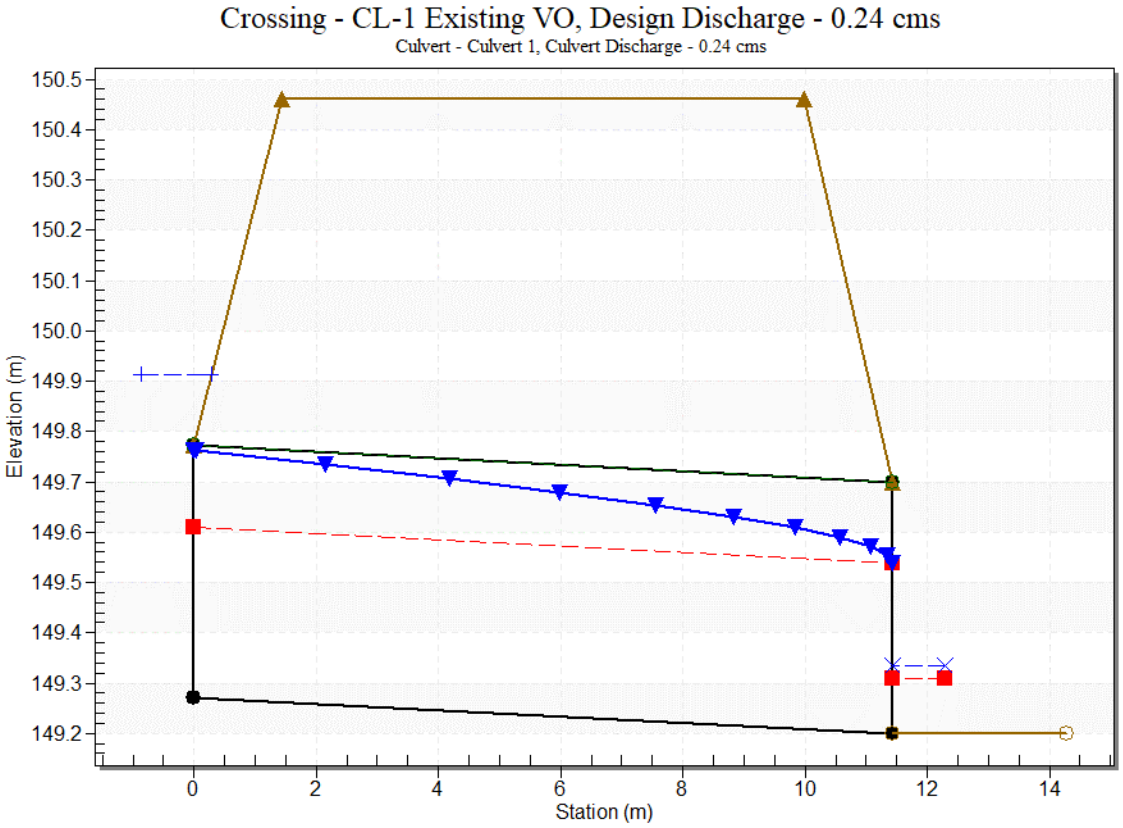
Table 2 - Culvert Summary Table: Culvert 1

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.11	0.11	149.65	0.35	0.378	0.23	2-M2c	0.30	0.23	0.23	0.09	1.30	0.61
0.15	0.15	149.72	0.41	0.444	0.27	2-M2c	0.37	0.26	0.26	0.10	1.42	0.67
0.18	0.18	149.78	0.47	0.508	0.31	7-M2c	0.50	0.29	0.29	0.11	1.53	0.72
0.21	0.21	149.85	0.54	0.575	0.35	7-M2c	0.50	0.32	0.32	0.12	1.63	0.76
0.24	0.24	149.91	0.60	0.640	0.39	7-M2c	0.50	0.34	0.34	0.13	1.72	0.80
0.28	0.28	150.04	0.69	0.769	0.47	7-M2c	0.50	0.36	0.36	0.15	1.84	0.84
0.32	0.32	150.16	0.78	0.891	0.54	7-M2c	0.50	0.39	0.39	0.16	1.95	0.87
0.35	0.35	150.30	0.88	1.023	0.62	7-M2c	0.50	0.40	0.40	0.17	2.06	0.90
0.38	0.38	150.44	0.99	1.167	0.71	7-M2c	0.50	0.42	0.42	0.18	2.18	0.93
0.42	0.39	150.48	1.02	1.204	0.73	7-M2c	0.50	0.43	0.43	0.18	2.21	0.96
0.45	0.40	150.49	1.03	1.216	0.74	7-M2c	0.50	0.43	0.43	0.19	2.22	0.99
0.45	0.40	150.49	1.03	1.216	0.74	7-M2c	0.50	0.43	0.43	0.19	2.22	0.99

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 m
Inlet Elevation: 149.27 m
Outlet Station: 11.43 m
Outlet Elevation: 149.20 m
Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular
Barrel Diameter: 500.00 mm
Barrel Material: Corrugated Steel
Embedment: 0.00 mm
Barrel Manning's n: 0.0240
Culvert Type: Straight
Inlet Configuration: Thin Edge Projecting
Inlet Depression: None

Tailwater Channel Data for Crossing: CL-1 Existing VO

Tailwater Channel Option: Trapezoidal Channel
Bottom Width: 2.00 m

a_side Slope (H:V): 2.00 (_:1)
Channel Slope: 0.01 m/m
Channel Manning's n: 0.0300
Channel Invert Elevation: 149.20 m

Roadway Data for crossing: CL-1 Existing VO

Roadway Profile Shape: Constant Roadway Elevation
Crest Length: 7.50 m
Crest Elevation: 150.46 m
Roadway Surface: Paved
Roadway Top Width: 8.55 m

Project:	City of Oshawa: Schedule "C" Municipal Class Environmental Assessment
Project No.:	0000034724
Date:	Monday, September 16, 2024
Modelled by:	A.Hazarika
Checked by:	D.Jackson

ROADWAY INFORMATION							EXISTING CULVERT PARAMETERS								CULVERT HYDROLOGY/HYDRAULIC INFORMATION EXISTING CONDITION												EXISTING CULVERT PERFORMANCE								
Cu vert #	Road C ass f cat on	Road Centerl ne Stat on	CL E ev.	Edge of Trave ed Lane E ev	Subgrade		S ze (mm)	Materia	Mann ng s n	Inverts		Length	S ope	Cover	Des gn F ow				Max. A owab e HW			Computed HW E evat on (m)			Downstream ve ocity			Freeboard to EP	Check F ow	Conta nment of f ow Depth to top of subgrade	F ow Depth (25yr)	F ow Depth (115% of 100yr)	HW/D	Comp ance to Standard		
			(m)	(m)	Depth (m)	E evat on (m)				Upstream (m)	Downstream (m)	(m)	%	(m)	Des gn Storm	25 (m3/s)	100yr (m3/s)	115% of 100yr (m3/s)	25 (m)	100yr (m)	115% of 100yr (m)	25 WS US	100yr WS US	115% of 100yr WS US	25 (m/s)	100yr (m/s)	115% of 100yr (m/s)	25yr (m)	115% of 100yr (m)	115% of 100yr (m)				F ow Depth HW/D (WC-7 3.5)	25yr Freeboard (SD 13 3.1 / WC 7 3.2)	Check F ow 115% of 100yr
CL-2	Arterial Road	11+823.42	149.37	149.062	0.65	148.41	900	CSP	0.024	147.739	146.985	15.946	4.73%	0.42	25-yr	0.687	0.979	1.126	148.06	149.06	149.06	148.49	148.70	148.86	3.07	3.26	3.43	0.57	0.20	0.20	0.75	1.12	0.83	✓	⊗	✓

APPENDIX D-2-1 – STORM SEWER ANALYSIS - PROPOSED CONDITION

IDF Info:		Design Info:	
c =	3.8	Inlet Time =	11

Prepared By:	Pankaj Thakur
Checked By:	
Date:	17-Dec-24

Stevenson Road

Structures											Area Breakdown					Rainfall Intensity	Flow	Storm Sewer Design Information						TIME		Pipe Capacity
U/S				D/S				Area	Area as per Landuse			Cumulative (A*C)			Size	Slope	Length	Type	Q full	V full	Sectional	Cumulative	
ID	INV	RIM EL	COVER	ID	INV	RIM EL	COVER	(ha)	0.20	0.60	0.90	(ha)	(mm/hr)	(m^3/s)	(mm)	(%)	(m)	PIPE	(m^3/s)	(m/s)	(min.)	(min.)	%
													-										

IDF Info:		Design Info:	
a =	102.1	Manning's 'n' =	0.013
b =	0.798	I (10-YEAR) =	$a*(t+b)^{-c}$
c =	4	Inlet Time =	11

CITY OF OSHAWA

STORM SEWER CAPACITY ASSESSMENT- PROPOSED CONDITIONS

Stevenson Road

Prepared By:	Pankaj Thakur
Checked By:	
Date:	17-Dec-24

Structures								Area Breakdown					Rainfall Intensity	Flow	Storm Sewer Design Information						TIME		Pipe Capacity
U/S				D/S				Area	Area as per Landuse			Cumulative (A*C)			Size	Slope	Length	Type	Q full	V full	Sectional	Cumulative	
ID	INV	RIM EL	COVER	ID	INV	RIM EL	COVER	(ha)	0.20	0.60	0.90	(ha)	(mm/hr)	(m^3/s)	(mm)	(%)	(m)	PIPE	(m^3/s)	(m/s)	(min.)	(min.)	%
-													-										

IDF Info: 1- Year Storm		Design Info: City IDF	
a =	51.95	Manning's 'n' =	0.013
b =	0.78	I (10-YEAR) =	$a/(t+b)^c$
c =	3.80	Inlet Time =	10

CITY OF OSHAWA

STORM SEWER CAPACITY ASSESSMENT- PROPOSED CONDITIONS

Stevenson Road

Prepared By:	Pankaj Thakur
Checked By:	Evan May
Date:	18-Feb-25

Structures									Area Breakdown					Rainfall Intensity	External Flow	Flow	Storm Sewer Design Information						TIME		Pipe Capacity
U/S				D/S				Catchment ID	Area	Area as per Landuse			Cumulative (A*C)				Size	Slope	Length	Type	Q full	V full	Sectional	Cumulative	
ID	INV	RIM EL	COVER	ID	INV	RIM EL	COVER		(ha)	0.20	0.60	0.90	(ha)	(mm/hr)	(m^3/s)	(m^3/s)	(mm)	(%)	(m)	PIPE	(m^3/s)	(m/s)	(min.)	(min.)	%

IDF Info: 1- Year Storm		Design Info: City IDF	
a =	102.10	Manning's 'n' =	0.013
b =	0.80	I (10-YEAR) =	$a/(t+b)^c$
c =	4.00	Inlet Time =	10

CITY OF OSHAWA

STORM SEWER CAPACITY ASSESSMENT- PROPOSED CONDITIONS

Stevenson Road

Prepared By:	Pankaj Thakur
Checked By:	Evan May
Date:	18-Feb-25

Structures									Area Breakdown					Rainfall Intensity	External Flow	Flow	Storm Sewer Design Information						TIME		Pipe Capacity
U/S				D/S				Catchment ID	Area	Area as per Landuse			Cumulative ($A*C$)				Size	Slope	Length	Type	Q full	V full	Sectional	Cumulative	
ID	INV	RIM EL	COVER	ID	INV	RIM EL	COVER		(ha)	0.20	0.60	0.90	(ha)	(mm/hr)	(m^3/s)	(m^3/s)	(mm)	(%)	(m)	PIPE	(m^3/s)	(m/s)	(min.)	(min.)	%

Pipe Storage SWM Design Sheet

A. Design Event — **Post Dev. 100-yr Flow to Pre Dev. 100-yr Flow**

Pre Dev. 100-yr Flow	0.136	m^3/s
Post Dev. 100-yr Flow	0.570	m^3/s
Vol. Storage Required		m^3

B. Pipe Data

Upstream Invert	-	
Downstream Invert	-	m
Dia. Of Pipe, d_{pipe}	3	m
Area. Of Pipe	7.07	
Length	160	m
Pipe Slope	0.002	m/m
Mannings n	0.013	
Full Flow, Q_{full}	20.07	m^3/s

C. Orifice Geometry

Dia. Of Orrifice, $d_{orifice}$	195	mm
Area of Orifice	0.030	m^2
Orifice Coefficient, C_d	0.61	-

$Q_O = C_d A (2 g h)^{1/2}$

Q = the orifice flow discharge

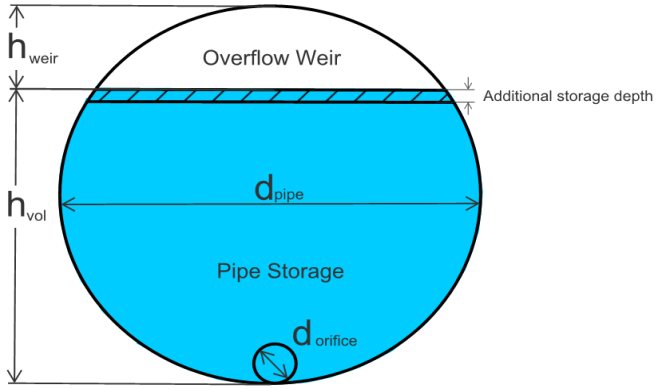
C_d = dimensionless coefficient of discharge

A_0 = cross-sectional area of orifice or pipe

g = acceleration due to gravity

D_o = diameter of orifice or pipe

h = effective head on the orifice, from the center of orifice to the water surface



Pipe Storage SWM Design Sheet

D. Stage Storage Discharge and Volume Control

Stage	Stage	Depth to Middle of Orifice	Orifice Discharge	Inc Cross Section	Total Storage	Inc Time	Cumulative Time
%	m	m	m^3/s	m^2	m^3	(hr)	(hr)
100	**3.00**	**3.00**	**0.140**	**7.07**	**1131.0**	**2.25**	**19.81**
90	**2.70**	**2.70**	**0.133**	**6.70**	**1072.1**	**2.25**	**17.56**
85	2.55	2.55	0.129	6.40	1024.6	2.21	15.32
80	2.40	2.40	0.125	6.06	969.9	2.16	13.11
75	2.25	2.25	0.121	5.69	909.9	2.09	10.95
70	2.10	2.10	0.117	5.29	845.6	2.01	8.86
60	1.80	1.80	0.108	4.43	708.5	1.82	6.86
50	1.50	1.50	0.099	3.53	565.5	1.59	5.04
40	1.20	1.20	0.088	2.64	422.5	1.33	3.45
30	0.90	0.90	0.077	1.78	285.4	1.04	2.12
20	0.60	0.60	0.063	1.01	161.0	0.72	1.09
10	0.30	0.30	0.044	0.37	58.9	0.37	0.37

E. Design Outputs

Pipe Full Percentage Required	95%	
Depth in Pipe Required for Volume Control	2.84	m
Additional Storage Depth (Safety Factor)	0.05	m
Depth in Pipe for Volume Control, h_{vol}	2.89	m
Overflow Weir Depth, h_{weir}	0.11	m
Maximum Weir Overflow	0.05	m^3/s
96% Vol. Storage	1116.4	

Pipe Storage SWM Design Sheet

D. Stage Storage Discharge and Volume Control

Stage	Stage	Depth to Middle of Orifice	Orifice Discharge	Inc Cross Section	Total Storage	Inc Time	Cumulative Time
%	m	m	m^3/s	m^2	m^3	(hr)	(hr)
100	**1.80**	**1.80**	**0.144**	**2.54**	**407.2**	**0.78**	**6.92**
90	**1.62**	**1.62**	**0.137**	**2.41**	**386.0**	**0.78**	**6.13**
85	1.53	1.53	0.133	2.31	368.9	0.77	5.35
80	1.44	1.44	0.129	2.18	349.2	0.75	4.58
75	1.35	1.35	0.125	2.05	327.6	0.73	3.82
70	1.26	1.26	0.121	1.90	304.4	0.70	3.09
60	1.08	1.08	0.112	1.59	255.1	0.63	2.39
50	0.90	0.90	0.102	1.27	203.6	0.55	1.76
40	0.72	0.72	0.091	0.95	152.1	0.46	1.20
30	0.54	0.54	0.079	0.64	102.7	0.36	0.74
20	0.36	0.36	0.064	0.36	58.0	0.25	0.38
10	0.18	0.18	0.046	0.13	21.2	0.13	0.13

E. Design Outputs

Pipe Full Percentage Required	89%	
Depth in Pipe Required for Volume Control	1.60	m
Additional Storage Depth (Safety Factor)	0.05	m
Depth in Pipe for Volume Control, h_{vol}	1.65	m
Overflow Weir Depth, h_{weir}	0.15	m
Maximum Weir Overflow	0.07	m^3/s
92% Vol. Storage	391.2	

APPENDIX D-2-2 – CULVERT ANALYSIS -PROPOSED CONDITION

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow
Minimum Flow: 0.21 cms
Design Flow: 0.69 cms
Maximum Flow: 1.14 cms

HY-8 Culvert Analysis Report

Table 1 - Project Headwater Table

Crossing Name	Culvert Name	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Outlet Velocity (m/s)
CL-2 Proposed Visual Otthymo Flows	CL-2	0.84	0.84	148.58	0.81	0.085	0.28	0.33	0.54	0.35	3.67

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow
Minimum Flow: 0.21 cms
Design Flow: 0.84 cms
Maximum Flow: 1.29 cms

Table 2 - Summary of Culvert Flows at crossing: CL-2 Proposed Visual Otthymo Flows

Headwater Elevation (m)	Total Discharge (cms)	CL-2 Discharge (cms)	Roadway Discharge (cms)	Iterations
148.12	0.21	0.21	0.00	1
148.21	0.32	0.32	0.00	1
148.30	0.42	0.42	0.00	1
148.38	0.53	0.53	0.00	1
148.45	0.64	0.64	0.00	1
148.52	0.75	0.75	0.00	1
148.58	0.84	0.84	0.00	1
148.66	0.97	0.97	0.00	1
148.74	1.07	1.07	0.00	1
148.82	1.18	1.18	0.00	1
148.90	1.29	1.29	0.00	1
149.64	2.00	2.00	0.00	Overtopping

Rating Curve Plot for crossing: CL-2 Proposed Visual Otthymo Flows

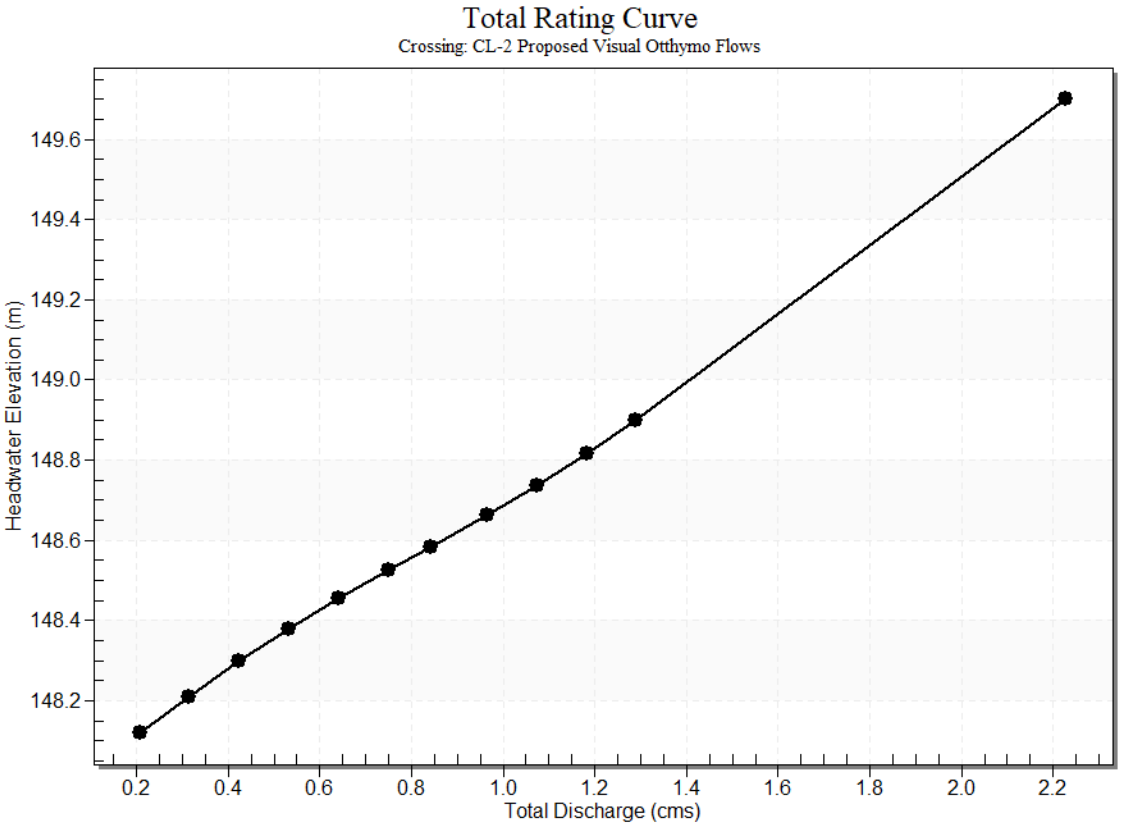


Table 3 - Culvert Summary Table: CL-2

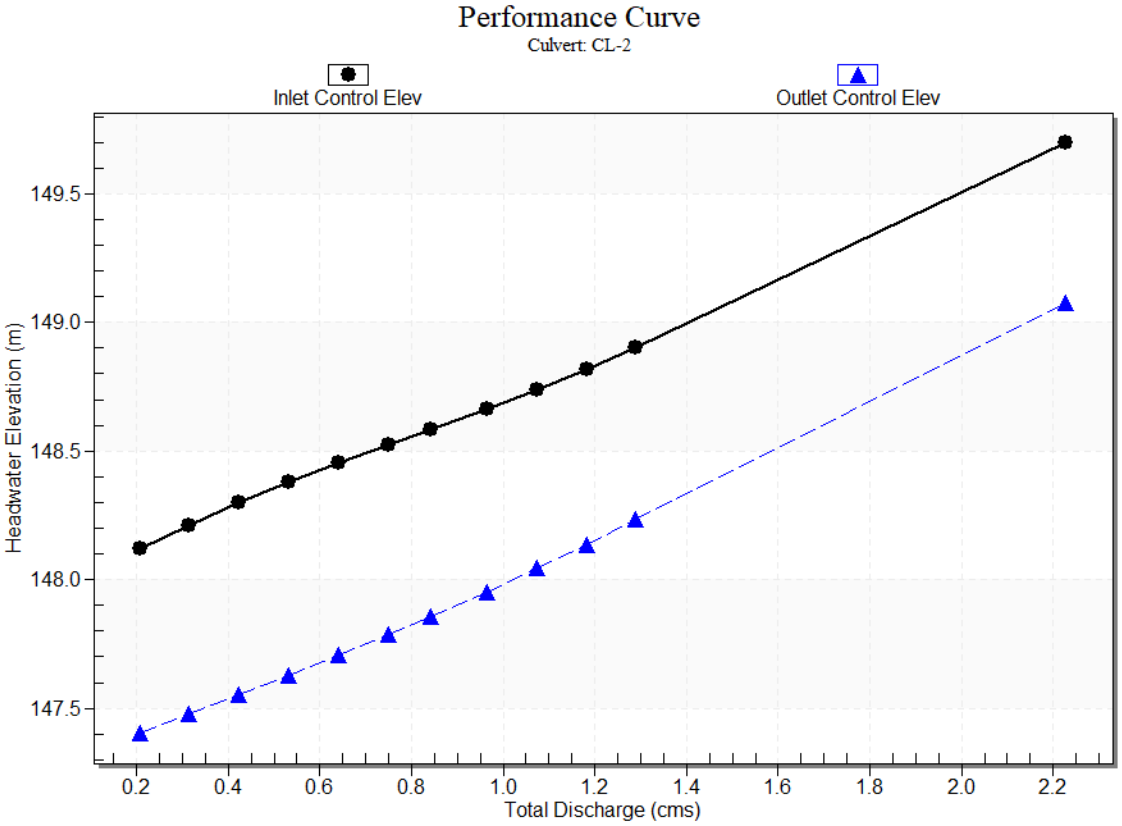
Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	HW / D (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.21	0.21	148.12	0.35	0.0*	0.12	1-S2n	0.16	0.26	0.16	0.08	2.70	0.51
0.32	0.32	148.21	0.44	0.0*	0.15	1-S2n	0.20	0.32	0.20	0.10	2.94	0.60
0.42	0.42	148.30	0.53	0.0*	0.18	1-S2n	0.23	0.38	0.24	0.12	3.12	0.67
0.53	0.53	148.38	0.61	0.0*	0.21	1-S2n	0.26	0.43	0.27	0.14	3.30	0.73
0.64	0.64	148.45	0.68	0.0*	0.23	1-S2n	0.28	0.47	0.30	0.15	3.46	0.78
0.75	0.75	148.52	0.75	0.015	0.26	1-S2n	0.31	0.51	0.33	0.17	3.59	0.83
0.84	0.84	148.58	0.81	0.085	0.28	1-S2n	0.33	0.54	0.35	0.18	3.67	0.87
0.97	0.97	148.66	0.89	0.183	0.30	1-S2n	0.35	0.58	0.38	0.20	3.78	0.91
1.07	1.07	148.74	0.97	0.274	0.33	5-S2n	0.37	0.61	0.40	0.21	3.87	0.95
1.18	1.18	148.82	1.05	0.368	0.35	5-S2n	0.39	0.64	0.43	0.22	3.96	0.98
1.29	1.29	148.90	1.13	0.466	0.38	5-S2n	0.41	0.67	0.45	0.23	4.03	1.01
2.23	2.04	149.70	1.93	1.308	0.65	5-S2n	0.55	0.82	0.60	0.32	4.50	1.23

* Full Flow Headwater elevation is below inlet invert.

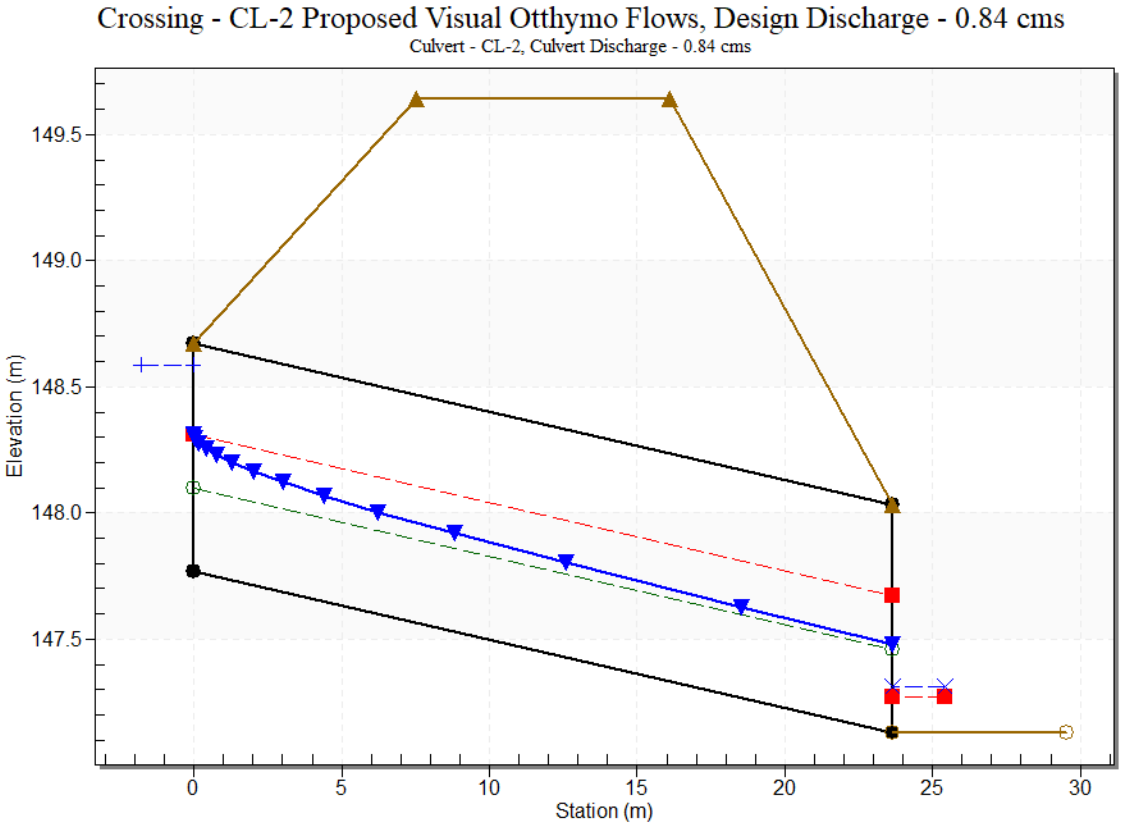
Culvert Barrel Data

Culvert Barrel Type: Straight Culvert
Inlet Elevation(invert): 147.77 m
Outlet Elevation (invert): 147.13 m
Culvert Length: 23.65 m
Culvert Slope: 0.03 m/m

Culvert Performance Curve Plot: CL-2



Water Surface Profile Plot for Culvert: CL-2



Site Data - CL-2

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 m
Inlet Elevation: 147.77 m
Outlet Station: 23.64 m
Outlet Elevation: 147.13 m
Number of Barrels: 1

Culvert Data Summary - CL-2

Barrel Shape: Circular
Barrel Diameter: 900.00 mm
Barrel Material: Concrete
Embedment: 0.00 mm
Barrel Manning's n: 0.0130
Culvert Type: Straight
Inlet Configuration: Square Edge with Headwall
Inlet Depression: None

Tailwater Channel Data for Crossing: CL-2 Proposed Visual Otthymo Flows

Tailwater Channel Option: Trapezoidal Channel
Bottom Width: 5.00 m
a_side Slope (H:V): 2.00 (_:1)
Channel Slope: 0.01 m/m

Channel Manning's n: 0.0350
Channel Invert Elevation: 147.13 m

Table 4 - Downstream Channel Rating Curve (crossing: CL-2 Proposed Visual Otthymo Flows)

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.21	147.21	0.08	0.51	7.70	0.59
0.32	147.23	0.10	0.60	9.89	0.61
0.42	147.25	0.12	0.67	11.80	0.63
0.53	147.27	0.14	0.73	13.51	0.65
0.64	147.28	0.15	0.78	15.09	0.66
0.75	147.30	0.17	0.83	16.55	0.67
0.84	147.31	0.18	0.87	17.74	0.67
0.97	147.33	0.20	0.91	19.25	0.68
1.07	147.34	0.21	0.95	20.50	0.69
1.18	147.35	0.22	0.98	21.70	0.69
1.29	147.36	0.23	1.01	22.85	0.70

Roadway Data for crossing: CL-2 Proposed Visual Otthymo Flows

Roadway Profile Shape: Constant Roadway Elevation
Crest Length: 7.50 m
Crest Elevation: 149.64 m
Roadway Surface: Paved
Roadway Top Width: 8.55 m

Project:	City of Oshawa: Schedule "C" Municipal Class Environmental Assessment
Project No.:	0000034724
Date:	Tuesday, October 29, 2024
Modelled by:	A.Hazarika
Checked by:	D.Jackson

ROADWAY INFORMATION							PROPOSED CULVERT PARAMETERS								CULVERT HYDROLOGY/HYDRAULIC INFORMATION - PROPOSED CONDITION											PROPOSED CULVERT PERFORMANCE								
Culvert #	Road Classification	Road Centerline Station	CL Elev.	Edge of Travelled Lane Elev	Subgrade		Size (mm)	Material	Manning's n	Inverts		Length	Slope	Cover	Design Flow				Max. Allowable HW			Computed HW Elevation (m)			Downstream velocity			Freeboard to EP	Check Flow	Containment of flow - Depth to top of subgrade	Flow Depth (25yr)	Flow Depth (115% of 100yr)	HW/D	Compliance to Standard		
					Depth	Elevation				Upstream (m)	Downstream (m)				Design Storm	50	100yr	130% of 100yr	50	100yr	130% of 100yr	50	100yr	130% of 100yr	50	100yr	130% of 100yr	50yr	130% of 100yr	130% of 100yr				Flow Depth HW/D (WC-7, 3.5)	50yr	Check Flow
			(m)	(m)	(m)	(m)						(m)	%	(m)		(m3/s)	(m3/s)	(m3/s)	(m)	(m)	(m)	WS US	WS US	WS US	(m/s)	(m/s)	(m/s)	(m)	(m)	(m)	(m)	(m)	(m)	Freeboard (SD-13 3.1 / WC-7, 3.2)	130% of 100yr
CL-2	Arterial Road	11+823.42	149.64	149.58	0.65	148.93	900	Concrete	0.013	147.770	147.130	23.643	2.71%	0.91	50-yr	0.841	0.992	1.290	148.58	149.58	149.58	148.58	148.66	148.90	3.67	3.78	4.03	1.00	0.68	0.68	0.81	1.13	0.90	✓	✓	✓

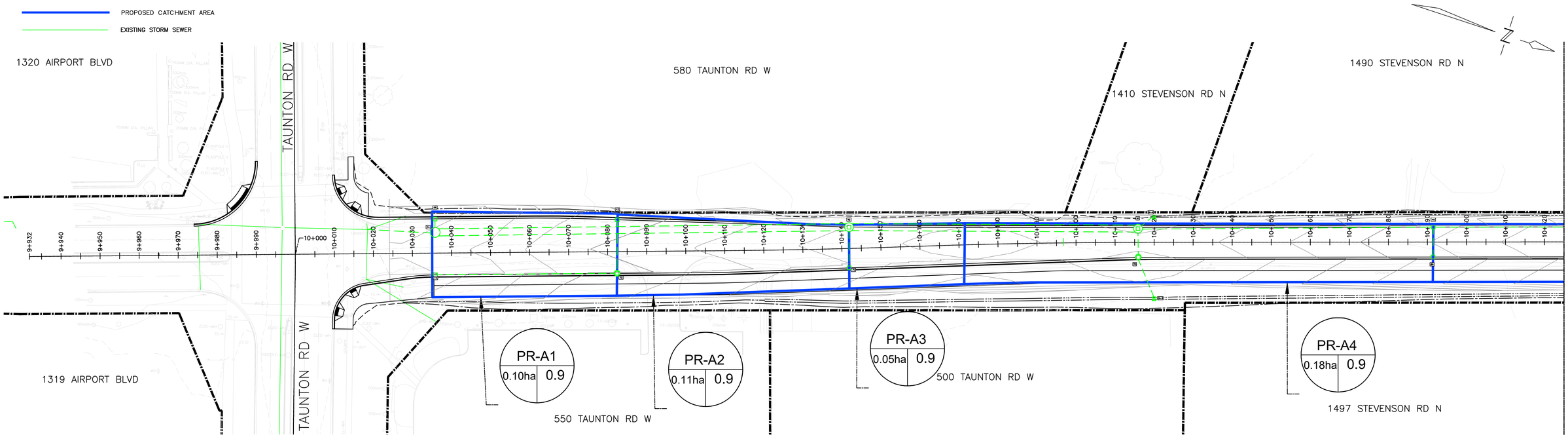
Appendix E: Design Drawings / Catchment Plans

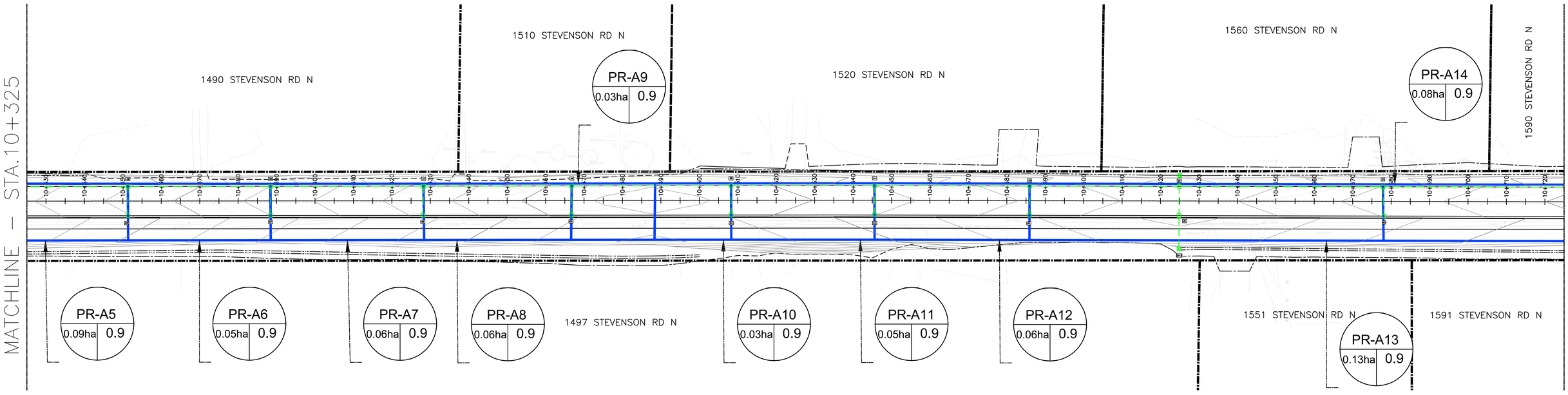
LEGEND

PROPOSED CATCHMENT AREA

EXISTING STORM SEWER

PROPOSED STORM SEWER





Oshawa®

GANNETT FLEMING

SCALE: HORIZONTAL 1:500 (10m 0 10m)

PROPOSED ROADWAY CATCHMENT AREA PLAN
SHEET 1 OF 3

2024-12-23 PRELIMINARY DESIGN – NOT FOR CONSTRUCTION

STEVENSON ROAD NORTH
SCHEDULE 'C' MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT
BETWEEN TAUNTON ROAD WEST AND CONLIN ROAD

LEGEND

PROPOSED CATCHMENT AREA

EXISTING STORM SEWER

PROPOSED STORM SEWER

MATCHLINE – STA.10+725

1590 STEVENSON RD N

1618 STEVENSON RD N

1642 STEVENSON RD N

1648 STEVENSON RD N

1650 STEVENSON RD N

1680 STEVENSON RD N

1720 STEVENSON RD N

MATCHLINE – STA.11+125

PR-A15 | 0.09ha | 0.9

1591 STEVENSON RD N

PR-A16 | 0.09ha | 0.9

PR-A17 | 0.09ha | 0.9

1645 STEVENSON RD N

PR-A18 | 0.09ha | 0.9

PR-A19 | 0.02ha | 0.9

PR-A20 | 0.14ha | 0.9

1707 STEVENSON RD N

PR-A21 | 0.08ha | 0.9

1715 STEVENSON RD N

MATCHLINE – STA.11+125

1720 STEVENSON RD N

1728 STEVENSON RD N

1750 STEVENSON RD N

1800 STEVENSON RD N

PR-A27 | 0.04ha | 0.9

1715 STEVENSON RD N

PR-A22 | 0.07ha | 0.9

1725 STEVENSON RD N

PR-A23 | 0.05ha | 0.9

PR-A24 | 0.02ha | 0.9

1739 STEVENSON RD N

PR-A25 | 0.14ha | 0.9

PR-A26 | 0.05ha | 0.9

1855 STEVENSON RD N

PR-A28 | 0.10ha | 0.9

MATCHLINE – STA.11+525

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GANNETT FLEMING

SCALE: HORIZONTAL 1:500 (10m 0 10m)

PROPOSED ROADWAY CATCHMENT AREA PLAN

SHEET 2 OF 3

2024-12-23 PRELIMINARY DESIGN – NOT FOR CONSTRUCTION

STEVENSON ROAD NORTH

SCHEDULE 'C' MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT

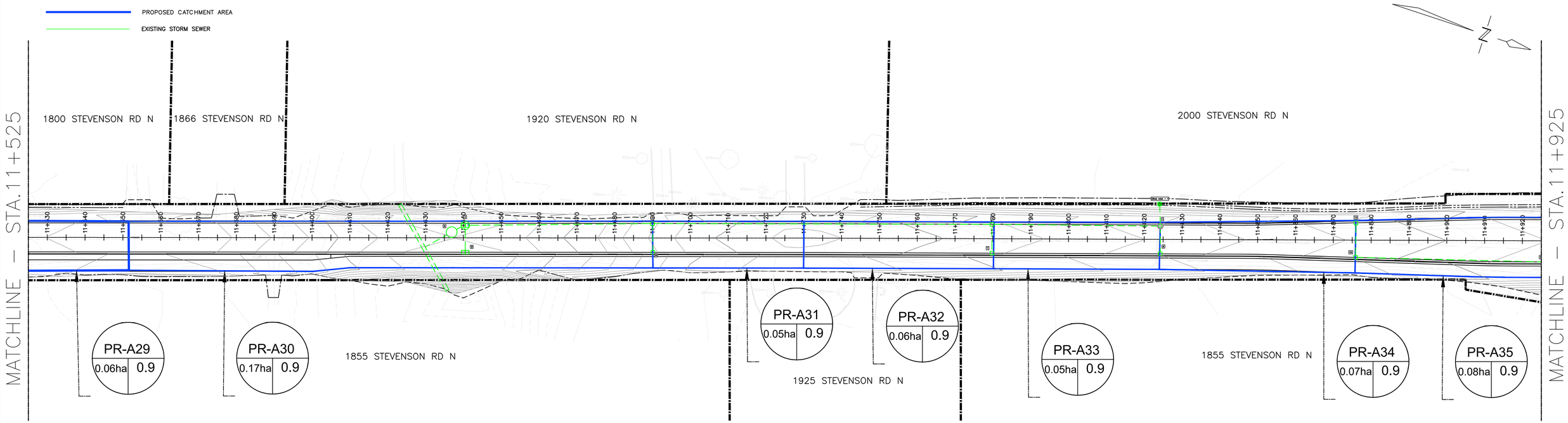
BETWEEN TAUNTON ROAD WEST AND CONLIN ROAD

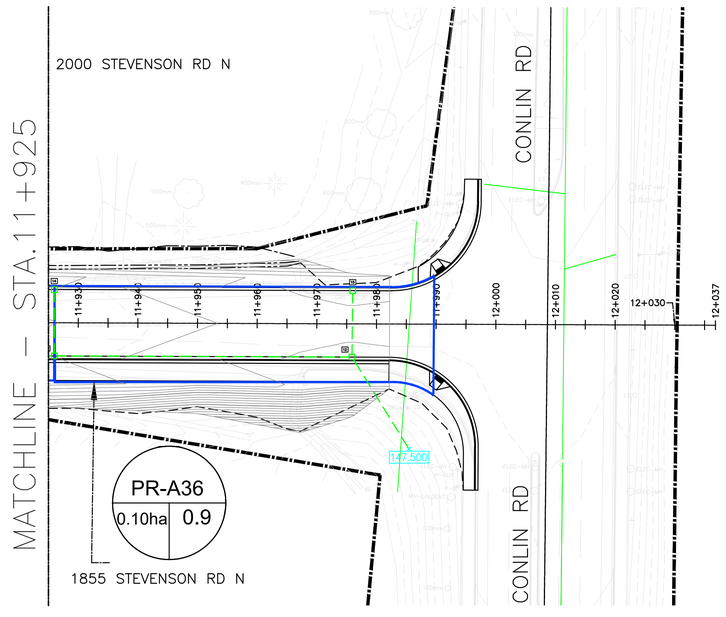
LEGEND

PROPOSED CATCHMENT AREA

EXISTING STORM SEWER

PROPOSED STORM SEWER





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GANNETT FLEMING

SCALE: HORIZONTAL 1:500 (10m 0 10m)

PROPOSED ROADWAY CATCHMENT AREA PLAN
SHEET 3 OF 3

2024-12-23 PRELIMINARY DESIGN – NOT FOR CONSTRUCTION

STEVENSON ROAD NORTH
SCHEDULE 'C' MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT
BETWEEN TAUNTON ROAD WEST AND CONLIN ROAD